

Abundance and Run Timing of Adult Salmon in Tanada Creek, Wrangell - St. Elias National Park and Preserve, Alaska, 1997

Randall S. Raeder

National Park Service
Resource Management Division
P.O. Box 439
Mile 105.5 Old Richardson Hwy.
Copper Center, Alaska 99573

Abstract - From June 23 to July 19, 1997 a portable rigid weir was operated on Tanada Creek, a third order perennial stream and a tributary to the upper Copper River in southeast interior Alaska. This is the first year of weir operation in a projected three year study. Only partial counts were obtained due to delayed installation, limited personnel and a washout of the weir in a high water event. A total of 20,729 (interpolated to 27,521) sockeye salmon (*Oncorhynchus nerka*) and two chinook salmon (*O. tshawytscha*) was counted. Only 16 samples for length and sex were sampled for sockeye salmon and did not constitute a representative subsample.

Introduction

Accurate assessment of yearly run strength and migratory timing in tributaries to the Copper River are essential to the development of a management strategy that meets the mandates of the Alaska National Interest Lands Conservation Act. National Park Service management of fish and wildlife will generally consist of baseline research and management of human activities that affect such populations and their habitat (WRST - General Management Plan 1986). Upper Copper River sockeye salmon populations are of particular importance to commercial, personal use and subsistence fisheries, especially in regards to ongoing legal challenges to Alaska State Fish and Game management strategies in Tanada Creek (John vs. Alaska 85-698 Civil). Subsistence uses are permitted in the park where such uses are traditional (ANILCA sec. 201(9)). A reliable method of enumerating sockeye salmon runs on Tanada Creek is required in order to determine harvest limits and appropriate fishing methods for existing salmon stocks.

Aerial surveys conducted on index streams in the Copper River Basin provide an estimate for total escapement to the Copper River drainage. In addition, these evaluations serve to document the distribution of spawning fish (Whitmore 1991). Aerial survey counts of sockeye salmon have been conducted on Tanada Lake since 1962 (ADF&G). To date, no clear correlation factor has been established between aerial counts on Tanada Lake and weir counts on Tanada Creek (Table 1). Light conditions, wind velocity, aquatic vegetation and other factors may obscure visibility and lead to an

under- or overestimate of the salmon present during overflights. The number of fish estimated in similar surveys is highly variable and at best serve as an index to relative strength of a salmon run on a particular stream (Melegari 1996). In 1976, ADF&G discovered a stock of sockeye salmon spawning at the outlet to the lake which had not been recognized in pre-1976 aerial counts. This nearly doubled the number of fish counted, making pre- and post 1976 data comparisons unreliable (Roberson 1987).

Alaska Department of Fish and Game operated fish weirs on Tanada Creek near its headwaters in 1975, 1978 and 1979. No formal reports were issued for these projects. Daily and total counts for salmon at these sites are listed in Appendix A.

In 1997, the National Park Service, with technical assistance from Alaska Department of Fish and Game, initiated a projected three year fish weir project on Tanada Creek near its confluence with the Copper River. A portable rigid weir was installed to determine daily escapement and run timing of salmon entering Tanada Creek. Sex and length frequencies for sockeye salmon were also collected. In addition, an opportunity exists to establish a protocol for correlating aerial surveys estimates and weir derived population data. An aerial survey of Tanada Lake was conducted by National Park Service in 1997. Refer to Raeder (1997) for a description of that operation.

The weir was operational from June 23 to July 19, 1997. Only partial counts were obtained due to the following factors: (1) delayed installation of the weir; (2) limited personnel and reduced operating hours due to budgetary constraints; (3) loss of weir due to high water event. During normal operation of the weir, accurate escapement data was collected and is presented in this report.

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 1987). 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. Fish wheels were introduced into the Copper Basin around 1913 by non-Native fishermen. Contemporary, non-commercial, salmon harvesting in the Upper Copper River District occurs by two means; subsistence and personal use. 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 to the Slana River, a distance of approximately 160 km. 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 and game. This is primarily a dip net fishery in regards to salmon take. Personal use fishing in the Copper River Basin is limited to the Chitina Subdistrict located on the Copper River from the Chitina River south to Haley Creek. In addition to subsistence and personal use, a relatively small number of sockeye are caught in sport fishing activities by both residents and non-residents (Roberson 1987).

Batzulnetas is a historical Athabaskan village site located near the mouth of Tanada Creek and has been occupied by Upper Ahtna peoples for about 1000 years (Kari 1986). A number of area residents who are descendants of earlier inhabitants still utilize its resources for cultural education purposes. Batzulnetas is a 4H1 selection documented by 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 to United States District Court case John vs. 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, Department of Fish and Game modified the Batzulnetas fishery to provide 24-hour a day access to the fishery.

The sockeye salmon return to the Copper River Delta was at record levels this year. Preliminary sonar counts indicate an escapement to the upper Copper River of over 1.1 million fish. Commercial harvest was approximately 3 million sockeye salmon and subsistence/personal use reported at about 200,000 salmon (Morstad pers. comm. 1997).

Habitat

Tanada Creek is a third order perennial stream and a tributary to the Upper Copper River in southeast 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 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. The ground vegetation is dominated by mosses, sedges, dwarf birch and willows. 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 northwest of the weir site. Annual precipitation 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 upstream from the Copper River and approximately 150 meters 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. Access through private inholdings was obtained from the Mentasta Village Council and private landholders.

The weir was placed at about midpoint in a straight 120 meter section of stream with moderate water velocity and laminar flow. Stream width was about 9 meters from the top of the cutbanks. The vertical banks were approximately 0.7 to 1.0 meter high and undercutting was minimal. Maximum depth at midstream during bankfull conditions was estimated at 1.2 meters. Channel substrate was predominately cobble, with interstitial sand and gravel. The stream banks were stabilized by willow, alder and horsetail ferns. Black and white spruce and cottonwoods contributed to stream shading. A beaver dam was located 360 meters below the weir site and provided a resting area for migrating salmon.

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 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 m (6 ft.) 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 upstream position and perpendicular to the flow. The third leg was placed in the downstream position and served as the primary support. Five tripods were placed across the creek. The foot of each leg was stabilized with sandbags.

2) Weir panels were composed of pickets placed in a frame. The pickets were made of 1.8 m (6 ft.) lengths of schedule 40 plumbing pipe. The frame was made of two 1.8 m

Table 1 - Weir counts at Tanada Creek and Aerial Surveys at Tanada Lake, 1962 - 1997 (ADF&G).

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	27521	7875 ³

¹ Peak survey count per year

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

³Aerial survey conducted by NPS

Table 2 - Daily, cumulative and total counts of salmon at Tanada Creek weir, 1997.

Date	Sockeye		Chinook	
	Daily	Cumulative	Daily	Cumulative
6/23	1134	1134	0	0
6/24	686	1820	0	0
6/25	730	2550	1	1
6/26	1692	4242	0	1
6/27	1640	5882	0	1
6/28	*1666	7548	0	1
6/29	* 769	8317	0	1
6/30	694	9011	0	1
7/1	844	9855	0	1
7/2	1615	11470	1	2
7/3	1099	12569	0	2
7/4	1585	14154	0	2
7/5	*1342	15496	0	2
7/6	*1582	17078	0	2
7/7	2145	19223	0	2
7/8	1018	20241	0	2
7/9	638	20879	0	2
7/10	572	21451	0	2
7/11	300	21751	0	2
7/12	* 436	22187	0	2
7/13	*997	23184	0	2
7/14	852	24036	0	2
7/15	1142	25178	0	2
7/16	1054	26232	0	2
7/17	801	27033	0	2
7/18	488	27521	0	2
Total	27521		2	

* Interpolated value

(6ft.) 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 upstream base of the pickets were covered with sandbags where they made contact with the stream substrate.

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 m (4 ft) by 1.2 m (4 ft) by 1.8 m (6 ft). Two small platforms served as seating areas during monitoring of the weir.

Weir Operation

The weir was monitored for fish passage 50 hours per week from June 23 to July 2, 1997. The hours were reduced to 40 hours a week from July 3 to July 19, 1997. Monitoring was conducted at night during periods of anticipated high salmon migration, normally from 2100 - 2200 hours until 0500 - 0700 hours the following day. During the weekends the weir gates were left open and allowed unimpeded salmon passage through the live box. At the end of each 8 or 10 hour monitoring period during the weekday, the weir gates were closed and then reopened at the beginning of the next days shift. This method provided for the intermittent passage of the fish during a period of over 100 consecutive hours per week, and permitted a count of the total number of salmon migrating during that time interval.

The panel components of the weir were inspected during operating hours for breaches or degradation due to substrate erosion. The weir panels were cleared of debris as necessary, usually at the beginning and end of each shift. Water temperatures were taken at the top of each hour (°F converted to °C) at the stream surface inside the live box.

Interpolated estimates of salmon passing during the weekends were derived by averaging the counts for two days before or two days after and applying that value to the unmonitored day (LaFlamme, pers. comm., 1997).

Biological Sampling

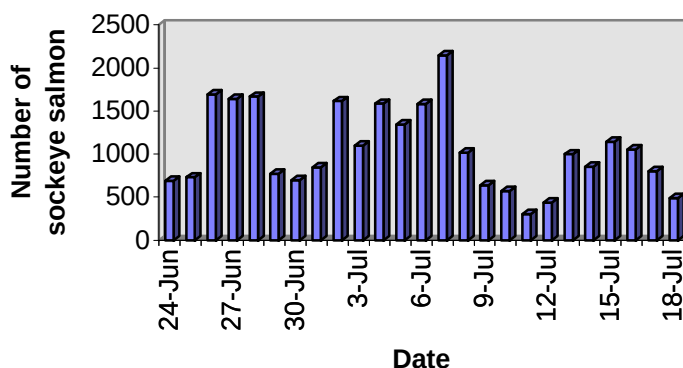
Sockeye salmon were collected in the live box and measured to the nearest millimeter from mid-eye to fork length. The measuring board was attached to the interior wall of the live box. Each salmon was caught and restrained inside a dip net to facilitate handling. The salmon were sexed using external secondary sex characteristics. Length and sex sampling was conducted only when at least two personnel were on duty. No scales were collected.

Results

Weir Operation

Weir monitoring began on June 23, 1997 and continued, with scheduled periods of non-monitoring, until July 19, 1997. Short periods of unscheduled weir closure occurred intermittently when a single person was on duty. These periods of closure totaled 5.2 hours throughout the project.

Figure 3 - Daily counts of sockeye salmon at the Tanada Creek weir in 1997. Values are interpolated for the following days; June 28 and June 29, July 5 and July 6, July 12 and July 13.



On July 21, 1997, portions of the weir became destabilized in a high water event due to record levels of precipitation throughout the Tanada Creek watershed area and accumulation of algal debris on the weir panels. Continued rain increased water levels and obliterated the remains of the weir. The live box and a tripod were carried downstream about 100 meters and sustained light damage. The heavier panel components remained submerged near the weir site. Water levels remained at or near flood stage until late August, delaying salvage operations and reconstruction of the weir.

During operations, the water temperature ranged from 8°C to 18°C. The low temperatures early in the project may reflect the final periods of snow melt in Tanada Lake.

Biological Sampling

The most abundant species enumerated in Tanada Creek were sockeye salmon (N=20,729; interpolated value = 27,521). Chinook salmon appeared in incidental numbers (N=2). A single resident species, slimy sculpin *Cottus cognatus* (N=1) was

observed. In addition, an unidentified species, probably arctic grayling, was seen several times in the live box. All were under 25cm in length and could have passed undetected through the pickets. Figure 3 shows daily sockeye salmon enumeration at Tanada Creek weir. Table 2 shows daily, cumulative and total counts for sockeye salmon at the weir.

Only 16 samples for length and sex were collected during the project. The data results are presented here as a matter of completeness and do not constitute a representative subsample. Females comprised 31% of the salmon sampled (N=5). Average length of females was 600 mm, SD=19. Males comprised 69% of the sample (N=11) and averaged 572 mm in length, SD=29 (Nielsen and Johnson 1983).

Fish passage was given priority over sampling due to the dispersal of the salmon downstream in response to the sampling activity in the live box. Salmon reaccumulation below the weir took 10 to 30 minutes after a single sampling event. Partial closure of the downstream gate during entrapment reduced attraction water flow and fewer salmon entered the live box during a given time interval.

Discussion

Weir operation

Portable fixed weirs, under normal conditions, are an efficient and economical means of gathering accurate data on anadromous fish escapement (Nielsen and Johnson 1983). Given the physical characteristics of Tanada Creek at Batzulnetas (light debris loads, well-armored channel, low water velocity) a fixed weir appears to be the most appropriate device to meet the needs of this project. During the month that the Tanada Creek fish weir was in operation, it performed well. The design and the structural integrity of the weir allowed it to withstand hours of moderate debris buildup during non-monitored periods and at near flood stage levels. The weir remained resistant to holes and breaches throughout the project. A small amount of erosion did occur on the north bank and was easily patched with a single sandbag. One case of erosion created a hanging picket that was reset at the start of the shift.

Unfortunately, a high water event combined with a period of non-maintenance precluded an emergency removal of pickets allowing debris to wash downstream. Unlike resistance board weirs, fixed weirs are vulnerable to washout and heavy debris load, making 24-hour monitoring essential to evaluating and responding to flooding during periods of high precipitation (Harper 1995). In addition, even minor breaches in the weir can decrease accuracy when personnel are not present to make repairs for 12 to 14 hours a day.

A biometric ground survey of Tanada Creek is recommended to; 1) locate potential weir sites that would be resistant to washout in high precipitation events and 2) to determine if other spawning sites exist below Tanada Lake. Disparities between weir counts and aerial survey estimates may be attributable to as yet undiscovered stocks of sockeye

salmon. Aerial surveys, although less costly than weirs, provide highly variable data and are of limited use unless a reliable correlation factor can be developed with an on site weir project (Melegari 1996). A protocol for the coordination of weir and aerial operations may improve the precision and reliability in aerial estimates.

Water temperature and flow rates influence migration and spawning success of adult salmonids (Magneson 1996). Stream temperature data can be collected at selected intervals with a digital temperature recorder submerged near the weir site. Maximum, minimum, and mean daily temperatures can be downloaded at the end of the run with appropriate software. A staff-gage can be installed and used to develop a discharge/water depth relationship. Stream flow rates can be determined with a digital flow meter.

Biological Sampling

Sockeye salmon arrive at the Copper River Delta in mid-May and are present in Tanada Creek by early to mid-June (Roberson 1987). Installation of the weir should be completed by the first week in June to insure that meaningful run timing data can be collected. A protocol for collecting biometric salmon data needs to be developed. This should include the following; 1) designated periods during which an adequate sub-sample of salmon would be captured inside the live box for sex, length and age data; 2) sampling from the downstream shore using dip nets to capture salmon; 3) a cooperative arrangement with subsistence users to sample fish taken in fish wheels located just downstream of the mouth of Tanada Creek.

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Appendix A - Tanada Lake Weir Daily Sockeye and Chinook Escapement - ADF&G, 1975, 1978 and 1979¹.

Date	Sockeye 1975	Sockeye 1978	Sockeye 1979	Chinook ²
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 ³	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

¹All data from each seasons original daily logs

² Chinook data available for 1979 only

³ Heavy rains for 2 days pulled section of weir - est. 1300 reds went through

