NULATO RIVER SALMON ESCAPEMENT PROJECT, 2001

By

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ABSTRACT

Chinook and summer chum salmon migrating into the Nulato River were counted using counting towers to estimate the spawning abundance in 2001. Before 1994, salmon escapements to the Nulato River were previously indexed only by aerial surveys. Beginning in 1994, a cooperative tower counting project was formed by the Tanana Chiefs Council, Nulato Tribal Council and Alaska Department of Fish and Game. The Nulato Tribal Council and Alaska Department of Fish and Game estimated the daily passage of summer chum salmon *Oncorhynchus keta* and chinook salmon *O. tshawytscha* using visual observations from towers during the period June 24 to July 28, 2001. In 2001, because of heavy snowfall in the spring, high water persisted throughout the entire season. Counting was not possible until July 12 and only possible through July 15, because rainfall in the headwaters caused poor counting conditions. With poor counting conditions and roughly one week left in the season, counting attempts ceased. No interpolations were calculated to estimate the total run for chinook or summer chum salmon. High water also prevented the installation of a weir. Observations of subsistence harvests, aerial survey data, and other escapement projects indicate that chinook salmon runs to the Yukon River were above average. However, summer chum salmon escapements into Yukon River spawning grounds were below average.

INTRODUCTION

The goal of the Nulato River Tower project is to provide area managers an inseason escapement index for the upper portion of the Yukon River District 4 management area. This project also assesses the age and sex composition of the summer chum salmon escapement into the Nulato River.

Historical aerial survey indices indicate summer chum salmon returning to the Nulato River (river kilometer [rkm] 777) may be the largest producer of summer chum salmon above the Anvik River (rkm 512) (Sandone 1995). Spawning chinook salmon also utilize the Nulato River. Some pink and coho salmon have been reported to spawn in the Nulato River but not in significant numbers. Management of subsistence and commercially targeted salmon species requires reliable run strength and run timing information from harvests and escapement information as salmon migrate through Yukon River districts. Ground based escapement projects throughout the Yukon River drainage are typically operated on tributaries that are easily accessible and are considered to be an important spawning tributary. These escapement projects provide researchers and managers quality escapement information and age, sex and size information that can be used for management of Yukon River salmon resources.

Nulato River escapements were previously indexed using aerial survey methodology. Aerial survey methods are inexpensive compared to ground based projects but sacrifice quality information. Aerial survey indices are susceptible to a host of factors, which influence the quality of the data, therefore do not provide accurate escapement estimates of chinook or summer chum migrating into the Nulato River. There is a lack of quality historical escapement information for Nulato River chinook and summer chum salmon. Without this information, it is difficult to determine whether escapement objectives are being met in this portion of the Yukon River. Without a historical database, it is also difficult to determine what the escapement objectives should be. Pilot Station Sonar, test fishing indices, age and sex composition information and commercial and subsistence harvests provide run strength and run timing information of salmon migrating up the Yukon River mainstem. However, these assessment projects and their indices do not provide quality escapement information for specific tributaries being used to index salmon runs in various districts of the Yukon River.

The Yukon River drainage supports major stocks of chinook salmon *Oncorhynchus tshatscha*, summer and fall run chum salmon *O. keta*, and coho salmon *O. kisutch*. These species contribute to commercial and subsistence fisheries throughout the Yukon River drainage. Pink salmon *O. gorbuscha* and Sockeye salmon *O. nerka* are also indigenous to the Yukon River. Pink salmon return to lower drainage tributaries and typically have stronger runs in even numbered years. Sockeye salmon are documented less frequently. Neither of the two later species are harvested commercially or targeted for subsistence use to any extent. Summer chum salmon are distinguished from fall chum salmon by their earlier entry timing (early June to mid-July) into the Yukon River. Summer chum salmon are smaller in size with spawning distributions into lower and middle Yukon River drainages. Fall chum salmon enter the Yukon River from mid-July to the first of September, are larger, and spawn primarily in middle to upper portions of the Yukon River drainage.

Before 1994, there were relatively few projects that provided spawning escapement information for the various Yukon River salmon stocks. Lower river test fishing catch rates, inseason passage estimates from Pilot Station Sonar (rkm 198) and the Anvik River sonar project (rkm 512) provided most of the available information used to make management decisions concerning commercial and subsistence harvests of summer chum salmon in District 4 (Figure 1).

Salmon returning to the Nulato River are most likely harvested in commercial and subsistence fisheries in coastal areas near the Yukon River delta and throughout the mainstem Yukon River. These areas include the Coastal District, Districts 1, 2, and 3 and most of District 4 (Figure 1). There was not an inseason salmon escapement, monitoring project within the upper portion of District 4 to serve as an index for run size and quality (sex composition) of spawning escapements in that portion of the river prior to the Nulato River Tower project. Federal agencies and private organizations have increased their involvement and participation by developing and implementing additional spawning escapement and assessment projects. These projects provide managers inseason escapement information necessary to manage for escapements. Operation of an inseason escapement monitoring project for summer chum salmon within the upper portion of District 4 would serve as an index for the middle Yukon River area and provide fishery managers additional information concerning the size and quality of spawning escapement in this area. Additional stock identification studies for mixed stock fisheries could provide information to develop stream specific biological escapement goals.

A thorough review of the Nulato River and probable contribution of salmon production from this stream to the Yukon River is presented in the report *Nulato River Salmon Escapement Project, 1994* (Sandone 1995), which was the first year of operation. With the exception of 1995, Nulato River salmon escapement reports have been written annually (Headlee 1996; Paulus 1997; Paulus *et. al.* 2001; Lingnau and De Hovanisian 2001, Lingnau 2002a, 2002b). The 1995 field project data was reported only as a brief summary by Paul Headlee, Water Resource Specialist, TCC. This report presents information gathered during the 2001 field season.

Nulato River Escapement Assessment

The Nulato River is one of the department's primary aerial survey index areas for assessment of the relative magnitude of chinook and summer chum salmon spawning escapement. All escapement goals pertaining to the Nulato River were, and presently are, based on aerial survey counts of salmon.

Nulato River escapement goals for chinook and summer chum salmon were first established in 1981 (Buklis 1993). For summer chum salmon, an escapement goal range of 33,700 to 78,400 aerial survey counts was initially proposed for the entire Nulato River drainage. This aerial survey goal was modified several times until 1990 when a minimum summer chum salmon goal of 53,000 was established in 1990 (Bergstrom, et al. 1992). No escapement goal was established for the South Fork Nulato River (Geiger et al. 1984). The various aerial survey-based escapement goals have been met only once since initially established (1986). However, survey conditions have not been acceptable in some years.

A chinook salmon aerial survey based escapement goal range of 400 to 1,100 was proposed in 1981 for the entire Nulato River (Buklis 1993). Similar to summer chum salmon aerial survey goals, this goal went through several changes (Sandone 1995). Chinook salmon escapement goals for the Yukon River were reevaluated in the spring of 1991 and were made effective for the 1992 season (Buklis 1993). At that time, minimum interim escapement goals for chinook salmon, based on aerial survey counts, were established for both forks: 800 for the North Fork and 500 for the South Fork.

Since data gathered from ground based sources (e.g., tower and weir counts, mark-recapture estimates) are considered more reliable than aerial survey data, ground based escapement goals will first be evaluated using such sources having at least 5 years of information. Aerial survey data will be secondarily used when ground based sources are limited or unavailable. Although this was the seventh year of ground based escapement estimates for the Nulato River, there is not enough information necessary to develop a Biological Escapement Goal (BEG) for either chinook or summer chum salmon spawning into the Nulato River. Information from the tower counting project may be used to re-evaluate the current escapement objectives for the Nulato River.

Study Area

The Nulato River is a narrow river with a substrate consisting mainly of gravel and cobble. The river is formed from two main branches, the North Fork and South Fork, which converge approximately 9 kilometer (km) above its mouth. Both forks of the Nulato River originate at an elevation of approximately 600 meter (m). From its source, the South Fork flows in a northeasterly and easterly direction about 98 km to the confluence with the North Fork. From its source, the North Fork, mostly flows in a northeasterly and easterly direction and is approximately 114 km long. The North Fork drainage includes the Kalasik Creek drainage, approximately 54 km in length. The mainstem Nulato River joins the Yukon River at rkm 777 at an approximate elevation of 33 m (Sandone 1995).

The Nulato River tower site is located approximately 5 km upstream of the confluence of the Nulato and Yukon Rivers (Figure 2). The water is typically clear with some brown (tannic) staining from peat and organic material along the watershed. Most of the chum salmon spawning area is upstream of the tower site.

Objectives

The objectives of this study were to:

1. Estimate the total escapement of summer chum and chinook salmon into the Nulato River using tower-counting methodology;

2. Estimate the age and sex composition of the summer chum spawning population;

3. Monitor climatological and hydrological conditions at the tower site.

METHODS

Site Selection and Preparation

The current site was selected in 1994 (Figure 2) after completing a reconnaissance of the mainstem Nulato River. The criteria used for selection included: 1) Location below most, if not all, chum salmon spawning areas; 2) A single, relatively narrow channel; and 3) Relatively shallow river depth to facilitate observation of migrating salmon from the towers. The right bank (south side of the river) is a wide gravel bar with gradual decline and the left bank (north side) is characterized as a cut bank with a rapid decline.

On the left bank, a single section of 3 m high steel scaffold tower was erected. On the right bank, two sections of scaffold were combined to make a 6 m high tower. The right bank tower was placed in the river to reduce the width of the counting area. A weir of wire fencing and T-stakes extended from the right bank to the tower to divert fish into the counting area. To make the fish easier to see, light-colored empty sandbags were attached to a bank-to-bank cable weighted with sandbags. Sandbags were also placed on the flash panel to keep it from flagging. This light-colored background improved the ability of the crew to see and count fish. Observers wore polarized glasses to reduce glare. During the darkest hours, several lights suspended on a line across the river illuminated the counting area.

Escapement Estimation Sampling

Tower counting operations were conducted 7 days a week, 24 hours a day, for a 15-minute period each hour on each bank as allowed by water clarity. The left bank counting period began at the top of the hour and the right bank began at the bottom of the hour. The observer counted fish passage by species and noted the direction of movement (upstream or downstream). Hand-held tally counters were used to record the observed tower counts. These counts were then transferred to data forms immediately after completion of a shift (Appendix A). Each count was expanded for each hour and each bank by dividing the count by the proportion of the hour counted. Missed counts were estimated by averaging the counts for the hours before and after the missed hourly count. When salmon were not counted for a portion of a day, the expanded total daily count for that day was estimated by dividing the expanded partial daily count by the mean proportion of the count, for the corresponding hours for the day before and day after having full 24-hour counts. When counting was not conducted for a full day, the salmon passage estimate for that day was calculated as the mean salmon passage for the day before and after. When counting was not conducted for more than one full day, the passage for those days were estimated by interpolating between the last full day and first full day of counts after counting resumed.

The daily passage for each bank was calculated by summing the expanded hourly counts for each species, for each bank. The total daily passage estimate for each species was the sum of the expanded count for each bank.

Age-Sex-Size Sampling

When the Nulato River tower project was initiated in 1994, dates needed to be established to define sampling strata for collecting age-sex-length (ASL) information. Run timing information did not exist for the Nulato River. Aerial survey information seemed to indicate, however, that the timing of peak abundance for summer chum salmon in the Nulato River was historically similar to that of the Anvik River for which sonar daily passage estimates were available dating back to 1979. Strata periods were initially selected for the Nulato River based on those used on the Anvik River, and were described as: early, June 20 to July 3; early-middle, July 4-8; late-middle, July 9-13; and late, July 14-26 (Sandone 1995).

The sample goal for each species was based on 95% precision with 10% accuracy for each time stratum. The season ASL sample goal was set at 640 chum salmon and all chinook salmon, with 160 chum salmon sampled in each of the strata described above. Beyond the required ASL sample, beach seining continues until an additional 200 chum salmon per stratum were caught and observed for male-female ratio. The additional 200 fish per strata, combined with the 160 summer chum salmon per strata, yielded a total sex ratio sample goal of 1,480 fish for the season on the Nulato River to define the quality of the escapement. For chinook salmon escapement, a sample size of 198 fish per stratum was the season goal based on the number of age classes that were expected in the run (Bromaghin 1993). While beach seine catches were expected to yield the desired total chum salmon sample, it was unlikely that the chinook salmon sample would be achieved because of the difficulty of catching chinook salmon by beach seine.

A beach seine 31 m long, 66 meshes deep of 6.35 centimeter (cm) mesh, was used to catch salmon for ASL samples. Data such as date, time of seine, number and sex of fish were recorded (Appendix A) Captured salmon were identified by species and sex, measured to the nearest 5 millimeter (mm) (mid-eye to fork-of-tail), sampled for scales and adipose fin-clipped to prevent re-sampling. Scales were taken from an area posterior to the base of the dorsal fin and above the lateral line on the left side of the fish (Clutter and Whitesel 1956). One scale was taken from chum salmon and three scales were taken from chinook salmon. Scales were wiped clean to remove slime and tissue and affixed to a gum-surfaced scale card with numbers that corresponded to recording form. The scales were processed and aged post-season, and ASL data compiled and summarized.

Hydrological and Climatological Sampling

Climatological and hydrological data were collected at approximately 1900 hours each day at the campsite. Relative stream depth was monitored on a staff gauge marked in 0.1-foot increments with measurements subsequently converted to cm. Water temperature was measured in Fahrenheit (°F) near shore at a depth of about 0.5 m and converted to Celsius. Notes describing wind direction, cloud cover and precipitation were recorded by the crew (Appendix A).

RESULTS AND DISCUSSION

Escapement Estimation

Counting towers were operated on each bank of the Nulato River for four days from July 12 to July 15 in 2001. Although camp was set up by June 20, near continuous poor counting conditions caused by high, turbid water prevented counting for all but the four previously mentioned days. Heavy snowfall occurring in late spring in the Nulato Hills caused substantial flooding in the village of Nulato and the Nulato River when the snow pack melted. Although no season total estimate was calculated for summer chum salmon or chinook salmon, the counts observed in 2001 are presented in Tables 1 and 2. These tables present the historical chinook and summer chum salmon daily and cumulative counts, and cumulative proportions. Figure 3 compares chinook and summer chum salmon cumulative escapement estimates. Tables 3 and 4 describe historical run timing and quartile dates.

A successful aerial survey for chinook salmon was conducted on July 31. Poor weather hampered attempts to conduct an aerial survey earlier in the season when summer chum salmon are normally at peak abundance. The combined North and South Fork Nulato River chinook salmon count for the 2001 aerial survey was 1,884 fish, well over the combined goal of 1,300 chinook salmon.

Age-Sex-Size

No useable biological information was collected in 2001 from individual fish. Although some scale, sex and length samples were collected, they were so few that accurate age, sex and size structure of the escapement for both summer chum salmon and chinook salmon was not possible.

Hydrology and Climate

For most tributaries of the Yukon River, the water is usually highest during or shortly after spring ice-breakup, and generally continues to drop during the summer as the snow pack decreases. Storage capacity of the Nulato River watershed, similar to the Anvik, appears to be minimal with limited retention of rainfall in the upper areas of the drainage. The Nulato River, similar to the Anvik River, has rapid changes in water depth when substantial rainfall occurs. These flood conditions make counting difficult or impossible because of the suspended solids, detritus, tannic staining, and increased water depth.

Climatological and hydrological data were collected for only five days in 2001. Because so few days of information were noted, no seasonal trend of temperatures, water height or water conditions are possible. Therefore, the few days of information recorded in 2001, intra-seasonal findings are not comparable and no findings are described in this report. Other tributaries of the Yukon River had similar water conditions. For example, the East Fork Andreafsky River weir was not operable until July 15.

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TABLES AND FIGURES

Table 1. Historic daily and cumulative Nulato River chinook salmon escapement passage estimates, and cumulative proportions, 1994-2001.

	1994			1995			1996			1997		
Date	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion
15-Jun												
16-Jun												
17-Jun												
18-Jun												
19-Jun												
20-Jun										0	0	0.00
21-Jun										0	0	0.00
22-Jun										0	0	0.00
23-Jun										20	20	0.00
24-Jun										16	36	0.01
25-Jun										16	52	0.01
26-Jun				4	4	0.00	12	12	0.02	32	84	0.02
27-Jun				4	8	0.01	12	24	0.03	52	136	0.03
28-Jun				0	8	0.01	8	32	0.04	84	220	0.05
29-Jun				0	8	0.01	4	36	0.05	136	356	0.07
30-Jun				0	8	0.01	8	44	0.06	144	500	0.10
1-Jul				8	16	0.01	12	56	0.07	144	644	0.13
2-Jul				0	16	0.01	8	64	0.08	172	816	0.17
3-Jul				12	28	0.02	13	77	0.10	184	1,000	0.21
4-Jul	0	0	0.00	24	52	0.04	19	96	0.13	344	1,344	0.28
5-Jul	3	3	0.00	64	116	0.08	24	120	0.16	336	1,680	0.35
6-Jul	6	9	0.01	44	160	0.11	48	168	0.22	352	2,032	0.42
7-Jul	72	81	0.05	36	196	0.14	40	208	0.28	308	2,340	0.49
8-Jul	72	153	0.09	8	204	0.14	8	216	0.29	368	2,708	0.56
9-Jul	60	213	0.12	16	220	0.16	12	228	0.30	212	2,920	0.61
10-Jul	216	429	0.24	52	272	0.19	108	336	0.44	344	3,264	0.68
11-Jul	208	637	0.35	100	372	0.26	36	372	0.49	128	3,392	0.71
12-Jul	120	757	0.42	52	424	0.30	80	452	0.60	152	3,544	0.74
13-Jul	84	841	0.47	112	536	0.38	52	504	0.67	290	3,834	0.80
14-Jul	92	933	0.52	84	620	0.44	48	552	0.73	108	3,942	0.82
15-Jul	100	1,033	0.58	56	676	0.48	16	568	0.75	252	4,194	0.87
16-Jul	112	1,145	0.64	60	736	0.52	36	604	0.80	184	4,378	0.91
17-Jul	92	1,237	0.69	164	900	0.64	64	668	0.88	108	4,486	0.93
18-Jul	96	1,333	0.74	56	956	0.68	16	684	0.90	52	4,538	0.94
19-Jul	100	1,433	0.80	56	1,012	0.72	16	700	0.93	68	4,606	0.96
20-Jul	104	1,537	0.86	76	1,088	0.77	24	724	0.96	116	4,722	0.98
21-Jul	44	1,581	0.88	92	1,180	0.84	24	748	0.99	44	4,766	0.99
22-Jul	51	1,632	0.91	56	1,236	0.88	8	756	1.00	45	4,811	1.00
23-Jul	40	1,672	0.93	28	1,264	0.90	0	756	1.00			
24-Jul	43	1,715	0.96	72	1,336	0.95	0	756	1.00			
25-Jul	28	1,743	0.97	48	1,384	0.98						
26-Jul	12	1,755	0.98	28	1,412	1.00						
27-Jul	8	1,763	0.98									
28-Jul	32	1,795	1.00									
29-Jul												
30-Jul												
31-Jul												
Total	1,795			1,412			756			4,811		

(Continued)

Table 1. (Page 2 of 2)

	1998 [a]			1999			2000			2001 [b]		
Date	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion
15-Jun												
16-Jun												
17-Jun												
18-Jun												
19-Jun												
20-Jun												
21-Jun												
22-Jun	0	0	0.00									
23-Jun	0	0	0.00									
24-Jun	8	8	0.01	0	0	0.00	0	0	0.00			
25-Jun	4	12	0.01	0	0	0.00	0	0	0.00			
26-Jun	4	16	0.01	0	0	0.00	0	0	0.00			
27-Jun	28	44	0.03	0	0	0.00	0	0	0.00			
28-Jun	88	132	0.09	0	0	0.00	28	28	0.03			
29-Jun	20	152	0.10	0	0	0.00	16	44	0.05			
30-Jun	12	164	0.11	0	0	0.00	20	64	0.07			
1-Jul	0	164	0.11	0	0	0.00	0	64	0.07			
2-Jul	20	184	0.12	0	0	0.00	0	64	0.07			
3-Jul	0	184	0.12	8	8	0.00	20	84	0.09			
4-Jul	0	184	0.12	48	56	0.03	104	188	0.21			
5-Jul	0	184	0.12	16	72	0.04	104	292	0.32			
6-Jul	36	220	0.15	52	124	0.06	68	360	0.39			
7-Jul	4	224	0.15	104	228	0.12	112	472	0.52			
8-Jul	84	308	0.20	88	316	0.16	68	540	0.59			
9-Jul	60	368	0.24	132	448	0.23	132	672	0.73			
10-Jul	84	452	0.30	152	600	0.31	16	688	0.75			
11-Jul	44	496	0.33	116	716	0.37	36	724	0.79			
12-Jul	92	588	0.39	128	844	0.44	72	796	0.87	28	28	
13-Jul	102	690	0.46	72	916	0.47	64	860	0.94	160	188	
14-Jul	184	874	0.58	76	992	0.51	28	888	0.97	48	236	
15-Jul	156	1,030	0.68	128	1120	0.58	0	888	0.97	60	296	
16-Jul	76	1,106	0.74	136	1256	0.65	0	888	0.97			
17-Jul	20	1,126	0.75	92	1348	0.70	0	888	0.97			
18-Jul	76	1,202	0.80	64	1412	0.73	0	888	0.97			
19-Jul	78	1,280	0.85	80	1492	0.77	0	888	0.97			
20-Jul	72	1,352	0.90	80	1572	0.81	0	888	0.97			
21-Jul	60	1,412	0.94	69	1641	0.85	0	888	0.97			
22-Jul	72	1,484	0.99	59	1700	0.88	0	888	0.97			
23-Jul	20	1,504	1.00	48	1748	0.90	0	888	0.97			
24-Jul				20	1768	0.92	8	896	0.98			
25-Jul				40	1808	0.94	8	904	0.99			
26-Jul				35	1843	0.95	4	908	0.99			
27-Jul				29	1872	0.97	0	908	0.99			
28-Jul				24	1896	0.98	8	916	1.00			
29-Jul				36	1932	1.00						
30-Jul												
31-Jul												
Total	1,504			1,932			916			296		

[a] No interpolations were calculated for missed counting period due to a lack of data.

[b] High water throughout the season prohibited acceptable counting conditions.

Table 2. Historic daily and cumulative Nulato River summer chum salmon escapement passage estimates, and cumulative proportions, 1994-2001.

	1994			1995			1996			1997		
Date	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion
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18-Jun												
19-Jun												
20-Jun										64	64	0.00
21-Jun				452	452	0.00	700	700	0.01	168	232	0.00
22-Jun				692	1,144	0.00	3,684	4,384	0.03	524	756	0.00
23-Jun				1,056	2,200	0.01	6,612	10,996	0.08	2,344	3,100	0.02
24-Jun				1,880	4,080	0.02	6,680	17,676	0.14	3,816	6,916	0.04
25-Jun				1,612	5,692	0.02	7,196	24,872	0.19	4,856	11,772	0.07
26-Jun				2,044	7,736	0.03	6,792	31,664	0.24	4,592	16,364	0.10
27-Jun				10,884	18,620	0.08	2,082	33,746	0.26	3,868	20,232	0.13
28-Jun				5,196	23,816	0.10	3,812	37,558	0.29	4,816	25,048	0.16
29-Jun	2,001	2,001	0.01	9,184	33,000	0.14	5,542	43,100	0.33	6,972	32,020	0.20
30-Jun	8,355	10,356	0.07	7,188	40,188	0.17	7,271	50,371	0.39	7,916	39,936	0.25
1-Jul	7,898	18,254	0.12	9,716	49,904	0.21	7,104	57,475	0.44	7,656	47,592	0.30
2-Jul	9,604	27,858	0.19	15,110	65,014	0.27	6,076	63,551	0.49	8,900	56,492	0.36
3-Jul	7,601	35,459	0.24	9,068	74,082	0.31	3,624	67,175	0.52	8,596	65,088	0.41
4-Jul	6,708	42,167	0.28	11,064	85,146	0.36	5,484	72,659	0.56	12,432	77,520	0.49
5-Jul	10,188	52,355	0.35	12,700	97,846	0.41	8,320	80,979	0.62	11,432	88,952	0.56
6-Jul	8,092	60,447	0.41	18,504	116,350	0.49	4,968	85,947	0.66	10,748	99,700	0.63
7-Jul	7,008	67,455	0.45	10,704	127,054	0.54	7,460	93,407	0.72	11,368	111,068	0.70
8-Jul	4,704	72,159	0.49	11,960	139,014	0.59	5,728	99,135	0.76	9,944	121,012	0.77
9-Jul	9,232	81,391	0.55	14,008	153,022	0.65	3,664	102,799	0.79	4,664	125,676	0.79
10-Jul	10,744	92,135	0.62	14,004	167,026	0.71	7,104	109,903	0.85	7,388	133,064	0.84
11-Jul	8,776	100,911	0.68	13,684	180,710	0.76	4,144	114,047	0.88	3,756	136,820	0.87
12-Jul	7,327	108,238	0.73	11,356	192,066	0.81	4,224	118,271	0.91	4,153	140,973	0.89
13-Jul	6,931	115,169	0.77	8,660	200,726	0.85	3,888	122,159	0.94	3,558	144,531	0.91
14-Jul	6,535	121,704	0.82	5,172	205,898	0.87	3,132	125,291	0.97	2,256	146,787	0.93
15-Jul	6,140	127,844	0.86	4,232	210,130	0.89	1,920	127,211	0.98	3,016	149,803	0.95
16-Jul	4,440	132,284	0.89	6,728	216,858	0.92	916	128,127	0.99	3,016	152,819	0.97
17-Jul	3,211	135,495	0.91	6,464	223,322	0.94	676	128,803	0.99	2,392	155,211	0.98
18-Jul	3,332	138,827	0.93	3,716	227,038	0.96	520	129,323	1.00	924	156,135	0.99
19-Jul	2,215	141,042	0.95	4,400	231,438	0.98	371	129,694	1.00	1,080	157,215	0.99
20-Jul	1,712	142,754	0.96	3,368	234,806	0.99				760	157,975	1.00
21-Jul	1,208	143,962	0.97	2,084	236,890	1.00				196	158,171	1.00
22-Jul	2,808	146,770	0.99									
23-Jul	1,992	148,762	1.00									
24-Jul												
25-Jul												
26-Jul												
27-Jul												
28-Jul												
29-Jul												
30-Jul												
31-Jul												
Total	148,762			236,890			129,694			158,171		

(Continued)

Table 2. (Page 2 of 2)

	1998			1999			2000			2001 [a]		
Date	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion
15-Jun												
16-Jun												
17-Jun												
18-Jun												
19-Jun												
20-Jun												
21-Jun												
22-Jun	0	0	0.00									
23-Jun	4	4	0.00									
24-Jun	36	40	0.00	0	0	0.00	4	4	0.00			
25-Jun	56	96	0.00	0	0	0.00	148	152	0.01			
26-Jun	180	276	0.01	0	0	0.00	284	436	0.01			
27-Jun	588	864	0.02	0	0	0.00	240	676	0.02			
28-Jun	770	1,634	0.03	0	0	0.00	364	1,040	0.04			
29-Jun	722	2,356	0.05	0	0	0.00	672	1,712	0.06			
30-Jun	716	3,072	0.06	0	0	0.00	200	1,912	0.07			
1-Jul	708	3,780	0.07	24	24	0.00	244	2,156	0.07			
2-Jul	496	4,276	0.08	12	36	0.00	220	2,376	0.08			
3-Jul	1,092	5,369	0.10	256	292	0.01	1,256	3,632	0.12			
4-Jul	1,688	7,057	0.14	720	1,012	0.03	2,940	6,572	0.22			
5-Jul	2,284	9,342	0.18	1,964	2,976	0.10	2,564	9,136	0.31			
6-Jul	2,880	12,222	0.23	2,220	5,196	0.17	2,104	11,240	0.38			
7-Jul	1,584	13,806	0.27	2,876	8,072	0.27	1,472	12,712	0.43			
8-Jul	2,752	16,558	0.32	2,300	10,372	0.34	1,168	13,880	0.47			
9-Jul	2,192	18,750	0.36	1,716	12,088	0.40	1,468	15,348	0.52			
10-Jul	4,768	23,518	0.45	2,100	14,188	0.47	1,004	16,352	0.56			
11-Jul	2,712	26,230	0.50	2,096	16,284	0.54	1,916	18,268	0.62			
12-Jul	2,292	28,522	0.55	2,092	18,376	0.61	2,056	20,324	0.69	4,172	4,172	
13-Jul	4,384	32,906	0.63	1,140	19,516	0.65	1,596	21,920	0.75	3,012	7,184	
14-Jul	4,860	37,766	0.73	1,008	20,524	0.68	968	22,888	0.78	1,284	8,468	
15-Jul	3,804	41,570	0.80	1,296	21,820	0.73	881	23,769	0.81	680	9,148	
16-Jul	2,780	44,350	0.85	1,332	23,152	0.77	796	24,565	0.84			
17-Jul	1,288	45,638	0.88	1,196	24,348	0.81	711	25,276	0.86			
18-Jul	1,856	47,494	0.91	1,100	25,448	0.85	623	25,899	0.88			
19-Jul	734	48,228	0.93	912	26,360	0.88	533	26,432	0.90			
20-Jul	1,340	49,568	0.95	596	26,956	0.90	455	26,887	0.92			
21-Jul	1,144	50,712	0.97	545	27,501	0.91	360	27,247	0.93			
22-Jul	816	51,528	0.99	495	27,996	0.93	273	27,520	0.94			
23-Jul	513	52,041	1.00	444	28,440	0.95	376	27,896	0.95			
24-Jul				420	28,860	0.96	308	28,204	0.96			
25-Jul				388	29,248	0.97	372	28,576	0.97			
26-Jul				311	29,559	0.98	330	28,906	0.98			
27-Jul				233	29,792	0.99	300	29,206	0.99			
28-Jul				156	29,948	1.00	160	29,366	1.00			
29-Jul				128	30,076	1.00						
30-Jul												
31-Jul												
Total	52,041			30,076			29,366			9,148		

[a] High water throughout the season prohibited acceptable counting conditions.

Table 3. Annual Nulato River tower passage estimates and associated passage timing statistics for the chinook salmon runs, 1994-2001.

Year	Sonar Passage Estimate [b]	Day of First Salmon Counts	First Quartile Day	Median Day	Third Quartile Day	First Count & First Quartile	Days Between Quartiles: First & Median	Median & Third	First & Third
1994	1,795	5-Jul	11-Jul	14-Jul	19-Jul	6	3	5	8
1995	1,412	26-Jun	11-Jul	16-Jul	20-Jul	15	5	4	9
1996	756	26-Jun	7-Jul	11-Jul	15-Jul	11	4	4	8
1997	4,811	23-Jun	4-Jul	8-Jul	13-Jul	11	4	5	9
1998	1,504	24-Jun	10-Jul	14-Jul	17-Jul	16	4	3	7
1999	1,932	3-Jul	10-Jul	14-Jul	19-Jul	7	4	5	9
2000	916	28-Jun	5-Jul	7-Jul	10-Jul	7	2	3	5
2001 [a]									
Mean	1,875	27-Jun	8-Jul	12-Jul	17-Jul	10.4	3.7	4.1	7.9
Median	1,504	26-Jun	10-Jul	14-Jul	17-Jul	11.0	4.0	4.0	8.0
SE	1,363	4.5	2.9	3.4	3.7	4.0	1.0	0.9	1.5

[a] Persistence high water throughout the 2001 season allowed only 4 days of counts. No interpolations were completed to estimate the total run.

Table 4. Annual Nulato River tower passage estimates and associated passage timing statistics for the summer chum salmon runs, 1994-2001.

Year	Sonar Passage Estimate [b]	Day of First Salmon Counts	First Quartile Day	Median Day	Third Quartile Day	First Count & First Quartile	Days Between Quartiles: First & Median	Median & Third	First & Third
1994	148,762	29-Jun	4-Jul	9-Jul	13-Jul	5	5	4	9
1995	236,890	21-Jun	2-Jul	7-Jul	11-Jul	11	5	4	9
1996	129,694	21-Jun	27-Jun	3-Jul	8-Jul	6	6	5	11
1997	158,171	20-Jun	30-Jun	5-Jul	8-Jul	10	5	3	8
1998	52,041	22-Jun	7-Jul	12-Jul	15-Jul	15	5	3	8
1999	30,076	24-Jun	7-Jul	11-Jul	16-Jul	13	4	5	9
2000	29,366	24-Jun	5-Jul	9-Jul	14-Jul	11	4	5	9
2001 [a]									
Mean	112,143	23-Jun	3-Jul	8-Jul	11-Jul	10.1	4.9	4.1	9.0
Median	129,694	22-Jun	4-Jul	9-Jul	13-Jul	11.0	5.0	4.0	9.0
SE	78,026	3.1	3.7	3.2	3.2	3.6	0.7	0.9	1.0

[a] Persistence high water throughout the 2001 season allowed only 4 days of counts. No interpolations were completed to estimate the total run.

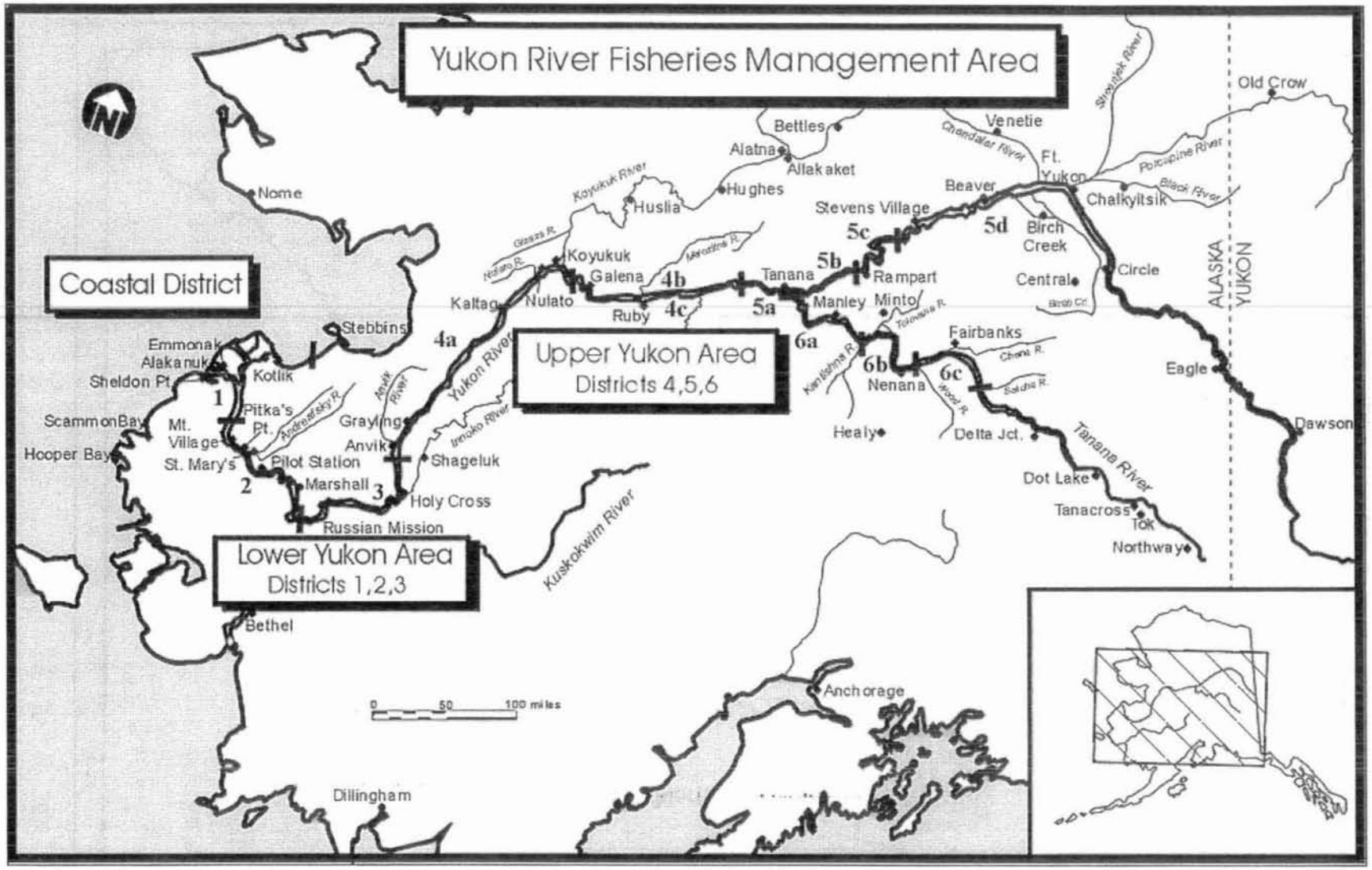


Figure 1. Alaska portion of the Yukon River showing villages and fishing district boundaries.

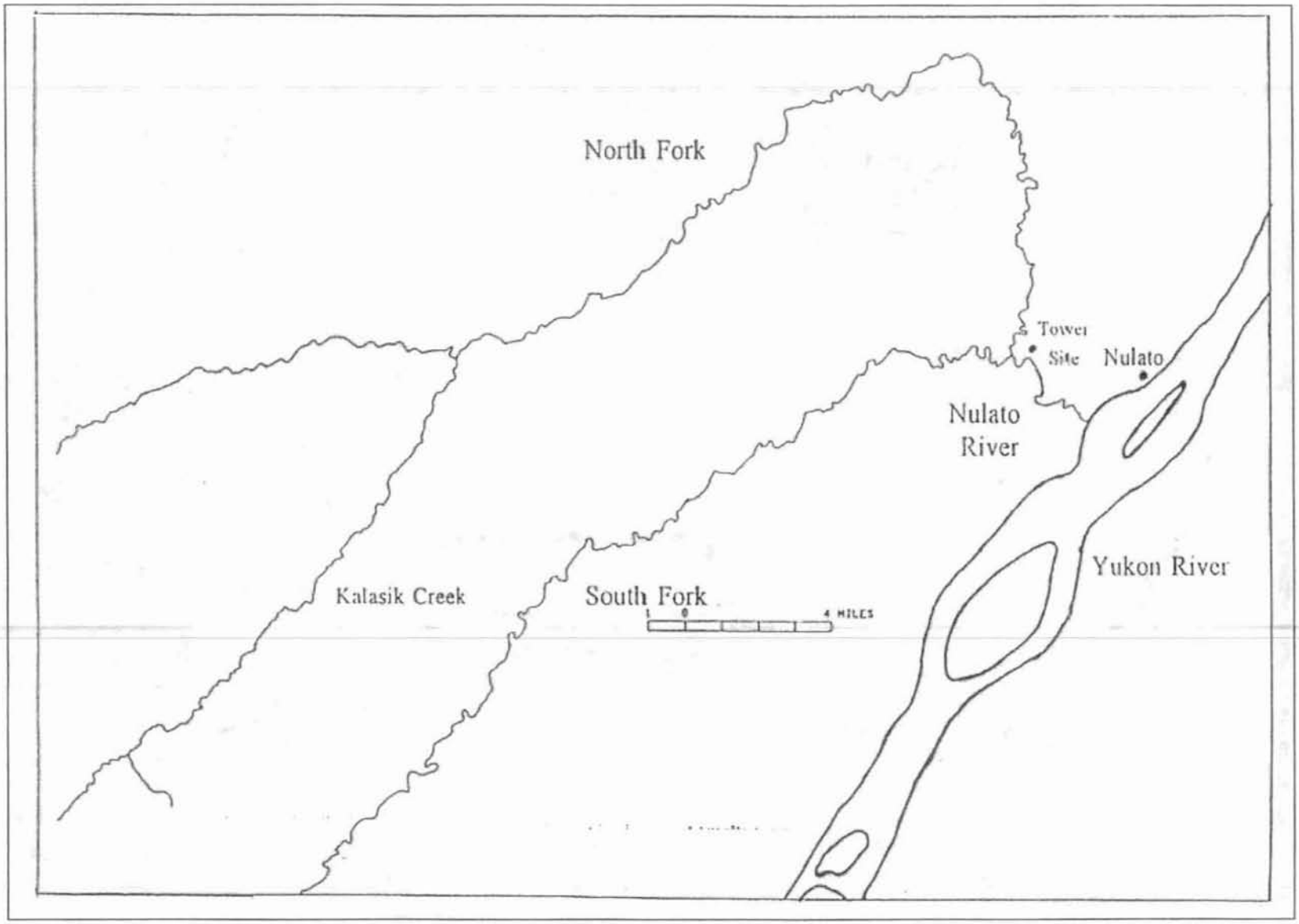
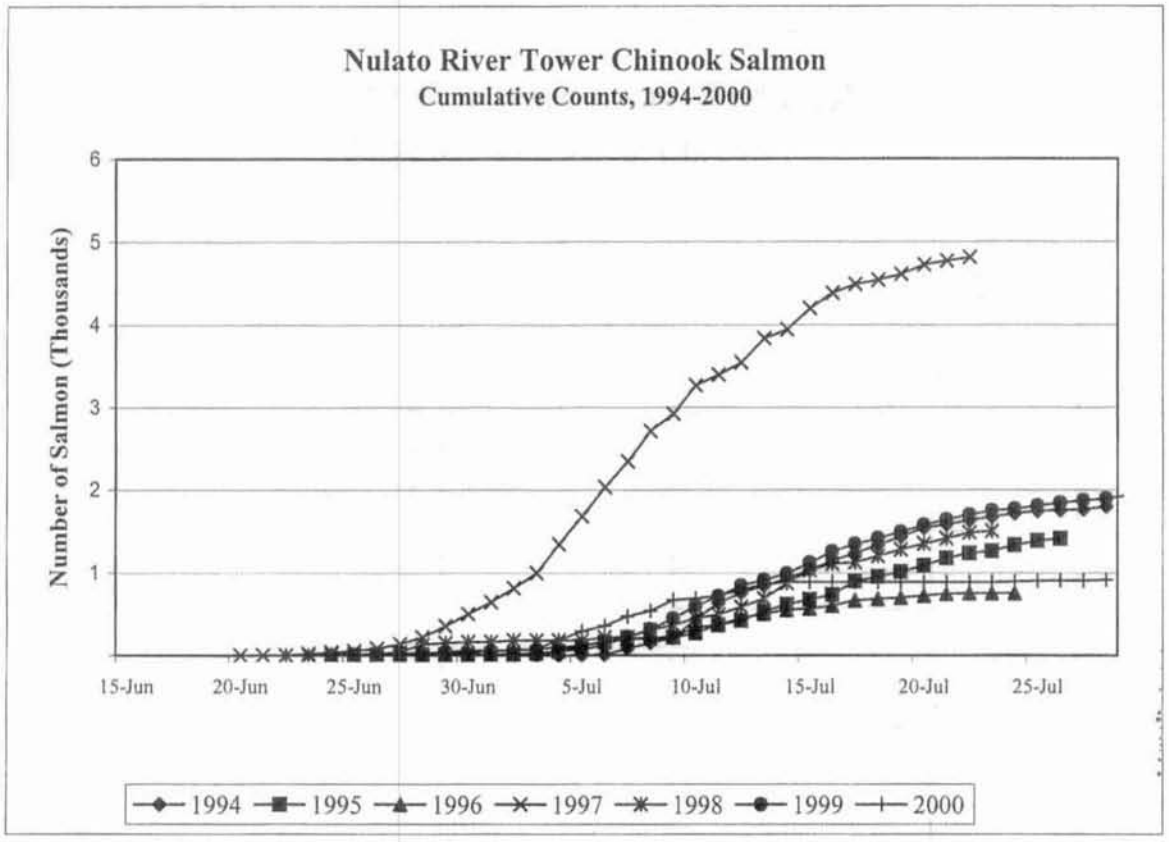


Figure 2. The Nulato River drainage showing the counting tower site.



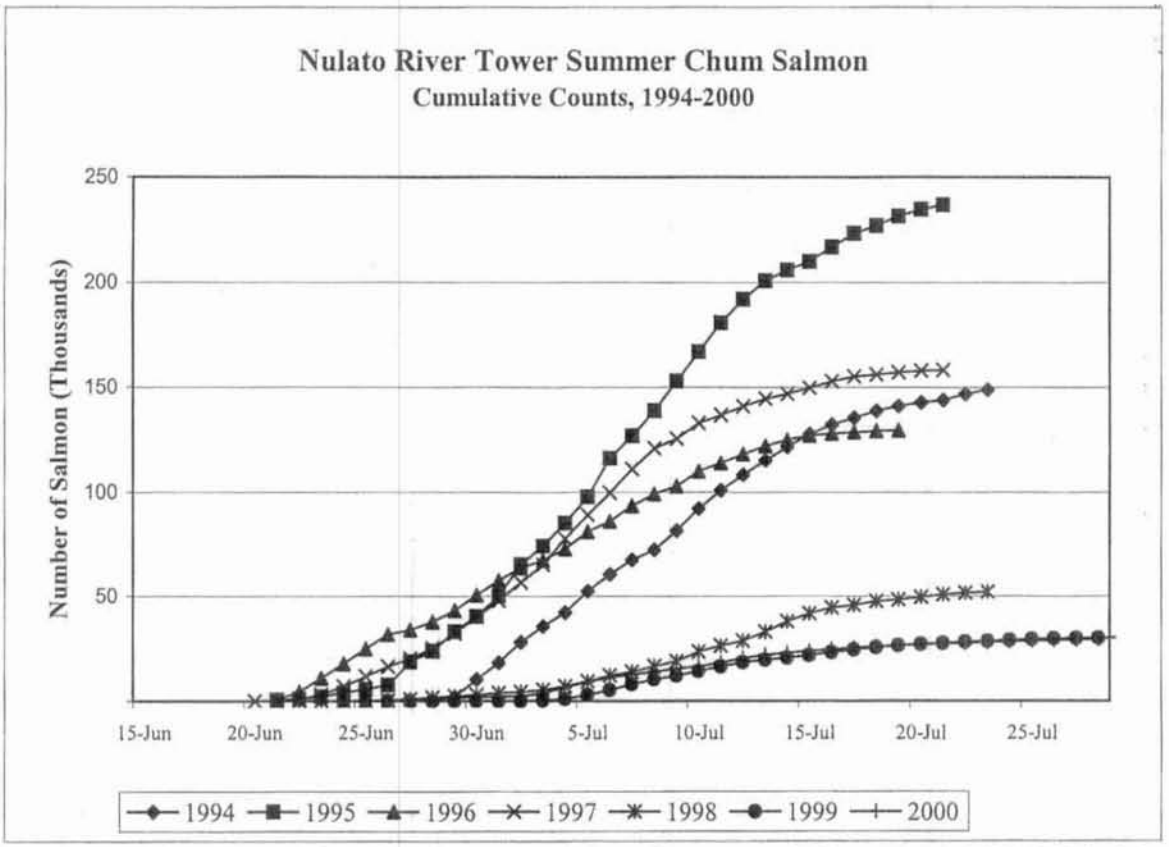


Figure 3. Nulato River chinook and summer chum salmon cumulative counts, 1994-2000. (No

Appendix A.1. Nulato River field purchase record form.

Nulato River Tower Project
Field Purchase Record

Date	FPO Number	Vendor	Total Purchase	Comments

Appendix A.2. Nulato River hourly tower count data log form.

Nulato River Tower Project Hourly Tower Count Data Log

Date ____________ **Bank** ____________

	Time			Chum Salmon			Chinook Salmon		
OBSERVER	**Start**	**Stop**	**Minutes Counted**	**Up Stream**	**Dn Stream**	**Net**	**Up Stream**	**Dn Stream**	**Net**

Comments:

Appendix A.3. Nulato River tower project hourly salmon counts.

Nulato River Tower Project Hourly Salmon Counts, Date_____, Year_____.

	Right Bank (gravel-bar side)						Left Bank (cut-bank side)						Total Both Banks	
			Chum		Chinook				Chum		Chinook		Chum	Chinook
Hour Ending	Minutes Counted	Expansion Factor *	Actual Counts	Expanded Counts	Actual Counts	Expanded Counts	Minutes Counted	Expansion Factor *	Actual Counts	Expanded Counts	Actual Counts	Expanded Counts	Expanded Counts	Expanded Counts
0100														
0200														
0300														
0400														
0500														
0600														
0700														
0800														
0900														
1000														
1100														
1200														
1300														
1400														
1500														
1600														
1700														
1800														
1900														
2000														
2100														
2200														
2300														
2400														
Total														
													100.0%	100.0%

* Hourly expansion factor = [60/(number of minutes counted)]

Appendix A.4. Nulato River radio reporting form.

Nulato River Tower Project
Radio Report: Adult Salmon Tower Counts

		Chum Salmon			Chinook Salmon		
Date	Minutes Counted	Actual Counts	Total Expanded Counts	Cumulative Counts To Date	Actual Counts	Total Expanded Counts	Cumulative Counts To Date

Appendix A.5. Nulato River beach seine catch record form.

Year________

Nulato River Tower Project Beach Seine Catch Record

Date	Time	Location	Chum Salmon				Chinook Salmon				Other Fish	Comments
			Caught		Sampled		Caught		Sampled			
			Male	Female	Male	Female	Male	Female	Male	Female	Speices& Sex	

Appendix A.6. Nulato River climatological and hydrological observation form.

Nulato River Tower Project
Climatological and Hydrological Observations

Year / Date	Time	Precipitation (code\amt)	Wind (Direction and) Velocity	Sky (code)	Temperature (C) Air Min	Air Max	Water	Water Gauge (ft)	Water Color (code)	Remarks

Codes					
SKY		PRECIPITATION		WATER COLOR	
0	No observation made	I	Intermittent rain	Clr	Clear
1	Clear sky, not over 10% cloud cover	R	Continuous rain	Dk grn	Dark green
2	Cloud cover not over 50%	S	Snow	Lt grn	Light green
3	Cloud cover over 50% of sky	S&R	Mixed snow & rain	Br	Brown
4	Completely overcast	H	Hail	Dk	Dark Brown
5	Fog or thick haze or smoke	T	Thunder showers	Tr	Turbid: murky or glacial