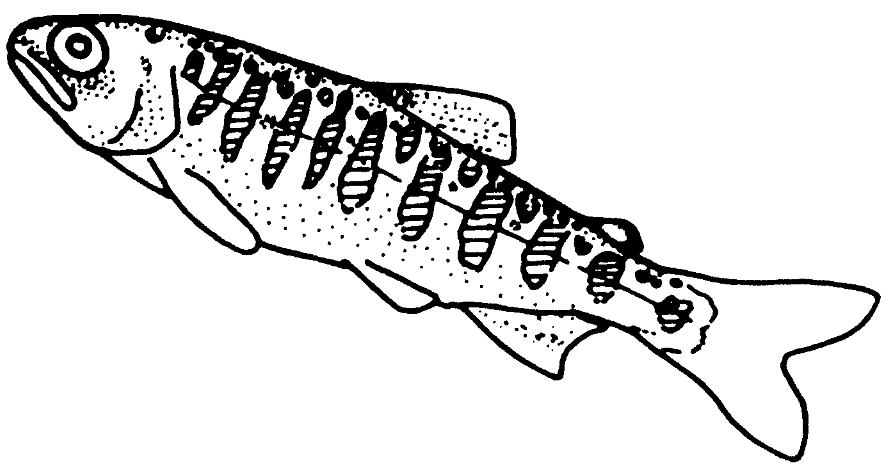
FISH USE OF CROOKED CREEK AFTER REMOVAL OF A FISH BARRIER

By

Alvin G. Ott and Alan H. Townsend

Technical Report 95-1



Alaska Department of Fish and Game
Habitat and Restoration Division

Jaunary 1995

FISH USE OF CROOKED CREEK AFTER REMOVAL OF A FISH BARRIER

By

Alvin G. Ott and Alan H. Townsend

Technical Report 95-1

Frank Rue
Director
Habitat and Restoration Division
Alaska Department of Fish and Game
P.O. Box 25526
Juneau, Alaska 99802-5526

January 1995

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

We would like to thank Mr. Carl Hemming (ADF&G) and Ms. Nancy McNay for assisting with field data collection. We also wish to recognize Mr. David Nixon (U.S. Army Corps of Engineers) and Mr. Dobberpuhl (University of Alaska Fairbanks) for working to identify and implement a mitigation project designed to reestablish fish passage in Crooked Creek. Mr. Jack Winters, Ms. Sheree Warner, and Dr. Phyllis Weber Scannell provided constructive review of the report.

ABSTRACT

A fish barrier and the associated gabion structure in Crooked Creek were removed in June 1992. Fisheries surveys in 1992, 1993, and 1994, following removal of the barrier documented use of upstream habitat by Arctic grayling, juvenile chinook salmon, and slimy sculpin. Loss of pool habitat in the disturbed area resulted in a reduction in the number of Arctic grayling. Juvenile chinook salmon use was highest in the lower part of the sample area which contained mainly shallow riffle habitat with minimal cover.

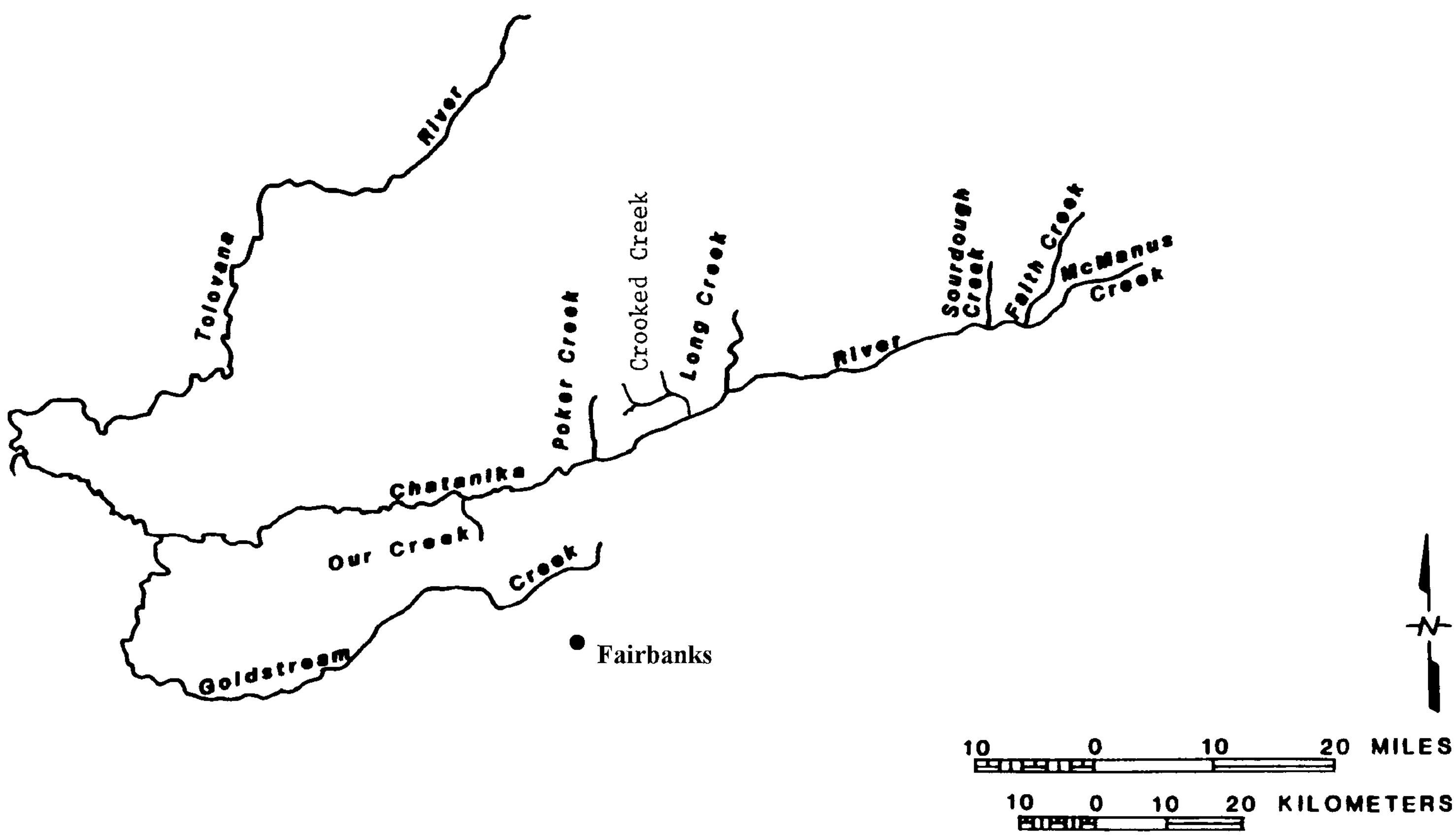
INTRODUCTION

Crooked Creek, a Chatanika River tributary, has a drainage area of 2306 ha (8.9 square miles) upstream from the Steese Highway (Figure 1). Crooked Creek is crossed by the highway near Milepost 41. The Chatanika River supports longnose suckers (*Catostomus catostomus*), Arctic grayling (*Thymallis arcticus*), round whitefish (*Prosopium cylindraceum*), chinook salmon (*Onchorhynchus tshawytscha*), coho salmon (*O. kisutch*), chum salmon (*O. keta*), Alaska blackfish (*Dallia pectoralis*), humpback whitefish (*Coregonus pidschian*), broad whitefish (*C. nasus*), least cisco (*C. sardinella*), burbot (*Lota lota*), northern pike (*Esox lucius*), slimy sculpin (*Cottus cognatus*), and sheefish (*Stenodus leucichthys*).

Crooked Creek immediately upstream from the highway and between the highway and the Chatanika River was channelized in the early 1970s by the Alaska Department of Transportation and Public Facilities. A gabion structure was installed in the creek to restrict winter flows in an incised notch with vertical walls. Channel dimensions within the notch were approximately 0.61 m wide by 0.91 m deep. The design was used in an attempt to reduce winter aufeis formation in the creek by restricting all flow during periods of low discharge to the rectangular notch. The gabion notch filled with streambed materials from the mid-1970s to the early 1990s, leaving about 50 m of the notch intact upstream from the road. A fish barrier consisting of a waterfall approximately 1 m high was created at the upstream end of the gabion structure.

During summer months the pool-type habitat between the gabions was used by Arctic grayling. Shallow-riffle habitat where gabions had filled with streambed material was used by juvenile chinook salmon and slimy sculpin. Visual estimates of Arctic grayling in the 50 m reach ranged from 10 to 30 fish. Upstream from

Figure 1. Crooked Creek In The Chatanika River Drainage.



the waterfall, Crooked Creek flows in a natural channel (2.4 to 3.1 m wide) with incised banks, dense streambank vegetation, overhanging alder and willow, and a substrate of gravel and cobble with some boulders.

Rehabilitation work in Crooked Creek was initiated by the University of Alaska Fairbanks as mitigation for an unauthorized wetland fill associated with the Poker Flats Rocket Research Site. Rehabilitation of Crooked Creek began on June 23, 1992, and was complete by the 24th (Figure 2). About 168 m of stream channel were ripped with a Komatsu 85E dozer to destroy gabion baskets and to remove the fish barrier. Total instream time was 3.5 hours. Gabion wires were bladed to the downstream end of the work area and removed. The fish block at the upstream end of the work area was ripped and bladed to remove the 1 m vertical waterfall. Upon completion of ripping, a pilot channel was constructed by angling the dozer blade creating a channel along the left limit of the creek. The stream channel was bladed extensively to distribute the 1 m vertical change in water elevation over a distance of about 91 m. Gabion wires remaining in the channel were clipped and removed manually. Water quality in Crooked Creek was highly turbid during instream dozer work but was clear within 20 minutes after dozer activity was complete. Willows uprooted during the instream work were left in the stream channel. Pool habitat that existed prior to rehabilitation work was changed to shallow-riffle habitat.

Figure 2. Dozer removing gabion structure from Crooked Creek (top photo) and sample reach #2 following completion of instream work (bottom photo).

OBJECTIVES

Our objectives were to evaluate fish use of Crooked Creek after removal of the fish barrier and associated gabions originally constructed in the early 1970s and to document fish use within the area changed from pool to riffle habitat.

METHODS

Sample reaches were located in Crooked Creek downstream of the Steese Highway, within the area disturbed during dozer removal of the fish barrier and gabions, and in Crooked Creek upstream of the fish barrier. The following sample reaches were established:

> Sample Reach 1 - located downstream of Steese Highway bridge, 52 m in length, riffle area;
>
> Sample Reach 2 - disturbed area where gabion structure and fish barrier were removed, 168 m in length, riffle area;
>
> Sample Reach 3 - upstream of fish barrier, 107 m in length, three riffles and three pools;
>
> Sample Reach 4 - upstream of fish barrier, 61 m in length, two riffles and three pools;
>
> Sample Reach 5 - upstream of fish barrier, 85 m in length, three riffles and four pools;
>
> Sample Reach 6 - upstream of fish barrier, 70 m in length, three riffles and two pools; and
>
> Sample Reach 7 - upstream of fish barrier, 113 m in length, four riffles and five pools.

Sample reach #1 was located in a channelized portion of Crooked Creek where the gabion baskets had been covered with streambed materials. Sample reach #2 was disturbed by dozer activity during removal of the fish barrier and gabions. Sample reaches 3 to 7 are spread over about 1.0 km of natural stream habitat above the former fish barrier. Sample reaches were marked and labeled with survey flagging and plastic laminated markers. Fish were collected with a Smith-Root model 15-A backpack electrofisher using a single pass upstream beginning at the downstream sample reach. Fish were identified, measured, and released immediately below the next sample reach.

RESULTS

In 1989, Crooked Creek was sampled in the channelized area immediately upstream of the Steese Highway and in the creek upstream of the gabion structure and waterfall. About 60 m of channel was electrofished upstream (one pass) without block nets. On July 11, 1989, the water was clear (7.2°C) and two Arctic grayling (190 and 210 mm), ten chinook salmon (45, 46, 47, and 47 mm, six released without measurement), and 11 slimy sculpin were collected in reach #2 and released. We also observed 12 Arctic grayling in the creek immediately below the waterfall. The same reach was sampled on September 1, 1989. Water was clear (3.3°C) and one Arctic grayling (132 mm), 24 chinook salmon ranging from 46 to 72 mm (x = 55.9, s_x = 6.7), and 16 slimy sculpin were collected and released.

On July 11, 1989, one pool and part of a riffle, about 30 m of stream, were electrofished above the fish barrier. Water was clear (7.2°C) and 18 slimy sculpin were collected and released. No Arctic grayling or juvenile chinook salmon were captured or observed.

Data on fish distribution in Crooked Creek were collected immediately before and after removal of the fish barrier. The entire length of Crooked Creek downstream of the work area was electrofished on June 23, 1992; eight slimy sculpin were captured and no Arctic grayling or juvenile chinook salmon were observed. Following completion of instream work the actual disturbed stream channel was checked on June 25, 1992, and one slimy sculpin was observed.

Sample reaches in Crooked Creek were electrofished on July 10 and August 4, 1992, and July 16, 1993 (Table 1). Juvenile chinook salmon were collected within the disturbed area (sample reach #2) and in sample reach #3 located upstream

Table 1. Number of juvenile chinook salmon, Arctic grayling, and slimy sculpin captured and released in selected sample reaches located in Crooked Creek in 1992, 1993, and 1994.

Date	Sample Reach	Number of Grayling	Number of Sculpin	Number of Chinook
6/23/92	#1	0	8	0
8/4/92		0	98	0
7/16/93		0	75	3
5/25/94		7	10	0
7/8/94		0	87	1
8/5/94		0	94	31
6/25/92	#2	0	1	0
7/10/92		0	73	0
8/4/92		0	77	1
7/16/93		0	33	8
5/25/94		4	9	1
7/8/94		0	76	3
8/5/94		0	55	33
8/4/92	#3	0	72	0
7/16/93		0	22	1
5/25/94		4	7	1
7/8/94		2	33	0
8/5/94		1	38	20
8/4/92	#4	0	22	0
7/16/93		1	12	0
5/25/94		0	2	0
7/8/94		0	3	0
8/5/94		0	7	0
8/4/92	#5	0	36	0
7/16/93		0	6	0
5/25/94		0	1	0
7/8/94		0	10	0
8/5/94		0	11	8
8/4/92	#6	0	21	0
7/16/93		0	4	0
5/25/94		3	0	1
7/8/94		1	0	0
8/5/94		0	4	0

Table 1. (Continued)

Date	Sample Reach	Number of Grayling	Number of Sculpin	Number of Chinook
8/4/92	#7	1	13	0
5/25/94		3	0	0
7/8/94		0	4	0
8/5/94		1	22	7

from the former fish barrier. Slimy sculpin were present in all sample reaches but few Arctic grayling were captured in 1992 and 1993.

In 1994, all sample reaches were electrofished on May 25, July 8, and August 5. A run (swift, deep narrow pool) had developed in sample reach #2. On May 25, 1994, 21 Arctic grayling were collected, four from sample reach #2. Water temperature was 3.4°C. Age 1+ chinook salmon and age 1+ Arctic grayling also were collected on May 25, 1994. The number of slimy sculpin present in the sample area increased from 29 on May 25 to 213 on July 8 (Table 2). Chinook salmon use was highest on August 5: 99 were collected compared with 3 and 4 on May 25 and July 8 (Table 2).

Table 2. Number of juvenile chinook salmon, Arctic grayling, and slimy sculpin captured and released in all seven sample reaches in Crooked Creek in 1994.

Date	Number of Grayling	Number of Sculpin	Number of Chinook
May 25	19	29	3
July 8	3	213	4
August 5	2	231	99

DISCUSSION AND CONCLUSIONS

A fish barrier created by a gabion structure in Crooked Creek blocked upstream movement of juvenile chinook salmon and Arctic grayling. The barrier was removed in June 1992, and in August 1992 one Arctic grayling was captured upstream from the former barrier. In 1993 and 1994, both Arctic grayling and juvenile chinook salmon were documented upstream from the former barrier. In 1994, use by Arctic grayling peaked in May and numbers of slimy sculpin and juvenile chinook salmon were highest on August 5.

Removal of the fish barrier replaced pool habitat in reach #2 with shallow riffle habitat. One swift run developed in reach #2 in 1994. Use by Arctic grayling in reach #2 decreased substantially when pool habitat was eliminated. The total number of Arctic grayling using Crooked Creek during the ice-free season may not have changed since fish had access to several miles of natural habitat upstream from the project area.

Sample reaches #1 and #2 were 220 m long and reaches 3 through 7 were 436 m long. Reaches #1 and #2 contained mainly channelized shallow riffle habitat bordered by gravel berms with minimal riparian vegetation. The 436 m of habitat upstream of the fish barrier was undisturbed, natural stream. Juvenile chinook salmon use of the disturbed area was substantially higher than use within the natural stream channel. On August 5, 1994, 64 of the 99 juvenile chinook salmon were collected in reaches #1 and #2.

Previous work in the Chatanika River drainage by Ott and Townsend (1989, unpublished data) documented the gradual dispersal of juvenile chinook salmon from known spawning areas upstream within the main river and into tributary streams. Most of the chinook salmon spawning in the Chatanika River occurs from the Elliott Highway upstream to Long Creek. In 1989, we sampled a 100 m reach of Sourdough Creek (Chatanika River tributary located about 35 km upstream of Long Creek) in mid-July, late July, and early September finding no juvenile chinook salmon in mid-July, 16 in late July, and seven in a 50 m subsample of the 100 m reach in early September (Figure 1). Our work on Sourdough Creek in 1989 included sampling for juvenile chinook salmon from the mouth of the creek upstream to Bear Creek, a distance of about 5 km. Juvenile chinook salmon were common in the lower Sourdough Creek sample area which was less than 1 km from the Chatanika River. The number of juvenile chinook salmon appeared to decrease as we sampled areas farther up Sourdough Creek. Juvenile chinook salmon were not observed or collected in the vicinity of Bear Creek. We have found similar use patterns in other tributaries in Interior Alaska. Juvenile chinook salmon appear to distribute upstream from known spawning areas and reach small clearwater tributaries by late July and early August.

General movement patterns for young-of-the-year chinook salmon have been studied in Interior Alaska streams. In the Salcha River, young-of-the-year chinook salmon appear to migrate from the mainstem of the river into larger tributaries during summer (Bendock 1974). Chinook salmon fry used Redmond Creek, a Salcha River tributary, during the summer but sampling in winter resulted in no fish caught (Bendock 1974, Francisco 1976).

Francisco (1976) and Dinneford (1977) studied the distribution and habitat use of juvenile chinook salmon in the Salcha River during summers 1974 and 1976. They found fry were most abundant in the mainstem of the Salcha River and in the lower 1.6 km of tributary streams. Preferred habitats included deep water pools, brush piles associated with beaver lodges, and in sloughs. Use of tributary streams peaked in late June and early July and decreased continuously until September when sightings of chinook fry were rare.

Juvenile chinook salmon, slimy sculpin, and Arctic grayling use of Crooked Creek appears to be limited to the ice-free season. Arctic grayling enter first and are found early in spring, just after breakup. Slimy sculpin and juvenile chinook salmon do not enter the creek until later in the summer, with use peaking in late July and early August. The disturbed portion of Crooked Creek contains wide, shallow riffle habitat whereas the natural stream channel is incised, flows are confined to a narrower channel, and the substrate is large (e.g., boulders and cobble in riffles). The higher use of the disturbed stream channel by slimy sculpin and chinook salmon may be related to habitat type and proximity to the Chatanika River. First, chinook salmon juveniles prefer water of moderate velocities (1 to 30 cm/sec) with cover (Hillman et al. 1987; Murphy et al. 1989; Richards et al. 1992). Cover includes substrate and edge as well as depth and vegetation. The disturbed habitat in Crooked Creek has water of moderate velocities and a substrate of gravel and angular rock. Second, the maximum upstream distribution of chinook salmon that occurs during mid-summer may be limited by the distance to known spawning areas and the length of time between emergence in spring and late summer natural downstream movement to overwintering habitats. Dinneford (1978) suggested that rearing juvenile chinook salmon in the Salcha River may use only the lower 0.8 to 1.6 km of tributary streams. The former fish barrier was located about 0.8 km from the Chatanika River.

We believe that removal of the Crooked Creek fish barrier has facilitated upstream movement of juvenile chinook salmon, Arctic grayling, and slimy sculpin. In August 1995, 35 of the 99 juvenile chinook salmon captured were in the creek upstream from the former barrier.

Future mitigation projects involving removal of fish barriers should include collection of baseline data to more fully predict the benefits which may be obtained. We anticipated that use by juvenile chinook salmon would increase and that Arctic grayling would spawn in upper Crooked Creek. Use by juvenile chinook salmon has occurred but successful spawning by Arctic grayling in upper Crooked Creek has not been documented.

LITERATURE CITED

Bendock, T. 1974. First interim report of the sport fish technical evaluation study. Special Report No. 6. Joint State/Federal Fish and Wildlife Advisory Team.

Dinneford, W.B. 1977. Third interim report of the commercial fish-technical evaluation study: Salcha River. Special Report No. 17. Joint State/Federal Fish and Wildlife Advisory Team. 88 pp.

Dinneford, W.B. 1978. Final report of the commercial fish-technical evaluation study: Salcha River. Special Report No. 21. Joint State/Federal Fish and Wildlife Advisory Team. 93 pp.

Francisco, K. 1976. First interim report of the commercial fish-technical evaluation study. Special Report No. 4. Joint State/Federal Fish and Wildlife Advisory Team. 85 pp.

Hillman, T.W., J.S. Griffith, and W.S. Platts. 1987. Summer and winter habitat selection by juvenile chinook salmon in a highly sedimented Idaho stream. Trans. Am. Fish. Soc. 16(2):185-195.

Murphy, M.L., J. Heifetz, J.F. Thedinga, S.W. Johnson, and K.V. Koski. 1989. Habitat utilization by juvenile Pacific salmon (*Onchorhynchus*) in the glacial Taku River, Southeast Alaska. Can. J. Fish. Aquat. Sci. 46:1677-1685.

Ott, A.G. and A.H. Townsend. 1989. Chatanika River and tributary stream surveys (unpublished data). Habitat and Restoration Division. Alaska Department of Fish and Game. Fairbanks.

Richards, C., P.J. Cernera, M.P. Ramey, and D.W. Reiser. 1992. Development of off-channel habitats for use by juvenile chinook salmon. N. Am. J. Fish. Manage. 12(4):721-727.