

Abundance and Run Timing of Adult Salmon in Tanada Creek, Wrangell - St. Elias National Park and Preserve, Alaska, 2000

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Abstract - From June 7 to June 18, 2000, a portable rigid picket weir was operated on Tanada Creek, a third order perennial stream and a tributary to the Upper Copper River in southeastern interior Alaska. This is the third year of weir operation at this site. Weirs were also operated at this site in 1997 and 1998. Year 2000 is the first year of a projected 3-year study. Due to high water flows, which continued throughout the field season, no fish were counted. The weir washed out on 2 occasions and was not put back in place a third time. The project was discontinued on July 17, 2000 for the remainder of the field season.

Introduction

The Copper River drainage provides spawning habitat for sockeye salmon (*Oncorhynchus nerka*) and chinook salmon (*O. tshawytscha*). Significant numbers of the adult salmon are harvested in commercial drift gillnet operations near the mouth of the Copper River from mid-May to September. Salmon escapement into the Upper Copper River system contributes to subsistence and sport fishing throughout the summer. The monitoring and evaluation of these runs is essential towards developing harvest management strategies that meet the mandates of the Alaska National Interest Lands Conservation Act (ANILCA). Subsistence uses are permitted on public lands where such activities have been traditional and have priority over the taking of fish for other purposes (ANILCA sec 201(9) and ANILCA sec. 804). In particular, legal challenges

to Alaska Department of Fish and Game (*John v. Alaska* A85-698 Civil) necessitate an accurate enumeration of the two stocks of sockeye salmon known to spawn in Tanada Lake.

Aerial survey counts of sockeye salmon have been conducted on Tanada Lake beginning in 1962 (**Table 1**). These estimates provide an index of relative run strength from year to year, but do not serve to independently enumerate salmon escapement (Melegari 1997). Aerial counts on Tanada Lake and weir counts on Tanada Creek conducted by Alaska Department of Fish and Game (ADF&G) in 1975, 1978 and 1979 did not establish a reliable correlation for determining stock levels in a given year. Daily and total counts for salmon at these weir sites are listed in **Appendix A**. Aerial surveys of Tanada Lake were conducted by the National Park Service in 1997 and 1998 (Raeder 1997a, Raeder and Rood 1998).

In response for the need to accurately determine escapement of sockeye salmon in this system, the National Park Service, with technical assistance from Alaska Department of Fish and Game, installed a portable rigid weir on Tanada Creek in 1997 and 1998 as part of a projected three-year study. Only a partial count of the salmon run was obtained in 1997 due to late installation and the loss of the weir due to flooding (Raeder 1997b). This report documents the continuation of the project in 2000. The objectives of the study are to: (1) determine daily escapement of adult sockeye salmon and chinook salmon entering Tanada Creek and (2) collect additional data for correlating aerial survey estimates and weir counts.

The weir was operational beginning June 7, 2000. Salmon migration into Tanada Creek was delayed, however, due to unusually high water levels. On June 13, 2000, one half of the pickets were pulled to relieve the pressure on the weir due to high water and debris. High water continued to move the weir out of place and on June 18, 2000, the weir washed out.

Study Area

Historical Fisheries

The Copper River system supports over 124 known stocks of sockeye (red) salmon of which at least 12 occur above the confluence of the Copper and Slana Rivers (Roberson 1987a). Two of these stocks migrate through Tanada Creek and spawn along the shores of Tanada Lake or in the lake outlet (**Figure 1**). King (chinook) salmon are present in incidental numbers.

Historically, local indigenous Alaskans harvested salmon with spears, gaffs, weirs and woven dip nets. Euro-Americans began commercial fishing activities in the Gulf of Alaska near the mouth of the Copper River in 1889. Non-Native fishermen introduced fish wheels into the Copper Basin around 1913 (Roberson 1987b).

Contemporary, non-commercial salmon harvesting in the Upper Copper River District occurs by two means; subsistence and sport fishing. A state subsistence law was passed in 1978 to accommodate Alaskans who have traditionally engaged in hunting and/or fishing in rural areas. Subsistence fishing in the Glennallen Subdistrict takes place along the mainstem of the Copper River from the Chitina-McCarthy Bridge upstream. This fishery utilizes fish wheels to take

salmon, with dip nets as a secondary method. The personal use category was established in 1984 to provide Alaskan residents, who did not qualify as subsistence users, an opportunity to harvest fish. This designation was changed in December, 1999 to a Subsistence use. This use includes the salmon dip net fishery in the Chitina Subdistrict located on the Copper River from the downstream edge of the Chitina –McCarthy bridge south to 200 yards upstream of Haley Creek. In addition to subsistence, both residents and non-residents catch a relatively small number of sockeye in sport fishing activities (Roberson 1987a).

Batzulnetas is a historical Athabaskan village site located near the mouth of Tanada Creek and has been occupied by Upper Ahtna peoples for at least 1000 years (Kari 1986). A number of area residents who are descendants of earlier inhabitants still utilize its resources for cultural education purposes including subsistence fishing. Batzulnetas is a 4H1 selection documented by the Bureau of Indian Affairs (Worthington, pers. comm., 1997). In 1985, descendants of Upper Ahtnas residing at Mentasta Village sued the State of Alaska to reestablish traditional subsistence fishing at Batzulnetas. An interim subsistence salmon fishery was created in 1987 under an Alaska Department of Fish and Game Emergency Regulation as a means of achieving a settlement in United States District Court case *John v. Alaska*, 85-698 Civil. The Copper River Subsistence Salmon Fisheries Management Plans have established weekly fishing periods to ensure adequate escapement to the spawning grounds at the Tanada Creek headwaters. In 1997 the Department of Fish and Game modified the Batzulnetas fishery to provide 24-hour a day access to the fishery due to record sockeye salmon runs in the Copper River. In 1998, the fishing period at Batzulnetas was set at 48 hours per week on June 5 and increased to 84 hours per week beginning on July 3. The fishery was closed on September 1, 1998. In 2000, the fishing period again remained at 48 hours per week until June 30 when it increased to 84 hours per week and will close on September 1 or by emergency order. **Table 3** shows salmon harvest at Batzulnetas.

Table 3 - Participation and harvest at Batzulnetas, Tanada Creek, 1987 – 2000

<u>Year</u>	<u>Permits Issued</u>	<u>Sockeye Harvest</u>
1987	8	22
1988	0	-
1989	0	-
1990	0	-
1991	0	-
1992	0	-
1993	1	160
1994	4	997
1995	4	-
1996	0	428
1997	1	450
1998	3	-
1999	1	-
2000	0	-

According to the Alaska Department of Fish and Game, the 2000 salmon runs in the Copper River Delta were below normal levels, with commercial harvest totaling 868,000 sockeye. Escapement to the upper Copper River as of July 24, 2000 was 555,761 fish based on sonar counts at Miles Lake.

Habitat

Tanada Creek is a third order perennial stream and a tributary to the Upper Copper River in southeastern interior Alaska. The stream flows through the Copper River Plateau and encompasses a watershed area of approximately 550-km². Originating at Tanada Lake (62°27'N, 143°23'W), Tanada Creek runs 30 km (18 miles) northwest to its confluence with the Copper River (62°37'N, 143°48'W). The terrain is nearly level to gently rolling throughout the creek basin and the stream gradient is less than 1% in both upper and lower reaches. Mosses, sedges, dwarf birch and willows dominate the ground vegetation. Black and white spruce are the primary evergreens, with stands of cottonwoods interspersed. The soils are poorly drained and are underlain by shallow permafrost (USDA 1979).

The town of Slana is located approximately 16 km (10 miles) northwest of the weir site. Annual precipitation in the area averages 39-cm and ambient temperature ranges from a high of 32° C to a low of - 46° C. Average annual temperature is - 2.5° C (NOAA 1995). Breakup normally occurs in May, and waterbodies freeze in September or October.

Site Selection

The weir site was located 930 meters (2993 feet) upstream from the Copper River and approximately 150 meters (483 feet) downstream from the Batzulnetas fish camp. The site falls within Ahtna, Inc. designated land in Section 29, SW1/4, T.10N, R.9E, C.R.M and is located on a private inholding. Permission to use the site was obtained from the Mentasta Village Council and the private landholder (**Figure 2**).

The weir was placed just past midpoint in a straight 120-meter (386 feet) section of stream with moderate water velocity and laminar flow. Stream width is about 9 meters (28 feet) from the top of the cutbanks. The vertical banks are approximately 0.7 to 1.0 meters (2.3 to 3.3 feet) high and undercutting is minimal. Maximum water depth at midstream during bankfull conditions is estimated at 1.2 meters (3.9 feet). Channel substrate is predominately cobble, with interstitial sand and gravel. Willow, alder and horsetail ferns stabilize the stream banks. Black and white spruce and cottonwoods contribute to stream shading. A beaver dam is located 360 meters (1,160 feet) below the weir site and acts as a fish barrier during periods of low flow. The beaver pond provides a resting area for migrating salmon.

A permanent cross section was established on June 9, 1998 about 1.8 meters (6 feet) downstream of the weir. Four brass cap reference markers were set along the transect.

A staff gauge was placed in the stream near the north bank intersecting the cross section. On June 5, 2000, the cross-section was again measured by Park Geologist Danny Rosenkrans and BioTech Jan Bullock to ascertain any change in the stream channel. Flowmeter measurements were also taken at this time.

Methods

Weir Design

A weir is a selectively permeable barrier set across a stream that blocks the passage of fish but allows water to pass (Harper 1995). The weir panels are made of evenly spaced tubular pickets aligned perpendicularly to the flow of the stream and extend across the entire channel. A chute or live trap is placed at an opening in this barrier and forms a narrow passage through which the fish can migrate upstream. An observer stationed on the live box can identify and enumerate the passing fish. The rigid picket weir used in this project was comprised of three, structurally simple, components:

- 1) Wooden tripods served as a framework to support the weir panels and to anchor the weir in the stream. The legs of the tripods were made of 1.8 meters (6 feet) cedar beams. The three beams were bolted together to form an apex. The legs of each tripod were arranged equidistant in the streambed. Two of the legs were placed in the downstream position and perpendicular to the flow. The third leg was placed in the upstream position and served as the primary support. Five tripods were placed across the creek. An all-thread bolt was inserted through the third leg and the crossbeam of each tripod to increase the stability of the legs. Sandbags were placed on the all-thread bolts and around each leg to prevent the tripods from floating and dislodging.
- 2) Weir panels were composed of pickets placed in a frame. The pickets were made of 1.8 meter (6-foot) lengths of schedule 40 plumbing pipe. The frame was made of two 1.8 meter (6-foot) lengths of aluminum "C" channel with evenly spaced holes. Each frame accommodated 26 pickets with 35-mm (1 3/8-inch) openings between pickets. Picket spacing was narrow enough to prevent passage of adult salmon. A single panel was placed on the upstream face of each tripod. The frames overlapped and were locked with a common picket. A total of 130 equally spaced pickets spanned the width of the channel. The weir was secured with ropes to a large tree on each bank. In addition, a 3/8-inch steel cable was run behind the weir and tripods and clamped to large trees on each bank. This cable acted as a safety line and also as a backstop to hold the weir in place in the event of high water and debris loading.
- 3) The live trap had an aluminum and wood framework enclosed with plywood. Trap doors were installed at the upstream and downstream openings. Outside dimensions were approximately 1.2 meters (4 feet) by 1.2 meters (4 feet) by 1.8 meters (6 feet). Sandbags were placed at the base of the upstream opening where it made contact with the stream substrate. The trap was secured to spruce trees on shore by ropes. Two small platforms at the top of the trap and on opposing sides served as seating areas during monitoring of the weir.

This box washed downstream approximately 300 meters during the high water event on June 18, 2000, and was not recoverable. Work was then started on a newly designed live trap box. This new box was constructed 2 inch Telspar and ¼ inch mesh hardware cloth. The outside dimensions mimicked those of the original box of 1.8 meters (6 feet) by 1.2 meters (4 feet) by 1.2 meters (4 feet). A plywood platform was bolted to the top of the box for seating and viewing fish. The bottom of the box was lined with white sandbags. These helped anchored the box in place and provided a light colored background for ease in seeing fish. The box was anchored by rope to both sides of the creek.

Weir Operation

The weir was installed and operational as of June 7, 2000. The site was checked every day to record stream gauge height, water temperature and to examine the creek downstream of the weir for salmon presence. The weir was monitored until June 13, 2000, when half the pickets were removed to allow high water and debris to pass through. Monitoring was conducted during the daytime. The panel components of the weir were inspected each day for breaches or degradation due to substrate erosion. Sandbags were added or repositioned when needed. The weir panels were cleared of debris as necessary, usually at the beginning of each shift. Water temperatures were taken daily at the stream surface inside the live box. On June 18, 2000, high water forced the live box and temperature gauge to disengage from the weir and float downstream 300 meters. The weir panels were submerged and became laden with debris. A fly over and subsequent video produced by Ranger Marshall Neeck showed the weir flooded and inoperable. Both foot trails to the weir were flooded and impassable for 2 days. On June 21, 2000, the fish weir crew visited the site to assess the damage. From June 26 through July 5, 2000, the weir was removed from the stream and left on shore. One tripod was lost down the stream. The new live box was assembled and put in place on July 5 but high water prevented the reinstallation of the weir. On July 11, 2000, a thermograph programmed to measure hourly water temperatures was attached to the staff gauge. On July 17, 2000, the project was halted for the season due to continued high water and the weir was disassembled and stored on shore at the site.

Flow Data

A pygmy current meter was used to measure flow on Tanada Creek in 1998. Several measurements were made and correlated with readings from the staff gauge. A logarithmic curve was derived from the data (**Appendix B**). An adjusted quadratic equation was applied to develop a conversion chart for water depth and discharge (**Appendix C**). Cubic feet per second (CFS) measurements were taken from the staff gauge on each day the weir was visited in 2000.

Cubic feet per second flows on Tanada Creek in 2000

<u>DATE</u>	<u>CFS</u>
June 15	66
June 16	63
June 21	90
June 26	60
June 30	86
July 5	72
July 6	70
July 10	56
July 11	56
July 12	68
July 18	78
July 19	70
July 20	68

Results

Weir Operation

The weir was only operated on Tanada Creek from June 7 through June 13, 2000. A high water event and heavy debris load washed the weir out on June 18, 2000. The weir was not reinstalled due to continued high water and the project was halted for the season on July 17, 2000. Water temperature ranges during weir operations are inconclusive at this time as the thermograph remains in place.

Flow Data

Flow rates influence migration and spawning of adult salmonids (Magneson, 1996). The stream discharge to stage level relationship developed in 1998 will aid in anticipating the arrival of salmon at the weir and in developing a relationship between flow and peak migration. Water levels in Tanada Creek increased throughout June with a peak CFS reading of 90 recorded on June 21, 2000. Flows were recorded from 56 to 90 CFS until July 17, 2000, when the project was halted for the season.

Fish Counts

No fish were seen or counted during the operation of the weir. No fish were seen downstream of the weir to the mouth of Tanada Creek during the operation of the weir.

Discussion

Weir Operation

The physical characteristics of Tanada Creek at Batzulnetas (low water velocity, light debris loads, and well-armored channel) and its accessibility make it suitable as a project site for future studies. Fixed picket weirs are an economical and efficient means of gathering accurate data on anadromous fish escapement (Nielson and Johnson 1983) but are vulnerable to high water flows and heavy debris loads making 24-hour monitoring essential to evaluating and responding to changes in stream conditions (Harper 1995). In addition, even minor breaches in the weir can decrease accuracy when personnel are not present to make repairs for 12 to 18 hours. Weir support tripods made of wood will float and consequently do not provide support during high water events. Supports made of heavy pipe that can be attached to the weir may be a better option. A live box made with plywood sides obstructs the flow of water and can be moved aside by high flows. Sides constructed of hardware cloth allow water to flow through more easily and do not create resistance.

A resistance board weir may be a better choice for a stream that experiences high water events. These weirs are anchored to the stream bottom and will float on the surface, allowing water to rise without causing increased pressure on the weir panels and live box. Extreme high water events will submerge the floating panels thus allowing some fish to pass but will allow the weir itself to stay in place and not be washed downstream. A resistance board weir is being looked into for the continuation of this project.

Fish Counts

Current analysis of commercial harvest and escapement at Miles Lake indicates a lower than expected return of sockeye salmon throughout the Copper River Basin (ADF&G). Based on the 20-year average of 558,000 salmon, escapement in 1998 was about 55% higher than normal. When this value was applied to the 1998 weir count at Tanada Creek (N=28,992), an average run on this tributary is in the order of 18,000 to 19,000 sockeye salmon. By the same standard, the 1997 run (N=27,521, partial count) may have totaled 37,000 to 38,000 sockeye. The Tanada Creek run represented 5.2% of the total salmon escapement to the Copper River in 1998. Based on data collected at the weir in 1997 and 1998, Tanada Creek could experience a high recruitment in 2002 and 2003.

The earliest recorded run, based on available data, was in 1994, when sockeye salmon were reported caught at Batzulnetas on June 4 (ADF&G). Weir counts conducted by the State of Alaska in the late 1970s indicate that the salmon first arrive at the upper reaches of Tanada

Creek in the last week of June or early July. Peak period of migration for these years could not be determined due to overall low daily counts.

A preliminary aerial survey on Tanada Creek was done on July 13, 2000. Due to high water and turbidity, no fish were seen or counted. Aerial surveys on Tanada Lake in 1997 and 1998 have contributed to developing a correlation factor based on salmon counts at the weir. Aerial estimates on Tanada Lake were 15% of the cumulative weir count on August 19, 1998. Applying the extrapolated weir count of about 38,000 salmon for 1997 and the aerial estimate that year of 7,875 fish provides an aerial/weir factor of 21%. Note, as stated, that the 1997 weir count was incomplete.

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Table 1 - Weir counts at Tanada Creek and aerial surveys at Tanada Lake, 1962 - 1998.

Sockeye Salmon

<u>Year</u>	<u>Weir</u>	<u>Aerial¹</u>
1962	—	1500
1963	—	1060
1964	—	1500
1965	—	3300
1966	—	10
1967	—	1
1968	—	150
1969	—	6
1970	—	1000
1971	—	3843
1972	—	480
1973	—	10
1974	—	2800
1975	128	700
1976 ²	—	2200
1977	—	2800
1978	2265	2625
1979	10244	5225
1980	—	13700
1981	—	11200
1982	—	11680
1983	—	10900
1984	—	16100
1985	—	11700
1986	—	8260
1987	—	8350
1988	—	3825
1989	—	3300
1990	—	3000
1991	—	3050
1992	—	3450
1993	—	—
1994	—	—
1995	—	—
1996	—	—
1997 ³	27521	7875
<u>1998</u>	<u>28992</u>	<u>4470</u>

¹ Peak survey count per year

² ADF&G identifies new stock of sockeye at Tanada Lake outlet. Subsequent values represent combined counts for lake and lake outlet

³ Aerial surveys conducted by NPS in 1997 and 1998

Appendix A - Tanada Creek weir daily sockeye and chinook escapement - ADF&G, 1975, 1978 and 1979.

	Sockeye	Sockeye	Sockeye	Chinook
<u>Date</u>	<u>1975</u>	<u>1978</u>	<u>1979</u>	
6/22	-	0	-	-

6/23	-	0	-	-
6/24	-	0	-	-
6/25	-	0	7	0
6/26	-	0	104	0
6/27	-	0	452	0
6/28	2	0	8	0
6/29	0	0	68	0
6/30	0	0	24	0
7/1	0	0	16	0
7/2	0	0	130	0
7/3	1	0	558	0
7/4	0	0	40	0
7/5	2	0	15	0
7/6	0	0	55	0
7/7	77	0	404	0
7/8	37	306	201	1
7/9	8	377	310	0
7/10	0	1	575	0
7/11	0	116	424	0
7/12	1	0	52	1
7/13	0	3	881	0
7/14	0	0	1	0
7/15	0	0	0	0
7/16	0	1	126	0
7/17	0	0	63	0
7/18	0	0	53	1
7/19	0	0	189	0
7/20	0	0	232	0
7/21	0	0	74	0
7/22	0	0	574	1
7/23	0	0	284	0
7/24	0	0	199	0
7/25	0	0	118	0
7/26	0	0	86	0
7/27	-	0	374	0
7/28	-	1300 ¹	55	0
7/29	-	0	337	1
7/30	-	0	295	0
7/31	-	21	22	0
8/1	-	41	155	0
8/2	-	1	509	0
8/3	-	6	147	0
8/4	-	2	269	0
8/5	-	0	138	0
8/6	-	8	110	0
8/7	-	16	27	0
8/8	-	0	99	0
8/9	-	1	183	0
8/10	-	0	211	0
8/11	-	0	209	0
8/12	-	0	312	0
8/13	-	3	38	0
8/14	-	60	4	0
8/15	-	-	17	0
8/16	-	-	144	0
8/17	-	-	1	0
8/18	-	-	229	0
8/19	-	-	35	0
8/20	-	-	0	0
8/21	-	-	1	0
Total	128	2265	10244	5

¹Heavy rains for 2 days pulled section of weir - est. 1300 reds went through.