U.S. Fish and Wildlife Service
Office of Subsistence Management
Fisheries Resource Monitoring Program

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

Final Report No. FIS04-502

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February 13, 2008

FINAL REPORT SUMMARY PAGE

Title: Abundance and Run Timing of Adult Salmon in Tanada Creek in the Wrangell-St. Elias National Park and Preserve

Study Number: FIS04-502

Investigators/Affiliations: Molly McCormick and David Sarafin, Wrangell - St. Elias National Park and Preserve (WRST) PO Box 439, Copper Center, Alaska, 99573.

Management Regions: Cook Inlet/Gulf of Alaska

Information Type: Stock status and trends

Issues Addressed: Tanada Creek salmon are highly susceptible to Federal and State subsistence users as well as commercial harvest. The Batzulnetas Area subsistence fisheries specifically target Tanada Creek salmon stocks. Monitoring Tanada Creek salmon stocks aids in assessing sockeye salmon escapement into the uppermost tributaries of the Copper River and in evaluating the harvest opportunity for subsistence fishers in the Batzulnetas Area fishery and the uppermost portion of the Glennallen Subdistrict. The dynamic nature of the flows in Tanada Creek has prevented a rigid picket weir from functioning successfully. The feasibility of a floating resistance board weir and a video counting tower as monitoring tools are tested in Tanada Creek.

Study Cost: $188,000

Study Duration: May 2004 to September 2006

Key Words: Batzulnetas, Copper River, Sockeye, Tanada Creek, Tanada Lake Stock/status and Trends, Use

Citation: McCormick, M.B. and D. Sarafin, 2006. Abundance and Run Timing of Adult Salmon in Tanada Creek in the Wrangell-St. Elias National Park and Preserve. USFWS Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report No. FIS06-502-1, Anchorage, Alaska.

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INTRODUCTION

The upper Copper River drainage provides spawning habitat for sockeye salmon, *Oncorhynchus nerka,* and Chinook salmon *Oncorhynchus tshawytscha*. Significant numbers of 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 Federal and State subsistence fishing through September 30. The monitoring and evaluation of these runs is essential to ensure that Wrangell - St. Elias National Park and Preserve (WRST) maintains natural and healthy populations of fish as required by the Alaska National Interest Lands Conservation Act (ANILCA).

The Copper River system supports over 124 known stocks of sockeye 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). Chinook salmon are present in incidental numbers in Tanada Creek (Veach and Scotton, 2001).

Tanada Creek sockeye are one of the uppermost runs of sockeye in the Copper River and support a subsistence salmon fishery both in the Copper River and in Tanada Creek. The native villages of Mentasta and Chistochina harvest salmon in the Batzulnetas Area fishery. Batzulnetas, the Ahtna name for the traditional fishing site on Tanada Creek, has been used by the Ahtna people for over 1,000 years (Kari, 1986). The Batzulnetas fishery was in litigation from 1985 –2000 as Katie John, Doris Charles and others attempted to reestablish their traditional subsistence fishery. The “Katie John Decision” resulted in the expansion of Federal management of fisheries in waters under Federal jurisdiction throughout Alaska.

The Tanada Lake sockeye salmon stocks typically compose the largest population of sockeye spawning and rearing within Wrangell-St.Elias National Park/Preserve, among those stocks which spawn upstream of the Gulkana River. Good escapement data will allow us to assess the management of these important sockeye salmon stocks.

OBJECTIVES

Specific objectives for this study were:

1. To use a weir to monitor annual variations in the abundance of adult sockeye and Chinook salmon in Tanada Creek and document the timing of the passage of these fish past the weir site between early June and late September.

2. To measure the entry pattern of sockeye and Chinook salmon to Tanada Creek and compare the entry pattern to the historic entry pattern data set to test for changes in annual run timing.
3. To estimate the age, sex and length of the sockeye population by sampling 10 percent of the sockeye salmon proportionate to their abundance with a minimum of 100 fish per week and a maximum of 100 fish per night.
4. To compare video estimates with weir counts to determine the effectiveness of a video tower to estimate salmon escapement in Tanada Creek.
5. To test the feasibility of sampling water quality and zooplankton to determine if variations in water quality and zooplankton biomass correlate with variations in adult sockeye salmon escapement to Tanada Lake.
6. To provide an educational opportunity for local students and residents to learn about the Tanada Creek salmon runs and how the weir counts help to provide information needed to manage subsistence fisheries on the Copper River.

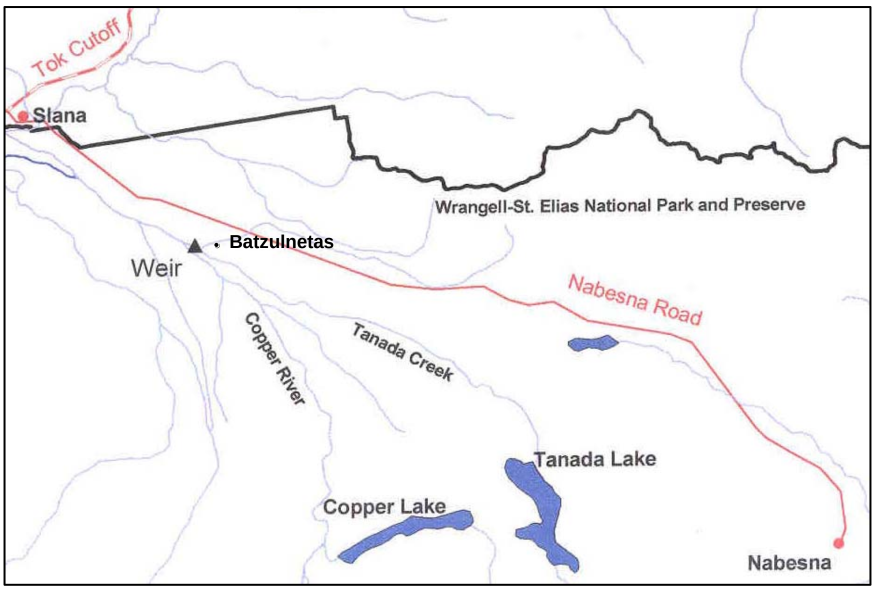

Figure 1. Tanada Creek and vicinity.

ESCAPEMENT ASSESSMENT 2004-2006

METHODS

Study Area

Watershed Description

Tanada Creek is a third order perennial stream and a tributary to the upper Copper River in southeast interior Alaska (Figure 1). The stream flows through the Copper River Plateau and encompasses a watershed area of approximately 550 km^2. 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 2%. The 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). 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 water bodies freeze in September or October.

Weir Site Description

In 2004 and 2005 the weir site was located 920 m upstream from the Copper River and approximately 160 m downstream from the Batzulnetas village site (Figure 2). Stream width at this site is about 9 m. The vertical banks are approximately 0.7 to 1.0 m high and bank undercutting ranges between 0 to 1 m. Maximum water depth at midstream during bank-full conditions is estimated at 1.2 m. The weir site was moved in 2006 approximately 100 m downstream from its previous location. The new site is located 820 m upstream from the Copper River and approximately 260 m downstream from the Batzulnetas village site (Figure 3). Stream width at this site is about 12 m. The vertical banks are approximately 0.65 m high. There is no bank undercutting. Maximum water depth at midstream during bank-full conditions is estimated at 1.1 m. Channel substrate at both sites is predominately cobble, with interstitial sand and gravel. The stream banks are stabilized by spruce, willow, alder and an understory of moss and horsetail ferns. Spruce and cottonwoods contribute to stream shading.

A permanent cross section was established on June 9, 1998 approximately 10 m upstream of the 2004-5 weir site. Four brass cap reference markers were set along the transect. A staff-gage was placed in the stream near the north bank intersecting the cross section.

Weir Installation and Operation

In 2004-2006 a floating resistance board weir was installed as described by Tobin (1994) (Figure 4). The weir, with picket spacing of 3.75 cm, was placed at the end of a straight 120 m section of stream with moderate water velocity and laminar flow. When resistance boards were in the "up" position the downstream end of the weir lay flat on the water surface. When resistance boards were in the "down" position, the downstream end of the weir was raised approximately 75 cm above the surface of the water (Figure 3). A sampling box, 1 m x 3 m, was constructed of aluminum channel, steel pipes, steel conduit, and PVC. Gates that could be raised and lowered were installed at either end to allow for holding, sampling, and releasing fish. The box was placed on the north bank side of the weir. Dates the weir was operational are displayed in Table 1. A staff gauge and water temperature reading were taken at the beginning of each shift. Gates on the box were closed when the weir was not monitored. The number of salmon counted was recorded hourly.

One *HOBO® TEMP* data logger was placed in a submersible case at the base of the staff gauge to collect water temperature data throughout the summer. The data logger recorded temperatures every hour and 30 minutes. Two depth readings were recorded daily; an average was calculated when different depths were recorded in a 24-hour period.

Figure 2. Weir with sampling box and counting platform at old site in 2005.

Figure 3. Constructing floating resistance board weir in Tanada Creek at new site in 2006.

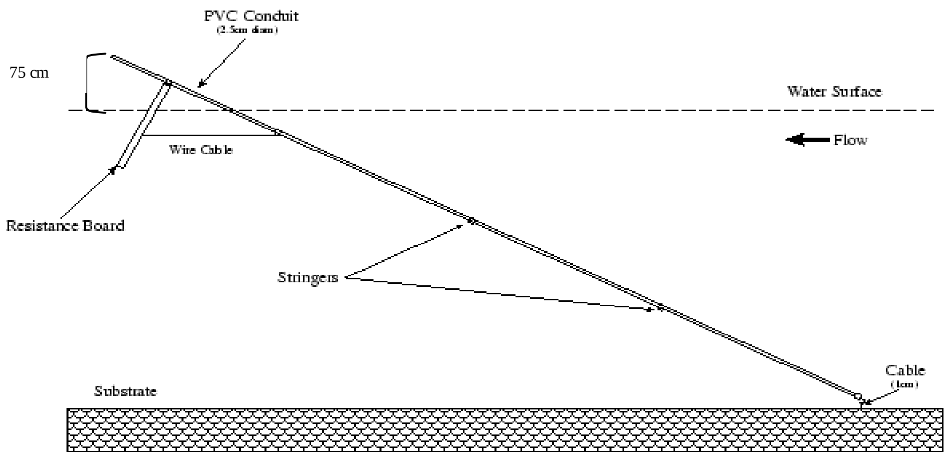

Figure 4. Placement of resistance boards in "down" position

Year	Start date	End date	Flood days	Days operational
2000	June 8	July 13		2
2001	June 5	August 23		60
2002	June 27	August 15		49
2003	May 31	September 19		112
2004	**May 29**	**September 7**		**99**
2005	**May 26**	**September 22**	**18**	**101**
2006	**June 6**	**September 21**		**108**

Table 1. Dates of weir operation.

Biological Data

Approximately 10 percent of the sockeye salmon were sampled to estimate the age, sex, and length composition of the escapement. Sampling was designed to be proportionate to their abundance with a minimum of 100 fish per week and a maximum of 100 fish per day. The salmon were sampled for scales and sexed using external characteristics. One measurement was taken on each fish, from mid-eye to fork length (MEF). Lengths were recorded to the nearest millimeter. A tagging cradle was used to facilitate handling. Scales were collected from the preferred area, located on the left side of the fish and two rows above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, according to Alaska Department of Fish and Game (ADFG) sampling protocol. One scale was taken from each sockeye salmon in accordance with this protocol. One scale is typically sampled from sockeye salmon while multiple scales would typically be sampled from Chinook salmon (Steve Moffitt, personal communication). Sampled fish were marked with a round left opercle punch. Scale samples were analyzed by the ADFG Commercial Fisheries Division in Cordova. Ages were adjusted for resorbed margins based on length frequency aggregations. The weir was checked regularly for gaps and fish leakage both above the water level and underwater by technicians using dry suits, face masks and snorkels.

In 2005, the investigators observed fish leakage through the weir during several high water events. The sockeye estimate in 2005 was based on the video count. In 2004 and 2006 no high water events compromised the weir: the weirs were constructed tightly and checked regularly for breaks in the structural integrity.

Video Escapement Operation

In 2004 and 2005, the video escapement recorder was installed 10 m upstream from the weir. A 1.5 inch in diameter pipe 15 m long was affixed horizontally between two spruce trees on either side of the creek. A 3 mm cable was attached to the trees above the pipe and was looped through guides along the pipe to provide extra support. Two remote cameras, sealed in waterproof housings were suspended from the pipe above the water surface approximately 5.5 m (Figure 5).

The cameras were equipped with a 3.5 mm ultra-wide angle lens to allow for field-of-view up to five meters. Four red lights were suspended with the cameras and aimed at the water surface (Figure 6). The lights were evenly spaced across the wetted width of the channel. Four more red lights were installed underwater, one on each bank pointing inward and one on each side of the center panel pointing towards each bank. A waterproof case containing a time-lapse frame recording system and multiplexer unit was housed on the north bank of the creek. Six 12-volt deep cycle batteries provided power to the system. A high contrast, permeable substrate panel was fixed to the streambed below the overhead cameras. This panel was approximately 1 m wide and was constructed of white PVC pipes that ran across the width of the creek and were spaced approximately 3 cm apart. Sandbags were placed along the downstream edge of the panel to keep fish from swimming under it. A vertical row of pickets 2 m high was placed in the streambed perpendicular to the panel (Figure 6). The pickets, which bisected the creek at approximately 4.8 m from each bank, served two purposes: (1) to delineate the midstream field of view of the two cameras, providing a defined edge for the mid stream frame of the video; (2) to prevent salmon from moving between one camera view and the other while swimming upstream. To eliminate glare from the water surface, an opaque plastic tarp was placed over the creek above the cameras (Figure 5). During the flooding events in 2005, the video camera was not operational for twenty days.

In 2006, the video escapement recorder and camera were moved to a new location approximately 1 km upstream from the weir. This was done because of the flooding events in 2005 that both compromised the weir estimate and created enough turbidity in the water to result in poor to unviewable video images for 20 days throughout the summer. The new location for the video camera in 2006 was located upstream of the confluence of Tanada Creek and Caribou Creek in order to eliminate the turbidity flowing in with floodwaters from Caribou Creek. The new video site also featured a wider stream cross section with a relatively shallow, less pronounced channel. The equipment at the new location was installed on June 26 and the video operation was shut down on September 26. Vertical rigid pickets were installed from each shore to reduce the fish passage area to approximately 6 m in width allowing for the use of one camera instead of two. These picket structures were supported by steel cables anchored to the stream bottom and shoreline. Sandbags were packed down along the upstream edge to prevent substrate scouring and thus maintain the fish-tight integrity of the channel-reducing picket structures. A 1.25 m wide ‘flash panel’ of white 1/16” thick UHMW polyethylene sheeting was secured to a cable and weighted down to the substrate with heavy plate steel (Figure 7). A camera, sealed in a waterproof housing was suspended approximately 4 m above, and directly over the fish passage by a 3 mm steel cable which was attached to trees on each side of the river. The camera was equipped with a 3.5 mm ultra-wide angle lens to allow for field-of-view up to five meters. Four red LED cluster lights were immersed to illuminate the fish passage area. Blue tarps were installed from the overhead cable to reduce glare and provide more stable lighting conditions throughout the day. Figure 8 shows the completed fish passage and overhead camera setup.

For all three years a weatherproof case containing a time-lapse frame S-VHS video recording system was housed on the north bank of the creek (Figure 9). A bank of four 12-volt deep cycle batteries provided power to the system. Charge was maintained in the battery bank primarily through the use of a gas powered 2000 W generator and 12-volt charger. Supplemental charge was also obtained from four 55 W photovoltaic solar panels and a charge controller. The time-lapse recorder was programmed to record in standard play (SP) mode, allowing for 48 hours of viewing on each T-160 tape. Tapes were changed every 48 hours. S-VHS tapes were used throughout the summer.

Figure 5. Cameras under tarp, 2004-2005.

Figure 6. Flash panel and lights under camera, 2004-2005

Figure 7. Flash panel at new site for video camera, 2006.

Figure 8. Video camera under tarp at new site, 2006.

Figure 9. Camera and video box at original camera site, 2004-2005

Limnological Data

Limnological data was collected in Tanada Lake four times throughout the summer of 2004. The intervals between sampling dates were at least two weeks: sampling dates were June 21, July 18, August 12, and September 6. Sampling took place from the floats of a plane (Figure 10). The two deepest areas of the lake were sampled both at the surface and at depth (Figure 11). On-site parameters were measured for temperature, pH and dissolved oxygen (DO). DO, pH and temperature were measured at 1 m intervals from the surface to the bottom using a Hydrolab meter. A Secchi disk was used to measure the depth of light penetration. Water samples were collected at each site (surface and depth approximately .5m above bottom) and sent to Analytica, Alaska (formerly Northern Testing Laboratories) (Figure 10). Analytica, Alaska (AA) uses a quantitative detection method; their Method Reporting Limits (MRL) are the lowest minimum concentrations at which a method or instrument will measure a relatively low value with low uncertainty in accuracy. The MRL for Kjeldahl Nitrogen was 1.0 mg/L; for Total Phosphate was 0.025 mg/L; and for Total Nitrites/Nitrates was 0.10 mg/L. Because the MRLs at AA are high and the nutrient levels found in Tanada Lake are low, we also sent water samples from one sampling event in 2004 to Oregon State University and from another sampling event to the University of Missouri and to the University of Hawaii for analysis of nitrogen, phosphorous and nitrates/nitrites.

Zooplankton samples were collected at two stations using a 0.3 m diameter, 153 um mesh, 1:3 conical net. Vertical zooplankton tows were pulled from a maximum depth of 50 m, or 2 m from the bottom of the lake if shallower than 50 m, at a constant speed of 0.5 m sec^{-1}. The net was rinsed prior to removing the organisms, and all specimens were preserved in neutralized 10% formalin (Koenings et al. 1987). Zooplankton samples were analyzed at EcoAnalysts in Moscow, Idaho where identification to genus or species, enumeration, and density and biomass estimates were performed. Zooplankton density (individuals per m^2 surface area) and biomass (weight per m^2 surface area) were estimated by species and by the sum of all species (referred to as total zooplankton density or biomass).

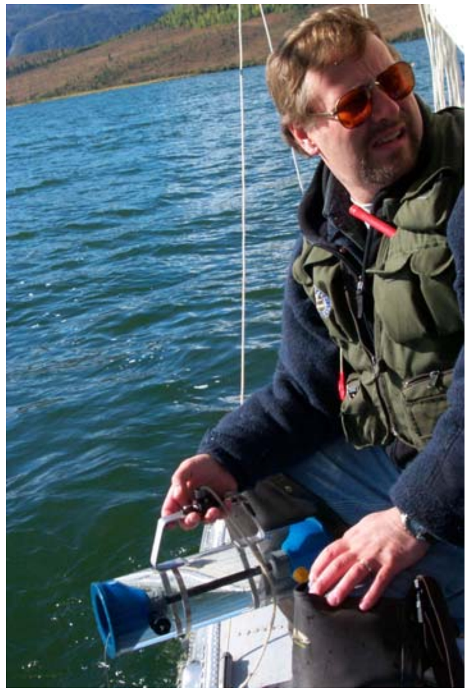

Figure 10. Sampling Tanada Lake from floats of plane in 2004.

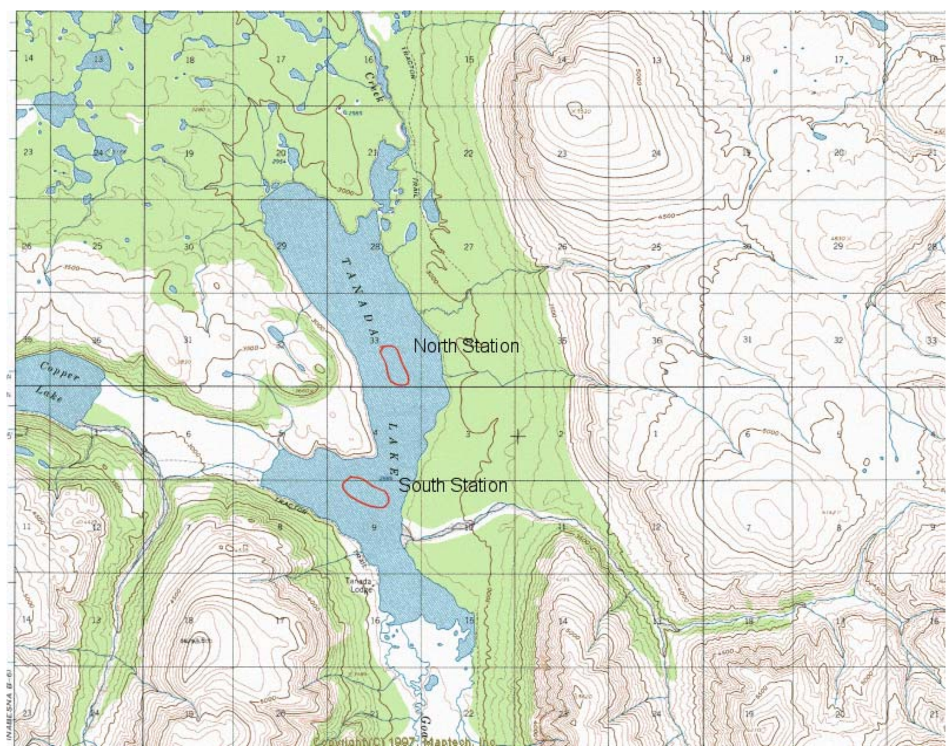

Figure 11. Water sampling sites in Tanada Lake, 2004.

No limnological samples were taken in Tanada Lake in 2005 or 2006. Weir operation expenses have increased substantially and this part of the project was costly. The zooplankton samples collected in 2003 and 2004 showed great variability that was hard to analyze, and the lab analysis of the water samples was often imprecise. Because of this, the data collected was difficult to interpret.

RESULTS

Weir Operation

The weir was operated during the dates displayed in Table 1. The floating resistance board weir was successfully operated during 2004 and 2006. In 2005 four high water events compromised the weir (Figure 12). The number of sockeye salmon migrating through the weir in 2005 was estimated by a video tape count. Staff gauge readings in 2006 showed an average year for water level ranging from 0.4 feet to 1.7 feet (Figure 13). By contrast the water level in 2005 ranged from 1.3 feet to 4.5 feet and was the highest since staff gauge readings were started in 2002 (Figure 14). The flow rate at 0.4 feet is 3.79 cubic feet per second (CFS) and at 4.5 feet is 1,153.8 CFS. The water temperature was measured with a *HOBO® TEMP* data logger in 2006 (Figure 15) and in 2004. The 2005 data logger was lost in the high water.

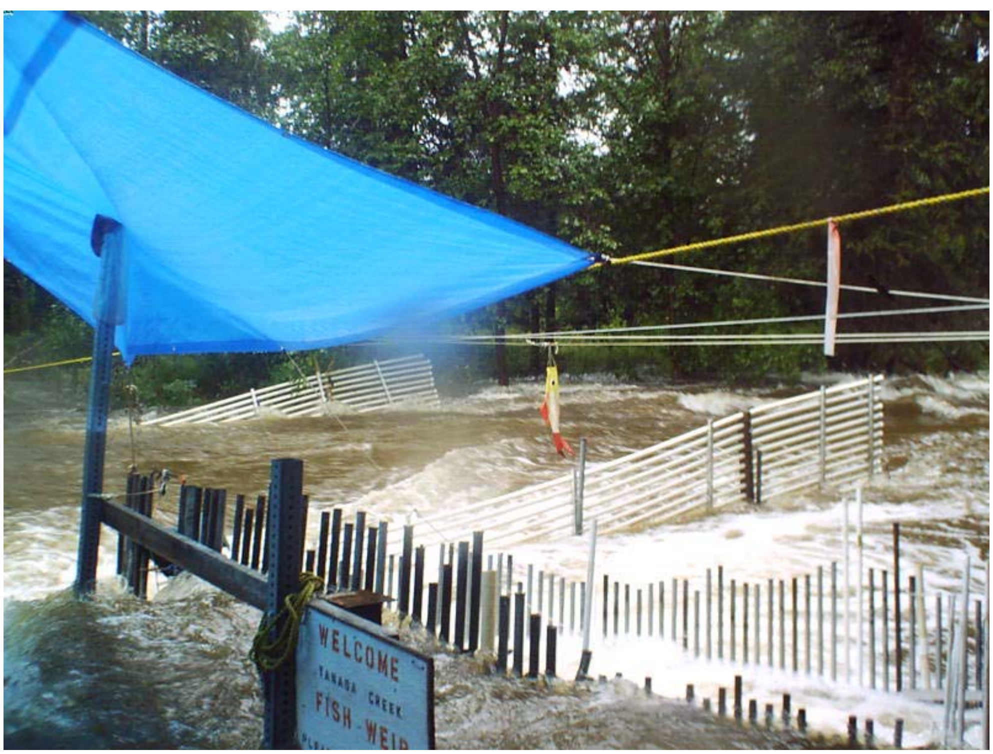

Figure 12. High water event of August 1, 2005.

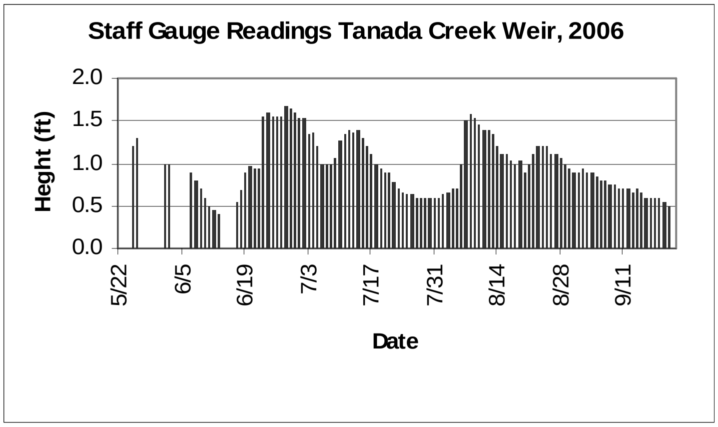

Figure 13. Staff gauge readings, 2006.

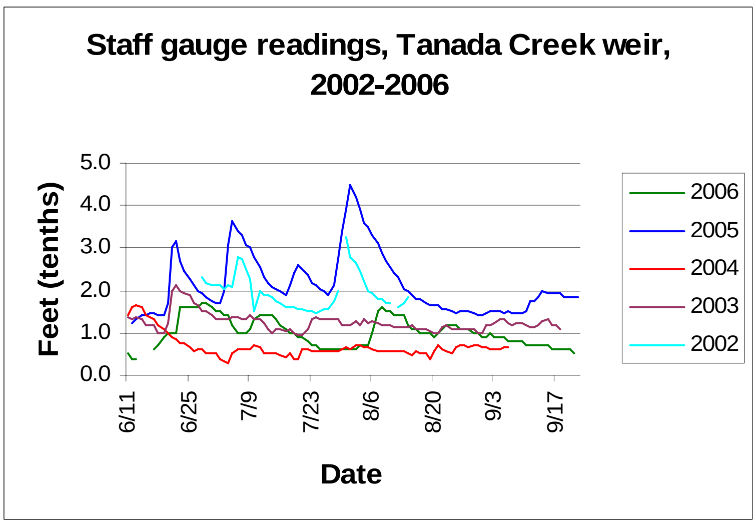

Figure 14. 2002-2006 staff gauge.

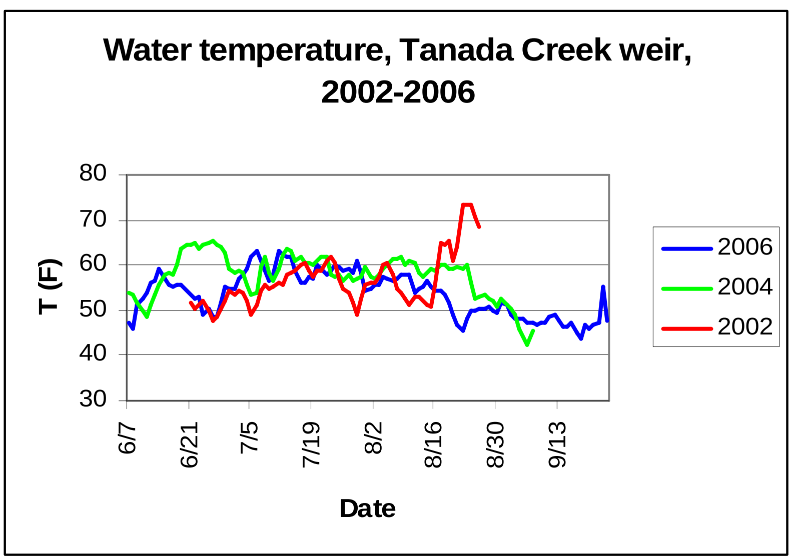

Figure 15. Water temperature at the Tanada Creek weir, 2002-2006.

Biological Data

Total sockeye salmon, *O. nerka*, observed at the weir are displayed in Table 2 and daily salmon counts are provided in Appendix A. In 2006, the number of sockeye salmon observed at the weir totaled 4,514 (Table 2.) Four Chinook salmon, *O. tshawytscha*, were observed in 2006. Eight hundred ninety eight sockeye were sampled. However, too many of the scales were unreadable and the ages generated by ADFG used the 5-year average (2001 - 2005) from Tanada Creek instead of the 2006 scales. Age, length and sex data are displayed in Tables

Year	Number of sockeye	Number of Chinook
1997	20,729*	5
1998	28,992	2
1999	—	—
2000	—	—
2001	1,649	16
2002	6,186**	5
2003	5,856	2
2004	17,120	0
2005	4,659***	1
2006	4,514	4

Table 2. Weir counts of sockeye salmon in Tanada Creek.

*Weir compromised by flood, estimate unreliably low.

** Estimate based upon mark-recapture sampling; the actual weir estimate was 2,489

***Weir compromised by flooding, estimate from video count; the actual weir estimate was 739

A total of 898 sockeye salmon were sampled for length and sex information and scale samples in 2006. There were a large number of resorbed scales in the samples and ADFG was not able to use them either to determine age classes or to compute the mean lengths of age classes. The age classes in Table 3 are a 5 year average. Tables 4-7 show the age, sex and length data from 2005 and 2006. The majority of the population for all three years was the 1.3 age class followed by the 1.2 age class of fish.

Stratum Dates: June 6 – September 21, 2006											
		Age Class								Weir Passage	n
Sex		0.2	0.3	1.1	1.2	1.3	2.1	2.2	2.3		
F	Percent	0	0.2	0	8.4	29.6	0	0	0.1		344
	Number	0	10	0	377	1337	0	0	5	1,729	
	SE	0	10.8	0	67.6	111.2	0	0	7.7		
M	Percent	0	0.4	0	11.2	50	0	0	0		554
	Number	0	20	0	83	228	0	0	0	2785	
	SE	0	37.6	0	60.5	95.9	0	0	0		
Total	Percent	0	0.7	0	19.6	79.6	0	0	0.1		898
	Number	0	30	0	885	3594	0	0	5	4514	
	SE		12		60	61			5		

Table 3. Tanada Creek Sockeye samples by sex and age, entire 2006 field season.

Stratum Dates: May 26 – September 22, 2005											
		Age Class									
Sex		0.2	0.3	1.1	1.2	1.3	2.1	2.2	2.3	Weir Passage	n
F	Percent	0	0	0	27	73	0	0	0		162
	Number	0	0	0	43	119	0	0	0	1,258	
	SE				3.5	3.5					
M	Percent	0	0	0	27	73	0	0	0		311
	Number	0	0	0	83	228	0	0	0	3,400	
	SE				2.5	2.5					
Total	Percent	0	0	0	27	73	0	0	0		473
	Number	0	0	0	126	347	0	0	0	4,659	
	SE				2.0	2.0					

Table 4. Tanada Creek Sockeye samples by sex and age, entire 2005 field season.

Sample dates: May 26 - September 22, 2005										
		Age Class								
Sex		0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	2.3
F	Avg. Length (mm)	0	0	0	540	583	0	0	0	0
	SE	0	0	0	2	2	0	0	0	0
	Sample Size	0	0	0	43	119	0	0	0	0
M	Avg. Length (mm)	0	0	0	577	617	0	0	0	0
	SE	0	0	0	2	1	0	0	0	0
	Sample Size	0	0	0	83	228	0	0	0	0
	Avg. Length (mm)	0	0	0	364	605	0	0	0	0
	SE	0	0	0	2	1	0	0	0	0
Total	Sample Size	0	0	0	126	347	0	0	0	0

Table 5. Tanada Creek Sockeye samples by sex and length for the entire 2005 field season.

Stratum Dates: May 29 - September 7, 2004											
		Age Class									
Sex		0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	Total Fish Counted	N
F	Percent	0.2	0.7	0	30.5	68.2	0.2	0	0		406
	Number	22	67	0	2,746	6,164	23	0	0	9,021	
	SE	22	38		206	208	22				
M	Percent	0	1.1	0	26.7	72.2	0	0	0		363
	Number	0	90	0	2,161	5,848	0	0	0	8,099	
	SE		44		188	191					
Total	Percent	0.1	0.9	0	28.7	70.2	0.1	0	0		769
	Number	22	157	0	4,907	12,012	23	0	0	17,120	
	SE	22	59		279	282	23				

Table 6. Age and sex data, May 29 – September 7, 2004

Sample Dates: May 29 - September 7, 2004										
Sex		Age Class								
		0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	2.3
F	Mean Length (mm)		573		531	582	590			
	SE		7.5		1.8	1.1				
	Sample Size		4		124	277	1			
M	Mean Length (mm)		605		566	613				
	SE		2.9		1.6	1.2				
	Sample Size		4		97	262				
Total	Mean Length (mm)		589		546	597	590			
	SE		7.2		1.7	1.1				
	Sample Size		8		221	539	1			

Table 7. Age, sex, length data, May 29-September 7, 2004.

Run Timing

The run timing for 2005 is based on the video count. In most years, sockeye salmon are first observed at the weir between the last week of June and the middle of July (Table 8). In 2006, the first sockeye salmon was observed at the weir June 17 (Figure 16). The median point in the run occurred July 2 when the cumulative total of sockeye salmon reached 2,257 (Table 8). The last sockeye was observed on film on September 20. Migratory run timing in 2006 appears to be the later than the average (1998, 2001, 2002, 2003, 2004, 2005) (Figure 17).

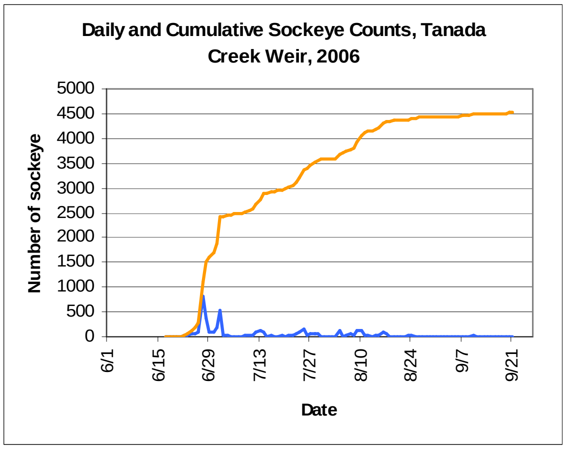

Figure 16. Cumulative and daily counts of sockeye salmon observations at the weir.

	First fish	Median date	Median Number
1998	13-Jul	19-Jul	14,496
2001	14-Jun	14-Jul	825
2002	28-Jun	12-Jul	3,094*
2003	11-Jun	5-Aug	2,929
2004	11-Jun	2-Aug	8,560
2005	13-Jun	23-Aug	2,539**
2006	June 17	July 2	2,257

*extrapolated based upon total run size estimate
**based on video count

Table 8. Annual date of arrival of the first sockeye salmon and the median point of the sockeye migration past the weir.

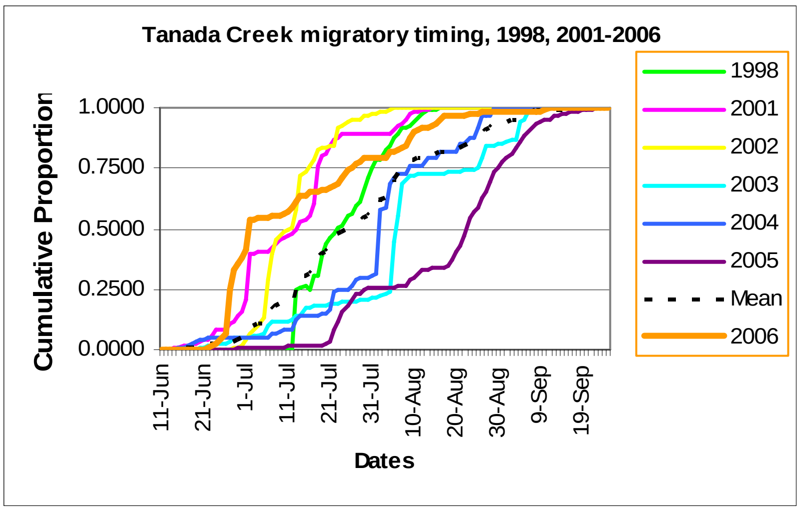

Figure 17. Migratory run timing, 1998-2006.

Capacity Building

The Batzulnetas culture camp took place from July 17-21 in 2006. The weir was operational throughout the entirety of this event. There were several tours of the weir given by NPS crew and staff members during the week of culture camp.


Figure 18. Batzulnetas culture camp, 2006

Reports of the weir data for all three years were given at the local Subsistence Resource Commission meetings, the South Central Resource Advisory Council meetings, the government-to-government meetings with Mentasta and Chistochina and to the Ahtna Subsistence Committee.

Video Escapement Estimation

In 2006, the video tower was erected and functioning while the weir was in operation. The site was moved approximately 1 km upstream of the former site because of major flooding that happened at the site in 2005. The four flood events of that year compromised the weir counts for at least 20 days throughout the summer and created structural problems in the weir itself. The new video site was located above the confluence of Caribou Creek and Tanada Creek in hopes of eliminating some of the turbid waters coming from Caribou Creek in a flood event. This site also enabled us to use one camera instead of two by narrowing the width of the fish passage with vertical pickets. Forty seven tapes recorded the creek from June 12 until the equipment was removed on September 25. The video camera functioned well in 2006 although having the video camera so far away from the weir was not as efficient use of the crew's time as having it closer to the weir. Each day the crew hiked approximately one mile to and one mile from the video site to make sure the camera and recording system was functioning properly and to change the video tape if necessary. This usually took around 2 hours of the time they were scheduled to work at the weir.

Limnological Data

Limnological data was collected in Tanada Lake only in 2004. The lake was sampled four times throughout the summer at the two deepest spots. Measurements of temperature, dissolved oxygen, pH, specific conductance, total Kjeldahl nitrogen, total phosphate, total nitrites/nitrates, chlorophyll A, and zooplankton density and presence were taken at each sampling event.

DISCUSSION

Weir Operation

The floating resistance board weir was installed correctly in 2006. The weir was routinely checked for holes and scours and none were found. The integrity of the weir was not compromised during this field season and the weir functioned properly from June 6 to September 21. Flooding events in 2005 resulted in a compromised weir. In 2006 the weir was moved downstream approximately 100 m to a location that has a more uniformly even streambed and bank sides, and no undercut banks.

Biological Data

The adult sockeye salmon population returning to Tanada Creek in 2006, estimated by video count at 4,515, was approximately 35 percent lower than the mean of 12,981 for the 7 years that salmon have been successfully enumerated at the weir's present location (Figure 19). The number estimated this year was the 2^{nd} lowest amount counted at the weir. The majority (80%) of the returning adults were five year-old fish having spent two years in freshwater and three years in marine waters; the remaining fish were primarily from brood year 2002 (either age class 1.2 (19.6%) or 0.3 (0.7 %)) (Table 3). There is no pronounced difference in the proportion of age classes sampled over the last 3 years. All three years show that the 1.3 age class represents the highest number of returning sockeyes, 72% or more. The second highest age class group for all three years was 1.2 age fish. Chinook salmon typically return to Tanada Creek in small numbers. Four Chinook salmon were observed returning to Tanada Creek in 2006; there was one in 2005 and none in 2004.

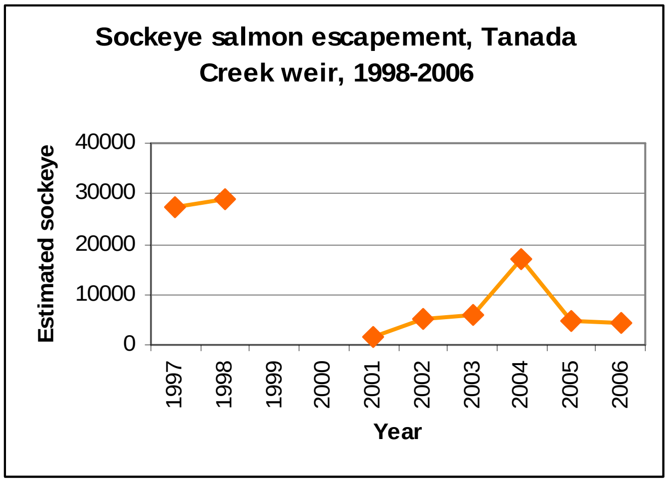

Figure 19. Estimated escapement by year.

Post-season analysis of commercial harvest and escapement at Miles Lake indicated a good return of sockeye salmon throughout the Copper River Basin for all three years. Based on the 27-year average of 632,014 sockeye salmon, escapement in 2006 of 959,731 salmon was about 35 % higher than average (Table 9).

Year	Total Salmon	Year	Total Salmon	Year	Total Salmon	Year	Total Salmon
1978	107,011	1986	507,477	1994	715,577	2002	816,825
1979	237,173	1987	483,478	1995	599,215	2003	695,233
1980	276,538	1988	488,398	1996	906,867	2004	669,646
1981	535,263	1989	607,797	1997	1,148,079	2005	854,268
1982	467,306	1990	581,859	1998	866,957	2006	959,731
1983	545,724	1991	579,435	1999	848,921		
1984	536,806	1992	601,952	2000	587,592		
1985	436,313	1993	833,387	2001	833,569		

Table 9. Miles Lake Sonar Fish Counts

Batzulnetas

Sockeye escapement in Tanada Creek has fluctuated substantially during the years that the weir has been in operation from a high of 28,992 in 1998 to a low of 1,660 in 2001 (Table 2). During those years the sockeye harvest in the Batzulnetas fishery has varied from a high of 582 in 1998 to a low of 0 in 2005 when the Batzulnetas fishwheel was damaged by the flood waters and no fish were caught (Table 10). In 2006 no Batzulnetas permits were issued.

	Permits Issued	Sockeye Harvest	Year	Permits Issued	Sockeye Harvest
1987	8	22	**1997**	1	428
1988	0	0	**1998**	3	582
1989	0	0	**1999**	1	55
1990	0	0	**2000**	0	0
1991	0	0	**2001**	1	62
1992	0	0	**2002**	1	208
1993	1	160	**2003**	1	164
1994	4	997	**2004**	1	182
1995	4	16	**2005**	1	0
1996	0	0	**2006**	0	0

Table 10. Participation and harvest in the Batzulnetas fishery, 1987-2006.

Run Timing

Table 8 and Figure 17 demonstrate that the run timing of the Tanada Creek stocks appear to be highly variable. Determining a median run date that could be used to forecast the total run size in-season would be useful to managers. However, with the high variability in run timing during the 7 years the weir has operated since 1998, this does not yet appear to be possible. The average median run date, based on the data collected since 1998, occurs on July 26. But since other variables that might affect migratory run timing, such as water discharge or climatic warming trends, have not yet been identified or assessed, prediction of run size by simply using the average median run date is not effective.

Capacity Building

During the Batzulnetas culture camps, WRST provided a forum for community members to observe the weir project in operation and to ask questions about the abundance, timing and management of the Tanada Creek run. In 2006 four local residents of the Slana area were employed by WRST to staff the weir including one graduate from the Fisheries Biotech Training Program that was taught in Slana in 2004. Through this employment, they gained experience in monitoring, sampling, problem solving, and collecting, reporting and entering data.

Video Escapement Estimation

The video camera was moved to a new location in 2006. At this location the viewed channel of the stream was narrowed down with fencing so that only one camera was needed. A new type of contrasting panel consisting of polyethylene sheeting was installed on the substrate under the cameras in 2005 created a larger viewing area. Tarps over the top and on the sides of the camera helped reduce sun glare.

Video monitoring was tested in 2003 and 2004 and appeared to be a useful tool to estimate escapement in Tanada Creek. In 2005 the weir estimate was based on the video estimate because the weir integrity was compromised by flooding events. In 2006 the integrity of the weir was maintained throughout the season and the weir count was used as the final estimate.

Limnological Data

No limnological data was collected in 2005 or 2006. In 2004 the data showed that nutrient levels were low and zooplankton mass was high.

CONCLUSIONS

Weir Operation

The new weir site worked well in 2006 although water levels were not high and it wasn't put to the test of flood waters. The floating resistance board weir can be successfully operated at this site.

Biological Data

The escapement into Tanada Creek was similar in 2005 and 2006. In 2006 it was the second lowest since 1997 (Table 2). Age composition of the majority of salmon migrating through the weir was similar to that in 2001-2005.

Run Timing

The first fish was seen on June 17 which is the second latest date that fish have migrated through the weir and the median run date for the 2006 Tanada Creek escapement was on July 2 which is the earliest. Run timing appears to be highly variable in Tanada Creek. The average median run date does not appear to be a useful tool for projecting total run size using the existing data.

Video Escapement Estimation

The new site worked as a good location for the video equipment and taping. However, the extra time it took for the crew to walk to the site and check the equipment was not an efficient use of their time, lessening the time they had to sample fish and keep the weir in good working order.

Limnological Data

Due to lack of funding, limnological sampling was ended in 2004.

RECOMMENDATIONS

Weir Operations

1. Continue to operate the weir at the site that was used in 2006.
2. Research combining the weir with an underwater video camera.

Video Escapement Operation

1. Move the video equipment back to the weir site.
2. Install an underwater camera instead of an overhead camera.
3. Continue operating the video escapement operation in conjunction with the weir to produce a reliable index of video estimates at a range of flow conditions.

Management

1. Continue monitoring to work towards defining what natural and healthy sockeye escapement is for Tanada Creek stocks.
2. Collect additional weir data to more accurately assess the trend in population abundance.

ACKNOWLEDGEMENTS

The National Park Service would like to thank the Village of Mentasta Lake, Katie John and Doris Charles for allowing use of their land for the purpose of conducting this project. The U.S. Fish and Wildlife Service (FWS), Office of Subsistence Management, provided $187,637 in funding support for this project FY04-FY06 through the Fisheries Resource Monitoring Program, under agreement number FIS04-502. Doug McBride and Karen Hyer, FWS, provided statistical support

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Appendix A. Tanada Creek daily salmon counts: 2004, 2005, 2006

	Daily sockeye salmon count	cumulative sockeye	Daily kings	cumulative kings
5/29/04	0	0	0	0
5/30/04	0	0	0	0
5/31/04	0	0	0	0
6/1/04	0	0	0	0
6/2/04	0	0	0	0
6/3/04	0	0	0	0
6/4/04	0	0	0	0
6/5/04	0	0	0	0
6/6/04	0	0	0	0
6/7/04	0	0	0	0
6/8/04	0	0	0	0
6/9/04	0	0	0	0
6/10/04	0	0	0	0
6/11/04	1	1	0	0
6/12/04	3	4	0	0
6/13/04	18	22	0	0
6/14/04	36	58	0	0
6/15/04	66	124	0	0
6/16/04	69	193	0	0
6/17/04	125	318	0	0
6/18/04	122	440	0	0
6/19/04	144	584	0	0
6/20/04	73	657	0	0
6/21/04	2	659	0	0
6/22/04	155	814	0	0
6/23/04	23	837	0	0
6/24/04	2	839	0	0
6/25/04	3	842	0	0
6/26/04	0	842	0	0
6/27/04	0	842	0	0
6/28/04	1	843	0	0
6/29/04	0	843	0	0
6/30/04	0	843	0	0
7/1/04	0	843	0	0
7/2/04	0	843	0	0
7/3/04	7	850	0	0
7/4/04	1	851	0	0
7/5/04	1	852	0	0
7/6/04	48	900	0	0
7/7/04	191	1091	0	0
7/8/04	16	1107	0	0
7/9/04	118	1225	0	0
7/10/04	148	1373	0	0

7/11/04	7	1380	0	0
7/12/04	16	1396	0	0
7/13/04	665	2061	0	0
7/14/04	326	2387	0	0
7/15/04	1	2388	0	0
7/16/04	5	2393	0	0
7/17/04	9	2402	0	0
7/18/04	0	2402	0	0
7/19/04	110	2512	0	0
7/20/04	3	2515	0	0
7/21/04	252	2767	0	0
7/22/04	1375	4142	0	0
7/23/04	44	4186	0	0
7/24/04	36	4222	0	0
7/25/04	1	4223	0	0
7/26/04	340	4563	0	0
7/27/04	414	4977	0	0
7/28/04	51	5028	0	0
7/29/04	54	5082	0	0
7/30/04	47	5129	0	0
7/31/04	108	5237	0	0
8/1/04	104	5341	0	0
8/2/04	4501	9842	0	0
8/3/04	256	10098	0	0
8/4/04	1583	11681	0	0
8/5/04	522	12203	0	0
8/6/04	187	12390	0	0
8/7/04	0	12390	0	0
8/8/04	36	12426	0	0
8/9/04	538	12964	0	0
8/10/04	7	12971	0	0
8/11/04	5	12976	0	0
8/12/04	9	12985	0	0
8/13/04	572	13557	0	0
8/14/04	16	13573	0	0
8/15/04	16	13589	0	0
8/16/04	458	14047	0	0
8/17/04	0	14047	0	0
8/18/04	0	14047	0	0
8/19/04	0	14047	0	0
8/20/04	27	14074	0	0
8/21/04	460	14534	0	0
8/22/04	3	14537	0	0
8/23/04	500	15037	0	0
8/24/04	30	15067	0	0
8/25/04	592	15659	0	0
8/26/04	844	16503	0	0
8/27/04	81	16584	0	0

8/28/04	1	16585	0	0
8/29/04	498	17083	0	0
8/30/04	8	17091	0	0
8/31/04	22	17113	0	0
9/1/04	0	17113	0	0
9/2/04	0	17113	0	0
9/3/04	0	17113	0	0
9/4/04	7	17120	0	0
9/5/04	0	17120	0	0
9/6/04	0	17120	0	0

2005 Weir and Video counts, Tanada Creek weir		
	Weir	Video
6/13	1	1
6/14	2	1
6/15	2	1
6/16	2	1
6/17	4	1
6/18	6	1
6/19	6	1
6/20	9	3
6/21	9	3
6/22	9	3
6/23	9	3
6/24	11	5
6/25	12	6
6/26	14	13
6/27	15	16
6/28	17	16
6/29	25	20
6/30	42	36
7/1	49	41
7/2	51	42
7/3	58	43
7/4	58	43
7/5	68	43
7/6	68	43
7/7	72	45
7/8	86	46
7/9	104	47
7/10	110	49
7/11	116	58
7/12	117	59
7/13	119	60

7/14	126	60
7/15	127	60
7/16	135	61
7/17	141	68
7/18	143	77
7/19	154	89
7/20	164	120
7/21	194	149
7/22	224	400
7/23	264	554
7/24	268	728
7/25	286	834
7/26	301	955
7/27	321	1060
7/28	333	1068
7/29	355	1156
7/30	356	1176
7/31	356	1208
8/1	356	1208
8/2	356	1208
8/3	356	1208
8/4	359	1208
8/5	359	1208
8/6	359	1218
8/7	359	1231
8/8	373	1247
8/9	390	1338
8/10	406	1383
8/11	406	1469
8/12	407	1536
8/13	405	1550
8/14	405	1572
8/15	406	1576
8/16	407	1577
8/17	407	1593
8/18	407	1625
8/19	407	1724
8/20	407	1880
8/21	412	2019
8/22	421	2203
8/23	453	2539
8/24	564	2639
8/25	576	2746
8/26	579	2916
8/27	588	3054
8/28	610	3232
8/29	622	3423
8/30	637	3523

8/31	642	3630
9/1	659	3700
9/2	664	3790
9/3	664	3883
9/4	670	4018
9/5	680	4108
9/6	690	4209
9/7	697	4281
9/8	701	4356
9/9	703	4391
9/10	706	4439
9/11	710	4446
9/12	712	4494
9/13	720	4522
9/14	724	4542
9/15	726	4552
9/16	729	4569
9/17	729	4579
9/18	731	4597
9/19	731	4605
9/20	735	4617
9/21	737	4629
9/22	739	4644
9/23		4648
9/24		4655
9/25		4659

2006 Tanada Creek Weir data, Wrangell-St. Elias National Park/Preserve				
Latitude/longitude Coordinates: 62°37'N, 143°47'W				
	Daily sockeye salmon count	cumulative sockeye	Daily kings	cumulative kings
6/6/06	0	0	0	
6/7/06	0	0	0	
6/8/06	0	0	0	
6/9/06	0	0	0	
6/10/06	0	0	0	
6/11/06	0	0	0	
6/12/06	0	0	0	
6/13/06	0	0	0	
6/14/06	0	0	0	
6/15/06	0	0	0	
6/16/06	0	0	0	
6/17/06	2	2	0	
6/18/06	1	3	0	

6/19/06	1	4	0	
6/20/06	5	9	0	
6/21/06	1	10	0	
6/22/06	32	42	0	
6/23/06	27	69	0	
6/24/06	58	127	0	
6/25/06	62	189	0	
6/26/06	94	283	0	
6/27/06	833	1,116	0	
6/28/06	391	1,507	0	
6/29/06	92	1,599	0	
6/30/06	99	1,698	0	
7/1/06	174	1,872	0	
7/2/06	538	2,410	2	2
7/3/06	24	2,434	0	2
7/4/06	26	2,460	0	2
7/5/06	6	2,466	0	2
7/6/06	6	2,472	1	3
7/7/06	10	2,482	0	3
7/8/06	9	2,491	0	3
7/9/06	19	2,510	0	3
7/10/06	29	2,539	0	3
7/11/06	39	2,578	0	3
7/12/06	85	2,663	0	3
7/13/06	114	2,777	1	4
7/14/06	108	2,885	0	4
7/15/06	0	2,885	0	4
7/16/06	45	2,930	0	4
7/17/06	6	2,936	0	4
7/18/06	13	2,949	0	4
7/19/06	20	2,969	0	4
7/20/06	6	2,975	0	4
7/21/06	41	3,016	0	4
7/22/06	34	3,050	0	4
7/23/06	64	3,114	0	4
7/24/06	99	3,213	0	4
7/25/06	153	3,366	0	4
7/26/06	39	3,405	0	4
7/27/06	48	3,453	0	4
7/28/06	60	3,513	0	4
7/29/06	53	3,566	0	4
7/30/06	4	3,570	0	4
7/31/06	0	3,570	0	4
8/1/06	0	3,570	0	4
8/2/06	0	3,570	0	4
8/3/06	2	3,572	0	4
8/4/06	121	3,693	0	4
8/5/06	9	3,702		

8/6/06	25	3,727		
8/7/06	51	3,778		
8/8/06	29	3,807		
8/9/06	132	3,939		
8/10/06	126	4,065		
8/11/06	47	4,112		
8/12/06	30	4,142		
8/13/06	1	4,143		
8/14/06	34	4,177		
8/15/06	34	4,211		
8/16/06	90	4,301		
8/17/06	51	4,352		
8/18/06	2	4,354		
8/19/06	5	4,359		
8/20/06	0	4,359		
8/21/06	0	4,359		
8/22/06	8	4,367		
8/23/06	17	4,384		
8/24/06	30	4,414		
8/25/06	4	4,418		
8/26/06	3	4,421		
8/27/06	3	4,424		
8/28/06	5	4,429		
8/29/06	8	4,437		
8/30/06	0	4,437		
8/31/06	1	4,438		
9/1/06	0	4,438		
9/2/06	4	4,442		
9/3/06	0	4,442		
9/4/06	0	4,442		
9/5/06	5	4,447		
9/6/06	1	4,448		
9/7/06	2	4,450		
9/8/06	0	4,450		
9/9/06	3	4,453		
9/10/06	29	4,482		
9/11/06	15	4,497		
9/12/06	10	4,507		
9/13/06	2	4,509		
9/14/06	0	4,509		
9/15/06	0	4,509		
9/16/06	0	4,509		
9/17/06	1	4,510		
9/18/06	0	4,510		
9/19/06	0	4,510		
9/20/06	4	4,514		
9/21/06	0	4,514		