

Fisheries Management Field Studies
Wrangell-St. Elias National Park and Preserve

Abundance and Run Timing of
Adult Salmon in Tanada Creek,
Wrangell-St. Elias National Park and Preserve,
Alaska, 1998

Randall Raeder
Vicki Rood
Brian Gavitt



United States Department of the Interior
National Park Service
Wrangell-St. Elias National Park and Preserve
Resource Management Division

September 1998

**Abundance and Run Timing of Adult
Salmon in Tanada Creek, Wrangell - St. Elias
National Park and Preserve, Alaska, 1998**

Randall Raeder
Vicki Rood
Brian Gavitt

National Park Service
Wrangell-St.Elias National Park and Preserve
Resource Management Division
P.O. Box 439
Mile 105.5 Old Richardson Hwy.
Copper Center, Alaska, 99573

September 1998

Table of Contents

List of Tables	ii
List of Figures	ii
List of Appendices	ii
Acknowledgments.....	iii
Introduction.....	1
Study Area	2
Historical Fisheries.....	2
Habitat	7
Site Selection	7
Bear Activity	8
Methods	9
Weir Design.....	9
Weir Operation	10
Flow Data	10
Biological Sampling	10
Results.....	11
Weir Operation	11
Flow Data	12
Biological Sampling	12
Discussion	1
Weir Operation	3
Flow Data	3
Biological Sampling	3
References.....	5
Personal Communications	7

List of Tables

<u>Table</u>	<u>Page</u>
1. Weir counts at Tanada Creek and aerial surveys at Tanada Lake, 1962 - 1998.	4
2. Copper River Sockeye Salmon Catch and Escapement Data, Copper River, 1978 - 1998.	6
3. Participation and harvest at Batzulnetas, Tanada Creek, 1987 - 1998.	5
4. Daily, cumulative and total counts of salmon at Tanada Creek weir, 1998.	14
5. Age, length and sex composition of sockeye salmon at Tanada Creek fish weir, 1998 ¹	13

List of Figures

<u>Figure</u>	<u>Page</u>
1. Tanada Creek and vicinity, Wrangell - St. Elias National Park and Preserve, Alaska, 1998.	3
2. Location of Tanada Creek Fish Weir, Wrangell - St. Elias National Park and Preserve, Alaska, 1998.	8
3. Comparison of discharge and daily totals of sockeye salmon on Tanada Creek, 1998. 1	
4. Daily counts of sockeye salmon at the Tanada Creek weir in 1997.	2
5. Comparative counts of sockeye salmon at Tanada Creek weir, 1997 & 1998.	5

List of Appendices

<u>Appendix</u>	<u>Page</u>
A. Tanada Creek weir daily sockeye and chinook escapement - ADF&G, 1975, 1978 and 1979.	8
B. Stage level vs. discharge, Tanada Creek Weir 1998.	9
C. Conversions for stage depth and discharge, Tanada Creek Weir 1998.	10

Acknowledgments

Special thanks to everyone who participated in this project. We appreciate the sponsorship and support we received from Marshall Neeck and his staff. They were generous with the use of the facilities at the Nabesna Ranger Station. We also thank the Mentasta Village Council and Katie John for access to the lands on which the project was conducted. Many thanks to Carl Mitchell for his assistance and advice throughout the summer. We particularly benefited from the assistance of Fred Snitzler, Maureen Lynch, Beate Lill, Thomas Annussat and Ryan Whisnant who served as volunteers in a variety of capacities throughout the season. They assisted us by supplementing our personnel at the weir and by giving lots of moral support. Thanks to Rick Lee for his advice and support regarding bear safety. Devi Sharp, Geoff Bleakley, and Heather Yates assisted in the installation of the weir. Kyle Rood participated with the dismantling of the weir. Thelma Schrank provided meteorological data in addition to handling field communications. Michael Murray assisted in producing the area maps and Bob Jones gave technical computer assistance. Thanks to Jim Hannah at NPS for flying the aerial survey on Tanada Lake. Danny Rosenkrans gave technical advise and assisted with the installation of the cross section. Tom Taube and Kathy Adler at ADF&G Glennallen provided technical support and source material. Thanks to Larry Larson at ADF&G Soldotna for the tagging cradle design and to Jim Baker at NPS for assistance in constructing it. Steve Moffitt at ADF&G Cordova processed and reported the age class data and Rod McLeod at USFWS supplied sampling literature. John Trawicki at NPS provided technical information on flow measurements. Thanks to Bob Schultz at USFWS for loaning us the flowmeter. And to anyone else we failed to mention, our thanks to you.

Abundance and Run Timing of Adult Salmon in Tanada Creek, Wrangell - St. Elias National Park and Preserve, Alaska, 1998

Randall Raeder
Vicki Rood
Brian Gavitt

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

Abstract - From June 2 to August 21, 1998, 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 second consecutive year of weir operation at this site in a projected three year study. A total of 28,992 sockeye salmon (*Oncorhynchus nerka*) and 2 chinook salmon (*O. tshawytscha*) was counted. A total of 137 sockeye salmon was sampled for age, length and sex frequencies. Females comprised 49% of the sample. Average mid-eye to fork length for female sockeye salmon was 540 mm (N=67, SD=30) and 600 mm (N=70, SD=30) for males. Two age groups were present in the sample, with age 1.3 representing 98% of those sampled, and age 1.2 representing 2%.

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, personal use 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 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 as part of a projected three year study. Only a partial count of the salmon run was obtained due to late installation and the loss of the weir due to flooding (Raeder 1997b). This report documents the continuation of the project in 1998. The objectives of the study are to: (1) determine daily escapement of adult sockeye salmon and chinook salmon entering Tanada Creek; (2) determine sex ratios, length and age composition of a subsample of the run; (3) establish baseline data for correlating aerial survey estimates and weir counts; and (4) establish a correlation between water depth and stream discharge.

The weir was operational beginning June 2, 1998. Salmon migration into Tanada Creek was delayed, however, due to unusually low water levels. The run did not arrive at the weir until July 13, 1998. Counts continued until the end of the run on August 21, 1998.

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. Fish wheels were introduced into the Copper Basin around 1913 by non-Native fishermen (Roberson 1987b).

Contemporary, non-commercial salmon harvesting in the Upper Copper River District occurs by three means; subsistence, personal use and sport fishing. A state subsistence law was passed in 1978 to accommodate Alaskans who have traditionally engaged in

Figure 1. Tanada Creek and vicinity, Wrangell - St. Elias National Park and Preserve, Alaska, 1998

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

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

³Aerial surveys conducted by NPS in 1997 and 1998

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 (100 miles). 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 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 1987a). See **Table 2** for Copper River sockeye salmon escapement and use totals over the past 20 years.

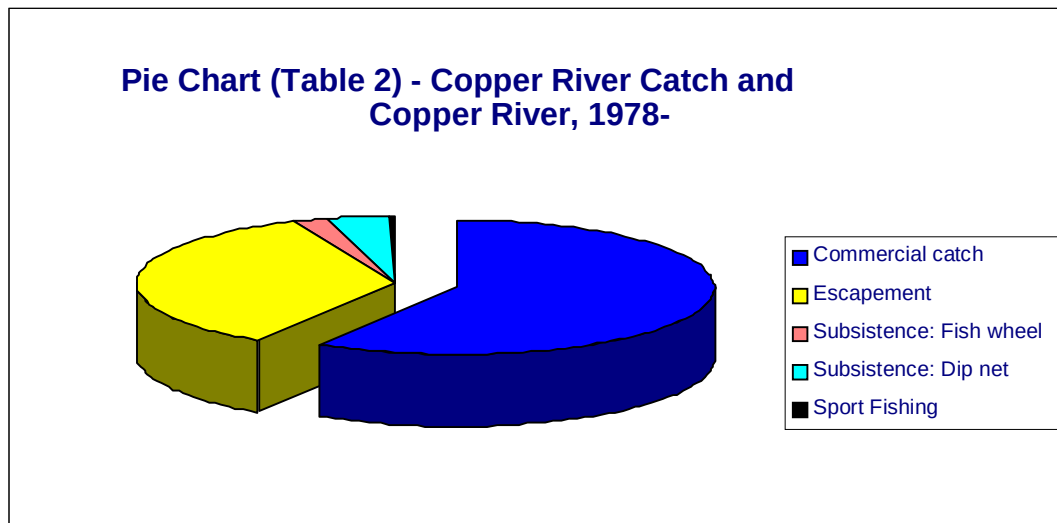
Batzulnetas is a historical Athabaskan village site located near the mouth of Tanada Creek and has been occupied by Upper Ahtna peoples for at least 1000 years (Kari 1986). A number of area residents who are descendants of earlier inhabitants still utilize its resources for cultural education purposes 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 a week beginning on July 3. The fishery was closed on September 1, 1998. **Table 3** shows salmon harvest at Batzulnetas.

Table 3 - Participation and harvest at Batzulnetas, Tanada Creek, 1987 - 1998.

<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	16
1996	0	-
1997	1	428
1998	3	384 (preliminary)

Table 2 - Copper River Sockeye Salmon Catch and Escapement Data, Copper River, 1978 - 1998.

Year	Commercial Catch	Escapement	Subsistence and Fishwheel ²	Personal Use ¹ Dip Net	Sport Catch
1978	250,629	107,011	6,406	19,377	1,606
1979	75,762	237,173	18,795	14,301	1,599
1980	18,451	276,538	15,811	15,230	2,109
1981	489,915	535,263	30,545	34,623	1,523
1982	1,190,730	467,306	39,968	65,463	3,343
1983	610,023	545,724	37,596	73,198	2,619
1984	895,235	536,806	27,941	48,236	3,267
1985	952,965	436,313	30,666	30,885	4,752
1986	780,808	509,275	27,441	41,054	4,137
1987	1,181,285	483,478	33,106	43,492	4,876
1988	576,960	488,398	29,194	42,331	3,038
1989	1,025,923	607,797	28,360	55,778	4,509
1990	844,767	581,895	31,765	65,432	3,569
1991	1,206,811	579,435	39,599	77,590	5,511
1992	970,938	601,952	45,232	86,724	4,560
1993	1,395,371	797,902	53,252	93,472	5,288
1994	1,152,220	715,181	68,278	94,024	6,533
1995	1,271,822	599,265	52,516	79,006	6,068
1996	2,356,365	906,867	52,052	95,007	14,170
1997	2,955,431	1,148,079	82,807	148,727	12,807
1998	1,339,860	861,979	Prelim.	Prelim.	Prelim.
Average	940,352	558,083 (454,524) ³	37,567	61,198	4,794
% of Average Run	58.7	34.8	2.3	3.8	0.3



1 A correction factor has been applied to the reported catch data to account for unreturned permits.

2 Since 1988, represents subsistence fishwheel and dipnet.

3 This value represents final escapement subsequent to subsistence/personal use/sport catch.

According to the Alaska Department of Fish and Game, the 1998 salmon runs in the Copper River Delta were above normal levels, with commercial harvest totaling 1,339,680 sockeye. Escapement to the upper Copper River exceeded 860,000 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 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 (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. 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 (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. Access through private inholdings was obtained from the Mentasta Village Council and private landholders (**Figure 2**).

The weir was placed at about 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 are estimated at 1.2 meters (3.9 feet). Channel substrate is predominately cobble, with interstitial sand and gravel. The stream banks are stabilized by willow, alder and horsetail ferns. Black and white spruce and cottonwoods contributed 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.

Figure 2. Location of Tanada Creek Fish Weir, Wrangell - St. Elias National Park and Preserve, Alaska, 1998.

A permanent cross section was established on June 9, 1998 about 17 meters (55 feet) downstream of the weir. 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.

Bear Activity

Bears were present in the vicinity during the project. Weir personnel underwent shotgun training under the supervision of an NPS instructor, and all received certification for the 1998 season. During most of the time of operation, the weir was manned by two people, at least one of whom carried a 12 gauge Remington Model 870 shotgun loaded with solids. As a safety precaution, one person counted while the other person scanned the creek and creek banks for bear. Weir personnel observed grizzly bear (*Ursa arctos*) at the weir on one occasion prior to the beginning of the run and on four occasions while on shifts during the peak of the run. These encounters were often at close range, usually within 10-12 meters (35-40 feet). In each instance, personnel shouted at the bear, and the bear turned and retreated from the area. There was evidence of fairly heavy use of the weir area by bears for feeding on salmon. Bear tracks, scat and partially eaten salmon carcasses were found on both banks of the creek downstream approximately 30 meters (100 feet) from the weir on a consistent basis. Weir personnel disposed of any salmon carcasses found on the creek banks in hopes that bears would be discouraged from returning to the area. Game trails along the downstream banks of the creek were heavily used. Bears were not encountered in the water or on the banks of the creek at the beginning of shifts at the weir, nor did bear activity interfere with manning the weir or biological sampling. Bear sign diminished as the bulk of the salmon run passed the lower reaches of the creek.

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 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 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. An all-thread bolt was inserted through the third leg and the crossbeam of each tripod to increase the stability of the legs.

- 2) Weir panels were composed of pickets placed in a frame. The pickets were made of .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 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 meter (4 feet) by 1.2 meter (4 feet) by 1.8 meter (6 feet). Sandbags were placed at the base of the up stream opening where it made contact with the stream substrate. The box 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.

Weir Operation

The weir was installed and operational as of June 2, 1998. The site was checked several times a week to record gage height and examine the creek downstream of the weir for salmon presence. The weir was monitored for fish passage approximately 50 hours per week from July 13 to August 21, 1998. Monitoring was conducted during the day and evening, normally between 0800 - 2300 hour. The weir was not monitored in the early morning hours due to low light levels in late July and August. The weir gates were closed between monitoring shifts. This method provided for the intermittent passage of the fish throughout the run and a count of the total number of salmon migrating upstream.

The panel components of the weir were inspected during operating hours 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 and end of each shift. Water temperatures were taken at the top of each hour (°C) at the stream surface inside the live box.

Flow Data

A pygmy current meter was used to measure flow on Tanada Creek. Several measurements were made and correlated with readings from the staff-gage. 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**).

Biological Sampling

Sockeye salmon were collected in the live box and measured to the nearest centimeter (expressed in millimeters in the results) from mid-eye to fork length (MEF). The salmon were sexed using external secondary sex characteristics. 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 sampling protocol. Scales were sent to ADF&G Commercial Fisheries Management Division in Cordova, Alaska for processing. All ages are listed using the European method (Burgner, 1991).

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 reassembled below the weir in about 20 to 40 minutes after a single sampling event. Partial closure of the downstream gate during entrapment reduced attraction water flow and the number of salmon entering the live box was greatly reduced. Samples were collected when salmon concentrations were relatively high, but not during periods of peak passage.

Results

Weir Operation

The weir was successfully operated on Tanada Creek from June 2 through August 21, 1998 and data collected represent the entire sockeye and chinook salmon run during that period.¹

The weir was initially installed on May 19, 1998 in anticipation of an early run. A high water event and a heavy debris load washed out the weir on June 1, 1998. The weir was reinstalled on June 2, 1998.

On July 17, 1998, a breach developed in the weir due to a hanging picket. The opening was discovered within 4 hours and repaired. An estimated 1,030 salmon passed through the breach and this number is included in the total count for that day.

Vandalism at the weir was reported on three occasions in late July and early August. Sandbags had been displaced from the downstream base of the live box and from the upstream base of the weir panels. Removal of the sandbags may have created small breaches in the weir. Two of the five tripods were displaced and had to be reset. The weir panels that rested on the tripods were secured by ropes to trees on the upstream bank

¹At the time weir operations ended, a minimum of 600 salmon remained in the beaver pond. These salmon were observed in the beaver pond for several days prior to the end of operations. The weir remained open to allow passage of these salmon. However, two or less salmon passed through the weir for four days, so operations were discontinued. This group presumably migrated upstream after the weir was pulled, but are not included in the total count.

to increase stability. The weir was easily repaired in each case and there was no evidence that salmon had escaped in significant numbers.

Water temperatures during weir operations ranged from 9°C to 17°C with an average temperature of 13.5°C at 1600 to 1700 hour. In late June and early July, groundwater alone maintained a low flow through the weir and water temperatures ranged from 6°C to 9°C. Lower water temperatures at the end of the run probably correspond to a decrease in ambient temperatures beginning in mid-August.

Flow Data

Water levels in Tanada Creek declined throughout June, and discharge at the weir remained at less than 1 cfs from June 17 until July 10, 1998. On June 30, a ground survey of Tanada Creek revealed that the streambed was dry 1.5 km to 6 km (0.9 miles to 3.6 miles) upstream of the weir. Sockeye salmon were first seen by weir staff members at the confluence of the Copper River and Tanada Creek on June 25, 1998. Between July 10 and July 12, 1998 the flow increased to about 6 cfs, but the salmon remained at the mouth of the creek. In the next 24 hours, the flow had reached about 22 cfs and salmon began accumulating at the weir (**Figure 3**). The minimum depth/flow necessary to permit salmon passage may occur between 7 cfs and less than 22 cfs. This corresponds to a change in water depth at the staff-gage of approximately 9 cm (0.3 feet).

Biological Sampling

The migration of sockeye salmon into Tanada Creek was delayed due to low water levels and a beaver dam that acted as a fish barrier. The earliest evidence that salmon had arrived at the confluence of the Copper River and Tanada Creek was from a fishwheel permit holder at Batzulnetas. Alaska Department of Fish and Game received a report on June 24, 1998 that two salmon had been caught. On June 25, weir staff members saw about 200 sockeye salmon at the mouth of the creek.

Salmon arrived at the weir on July 13, 1998. In less than 10 hours of monitoring a total of 6,831 sockeye salmon were counted. This first pulse of fish represented over 23% of the entire 1998 run. The run intensity leveled off after July 21. Counts continued until August 21 and the weir was dismantled and removed from the stream between August 22 and August 26, 1998.

The most abundant species enumerated in Tanada Creek were sockeye salmon (N=28,922). Chinook salmon appeared in incidental numbers (N=2). See **Table 4** and **Figure 4** for daily counts. Arctic grayling (*Thymallus arcticus*) were observed on several occasions in the live box. Additional arctic grayling and other smaller fish species under 25 cm in length could have passed through the pickets undetected. On August 2, 1998 two putative steelhead (*Oncorhynchus mykiss*) were seen at the weir. Alaska Department

of Fish and Game assisted with making the identification (Fleming, pers. comm., 1998). On June 30, 1998, during the drought, 10,000 to 15,000 dead fish were observed in the dry creek bed between 5 to 6 km (3 to 3.6 miles) upstream of the weir. These were tentatively identified from a frozen specimen as either salmon smolts or juvenile whitefish (*Coregonus* or *Prosopium* spp.) (Taube, pers. comm., 1998).

A total of 137 samples for length and sex were collected during the project. Females comprised 49% (N=67), and males 51% (N=70) of the salmon sampled. The average length of females was 540 mm, SD=30. The average length of males was 600 cm, SD=30 (Nielson and Johnson 1983).

Age frequencies were derived from 42 scale samples. Age 1.3 predominated, accounting for 98% of the sample and the remainder representing age 1.2 (**Table 5**). Most of the scales (91 of 133) had resorbed margins and were not suitable for age analysis. The estimate of age composition is probably biased toward fish arriving in the later portion of the run (Moffitt pers. comm. 1998).

Table 5 - Age, length and sex composition of sockeye salmon at Tanada Creek. fish weir, 1998¹

<u>Males</u>						<u>Females</u>					
Mid-eye to fork (mm)						Mid-eye to fork (mm)					
<i>Age</i>	<i>N</i>	<i>%</i>	<i>Range</i>	<i>Mean</i>	<i>SD</i>	<i>N</i>	<i>%</i>	<i>Range</i>	<i>Mean</i>	<i>SD</i>	
1.2	0	NA	NA	NA	NA	1	3.3	540-540	NA	NA	
1.3	12	100.0	530-740	603	54	29	96.7	490-600	540	35	
Total	70	51.5	520-740	593	84	66	48.5	440-620	542	36	

¹ Age 1.2 denotes an anadromous life cycle with one year as a free-swimming juvenile in freshwater and two years as an adult in saltwater. Age 1.3 indicates three years in saltwater.

Table 4 - Daily, cumulative and total counts of salmon at Tanada Creek weir, 1998.

Sockeye					Chinook				
Sockeye					Chinook				
<i>Date</i>	<i>Daily</i>	<i>Cum.</i>	<i>Daily</i>	<i>Cum.</i>	<i>Date</i>	<i>Daily</i>	<i>Cum.</i>	<i>Daily</i>	<i>Cum.</i>
6/2	0	0	0	0	7/13	6831	6831	0	2
6/3	0	0	0	0	7/14	1095	7926	0	2
6/4	0	0	0	0	7/15	1246	9172	0	2
6/5	0	0	0	0	7/16	702	9874	0	2
6/6	0	0	0	0	7/17	2188*	12062	0	2
6/7	0	0	0	0	7/18	507	12569	0	2
6/8	0	0	0	0	7/19	1956	14525	0	2
6/9	0	0	0	0	7/20	1138	15663	0	2
6/10	0	0	0	0	7/21	616	16279	0	2
6/11	0	0	0	0	7/22	443	16722	0	2
6/12	0	0	0	0	7/23	460	17182	0	2
6/13	0	0	0	0	7/24	291	17473	0	2
6/14	0	0	0	0	7/25	895	18368	0	2
6/15	0	0	0	0	7/26	190	18558	0	2
6/16	0	0	0	0	7/27	887	19445	0	2
6/17	0	0	0	0	7/28	427	19872	0	2
6/18	0	0	0	0	7/29	1019	20891	0	2
6/19	0	0	0	0	7/30	1262	22153	0	2
6/20	0	0	0	0	7/31	1008	23161	0	2
6/21	0	0	1	1	8/1	703	23864	0	2
6/22	0	0	1	2	8/2	21	23885	0	2
6/23	0	0	0	2	8/3	1058	24943	0	2
6/24	0	0	0	2	8/4	429	25372	0	2
6/25	0	0	0	2	8/5	597	25969	0	2
6/26	0	0	0	2	8/6	409	26378	0	2
6/27	0	0	0	2	8/7	578	26956	0	2
6/28	0	0	0	2	8/8	1	26957	0	2
6/29	0	0	0	2	8/9	260	27217	0	2
6/30	0	0	0	2	8/10	392	27609	0	2
7/1	0	0	0	2	8/11	448	28057	0	2
7/2	0	0	0	2	8/12	276	28333	0	2
7/3	0	0	0	2	8/13	397	28730	0	2
7/4	0	0	0	2	8/14	93	28823	0	2
7/5	0	0	0	2	8/15	3	28826	0	2
7/6	0	0	0	2	8/16	161	28987	0	2
7/7	0	0	0	2	8/17	2	28989	0	2
7/8	0	0	0	2	8/18	0	28989	0	2
7/9	0	0	0	2	8/19	2	28991	0	2
7/10	0	0	0	2	8/20	1	28992	0	2
7/11	0	0	0	2	8/21	0	28992	0	2
7/12	0	0	0	2	Total	28992	28992	2	2

* Value includes an estimated 1,030 salmon passed due to breach in weir.

Figure 3. Comparison of discharge and daily totals of sockeye salmon on Tanada Creek, 1998.

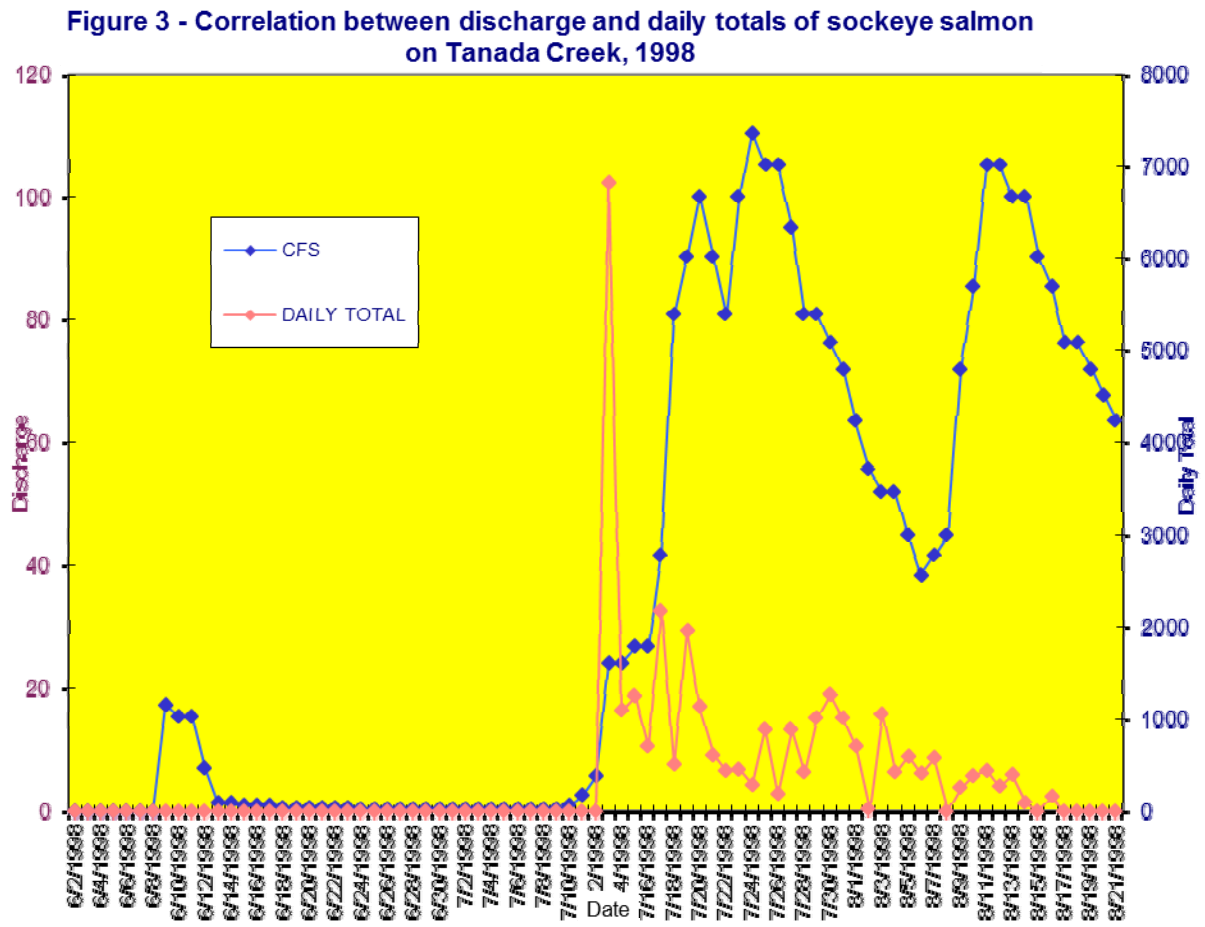
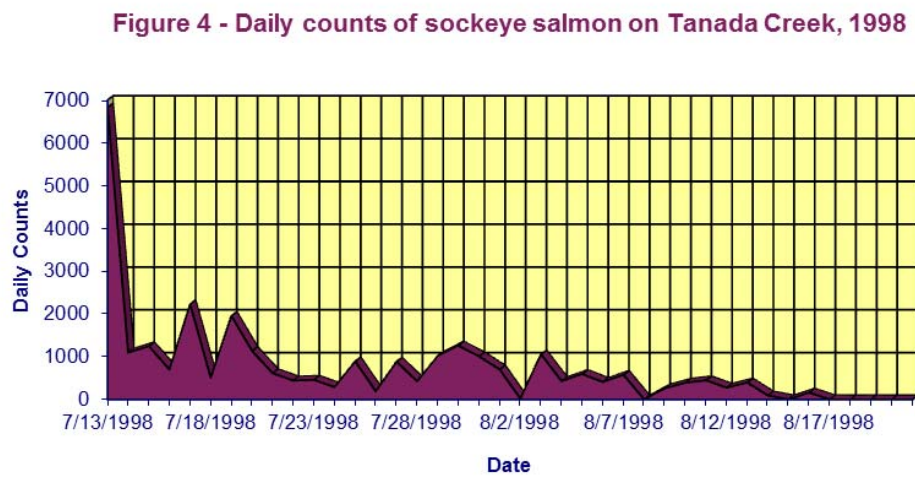


Figure 4. Daily counts of sockeye salmon at the Tanada Creek weir in 1997.



Discussion

Weir Operation

Fixed weirs are an economical and efficient means of gathering accurate data on anadromous fish escapement (Nielson and Johnson 1983). The physical characteristics of Tanada Creek at Batzulnetas (low water velocity, light debris loads, well-armored channel) and its accessibility make it suitable as a project site for future studies. The weir performed well under conditions of normal flow and light debris buildup and remained resistant to developing holes and breaches throughout the run.

Unlike resistant board weirs, fixed weirs are vulnerable to high flow 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.

Flow Data

Flow rates influence migration and spawning success of adult salmonids (Magneson 1996). The stream discharge to stage level relationship developed this year will aid in anticipating the arrival of salmon at the weir and in developing a relationship between flow and peak migration.

Biological Sampling

Post season analysis of commercial harvest and escapement at Miles Lake indicated a high 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 is 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 reds. 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.

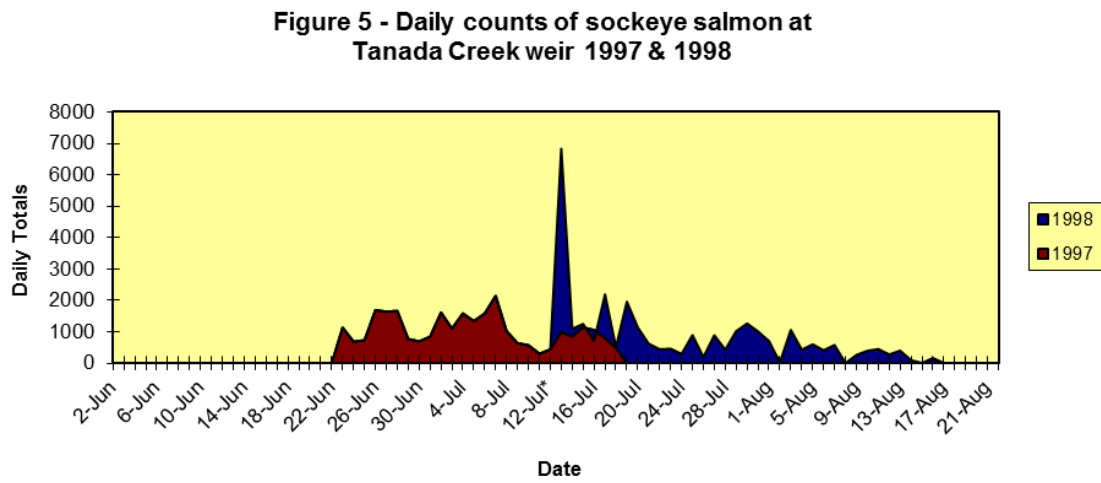
The earliest recorded run, based on available data, was in 1994, when sockeye salmon were reported caught at Batzulnetas on June 4 (ADF&G). Weir counts conducted by the State of Alaska in the late 1970s indicate that the salmon run first arrive at the upper reaches of Tanada Creek in the last week of June or early July. Peak period of migration for these years could not be determined due to overall low daily counts.

The timing characteristics and peak migration of the 1998 sockeye salmon run on Tanada Creek could not be accurately determined due to natural impediments i.e. low flow and a

fish barrier. The arrival of the salmon at the mouth of the creek occurred in the third week of June, but the reds could not ascend to the weir until mid-July. The largest pulse of salmon moved through the weir in the third week of July. By the end of July and early August, the run strength had stabilized, then rapidly declined after mid-August (**Figure 5**). Because of the skewed nature of the run, a median run day (when 50% of the total count has passed the weir) was not calculated.

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 reds, provides a aerial/weir factor of 21%. Note, as stated, that the 1997 weir count was incomplete.

Figure 5. Comparative counts of sockeye salmon at Tanada Creek weir, 1997 & 1998.



References

- Burgner, R.L. 1991. Life History of Sockeye Salmon (*Oncorhynchus nerka*) pp 3-116 in Pacific Salmon Life Histories, Edited by C. Groot and L. Margolis, UCB Press Vancouver, 1991.
- Harper, K.C. 1995. Run timing and abundance of adult salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 1991. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Progress Report Number 95-1, Kenai, Alaska.
- Kari, J. 1986. Tatl'ahwt'aenn Nenn', The Headwaters People's Country: Narratives of the Upper Ahtna Athabaskans. Alaska Native Language Center, University of Alaska. Fairbanks, Alaska.
- Magneson, M.D. 1996. Progress Report: Fisheries Investigations in New River, Tributary to Trinity River, Northern California. U.S. Fish and Wildlife Service, Coastal California Fish and Wildlife Office. Arcata, California.
- Melegari, J.L. 1997. Abundance and run timing of adult salmon in the Gisasa River, Koyukuk National Wildlife Refuge, Alaska, 1996. U.S. Fish and Wildlife Service, Fairbanks Fishery Resource Office, Alaska Fisheries Data Series Number 97-1, Fairbanks, Alaska.
- National Oceanic and Atmospheric Administration, 1995. Annual Climatological Summary, Slana, Alaska. National Climatic Data Center, Asheville, North Carolina.
- Nielsen, L.A. and Johnson, D.L. 1983. Fisheries Techniques. Southern Printing Company. Blackburg, Virginia.
- Raeder, R. 1997a. Aerial Survey for Adult Sockeye Salmon at Tanada Lake, Wrangell-St.Elias National Park and Preserve, Alaska, 1997. National Park Service. Copper Center, Alaska.
- Raeder, R. 1997b. Abundance and Run Timing of Adult Salmon in Tanada Creek, Wrangell-St.Elias National Park and Preserve, Alaska, 1997. National Park Service. Copper Center, Alaska.
- Raeder, R. and Rood, V. 1998. Aerial Survey for Adult Sockeye Salmon at Tanada Creek. Wrangell-St.Elias National Park and Preserve. National Park Service Copper Center, Alaska.

Roberson, K. 1987a. Affidavit of Kenneth Roberson, State of Alaska, Third Judicial district, No. A85-698 Civil, Katie John, Dora Charles and Mentasta Village Council vs. State of Alaska, 1985.

Roberson, K. 1987b. Copper river subsistence and personal use salmon fishery management and research - 1987, Report to the Alaska Board of Fisheries (Prince William Sound Data Report#1987-9). Alaska Department of Fish and Game, Division of Commercial Fisheries, Glennallen, Alaska.

United States Department of Agriculture, Soil Conservation Service, 1979. Exploratory Soil Survey of Alaska, National Cooperative Soil Survey.

Personal Communications

Fleming, D., 1998. Alaska Department of Fish and Game, Fairbanks, Alaska.

Moffitt, S., 1998. Alaska Department of Fish and Game, Cordova, Alaska.

Taube, T. 1998. Alaska Department of Fish and Game, Glennallen, Alaska.

Worthington, A. 1997. Wrangell-St.Elias National Park and Preserve, Copper Center, Alaska..

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

	Sockeye	Sockeye	Sockeye	Chinook
<i>Date</i>	<i>1975</i>	<i>1978</i>	<i>1979</i>	
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.

Appendix B – Stage level vs. discharge, Tanada Creek Weir 1998.

Appendix C – Conversions for stage depth and discharge, Tanada Creek Weir 1998.

<u>STAGE LEVEL</u> <u>(cm)</u>	<u>Cubic Feet per</u> <u>Second</u>	<u>STAGE LEVEL</u> <u>(10THS OF FEET)</u>	<u>Cubic Feet per</u> <u>Second</u>
5	0.33	0.10	0.26
6	0.56	0.15	0.27
7	0.92	0.20	0.59
8	1.40	0.25	1.20
9	2.02	0.30	2.12
10	2.77	0.35	3.34
11	3.64	0.40	4.86
12	4.65	0.45	6.68
13	5.78	0.50	8.80
14	7.05	0.55	11.22
15	8.44	0.60	13.94
16	9.97	0.65	16.97
17	11.62	0.70	20.29
18	13.41	0.75	23.92
19	15.32	0.80	27.85
20	17.36	0.85	32.08
21	19.54	0.90	36.61
22	21.84	0.95	41.44
23	24.27	1.00	46.58
24	26.83	1.05	52.01
25	29.52	1.10	57.75
26	32.34	1.15	63.78
27	35.30	1.20	70.12
28	38.38	1.25	76.76
29	41.59	1.30	83.70
30	44.93	1.35	90.94
31	48.40	1.40	98.49
32	52.00	1.45	106.33
33	55.72	1.50	114.48
34	59.58	1.55	122.92
35	63.57	1.60	131.67
36	67.69	1.65	140.72
37	71.94	1.70	150.07
38	76.32		
39	80.82		
40	85.46		
41	90.23		
42	95.12		
43	100.15		
44	105.30		
45	110.59		
46	116.00		
47	121.55		
48	127.22		
49	133.03		
50	138.96		