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COPPER RIVER HYDROACOUSTIC SALMON ENUMERATION STUDIES, 1997 AND 1998

by

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ABSTRACT

To estimate annual salmon escapement in to the Copper River, the Miles Lake hydroacoustic project was begun in 1978. Studies conducted during 1997 and 1998 used Bendix Corporation single beam side-scanning sonar equipment deployed on the north and south banks of the Copper River near the outlet of Miles Lake, approximately 53 km upriver from the commercial fishing district. In 1997, salmon escapement was estimated to be 1,148,079 during the time period of May 16 through August 3. In 1998, salmon escapement was estimated to be 866,957 during the time period of May 18 through August 4. Escapement in 1997, was the largest since the projects inception. Although it has not been possible to collect information at the site on species composition, most of the salmon passing the site are assumed to be sockeye salmon *Oncorhynchus nerka* since this species comprises more than 95 percent of the salmon harvest in Copper River subsistence, commercial, recreational and personal use fisheries.

KEY WORDS: Copper River, hydroacoustics, migration, Miles Lake, *Oncorhynchus nerka*, Pacific salmon, riverine sonar, sockeye salmon, side-scanning sonar, spawning escapement

INTRODUCTION

The Copper River drainage (Figure 1) has supported a commercial fishery since the early 1890's and a subsistence life style for the residents of this drainage for many years before that. Five species of Pacific salmon spawn in the Copper River. The most abundant species is sockeye salmon, which makes up more than 95 percent of the total run. Coho salmon *Oncorhynchus kisutch* comprise approximately five percent and chinook salmon *O. tshawytscha* makes up about three percent of the total run. Populations of pink *O. gorbuscha* and chum *O. keta* salmon are not abundant.

There are three major sockeye salmon spawning components in the Copper River system. The most abundant component, referred to as upper Copper River stocks, spawn in Copper River tributaries above Miles Lake. The second component, derived from upper Copper River stocks, is an artificially propagated Gulkana River hatchery stock. The hatchery, which has operated since the early 1970's, produces approximately 350,000 returning adult sockeye salmon. The third component, referred to as lower delta stocks, spawn in systems below the Chugach Mountains, between Eyak Lake and Katalla River.

Management of Copper River salmon resources is difficult due to several factors. The Copper River is a cold turbid system draining extensive glaciers originating in the Alaska, Chugach, Wrangell, and St. Elias mountain ranges. Enumerating the escapement within this drainage has been difficult since the main stem Copper River is too turbid to allow visual counting of salmon. While it is possible to survey clear tributary streams, sockeye and chinook salmon reach these months after they have passed through the commercial fishery. Such surveys have little value for inseason management decisions and make it impossible to ensure that minimum escapement levels are achieved. However, post season escapement estimates do provide data to forecast subsequent runs and to establish escapement goals.

Inseason escapement estimates first became possible in 1978, with the deployment of a single side scanning sonar salmon counter on the south bank of the Copper River at the outlet of Miles Lake (Mile 49 of the Copper River Highway) approximately 53 km upstream from the commercial fishing zone. In 1979 an additional side-scanning unit was installed on the north bank of the river. Information from this project has been used for real time management of both the commercial and personal use fisheries. During the winter of 1996 the Board of Fisheries made significant changes to The Copper River management plan, 5AAC 24.360 (State of Alaska, 1997). Emergency order regulation of the multi-million dollar commercial fishery as well as subsistence, personal use, and sport fisheries is based on escapement information collected at the Miles Lake sonar site.

METHODS

To estimate total escapement, the sonar system must be placed in an area of the river where salmon do not mill and all salmon traveling upriver have a high probability of passing through the sounding beam. An area of the river with a single channel, uniform slope, smooth bottom and adequate current velocity is most desirable. The most suitable location, closest to the river mouth, was found just downstream of Miles Lake. This site is 53 km above the upper commercial district boundary. This section of the river is influenced by two glaciers: Childs Glacier, which is below Miles Lake, and Miles Glacier, which is on the eastern shore of Miles Lake (Figure 2). Although the Copper River Highway provides access to the site, deep snowdrifts historically have rendered the highway impassable well into June most years. Since 1994, the Department of Transportation (DOT) has opened the road for vehicle travel to the sonar site, however, in 1998 snow depth prevented DOT from opening the road and the United States Coast Guard deployed gear and personnel to the site via helicopter.

Sonar Operations

The basic adult salmon counter system consists of four main elements: an electronic counting unit, a transducer, an artificial bottom substrate, and an oscilloscope for calibration. The system is powered by a 12-volt battery continuously recharged by a solar panel.

Electronic counting units used on this project varied within and between years. Two 16 sector, 1985 Bendix units with adjustable hit criteria by sector are currently used. Two 12 sector 1981, Bendix units with rock inhibiting functions are available to replace 16 sector units which malfunction or are damaged.

Transducers operate at 515 kHz and have alternating beam widths of 2 and 4 degrees. Each transducer is mounted on an underwater stand near the riverbank and aimed horizontally across the river so that the beam is perpendicular to the current and slightly off the bottom. This allows monitoring of that portion of river most frequently used by migrating sockeye salmon. On the south bank the transducer is aimed over an artificial bottom substrate with a smooth straight surface. On the north bank the natural river bottom is used where the slope is smooth and uniform. The south bank permanent artificial substrate is constructed of concrete with a steel rail embedded in the concrete to form a uniform surface along the river bottom. The rail also serves as a guide along which the transducer stand is moved in response to water level fluctuations. Through 1995, a minimum water level of 40.1 m above mean sea level was needed for use of the permanent substrate. When water levels are lower, a portable tripod is used to hold and aim the transducer. However, during the high water

period in 1995 the lower portion of the rail was damaged by an iceberg and the required water level to move to the permanent substrate is now 40.9 m above sea level.

Each transducer stand has an adjustment wheel at the top that is manually turned to aim the sonar beam along the river bottom or substrate. To position the beam up- or down river, the entire tripod must be shifted in the desired direction (Morstad 1992). These manually adjustable stands are less prone to damage by large pieces of ice and debris than remote controlled pan and tilt rotator units.

Calibrations

Each year, frequent adjustments of transducers have been required on both riverbanks because of large fluctuations in river level, wave action caused by strong winds, and periods of heavy ice passage. The north bank sonar unit was calibrated every four hours for 30 minutes or until 100 salmon were counted Do to the low frequency of fish passage calibrating the north bank during most instances is difficult. Low fish passage less than 10 fish per hour is common and makes sonar adjustments difficult.

Since 1994, when the south bank unit was on permanent substrate, calibrations were conducted every three hours for 30 minutes or until 100 salmon were counted (Morstad 1992). When the south bank transducer was mounted on the tripod, visual counting with the aid of the oscilloscope were conducted every hour for 30 minutes and then expanded to obtain a cumulative hourly count. During this period, the firing rate of the sonar counter was increased, aiding in visual counting. There were no adjustments to the sonar counter and all hourly printouts from the counter were discarded when the transducer was attached to the tripod. The basis for visual counting versus the sonar counts while using the tripod is that during the low water periods in May and early June large amounts of shore, lake and glacial ice are drifting down river on the surface causing high counts in the inshore sectors. Interpolations of the inshore sectors were constant thereby producing data based on averages (Morstad 1992).

Species Apportionment

Test fishing programs using gill nets and beach seines were attempted in the vicinity of the sonar site from 1985 through 1987, but lack of good sampling locations and small catches indicated that this was not a viable way to collect data on species composition (Morstad 1992). No species apportionment information was collected at the site in either 1997 or 1998. However, based on information from subsistence, commercial, recreational and personal use harvests, as well as aerial surveys, most salmon migrating up the Copper River are sockeye salmon. Therefore, it was assumed that most sonar counts could be attributed to this species.

RESULTS and DISCUSSION

In 1997, the sonar project operated from 16 May to 3 August. Estimated escapement during that time period was 1,148,079 salmon, nearly double the escapement goal of 592,000 (Table 1). This is by far the largest recorded run of sockeye salmon to the Copper River system. Daily passage was below the anticipated level from May 15 through May 23 and then surpassed the dailies for most of the season. The cumulative escapement surpassed the cumulative projected on May 25 and never dropped below for the rest of the season (Figure 3). The south bank transducer was mounted on a tripod from 16 May until 7 June (Tables 2-4) when water level dropped below 40.1 m (Figure 4).

In 1998, the sonar project operated from 18 May to 4 August. Estimated passage during that time period was 866,957 salmon, 40 percent above the goal (Table 5) Daily passage rates were below anticipated values at the start of the project but surpassed anticipated values on 28 May and remained above them the rest of the season (Figure 5). The south bank sonar was mounted on the tripod from 18 May through 1 June (Tables 6-8) (Figure 6).

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TABLES

Table 1. Daily sockeye salmon escapement estimates at Miles Lake sonar, 1997.

		Estimated Daily Escapement				Escapement Objective			
Date	Water Level [a]	North Bank	South Bank	Daily	Cumulative	Daily	Cumulative	0600 Count	Projected Daily
15-May	39.65								
16-May	39.65		64 [b]	64	64	107	107		
17-May	39.49		88	88	152	1,339	1,446		
18-May	39.44		136	136	288	2,052	3,498		
19-May	39.35		168	168	456	2,542	6,040		
20-May	39.28		486	486	942	3,032	9,072		
21-May	39.29		464	464	1,406	2,877	11,949		
22-May	39.62		1,742	1,742	3,148	2,917	14,866		
23-May	40.08		2,744	2,744	5,892	3,179	18,045		
24-May	40.49		12,196	12,196	18,088	5,543	23,588		
25-May	40.50		26,923	26,923	45,011	5,454	29,042	5,742	22,968
26-May	40.40		27,389	27,389	72,400	6,973	36,015	6,722	26,888
27-May	40.27		31,978	31,978	104,378	7,952	43,967	7,200	28,800
28-May	40.22		46,182	46,182	150,560	8,985	52,952	9,729	38,916
29-May	40.22		46,539	46,539	197,099	6,929	59,881	11,556	46,224
30-May	40.40		37,554	37,554	234,653	7,053	66,934	10,287	41,148
31-May	40.42		46,197	46,197	280,850	10,228	77,162	12,912	51,648
01-Jun	40.40		31,557	31,557	312,407	9,981	87,143	9,177	36,708
02-Jun	40.45		30,744	30,744	343,151	10,941	98,084	10,584	42,336
03-Jun	40.45		18,078	18,078	361,229	10,357	108,441	6,585	26,340
04-Jun	40.37		17,562	17,562	378,791	11,096	119,537	3,384	13,536
05-Jun	40.57		16,188	16,188	394,979	13,286	132,823	4,686	18,744
06-Jun	41.06	167 [c]	19,818	19,985	414,964	11,288	144,111	4,167	16,668
07-Jun	41.42	478	22,134 [d]	22,612	437,576	11,089	155,200	5,504	22,016
08-Jun	41.49	448	33,521	33,969	471,545	12,791	167,991	7,879	31,516
09-Jun	41.45	855	36,223	37,078	508,623	12,254	180,245	8,133	32,532
10-Jun	41.45	1,203	32,977	34,180	542,803	12,162	192,407	6,630	26,520
11-Jun	41.46	2,551	28,390	30,941	573,744	12,027	204,434	7,321	29,284
12-Jun	41.44	1,317	17,802	19,119	592,863	11,420	215,854	5,208	20,832
13-Jun	41.45	1,144	12,220	13,364	606,227	9,774	225,628	3,438	13,752
14-Jun	41.51	1,026	15,054	16,080	622,307	9,290	234,918	2,435	9,740
15-Jun	41.51	854	22,366	23,220	645,527	11,261	246,179	5,172	20,688
16-Jun	41.49	563	16,426	16,989	662,516	9,503	255,682	3,988	15,952
17-Jun	41.48	445	21,356	21,801	684,317	9,438	265,120	5,020	20,080
18-Jun	41.41	2,107	19,985	22,092	706,409	7,979	273,099	4,410	17,640
19-Jun	41.52	1,901	10,810	12,711	719,120	7,263	280,362	3,230	12,920
20-Jun	41.69	1,042	6,802	7,844	726,964	6,799	287,161	1,363	5,452
21-Jun	41.67	928	7,461	8,389	735,353	6,896	294,057	1,988	7,952
22-Jun	41.73	680	16,873	17,553	752,906	6,912	300,969	4,187	16,748
23-Jun	42.03	628	7,077	7,705	760,611	7,438	308,407	3,158	12,632
24-Jun	42.43	938	4,372	5,310	765,921	6,857	315,264	1,249	4,996
25-Jun	42.72	404	5,056	5,460	771,381	7,458	322,722	1,607	6,428
26-Jun	42.99	300	7,685	7,985	779,366	6,371	329,093	1,562	6,248
27-Jun	43.28	265	11,746	12,011	791,377	6,234	335,327	2,181	8,724
28-Jun	43.28	224	10,203	10,427	801,804	6,061	341,388	2,316	9,264
29-Jun	43.66	365	10,044	10,409	812,213	6,513	347,901	2,375	9,500
30-Jun	43.71	346	13,395	13,741	825,954	6,920	354,821	3,248	12,992

-Continued-

Table 1. (page 2 of 2)

Date	Water Level [a]	North Bank	Estimate South Bank	Daily	Cumulative	Escapement Objective Daily	Escapement Objective Cumulative	0600 Count	Projected Daily
01-Jul	43.75	788	11,936	12,724	838,678	5,748	360,569	3,864	15,456
02-Jul	43.71	1,147	12,419	13,566	852,244	6,182	366,751	2,810	11,240
03-Jul	43.70	1,053	14,377	15,430	867,674	6,713	373,464	3,849	15,396
04-Jul	43.65	654	13,964	14,618	882,292	6,903	380,367	3,613	14,452
05-Jul	43.71	1,034	12,414	13,448	895,740	6,798	387,165	3,241	12,964
06-Jul	43.76	515	10,509	11,024	906,764	6,172	393,337	2,799	11,196
07-Jul	43.71	1,024	10,510	11,534	918,298	6,563	399,900	2,296	9,184
08-Jul	43.72	497	13,239	13,736	932,034	7,991	407,891	3,260	13,040
09-Jul	43.46	759	7,118	7,877	939,911	7,931	415,822	1,872	7,488
10-Jul	43.22	476	13,281	13,757	953,668	8,916	424,738	3,276	13,104
11-Jul	43.18	491	16,207	16,698	970,366	8,166	432,904	5,898	23,592
12-Jul	43.24	465	9,694	10,159	980,525	7,982	440,886	2,911	11,644
13-Jul	43.17	298	8,951	9,249	989,774	7,446	448,332	2,881	11,524
14-Jul	43.14	609	12,299	12,908	1,002,682	8,198	456,530	2,616	10,464
15-Jul	43.11	1,166	14,585	15,751	1,018,433	7,921	464,451	4,803	19,212
16-Jul	43.05	598	13,358	13,956	1,032,389	8,119	472,570	3,181	12,724
17-Jul	43.04	781	14,330	15,111	1,047,500	7,341	479,911	4,065	16,260
18-Jul	42.97	832	9,032	9,864	1,057,364	7,377	487,288	2,563	10,252
19-Jul	42.93	719	10,549	11,268	1,068,632	7,795	495,083	2,887	11,548
20-Jul	42.90	851	10,523	11,374	1,080,006	8,014	503,097	2,467	9,868
21-Jul	42.87	763	9,213	9,976	1,089,982	7,199	510,296	3,022	12,088
22-Jul	42.65	704	6,045	6,749	1,096,731	6,262	516,558	1,600	6,400
23-Jul	42.66	1,119	5,918	7,037	1,103,768	5,921	522,479	1,835	7,340
24-Jul	42.66	672	4,539	5,211	1,108,979	5,319	527,798	1,464	5,856
25-Jul	42.75	286	3,307	3,593	1,112,572	4,999	532,797	1,123	4,492
26-Jul	42.85	376	3,102	3,478	1,116,050	5,135	537,932	555	2,220
27-Jul	42.85	228	4,042	4,270	1,120,320	4,589	542,521	641	2,564
28-Jul	43.28	356	4,133	4,489	1,124,809	4,801	547,322	1,182	4,728
29-Jul	43.63	657	2,661	3,318	1,128,127	5,043	552,365	657	2,628
30-Jul	43.80	442	2,812	3,254	1,131,381	4,771	557,136	836	3,344
31-Jul	43.81	391	2,188	2,579	1,133,960	4,090	561,226	757	3,028
01-Aug	43.65	813	3,583	4,396	1,138,356	3,735	564,961	859	3,436
02-Aug	43.45	607 [e]	4,102	4,709	1,143,065	3,281	564,507	1,027	4,108
03-Aug	43.34		5,014	5,014	1,148,079	3,281	568,242	1,131	4,524
Total		43,350	1,104,729	1,148,079					

[a] Meters above sea level.

[b] South bank transducer was deployed on the tripod

[c] North bank tripod was deployed.

[d] South bank transducer was deployed on the permanent substrate at midnight.

[e] North Bank counter was pulled at 12:00 midnight.

Table 2. The number of minutes each hour the oscilloscope was monitored on the south bank tripod , Miles Lake sonar, 1997.

HOUR	16-May	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May	01-Jun	02-Jun	03-Jun	04-Jun	05-Jun	06-Jun
0000-0100	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0100-0200	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0200-0300	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0300-0400	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0400-0500	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0500-0600	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0600-0700	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0700-0800	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0800-0900	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
0900-1000	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
1000-1100	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
1100-1200	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
1200-1300	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20	20
1300-1400	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20	20
1400-1500	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20	20
1500-1600	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20	20
1600-1700	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
1700-1800	30	30	30	30	30	30	30	30	30	30	0	30	20	20	20	20	20	20	20	20	20	20
1800-1900	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
1900-2000	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
2000-2100	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
2100-2200	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
2200-2300	30	30	30	30	30	30	30	30	30	18	30	30	20	20	20	20	20	20	20	20	20	20
2300-2400	30	30	30	30	30	30	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20
TOTAL	720	720	720	720	720	720	720	720	720	708	690	680	480	480	480	480	480	480	480	480	480	480

Table 3. The number of fish observed passing the south bank tripod during visual monitoring of the oscilloscope, Miles Lake sonar, 1997.

HOUR	16-May	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May	01-Jun	02-Jun	03-Jun	04-Jun	05-Jun	06-Jun
0000-0100	4	0	6	3	4	16	9	13	149	666	895	567	753	480	396	643	435	568	359	213	231	264
0100-0200	0	1	1	4	2	15	37	21	162	609	313	646	541	601	476	794	683	638	374	240	330	201
0200-0300	1	1	0	3	3	9	33	55	103	430	368	531	583	734	768	806	504	573	457	107	287	249
0300-0400	2	4	1	2	10	13	47	18	120	419	468	617	489	701	547	652	527	663	325	188	245	216
0400-0500	1	2	2	1	2	10	24	23	86	364	687	588	423	679	598	713	494	497	389	172	254	182
0500-0600	0	1	3	1	4	7	17	10	44	483	630	651	454	667	644	686	516	589	291	208	215	277
0600-0700	1	3	4	0	3	14	8	30	145	477	532	330	247	788	322	823	384	340	363	233	189	236
0700-0800	1	2	2	7	4	6	14	33	132	398	454	511	309	826	306	818	468	375	257	198	79	152
0800-0900	2	0	2	0	2	5	87	27	204	500	684	599	429	597	384	602	307	274	223	220	220	286
0900-1000	0	2	2	2	8	6	102	62	307	626	479	781	810	673	322	611	333	312	236	229	284	323
1000-1100	1	2	1	6	32	4	95	91	306	463	597	725	719	692	219	586	427	358	223	222	44	264
1100-1200	4	0	1	7	21	12	21	72	336	581	781	675	674	683	234	522	396	421	182	278	241	379
1200-1300	2	4	3	2	13	13	78	74	172	482	484	487	659	700	236	604	424	205	213	339	210	387
1300-1400	3	1	6	1	18	7	49	67	304	507	665	688	762	649	701	664	390	203	242	239	232	406
1400-1500	2	1	5	9	19	6	47	66	212	545	787	371	800	608	638	584	380	228	222	295	231	213
1500-1600	2	2	6	5	13	4	52	60	230	650	452	414	812	535	583	767	208	386	197	275	300	279
1600-1700	0	0	4	5	10	7	48	57	366	664	288	617	766	542	682	596	544	452	133	255	219	272
1700-1800	1	2	3	6	6	14	10	48	449	387		702	584	668	712	631	620	388	170	273	183	256
1800-1900	0	1	0	7	14	24	26	93	432	426	459	816	916	398	711	572	448	370	134	270	133	437
1900-2000	1	4	4	3	8	8	18	48	268	689	529	833	588	632	476	506	450	508	181	267	126	245
2000-2100	1	2	1	2	11	4	9	36	356	708	633	708	871	660	620	578	360	431	176	340	130	280
2100-2200	2	3	3	1	15	8	6	118	397	813	711	882	760	608	628	564	453	496	236	252	298	263
2200-2300	1	4	4	3	7	3	21	83	438	541	576	831	598	648	639	573	427	532	215	298	472	251
2300-2400	0	2	5	4	15	18	13	167	380	673	652	589	847	756	676	497	441	441	248	243	243	288
TOTAL	32	44	68	84	243	232	871	1,372	6,098	13,101	13,124	15,059	15,394	15,515	12,518	15,400	10,519	10,248	6,026	5,854	5,396	6,606

Table 4. Expanded hourly and daily counts from the south bank tripod , Miles Lake sonar, 1997.

HOUR	16-May	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May	01-Jun	02-Jun	03-Jun	04-Jun	05-Jun	06-Jun
0000-0100	8	0	12	6	8	32	18	26	298	1,332	1,790	1,134	2,259	1,440	1,188	1,929	1,305	1,704	1,077	639	693	792
0100-0200	0	2	2	8	4	30	74	42	324	1,018	626	1,292	1,623	1,803	1,428	2,382	1,749	1,914	1,122	720	990	603
0200-0300	2	2	0	6	6	18	66	110	206	860	736	1,062	1,749	2,202	2,304	2,418	1,512	1,719	1,371	321	861	747
0300-0400	4	8	2	4	20	26	94	36	240	838	936	1,234	1,467	2,103	1,641	1,956	1,581	1,989	975	564	735	648
0400-0500	2	4	4	2	4	20	48	46	172	728	1,374	1,176	1,269	2,037	1,794	2,139	1,482	1,491	1,167	516	762	546
0500-0600	0	2	6	2	8	14	34	20	88	966	1,260	1,302	1,262	1,971	1,932	2,088	1,548	1,767	873	624	645	831
0600-0700	2	6	8	0	6	28	16	60	290	954	1,064	660	741	2,364	966	2,469	1,152	1,020	1,089	699	567	708
0700-0800	2	4	4	14	8	12	28	66	264	796	906	1,022	927	2,478	918	2,448	1,404	1,125	771	594	237	456
0800-0900	4	0	4	0	4	10	174	54	408	1,000	1,368	1,198	1,287	1,791	1,152	1,806	921	822	669	660	660	858
0900-1000	0	4	4	4	18	10	204	124	614	1,052	868	1,562	2,430	2,019	966	1,833	999	936	708	687	882	969
1000-1100	2	4	2	12	64	8	190	182	612	926	1,194	1,450	2,157	2,076	657	1,758	1,281	1,074	669	666	132	792
1100-1200	8	0	2	14	42	24	42	144	872	1,162	1,562	1,350	2,022	2,049	702	1,566	1,188	1,263	546	834	723	1,137
1200-1300	4	8	6	4	26	26	156	148	344	964	968	1,461	1,977	2,100	708	1,812	1,272	615	639	1,017	630	1,161
1300-1400	6	2	10	2	36	14	98	134	608	1,014	1,330	1,764	2,286	1,947	2,103	1,992	1,170	609	726	717	696	1,218
1400-1500	4	2	10	18	38	12	94	132	424	1,090	1,574	1,113	2,400	1,824	1,914	1,752	1,140	684	666	885	693	639
1500-1600	4	4	12	10	26	8	104	120	480	1,300	904	1,242	2,436	1,605	1,749	2,301	624	1,158	591	825	900	837
1600-1700	0	0	8	10	20	14	96	114	732	1,328	576	1,234	2,298	1,626	2,046	1,788	1,632	1,356	399	765	657	816
1700-1800	2	4	6	12	12	28	20	96	898	774		1,404	1,752	2,004	2,136	1,893	1,860	1,164	810	819	549	768
1800-1900	0	2	0	14	28	48	52	186	864	852	918	1,632	2,748	1,194	2,133	1,716	1,344	1,110	402	810	399	1,311
1900-2000	2	8	8	6	12	16	38	96	536	1,378	1,058	1,666	1,764	1,898	1,428	1,518	1,350	1,524	483	801	378	735
2000-2100	2	4	2	4	22	8	18	72	712	1,416	1,266	1,416	2,613	1,980	1,860	1,734	1,080	1,293	528	1,020	390	840
2100-2200	4	6	6	2	30	16	12	236	794	1,626	1,422	1,764	2,280	1,824	1,884	1,892	1,359	1,488	708	756	894	789
2200-2300	2	8	8	6	14	6	42	166	876	1,803	1,152	1,662	1,794	1,944	1,917	1,719	1,281	1,596	645	894	1,416	753
2300-2400	0	4	10	8	30	36	26	334	760	1,746	1,304	1,178	2,541	2,268	2,028	1,491	1,323	1,323	744	729	729	864
Total	64	88	136	168	486	464	1,742	2,744	12,196	26,923	26,248	31,978	46,182	46,539	37,554	46,197	31,557	30,744	18,078	17,562	16,188	19,818
Daily	64	88	136	168	486	464	1,742	2,744	12,196	26,923	27,389	31,978	46,182	46,539	37,554	46,197	31,557	30,744	18,078	17,562	16,188	19,818

Table 5. Daily sockeye salmon escapement estimates at Miles Lake sonar, 1998.

Date	Water Level [a]	Estimated Daily Escapement: North Bank	South Bank	Daily	Cumulative	Escapement Objective: Daily	Cumulative	0600 Count	Projected Daily
15-May									
16-May	38.76					112	112		
17-May	38.80					1,397	1,509		
18-May	38.85		158 [b]	158	158	2,141	3,650		
19-May	39.00		254	254	412	2,652	6,302		
20-May	39.06		173	173	585	3,162	9,464		
21-May	39.08		1,477	1,477	2,062	3,001	12,465		
22-May	39.04		1,277	1,277	3,339	3,051	15,516		
23-May	39.09		1,327	1,327	4,666	3,351	18,867		
24-May	39.13		3,582	3,582	8,248	5,816	24,683		
25-May	39.16		5,851	5,851	14,099	5,704	30,387		
26-May	39.28		5,608	5,608	19,707	7,312	37,699		
27-May	39.58		9,011	9,011	28,718	8,342	46,041		
28-May	39.91		10,275	10,275	38,993	9,378	55,419		
29-May	40.26		11,226	11,226	50,219	7,276	62,695		
30-May	40.64		18,442	18,442	68,661	7,417	70,112		
31-May	41.09		23,018	23,018	91,679	10,699	80,811		
01-Jun	41.27		21,312 [d]	21,312	112,991	10,441	91,252	6,058	24,232
02-Jun	41.25		24,206	24,206	137,197	11,496	102,748	4,649	18,596
03-Jun	41.21		25,724	25,724	162,921	10,845	113,593	7,453	29,812
04-Jun	41.42		25,530	25,530	188,451	11,655	125,248	6,236	24,944
05-Jun	41.45	56 [c]	19,008	19,064	207,515	13,945	139,193	5,151	20,604
06-Jun	41.55	137	13,993	14,130	221,645	11,875	151,068	3,617	14,468
07-Jun	41.54	196	18,405	18,601	240,246	11,625	162,693	4,736	18,944
08-Jun	41.96	173	13,546	13,719	253,965	13,414	176,107	4,934	19,736
09-Jun	42.50	270	7,055	7,325	261,290	12,831	188,938	2,249	8,996
10-Jun	42.86	360	10,134	10,494	271,784	12,734	201,672	1,979	7,916
11-Jun	42.63	484	17,987	18,471	290,255	12,584	214,256	3,954	15,816
12-Jun	42.25	1,043	16,638	17,681	307,936	11,986	226,242	3,659	14,636
13-Jun	41.89	629	21,089	21,718	329,654	10,275	236,517	2,384	9,536
14-Jun	41.71	437	27,844	28,281	357,935	9,757	246,274	7,196	28,784
15-Jun	41.65	382	20,487	20,869	378,804	11,823	258,097	7,012	28,048
16-Jun	41.72	258	17,003	17,261	396,065	9,986	268,083	3,717	14,868
17-Jun	41.82	542	20,219	20,761	416,826	9,874	277,957	4,793	19,172
18-Jun	41.96	418	18,117	18,535	435,361	8,352	286,309	4,511	18,044
19-Jun	42.08	379	11,239	11,618	446,979	7,695	294,004	2,955	11,820
20-Jun	42.24	403	11,097	11,500	458,479	7,213	301,217	2,646	10,584
21-Jun	42.21	394	11,882	12,276	470,755	7,276	308,493	2,402	9,608
22-Jun	42.25	277	10,511	10,788	481,543	7,362	315,855	3,149	12,596
23-Jun	42.27	292	10,615	10,907	492,450	7,974	323,829	1,806	7,224
24-Jun	42.19	570	12,951	13,521	505,971	7,273	331,102	2,193	8,772
25-Jun	42.12	383	12,618	13,001	518,972	7,896	338,998	2,523	10,092
26-Jun	42.25	249	10,968	11,217	530,189	6,908	345,906	3,056	12,224
27-Jun	42.37	294	10,428	10,722	540,911	6,857	352,763	2,048	8,192
28-Jun	42.38	209	12,613	12,822	553,733	6,574	359,337	2,418	9,672
29-Jun	42.40	414	15,437	15,851	569,584	7,196	366,533	3,646	14,584
30-Jun	42.46	246	14,435	14,681	584,265	7,863	374,396	3,847	15,388

-Continued-

Table 5. (page 2 of 2)

Date	Water Level [a]	North Bank	Estimate South Bank	Daily	Cumulative	Escapement Objective Daily	Escapement Objective Cumulative	0600 Count	Projected Daily
01-Jul	42.65	272	13,374	13,646	597,911	6,585	380,981	3,189	12,756
02-Jul	42.90	259	11,173	11,432	609,343	6,812	387,793	4,203	16,812
03-Jul	43.16	110	10,926	11,036	620,379	7,804	395,597	2,347	9,388
04-Jul	43.36	291	8,258	8,549	628,928	8,115	403,712	2,410	9,640
05-Jul	43.44	385	9,240	9,625	638,553	7,700	411,412	1,611	6,444
06-Jul	43.48	861	7,896	8,757	647,310	7,081	418,493	1,226	4,904
07-Jul	43.47	504	9,514	10,018	657,328	7,630	426,123	2,808	11,232
08-Jul	43.31	664	8,686	9,350	666,678	8,474	434,597	1,970	7,880
09-Jul	42.87	201	11,106	11,307	677,985	8,073	442,670	2,735	10,940
10-Jul	42.53	296	13,266	13,562	691,547	9,384	452,054	3,152	12,608
11-Jul	42.43	539	17,243	17,782	709,329	8,639	460,693	3,967	15,868
12-Jul	42.63	604	17,057	17,661	726,990	8,240	468,933	3,860	15,440
13-Jul	42.62	460	15,619	16,079	743,069	7,828	476,761	4,237	16,948
14-Jul	42.58	295	7,968	8,263	751,332	8,695	485,456	2,120	8,480
15-Jul	42.65	418	10,464	10,882	762,214	8,058	493,514	2,024	8,096
16-Jul	42.60	439	8,745	9,184	771,398	7,947	501,461	2,201	8,804
17-Jul	42.66	395	6,983	7,378	778,776	7,322	508,783	1,428	5,712
18-Jul	42.61	335	6,248	6,583	785,359	7,263	516,046	1,471	5,884
19-Jul	42.51	472	5,711	6,183	791,542	7,596	523,642	1,338	5,352
20-Jul	41.78	727	6,207	6,934	798,476	7,902	531,544	1,495	5,980
21-Jul	42.33	587	7,203	7,790	806,266	7,204	538,748	1,661	6,644
22-Jul	42.44	466	6,881	7,347	813,613	6,057	544,805	2,622	10,488
23-Jul	42.42	270	5,683	5,953	819,566	5,779	550,584	1,691	6,764
24-Jul	42.33	203	4,565	4,768	824,334	5,212	555,796	976	3,904
25-Jul	42.17	352	5,014	5,366	829,700	4,781	560,577	1,195	4,780
26-Jul	42.28	374	3,432	3,806	833,506	4,843	565,420	1,168	4,672
27-Jul	42.36	661	2,851	3,512	837,018	4,391	569,811	758	3,032
28-Jul	42.31	569	3,861	4,430	841,448	4,706	574,517	954	3,816
29-Jul	42.18	234	3,609	3,843	845,291	4,837	579,354	743	2,972
30-Jul	42.18	296	4,903	5,199	850,490	4,650	584,004	1,337	5,348
31-Jul	42.15	97	4,713	4,810	855,300	4,041	588,045	1,058	4,232
01-Aug	42.28	164	3,025	3,189	858,489	3,620	591,665	804	3,216
02-Aug	42.35	91	3,399	3,490	861,979	3,093	594,758	707	2,828
03-Aug	42.38	81	2,893	2,974	864,953	2,574	597,332	942	3,768
04-Aug	42.16		2,004	2,004	866,957	2,476	599,808	191	764

[a] Meters above sea level.

[b] South bank transducer was deployed on the tripod

[c] North bank tripod was deployed

[d] South bank transducer was deployed on the permanent substrate at midnight.

Table 6. The number of minutes each hour the oscilloscope was monitored on the south bank tripod , Miles Lake sonar, 1998.

HOUR	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May
0000-0100	0	0	0	0	30	30	30	30	30	30	30	22	30	30
0100-0200	0	0	0	0	30	30	30	30	30	30	30	30	30	30
0200-0300	0	0	0	0	30	30	30	30	30	30	30	0	30	30
0300-0400	0	0	0	0	30	30	30	30	30	30	30	0	30	30
0400-0500	0	0	0	0	30	30	30	30	30	30	30	15	30	30
0500-0600	0	0	30	30	30	30	30	30	30	30	30	0	30	30
0600-0700	0	0	30	30	30	30	30	30	30	30	30	0	30	30
0700-0800	0	0	30	30	30	30	30	30	30	30	30	30	30	30
0800-0900	6	15	30	30	30	30	30	30	30	30	30	30	30	30
0900-1000	30	30	30	20	20	20	20	20	20	20	20	20	20	20
1000-1100	15	30	30	30	30	30	30	30	30	30	30	30	30	30
1100-1200	30	30	30	30	30	30	30	30	30	30	30	30	30	30
1200-1300	0	30	30	30	30	30	30	30	30	30	30	30	30	30
1300-1400	30	30	30	30	30	30	30	30	30	30	30	30	30	30
1400-1500	30	30	30	30	30	30	30	30	30	30	30	30	30	30
1500-1600	30	30	30	30	30	30	30	30	30	30	30	30	30	30
1600-1700	0	30	20	20	30	30	30	30	30	30	30	30	30	30
1700-1800	0	15	30	30	30	30	30	30	30	30	30	30	30	30
1800-1900	0	0	30	30	30	30	30	30	30	30	30	30	30	30
1900-2000	0	0	30	30	30	30	30	30	30	30	30	30	30	30
2000-2100	0	0	30	30	30	30	30	30	30	30	30	30	30	30
2100-2200	0	0	30	30	30	30	30	30	30	30	30	30	30	30
2200-2300	0	0	30	30	30	30	30	30	30	30	30	30	30	30
2300-2400	0	0	0	30	30	30	30	30	30	30	30	30	30	30
TOTAL	171	270	530	550	710	710	710	710	710	710	710	567	710	710

Table 7. The number of fish observed passing the south bank tripod during visual monitoring of the oscilloscope, Miles Lake sonar, 1998.

HOUR	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May
0000-0100					59	23	32	92	105	226	207	133	348	411
0100-0200					54	18	24	57	131	199	139	270	225	525
0200-0300					23	33	21	123	75	218	105		191	399
0300-0400					32	30	39	94	54	221	144		268	516
0400-0500					16	27	27	151	65	186	99	68	207	400
0500-0600			4	23	17	23	30	117	131	193	178		216	534
0600-0700			2	18	20	17	26	136	73	170	265		199	459
0700-0800			3	32	8	6	48	78	78	210	165	242	255	465
0800-0900	1	3	2	1	25	17	55	144	55	90	165	160	309	493
0900-1000	0	5	0	5	23	13	46	89	40	151	163	96	256	248
1000-1100	0	9	6	28	9	14	49	125	56	168	257	242	402	512
1100-1200	3	4	2	39	16	24	45	140	96	189	190	263	391	478
1200-1300		6	8	46	13	21	38	167	148	156	187	321	391	610
1300-1400	6	1	3	47	11	13	92	158	128	286	235	186	424	541
1400-1500	5	2	4	5	9	33	115	169	116	162	261	180	545	506
1500-1600	4	9	13	70	16	28	111	88	174	86	304	189	610	499
1600-1700		5	2	18	25	25	122	140	162	202	241	393	548	535
1700-1800		3	3	35	23	27	123	164	128	185	312	269	602	401
1800-1900			2	63	46	42	111	149	136	198	325	279	384	413
1900-2000			5	28	35	50	107	130	164	160	223	395	585	492
2000-2100			1	30	51	57	134	85	209	177	194	234	605	522
2100-2200			0	26	41	60	99	96	191	198	285	199	397	382
2200-2300			4	28	31	32	144	109	142	207	203	240	373	494
2300-2400				31	24	24	130	80	127	192	209	154	362	550
TOTAL	19	47	64	573	627	657	1,768	2,881	2,784	4,430	5,056	4,513	9,093	11,385

Table 8. Expanded hourly and daily counts from the south bank tripod , Miles Lake sonar, 1998.

HOUR	18-May	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May
0000-0100					118	46	64	184	210	452	414	363	696	822
0100-0200					108	36	48	114	262	398	278	540	450	1,050
0200-0300					46	66	42	246	150	436	210		382	798
0300-0400					64	60	78	188	108	442	288		536	1,032
0400-0500					32	54	54	302	130	372	198	272	414	800
0500-0600			8	46	34	46	60	234	262	386	356		432	1,068
0600-0700			4	36	40	34	52	272	146	340	530		398	918
0700-0800			6	64	16	12	96	156	156	420	330	484	510	930
0800-0900	10	12	4	2	50	34	110	288	110	180	330	320	618	986
0900-1000	0	10	0	15	69	39	138	267	120	453	489	288	768	744
1000-1100	0	18	12	56	18	28	98	250	112	336	514	484	804	1,024
1100-1200	6	8	4	78	32	48	90	280	192	378	380	526	782	956
1200-1300		12	16	92	26	42	76	334	296	312	374	642	782	1,220
1300-1400	12	2	6	94	22	26	184	316	256	572	470	372	848	1,082
1400-1500	10	4	8	10	18	66	230	338	232	324	522	360	1,090	1,012
1500-1600	8	18	26	140	32	56	222	176	348	172	608	378	1,220	998
1600-1700		10	6	54	50	50	244	280	324	404	482	786	1,096	1,070
1700-1800		12	6	70	46	54	246	328	256	370	624	538	1,204	802
1800-1900			4	126	92	84	222	298	272	396	650	558	768	826
1900-2000			10	56	70	100	214	260	328	320	446	790	1,170	984
2000-2100			2	60	102	114	268	170	418	354	388	468	1,210	1,044
2100-2200			0	52	82	120	198	192	382	396	570	398	794	764
2200-2300			8	56	62	64	288	218	284	414	406	480	746	988
2300-2400				62	48	48	260	160	254	384	418	308	724	1,100
Total	46	106	130	1,169	1,277	1,327	3,582	5,851	5,608	9,011	10,275	9,355	18,442	23,018
Daily	158	254	173	1,477	1,277	1,327	3,582	5,851	5,608	9,011	10,275	11,226	18,442	23,018

FIGURES

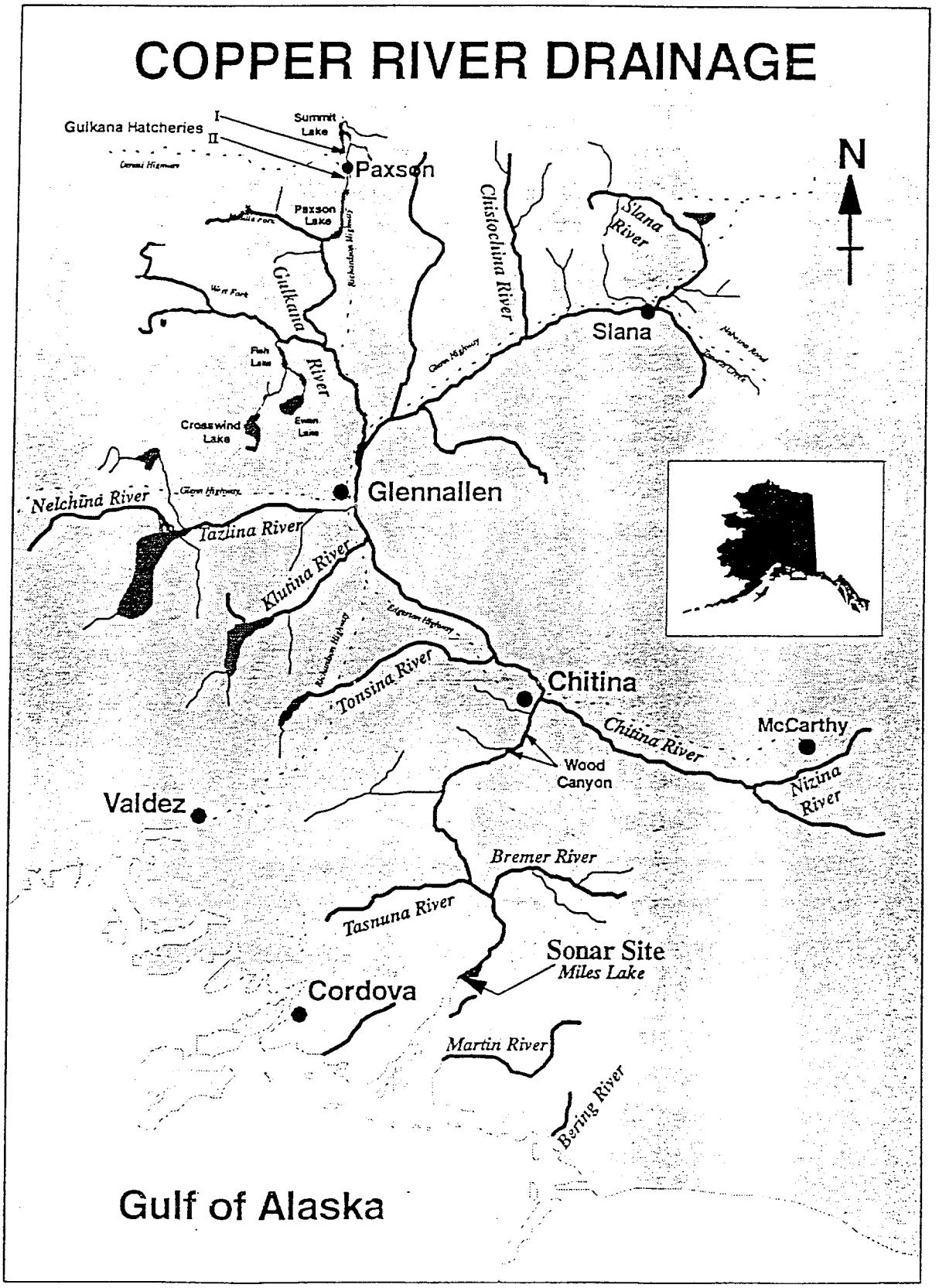


Figure 1.-The Copper River and Copper River delta area.

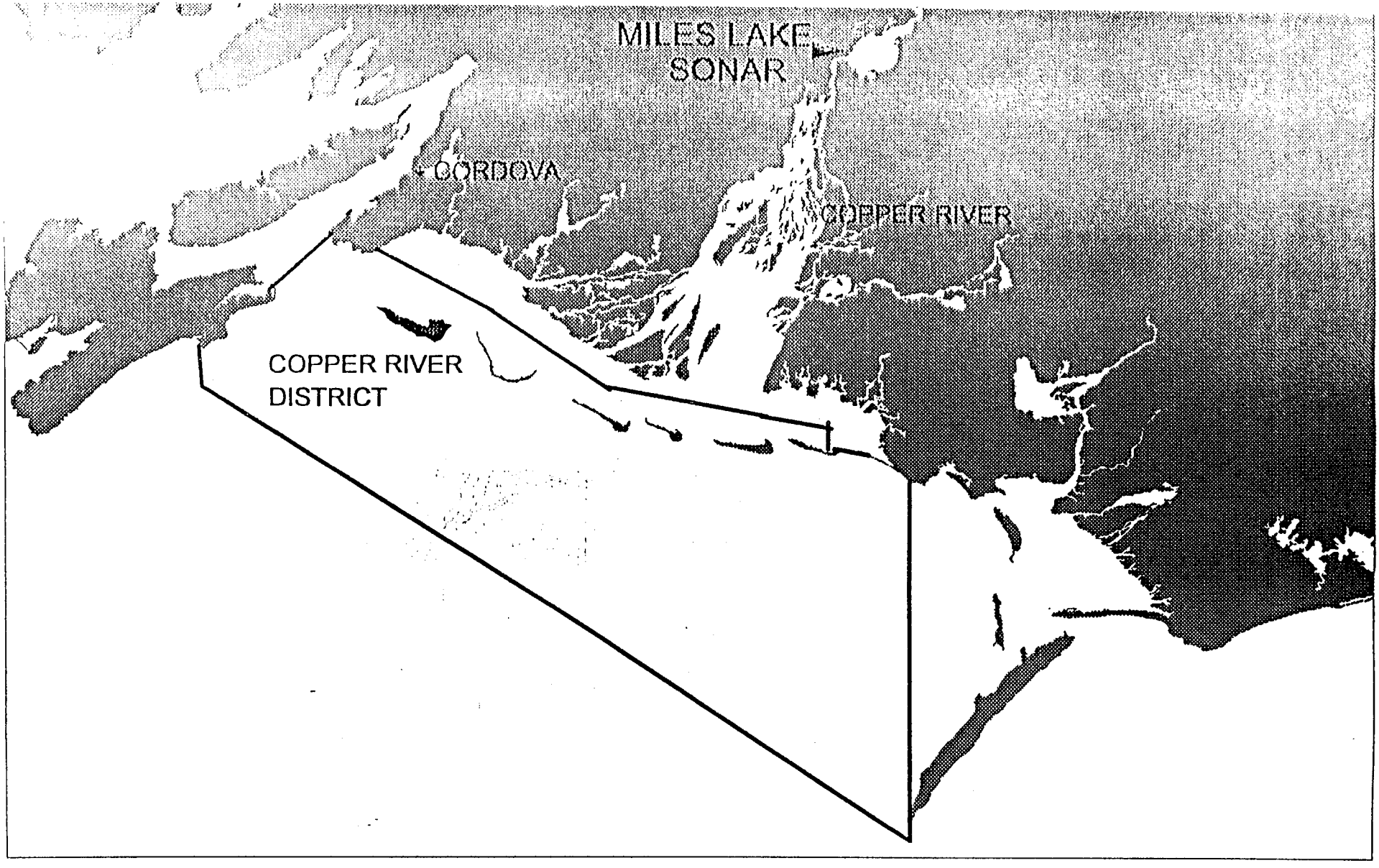


Figure 2. Commercial fishing area in relation to Miles Lake sonar,Copper River,

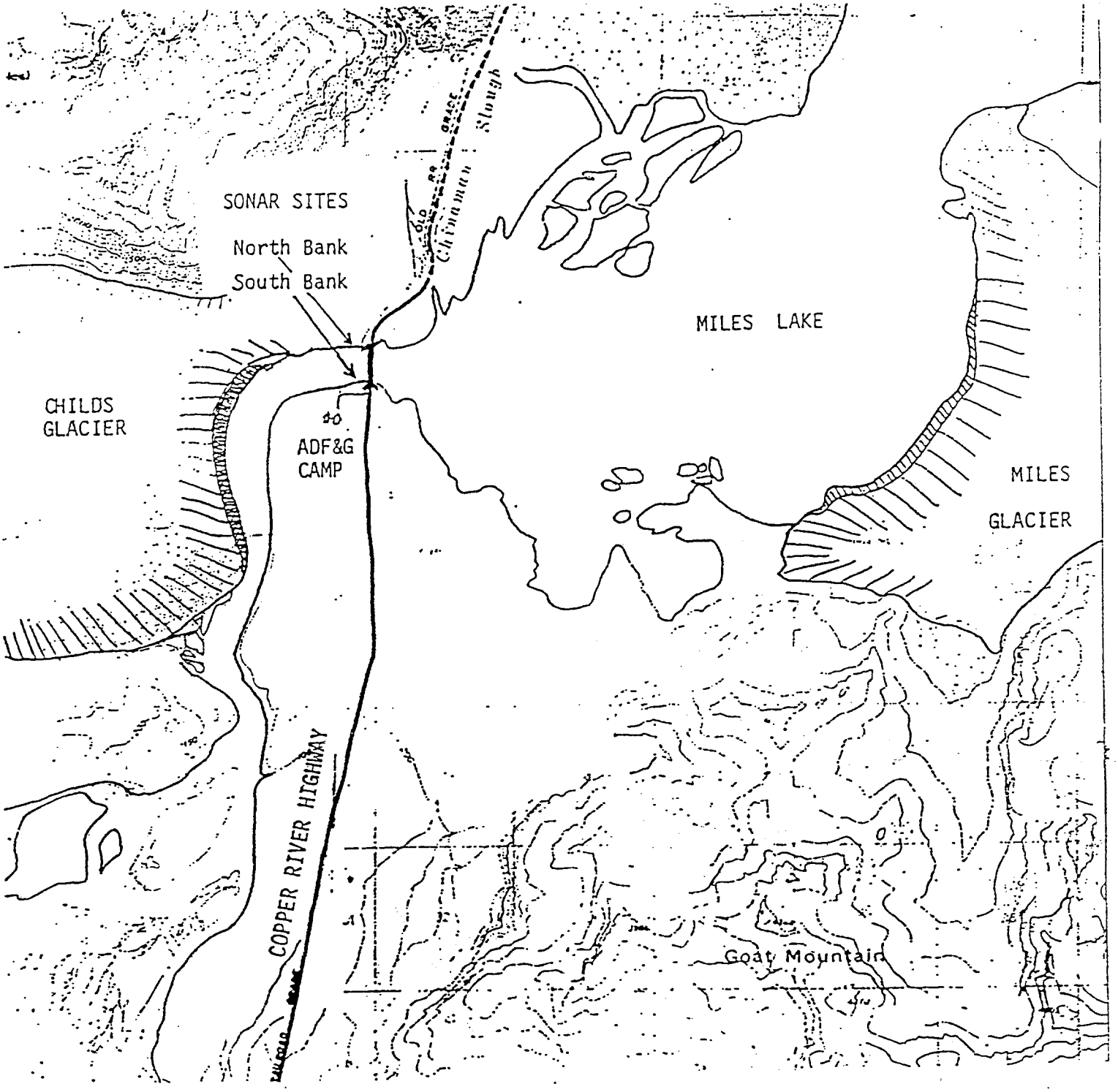


Figure3. North and south bank sonar sites,Miles Lake area,Copper River.

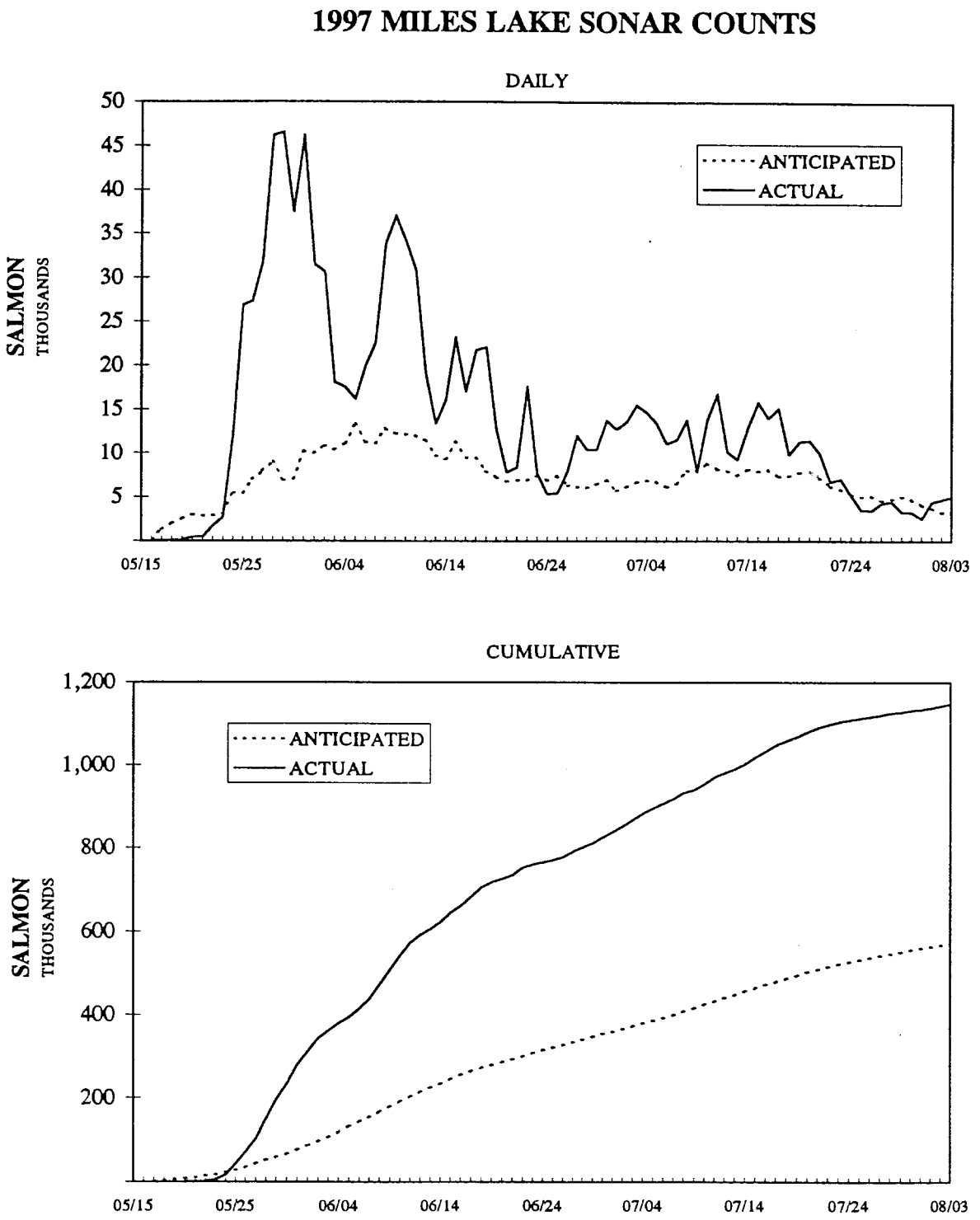


Figure 4. Anticipated versus actual daily and cumulative salmon escapement, Miles Lake sonar, 1997.

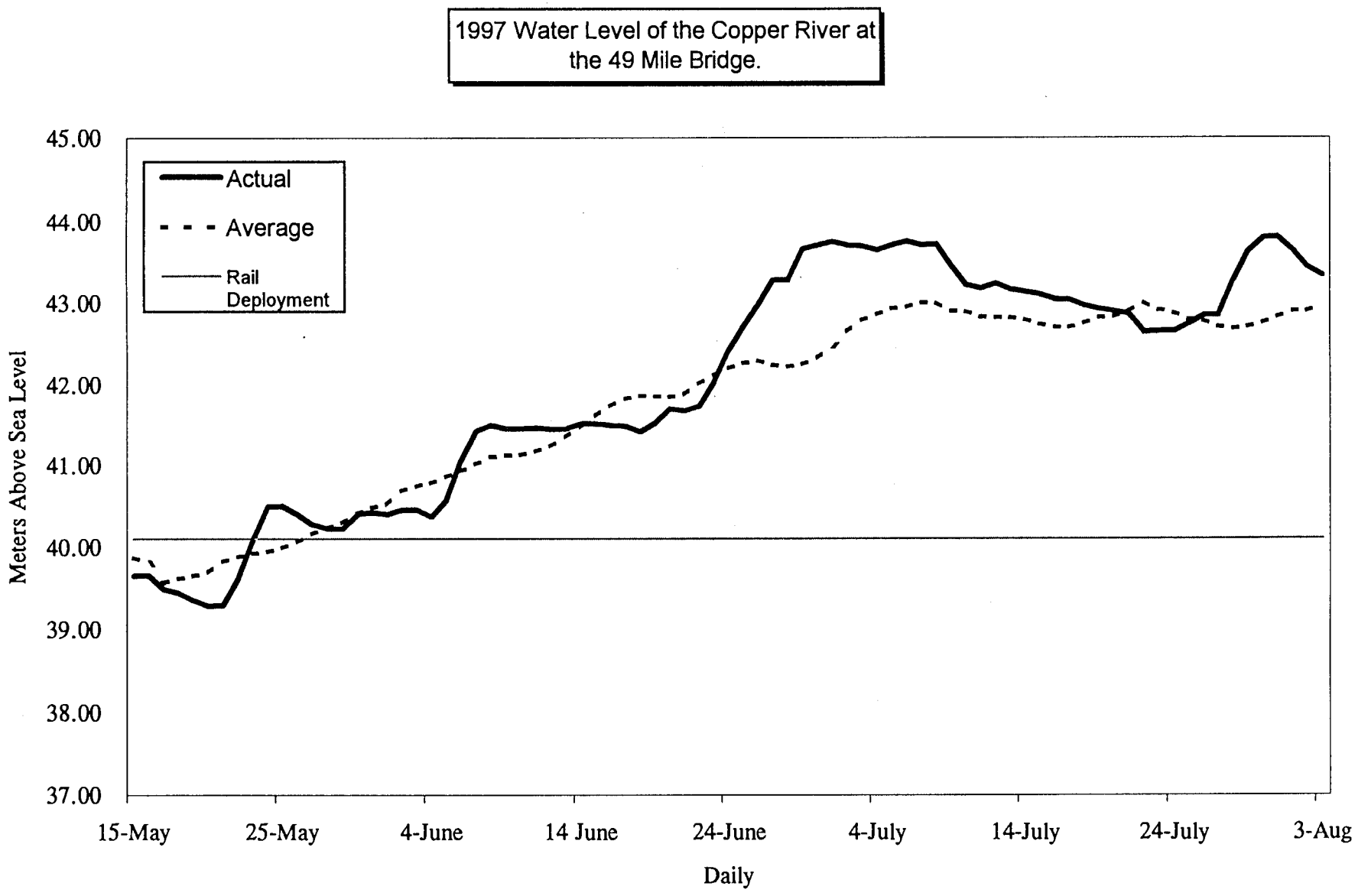
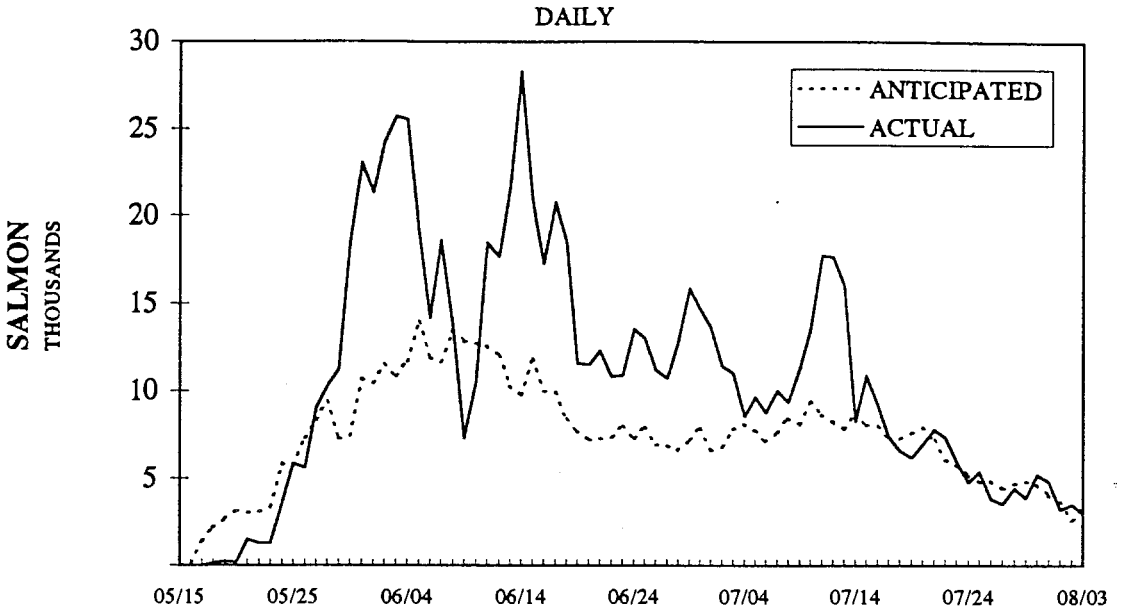


Figure 5. The 1997 daily water levels versus the average 1982 -1996, Copper River, Alaska.

1998 MILES LAKE SONAR COUNTS



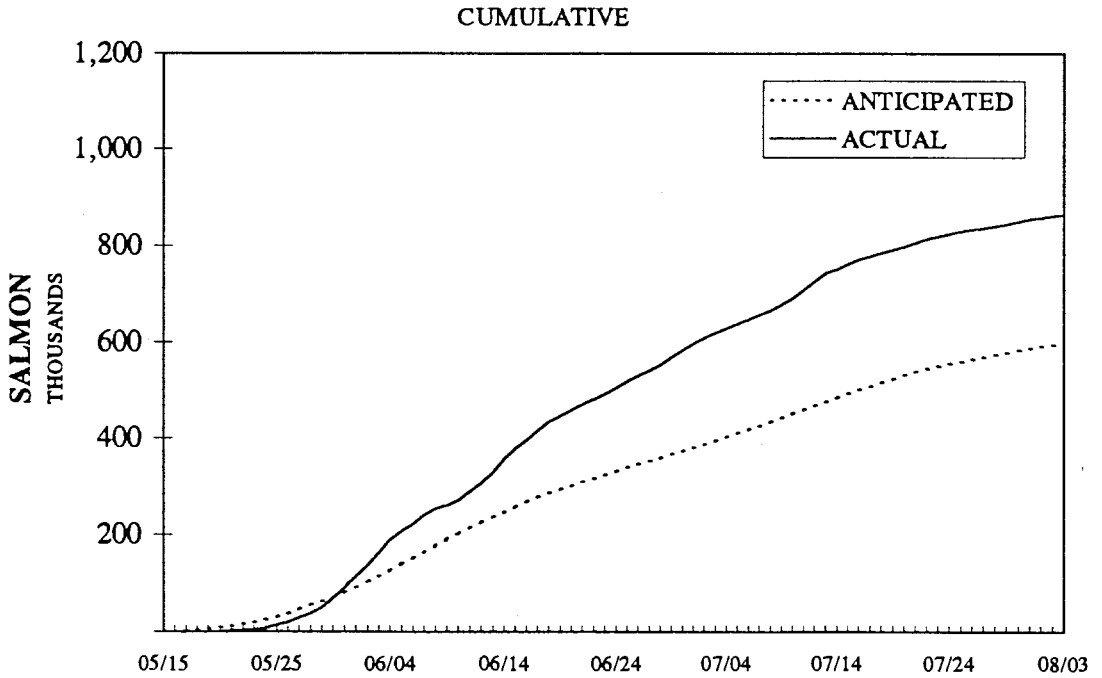


Figure 6. Anticipated versus actual daily and cumulative salmon escapement, Miles Lake sonar, 1998.

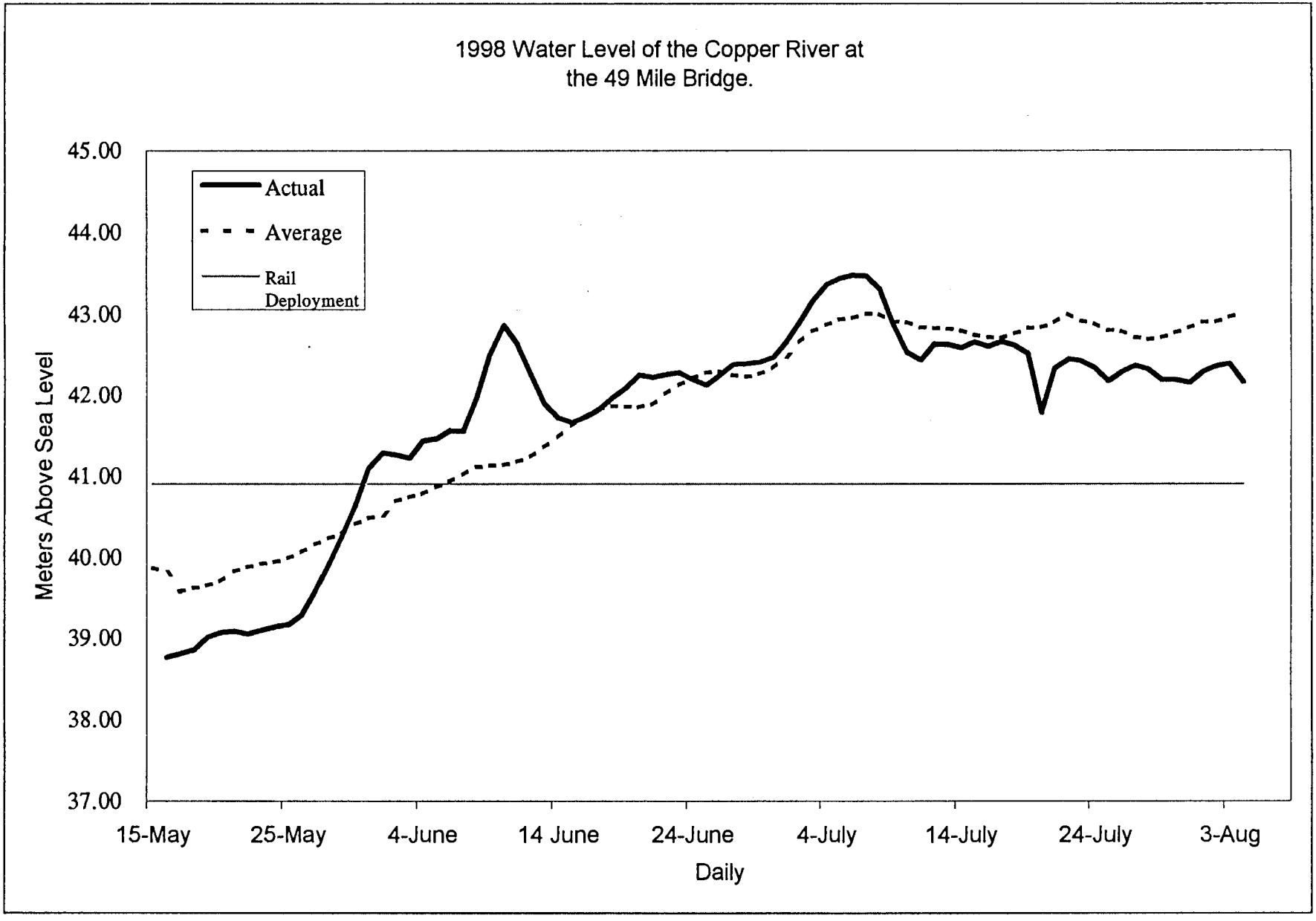


Figure 7. The 1998 daily water levels versus the average 1982 -1996, Copper River, Alaska.

APPENDICES

Appendix 1. Daily salmon escapement estimates, Miles Lake sonar, Copper River, 1978-1998.

Date	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
15-May											
16-May											
17-May				5,372							
18-May		381	218	9,665							
19-May		487	167	11,409			725				313
20-May		847	221	10,733			1,924			167	877
21-May		1,199	88	9,729			1,986			36	1,140
22-May		1,916	391	7,558			5,124			482	2,256
23-May		2,901	594	6,214		3,310	5,042			1,732	5,078
24-May		3,402	494	12,985	90	8,620	4,486			2,040	11,033
25-May		2,397	713	12,816	493	11,587	3,120		534	4,263	9,979
26-May	502	4,927	1,057	6,383	1,023	10,575	4,645		1,694	7,115	8,946
27-May	837	6,821	2,115	2,842	12,091	8,661	5,836		2,092	12,176	13,247
28-May	1,047	2,768	1,693	2,560	47,303	8,456	4,978	1,031	3,384	16,392	14,201
29-May	661	3,905	1,080	2,160	19,671	6,380	7,126	417	2,393	14,485	10,022
30-May	3,241	7,482	1,903	11,822	8,781	8,296	4,951	599	3,173	18,196	6,806
31-May	2,549	8,655	3,620	21,126	11,389	17,123	4,278	1,758	4,150	18,540	7,586
01-Jun	2,616	4,078	5,257	18,415	15,385	18,428	8,536	3,462	7,001	16,395	5,205
02-Jun	2,811	3,465	7,061	23,771	17,213	14,414	8,483	6,726	20,638	14,385	3,558
03-Jun	1,837	3,536	7,437	16,716	13,383	13,137	9,730	10,691	20,237	17,666	4,626
04-Jun	3,256	2,778	8,996	9,755	12,355	15,357	12,496	24,272	26,626	14,632	7,877
05-Jun	2,970	4,352	9,746	10,478	14,806	19,110	16,728	30,507	27,934	10,962	6,755
06-Jun	3,318	6,453	5,407	11,975	15,585	14,069	18,097	32,953	14,527	4,322	8,895
07-Jun	3,808	7,031	2,093	13,585	12,506	19,309	18,515	27,256	9,658	5,755	9,096
08-Jun	3,275	11,078	1,349	14,412	8,430	16,094	26,619	30,925	24,938	6,366	11,322
09-Jun	2,252	7,985	3,543	15,694	7,017	11,415	20,476	29,702	28,242	7,922	14,641
10-Jun	3,475	5,205	7,301	12,856	7,599	8,009	19,275	12,010	29,952	11,553	15,216
11-Jun	2,490	4,426	12,032	7,877	7,879	9,563	17,237	11,826	25,418	11,194	16,255
12-Jun	2,082	2,227	11,584	4,844	8,587	13,292	21,706	8,231	16,494	6,506	14,959
13-Jun	2,419	3,903	7,600	3,556	9,932	13,444	12,072	6,829	11,453	4,053	10,751
14-Jun	2,835	2,563	5,661	5,228	12,551	13,831	5,981	6,800	11,393	8,053	9,382
15-Jun	2,913	3,351	7,308	7,071	12,677	15,915	10,291	8,825	8,747	5,485	9,910
16-Jun	2,782	3,473	5,655	6,885	13,595	7,938	13,930	9,347	10,099	5,516	6,484
17-Jun	2,779	4,640	7,189	6,467	12,030	5,671	19,809	6,270	8,772	5,406	4,910
18-Jun	2,261	3,911	6,741	4,565	6,544	5,689	12,850	3,738	9,050	4,815	6,469
19-Jun	3,035	3,413	2,391	2,985	4,369	6,461	7,474	3,251	7,910	3,983	7,855
20-Jun	3,035	1,954	3,597	2,891	3,352	7,382	9,258	2,423	7,240	3,933	7,952
21-Jun	2,515	2,223	4,142	3,446	3,346	8,124	7,159	2,061	6,741	3,924	5,770
22-Jun	2,068	2,585	3,954	3,997	4,467	8,005	5,522	2,763	9,026	6,379	6,985
23-Jun	2,841	2,865	3,896	4,363	7,031	7,528	5,913	3,369	8,010	10,111	7,699
24-Jun	2,616	1,877	5,217	4,651	6,329	6,009	6,741	2,950	6,968	15,708	5,582
25-Jun	2,130	3,013	5,104	3,398	4,903	5,226	6,503	1,585	5,731	16,517	5,597
26-Jun	1,771	1,973	3,595	2,412	4,416	5,638	4,385	2,381	5,410	12,500	6,378
27-Jun	2,178	1,315	3,421	2,507	2,732	4,738	7,224	3,035	5,153	7,010	6,559
28-Jun	1,103	1,697	4,324	2,949	2,174	4,771	6,728	2,264	5,022	5,644	6,259
29-Jun	1,604	1,450	3,845	3,421	2,130	4,304	4,453	2,147	3,578	6,836	8,220
30-Jun	1,632	1,899	3,465	2,378	2,313	6,146	6,449	2,139	3,771	4,636	6,497

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Date	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
01-Jul	1,587	2,651	3,559	2,723	2,190	6,106	8,226	2,620	3,584	2,012	5,602
02-Jul	2,533	2,524	3,365	2,606	4,420	6,113	7,554	2,608	3,152	3,406	4,680
03-Jul	2,527	2,859	4,104	2,548	5,751	6,026	8,581	1,819	2,311	4,096	4,222
04-Jul	2,980	3,806	2,934	4,094	5,245	6,943	6,515	3,536	1,805	7,100	3,532
05-Jul	2,269	3,008	2,879	4,256	4,995	5,347	6,662	3,254	1,499	4,351	3,304
06-Jul	1,623	1,996	3,025	3,476	6,300	3,973	5,449	4,664	2,809	3,393	3,510
07-Jul	1,152	892	3,291	3,863	6,171	4,209	4,040	3,627	2,991	5,617	4,324
08-Jul	831	2,091	2,995	3,774	3,990	4,080	3,906	3,893	2,860	6,616	8,499
09-Jul	947	3,190	2,817	3,449	2,210	3,353	3,210	6,827	3,077	6,352	5,167
10-Jul	1,252	4,209	3,642	2,942	2,070	3,644	2,927	10,607	5,435	8,585	6,347
11-Jul	841	3,684	5,763	2,271	1,980	4,454	3,608	5,457	5,115	5,322	7,620
12-Jul	341	3,262	4,788	3,468	3,420	4,541	4,280	6,329	5,042	5,757	7,881
13-Jul	167	3,144	1,725	2,265	4,032	4,543	4,582	5,252	3,696	6,583	7,087
14-Jul	290	4,124	1,679	2,596	4,339	5,819	6,573	6,113	3,530	6,439	7,012
15-Jul	275	3,535	1,743	3,691	4,714	6,496	5,521	5,024	4,699	5,722	6,924
16-Jul	538	5,175	2,515	2,580	3,561	6,970	6,755	5,339	2,227	6,259	5,457
17-Jul	304	3,555	3,419	780	2,925	6,327	4,955	5,960	4,108	4,467	4,877
18-Jul	284	3,760	5,878	8,633	3,413	4,326	4,736	5,110	4,993	4,620	3,857
19-Jul	321	3,344	5,613	20,975	4,296	3,703	3,140	4,560	6,066	4,127	4,583
20-Jul	238	2,716	5,060	20,511	3,920	3,988	3,389	8,176	5,997	3,634	4,483
21-Jul	81	2,583	3,826	15,741	4,049	4,463	3,204	4,128	4,746	2,441	3,964
22-Jul	18	2,012	3,173	6,566	3,871	4,881	3,780	3,158	3,408	1,273	2,797
23-Jul	15	1,915	2,143	5,787	3,099	3,603	3,205	2,870	2,909	1,002	3,429
24-Jul	40	2,182	1,353	5,063	3,061	3,903	2,198	2,162	2,633	625	3,900
25-Jul	13	1,112	1,623	3,391	3,374	4,535	1,937	2,449	2,292	2,014	4,023
26-Jul		771	1,256	2,493	2,596	3,839	1,687	1,974	1,799	368	4,142
27-Jul		318	1,198	2,451	2,247	3,687	1,391	2,191	1,626	626	3,920
28-Jul		387	698	2,785	2,375	5,234	1,004	2,839	1,797	2,494	3,452
29-Jul		365	400	3,686	1,426	4,138	891	2,813	1,563	2,341	3,476
30-Jul		491	470	3,814	963	3,512	938	2,790	1,489	2,075	2,423
31-Jul		703	353	3,802	1,176	1,835	1,093	1,848	1,259	2,226	1,920
01-Aug		758	825	3,396	511	1,912	1,047	1,070	1,172	2,726	1,438
02-Aug		379	1,034	2,304	942	2,211	1,088	703	1,045	1,299	1,098
03-Aug		227	764	1,913	494	2,088	1,213		770	1,702	
04-Aug		286	708	1,297	581	2,897	1,118		814	1,499	
05-Aug		173	758	1,181	122		1,009		435	518	
06-Aug		103	877	1,170			533		416		
07-Aug		76	615						192		
08-Aug			166						33		
09-Aug			239						47		
Total	107,011	237,173	276,538	535,263	467,306	545,724	536,806	436,313	508,600	483,478	488,098

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Date	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average
15-May							491				
16-May							468		64		
17-May	732					448	532		88		1,195
18-May	3,660					686	522	84	136	158	1,723
19-May	6,588					952	1,331	72	168	254	2,042
20-May	6,935				9,503	955	3,028	130	486	173	2,768
21-May	4,834	1,121	1,087		13,677	1,610	3,504	338	464	1,477	2,819
22-May	4,030	4,843	1,717		22,706	2,422	2,808	1,023	1,742	1,277	4,020
23-May	6,472	7,177	3,161		28,425	3,558	4,301	1,766	2,744	1,327	5,238
24-May	7,448	11,923	2,465		31,980	2,897	2,473	1,330	12,196	3,582	7,026
25-May	4,658	14,333	3,046		38,581	4,083	1,841	1,363	26,923	5,851	8,143
26-May	8,318	11,337	3,274		23,647	3,282	3,032	2,192	27,389	5,608	7,102
27-May	13,143	12,060	3,893	1,226	12,885	2,855	3,806	4,790	31,978	9,011	8,118
28-May	13,880	7,434	3,389	1,431	17,476	3,047	7,168	12,856	46,182	10,275	10,807
29-May	10,677	9,176	3,933	2,362	13,156	2,888	9,878	12,008	46,539	11,226	9,054
30-May	5,375	9,541	4,417	5,736	8,478	1,966	12,779	10,861	37,554	18,442	9,067
31-May	7,316	10,343	9,362	7,931	16,686	4,616	10,755	19,994	46,197	23,018	12,238
01-Jun	7,041	10,026	16,833	6,610	16,473	9,423	8,980	25,530	31,557	21,312	12,313
02-Jun	5,234	9,909	21,151	7,919	22,831	7,767	9,428	25,977	30,744	24,206	13,700
03-Jun	6,867	8,576	17,808	11,535	14,591	3,137	5,647	27,265	18,078	25,724	12,296
04-Jun	8,555	7,572	14,557	7,921	17,585	6,143	6,745	22,231	17,562	25,530	12,991
05-Jun	7,512	10,173	18,673	9,295	25,779	5,265	5,895	18,009	16,188	19,064	13,819
06-Jun	7,719	10,410	11,688	14,552	25,643	12,100	9,236	11,310	19,985	14,130	12,970
07-Jun	12,693	11,137	8,440	16,734	18,068	16,732	8,044	16,743	22,612	18,601	13,258
08-Jun	14,565	7,637	9,471	17,729	20,762	18,022	5,738	26,585	33,969	13,719	15,381
09-Jun	9,440	9,905	11,665	20,719	24,997	18,042	5,479	35,684	37,078	7,325	15,677
10-Jun	12,126	11,660	8,565	23,430	19,794	17,588	8,054	31,792	34,180	10,494	14,768
11-Jun	9,663	16,181	8,104	18,591	11,119	12,272	11,950	29,085	30,941	18,471	13,932
12-Jun	8,256	23,929	12,688	14,096	18,322	13,008	7,274	35,637	19,119	17,681	13,358
13-Jun	10,626	24,448	9,066	18,257	12,872	9,081	8,945	27,036	13,364	21,718	11,496
14-Jun	13,548	14,302	9,236	20,456	8,357	15,639	14,021	14,958	16,080	28,281	11,388
15-Jun	9,922	8,390	14,967	23,957	13,351	11,679	11,853	15,548	23,220	20,869	11,726
16-Jun	8,889	10,112	14,367	13,914	14,247	14,227	19,732	13,809	16,989	17,261	10,917
17-Jun	10,020	12,695	10,129	14,509	7,621	11,445	19,918	10,298	21,801	20,761	10,626
18-Jun	11,131	8,052	11,051	14,893	4,921	17,223	17,938	7,359	22,092	18,535	9,516
19-Jun	8,345	9,763	12,921	12,324	6,324	19,392	16,025	15,303	12,711	11,618	8,469
20-Jun	7,575	9,315	14,146	19,480	4,900	11,498	16,863	12,071	7,844	11,500	8,010
21-Jun	7,169	10,292	8,750	16,882	3,536	11,699	15,430	7,570	8,389	12,276	7,212
22-Jun	8,868	10,157	7,830	9,452	2,864	13,305	9,862	10,851	17,553	10,788	7,490
23-Jun	5,850	10,166	6,358	7,234	5,069	18,686	5,320	15,544	7,705	10,907	7,451
24-Jun	3,927	9,340	5,963	6,319	6,071	24,282	7,357	10,226	5,310	13,521	7,474
25-Jun	2,996	10,010	7,660	6,675	4,321	14,140	9,211	7,963	5,460	13,001	6,721
26-Jun	3,426	6,812	9,500	7,180	2,718	12,204	9,989	8,668	7,985	11,217	6,217
27-Jun	3,240	9,234	10,355	6,266	3,370	14,146	16,025	10,255	12,011	10,722	6,738
28-Jun	6,302	6,881	10,810	8,084	4,361	9,213	13,673	9,195	10,427	12,822	6,414
29-Jun	6,490	4,499	10,439	9,258	4,976	15,859	9,723	12,621	10,409	15,851	6,767
30-Jun	7,354	3,975	9,113	7,416	8,384	10,845	4,402	13,091	13,741	14,681	6,397

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Appendix 1. (page 4 of 4)

Date	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average
01-Jul	7,930	4,323	7,303	7,120	7,639	10,359	5,730	15,487	12,724	13,646	6,339
02-Jul	5,296	5,067	5,109	5,591	5,720	9,802	5,218	13,066	13,566	11,432	5,849
03-Jul	4,976	4,682	6,335	4,641	5,145	9,965	4,851	12,949	15,430	11,036	5,945
04-Jul	7,369	5,665	6,680	5,413	5,527	8,782	4,291	12,956	14,618	8,549	6,111
05-Jul	10,739	7,998	5,845	4,424	6,339	6,196	7,787	8,829	13,448	9,625	5,860
06-Jul	10,024	7,749	6,213	6,987	6,431	9,544	8,172	8,818	11,024	8,757	5,902
07-Jul	10,236	5,700	6,222	7,361	9,229	9,921	6,620	9,007	11,534	10,018	6,001
08-Jul	11,113	5,192	7,069	5,758	10,386	7,947	4,272	8,424	13,736	9,350	6,037
09-Jul	10,761	5,153	6,453	11,937	11,105	9,391	6,845	7,802	7,877	11,307	6,154
10-Jul	9,506	6,620	4,610	9,139	9,566	14,539	14,846	9,792	13,757	13,562	7,505
11-Jul	8,453	5,402	4,477	8,380	7,364	13,656	9,368	10,608	16,698	17,782	7,062
12-Jul	11,953	9,338	4,818	7,959	6,819	16,223	6,467	11,805	10,159	17,661	7,253
13-Jul	9,329	11,432	3,969	6,741	5,615	13,924	5,978	10,829	9,249	16,079	6,487
14-Jul	10,270	8,206	7,498	8,574	7,673	13,333	9,602	9,959	12,908	8,263	6,895
15-Jul	12,283	8,309	7,550	8,971	6,112	10,161	11,587	9,465	15,751	10,882	7,115
16-Jul	10,897	6,093	9,671	7,683	6,880	7,955	5,935	11,311	13,956	9,184	6,521
17-Jul	8,903	6,259	9,668	6,718	5,175	7,642	10,858	11,586	15,111	7,378	6,237
18-Jul	11,811	5,726	7,340	8,807	5,398	7,063	10,642	7,234	9,864	6,583	6,194
19-Jul	10,567	5,975	7,513	8,615	6,782	4,675	8,164	6,373	11,268	6,183	6,516
20-Jul	10,169	4,315	10,681	7,102	7,417	3,922	7,003	5,609	11,374	6,934	6,507
21-Jul	8,639	2,534	10,268	4,898	7,844	7,756	5,354	7,439	9,976	7,790	5,796
22-Jul	8,908	2,457	9,702	4,612	9,241	13,476	4,596	7,282	6,749	7,347	5,205
23-Jul	8,103	3,901	9,017	5,426	14,012	14,447	4,256	6,734	7,037	5,953	5,184
24-Jul	6,250	2,883	4,245	3,821	12,723	10,424	4,255	8,883	5,211	4,768	4,313
25-Jul	5,303	2,050	3,066	2,984	9,048	13,043	3,310	9,120	3,593	5,366	3,983
26-Jul	5,706	2,257	4,422	3,412	6,406	5,897	3,190	7,536	3,478	3,806	3,352
27-Jul	5,699	2,885	3,884	3,619	7,465	4,888	5,196	4,834	4,270	3,512	3,295
28-Jul	4,926	1,934	4,793	3,205	5,972	5,467	5,093	8,560	4,489	4,430	3,597
29-Jul	4,150	2,808	5,354	3,954	6,116	3,996	5,973	7,389	3,318	3,843	3,400
30-Jul	2,519	2,462	4,711	3,872	6,503	3,156	6,281	5,481	3,254	5,199	3,120
31-Jul	1,551	2,550	2,901	3,855	5,539	3,686	5,039	3,915	2,579	4,810	2,632
01-Aug	2,299	3,839			4,560	4,014	3,425	4,065	4,396	3,189	2,480
02-Aug	1,744	5,249			4,209		1,589	4,253	4,709	3,490	2,197
03-Aug								4,383	5,014	2,974	1,958
04-Aug								5,082		2,004	1,629
05-Aug								6,929			1,391
06-Aug								5,424			1,421
07-Aug											294
08-Aug											100
09-Aug											143
Total	607,797	581,859	579,435	601,952	833,387	715,577	599,267	906,239	1,148,079	866,957	

Appendix 2. Cumulative daily salmon escapement estimates, Miles Lake sonar, Copper River, 1978-1998.

Date	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
15-May											
16-May											
17-May				5,372							
18-May		381	218	15,037							
19-May		868	385	26,446			725				313
20-May		1,715	606	37,179			2,649			167	1,190
21-May		2,914	694	46,908			4,635			203	2,330
22-May		4,830	1,085	54,466			9,759			685	4,586
23-May		7,731	1,679	60,680		3,310	14,801			2,417	9,664
24-May		11,133	2,173	73,665	90	11,930	19,287			4,457	20,697
25-May		13,530	2,886	86,481	583	23,517	22,407		534	8,720	30,676
26-May	502	18,457	3,943	92,864	1,606	34,092	27,052		2,228	15,835	39,622
27-May	1,339	25,278	6,058	95,706	13,697	42,753	32,888		4,320	28,011	52,869
28-May	2,386	28,046	7,751	98,266	61,000	51,209	37,866	1,031	7,704	44,403	67,070
29-May	3,047	31,951	8,831	100,426	80,671	57,589	44,992	1,448	10,097	58,888	77,092
30-May	6,288	39,433	10,734	112,248	89,452	65,885	49,943	2,047	13,270	77,084	83,898
31-May	8,837	48,088	14,354	133,374	100,841	83,008	54,221	3,805	17,420	95,624	91,484
01-Jun	11,453	52,166	19,611	151,789	116,226	101,436	62,757	7,267	24,421	112,019	96,689
02-Jun	14,264	55,631	26,672	175,560	133,439	115,850	71,240	13,993	45,059	126,404	100,247
03-Jun	16,101	59,167	34,109	192,276	146,822	128,987	80,970	24,684	65,296	144,070	104,873
04-Jun	19,357	61,945	43,105	202,031	159,177	144,344	93,466	48,956	91,922	158,702	112,750
05-Jun	22,327	66,297	52,851	212,509	173,983	163,454	110,194	79,463	119,856	169,664	119,505
06-Jun	25,645	72,750	58,258	224,484	189,568	177,523	128,291	112,416	134,383	173,986	128,400
07-Jun	29,453	79,781	60,351	238,069	202,074	196,832	146,806	139,672	144,041	179,741	137,496
08-Jun	32,728	90,859	61,700	252,481	210,504	212,926	173,425	170,597	168,979	186,107	148,818
09-Jun	34,980	98,844	65,243	268,175	217,521	224,341	193,901	200,299	197,221	194,029	163,459
10-Jun	38,455	104,049	72,544	281,031	225,120	232,350	213,176	212,309	227,173	205,582	178,675
11-Jun	40,945	108,475	84,576	288,908	232,999	241,913	230,413	224,135	252,591	216,776	194,930
12-Jun	43,027	110,702	96,160	293,752	241,586	255,205	252,119	232,366	269,085	223,282	209,889
13-Jun	45,446	114,605	103,760	297,308	251,518	268,649	264,191	239,195	280,538	227,335	220,640
14-Jun	48,281	117,168	109,421	302,536	264,069	282,480	270,172	245,995	291,931	235,388	230,022
15-Jun	51,194	120,519	116,729	309,607	276,746	298,395	280,463	254,820	300,678	240,873	239,932
16-Jun	53,976	123,992	122,384	316,492	290,341	306,333	294,393	264,167	310,777	246,389	246,416
17-Jun	56,755	128,632	129,573	322,959	302,371	312,004	314,202	270,437	319,549	251,795	251,326
18-Jun	59,016	132,543	136,314	327,524	308,915	317,693	327,052	274,175	328,599	256,610	257,795
19-Jun	62,051	135,956	138,705	330,509	313,284	324,154	334,526	277,426	336,509	260,593	265,650
20-Jun	65,086	137,910	142,302	333,400	316,636	331,536	343,784	279,849	343,749	264,526	273,602
21-Jun	67,601	140,133	146,444	336,846	319,982	339,660	350,943	281,910	350,490	268,450	279,372
22-Jun	69,669	142,718	150,398	340,843	324,449	347,665	356,465	284,673	359,516	274,829	286,357
23-Jun	72,510	145,583	154,294	345,206	331,480	355,193	362,378	288,042	367,526	284,940	294,056
24-Jun	75,126	147,460	159,511	349,857	337,809	361,202	369,119	290,992	374,494	300,648	299,638
25-Jun	77,256	150,473	164,615	353,255	342,712	366,428	375,622	292,577	380,225	317,165	305,235
26-Jun	79,027	152,446	168,210	355,667	347,128	372,066	380,007	294,958	385,635	329,665	311,613
27-Jun	81,205	153,761	171,631	358,174	349,860	376,804	387,231	297,993	390,788	336,675	318,172
28-Jun	82,308	155,458	175,955	361,123	352,034	381,575	393,959	300,257	395,810	342,319	324,431
29-Jun	83,912	156,908	179,800	364,544	354,164	385,879	398,412	302,404	399,388	349,155	332,651
30-Jun	85,544	158,807	183,265	366,922	356,477	392,025	404,861	304,543	403,159	353,791	339,148

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Date	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
01-Jul	87,131	161,458	186,824	369,645	358,667	398,131	413,087	307,163	406,743	355,803	344,750
02-Jul	89,664	163,982	190,189	372,251	363,087	404,244	420,641	309,771	409,895	359,209	349,430
03-Jul	92,191	166,841	194,293	374,799	368,838	410,270	429,222	311,590	412,206	363,305	353,652
04-Jul	95,171	170,647	197,227	378,893	374,083	417,213	435,737	315,126	414,011	370,405	357,184
05-Jul	97,440	173,655	200,106	383,149	379,078	422,560	442,399	318,380	415,510	374,756	360,488
06-Jul	99,063	175,651	203,131	386,625	385,378	426,533	447,848	323,044	418,319	378,149	363,998
07-Jul	100,215	176,543	206,422	390,488	391,549	430,742	451,888	326,671	421,310	383,766	368,322
08-Jul	101,046	178,634	209,417	394,262	395,539	434,822	455,794	330,564	424,170	390,382	376,821
09-Jul	101,993	181,824	212,234	397,711	397,749	438,175	459,004	337,391	427,247	396,734	381,988
10-Jul	103,245	186,033	215,876	400,653	399,819	441,819	461,931	347,998	432,682	403,319	388,335
11-Jul	104,086	189,717	221,639	402,924	401,799	446,273	465,539	353,455	437,797	410,641	395,955
12-Jul	104,427	192,979	226,427	406,392	405,219	450,814	469,819	359,784	442,839	416,398	403,836
13-Jul	104,594	196,123	228,152	408,657	409,251	455,357	474,401	365,036	446,535	422,981	410,923
14-Jul	104,884	200,247	229,831	411,253	413,590	461,176	480,974	371,149	450,065	429,420	417,935
15-Jul	105,159	203,782	231,574	414,944	418,304	467,672	486,495	376,173	454,764	435,142	424,859
16-Jul	105,697	208,957	234,089	417,524	421,865	474,642	493,250	381,512	456,991	441,401	430,316
17-Jul	106,001	212,512	237,508	418,304	424,790	480,969	498,205	387,472	461,099	445,868	435,193
18-Jul	106,285	216,272	243,386	426,937	428,203	485,295	502,941	392,582	466,092	450,488	439,050
19-Jul	106,606	219,616	248,999	447,912	432,499	488,998	506,081	397,142	472,158	454,615	443,633
20-Jul	106,844	222,332	254,059	468,423	436,419	492,986	509,470	405,318	478,155	458,249	448,116
21-Jul	106,925	224,915	257,885	484,164	440,468	497,449	512,674	409,446	482,901	460,690	452,080
22-Jul	106,943	226,927	261,058	490,730	444,339	502,330	516,454	412,604	486,309	461,963	454,877
23-Jul	106,958	228,842	263,201	496,517	447,438	505,933	519,659	415,474	489,218	462,965	458,306
24-Jul	106,998	231,024	264,554	501,580	450,499	509,836	521,857	417,636	491,851	463,590	462,206
25-Jul	107,011	232,136	266,177	504,971	453,873	514,371	523,794	420,085	494,143	465,604	466,229
26-Jul		232,907	267,433	507,464	456,469	518,210	525,481	422,059	495,942	465,972	470,371
27-Jul		233,225	268,631	509,915	458,716	521,897	526,872	424,250	497,568	466,598	474,291
28-Jul		233,612	269,329	512,700	461,091	527,131	527,876	427,089	499,365	469,092	477,743
29-Jul		233,977	269,729	516,386	462,517	531,269	528,767	429,902	500,928	471,433	481,219
30-Jul		234,468	270,199	520,200	463,480	534,781	529,705	432,692	502,417	473,508	483,642
31-Jul		235,171	270,552	524,002	464,656	536,616	530,798	434,540	503,676	475,734	485,562
01-Aug		235,929	271,377	527,398	465,167	538,528	531,845	435,610	504,848	478,460	487,000
02-Aug		236,308	272,411	529,702	466,109	540,739	532,933	436,313	505,893	479,759	488,098
03-Aug		236,535	273,175	531,615	466,603	542,827	534,146		506,663	481,461	
04-Aug		236,821	273,883	532,912	467,184	545,724	535,264		507,477	482,960	
05-Aug		236,994	274,641	534,093	467,306		536,273		507,912	483,478	
06-Aug		237,097	275,518	535,263			536,806		508,328		
07-Aug		237,173	276,133						508,520		
08-Aug			276,299						508,553		
09-Aug			276,538						508,600		

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Date	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average
15-May							491		0	0	
16-May							959		64	0	
17-May	732					448	1,491		152	0	1,195
18-May	4,392					1,134	2,013	84	288	158	2,919
19-May	10,980					2,086	3,344	156	456	412	4,961
20-May	17,915				9,503	3,041	6,372	286	942	585	7,729
21-May	22,749	1,121	1,087		23,180	4,651	9,876	624	1,406	2,062	10,548
22-May	26,779	5,964	2,804		45,886	7,073	12,684	1,647	3,148	3,339	14,568
23-May	33,251	13,141	5,965		74,311	10,631	16,985	3,413	5,892	4,666	19,805
24-May	40,699	25,064	8,430		106,291	13,528	19,458	4,743	18,088	8,248	26,831
25-May	45,357	39,397	11,476		144,872	17,611	21,299	6,106	45,011	14,099	34,975
26-May	53,675	50,734	14,750		168,519	20,893	24,331	8,298	72,400	19,707	42,077
27-May	66,818	62,794	18,643	1,226	181,404	23,748	28,137	13,088	104,378	28,718	50,195
28-May	80,698	70,228	22,032	2,657	198,880	26,795	35,305	25,944	150,560	38,993	61,003
29-May	91,375	79,404	25,965	5,019	212,036	29,683	45,183	37,952	197,099	50,219	70,057
30-May	96,750	88,945	30,382	10,755	220,514	31,649	57,962	48,813	234,653	68,661	79,124
31-May	104,066	99,288	39,744	18,686	237,200	36,265	68,717	68,807	280,850	91,679	91,361
01-Jun	111,107	109,314	56,577	25,296	253,673	45,688	77,697	94,337	312,407	112,991	103,674
02-Jun	116,341	119,223	77,728	33,215	276,504	53,455	87,125	120,314	343,151	137,197	117,373
03-Jun	123,208	127,799	95,536	44,750	291,095	56,592	92,772	147,579	361,229	162,921	129,670
04-Jun	131,763	135,371	110,093	52,671	308,680	62,735	99,517	169,810	378,791	188,451	142,660
05-Jun	139,275	145,544	128,766	61,966	334,459	68,000	105,412	187,819	394,979	207,515	156,479
06-Jun	146,994	155,954	140,454	76,518	360,102	80,100	114,648	199,129	414,964	221,645	169,450
07-Jun	159,687	167,091	148,894	93,252	378,170	96,832	122,692	215,872	437,576	240,246	182,708
08-Jun	174,252	174,728	158,365	110,981	398,932	114,854	128,430	242,457	471,545	253,965	198,089
09-Jun	183,692	184,633	170,030	131,700	423,929	132,896	133,909	278,141	508,623	261,290	213,766
10-Jun	195,818	196,295	178,595	155,130	443,723	150,484	141,963	309,933	542,803	271,784	228,534
11-Jun	205,481	212,474	186,699	173,721	454,842	162,756	153,913	339,018	573,744	290,255	242,466
12-Jun	213,737	236,403	199,387	187,817	473,164	175,764	161,187	374,655	592,863	307,936	255,825
13-Jun	224,363	260,851	208,453	206,074	486,036	184,845	170,132	401,691	606,227	329,654	267,321
14-Jun	237,911	275,153	217,689	226,530	494,393	200,484	184,153	416,649	622,307	357,935	278,709
15-Jun	247,833	283,543	232,656	250,487	507,744	212,163	196,006	432,197	645,527	378,304	290,436
16-Jun	256,722	293,655	247,023	264,401	521,991	226,390	215,738	446,006	662,516	396,065	301,352
17-Jun	266,742	306,350	257,152	278,910	529,612	237,835	235,656	456,304	684,317	416,826	311,978
18-Jun	277,873	314,402	268,203	293,803	534,533	255,058	253,594	463,663	706,409	435,361	321,494
19-Jun	286,218	324,165	281,124	306,127	540,857	274,450	269,619	478,966	719,120	446,979	329,963
20-Jun	293,793	333,480	295,270	325,607	545,757	285,948	286,482	491,037	726,964	458,479	337,973
21-Jun	300,962	343,772	304,020	342,489	549,293	297,647	301,912	498,607	735,353	470,755	345,184
22-Jun	309,830	353,929	311,850	351,941	552,157	310,952	311,774	509,458	752,906	481,543	352,674
23-Jun	315,680	364,095	318,208	359,175	557,226	329,638	317,094	525,002	760,611	492,450	360,125
24-Jun	319,607	373,435	324,171	365,494	563,297	353,920	324,451	535,228	765,921	505,971	367,599
25-Jun	322,603	383,445	331,831	372,169	567,618	368,060	333,662	543,191	771,381	518,972	374,320
26-Jun	326,029	390,257	341,331	379,349	570,336	380,264	343,651	551,859	779,366	530,189	380,537
27-Jun	329,269	399,491	351,686	385,615	573,706	394,410	359,676	562,114	791,377	540,911	387,275
28-Jun	335,571	406,372	362,496	393,699	578,067	403,623	373,349	571,309	801,804	553,733	393,690
29-Jun	342,061	410,871	372,935	402,957	583,043	419,482	383,072	583,930	812,213	569,584	400,457
30-Jun	349,415	414,846	382,048	410,373	591,427	430,327	387,474	592,021	825,954	584,265	406,853

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Date	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average
01-Jul	357,345	419,169	389,351	417,493	599,066	440,686	393,204	612,508	838,678	597,911	413,193
02-Jul	362,641	424,236	394,460	423,084	604,786	450,488	398,422	625,574	852,244	609,343	419,042
03-Jul	367,617	428,918	400,795	427,725	609,931	460,453	403,273	638,523	867,674	620,379	424,987
04-Jul	374,986	434,583	407,475	433,138	615,458	469,235	407,564	651,479	882,292	628,928	431,098
05-Jul	385,725	442,581	413,320	437,562	621,797	475,431	415,351	660,308	895,740	638,553	436,958
06-Jul	395,749	450,330	419,533	444,549	628,228	484,975	423,523	669,126	906,764	647,310	442,860
07-Jul	405,985	456,030	425,755	451,910	637,457	494,896	430,143	678,133	918,298	657,328	448,861
08-Jul	417,098	461,222	432,824	457,668	647,843	502,843	434,415	686,557	932,034	666,678	454,898
09-Jul	427,859	466,375	439,277	469,605	658,948	512,234	441,260	694,359	939,911	677,985	461,052
10-Jul	437,365	472,995	443,887	478,744	668,514	526,773	456,106	704,151	953,668	691,547	468,557
11-Jul	445,818	478,397	448,364	487,124	675,878	540,429	465,474	714,759	970,366	709,329	475,619
12-Jul	457,771	487,735	453,182	495,083	682,697	556,652	471,941	726,564	980,525	726,990	482,872
13-Jul	467,100	499,167	457,151	501,824	688,312	570,576	477,919	737,393	989,774	743,069	489,358
14-Jul	477,370	507,373	464,649	510,398	695,985	583,909	487,521	747,352	1,002,682	751,332	496,254
15-Jul	489,653	515,682	472,199	519,369	702,097	594,070	499,108	756,817	1,018,433	762,214	503,369
16-Jul	500,550	521,775	481,870	527,052	708,977	602,025	505,043	768,128	1,032,389	771,398	509,890
17-Jul	509,453	528,034	491,538	533,770	714,152	609,667	515,901	779,714	1,047,500	778,776	516,127
18-Jul	521,264	533,760	498,878	542,577	719,550	616,730	526,543	786,948	1,057,364	785,359	522,321
19-Jul	531,831	539,735	506,391	551,192	726,332	621,405	534,707	793,321	1,068,632	791,542	528,837
20-Jul	542,000	544,050	517,072	558,294	733,749	625,327	541,710	798,930	1,080,006	798,476	535,344
21-Jul	550,639	546,584	527,340	563,192	741,593	633,083	547,064	806,369	1,089,982	806,266	541,140
22-Jul	559,547	549,041	537,042	567,804	750,834	646,559	551,660	813,651	1,096,731	813,613	546,345
23-Jul	567,650	552,942	546,059	573,230	764,846	661,006	555,916	820,385	1,103,768	819,566	551,529
24-Jul	573,900	555,825	550,304	577,051	777,569	671,430	560,171	829,268	1,108,979	824,334	555,843
25-Jul	579,203	557,875	553,370	580,035	786,617	684,473	563,481	838,388	1,112,572	829,700	559,826
26-Jul	584,909	560,132	557,792	583,447	793,023	690,370	566,671	845,924	1,116,050	833,506	563,177
27-Jul	590,608	563,017	561,676	587,066	800,488	695,258	571,867	850,758	1,120,320	837,018	566,473
28-Jul	595,534	564,951	566,469	590,271	806,460	700,725	576,960	859,318	1,124,809	841,448	570,069
29-Jul	599,684	567,759	571,823	594,225	812,576	704,721	582,933	866,707	1,128,127	845,291	573,469
30-Jul	602,203	570,221	576,534	598,097	819,079	707,877	589,214	872,188	1,131,381	850,490	576,590
31-Jul	603,754	572,771	579,435	601,952	824,618	711,563	594,253	876,103	1,133,960	855,300	579,222
01-Aug	606,053	576,610			829,178	715,577	597,678	880,168	1,138,356	858,489	581,702
02-Aug	607,797	581,859			833,387		599,267	884,421	1,143,065	861,979	583,899
03-Aug							599,267	888,804	1,148,079	864,953	585,857
04-Aug							599,267	893,886	1,148,079	866,957	587,486
05-Aug							599,267	900,815	1,148,079	866,957	588,876
06-Aug							599,267	906,239	1,148,079	866,957	590,297
07-Aug							599,267	906,239	1,148,079	866,957	590,591
08-Aug							599,267	906,239	1,148,079	866,957	590,690
09-Aug											590,833

Appendix 3. Daily water levels in meters above sea level, at Mile 49 Bridge, Copper River, 1982 - 1998.

Elevation Above Sea Level

Date	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1983-97 Average
11-May												39.03					
12-May																	
13-May												39.12				39.32	
14-May												39.18				38.74	
15-May					38.99		40.05					39.26	40.71	40.33	39.65		39.87
16-May							40.04					39.33		40.07	39.65	38.76	39.81
17-May					39.09		40.01					39.43		39.77	39.49	38.80	39.58
18-May				39.19	39.10		40.01					39.53	40.27	39.60	39.44	38.85	39.62
19-May				39.31	39.05	39.70	40.06					39.76	40.09	39.57	39.35	39.00	39.65
20-May		39.05		38.97	39.05	39.62	40.07				41.12	40.17	39.65	39.60	39.28	39.06	39.70
21-May		39.08		38.95	39.10	39.65	40.02	40.79	39.42		41.26	40.35	39.87	39.55	39.29	39.08	39.82
22-May		39.31		39.19	39.14	39.65	40.14	40.92	39.52	39.62	41.40	40.19	39.90	39.55	39.62	39.04	39.88
23-May		39.45		39.29	39.21	39.60	40.23	40.81	39.70	39.68	41.39	40.07	39.98	39.62	40.08	39.09	39.92
24-May	39.39	39.48		39.37	39.28	39.61	40.27	40.63	39.96		41.38	40.12	40.08	39.75	40.49	39.13	39.94
25-May	39.39	39.57		39.38	39.29	39.64	40.16	40.48	40.17	39.92	41.54	40.17	40.31	39.85	40.50	39.16	39.99
26-May	39.36	39.61		39.46	39.36	39.67	40.17	40.48	40.33	40.10	41.68	40.05	40.71	39.87	40.40	39.28	40.07
27-May	39.37	39.71		39.54	39.46	39.75	40.27	40.58	40.41	40.30	41.67	40.03	41.06	39.89	40.27	39.58	40.16
28-May	39.39	39.75	40.28	39.60	39.46	39.78	40.42	40.77	40.51	40.55	41.65	40.11	41.04	39.95	40.22	39.91	40.23
29-May	39.38	39.61	40.34	39.77	39.48	39.82	40.60	41.00	40.55	40.73	41.77	40.08	41.04	39.98	40.22	40.26	40.30
30-May	39.44	39.55	40.31	39.97	39.45	39.87	41.00	41.47	40.56	40.94	41.93	40.22	40.88	40.11	40.40	40.64	40.41
31-May	39.58	39.47	40.18	39.96	39.48	40.00	41.49	41.72	40.58	40.97	42.11	40.23	40.69	40.29	40.42	41.09	40.48
01-Jun	39.94	39.46	40.03	39.97	39.76	40.12	41.82	41.00	40.51	41.13	42.35	40.21	40.54	40.51	40.40	41.27	40.52
02-Jun	40.64	39.42	39.90	39.96	39.98	40.14	41.87	42.03	40.42	41.22	42.37	40.22	40.45	40.96	40.45	41.25	40.68
03-Jun	41.00	39.39	39.88	39.97	40.33	40.16	41.70	42.18	40.32	41.34	42.40	40.27	40.37	41.08	40.45	41.21	40.74
04-Jun	40.94	39.45	39.95	39.90	40.36	40.26	41.70	42.26	40.31	41.50	42.49	40.30	40.26	41.18	40.37	41.42	40.78
05-Jun	40.94	39.61	40.18	39.88	40.30	40.32	42.02	42.45	40.38	41.56	42.53	40.40	40.22	41.22	40.57	41.45	40.86
06-Jun	40.89	39.75	40.44	39.98	40.43	40.35	42.11	42.67	40.42	41.52	42.60	40.52	40.22	41.08	41.06	41.55	40.93
07-Jun	40.82	40.04	40.36	40.19	40.73	40.61	42.06	42.81	40.47	41.38	42.74	40.75	40.29	40.90	41.42	41.54	41.01
08-Jun	40.82	40.34	40.11	40.43	40.88	40.82	42.00	42.98	40.55	41.53	42.68	40.88	40.45	40.97	41.49	41.96	41.10
09-Jun	40.85	40.36	40.03	40.46	40.69	41.15	41.89	42.96	40.60	41.62	42.35	40.97	40.63	41.08	41.45	42.50	41.12
10-Jun	40.84	40.36	40.06	40.36	40.64	41.48	41.92	42.85	40.58	41.73	42.03	41.10	40.81	41.03	41.45	42.86	41.13
11-Jun	40.82	40.43	40.01	40.24	40.54	41.80	41.80	42.63	40.71	41.91	41.84	41.38	41.35	40.88	41.46	42.63	41.17
12-Jun	40.84	40.56	40.01	40.13	40.38	42.00	41.65	42.47	40.87	42.17	41.84	41.55	42.09	40.70	41.44	42.25	41.23
13-Jun	40.81	40.68	40.11	40.22	40.34	42.19	41.73	42.44	41.06	42.48	41.86	41.74	42.71	40.54	41.45	41.89	41.35
14-Jun	40.67	40.84	40.13	40.33	40.37	42.36	41.78	42.61	41.31	42.74	41.94	42.00	43.04	40.51	41.51	41.71	41.47
15-Jun	40.71	40.97	40.16	40.62	40.36	42.45	42.03	42.66	41.53	42.89	42.08	42.44	43.22	40.47	41.51	41.65	41.61
16-Jun	40.60	41.07	40.13	41.05	40.36	42.64	42.13	42.58	41.77	43.01	42.35	42.82	43.33	40.43	41.49	41.72	41.73
17-Jun	40.75	41.05	40.13	41.58	40.44	42.80	42.02	42.52	42.00	42.97	42.58	43.11	43.09	40.50	41.48	41.82	41.82
18-Jun	40.88	40.89	40.36	41.83	40.57	42.99	41.94	42.39	42.10	42.85	42.61	43.26	42.67	40.72	41.41	41.96	41.86
19-Jun	40.97	40.97	40.49	41.88	40.51	42.90	42.02	42.15	42.04	42.63	42.57	43.25	42.62	40.97	41.52	42.08	41.86
20-Jun	41.31	41.15	40.49	41.89	40.43	42.56	42.09	42.03	42.05	42.47	42.60	43.02	42.65	41.14	41.69	42.24	41.85
21-Jun	41.58	41.31	40.51	41.71	40.36	42.32	42.15	41.91	42.53	42.58	42.46	42.89	42.68	41.35	41.67	42.21	41.88
22-Jun	41.85	41.66	40.34	41.54	40.70	42.53	42.22	41.92	43.14	42.91	42.50	42.72	42.65	41.48	41.73	42.25	42.01
23-Jun	41.95	41.76	40.39	41.43	41.18	42.25	42.34	41.93	43.69	42.99	42.52	42.85	42.67	41.70	42.03	42.27	42.12
24-Jun	42.01	41.99	40.46	41.29	41.27	41.82	42.48	42.01	44.02	42.90	42.58	43.16	42.85	42.03	42.43	42.19	42.21
25-Jun	42.19	42.35	40.74	41.11	41.23	41.73	42.84	42.02	44.03	42.66	42.64	43.34	42.60	42.28	42.72	42.12	42.27
26-Jun	42.43	42.60	40.79	41.00	41.10	41.68	43.13	42.09	43.83	42.42	43.00	43.39	42.22	42.43	42.99	42.24	42.29
27-Jun	42.44	42.75	40.77	40.97	40.98	41.68	43.11	42.31	43.64	42.26	42.75	43.06	42.35	42.43	43.28	42.37	42.25
28-Jun	42.43	42.58	40.97	41.17	41.28	41.55	43.01	42.59	43.57	42.44	42.61	42.54	42.11	42.25	43.28	42.38	42.22
29-Jun	42.60	42.37	41.20	41.52	41.00	41.79	42.98	42.96	43.66	42.68	42.57	42.20	42.20	41.82	43.66	42.40	42.25
30-Jun	42.55	42.14	41.43	41.62	41.53	41.79	43.03	43.27	43.78	42.99	42.60	42.05	42.35	41.51	43.71	42.46	42.33

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Appendix 3. (page 2 of 2).

Elevation Above Sea Level

Date	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1983-96 Average
01-Jul	42.43	41.88	41.86	41.96	42.37	41.73	43.10	43.49	43.87	43.28	42.65	42.08	42.53	41.43	43.75	42.65	42.48
02-Jul	42.24	41.94	42.32	42.37	42.83	41.82	43.31	43.78	43.90	43.61	42.61	42.34	42.76	41.44	43.71	42.90	42.66
03-Jul	42.33	41.91	42.55	42.61	42.85	41.99	43.49	43.76	43.77	44.15	42.62	42.47	42.98	41.56	43.70	43.16	42.79
04-Jul	42.51	41.91	42.62	42.70	42.91	42.29	43.41	43.71	43.76	44.35	42.55	42.48	43.16	41.71	43.65	43.36	42.86
05-Jul	42.60	41.96	42.62	42.85	43.04	42.51	43.43	43.71	43.53	44.53	42.63	42.55	43.23	41.90	43.71	43.44	42.93
06-Jul	42.67	41.86	42.67	43.03	43.16	42.66	43.38	43.74	43.24	44.55	42.59	42.55	43.40	41.95	43.76	43.48	42.96
07-Jul	42.70	42.06	42.85	43.11	43.12	42.95	43.42	43.85	43.07	44.38	42.53	42.44	43.60	41.99	43.71	43.47	43.00
08-Jul	42.84	42.29	42.93	43.13	42.93	43.08	43.43	43.75	43.08	44.19	42.34	42.23	43.75	42.11	43.72	43.31	43.01
09-Jul	42.81	42.52	42.75	43.03	42.33	43.06	43.50	43.51	43.22	43.71	42.08	42.24	43.71	42.21	43.46	42.87	42.91
10-Jul	42.82	42.72	42.55	42.70	42.52	42.94	43.63	43.14	43.49	43.39	42.50	42.38	43.58	42.28	43.22	42.53	42.90
11-Jul	42.72	42.62	42.52	42.62	42.49	42.72	43.74	42.81	43.22	43.34	42.82	42.34	43.53	42.24	43.18	42.43	42.84
12-Jul	42.55	42.47	42.55	42.76	42.50	42.53	43.95	42.58	43.04	43.48	43.07	42.43	43.61	42.03	43.24	42.63	42.82
13-Jul	42.14	42.32	42.62	42.80	42.53	42.72	44.07	42.51	42.94	43.72	43.16	42.52	43.51	41.98	43.17	42.62	42.82
14-Jul	41.98	42.19	42.60	42.78	42.41	42.73	44.03	42.42	42.92	43.65	43.45	42.63	43.40	42.02	43.14	42.58	42.80
15-Jul	41.80	42.16	42.55	42.51	42.47	42.66	43.82	42.37	42.85	43.42	43.61	42.78	43.35	42.11	43.11	42.65	42.75
16-Jul	41.95	42.06	42.44	42.35	42.43	42.64	43.51	42.28	42.82	43.41	43.76	42.98	43.30	42.01	43.05	42.60	42.71
17-Jul	42.10	41.96	42.42		42.47	42.72	43.20	42.12	42.96	43.27	44.04	42.99	43.01	41.91	43.04	42.66	42.71
18-Jul	42.23	41.83	42.49		42.35	43.03	43.14	42.50	42.86	43.19	44.14	42.97	43.01	42.10	42.97	42.61	42.76
19-Jul	42.46	41.96	42.49		42.36	43.18	43.30	42.78	42.50	43.16	44.07	43.06	43.12	42.30	42.93	42.51	42.83
20-Jul	42.55	41.99	42.60		42.63	43.18	43.47	43.06	42.17	43.16	43.82	42.68	43.10	42.44	42.90	41.78	42.83
21-Jul	42.53	41.76	42.90		42.78	43.24	43.58	43.28	42.11	43.31	43.85	42.73	43.17	42.47	42.87	42.33	42.90
22-Jul	42.48	41.63	42.88	43.53	43.36	43.53	43.32	43.57	42.27	43.34	43.87	42.44	43.32	42.53	42.65	42.44	43.00
23-Jul	42.27	41.61	42.62	43.41	43.51	43.40	43.14	43.62	42.41	43.14	43.44	42.21	43.59	42.53	42.66	42.42	42.92
24-Jul	42.30	41.66	42.37	43.34	43.39	43.38	43.00	43.72	42.70	42.92	43.29	42.13	43.74	42.46	42.66	42.33	42.89
25-Jul	42.30	41.86	42.24		43.17	43.04	42.91	43.83	42.87	42.84	43.19	42.26	43.42	42.56	42.75	42.17	42.81
26-Jul	42.20	42.06	42.24	42.77	43.01	42.70	42.86	43.75	42.97	43.11	43.21	42.40	43.16	42.67	42.85	42.28	42.79
27-Jul	42.10	42.19	41.99	42.45	43.02	42.54	42.81	43.25	42.95	43.26	43.29	42.68	42.89	42.65	42.85	42.36	42.72
28-Jul	42.23	42.29	41.99	42.22	43.16	42.58	42.75	42.90	42.90	43.18	43.33	42.76	42.72	42.65	43.28	42.31	42.69
29-Jul	42.51	42.29	42.11	42.01	43.23	42.58	42.87	43.15	42.82	42.99	43.43	42.83	42.38	42.75	43.63	42.18	42.71
30-Jul	42.68	42.39	42.24	41.94	43.29	42.43	42.96	43.46	42.77	42.88	43.49	42.94	42.31	42.88	43.80	42.18	42.76
31-Jul	42.76	42.34	42.39	41.98	43.26	42.38	43.13	43.51	42.65	42.81	43.53	43.28	42.33	43.21	43.81	42.15	42.83
01-Aug	42.79	42.39	42.55		43.07	42.31	43.29	43.51			43.60	42.96	42.33	43.13	43.65	42.28	42.90
02-Aug	42.66	42.32	42.98		42.98	42.33	43.37	43.51			43.40	43.17	42.33	42.92	43.45	42.35	42.91
03-Aug	42.61	42.34	44.35		42.92	42.48						43.52		42.51	43.34	42.38	42.96
04-Aug	42.55	42.34	45.09		42.93	42.81								42.35		42.16	43.01
05-Aug	42.62	42.42			42.88									42.29			42.55
06-Aug		42.42												42.11			42.26
07-Aug		42.42												41.91			42.16
08-Aug		42.42															42.42

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