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

Neva, Pavlof, and Hoktaheen Sockeye Salmon Stock Assessment, 2002

Annual Report for Study FIS02-012-1

This report has been prepared to assess project progress. Review comments may not be addressed in this report, but will be incorporated into the final report for this project.

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ABSTRACT

Sockeye salmon (*Oncorhynchus nerka*) returns to Neva, Pavlof, and Hoktaheen Lakes have long been an important subsistence resource for Tlingit families living in Hoonah and other areas of northern Southeast Alaska. This annual report summarizes the sockeye stock assessment project findings from the first year, 2002, of a three-year cooperative Hoonah Indian Association, Alaska Department of Fish and Game, and U.S. Forest Service study. This project uses a weir and mark-recapture methods to estimate the sockeye escapement into Neva Lake, a fishpass trap and mark-recapture to estimate the sockeye escapement into Pavlof Lake, and mark-recapture to index the sockeye escapement in Hoktaheen Lake. Age, sex, and length data and limnology data were also collected to help assess the status of these stocks. The Neva sockeye escapement was 4,951 (CV = 8%) - 3,738 (CV = 6%) were adults and 1,213 (CV = 12%) were jacks. They migrated into the lake from mid-June through mid-September and the midpoint of the run was in early August. The early running fish spawned in the main inlet stream and the later running fish were beach spawners. Ninety-five percent of the Neva sockeye escapement was age-1.-. The Pavlof sockeye escapement was 1,350 (CV = 6%). The run extended from the third week in June to the third week in July with a midpoint around July 3. Less than half the sockeye salmon used the fishpass to migrate into the lake. The sockeye spawned in the lower part of the main inlet stream from late-July to mid-August. Age-1.3 fish dominated the escapement. Estimates of the abundance of sockeye salmon in the upper Hoktaheen Lake were 737, 763, and 156 on September 6, 7, and 18 in the main inlet stream index area and 139 and 233 on September 7 and 18 in the outlet index area. Only a few spawning sockeye were observed outside of these two index areas. Age-1.2, 1.3, and 2.2 fish each comprised about one-third of the sockeye sampled. The dominant zooplankton was *Daphnia* sp. in Neva Lake, *Cyclops* sp. in Pavlof, and *Bosmina* sp. in Hoktaheen. The weighted “seasonal” biomass of zooplankton was 402, 1, and 618 mg m^{-2}, respectively, in Neva, Pavlof, and Hoktaheen Lakes and euphotic zone depths were 12.1, 4.9, and 4.2 m.

Key Words: Sockeye salmon, *Oncorhynchus nerka*, Neva, Pavlof, Hoktaheen, escapement, mark-recapture, age composition, limnology.

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INTRODUCTION

Sockeye salmon returns to Neva Lake (Alaska Department of Fish and Game stream number 114-80-045), Pavlof Lake (112-50-010), and Hoktaheen Lake (113-94-003) have long been an important subsistence resource for Tlingit families living in Hoonah and other areas of northern Southeast Alaska (de Laguna 1960; Schroeder and Kookesh 1990; Goldschmidt and Haas 1998; Figure 1). Household subsistence surveys done in Hoonah in 1996 found that 86% of the families used salmon and 65% used sockeye salmon (Table 1).

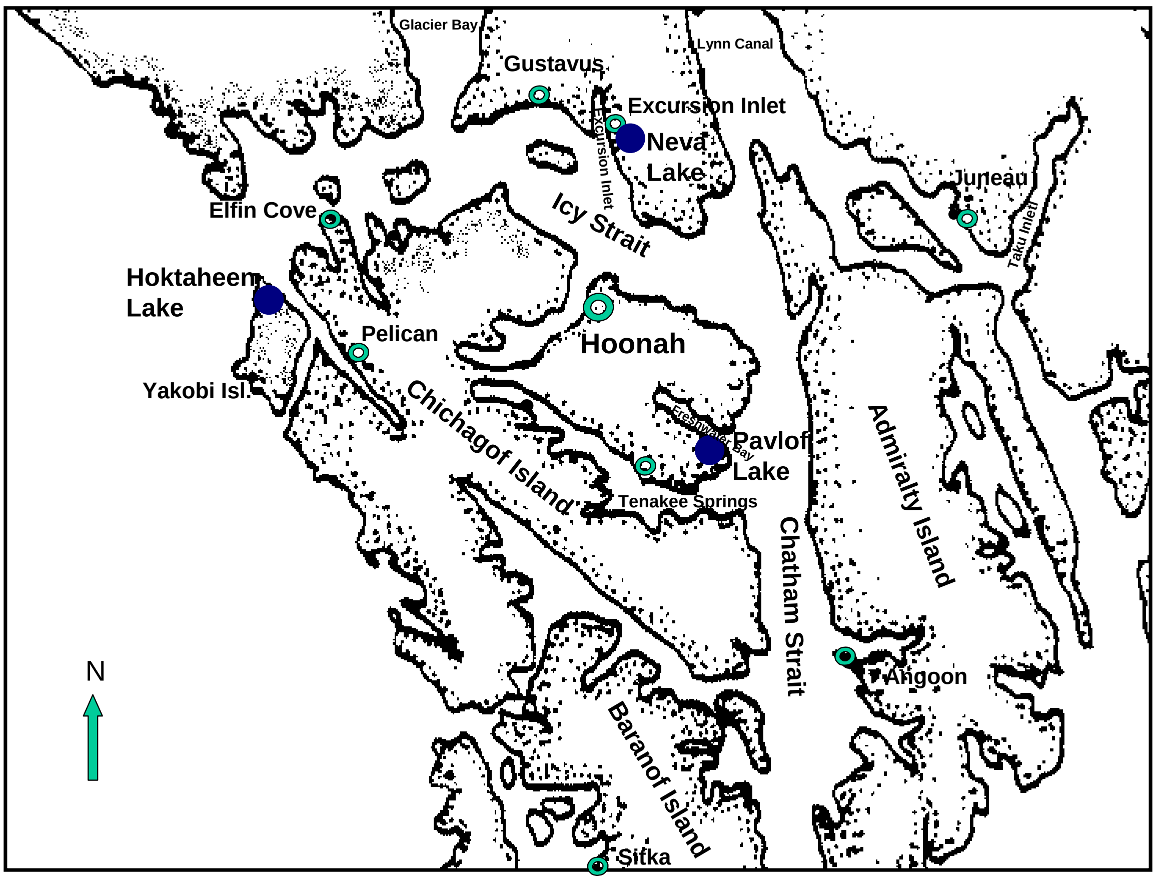


Figure 1. Map of northern Southeast Alaska showing the location of Neva, Pavlof, and Hoktaheen Lakes.

Table 1. Subsistence use and harvest of salmon by households in Hoonah. (ADF&G, Division of Subsistence, Community Profile Database, 2003).

	Sockeye Salmon		All Salmon	
Year	Percent Households Using	Percent Households Harvesting	Percent Households Using	Percent Households Harvesting
1985	32%	17%	86%	55%
1987	38%	29%	92%	69%
1996	65%	43%	86%	74%

Unfortunately, little is known about the health of these sockeye runs. Management has had to rely on infrequent and imprecise aerial survey counts and subsistence harvest reports to assess run sizes and trends. I am not aware of any prior studies that estimated or indexed the sockeye escapement into these lakes. We do not know if escapements are at levels that would maximize returns and harvests. We do not know if management is too conservative and if subsistence harvests limits could be liberalized, or, if these runs are depressed and need rebuilding from over harvesting that occurred with the onset of commercial fishing in the late-1800s and early-1900s (Bean 1891; Moser 1899; Rich and Ball 1933; Cooley 1963; Van Alen 2000). Most importantly, we do not know if escapements are trending downward and if management actions are needed to protect these important subsistence resources.

This project estimates sockeye escapements into Neva and Pavlof Lakes, indexes the sockeye escapement into Hoktaheen Lake, and collects associated biological and limnological data need to assess the current status of these important subsistence stocks. Mark-recapture methods are used to estimate the relative and/or absolute sockeye escapement in all lakes. This information is needed to estimate escapement goals and understand the current status of these runs (Geiger et al. 2003).

This report covers the first season (2002) of a joint Hoonah Indian Association (HIA)/U.S. Forest Service (USFS)/Alaska Department of Fish and Game (ADF&G) study into the status of Neva, Pavlof, and Hoktaheen sockeye salmon. The stock assessment of sockeye salmon in Hoktaheen Lake was part of an Organized Village of Kake and ADF&G project in 2001 (Conitz and Cartwright 2002a) but was included in this project since Hoktaheen is in the traditional fishing area of the Hoonah people.

This Neva, Pavlof, and Hoktaheen Sockeye Salmon Project is one of eight new projects, initiated in 2001 and funded through the U.S. Fish & Wildlife Service Fisheries Resource Monitoring Program, to assess significant subsistence sockeye runs in southeast Alaska (Conitz and Cartwright 2002a, 2002b, 2002c; Conitz et al. 2002; Lewis and Cartwright 2002a, 2002b, 2002c). Funding for these projects has been a fortunate consequence of the Federal government's 1999 assumption from the State of Alaska of the management of subsistence fisheries on Federal public lands. These projects all involve cooperation among community Tribal associations, ADF&G, and USFS.

There is also a Federal Office of Subsistence Management-funded, cooperative HIA and ADF&G, Division of Subsistence, project currently studying the historic and contemporary subsistence use by the people of Hoonah. Results from both these studies will help us assure the adequacy of these runs for meeting escapement and customary and traditional subsistence needs.

Neva

Neva Lake (58˚24.219' N, 135˚24.258' W; NAD27 datum) is located on the mainland on the east side of Excursion Inlet (Figure 2). The lake is about 2 km southeast of the unincorporated community of Excursion Inlet, about 22 km east of Gustavus, and about 40 km across Icy Strait from Hoonah. The lake lies at an elevation of 44 m, has a surface area of 36.1 ha, and a maximum depth of 19 m. There is one main inlet stream that flows into the northeast end of the lake. The outlet of Neva Lake (Neva Creek) flows from the northwest end of the lake about 1.2 km before entering the glacial South Creek which then flows about 1 km before entering Excursion Inlet on the south side of the cannery complex.

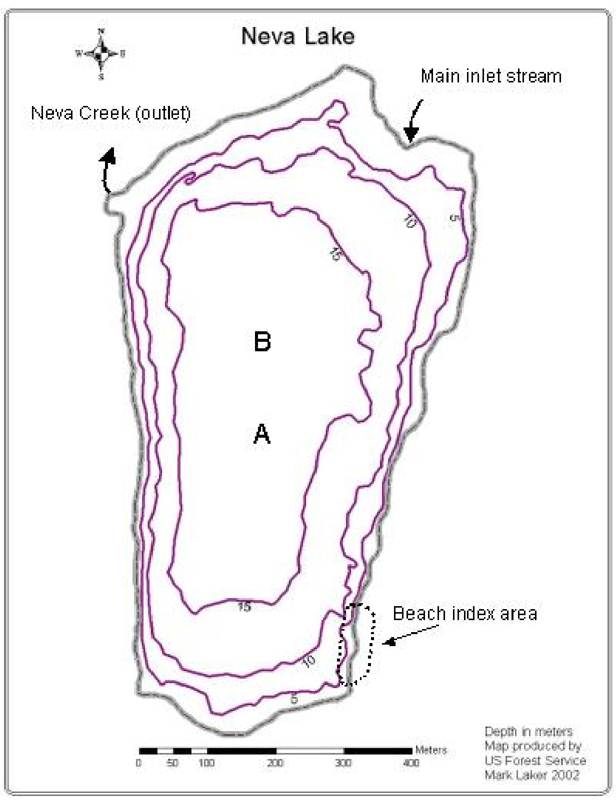


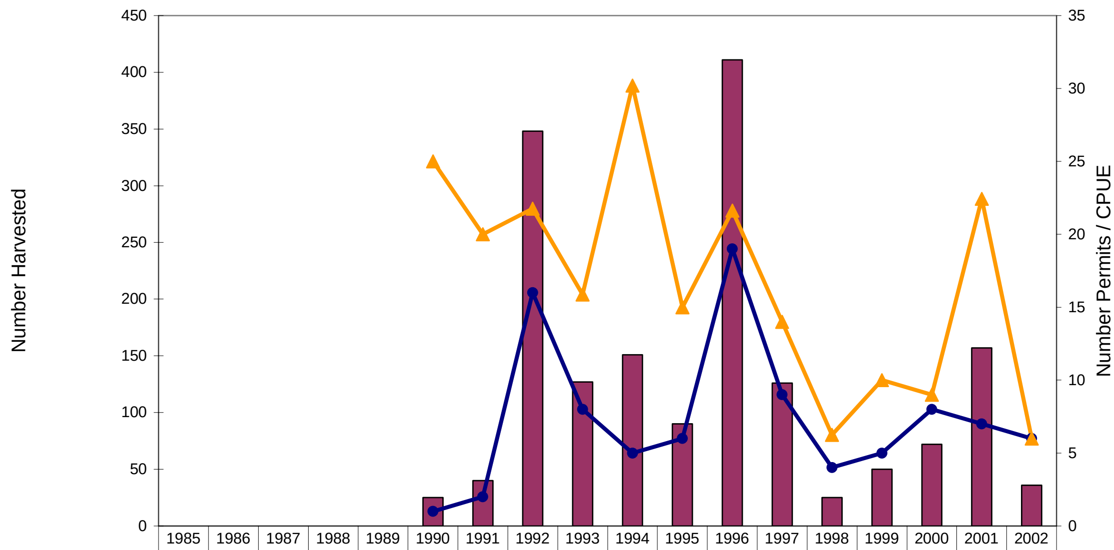
Figure 2. Bathymetric map of Neva Lake showing 5 m depth contours and approximate locations of the two fixed sampling stations, the main inlet stream, the outlet, and the beach spawning index area.

Neva Lake is in the traditional lands used for subsistence harvesting and gathering by the Huna Tlingit (Schroeder and Kookesh 1990). There used to be a village of Wooshkeetaan clan people in Excursion Inlet near the present cannery site (Goldschmidt and Haas 1998). Villagers would fish for “a good run of sockeye” salmon returning to Neva Lake and there were several smokehouses in the area. Stone barriers are still evident in Neva Creek that were built to impede the upstream migration of salmon.

A salmon cannery began operation in Excursion Inlet in 1918. The location and ownership of the cannery has changed several times over the years (Galginaitis 2003). During World War II construction began on facilities for a resupply point for the Aleutian campaign. A dam, reservoir, and water distribution system was built which taps water out of Neva Lake’s main inlet stream. This water system is still used by the cannery today. Neva Lake is accessible by road from the cannery.

The State currently holds title to the land surrounding Neva Lake and outlet, and the cannery site is privately owned, but the majority of the watershed is on National Forest System Land. The State has subdivided and sold land along the eastern shore of Excursion Inlet and there are now about 80 cabins/homes and a sport fishing lodge in the area that are mostly used for summer recreation. Unguided fishing excursions commonly target salmon at the mouth of South Creek.

This area is in the Federal subsistence customary and traditional use area for residents in the Hoonah area (Federal Register 50 CFR Part 100 and 36 CFR Part 242) and in an area designated by the State as subsistence (5 AAC 01.716). A permit is required to take salmon for subsistence or personal use in southeast Alaska. ADF&G, Commercial Fisheries Division, staff have issued these permits, one per household, and has maintained records of the permits issued, returned, and the reported harvest since 1984. The return of these permits is voluntary. No sockeye salmon were reported harvested at Neva prior to 1990 and the peak effort (22 permits) and harvest (411 sockeye salmon) was in 1996 (Figure 3). Subsistence and personal use fishing for Neva sockeye salmon occurs both in saltwater, at the mouth of South Creek, and in freshwater in South Creek and Neva Creek. A pool in the lower part of Neva Creek is a traditional site for taking sockeye salmon with a gaff.



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Sockeye						25	40	348	127	151	90	411	126	25	50	72	157	36
Permits						1	2	16	8	5	6	19	9	4	5	8	7	6
Fish/Permit						25	20	22	16	30	15	22	14	6	10	9	22	6

Figure 3. Subsistence/personal use effort and harvest of sockeye salmon at Neva from 1985 to 2002 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries database, 2003).

Neva sockeye salmon would primarily be harvested in commercial fisheries in Excursion Inlet and Icy Strait. These fisheries also harvest sockeye salmon bound for Lynn Canal, Taku River, Chatham Strait, and other northern inside systems. Rich and Ball (1933) reported no harvests of sockeye salmon in Excursion Inlet prior to 1914 and annual harvests of zero to 50,722 sockeye salmon in Excursion Inlet from 1914 to 1927 (Table 2). Beach seines, purse seines, gillnets, and traps fishing on passing stocks in Icy Strait harvested hundreds of thousands of sockeye salmon annually through 1927 (Rich and Ball 1933; Table 2). Commercial harvest estimates for Icy Strait and Excursion Inlet from 1928 to statehood (1959) are not available. Traps were outlawed in 1959; however, the purse seine fishing effort remained high in Icy Strait into the early 1970s (Table 3). The annual sockeye harvest has ranged between zero and 2,584 fish in Excursion Inlet since 1960 (Table 3). Seine openings in Excursion Inlet have not been directed at Neva sockeye salmon and it is likely that many of the sockeye harvested there were bound for other systems.

The ADF&G, Division of Sport Fish, estimates sport effort, catch, and harvest from an annual statewide mail survey (Mills and Howe 1992). Twelve or more responses are needed for estimates to be useable. There have been too few responses to estimate effort or harvests of salmon in the Neva Lake system but the sport fish harvest of sockeye salmon in the entire Excursion Inlet area (excluding Excursion River) has averaged only 34 fish from 1984 to 1999 (Table 4). There has been an increasing trend in sport effort and harvest in both the Excursion Inlet area (Table 4) and the Glacier Bay Area that includes Excursion Inlet (Table 5).

Aerial and foot escapement surveys have been conducted by ADF&G, Commercial Fisheries Division, intermittently since 1960. These surveys are primarily geared to indexing pink and chum salmon escapements. They should not be considered a reliable estimate or index of sockeye abundance without further study. Survey locations, dates, and observers are not standardized (Bevan 1961; Jones *et al.* 1998) and usually only a small fraction of the escapement is visible due to the forest canopy, dark water, and the natural dispersal of fish within a system. Nevertheless, counts as high as 1,250 sockeye salmon have been made in Neva Lake in recent years (Table 6).

Table 2. Historic commercial harvest of sockeye salmon in Icy Strait, and Hoktaheen Cove and Excursion Inlet (Neva), and Northern Chatham Strait, and Freshwater Bay (Pavlof), 1889 to 1927 (Rich and Ball, 1933).

Year	Icy Strait[a]	Hoktaheen Cove	Excursion Inlet	Northern Chatham Strait[b]	Freshwater Bay
1889	51,600				
1890	144,000			4,902	
1891	91,200				
1892				21,875	
1893					
1894					
1895				4,260	
1896				36,969	
1897				566	
1898					
1899					
1900	151,901			194,200	25,000
1901	96,547			131,055	
1902	218,084			128,080	
1903	236,167			241,175	
1904	432,262			199,200	
1905	584,275	8,279		93,664	
1906	375,459	11,348		177,200	
1907	511,265	7,000		121,394	
1908	661,140	10,677		256,619	
1909	626,511	10,391		304,351	
1910	609,802	9,896		150,892	
1911	635,726	7,196		158,956	
1912	818,162	7,197		248,964	1,000
1913	686,268	5,344		208,937	
1914	1,304,877	7,686	3	223,738	
1915	768,068	8,301		241,763	
1916	679,561			127,681	560
1917	712,770		6,036	270,713	179
1918	827,768	2,519	61	242,056	
1919	822,679	5,463	385	205,552	808
1920	608,953	3,218	50,722	173,875	
1921	271,138			91,406	
1922	425,725	653	390	103,996	
1923	518,006	5,266	78	86,297	30
1924	552,789	2,310	2,382	121,589	
1925	525,391	2,335	3,039	153,412	
1926	523,110	1,834	546	140,680	
1927	345,635	2,021	2,469	102,367	
Spearman's rho non-parametric trend test (Conover 1980):					
rho	0.46	-0.85	0.35	0.22	-0.83
P-value	0.01	0.00	0.30	0.21	0.04
N	31	20	11	33	6

[a] The beach seine, purse seine, gillnet, and traps in the Icy Strait District primarily targeted passing stocks. Hoktaheen and Excursion Inlet (Neva) are in this district.

[b] The Northern Chatham Strait area includes the beach seine, purse seine, gillnet, and trap harvests north of Pt. Gardner and Takatz Bay. Freshwater Bay (Pavlof) is in this district.

Table 3. Commercial purse seine effort and harvest of sockeye salmon in waters adjacent to Neva Lake (Icy Strait and Excursion Inlet), Pavlof Lake (Upper Chatham Strait and Freshwater Bay), and Hoktaheen Lake (Hoktaheen Cove), 1960 to 2002 (from ADF&G, Division of Commercial Fisheries, Alexander Database, 2003).

	Icy Strait (Dist. 114)		Excursion Inlet (Dist. 114-80)		Upper Chatham (Dist. 112)		Freshwater Bay (Dist. 112-50)		Hoktaheen Cove (Dist. 113-94)	
Year	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days	Sockeye Harvest	Boat-Days
1960	136,796	1,552			12,399	236	1,046	58		
1961	213,619	2,965			45,493	726	69	15		
1962	136,712	1,208			11,148	160	114	0		
1963	201,535	5,440			24,268	1,312	18	4		
1964	204,304	4,162	9		34,225	1,282				
1965	280,730	4,682	1		48,756	1,383	15	0		
1966	216,858	2,747	12		28,737	1,363	3	0		
1967	160,019	3,113	306		15,891	525	17	0		
1968	230,741	3,004	2		41,874	3,213	448	0	1,073	
1969	231,624	3,627			29,563	1,610				
1970	163,224	4,384	4	190	49,598	4,844	14	27	149	6
1971	88,758	3,188	3	232	18,533	1,728			315	36
1972	96,853	3,374	13	220	33,761	2,651	528	48	8	3
1973	130,805	1,714	10	102	32,118	620			205	4
1974	20,594	656	2	184	23,639	858				
1975	2,391	226	0	110						
1976	21	303	21	303						
1977										
1978					1,261	434				
1979	3	53	2	52	1,577	261	8	4		
1980	1,792	216	1,685	198	1,300	662				
1981	10,638	596	266	238	17,188	602				
1982	234	119			26,524	3,408				
1983	2,333	135	85	28	25,979	1,001				
1984	6,882	190	1,876	138	22,208	1,548				
1985	3,638	253	919	26	37,140	2,448				
1986	1,479	69	168	35	8,391	2,181				
1987	3,793	307	396	156	44,989	1,486				
1988	1,244	135	952	73	3,927	642				
1989	6,111	164	151	2	48,985	1,653				
1990	4,161	110	2,348	52	17,477	873				
1991	4,307	208	1,153	31	40,289	2,735				
1992	6,454	180	2,584	65	54,403	1,869				
1993	9,806	249	216	1	81,676	2,989				
1994	10,536	412			76,582	4,044				
1995	264	8	264	8	20,387	2,799	1,576	54		
1996					37,482	3,102				
1997	5,123	259	518	5	25,946	2,528	1,582	46		
1998					30,820	2,546				
1999	17,301	893	105	24	55,942	3,725				
2000	1,111	99	376	77	30,594	2,538				
2001	43,739	443			64,427	1,777				
2002	4,592	262			24,751	1,761				

Table 4. Sport fish effort and harvest in Excursion Inlet and Neva Lake, 1984 to 1999 (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2003).

Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Responses
1984	12	55	33	59	0	1
1985	163	130	121	50	0	3
1986	204	681	706	45	11	6
1987	225	449	444	44	110	6
1988	402	2,135	1,893	54	0	5
1989	290	273	321	152	28	10
1990	232	249	443	0	21	9
1991	724	1,252	3,164	176	0	19
1992	660	1,383	1,420	97	66	29
1993	588	1,042	1,062	163	0	24
1994	1,166	1,428	2,496	1,053	74	42
1995	1,113	1,419	3,042	290	34	40
1996	613	1,197	1,633	620	0	34
1997	1,170	1,921	2,867	840	50	52
1998	1,005	1,955	2,720	924	124	49
1999	1,257	1,675	3,357	2,762	32	51
Average	614	1,078	1,608	458	34	24
Spearman's non-parametric trend test:						
Rho	0.91	0.71	0.79	0.85	0.43	0.96
P-value	0.00	0.00	0.00	0.00	0.10	0.00
N	16	16	16	16	16	16

Table 5. Sport fish harvest and effort in the Sitka area (on and around Baranof and Chichagof Islands) and Glacier Bay areas, 1977 to 2001 (from ADF&G, Division of Sport Fish, Statewide Harvest Database, 2003).

		Sitka Area (includes Pavlof and Hoktaheen):					Glacier Bay Area (includes Excursion Inlet and Neva):				
Watertype	Year	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest	Number of Anglers	Number of Trips	Days Fished	Coho Harvest	Sockeye Harvest
Freshwater	1977			6,927	261	192			1,362	0	6
	1978			5,303	176	56			129	0	0
	1979			3,946	154	36			79	0	0
	1980			5,510	326	69			143	9	43
	1981			3,844	184	0			196	11	22
	1982			5,663	146	0			17	0	0
	1983			4,998	336	76			253	0	0
	1984	2,720	2,938	4,258	255	102	208	429	535	124	78
	1985	2,941	4,670	4,680	348	0	291	747	433	12	0
	1986	2,809	3,942	4,587	115	38	646	805	651	167	11
	1987	2,582	4,826	5,611	42	14	428	673	1,845	88	143
	1988	3,089	4,112	5,077	308	1,092	682	1,176	1,009	837	419
	1989	2,424	4,017	5,154	261	214	511	1,023	887	559	0
	1990	2,826	3,676	4,404	87	120	598	813	1,371	495	0
	1991	3,026	3,610	6,970	390	323	997	1,995	2,335	780	48
	1992	3,535	5,066	6,674	461	0	559	1,706	2,029	349	164
	1993	3,148	6,142	9,444	925	177	627	1,640	1,912	212	142
	1994	3,031	5,776	7,789	389	151	627	1,788	2,114	669	0
	1995	3,251	4,273	7,718	937	77	866	2,808	4,071	846	219
	1996	2,355	3,324	4,426	479	252	369	877	903	154	99
	1997	3,309	4,840	7,123	828	547	1,173	1,931	3,087	815	271
	1998	2,822	3,075	5,298	823	259	804	598	1,187	129	81
	1999	3,268	5,051	8,368	1,196	637	666	1,118	1,351	197	0
	2000	1,748	4,178	6,289	324	212	1,026	2,257	3,249	749	244
	2001	1,369	3,163	4,733	137	133	1,111	2,905	3,503	1,668	108
Spearman's non-parametric trend test:											
	Rho	0.00	0.07	0.37	0.50	0.56	0.67	0.61	0.77	0.78	0.48
	P-value	0.99	0.79	0.07	0.01	0.00	0.00	0.01	0.00	0.00	0.02
	N	18	18	25	25	25	18	18	25	25	25
Saltwater	1977			30,817	2,855	620			3,013	744	231
	1978			27,638	2,188	268			1,529	880	169
	1979			36,564	1,554	754			2,563	227	0
	1980			33,172	1,876	1,326			2,299	207	17
	1981			34,650	3,122	594			2,242	562	22
	1982			37,686	3,741	628			2,747	1,163	0
	1983			39,160	4,312	306			3,237	619	41
	1984	9,367	28,715	35,791	2,389	533	941	1,411	2,848	247	0
	1985	12,429	32,650	31,935	3,332	210	1,876	3,407	3,468	324	0
	1986	13,733	32,786	35,173	3,962	328	2,380	2,973	3,213	224	0
	1987	14,005	38,882	39,972	2,673	433	2,716	4,023	5,333	956	121
	1988	16,736	36,028	43,603	2,437	2,055	2,445	7,395	8,267	508	91
	1989	17,618	44,824	54,076	8,030	1,934	4,144	5,612	8,008	1,817	216
	1990	22,612	46,777	57,502	7,721	1,224	3,483	5,013	6,486	1,251	21
	1991	23,009	44,672	61,223	11,084	487	7,318	12,145	19,630	4,873	84
	1992	29,824	55,978	71,607	8,706	434	5,221	9,072	13,250	1,158	215
	1993	28,460	52,358	65,500	13,593	949	6,017	9,394	13,142	2,508	172
	1994	40,327	67,455	100,204	42,489	1,987	8,220	9,401	16,105	6,142	93
	1995	37,258	62,777	93,420	15,677	1,502	9,224	13,343	21,243	2,130	477
	1996	32,219	41,539	60,556	35,413	2,789	6,266	9,224	13,533	4,513	228
	1997	34,501	53,446	81,442	37,125	2,962	8,890	12,763	20,083	5,140	264
	1998	37,305	46,188	72,136	50,645	3,522	6,812	8,368	13,071	3,652	99
	1999	34,042	55,906	96,789	75,050	6,929	7,955	11,361	21,556	11,793	85
	2000	22,190	50,067	84,602	39,182	2,170	8,115	21,355	38,126	12,522	172
	2001	24,502	50,642	87,657	83,377	1,829	8,415	18,499	38,963	25,250	146
Spearman's non-parametric trend test:											
	Rho	0.74	0.68	0.91	0.92	0.68	0.87	0.86	0.94	0.84	0.46
	P-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	N	18	18	25	25	25	18	18	25	25	25

Table 6. Peak aerial, foot, or boat counts of sockeye salmon at Neva, Pavlof, and Hoktaheen, 1960 to 2002 (from ADF&G, Division of Commercial Fisheries, Alexander Database, May 2003).

	Neva Creek		Pavlof River		Hokatheen Cove	
Year	Number Counted	Number of Surveys	Number Counted	Number of Surveys	Number Counted	Number of Surveys
1960						
1961			200	1		
1962			300	1		
1963			850	1		
1964						
1965			2,500	3	3,000	1
1966			4,000	1		
1967			2,500	5		
1968			3,300	4	2,000	2
1969					1,500	2
1970						
1971						
1972					0	1
1973					500	2
1974						
1975						
1976						
1977					1,500	1
1978					500	1
1979						
1980						
1981			800	1		
1982			200	2		
1983			170	4		
1984			150	2		
1985			0	1		
1986			0	2		
1987			200	5		
1988	100	1				
1989	140	2	100	3		
1990	470	3	300	6		
1991	300	2				
1992	0	1	300	4		
1993	0	1	800	5		
1994	0	2	100	2		
1995	250	1	400	3		
1996	610	2	400	2		
1997	50	4	620	2	2	3
1998	123	10	350	5		
1999	810	4	40	3	150	2
2000	215	4	200	4	404	3
2001	1,250	4	300	2	745	3
2002	100	2	100	2		

Pavlof

Pavlof Lake (57°50.605' N, 135°02.672' W) is located on the northeast side of Chichagof Island (Figure 1). Pavlof Lake empties directly into Pavlof Harbor on the southeast side of Freshwater Bay. There is a short 4 m falls on the outlet. Pavlof Harbor is about 48 km by boat from Hoonah and Angoon and 24 km from Tenakee Springs. Pavlof Lake has a surface area of 36.6 ha, a maximum depth of 8 m, a mean depth of 2.3 m, a volume of 860,000 m^3, and an elevation of 5 m (Figure 4; Barto and Cook 1999). This small, shallow lake has an extensive growth of lily pads (*Nuphar* spp.) and other aquatic vegetation. The small lake does little to buffer rainfall or snowmelt events and there is a wide range in daily stream flows, particularly in the fall (Figure 5).

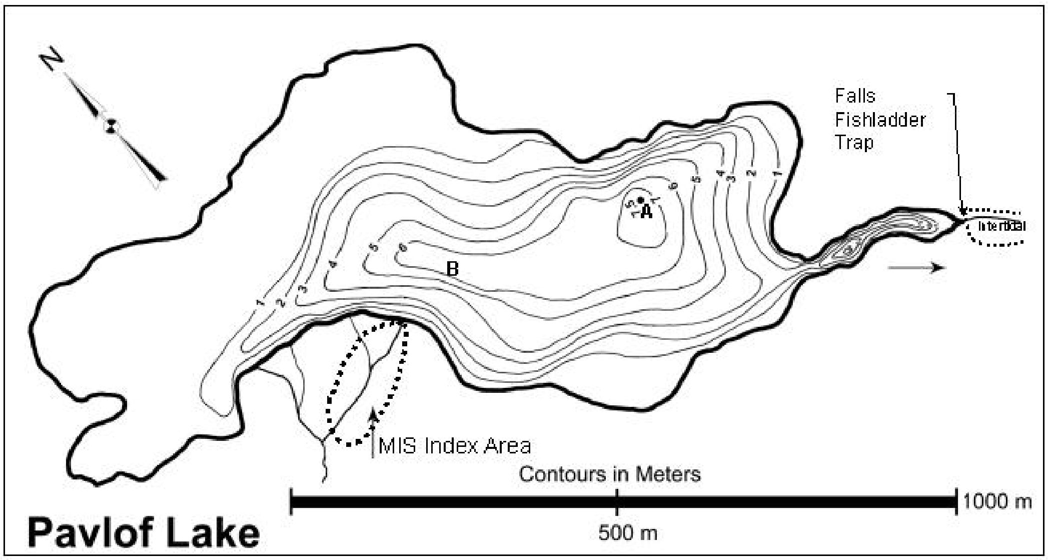


Figure 4. Bathymetric map of Pavlof Lake showing 1 m depth contours and locations of the two fixed sampling stations, the index area in the main inlet stream, and the fish pass and trap at the outlet of the lake (from ADF&G).

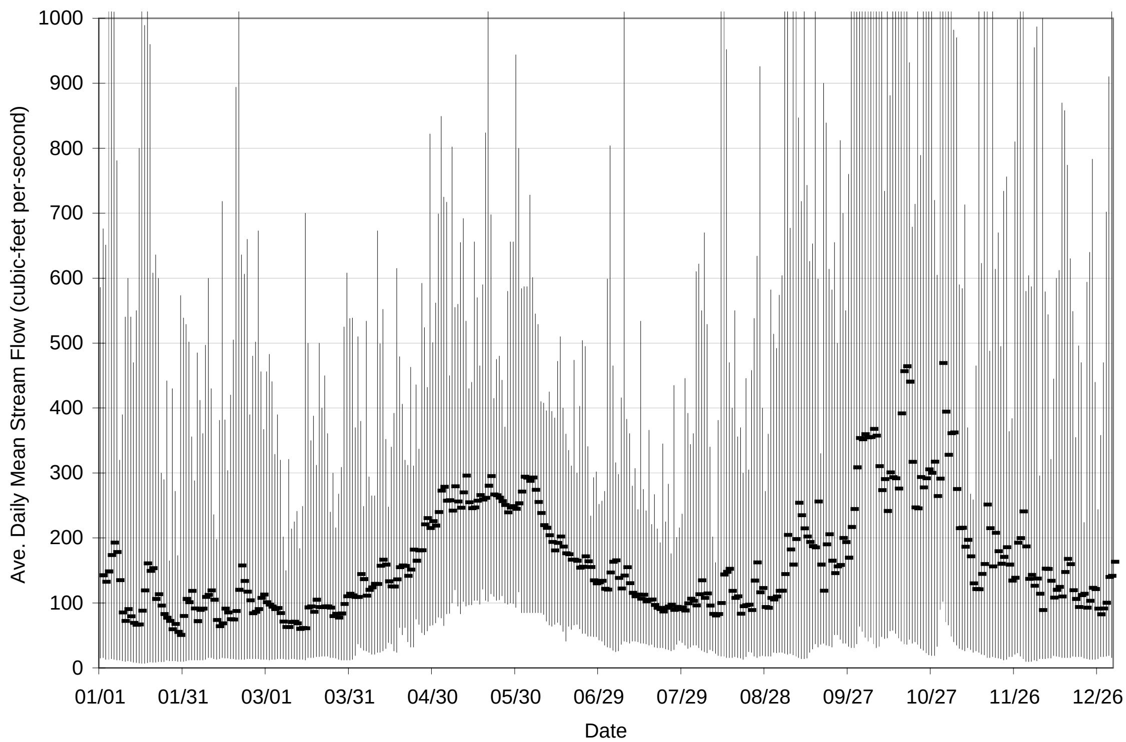


Figure 5. Average daily mean stream flow (cubic-feet per-second) and minimum and maximum (truncated at 1,000 from peaks up to 3,370) daily measurements for Pavlof River, June 1, 1957 to September 30, 1981. (From USGS)

The Pavlof Harbor area is in the traditional territory of Wooshkeetaan clan members associated with Angoon, Auk (Juneau), and Tenakee (Goldschmidt and Haas 1998). Goldschmidt and Haas reported that Wooshkeetan people from Angoon had lived for a time in a small village near Pavlof Harbor called Asaank'´i and that a smoke house was located below the waterfall at the outlet of Pavlof Lake. De Laguna (1960) interviewed an elderly man in Angoon who also collaborated Goldschmidt and Haas's report. He said when he was a small boy there were two "Wuckitan" lineage houses in a small village about a mile east of "the sockeye stream in Freshwater Bay". De Laguna (1960) clarifies that this territory originally belonged to an independent division of the Wuckitan, the Freshwater Bay branch, and that they subsequently "inherited rights at Angoon when the Kootznahoo branch of this sib became extinct." A picture of a Tlingit man gaffing salmon in 1901 in a Freshwater Bay creek (believed to be Pavlof Creek with the waterfall in the background) is shown on Page 107 in the book "The Tlingit Indians" by Emmons (1991).

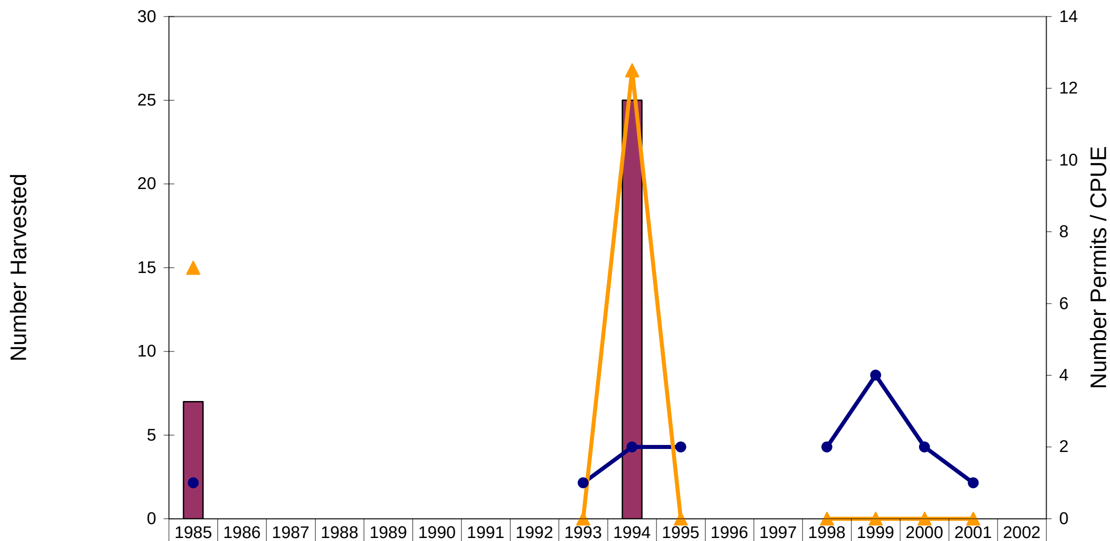
Shroeder and Kookesh (1990) report that a cannery was operated in Pavlof Harbor in 1889 and 1919-1923. The waterfall was incorporated into cannery operations. The Federal Works Progress Administration constructed a concrete fish ladder with 14 step pools on the left side (looking downstream) of the falls in 1935. Prior to the construction of this fish ladder it is believed that the cascading falls at the outlet of the lake was a partial barrier to upstream migrating salmon (Barto and Cook 1999). The USFS installed an aluminum "Alaskan steep pass" inside the concrete fish ladder in 1986. The USFS also installed an "Alaskan steep pass" fishpass on a waterfall in the main inlet tributary in 1987. The intent of this upper fishpass is to provide coho salmon with better access to upriver spawning and rearing habitat.

The State of Alaska currently holds title to the land around the lake and outlet but the majority of the watershed is on National Forest System Lands. Large portions of the watershed were clearcut logged in years 1977 to 1981, 1987 and 1988, and 1991 to 1993. Roads now traverse the watershed and provide vehicle access with Hoonah. The area immediately around the lake and outlet has not been logged and it is not possible to drive to the lake or outlet.

Barto and Cook (1999) conducted a limnology and fisheries investigation of Pavlof Lake in 1997. Their study evaluated rearing conditions for sockeye salmon and applied empirical sockeye production models developed by Koenings and Burkett (1987) to identify potential management or enhancement strategies for optimizing sockeye production. They concluded that the lake's sockeye carrying capacity was relatively small, that sockeye production was near capacity, and that coho production might be compromised if the lake was fertilized in an attempt to boost sockeye production.

Coho salmon spawners from Pavlof were a brood source for an ADF&G, Fisheries Rehabilitation Enhancement and Development Division's, effort to boost recreational sport fishing opportunities in the Juneau area. Between 1987 and 1996, 109 coho salmon adults were killed during egg take operations in late-September in the upper reaches of the main inlet stream. These eggs were incubated in Juneau and the fry released into Juneau area streams.

The Pavlof area is not in either a Federal or State customary and traditional use area. Subsistence use data ranked the Pavlof Lake area as high use by residents of Tenakee Springs and middle use by residents of Hoonah and Angoon (ADF&G, Subsistence Division, Tongass Land Management Plan Revision, 1996). Pavlof has not been listed on the annual subsistence/personal use permits issued by ADF&G and sockeye harvests have only been reported in two years (Figure 6).



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Sockeye	7								0	25	0			0	0	0	0	
Permits	1								1	2	2			2	4	2	1	
Fish/Permit	7								0	13	0			0	0	0	0	

Figure 6. Subsistence/personal use effort and harvest of sockeye salmon at Pavlof from 1985 to 2002 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries, Alexander Database, 2003).

Sockeye salmon returning to Pavlof Lake would be harvested in Icy Strait and Chatham Strait area fisheries. Rich and Ball (1933) reported six years of sockeye harvested in Freshwater Bay starting with 25,000 harvested in 1900 and ending with 30 in 1923 (Table 2). Sockeye harvests in Freshwater Bay since statehood (1959) are between zero and 1,582 fish (Table 3). These seine openings target pink salmon.

Pavlof Harbor is a popular anchorage for pleasure boaters and sport fishing for trout and salmon is also popular in the area. However, the sport harvest of sockeye salmon in the Pavlof area is small. Only nine sockeye salmon were reported harvested in the Pavlof Lake, Pavlof Bay, Freshwater Bay area from 1977 to 1999 (ADF&G, Division of Sport Fish, Statewide Harvest Survey database, 2002). The saltwater sport effort and harvests are trending upward in the area (Table 5).

Aerial and foot escapement surveys since 1980 have usually counted around 200 sockeye salmon in the Pavlof River (Table 6). The run timing of sockeye and pink salmon overlaps and the tannin stained water makes counting fish difficult.

Hoktaheen

Hoktaheen Lake (58°03.236' N, 136°30.381' W) is located on the northwest side of Yakobi Island, about 25 km from the community of Pelican (Figure 1). The lake is at about 51 m in elevation and drains a watershed area of about 20 km^2. It has a surface area of 67 ha, an average depth of about 20 m, and a maximum depth of about 50 m (Conitz and Cartwright 2002a; Figure 7). There are two lakes in the Hoktaheen Lake system. A short, 0.5 km, stream connects the larger, upper lake to the lower lake. The outlet of the smaller lake flows about 2 km to Hoktaheen Cove on the Gulf of Alaska.

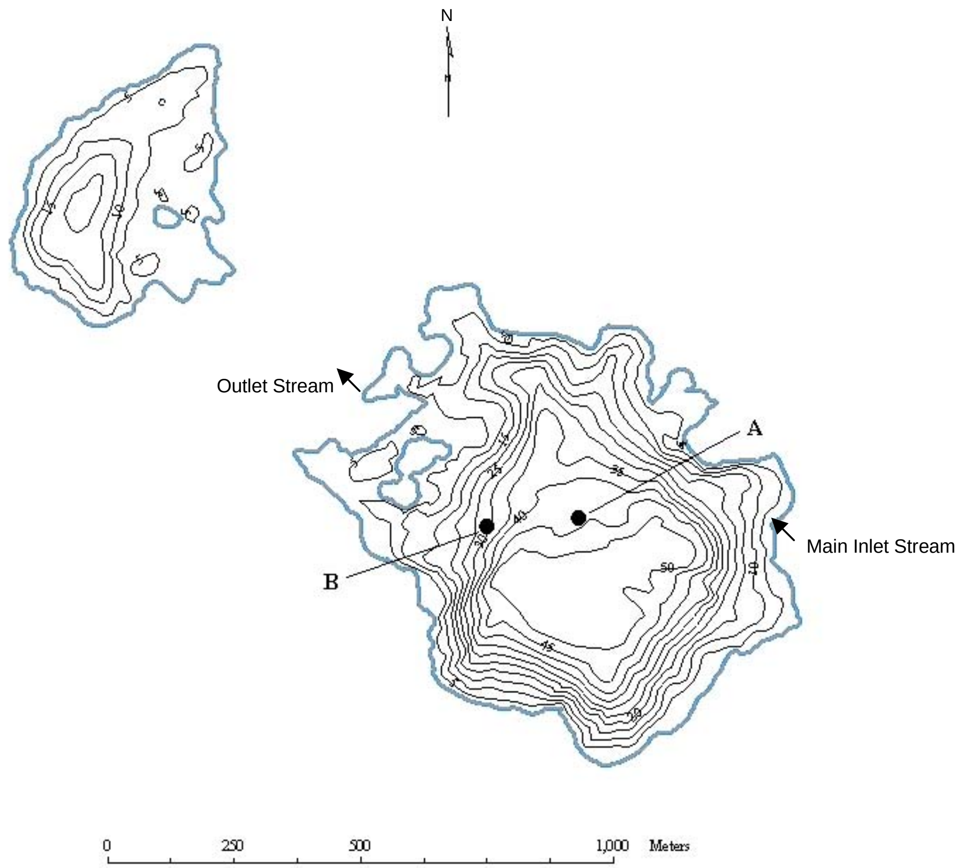
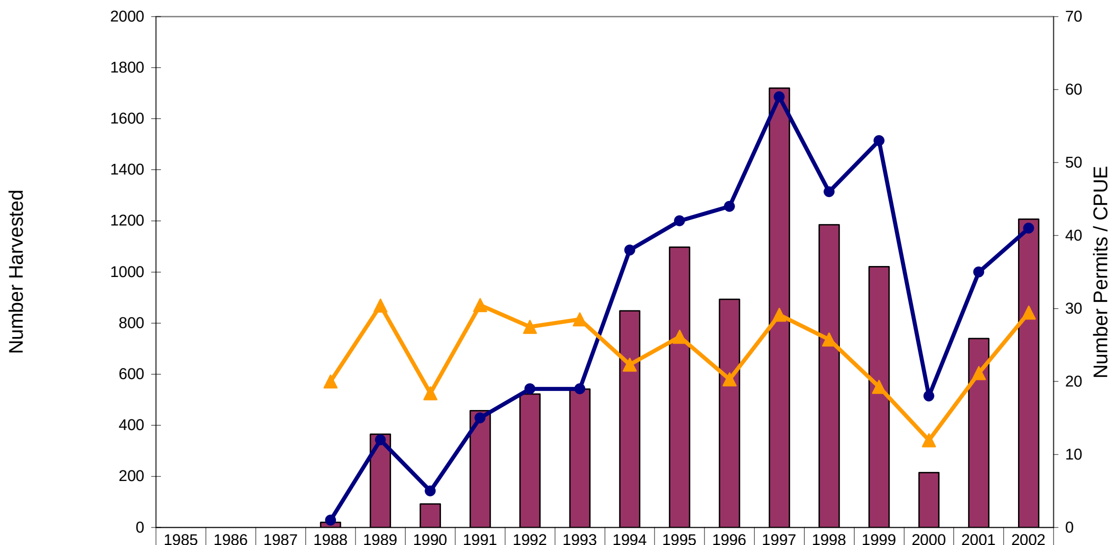


Figure 7. Bathymetric map of Hoktaheen Lakes with 5 m depth contours, location of limnology sampling stations A and B, and locations of the Main Inlet Stream and outlet.

The Hoktaheen Lake system on Yakobi Island is within the traditional subsistence harvesting and gathering area claimed by the Hoonah people. Goldschmidt and Hass (1946) believed that the Hoktaheen Cove area belonged to the T'akdeintaan clan. They reported that "Hoktaheen Creek is a good sockeye stream" and that smokehouses were located there. The summer camps and smoke houses are now gone but subsistence fishers from Hoonah, Pelican, and Elfin Cove continue to make day or overnight trips to Hoktaheen Cove. Travel is often by skiff and weather and sea conditions must be good for safe boating.

Hoktaheen Lake is in the West Chichagof Yakobi Wilderness Area. The entire watershed is on National Forest land.

The reported subsistence harvest of sockeye salmon at Hoktaheen peaked at 1,720 fish in 1997 (Figure 8). Harvests vary with effort and the fish-per-permit, a rough indicator of annual abundances, is variable but steady. The public has expressed concern about aggressive fishing and possible overharvest in the Hoktaheen subsistence and personal use fisheries (Conitz and Cartwright 2002a).



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Sockeye				20	365	92	457	522	542	848	1097	893	1720	1185	1021	215	740	1207
Permits				1	12	5	15	19	19	38	42	44	59	46	53	18	35	41
Fish/Permit				20	30	18	30	27	29	22	26	20	29	26	19	12	21	29

Figure 8. Subsistence/personal use effort and harvest of sockeye salmon at Hoktaheen from 1985 to 2002 as reported on permits returned to ADF&G (ADF&G, Division of Commercial Fisheries database, 2004).

The historical commercial harvests of sockeye salmon in Hoktaheen Cove decreased significantly (Spearman's rho rank correlation trend test, at $\rho = 0.05$; Conover 1980) from around 10,000 fish a year in years 1905 to 1910 to around 2,000 fish a year by 1927 (Rich and Ball 1933; Table 2). We don't know what the sockeye harvest was from then to statehood but less than 1,800 have been harvested since statehood and the last time Hoktaheen Cove was open to seining was in 1973 (Table 3). There have not been seine fisheries operating in the immediate vicinity of Hoktaheen Cove in recent years, but those at the mouth of Lisianski Inlet, in Icy Straits, and southward along the outside Chichagof Island coast may incidentally harvest some sockeye salmon returning to Hoktaheen Lake.

The sport harvest of sockeye salmon from Hoktaheen is unknown; the ADF&G, Division of Sport Fish Division's statewide harvest survey has received less than three responses a year from those fishing in the Hoktaheen area. However, the area around Hoktaheen

Cove has become increasingly popular for sport fishing since the late 1980s (Conitz and Cartwright 2002a).

Escapement surveys have only been done in a few years at Hoktaheen. These aerial surveys have been directed at indexing escapements of pink salmon and no surveys were flown in the 1980s and early 1990s. Recent counts have been in the hundreds and historical counts were in the thousands (Table 6).

OBJECTIVES

The original Investigation Plan listed the following objectives:

1) Estimate the annual escapement of sockeye salmon into Neva Lake such that the estimate is within 10% of the actual abundance 95% of the time.

2) Index the escapement of sockeye salmon into Pavlof Lake such that:
    a. The index reflects the actual annual abundance; and
    b. The index is not biased high.

3) Estimate the age, length, and sex composition of the sockeye escapements into Neva and Pavlof Lakes such that the estimates are within 10% of the true composition, 95% of the time.

4) Estimate the sockeye carrying capacity in Neva and Pavlof Lakes using established ADF&G limnological sampling and analytical procedures.

These objectives were expanded to include estimating the total escapement of sockeye salmon into Pavlof Lake and indexing the escapement of sockeye salmon in Hoktaheen Lake. The precision goals were also reworded to follow the revised objectives listed in Conitz and Cartwright (2002a). The revised objectives now read:

1) Use an outlet weir/trap and mark-recapture methods to estimate the annual escapement of sockeye salmon into Neva and Pavlof Lakes such that the estimated coefficient of variation is less than 10%.

2) Use mark-recapture methods to index the escapement of sockeye salmon into Neva, Pavlof, and Hoktaheen Lakes such that:
    a. The index reflects the actual annual abundance;
    b. The index is not biased high; and
    c. The estimated coefficient of variation is less than 15%.

3) Estimate the age, length, and sex composition of the sockeye escapements into Neva, Pavlof, and Hoktaheen Lakes such that the estimated coefficient of variation is less than 5%.

4) Collect baseline data on in-lake productivity of each lake using established ADF&G limnological sampling procedures which may include zooplankton sampling and vertical sub-surface temperature, dissolved oxygen, and light intensity measurements.

5) Describe the distribution of spawning sockeye salmon in the Neva Lake system using radio tags.

METHODS

Adult Sockeye Escapement Assessment

Neva

The escapement of adult sockeye salmon into Neva Lake was estimated using the combination of a weir and mark-recapture. Validating weir counts with a companion mark-recapture study is to assure that Objective #1, the estimate of total escapement, is accurate. Only the fish observed at a weir are counted and fish could pass uncounted before or after the weir is operated, at times when the weir is not operational, or through unknown breaks in the weir (McGregor and Bergander 1993; Shaul 1994; Kelley and Josephson 1997; Kelley and Bachman 1999; Kelley and Bachman 2000; Lewis and Cartwright 2002a; Conitz and Cartwright 2003b).

Independent mark-recapture studies and visual survey counts were also done to index the abundance of sockeye spawning in the main inlet stream (MIS) and lake. These visual or mark-recapture indices might prove to be a good predictor of the total escapement but three or more years of paired observations are needed to develop expansion factors (Heinl et al. 2000).

Weir.

Upstream migrating adult salmon, trout, and char were captured and counted as they were passed upstream of a trap mounted on the face of a weir installed across Neva Creek. The weir was placed about 80 meters downstream from the lake (58˚24.894' N, 135˚26.295' W). The weir was in place from June 4 to September 15 but project personnel had to pull pickets and allow fish to pass uncounted on three occasions late in the season due to work commitments at other locations. Separate counts were kept for adult and jack sockeye and coho salmon. Jacks were identified by their visual appearance.

The weir was constructed using an aluminum bipod and channel superstructure and 19.05 mm x 305 cm (¾ in x 10 ft) EMT conduit pickets (Appendix A). Seven bipods were used to support the 16.5 m wide weir. Upstream migrating salmon, trout, and char were counted and sampled from a 152.5 x 244 x 244 cm (5 x 8 x 8 ft), bear proof, trap attached to the front of the weir. The maximum gap between pickets in the weir and trap was 2.54 cm. Filter fabric was laid bank-to-bank under the weir and trap to control erosion and sandbags were placed end-to-end around the upstream base of both. Fish were passed upstream out of the trap through pulled pickets or through a "fish" door in the side of the trap and into quiet water created with a short sand bag and picket diversion. A plastic fish tub, aluminum fish-measuring trough, and scale card/data holder were mounted on the side of the trap next to the fish door. A labeled array of hand tally counters was used to initially record the number of adult and jack, marked and unmarked, salmon, trout, and char passed upstream. Five mL of a 20:80, Clove oil:ethyl alcohol (Everclear), mix in 40+ L fresh river water was occasionally used to lightly anesthetize the sockeye or coho salmon that were marked or scale sampled (Anderson et al. 1997).

The weather (clear, partly cloudy, overcast, showers, rain), stream depth, and water and air temperature was recorded at a gauging station located about 20 meters above the weir each morning between 0800 and 0900 hour. Recording thermometers (Onset Computer Corporation, "Optic StowAway Temp" loggers[1]) were also deployed on July 27, 2002 at the weir gauging station and in the lower part of the main inlet stream. These thermographs were placed about three inches below the streambed in short aluminum pipes. They recorded the temperature every six hours at 0000, 0400, 0800, 1200, 1600, and 2000 hour. Two additional thermographs were deployed at depths of 1 m and 13 m at Station A on May 23.

Weir-to-Spawning Ground Mark-Recapture Escapement Estimate.

The total escapement of sockeye salmon into Neva Lake was estimated by marking fish at the weir and sampling them for marks on the spawning grounds. A running average of half (50%) of the sockeye salmon counted through the weir each day were marked with an adipose fin clip and either a left axillary clip for the first third of the run, a left ventral clip for the middle third of the run, or a dorsal clip for the last third of the run. The dates for each third of the run were approximated as start-of-run to July 2, July 2 to July 21, and July 22 to end-of-run since there are no historical records of the timing of sockeye salmon into this system. These finclips involved severing the entire adipose fin, the entire axillary fin, the lower two-thirds of the ventral fin, and cutting across the posterior

[1] Product names used in this report are included for scientific completeness but do not constitute product endorsement.

base of the last four dorsal fin rays. Scissors were used to do the finclips. All clips could be done with the fish's head underwater.

Nine "recapture" trips were then made between August 9 and November 13 to examine sockeye salmon for marks in the main inlet stream (MIS) and beach spawning areas. Hand punches were used to give an opercule mark to all fish examined so fish were only sampled once (i.e., sampled without replacement). Again, separate counts were kept of the number of adult and jack sockeye salmon marked and examined for marks.

Stratified Darroch and "pooled" Peterson estimates and associated statistics (Standard Error, normal 95% Confidence Intervals) were calculated with the Stratified Population Analysis System (SPAS) software (Arnason et al. 1995). The Darroch estimator was used if either the SPAS test for "complete mixing" or "equal proportions" was significant at $P \leq 0.05$. Release and recovery strata for adults and jacks were pooled as needed to make abundance estimates and compare results.

***Stream and Beach Mark-Recapture Escapement Indexing*.**

Two, two-day, mark and recapture trips were made to estimate jack and adult sockeye salmon in both the main inlet stream (MIS) and the beach "index" areas. The stream "study area" was between the lake and 58˚24.561' N, 135˚23.967' W. All sockeye observed in the MIS were within the study area. The beach study area included two small (one set) beach spawning areas on the Southeast side of the lake between about 58˚23.981' N, 135˚24.246' W and 58˚23.949' N, 135˚24.348' W. Fish were captured in the MIS using dip nets and in the beach study areas with a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web. We assume that the sockeye spawning in the MIS and beach study areas are separate populations given their geographic and temporal separation.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given that trip's mark – a left opercule punch unique for that trip (round or triangle). All sockeye captured on the day 2 were also given that trip's right opercule punch to facilitate sampling without replacement. Records were kept, for jacks and adults, of the number of new fish marked on both days, the number of day 1 recaptures on day 2, and, on the second trip, the number of trip 1 recaptures on trip 2. All sampling was done without replacement by disregarding a fish with that trips left opercule punch on day 1 and disregarding a fish with that trips right opercule punch on day 2.

A two-sample Peterson estimate was calculated for each trip using the SPAS program. Use of a modified Jolly-Seber method for multiple mark-recaptures in an open population (Cook 1998; Crabtree 2001; Conitz and Cartwright 2003a) was not possible since three or more recovery events are needed (Seber 1982) and weather and manpower constraints limited us to only two mark-recapture trips to both the MIS and beach study areas.

***Visual Survey Counts*.**

Foot and boat surveys were conducted in conjunction with the MIS and beach mark-recapture indexing trips. In the MIS study area each observer counted live sockeye salmon when walking upstream and then when walking downstream. In the lake, each observer counted live sockeye salmon in, and out of, the beach study area from a skiff that was slowly motored around the perimeter of the lake. Each observer's counts were recorded separately and collectively they provide an estimate of what proportion of all the sockeye observed are in the study area(s). Separate counts were not made for adult and jack sockeye salmon.

Foot surveys were also done periodically through the summer to count the number of live sockeye and coho salmon in Neva Creek from the weir to the confluence with South Creek. Coho salmon were also counted in the MIS and lake on a few occasions.

***Age, Sex, and Length Sampling*.**

Adult sockeye salmon were sampled at the weir for age (scales), sex, and length data following standard ADF&G sampling procedures (ADF&G 2001). Approximately every fifth jack or adult sockeye salmon was systematically sampled through the course of the run. Tweezers were used to pluck three scales from the preferred area on the left side of the each fish (INPFC 1963). Scales were mounted on gummed "scale cards" (Clutter and Whitesel 1956) and sex and length data recorded on optical scanner data forms. Mid-eye to fork length was measured to the nearest millimeter by laying each fish on a fixed ruler in a "measuring trough". Scales were aged at the ADF&G, Commercial Fisheries Division, Aging Lab in Juneau. Age classes are recorded in European notation where a period separates the number of fresh water and marine annuli (Koo 1962).

After the scales were aged, the scale samples were stratified by age and sex as described by Conitz and Cartwright (2003a). Let n be the total number of samples aged, n_k be the number of samples in stratum k, and N be the estimated escapement. The proportion of each stratum k was calculated by

$$\hat{p}_k = \frac{n_k}{n} \qquad (1)$$

The estimated standard error was derived from the binomial formula with correction for finite population size (Thompson 1992, p. 35-36):

$$SE(\hat{p}_k) = \sqrt{\left(1 - \frac{n}{N}\right)\frac{\hat{p}_k(1-\hat{p}_k)}{n-1}} \qquad (2)$$

The estimated mean length and associated standard error for stratum k were calculated as the sample mean of a simple random sample (Thompson 1992, p. 42-43):

$$\bar{y}_k = \frac{1}{n_k}\sum_{i=1}^{n_k} y_{ki} \text{ , and } SE(\bar{y}_k) = \sqrt{\frac{1}{n_k}}\sqrt{\left(\frac{1}{n_k - 1}\right)\sum_{i=1}^{n_k}(y_{ki} - \bar{y}_i)^2} \quad (3)$$

Radio Tagging.

Seventeen adult sockeye salmon were radio tagged at the weir through the course of the summer. A study design called for radio tagging approximately one out of every 100 sockeye passed through the weir. The radio tags (transmitters) were manufactured by Advanced Telemetry Systems. The Model F1845 transmitters were bottle shaped, weighed 24 g, and were 51 mm long and 20 mm in diameter with a 30.5 cm long wire antenna. Their pulse rate was 65 min^{-1}. Inserting these "esophageal" transmitters involved threading the antenna through a 3 x 20 cm plastic tube and using this tube to gently push the transmitter through the fish's mouth and into the stomach. The antenna was left sticking out of the mouth. Tagged fish were measured for mid-eye-to-fork length then tagged and released quickly to minimize handling stress. Tagged fish were watched till they swam out of sight above the weir to check for tag loss or handling mortality.

Harvest Monitoring.

The weir technician made an effort to monitor the subsistence/personal use fishing activities during the period from June 1 to July 31 that the fishery was open. His route to and from the weir site, two or more times a day, enabled routine monitoring of fishing activities in and off the mouth of South Creek. Fishing activities in Neva Creek were monitored during routine foot surveys of the creek (see the "Visual Survey Counts" section above) and by occasional visits to the traditional fishing site in the lower part of the creek. An effort was made to get harvest and effort information by speaking directly with the participants but this was not always possible. Records were kept of all the sockeye subsistence fishing activity observed.

Pavlof

The original project plan was to index the annual escapement of Pavlof sockeye salmon by marking and recapturing them on the spawning ground. Plans were expanded to also estimate the total escapement by marking fish as they enter the lake through a trap installed at the top the existing fishpass and recapturing them on the spawning grounds. We assumed that sockeye migrate into Pavlof Lake both up the fish ladder and up the falls so the trap count was not anticipated to be the total escapement estimate.

This was the first fishery technician work for the Hoonah Indian Association crew working at Pavlof Lake. Project activities focused on camp and field safety and procedures, how to capture, handle, and sample fish, and basic record keeping. The crew lived in a floating wall tent anchored near the outlet of Pavlof Lake (Appendix B); this minimized habitat impacts and human-bear interactions.

Trap-to-Spawning Ground Mark-Recapture Estimate.

Upstream migrating salmon were captured and counted as they were passed upstream of a trap installed at the top of the outlet fishpass. Separate counts were not made for adults and jacks. All of the sockeye (and coho) salmon were marked with an adipose fin clip. The trap was in place from 1600 hour on June 21 to 1500 hour on August 8 but project personnel had to pull pickets and allow fish to pass uncounted on two occasions – June 28-30 and July 30–August 3 – due to manpower constraints and work commitments at other locations.

The aluminum channel and picket trap design was the same as used at the Neva weir (Appendix A). Salmon that ascended the fish pass were led through a "V" channel and picket entrance into the trap. The trap and V-entrance were on bedrock and sand bags were placed end-to-end around the outside of both.

Recording thermometers were deployed on July 29 at the top of the fish pass, at the lower end of the MIS, and at 1m and 6m depths at limnological sampling Station A (Figure 4). They recorded the temperature every six hours at 0000, 0400, 0800, 1200, 1600, and 2000 hour.

The crew did boat surveys around the lake and foot surveys up the main inlet stream in July and only found sockeye spawning in the lower part of the main inlet stream. The lower approximately 300 meters of the main inlet stream was designated the MIS study area. The upper end of the study area was at 57˚50.468' N, 135˚03.211' where there was a logjam extending across the river. Both left and right forks of the main inlet stream are included in the MIS study area but water only flows out the left fork at high water levels. A few sockeye salmon were observed upstream of the MIS study area but the highest concentration of fish was clearly between the upper end of the study area and where the river forks before emptying into Pavlof Lake.

One "recapture" trip was accomplished on August 4 and 5 to examine sockeye salmon for marks in the MIS study area. A 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh and No. 9 knotted Nylon web was used to catch the sockeye salmon in a sequence of sets from upstream to downstream. A mark-recapture trip was also attempted on July 29 using dip nets but the river was too deep and wide for this capture method to be effective. Hand punches were used to give an opercule mark to all fish examined as part of the "Stream Mark-Recapture Escapement Indexing" study (see below). These opercule marks enabled us to "sample without replacement". The SPAS software (Arnason et al. 1995) was used to make a pooled Peterson estimate of the total escapement.

Stream Mark-Recapture Escapement Indexing.

Three, two-day, mark and recapture trips were planned to the MIS index area from late July to late August. Sockeye salmon were abundant on July 29 but, as mentioned above, we only had dip nets and the water was too deep for us to catch them. On an August 27 trip, there were only a few sockeye salmon left in the stream following a period of heavy rain and high water. The crew did complete a successful, two-day, mark-recapture trip using the beach seine on August 4 and 5 to index the abundance of sockeye salmon in the MIS index area.

All sockeye captured on both the marking (day 1) and recapture (day 2) days were given a round opercule punch. All sockeye captured on the day 2 were also given a round right opercule punch. Records were kept of the number of new fish marked on both days and the number of day 1 recaptures on day 2. All sampling was done without replacement by disregarding a fish with that trips' left opercule punch on day 1 and disregarding a fish with that trips' right opercule punch on day 2. A simple Peterson estimate was calculated for the August 4 and 5 trip following the method described above for Neva Lake's index estimates.

Visual Survey Counts.

Foot and boat surveys were conducted in conjunction with the MIS mark-recapture indexing trips on July 29, August 5, and August 27. Counting procedures were the same as those used at Neva Lake.

Age, Sex, and Length Sampling.

Adult sockeye salmon were sampled at the trap for age (scales), sex, and length data. Sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Hoktaheen

The escapement of sockeye salmon into Hoktaheen Lake was indexed in 2001 by an Organized Village of Kake and ADF&G crew (Conitz and Cartwright 2002a). Their studies found sockeye spawning in an inlet stream on the East side of the upper (larger) lake (58˚03.379' N, 136˚30.973' W) and in the upper section of the stream that connects the two lakes. Live sockeye salmon were available for sampling in the MIS on their September 9 and 20 trips but only carcasses were in the MIS on October 2. Based on this information we planned four mark and recapture trips to index the sockeye escapement into Hoktaheen Lake between late August and late September.

Stream Mark-Recapture Escapement Indexing.

We completed three trips to index the escapement of Hoktaheen sockeye salmon on August 19-21, September 5-7, and September 17-18. There were no sockeye salmon available for sampling in either the MIS or outlet stream on the August 19-21 trip and a fourth trip planned for late-September was not possible due to stormy weather conditions. The crew marked and recaptured sockeye salmon in both the MIS and outlet streams on the September 5-7 and 17-18 trips. Dip nets were used to capture sockeye salmon in the MIS and a 21 m long by 3.66 m deep beach seine with 3.81 cm square mesh of No. 9 knotted Nylon web was used to capture sockeye off the mouth of the MIS and in the outlet. The index study area in the MIS included sockeye schooling immediately off the mouth of the stream and extended upstream to a bedrock section of the stream at 58˚03.897' N, 136˚30.951' W. Few sockeye were observed spawning above this MIS index area. The index study area in the outlet stream extended from the outlet of the upper lake at 58˚03.370' N, 136˚30.939' W downstream about 0.2 km. Again few sockeye salmon were observed spawning downstream from the index area.

All sockeye captured on both the marking and recapture days were given a unique mark for that trip (left square opercule punch or adipose finclip). All sockeye captured during the recapture day(s) were also given a right opercule punch. Records were kept of the number of new fish marked on both days and the number of day 1 recaptures on day 2. All sampling was done without replacement by disregarding a fish with that trips' mark on the marking day and disregarding a fish with that trips' right opercule punch on the recapture day(s).

Simple Peterson estimates were calculated for each day that fish were examined for marks. The abundance of sockeye salmon was estimated on September 5, 6, 7, and 18 in the MIS index area and on September 7 and 18 in the outlet index area.

Visual Survey Counts. Foot and boat surveys were conducted in conjunction with the mark-recapture indexing trips on August 20, September 6, and September 18. Counting procedures were the same as those used at Neva Lake.

Age, Sex, and Length Sampling.

Adult sockeye salmon were sampled for age (scales), sex, and length data from both the MIS and outlet study areas. The sampling, processing, and analysis procedures were the same as described above for the Neva Lake samples.

Limnology Sampling

Four limnology sampling trips were scheduled to each lake at approximately six-week intervals from mid-May through October. Sampling trips were actually competed on the following dates:

Neva Lake	Pavlof Lake	Hoktaheen Lake
5/23	5/24	5/24
7/26	7/29	8/20
8/25	8/27	9/6
10/5		9/17

Two buoy and anchor sampling stations, "Station A" and "Station B", were setup over the deepest part of each lake (Table 7). Zooplankton samples were taken at both stations and physical data at Station A.

Table 7. Latitude and longitude coordinates for the limnological sampling stations in Neva, Pavlof, and Hoktaheen Lakes, 2002.

Lake	Station A	Station B
Neva	58^{o}24.219' N, 135^{o}24.258' W	58^{o}24.270' N, 135^{o}24.290' W
Pavlof	57^{o}50.605' N, 135^{o}02.672' W	57^{o}50.629' N, 135^{o}02.921' W
Hoktaheen	58^{o}03.236' N, 136^{o}30.381' W	58^{o}03.292' N, 136^{o}30.630' W

Light, Temperature, and Dissolved Oxygen Profiles

The subsurface light intensity was measured at 0.5-meter intervals from just below (5 cm) the surface down to one percent of the surface light reading. Protomatic International Light and Licor LI-250 submarine photometers were used; readings were in footcandles and µmol s^{-1} m^{-2}, respectively. The vertical light extinction coefficient (K_d) and euphotic zone depth (EZD) was calculated following procedures described by Conitz and Cartwright (2002a). The vertical light extinction coefficient (K_d) was calculated as the slope of the light intensity (natural log of percent subsurface light) versus depth. The euphotic zone depth (EZD) was calculated as EZD = 4.6205/K_d and is defined as the part of the lake where photosynthesis is possible. Water transparency was also measured with a 20 cm diameter Secchi disk (Koenings *et al.* 1987).

All vertical temperature and dissolved oxygen (DO) measurements were made with a Yellow Springs Instruments Model 58 DO meter and probe except the May 23 measurements at Neva Lake were made with a Minnisonde 4a. The Model 58 DO meter was calibrated each trip by taking the average value of two 30 ml Winker titrations from a water sample collected at 1 m (Koenings *et al.* 1987). Readings were taken at one-meter intervals down to 20 meters then at five-meter intervals to within 2 m of the bottom or 50 meters, whichever is less. Dissolved oxygen (DO) readings were in mg L^{-1} and temperature readings were in ^{o}C. The mg L^{-1} DO readings were converted to percent O_2 saturation using the following formula:

$$\%O_2 saturation = (DO/(0.004399 * temp^2 - 0.381784 + 14.571252)) * 100 \quad (4)$$

The parameters in this equation were computed from data presented in Table 6.1 of Wetzel and Likens (2000). This regression of the solubility of O_2 on temperature had a correlation coefficient of 0.9998. No adjustment was made for altitude (barometric pressure) since Neva, Pavlof, and Hoktaheen Lakes are all at relatively low elevations of 44, 5, and 51 meters, respectively.

Zooplankton Composition and Density

A vertical zooplanton tow was made at both stations each trip. A 0.5 m diameter, 153 um mesh, 1:3 conical net was used. Vertical tows were pulled from 2 m from the bottom of the lake at 0.5 m sec^{-1}. Specimens were preserved in neutralized 10% formalin (Koenings *et al.* 1987). Zooplankton samples were analyzed at the ADF&G Commercial Fisheries Division Limnology Laboratory in Soldotna, Alaska. The identification to genus or species, enumeration, and density and biomass estimates were done as described by Conitz *et al.* 2002 and Koenings *et al.* 1987). The zooplankton density (individuals per m^2 surface area) and biomass (weight per m^2 surface area) were estimated by species and by the sum of all species (referred to as total zooplankton density or biomass).

The May 23 sample from Neva Lake was a single tow taken at Station A, the samples were preserved in 10% ethyl alcohol, and the sample was analyzed by Inverte, Inc. in Susquehanna, PA. The density (individuals per m^2 surface area) and mean wet length (mm) of the Cyclops, Bosmina, and Daphnia was measured.

RESULTS

Adult Sockeye Escapement Assessment

Neva

Weir and Weir-based Mark-Recapture Estimate of Total Escapement.

The adult salmon weir was in operation on the outlet of Neva Lake from June 4 to September 15 (Table 8; Appendix C.1). The weir was operated intermittently after August 29 and a concerned citizen passed an unknown number of fish through the trap on

June 3 when there was a surge of sockeye salmon moving upstream. Project personnel succeeded in finclipping a running average of 51% of the 3,397 adult sockeye and 1,074 jack sockeye that were physically counted through the weir. There was no indication of any handling mortality associated with the counting, marking, and sampling of fish at the weir. No fresh dead salmon were observed on the face of the weir or anywhere upstream.

Table 8. Daily counts, and estimated number, of sockeye salmon that passed through the Neva Creek weir, 2002.

	Daily Weir Counts:			Estimated Number Uncounted:			Estimated Daily Escapement:			Estimated Cum. Daily Escapement:						
Date	Adults	Jacks	Total	Adults	Jacks	Total	Adults	Jacks	Total	Adults	%	Jacks	%	Total	%	Comments:
6/4	0	0	0	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/5	0	0	0	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/6	0	0	0	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/7	0	0	0	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/8	0	0	0	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/9	0	0	0	0	0	0	0	0	0	0	0%	0	0%	0	0%	
6/10	1	0	1	0	0	0	1	0	1	1	0%	0	0%	1	0%	
6/11	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/12	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/13	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/14	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/15	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/16	0	0	0	0	0	0	0	0	0	1	0%	0	0%	1	0%	
6/17	1	0	1	0	0	0	1	0	1	2	0%	0	0%	2	0%	
6/18	2	0	2	0	0	0	2	0	2	4	0%	0	0%	4	0%	
6/19	0	0	0	0	0	0	0	0	0	4	0%	0	0%	4	0%	
6/20	1	0	1	0	0	0	1	0	1	5	0%	0	0%	5	0%	
6/21	0	0	0	0	0	0	0	0	0	5	0%	0	0%	5	0%	
6/22	1	0	1	0	0	0	1	0	1	6	0%	0	0%	6	0%	
6/23	1	0	1	0	0	0	1	0	1	7	0%	0	0%	7	0%	
6/24	0	0	0	0	0	0	0	0	0	7	0%	0	0%	7	0%	
6/25	0	0	0	0	0	0	0	0	0	7	0%	0	0%	7	0%	
6/26	1	0	1	0	0	0	1	0	1	8	0%	0	0%	8	0%	
6/27	62	0	62	0	0	0	62	0	62	70	2%	0	0%	70	1%	
6/28	35	0	35	0	0	0	35	0	35	105	3%	0	0%	105	2%	
6/29	0	0	0	0	0	0	0	0	0	105	3%	0	0%	105	2%	
6/30	31	0	31	0	0	0	31	0	31	136	4%	0	0%	136	3%	
7/1	188	0	188	0	0	0	188	0	188	324	9%	0	0%	324	7%	
7/2	333	7	340	0	2	2	333	9	342	657	18%	9	1%	666	13%	
7/3	52	2	54	184	1	185	236	3	239	893	24%	12	1%	905	18%	Fish passed uncounted by non-project person.
7/4	28	0	28	0	0	0	28	0	28	921	25%	12	1%	933	19%	
7/5	83	1	84	0	0	0	83	1	84	1,004	27%	13	1%	1,017	21%	
7/6	12	0	12	0	0	0	12	0	12	1,016	27%	13	1%	1,029	21%	
7/7	11	3	14	0	1	1	11	4	15	1,027	27%	17	1%	1,044	21%	
7/8	8	0	8	0	0	0	8	0	8	1,035	28%	17	1%	1,052	21%	
7/9	18	3	21	0	1	1	18	4	22	1,053	28%	21	2%	1,074	22%	
7/10	8	0	8	0	0	0	8	0	8	1,061	28%	21	2%	1,082	22%	
7/11	11	0	11	0	0	0	11	0	11	1,072	29%	21	2%	1,093	22%	
7/12	9	2	11	0	1	1	9	3	12	1,081	29%	24	2%	1,105	22%	
7/13	0	4	4	0	1	1	0	5	5	1,081	29%	29	2%	1,110	22%	
7/14	28	9	37	0	3	3	28	12	40	1,109	30%	41	3%	1,150	23%	
7/15	22	18	40	0	6	6	22	24	46	1,131	30%	64	5%	1,195	24%	
7/16	11	10	21	0	3	3	11	13	24	1,142	31%	77	6%	1,219	25%	
7/17	4	6	10	0	2	2	4	8	12	1,146	31%	85	7%	1,231	25%	
7/18	28	15	43	0	5	5	28	20	48	1,174	31%	105	9%	1,279	26%	
7/19	35	17	52	0	5	5	35	22	57	1,209	32%	127	10%	1,336	27%	
7/20	1	4	5	0	1	1	1	5	6	1,210	32%	132	11%	1,342	27%	
7/21	0	2	2	0	1	1	0	3	3	1,210	32%	135	11%	1,345	27%	
7/22	13	18	31	0	0	0	13	18	31	1,223	33%	153	13%	1,376	28%	
7/23	1	3	4	0	0	0	1	3	4	1,224	33%	156	13%	1,380	28%	
7/24	190	49	239	0	0	0	190	49	239	1,414	38%	205	17%	1,619	33%	
7/25	79	24	103	0	0	0	79	24	103	1,493	40%	229	19%	1,722	35%	
7/26	247	26	273	0	0	0	247	26	273	1,740	47%	255	21%	1,995	40%	
7/27	81	13	94	0	0	0	81	13	94	1,821	49%	268	22%	2,089	42%	
7/28	94	16	110	0	0	0	94	16	110	1,915	51%	284	23%	2,199	44%	
7/29	25	14	39	0	0	0	25	14	39	1,940	52%	298	25%	2,238	45%	
7/30	15	8	23	0	0	0	15	8	23	1,955	52%	306	25%	2,261	46%	
7/31	25	24	49	0	0	0	25	24	49	1,980	53%	330	27%	2,310	47%	
8/1	49	47	96	0	0	0	49	47	96	2,029	54%	377	31%	2,406	49%	
8/2	12	13	25	0	0	0	12	13	25	2,041	55%	390	32%	2,431	49%	
8/3	3	5	8	0	0	0	3	5	8	2,044	55%	395	33%	2,439	49%	
8/4	3	14	17	0	0	0	3	14	17	2,047	55%	409	34%	2,456	50%	
8/5	32	32	64	0	0	0	32	32	64	2,079	56%	441	36%	2,520	51%	
8/6	3	4	7	0	0	0	3	4	7	2,082	56%	445	37%	2,527	51%	
8/7	10	13	23	0	0	0	10	13	23	2,092	56%	458	38%	2,550	52%	
8/8	297	64	361	0	0	0	297	64	361	2,389	64%	522	43%	2,911	59%	
8/9	176	30	206	0	0	0	176	30	206	2,565	69%	552	46%	3,117	63%	
8/10	92	54	146	0	0	0	92	54	146	2,657	71%	606	50%	3,263	66%	
8/11	74	42	116	0	0	0	74	42	116	2,731	73%	648	53%	3,379	68%	
8/12	177	29	206	0	0	0	177	29	206	2,908	78%	677	56%	3,585	72%	
8/13	25	12	37	0	0	0	25	12	37	2,933	78%	689	57%	3,622	73%	

(continued)

Table 8. (continued)

Date	Daily Weir Counts: Adults	Jacks	Total	Estimated Number Uncounted: Adults	Jacks	Total	Estimated Daily Escapement: Adults	Jacks	Total	Estimated Cum. Daily Escapement: Adults	%	Jacks	%	Total	%	Comments:
8/14	26	9	35	0	0	0	26	9	35	2,959	79%	698	58%	3,657	74%	
8/15	38	42	80	0	0	0	38	42	80	2,997	80%	740	61%	3,737	75%	
8/16	26	15	41	0	0	0	26	15	41	3,023	81%	755	62%	3,778	76%	
8/17	33	19	52	0	0	0	33	19	52	3,056	82%	774	64%	3,830	77%	
8/18	54	20	74	0	0	0	54	20	74	3,110	83%	794	65%	3,904	79%	
8/19	24	21	45	0	0	0	24	21	45	3,134	84%	815	67%	3,949	80%	
8/20	22	18	40	0	0	0	22	18	40	3,156	84%	833	69%	3,989	81%	
8/21	31	25	56	0	0	0	31	25	56	3,187	85%	858	71%	4,045	82%	
8/22	54	25	79	0	0	0	54	25	79	3,241	87%	883	73%	4,124	83%	
8/23	39	8	47	0	0	0	39	8	47	3,280	88%	891	73%	4,171	84%	
8/24	15	14	29	0	0	0	15	14	29	3,295	88%	905	75%	4,200	85%	
8/25	20	20	40	0	0	0	20	20	40	3,315	89%	925	76%	4,240	86%	
8/26	16	11	27	0	0	0	16	11	27	3,331	89%	936	77%	4,267	86%	
8/27	19	16	35	0	0	0	19	16	35	3,350	90%	952	78%	4,302	87%	
8/28	28	12	40	0	0	0	28	12	40	3,378	90%	964	79%	4,342	88%	
8/29	17	10	27	9	6	16	26	16	43	3,404	91%	980	81%	4,385	89%	Pickets pulled at 0930hr.
8/30			0	18	13	31	18	13	31	3,423	92%	993	82%	4,416	89%	Pickets re-installed at 1700hr.
8/31	43	23	66	0	0	0	43	23	66	3,466	93%	1,016	84%	4,482	91%	
9/1	16	10	26	0	0	0	16	10	26	3,482	93%	1,026	85%	4,508	91%	
9/2	45	35	80	0	0	0	45	35	80	3,527	94%	1,061	87%	4,588	93%	Pickets pulled at 1730hr.
9/3	13	14	27	9	6	16	22	20	43	3,549	95%	1,081	89%	4,630	94%	Pickets re-installed at 1145hr.
9/4	22	9	31	0	0	0	22	9	31	3,571	96%	1,090	90%	4,661	94%	Pickets pulled at 1745hr.
9/5			0	18	13	31	18	13	31	3,589	96%	1,103	91%	4,692	95%	
9/6			0	18	13	31	18	13	31	3,608	97%	1,115	92%	4,723	95%	
9/7			0	18	13	31	18	13	31	3,626	97%	1,128	93%	4,754	96%	
9/8			0	18	13	31	18	13	31	3,645	98%	1,141	94%	4,785	97%	
9/9	6	9	15	9	6	16	15	15	31	3,660	98%	1,156	95%	4,816	97%	Pickets re-installed at 1730hr.
9/10	28	7	35	0	0	0	28	7	35	3,688	99%	1,163	96%	4,851	98%	
9/11	0	5	5	0	0	0	0	5	5	3,688	99%	1,168	96%	4,856	98%	
9/12	5	0	5	0	0	0	5	0	5	3,693	99%	1,168	96%	4,861	98%	
9/13	4	9	13	0	0	0	4	9	13	3,697	99%	1,177	97%	4,874	98%	
9/14	3	0	3	0	0	0	3	0	3	3,700	99%	1,177	97%	4,877	99%	
9/15	1	11	12	37	25	62	38	36	74	3,738	100%	1,213	100%	4,951	100%	Pickets pulled for season at 1400hr.
Total	3,397	1,074	4,471	341	139	480	3,738	1,213	4,951							

Sockeye salmon were sampled for marks in the main inlet stream (MIS) that flows into the Northwest end of the lake on five occasions and in the beach index area on four occasions. One hundred and thirty three marked adult and 39 marked jack sockeye salmon were recovered. Combinations of pooled and non-pooled, adult and jack, Darroch and Pooled Peterson methods all yielded similar estimates (Table 9). I estimate that 4,951 sockeye salmon escaped into Neva Lake in 2002 – 3,738 adults and 1,213 jacks (Tables 8 and 9). The weir count was 10% less than the estimated total escapement (Table 10).

Table 9. Mark-recapture estimate of the escapement of sockeye salmon in Neva Lake, 2002.

Marking Data: At the Neva Creek weir: Marking Dates	Finclip Strata	Weir Count	Number Marked	Recapture Data: Main Inlet Stream Aug. 9	Aug. 10	Aug. 24	Aug. 25	Sept. 11	Beach Oct. 5	Oct. 6	Nov. 12	Nov. 13	Total	% Recap-tured	Darroch Abundance Estimate: Number[a]	S.E. (Number)	Probability of Capture	S.E. (Prob. Capture)	Pooled Peterson Estimate: Number	S.E. (Number)
Adults 3x9 (all data, no pooling)																				
				Number recaptured:											(Complete mixing Significance = 0.01, Equal proportions significance = 0.88)					
June 10 to July 2	Left Axillary	426	196	4	4	8	2	0	0	0	0	0	18	9%	730	282	0.27	0.10		
July 2 to July 21	Dorsal	600	317	11	2	12	11	0	0	0	0	0	36	11%	523	210	0.61	0.24		
July 22 to Sept. 15	Left Ventral	2371	1,213	0	0	2	4	3	23	24	8	15	79	7%	2,541	214	0.48	0.04		
	Total	3,397	1,726	15	6	22	17	3	23	24	8	15	133		3,795	255			3,775	230
				Number examined for marks and Percent Marked:											(CV = 7%)				(CV = 6%)	
				34	19	52	34	8	49	45	20	31	292							
				44%	32%	42%	50%	38%	47%	53%	40%	48%	46%							
Jacks 3x9 (all data, no pooling)																				
				Number recaptured:																
June 10 to July 2	Left Axillary	0	0	0	0	0	0	0	0	0	0	0	0		See "Jacks 2x5" below, no jacks were observed at the weir prior to July 2.					
July 2 to July 21	Dorsal	103	51	0	0	4	2	0	0	0	0	0	6	12%						
July 22 to Sept. 15	Left Ventral	971	500	0	0	4	5	0	12	11	0	1	33	7%						
	Total	1,074	551	0	0	8	7	0	12	11	0	1	39							
				Number examined for marks and Percent Marked:																
				2	1	18	13	0	23	26	1	3	87							
				0%	0%	44%	54%		52%	42%	0%	33%	45%							
Adults 2x9																				
				Number recaptured:											(Complete mixing Significance = 0.00, Equal proportions significance = 0.88)					
June 10 to July 21	LA & D Pooled	1,026	513	15	6	20	13	0	0	0	0	0	54	11%	**1,210**	129	0.42	0.05		
July 22 to Sept. 15	Left Ventral	2,371	1,213	0	0	2	4	3	23	24	8	15	79	7%	**2,528**	212	0.48	0.04		
	Total	3,397	1,726	15	6	22	17	3	23	24	8	15	133		**3,738**	232			3,775	230
				Number examined for marks and Percent Marked:											(CV = 6%)				(CV = 6%)	
				34	19	52	34	8	49	45	20	31	292							
				44%	32%	42%	50%	38%	47%	53%	40%	48%	46%							
Jacks 2x5																				
				Number recaptured:											(Complete mixing Significance = 0.17, Equal proportions significance = 0.73)					
June 10 to July 21	LA & D	103	51			4		2	0	0		0	6	12%	**135**	60	0.38	0.17		
July 22 to Sept. 15	Left Ventral	971	500			4		5	12	11		1	33	7%	**1,078**	158	0.46	0.07		
	Total	1,074	551			8		7	12	11		1	39		**1,213**	143			1,213	135
				Number examined for marks and Percent Marked:											(CV = 12%)				(CV = 11%)	
				2	1	18	13	0	23	26	1	3	87							
				0%	0%	44%	0%		52%	42%	0%	33%	45%							
Adults and Jacks 2x9																				
				Number recaptured:											(Complete mixing Significance = 0.00, Equal proportions significance = 0.83)					
June 10 to July 21	LA & D	1,129	564	15	6	24	15	0	0	0	0	0	60	11%	1,353	143	0.42	0.04		
July 22 to Sept. 15	Left Ventral	3,342	1,213	0	0	2	4	3	23	24	8	15	79	7%	3,596	260	0.48	0.03		
	Total	4,471	1,777	15	6	26	19	3	23	24	8	15	139		4,948	271			5,003	269
				Number examined for marks and Percent Marked:											(CV = 5%)				(CV = 5%)	
				34	19	52	34	8	49	45	20	31	292							
				44%	32%	50%	56%	38%	47%	53%	40%	48%	48%							

[a] The final estimates are in bold type - **3,738** adults (CV = 6%) plus **1,213** jacks (CV = 12%) equals a total sockeye escapement of **4,951** (CV = 8%).

Table 10. Observed (weir counts) and expected (mark-recapture) estimates of sockeye salmon escapement into Neva Lake, 2002.

	Counted through weir:					ML Darroch M-R estimate:			Difference Weir from Mark-Recapture:			
Period	Adults	Jacks	Total	Adults Marked	Jacks Marked	Adults	Jacks	Total	Adults	Jacks	Total	% Relative Difference
6/4-7/21	1,026	103	1,129	513	51	1,210	135	1,345	-184	-32	-216	-16%
7/22-9/15	2,371	971	3,342	1,213	500	2,528	1,078	3,606	-157	-107	-264	-7%
Total	3,397	1,074	4,471	1,726	551	3,738	1,213	4,951	-341	-139	-480	-10%
	76%	24%	100%			75%	25%	100%				

I estimated the daily passage of jack and adult sockeye salmon through the weir using weir counts and mark-recapture results (Table 8). The mark-recapture estimate of adult sockeye that passed through the weir prior to July 22 was 184 fish higher than the weir count. I assumed that these fish passed uncounted on July 3 when a concerned citizen pulled pickets and passed fish during the first surge of fish at the weir (Figure 9). The remaining 32 jacks that were estimated to have passed prior to July 22 were added to the daily jack counts in proportion to the number of jacks counted during this period. The additional 157 adults and 107 jacks that were estimated to have passed after July 21 were apportioned among the days near the end of the run that the crew had to pull pickets due to work commitments at other locations. The half days that the weir was operational were weighted 0.5 and the last day was weighted 2.0 since a few sockeye salmon were still passing when the weir was pulled on September 15.

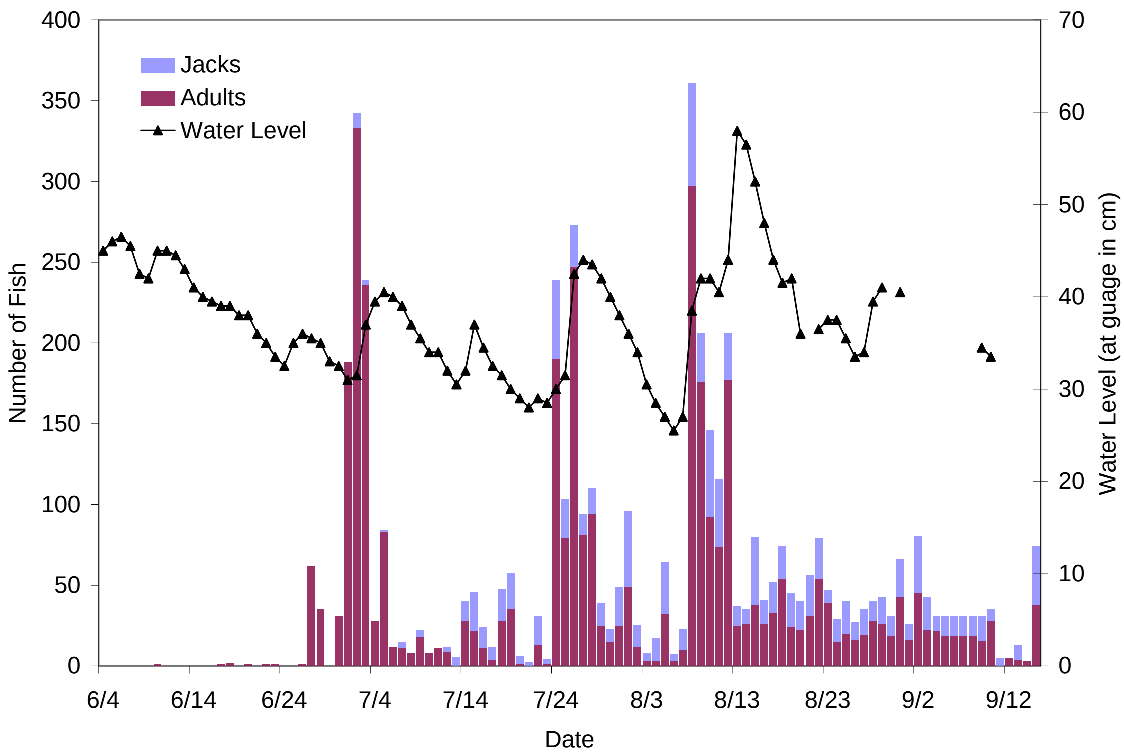


Figure 9. Daily escapement of jack and adult sockeye salmon and water level at the Neva Creek weir, 2002.

There were three surges of sockeye passage through the weir, each timed with rainfall events and increases in water level (Figure 9). The sockeye run was quite protracted. The first sockeye passed on June 10 and a few sockeye salmon were still entering the lake when the weir was pulled on September 15.

Project personnel also recorded the number of other salmon, trout, and char that they passed upstream through the Neva Creek weir. These unexpanded counts totaled 496 adult coho salmon, 85 jack coho salmon, 98 pink salmon, 2 chum salmon, 12 cutthroat trout, and 287 dolly varden char (Appendix C.1).

Stream and Lake Mark-Recapture for Indexing Escapement.

Two mark-recapture trips were successfully accomplished in both the MIS (August 9-10 and 24-25) and lake index areas (October 5-6 and November 12-13; Table 11). The Peterson estimates (and coefficient of variations) of the number of adult and jack sockeye salmon in the index areas on each trip were 100 (20%) and 151 (9%) in the MIS and 206 (13%) and 96 (20%) in the lake.

Table 11. Mark and recapture data, and abundance estimates, for sockeye salmon in the main inlet stream (MIS) and lake index areas, Neva Lake, 2002.

			Adults								Jacks								Adults and Jacks		
Location and Trip Number	Date	Mark Used[a]	Number Marked	Number Examined for Marks[b]	Trip #1 Recaps	Trip #2 Recaps	Total Recaps	Peterson Estimate	SE	CV	Number Marked	Number Examined for Marks[b]	Trip #1 Recaps	Trip #2 Recaps	Total Recaps	Peterson Estimate	SE	CV	Total	SE	CV
MIS #1	Aug-09	LRO	33	-	-	-	-	-	-	-	2	-	-	-	-	-	-				
	Aug-10	LRO	19	29	10	-	10	92	18	19%	1	1	0	-	0	-	-		100	20	20%
								(95% CI = 57 - 126)											(95% CI = 62 - 138)		
MIS #2	Aug-24	LTO	52	54	2	-	2	-	-		18	18	0	-	0	-	-				
	Aug-25	LTO	27	53	0	26	26	105	10	9%	12	19	0	7	7	47	9	20%	151	14	9%
								(95% CI = 85 - 124)								(95% CI = 28 - 64)			(95% CI = 124 - 178)		
Beach #1	Oct-05	LRO	49	-	-	-	-	-	-		23	-	-	-	-	-	-				
	Oct-06	LRO	27	45	18	-	18	120	16	14%	19	25	6	-	6	88	23	26%	206	27	13%
								(95% CI = 88 - 152)								(95% CI = 43 - 132)			(95% CI = 154 - 258)		
Beach #2	Nov-12	LTO	20	20	0	0	0	-	-		1	1	0	-	0	-	-				
	Nov-13	LTO	31	40	0	9	9	85	16	19%	3	3	0	0	0	-	-		96	19	20%
								(95% CI = 53 - 117)											(95% CI = 58 - 132)		

[a] LRO = left round opercule punch; LTO = left triangle opercule punch.

[b] Sampled without replacement.

There was no mixing of marked fish observed between the MIS and beach index areas. There was a geographic and temporal separation in the sockeye spawning in these two areas. Sockeye spawned in the MIS from late July through late September and on the beaches from mid-September through November.

Visual Survey Counts.

Foot surveys of Neva Creek, from the weir to below the lowest subsistence fishing site (just above the swift water section as Neva Creek flows into South Creek), were done periodically from June 1 to November 13 (Table 12). Double-digit counts of sockeye salmon were made on only 8 of the 36 surveys. The counts were highest in early June and late July (the subsistence/personal use fishing is open from June 1 to July 31). The 248 adult sockeye counted in 34 surveys prior to August 2 represented 12% of the pre-August 2 escapement. The daily foot survey counts were a poor predictor of weir counts. The best fit had an $r^2 = 0.35$ when daily weir counts were regressed on the daily survey counts with a lag of 0-days (Figure 10) although I tried different combinations of moving averages and laggings.

Table 12. Foot survey counts of live sockeye and coho salmon in Neva Creek, 2002

Date	Observer	Sockeye	Coho
01-Jun	Van Alen	0	0
09-Jun	Lonn	0	0
10-Jun	Lonn	0	0
17-Jun	Lonn	0	0
19-Jun	Lonn	0	0
24-Jun	Lonn	0	0
27-Jun	Lonn	1	0
28-Jun	Lonn	3	0
29-Jun	Lonn	4	0
01-Jul	Lonn	10	0
02-Jul	Lonn	38	0
03-Jul	Lonn	15	0
04-Jul	Lonn	30	0
05-Jul	Lonn	7	0
06-Jul	Lonn	5	0
07-Jul	Lonn	1	0
08-Jul	Lonn	6	0
09-Jul	Lonn	2	0
11-Jul	Lonn	1	0
12-Jul	Lonn	7	0
13-Jul	Lonn	5	0
14-Jul	Lonn	8	0
15-Jul	Lonn	4	0
17-Jul	Lonn	2	0
20-Jul	Lonn	0	0
21-Jul	Lonn	19	0
22-Jul	Lonn	5	0
23-Jul	Lonn	0	0
24-Jul	Lonn	14	0
27-Jul	Lonn	35	0
28-Jul	Lonn	5	0
30-Jul	Lonn	8	0
31-Jul	Lonn	10	0
01-Aug	Lonn	3	0
06-Oct	Van Alen	0	2
13-Nov	Van Alen	0	0
Total		248	2

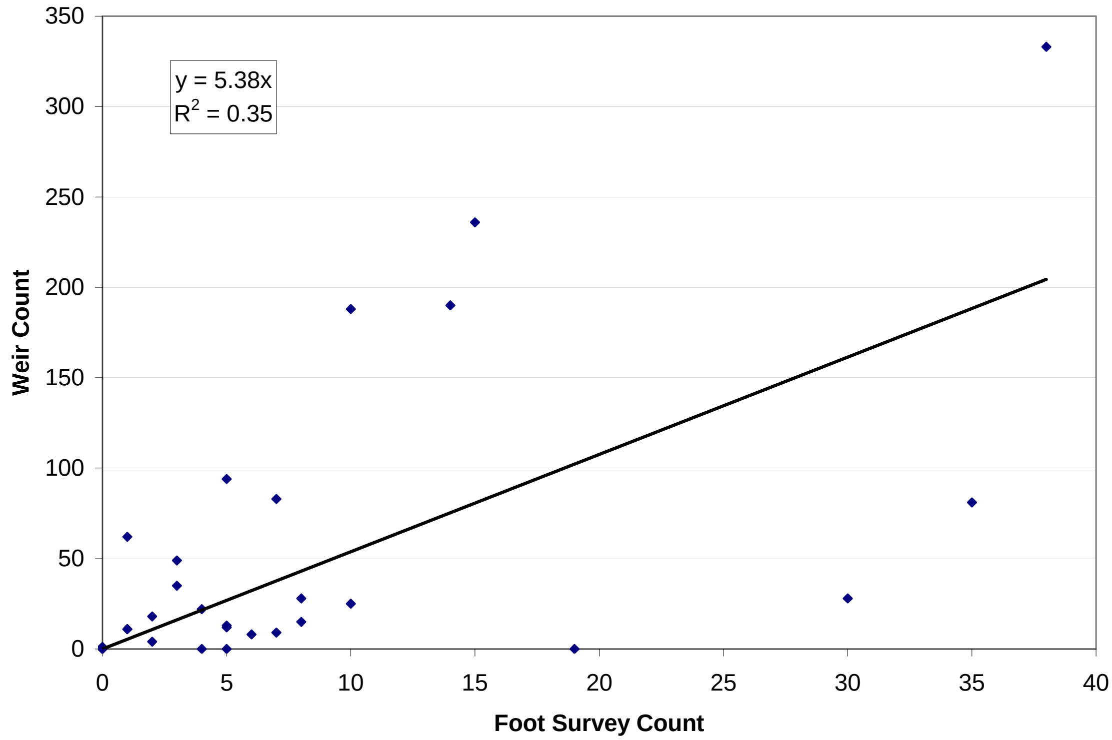


Figure 10. Foot survey counts of live sockeye salmon in Neva Creek on Neva Creek weir counts lagged 0 days, 2002.

Foot survey counts were made for sockeye salmon on eight occasions in the MIS index area (Table 13). Sockeye counts were highest in the August 15 and 24 surveys, 120 and 80 fish, respectively.

Table 13. Foot survey counts of sockeye salmon in Neva Lake's main inlet stream, 2002.

Date	Observer	Count Walking Upstream	Count Walking Downstream	Average
Jul-26	Lonn	2	2	2
	Van Alen	2	2	2
	Average	2	2	2
Aug-10	Abbott	17	22	20
	Gallant	15	16	16
	Lonn	15	17	16
	Sanders	9	4	7
	Average	14	15	14
Aug-15	Lagoudakis/Sanders	120		120
Aug-24	Abbott	82	67	75
	Gallant	86		86
	Van Alen	80	77	79
	Average	83	72	80
Sep-09	Abbott	25	45	35
	Gallant	35	43	39
	Average	30	44	37
Sep-10	Abbott/Gallant	32	29	31
Oct-05	Gallant	0	0	0
	Sanders	0	0	0
	Van Alen	0	0	0
	Average	0	0	0
Nov-12	Abbott	0	0	0
	Gallant	0	0	0
	Van Alen	0	0	0
	Average	0	0	0

Boat survey counts were made for sockeye salmon on six occasions in Neva Lake (Table 14). Sockeye counts peaked off the MIS in early August, peaked off and on index beaches in early October. There were still sockeye milling off the index beaches waiting to spawn when we made our last trip of the season on November 12-13.

Table 14. Boat survey counts of sockeye salmon in Neva Lake, 2002.

			Area of Lake							
					NE		SE			
Date	Observer	Boat Operator	SW	NW	Away from MIS	Near MIS	Off Index Beaches	On Index Beaches	Total	% on Index Beaches
Aug-10	Abbott		7	11		37	1		56	
	Gallant		5	0		71	0		76	
	Lonn		6	15		280	5		306	
	Sanders	yes	6	0		4	0		10	
	Average		6	7		98	2		112	
Aug-24	Abbott								82	
	Gallant								37	
	Van Alen	yes							50	
	Average								56	
Sep-10	Abbott		52	23	23	120	85		303	
	Gallant		53	19	14	110	93		289	
	Average		53	21	19	115	89		296	
Oct-05	Gallant		31	92	35	6	272	53	489	11%
	Van Alen		63	140	41	7	300	66	617	11%
	Average		47	116	38	7	286	60	553	11%
Oct-06	Gallant		10	26	67	10	51	93	257	36%
	Sanders	yes						91		
	Van Alen		8	43	33	9	99	93	285	33%
	Average		9	35	50	10	75	92	271	34%
Nov-12	Abbott		0	0	0	0	60	60	120	50%
	Gallant	yes	0	0	0	0	39	55	94	59%
	Van Alen		0	0	0	0	65	61	126	48%
	Average		0	0	0	0	55	59	113	52%

The visual survey counts were small relative to the total sockeye escapement. The highest relative count of adult sockeye salmon was from a boat survey on October 5 when 553 were counted in a boat survey around the lake – 15% of the estimated 3,738 adult sockeye escapement and 11% of the 4,951 total escapement.

Coho salmon were difficult to count in the system but counts of 50, 43, and 23 were made during lake surveys on October 5, 6, and November 12 (Table 15).

Table 15. Survey counts of coho salmon in the Neva Lake area, 2002.

Location	Date	Observer	Count
Neva Creek	Oct-06	Van Alen	2
Main Inlet Stream	Oct-05	Van Alen	1
	Nov-12	Van Alen	2
Lake	Oct-05	Van Alen	50
	Oct-06	Van Alen	43
	Nov-12	Van Alen	23

Age, Sex, and Length Composition

Ninety-five percent of the Neva sockeye escapement were "one check", age-1.-, fish aged 1.2 (45%), 1.3 (28%), and 1.1 (jacks, 22%, Table 16, Appendix C.2). The high proportion of jacks resulted in a sex composition of 60 percent males.

Table 16. Age and sex composition of sockeye salmon in the Neva Lake escapement, 2002.

	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
Male									
Sample Size	1	116	131	1	85	8	1	1	344
Percent	0.1	22.4	22.0	0.5	13.1	1.9	0.1	0.1	60.1
Std. Error	0.1	2.0	1.9	0.5	1.5	0.7	0.1	0.1	2.2
Escapement	5	1,105	1,090	24	649	93	4	5	2,975
Female									
Sample Size			147		106	7		2	262
Percent			23.2		14.6	1.9		0.2	39.9
Std. Error			1.9		1.4	0.8		0.1	2.2
Escapement			1,147		723	95		11	1,976
All Fish									
Sample Size	1	116	278	1	191	15	1	3	606
Percent	0.1	22.4	45.2	0.5	27.7	3.8	0.1	0.3	100.0
Std. Error	0.1	2.0	2.3	0.5	1.9	1.0	0.1	0.2	
Escapement	5	1,105	2,237	24	1,372	188	4	16	4,951

The average mid-eye-to-fork length was 363 mm for the age-1.1 jacks, 510 mm for the age-1.2 fish, and 565 mm for the age-1.3 fish (Table 17, Appendix C.3).

Table 17. Length composition (mm), by sex, of sockeye salmon in the Neva Lake escapement, 2002.

		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
Male	Avg. Length	380	363	511	402	563	507	585	580	473
	Std. Error		2.0	1.8		2.6	10.1			4.6
	Sample Size	1	115	131	1	85	8	1	1	343
Female	Avg. Length			508		568	523		568	529
	Std. Error			1.6		2.0	4.5		12.5	2.1
	Sample Size			147		106	7		2	262
All Fish	Avg. Length	380	363	510	402	565	518	585	572	493
	Std. Error		2.0	1.2		1.6	5.6		8.3	3.0
	Sample Size	1	115	278	1	191	15	1	3	605

Radio Tagging

Seventeen adult sockeye salmon were radio tagged at the Neva weir (Table 18). One tag was never detected. Of the 16 fish successfully tracked, 8 tags were recovered on August 24 from the banks of the MIS and the rest were tracked to the South or East side of the lake (one tag was recovered from a live fish caught while mark-recapture beach seining on November 12). The last radio tag tracking was done on October 5; there were no more radio tags detected in the MIS area.

Table 18. Release and recovery history for sockeye salmon radio tagged at the Neva Creek weir, 2002.

Release Data:				Recovery Data:			
Date	Sex	Length	Cum. % Run	Recovered[a]	Date	From	Where
Jun-27	F	580	2%	yes	Aug-24	loose on stream bank	MIS index area
Jun-30	M	515	4%	yes	Aug-24	loose on stream bank	MIS index area
Jul-02	F	575	18%	yes	Aug-24	loose on stream bank	MIS index area
Jul-02	M	545	18%	yes	Aug-24	loose on stream bank	MIS index area
Jul-05	M	590	27%	yes	Aug-24	loose on stream bank	MIS index area
Jul-07	F	580	27%	yes	Aug-24	loose on stream bank	MIS index area
Jul-12	F	565	29%	no, but somewhere in the South end of the lake on October 5.			
Jul-15	F	530	30%	no, but somewhere on the East shore of the lake on October 5.			
Jul-18	M	580	31%	no, but somewhere in the South end of the lake on October 5.			
Jul-22	F	565	33%	yes	Aug-24	loose on stream bank	MIS index area
Jul-24	F	575	38%	no, no signal detected			
Jul-24	M	565	38%	no, but somewhere in the South end of the lake on October 5.			
Jul-25	M	575	40%	yes	Aug-24	loose on stream bank	MIS index area
Jul-26	M	565	47%	no, but somewhere in the South end of the lake on October 5.			
Aug-08	M	550	64%	yes	Nov-12	live fish in seine set	beach index area
Aug-15	M	545	80%	no, but somewhere in the South end of the lake on October 5.			
Aug-26	M	506	89%	no, but somewhere in the South end of the lake on October 5.			

[a] The last tag recovery survey was conducted on October 5; there were no more tags in the MIS area.

The radio tagging results show that most MIS spawners entered the lake before the beach spawners did. All the adult sockeye salmon that were radio tagged in the first quarter of the run (on or before July 7) spawned in the MIS and all the sockeye radio tagged after 40% of the run (after July 25) were tracked to beach spawning areas. The adult sockeye that passed through the weir between 25 and 40% of the run were a mixture of MIS and beach spawners. The radio tag results suggest that lake spawners comprised over half of the run.

Harvest Monitoring

The subsistence/personal use fishery for Neva sockeye salmon was open from June 1 to through July 31. The daily and household possession limit was 10 sockeye salmon. The fishery was open to any Alaskan resident who obtained a permit from ADF&G, Division of Commercial Fisheries. Federal and State regulations provide Hoonah area residents with a “Customary and Traditional Use Determination” for the subsistence harvest of salmon in this area. This distinction allows Federally-qualified users from Hoonah to also use rod and reel gear to take salmon in freshwater under Federal regulations.

The weir technician made a special effort to document subsistence/personal use fishing activities during June and July during the two or more times that he traveled the road(s) between Excursion Inlet and the weir. The subsistence/personal use effort and harvest was relatively small. The documented harvest was only 44 sockeye salmon (Table 19), which is close to the 36 sockeye salmon reported on subsistence/personal use permits returned to ADF&G (Figure 3). No subsistence users were observed using rod and reel gear.

Table 19. Observations of subsistence/personal use fishing effort and sockeye harvest in the Neva area, June 1 to July 31, 2002.

Date	Documented Harvest	Location	Gear	Observations
Jul-01	4	Lower Neva Creek subsistence fishing site	unknown	Four heads found.
Jul-03	19	Lower Neva Creek subsistence fishing site	unknown	Ninteen filleted carcasses found at weir.
Jul-06	unknown	In saltwater off mouth of South Creek	gillnet	Boat observed fishing at 0830 hour.
Jul-10	2	In saltwater off mouth of South Creek	gillnet	Boat fished from 0930 to 1300 hour. Skipper interviewed.
Jul-10	4	Lower Neva Creek subsistence fishing site	gaff	Harvest reported by subsistence fisherman.
Jul-11	1	Lower Neva Creek subsistence fishing site	gaff	Fisherman interviewed at fishing site.
Jul-19	6	Lower Neva Creek subsistence fishing site	gaff	Fisherman interviewed at fishing site.
Jul-20	5	Lower Neva Creek subsistence fishing site	unknown	Five new dorsal fins found at fishing site.
Jul-20	0	Neva Creek	dipnet	Fisherman reported seeing and harvesting no sockeye today.
Jul-22	1	Lower Neva Creek subsistence fishing site	unknown	Evidence of one new sockeye taken at fishing site.
Jul-23	1	Lower Neva Creek subsistence fishing site	unknown	Evidence of one new sockeye taken at fishing site.
Jul-24	1	Lower Neva Creek subsistence fishing site	unknown	One jack sockeye head found at fishing site.
Total	44			

Pavlof

Trap-to-Spawning Ground Mark-Recapture Estimate of Total Escapement

The trap was operated at the top of the fishpass at the outlet of Pavlof Lake from June 21 to 27, July 1 to 29, August 4 to 8, and on August 27 to 28. All the sockeye, coho, pink and chum salmon that ascended the fish pass on these dates were counted. Counts totaled 557 sockeye, 853 coho, 435 pink, and 7 chum salmon (Table 20).

Table 20. Daily counts of salmon through the trap at the top of Pavlof Lake's outlet fishpass, 2002.

Date	Daily Sockeye	Cumulative Sockeye	Cumulative Percent Sockeye	Daily Coho	Daily Pink	Daily Chum	Comments
Jun-21	0	0	0%	0	0	0	trap fish tight, 1600hr.
Jun-22	1	1	0%	0	0	0	
Jun-23	23	24	4%	0	0	0	
Jun-24	0	24	4%	0	0	0	
Jun-25	29	53	10%	0	0	0	
Jun-26	10	63	11%	0	0	0	
Jun-27	19	82	15%	0	0	0	trap closed 1600
Jun-28		82	15%				trap closed
Jun-29		82	15%				trap closed
Jun-30		82	15%				trap closed
Jul-01	76	158	28%	0	0	0	trap open 0930
Jul-02	35	193	35%	0	0	0	
Jul-03	74	267	48%	0	0	0	
Jul-04	42	309	55%	0	0	0	
Jul-05	36	345	62%	0	0	0	
Jul-06	1	346	62%	0	0	0	
Jul-07	15	361	65%	0	0	0	
Jul-08	30	391	70%	6	0	0	
Jul-09	7	398	71%	1	0	1	
Jul-10	13	411	74%	1	0	0	
Jul-11	20	431	77%	8	0	0	
Jul-12	17	448	80%	6	0	0	
Jul-13	0	448	80%	0	0	0	
Jul-14	12	460	83%	0	0	0	
Jul-15	19	479	86%	20	0	0	
Jul-16	4	483	87%	0	0	0	
Jul-17	12	495	89%	5	0	0	
Jul-18	6	501	90%	5	0	0	
Jul-19	2	503	90%	0	0	0	
Jul-20	31	534	96%	41	0	1	
Jul-21	2	536	96%	24	0	0	
Jul-22	4	540	97%	163	0	1	
Jul-23	0	540	97%	11	0	0	
Jul-24	5	545	98%	27	3	0	
Jul-25	5	550	99%	19	6	0	
Jul-26	4	554	99%	1	5	0	
Jul-27	3	557	100%	17	5	0	
Jul-28	0	557	100%	11	3	0	
Jul-29	0	557	100%	35	3	0	trap closed 1800hr
Jul-30		557	100%				trap closed
Jul-31		557	100%				trap closed
Aug-01		557	100%				trap closed
Aug-02		557	100%				trap closed
Aug-03		557	100%				trap closed
Aug-04	0	557	100%	84	129	1	trap open 1430 hr
Aug-05	0	557	100%	115	120	1	
Aug-06	0	557	100%	162	117	1	
Aug-07	0	557	100%	16	41	1	
Aug-08	0	557	100%	65	2	0	trap closed 1500 hr
Aug-09		557	100%				trap closed
Aug-10		557	100%				trap closed
Aug-11		557	100%				trap closed
Aug-12		557	100%				trap closed
Aug-13		557	100%				trap closed
Aug-14		557	100%				trap closed
Aug-15		557	100%				trap closed
Aug-16		557	100%				trap closed
Aug-17		557	100%				trap closed
Aug-18		557	100%				trap closed
Aug-19		557	100%				trap closed
Aug-20		557	100%				trap closed
Aug-21		557	100%				trap closed
Aug-22		557	100%				trap closed
Aug-23		557	100%				trap closed
Aug-24		557	100%				trap closed
Aug-25		557	100%				trap closed
Aug-26		557	100%				trap closed
Aug-27		557	100%				trap opened 1300 hr
Aug-28	0	557	100%	10	1	0	trap closed 1100 hr
Total	557			853	435	7	

The first sockeye salmon passed on June 22 and the last on July 27. The midpoint of the sockeye run was probably on July 3 but could have been on July 2 if more than 170 sockeye escaped between June 27 and 30 when the crew was not available to operate the trap. The number of jack sockeye salmon was not recorded and few were observed. All 557 sockeye salmon were marked with an adipose clip. No handling induced mortality was observed. Two marked fish were recaptured in the trap – these fish had dropped back over the falls and re-ascended the fish pass.

On August 4 and 5 we examined 304 sockeye salmon for adipose clips in the MIS study area. One hundred and twenty five marked fish were observed (41% marked) yielding a pooled Peterson estimate of 1,350 (CV 6%) adult sockeye salmon in the escapement (Table 21). The fishpass was apparently used by less than half of the sockeye run. The MIS index area was an excellent place to seine sockeye salmon during normal flow conditions. On July 29 we tried to use dipnets but only caught a few fish before they moved out of reach into deep pools. No attempt was made to seine fish on the August 27 trip due to high water and few fish.

Table 21. Mark-recapture estimate of the escapement of adult sockeye salmon in Pavlof Lake, 2002.

Marking Data - from Trap on Outlet Fishpass:			
Dates	Trap Count	Number Marked	Percent Marked
6/22-7/27	557	557	100%
Recapture Data - from MIS Index Area:			
Date	Number Examined	Number with Marks	Percent Marked
8/4	173	69	40%
8/5	131	56	43%
Total	304	125	41%
Pooled Peterson Estimate:			
Number	S.E.	CV	
1,350	81	6%	

Stream Mark-Recapture for Indexing Escapement

An estimated 326 (CV 2%) adult sockeye salmon were in the MIS study area on August 5 (Table 22).

Table 22. Mark-recapture index of the abundance of adult sockeye salmon in Pavlof Lake's MIS study area on August 5, 2002.

Number Marked on 8/4	Number Examined for Marks on 8/5	Number of Recaptures	Peterson Estimate	S.E.	CV
173	279	148	326	7	2%

Foot/Boat Survey Counts

No beach spawning sockeye salmon were observed in the lake. A few sockeye salmon were observed milling off the main inlet stream in mid- to late-July. These fish were difficult to see and no counts were attempted. Formal survey counts were conducted in the main inlet stream on July 29, August 5, and August 27 (Table 23).

Table 23. Foot survey counts of sockeye salmon in the MIS index area, Pavlof Lake, 2002.

Date	Observer	Count
Jul-29	Ben Van Alen	249
	Fred Gallant	166
	William Sanders	55
	Average	157
Aug-05	Ben Van Alen	245
	Fred Gallant	187
	William Sanders	92
	Jerome Abbott	202
	Average	182
Aug-27	Fred Gallant	2
	William Sanders	2
	Jerome Abbott	2
	Average	2

There was about the same number of sockeye salmon in the MIS index area on July 29 and August 5. The average counts for the three observers who made counts on both July 29 and August 5 were 157 and 175. Survey conditions in the main inlet stream were excellent in normal flows and good lighting but poor when the water was high or if counts were attempted too early or late in the day. Conditions were excellent for the July 29 and August 5 surveys but the water was extremely high on August 27. Nevertheless, it was evident that sockeye spawning was over for the year.

Age, Sex, and Length Composition

Forty six (94%) of the 49 Pavlof sockeye sampled at the trap for scales were age-1.3 (Table 24). There was one age-1.2 and two age-2.2 fish in the sample. The average length of the age-1.3 fish was 525 mm (Table 25).

Table 24. Age and sex composition of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2002.

	Brood Year and Age Class			
	1998	1997	1997	
	1.2	1.3	2.2	Total
June 30 - July 27				
Male				
Sample Size	1	35		36
Percent	2.0	71.4		73.5
Std. Error	2.0	6.5		6.4
Female				
Sample Size		11	2	13
Percent		22.4	4.1	26.5
Std. Error		6.0	2.9	6.4
All Fish				
Sample Size	1	46	2	49
Percent	2.0	93.9	4.1	100.0
Std. Error	2.0	3.5	2.9	

Table 25. Length composition (mm), by sex, of sockeye salmon sampled from the trap at the top of the outlet fishpass at Pavlof Lake, 2002.

		Brood Year and Age Class			
		1998	1997	1997	
		1.2	1.3	2.2	Total
June 30 - July 27					
Male	Avg. Length	420	532		529
	Std. Error		5.8		6.4
	Sample Size	1	34		35
Female	Avg. Length		503	515	505
	Std. Error		7.5	45.0	8.2
	Sample Size		11	2	13
All Fish	Avg. Length	420	525	515	523
	Std. Error		5.1	45.0	5.4
	Sample Size	1	45	2	48

Hoktaheen

Stream Mark-Recapture for Indexing Escapement

Three multi-day trips were made into Hoktaheen Lake (the upper lake) in 2002 to index the escapement of sockeye salmon – August 19-21, September 5-7, and September 17-18. On the first trip, sockeye salmon were observed surfacing in the lake but none had moved into stream or beach areas where they could be captured with a beach seine or dip nets. On the second and third trips, sockeye salmon were found in, and off the mouth of, the "main inlet stream" (MIS) that flows into the East side of the lake (the inlet stream index area was from the stream mouth to GIS coordinates 58˚03.897' N, 136˚30.951' W) and in the upper third of the stream that connects the upper and lower lakes (the outlet stream index area was from 58˚03.370' N, 136˚30.939' W downstream about 0.2 m).

Main Inlet Stream.

On September 5, project personnel marked 185 sockeye salmon working upstream (99 caught with a beach seine off the mouth of the MIS and 86 caught with dip nets in the MIS) and 127 sockeye salmon working downstream (38 in the MIS and 89 off the mouth of the MIS, Table 26). Most of the sockeye salmon that were in the MIS were in the lower section below a logjam but the index area extended upstream to where the MIS turns sharply left (looking downstream) in the first bedrock section (58˚03.897' N, 136˚30.951' W). On September 6, project personnel marked 110 sockeye salmon working upstream (55 off the MIS and 55 in the MIS) and 30 sockeye salmon working downstream (18 in the MIS and 12 off the MIS). On September 7, 70 sockeye salmon were marked in the MIS. Heavy rainfall on the evenings of September 5 and 6 appeared to draw nearly all of the sockeye salmon that were schooled off the mouth of the MIS into the MIS by September 7. Recaptures totaled 66, 102, and 101 fish respectively on September 5, 6, and 7.

On September 17, project personnel caught and marked 60 sockeye salmon (48 in the MIS and 12 off the mouth, Table 26.) Ten sockeye salmon were marked in the MIS on September 18. Fifteen fish were recaptured from the September 5-7 trip and seven from September 17.

The Pooled Peterson abundance estimates for the MIS index area totaled 538, 737, 763, and 156 on September 5, 6, 7, and 18 (Table 26). Sockeye spawning in the MIS appeared to peak abruptly in early-mid September and be timed with rainfall events. This is consistent with observations in 2001.

Table 26. Mark and recapture data, and abundance estimates, for sockeye salmon in the main inlet stream (MIS) and outlet stream index areas, Hoktaheen Lake, 2002.

Location and Trip Number	Date	Mark Used[a]	Number Marked	Number Examined for Marks[b]	Trip #1 Recaps	Trip #2 Recaps	Both Trip #1 and #2 Recaps	Total Recaps	Peterson Estimate	SE	Lower 95% CI	Upper 95% CI	CV%
MIS #1	05-Sep	LSO	185	na	na	na	na	na	na	na	na	na	
	05-Sep	LSO	127	193	66	na	na	66	538 [c]	42	455	620	8%
	06-Sep [d]	LSO	140	242	102	na	na	102	737 [e]	45	649	826	6%
	07-Sep	LSO	70	171	101	na	na	101	763 [f]	42	680	846	6%
MIS #2 [g]	17-Sep	AD	60	60	11	na	na	na	na	na	na	na	
	18-Sep	AD	10	17	3	6	1	10	156 [h]	41	236	131	26%
Outlet#1	06-Sep	LSO	26	na	na	na	na	na	na	na	na	na	
	07-Sep	LSO	25	30	5	na	na	5	139 [i]	42	57	220	30%
Outlet#2 [g]	17-Sep	AD	140	140	11	na	na	na	na	na	na	na	
	18-Sep	AD	25	62	0	32	5	37	233 [j]	20	193	272	9%

[a] LSO = left square opercule punch; AD = adipose fin clip.

[b] Sampled without replacement.

[c] N(est) = 538 (M=185, C=193, R=66).

[d] It rained hard over night and nearly all sockeye that were schooled off the stream mouth on Sept. 5 had migrated into the stream on Sept. 6.

[e] N(est.) = 737 (M=312, C=242, R=102).

[f] N(est.)=763 (M=452, C=171, R=101).

[g] All Trip #1 recaptures were also given the Trip #2 mark.

[h] N(est.)=156 (M=60, C=17, R=7).

[i] N(est.)=139 (M=26, C=30, R=5).

[j] N(est.)=239 (M=140, C=62, R=37).

I compared sockeye escapement indices between 2001 and 2002 three ways (Table 27). In 2001, 178 sockeye salmon were marked on September 3 and fish were examined for marks on September 4 and 19-20 (J. Conitz, ADF&G, personal communication, Table 27). The sockeye escapement in 2002 was larger than in 2001. When I compare indices of sockeye marked and recaptured in the early September trip (September 3-4, 2001 and September 5-7, 2002) the 2002 estimate was 737 or 763 compared to 660 in 2001, a relative difference of 12-16% (Table 27). When I compare estimates from fish marked in early September and examined for marks later in the month (September 19-20, 2001 and September 17-18, 2002) the 2002 index of 2,719 is much greater than the 2001 index of 920, a relative difference of 196%. Finally, when the mark-recapture data is pooled from both trips, as reported in Conitz and Cartwright 2002a, the 2002 and 2001 indices were 1,271 and 745, a relative difference of 71%.

Table 27. Sockeye abundance indices for the main inlet stream (MIS), Hoktaheen Lake, 2001 and 2002.

Year	Date(s) Marked	Number Marked	Date(s) Examined	Number Examined for Marks	Number Recaptured	Peterson Estimate	SE	Lower 95% CI	Upper 95% CI	CV%	Relative Difference 2001-2002
Comparing indices of sockeye marked and recaptured on Trip #1:											
2001	9/3	178	9/4	132	35	660	83	498	83	13%	
2002	9/5	312	9/6	242	102	737	45	649	826	6%	12%
2002	9/5-6	452	9/7	171	101	763	42	680	846	6%	16%
Comparing indices of fish marked on Trip #1 and recaptured on Trip #2:											
2001	9/3	178	9/19-20	71	13	920	205	518	1,321	22%	
2002	9/5-7	522	9/17-18	77	14	2,719	602	1,538	3,899	22%	196%
Comparing indices of fish with mark and recapture data pooled for Trips #1 and #2:											
2001	9/3	178	9/4	132	35						
	9/19	1	9/20	70	13						
		179		202	48	745	78	591	898	11%	
2002	9/5-7	522	9/5-7	606	269						
	9/17[a]	0	9/17-18	77	15						
		522		683	284	1,254	38	1,179	1,329	3%	68%
2002	9/5-7	522	9/6-7	413	203						
	9/17	60	9/17-18	77	21						
		582		490	224	1,271	49	1,176	1,367	4%	71%

[a] Restricted to just the sockeye marked in Trip #1. This index is the most comparable to the index for 2001.

[b] Includes the sockeye marked in both Trip #1 and Trip #2.

<u>Outlet of Upper Lake.</u>

The pooled Peterson abundance estimates for the outlet index area totaled 139 sockeye salmon on September 6-7 and 233 on September 17-18 (Table 26). Of 51 sockeye marked on September 6-7, 16 were recaptured out of 202 fish examined for marks on September 17-18. This suggests that the stream life is relatively long and that there was not a lot of new fish moving into the stream.

Foot/Boat Survey Counts

Most adult sockeye salmon were observed in the MIS below the bedrock turn and in the upper third of the stream that connects the two lakes (Table 28). A few sockeye salmon were also counted in the small tributary that flows south into the outlet of the upper lake. The lake water is tannin stained and dark and it is difficult to see sockeye deeper than a meter or so. We did not observe any beach spawning. Sockeye were observed surfacing in the lake during the August 17-20 trip but none were seen in foot surveys of the MIS (up to the falls on each fork), the outlet tributary (20 minute hike upstream), or in a boat survey that circumnavigated the upper lake, the outlet stream, and the upper part of the lower lake. The highest sockeye counts were made on September 6 in both the MIS and the upper third of the outlet index areas. However, the outlet stream was high, dark, and hard to see fish in during the September 18 survey. We counted four live sockeye spawners in the inlet stream that flows into the outlet. We also saw five dead sockeye in this stream and three of them had been marked during the September 6-7 trip. Thus, some of the sockeye marked in the outlet stream move into this small tributary to spawn.

Table 28. Boat and foot survey counts of live adult sockeye salmon in Hoktaheen Lake, 2002.

		Inlet	Main Inlet Stream Index			Outlet Upper Lake Index					
Date	Observer	Inlet Stream Near Outlet	Count Up	Count Down	Average	Count Up	Count Down	Average	Upper Lake Beaches	Total	% in Index Areas
Aug-20	Ben Van Alen	0	0		0		0	0	0	0	
	Fred Gallant	0	0		0		0	0	0	0	
	Jerome Abbott	0	0		0		0	0	0	0	
	William Sanders	0	0		0		0	0	0	0	
	Average	0	0		0		0	0	0	0	
Sep-06	Ben Van Alen	0	247	258	253	68	66	67	0	320	100%
	Fred Gallant	0	200	269	235	43	37	40	0	275	100%
	Jerome Abbott	0	208	237	223	70	48	59	0	282	100%
	William Sanders	0	156	120	138	15		15	0	153	
	Average	0	203	221	212	49	50	50	0	262	100%
Sep-18	Ben Van Alen	4		31	31	47		47	0	82	95%
	Fred Gallant	4		6	6	26		26	0	36	89%
	Jerome Abbott	4		11	11	44		44	0	59	93%
	William Sanders	4		5	5				0	9	
	Average	4		13	13	39		39	0	56	93%

Adult Age, Sex, and Length

Sockeye salmon were sampled for scales (age), sex, and length data both from the main inlet stream (218 ageable scales) and the outlet (213 ageable scales) index areas. Age-1.2, 1.3, and 2.2 fish each comprised about one-third of all those sampled (Table 29). However, age-2.- fish comprised 50 percent of the inlet spawners (Table 30) and only 25 percent of the outlet spawners (Table 31). Only one jack (age-1.1) was sampled and few were observed in all our sampling.

Table 29. Age and sex composition of sockeye salmon sampled in the inlet and outlet streams of upper Hoktaheen Lake, September 5, 6, 17, and 18, 2002.

	Brood Year and Age Class					
	1999	1998	1997	1997	1996	
	1.1	1.2	1.3	2.2	2.3	Total
Male						
Sample Size	1	91	90	67	25	274
Percent	0.2	20.1	19.9	14.8	5.5	60.6
Std. Error	0.2	1.9	1.9	1.7	1.1	2.3
Female						
Sample Size		51	53	64	10	178
Percent		11.3	11.7	14.2	2.2	39.4
Std. Error		1.5	1.5	1.6	0.7	2.3
All Fish						
Sample Size	1	142	143	131	35	452
Percent	0.2	31.4	31.6	29.0	7.7	100.0
Std. Error	0.2	2.2	2.2	2.1	1.2	

Table 30. Age and sex composition of sockeye salmon sampled in the main inlet stream to upper Hoktaheen Lake, September 5 and 17, 2002.

	Brood Year and Age Class				
	1998	1997	1997	1996	
	1.2	1.3	2.2	2.3	Total
Male					
Sample Size	31	20	44	7	102
Percent	14.2	9.2	20.2	3.2	46.8
Std. Error	2.4	1.9	2.7	1.2	3.4
Female					
Sample Size	24	33	51	8	116
Percent	11.0	15.1	23.4	3.7	53.2
Std. Error	2.1	2.4	2.9	1.3	3.4
All Fish					
Sample Size	55	53	95	15	218
Percent	25.2	24.3	43.6	6.9	100.0
Std. Error	2.9	2.9	3.3	1.7	

Table 31. Age and sex composition of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake, September 6, 17, and 18, 2002.

	Brood Year and Age Class					
	1999	1998	1997	1997	1996	
	1.1	1.2	1.3	2.2	2.3	Total
Male						
Sample Size	1	52	64	22	18	157
Percent	0.5	24.4	30.0	10.3	8.5	73.7
Std. Error	0.5	2.9	3.1	2.1	1.9	3.0
Female						
Sample Size		27	15	13	1	56
Percent		12.7	7.0	6.1	0.5	26.3
Std. Error		2.3	1.7	1.6	0.5	3.0
All Fish						
Sample Size	1	79	79	35	19	213
Percent	0.5	37.1	37.1	16.4	8.9	100.0
Std. Error	0.5	3.3	3.3	2.5	1.9	

On average, the males were larger than the females, the age-2.2 were longer than the age-1.2, and the age-1.3 were longer than the age-2.3 (Tables 32 to 34).

Table 32. Length composition (mm), by sex, of sockeye salmon sampled in the inlet and outlet streams of upper Hoktaheen Lake, September 5, 6, 17, and 18, 2002.

		Brood Year and Age Class					
		1999	1998	1997	1997	1996	
		1.1	1.2	1.3	2.2	2.3	Total
Male	Avg. Length	295	483	558	495	543	515
	Std. Error		3.2	3.7	3.1	3.7	2.8
	Sample Size	1	91	89	66	24	271
Female	Avg. Length		472	539	485	530	500
	Std. Error		3.4	3.7	2.8	4.2	2.8
	Sample Size		51	53	64	9	177
All Fish	Avg. Length	295	479	551	490	540	509
	Std. Error		2.4	2.8	2.1	3.1	2.1
	Sample Size	1	142	142	130	33	448

Table 33. Length composition (mm), by sex, of sockeye salmon sampled in the inlet streams of upper Hoktaheen Lake, September 5 and 17, 2002.

		Brood Year and Age Class				
		1998	1997	1997	1996	
		1.2	1.3	2.2	2.3	Total
Male	Avg. Length	467	560	492	551	502
	Std. Error	6.8	7.0	4.1	9.8	4.7
	Sample Size	31	20	44	7	102
Female	Avg. Length	473	542	483	528	501
	Std. Error	5.3	5.0	3.2	4.4	3.5
	Sample Size	24	33	51	7	115
All Fish	Avg. Length	470	549	487	540	501
	Std. Error	4.5	4.2	2.6	6.1	2.9
	Sample Size	55	53	95	14	217

Table 34. Length composition (mm), by sex, of sockeye salmon sampled in the outlet stream of upper Hoktaheen Lake, September 6, 17, and 18, 2002.

		Brood Year and Age Class					
		1999	1998	1998	1997	1996	
		1.1	1.2	1.3	2.2	2.3	Total
Male	Avg. Length	295	493	558	504	540	525
	Std. Error		2.8	4.4	3.9	3.4	3.5
	Sample Size	1	52	63	21	17	154
Female	Avg. Length		472	536	491	525	494
	Std. Error		4.6	6.4	6.3		4.8
	Sample Size		27	15	13	1	56
All Fish	Avg. Length	295	486	554	499	539	517
	Std. Error		2.7	3.9	3.5	3.3	3.0
	Sample Size	1	79	78	34	18	210

Limnology

Light, Temperature, and Dissolved Oxygen Profiles

An underwater photometer was used to record the incident light levels in Neva, Pavlof, and Hoktaheen Lakes at 0.5 m intervals from just below the lake surface (depth 0.0) to the depth with about 1% of this subsurface reading (Table 35).

Table 35. Light meter and secchi disk readings at Stations A in Neva, Pavlof, and Hoktaheen Lakes, 2002.

Light Meter Readings:									
Lake:	Neva				Pavlof		Hoktaheen		
Date:	May-23	Jul-26	Aug-25	Oct-05	May-24	Jul-29	May-24	Aug-20	Sep-17
Meter:	LiCor LI-250	Protomatic	LiCor LI-250	LiCor LI-250	Protomatic	Protomatic	Protomatic	LiCor LI-250	LiCor LI-250
Units:	$\mu mol\ s^{-1}\ m^{-2}$	footcandles	$\mu mol\ s^{-1}\ m^{-2}$	$\mu mol\ s^{-1}\ m^{-2}$	footcandles	footcandles	footcandles	$\mu mol\ s^{-1}\ m^{-2}$	$\mu mol\ s^{-1}\ m^{-2}$
Depth (m)									
0.0	-244	6,067	-202.8	-61.92	1200	1,600.0	2000	-922.5	-148.27
0.5	-204	4,000	-102.83	-33.28	650	650.0	1300	-238.5	
1.0	-200	3,000	-77.5	-19.31	350	320.0	800	-98.06	-21.24
1.5		2,400	-58.71	-14.43	220	140.0	450	-57.2	-8.38
2.0	-130	2,100	-47.44	-9.93	150	85.0	270	-25.91	-4.94
2.5		2,000	-44.3	-7.55	93	53.0	180	-13.85	-2.32
3.0	-93	1,800	-30.56	-6.05	65	33.0	110	-9.42	-1.21
3.5		1,600	-23.13	-4.55	40	20.0	90	-3.93	-0.61
4.0	-73	1,400	-19.08	-3.41	28	13.0	55	-2.83	-0.35
4.5		1,150	-15.45	-2.52	20	7.4	42	-1.56	-0.21
5.0	-50	1,000	-11.59	-2.01	15	4.7	25	-0.99	-0.16
5.5		880	-9.2	-1.26	10	3.0	17	-0.57	
6.0	-35	750	-7.39	-1.06		1.8	11		
6.5		620	-5.8	-0.88		1.0			
7.0	-24	530	-4.79	-0.76		0.5			
7.5		440	-4.18	-0.66		0.5			
8.0	-17	360	-3.55	-0.56					
8.5		310	-2.95	-0.51					
9.0	-12	260	-2.51	-0.46					
9.5		220	-2.07	-0.42					
10.0		190	-1.79	-0.35					
10.5			-1.51						
11.0			-1.29						
Secchi Disk (averaged depth of disappear/reappear readings in meters):									
	4.25	-	9.5	4.5	-	-	-	3	3

The mean euphotic zone depths (EZD) were 12.1 m in Neva Lake, 4.9 m in Pavlof Lake, and 4.2 m in Hoktaheen Lake (Table 36). The EZD's were the shallowest in the fall.

Table 36. Euphotic zone depths in Neva, Pavlof, and Hoktaheen Lakes, 2002.

Lake	Sample Date	EZD (m)
Neva	May-23	13.7
	Jul-26	14.6
	Aug-25	10.7
	Oct-05	9.4
	seasonal mean	12.1
Pavlof	May-24	5.4
	Jul-29	4.4
	seasonal mean	4.9
Hoktaheen	May-24	5.4
	Aug-20	3.7
	Sep-17	3.4
	seasonal mean	4.2

Vertical temperature stratification was evident in Neva Lake from the first sampling on May 23 to the last sampling on October 5 (Table 37). The epilimnion extended down to about 6 m on the July 26 and August 25 sampling dates. The lowest reading in the hypolimnion was 5.0 ^oC. The percent O_2 saturation was over 100% in most readings near the surface and was above 90% at all depths down to 6 m in all four trips (Table 37). In all lakes the percent O_2 saturation decreased both through the summer and with depth.

There was little vertical stratification in temperature or dissolved oxygen in the 8 m deep Pavlof Lake (Table 38). The temperature averaged 5.8, 10.3, and 10.3 ^oC on the May, July, and August trips. The percent O_2 saturation was 38-43% in May and 91-95% in July. No dissolved oxygen readings were made on the August trip due to problems with the meter.

Vertical temperature stratification was evident in Hoktaheen Lake in the May, August, and September trips (Table 39). The epilimnion extended down to about 7 m in August and September. The hypolimnion remained below 6 ^oC the whole summer. Compared to Neva Lake, the percent O_2 saturation was lower near the surface but higher at depths.

Table 37. Temperature and dissolved oxygen profiles for Neva Lake, 2002.

	Temperature (^oC)				Dissolved Oxygen (mg L^{-1})				Percent O_2 Saturation[a]			
Depth (m)	May-23	Jul-26	Aug-25	Oct-05	May-23	Jul-26	Aug-25	Oct-05	May-23	Jul-26	Aug-25	Oct-05
1	10.8	14.8	13.3	10.0	12.9	9.7	10.6	11.3	116%	96%	101%	100%
2	10.6	14.7	13.2	10.0	13.0	10.3	10.6	11.2	116%	102%	101%	99%
3	9.9	14.5	12.9	10.0	13.1	10.5	10.7	11.2	116%	103%	101%	99%
4	9.8	13.7	12.6	10.0	13.1	11.0	10.4	11.1	115%	106%	98%	98%
5	9.2	13.5	12.3	10.0	13.0	11.3	10.3	11.1	112%	109%	96%	98%
6	8.7	12.4	11.9	9.8	12.8	12.3	10.3	10.3	110%	115%	95%	91%
7	7.3	10.9	10.8	9.6	12.5	12.1	10.3	9.8	103%	110%	93%	86%
8	6.6	9.6	9.3	9.1	11.8	12.0	10.1	8.2	96%	105%	88%	71%
9	5.9	8.0	8.1	8.0	11.3	10.8	9.3	6.9	91%	91%	79%	58%
10	5.4	7.4	7.2	7.2	10.7	10.4	8.3	6.3	85%	87%	68%	52%
11	5.2	6.8	6.8	6.7	10.4	10.0	7.5	5.7	82%	82%	61%	47%
12	5.1	6.2	6.2	6.4	9.8	8.6	6.7	5.0	77%	69%	54%	41%
13	5.0	5.7	6.1	6.1	9.4	7.7	5.3	3.1	73%	61%	43%	25%
14		5.5	5.7	5.8		6.0	4.8	1.4		48%	38%	11%
15		5.3	5.6	5.5		4.2	3.2	1.2		33%	25%	10%
16		5.3	5.5	5.5		2.5	1.7	1.2		20%	13%	10%
17		5.2		5.5		1.1		1.2		9%		10%
18		5.1		5.5		0.1		1.1		1%		9%

[a] $\%O_2$ saturation = 0.005399 * temperature^2 - 0.381784 * temperature + 14.571252

Table 38. Temperature and dissolved oxygen profiles for Pavlof Lake, 2002.

	Temperature (^oC)			Dissolved Oxygen (mg L^{-1})			Percent O_2 Saturation[a]		
Depth (m)	May-24	Jul-29	Aug-27	May-24	Jul-29	Aug-27	May-24	Jul-29	Aug-27
1	6.2	10.9	10.7	9.3	11.0	meter problems	43%	95%	meter problems
2	5.8	10.6	10.3	9.7	11.0		40%	93%	
3	5.9	10.3	10.3	10.1	11.4		40%	91%	
4	5.7	10.2	10.2	10.5	11.3		39%	91%	
5	5.6	10.2	10.2	10.9	11.1		38%	92%	
6	5.6	10.1	10.2	11.1	11.0		38%	92%	
7	5.5	10.0	10.1	11.4	11.4		38%	92%	

[a] $\%O_2$ saturation = 0.005399 * temperature^2 - 0.381784 * temperature + 14.571252

Table 39. Temperature and dissolved oxygen profiles for Hoktaheen Lake, 2002.

	Temperature (^oC)			Dissolved Oxygen (mg L^{-1})			Percent O_2 Saturation[a]		
Depth (m)	May-24	Aug-20	Sep-17	May-24	Aug-20	Sep-17	May-24	Aug-20	Sep-17
1	10.3	13.8	11.5	9.3	8.7	8.7	83%	84%	80%
2	9.9	13.7	11.5	9.8	8.9	8.7	87%	86%	80%
3	9.3	12.3	11.5	10.4	8.8	8.7	91%	82%	80%
4	8.2	11.2	11.3	10.8	8.9	8.7	91%	81%	79%
5	7.7	10.8	11.2	11.2	9.0	8.6	94%	81%	78%
6	7.0	10.3	11.1	11.4	9.0	8.6	94%	80%	78%
7	5.8	9.7	10.7	11.7	9.2	8.6	93%	81%	77%
8	5.7	9.3	9.5	11.7	9.1	8.6	93%	79%	75%
9	5.5	7.4	7.8	11.7	9.6	8.7	93%	80%	73%
10	5.3	6.4	7.4	11.7	9.8	9.0	92%	79%	75%
11	5.2	5.7	6.3	11.6	10.1	9.2	91%	80%	74%
12	5.1	5.2	5.5	11.4	10.1	9.3	89%	79%	74%
13	5.0	5.0	5.1	11.3	10.1	9.5	88%	79%	74%
14	4.8	4.8	4.9	11.1	10.2	9.5	86%	79%	74%
15	4.7	4.7	4.8	11.1	10.0	9.6	86%	78%	75%
16	4.6	4.6	4.6	10.9	10.0	9.7	84%	77%	75%
17	4.5	4.4	4.5	10.8	10.1	9.9	83%	78%	76%
18	4.4	4.4	4.4	10.7	10.2	9.9	82%	78%	76%
19	4.4	4.4	4.4	10.6	10.1	9.8	82%	78%	75%
20	4.3	4.3	4.3	10.6	10.1	9.8	81%	78%	75%
25	4.1	4.3	4.3	10.3	9.5	9.1	79%	73%	70%
30	4.1	4.2	4.3	9.9	8.9	8.6	76%	68%	66%
35	4.0	4.2	4.2	9.3	8.4	8.1	71%	64%	62%
40	4.0	4.2	4.3	8.6	8.1	7.9	65%	62%	61%
45	4.0	4.2	4.3	7.3	7.2	7.3	56%	55%	56%

[a] $\%O_2$ saturation = $0.005399 * temperature^2 - 0.381784 * temperature + 14.571252$

Daily and Seasonal Temperatures

Wide seasonal variations in water temperatures were observed in the inlet and outlet streams and at 1 m and mid-hypolimnion depths at Station A in each lake (Figures 11 to 22). The maximum temperature observed in 2002 in Neva Lakes main inlet stream was 9˚C on August 4 (Figure 11). Temperatures at the 1 m depth and in the outlet of Neva Lake peaked at 18˚C on August 4 and August 5, respectively (Figure 13 and 12). Temperatures also peaked in early August in Pavlof Lake – the peak average daily readings were 13˚C in the inlet stream (Figure 15), 15˚C in the outlet stream (Figure 16), and 15˚C in the lake at 1 m (Figure 17). At Hoktaheen, temperatures were already trending down in the inlet (Figure 19), outlet (Figure 20), and lake (Figures 21 and 22) when the thermographs were deployed in late August and early September. The main inlet stream to Neva Lake had the coldest average September through December temperature (5˚C) but lake and outlet temperatures averaged the coldest (6˚C) at Pavlof (Table 40).

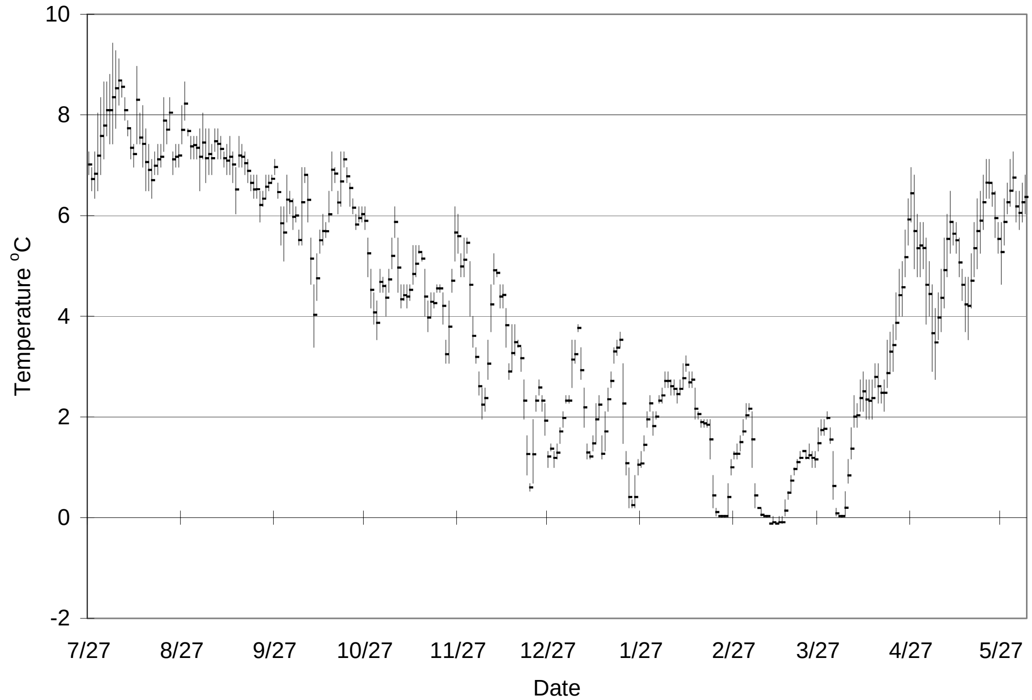


Figure 11. Daily maximum, minimum, and average stream temperatures at the lower end of the Neva Lake's main inlet stream, July 27, 2002 to June 4, 2003.

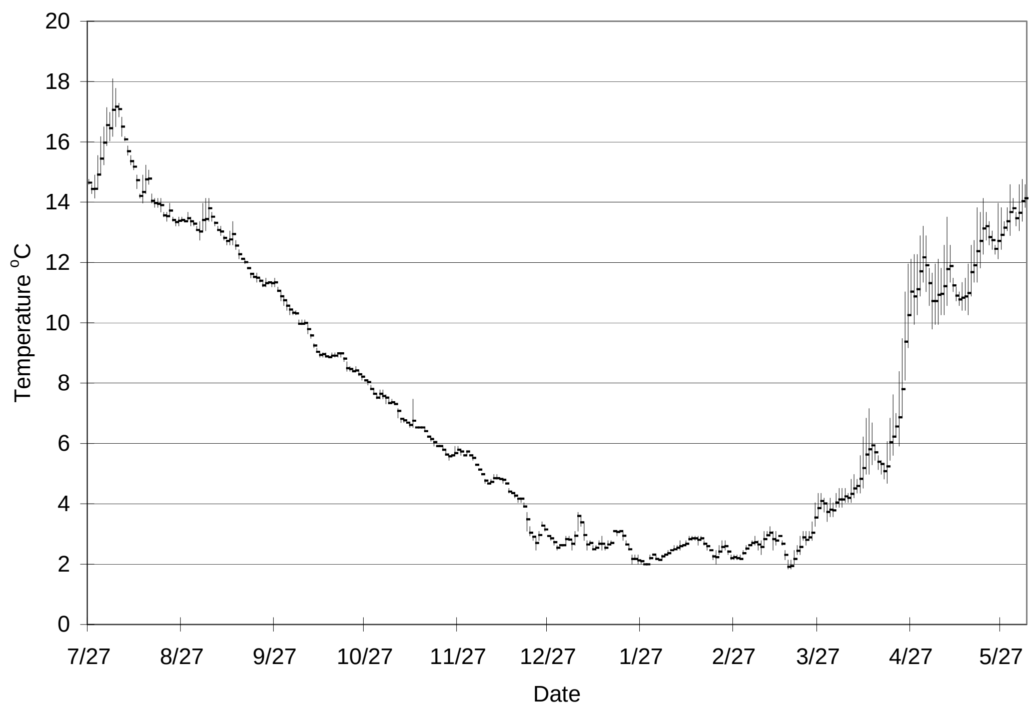


Figure 12. Daily maximum, minimum, and average stream temperatures at the upper end of Neva Creek, July 27, 2002 to June 4, 2003.

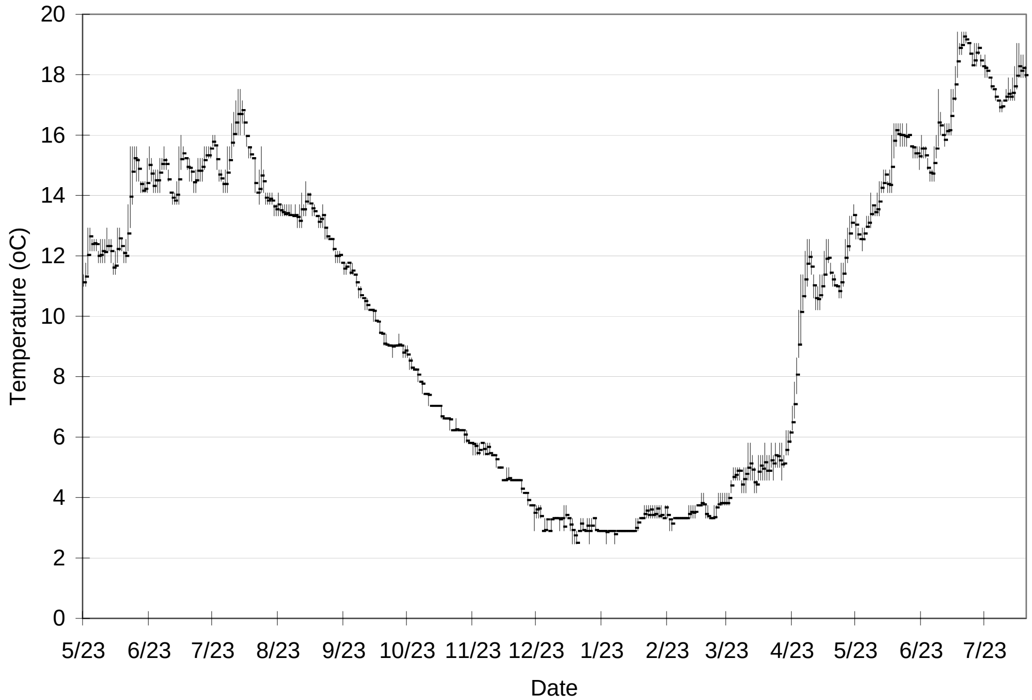


Figure 13. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Neva Lake, May 23, 2002 to August 11, 2003.

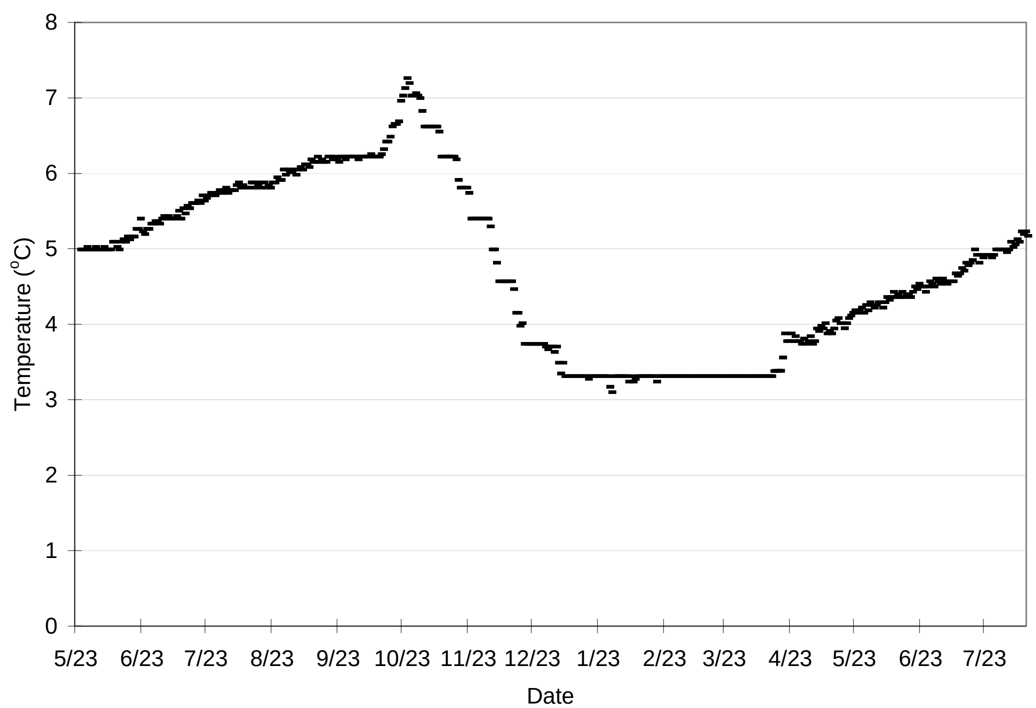


Figure 14. Daily maximum, minimum, and average temperature at a depth of 13 m at Station A in Neva Lake, May 23, 2002 to August 11, 2003.

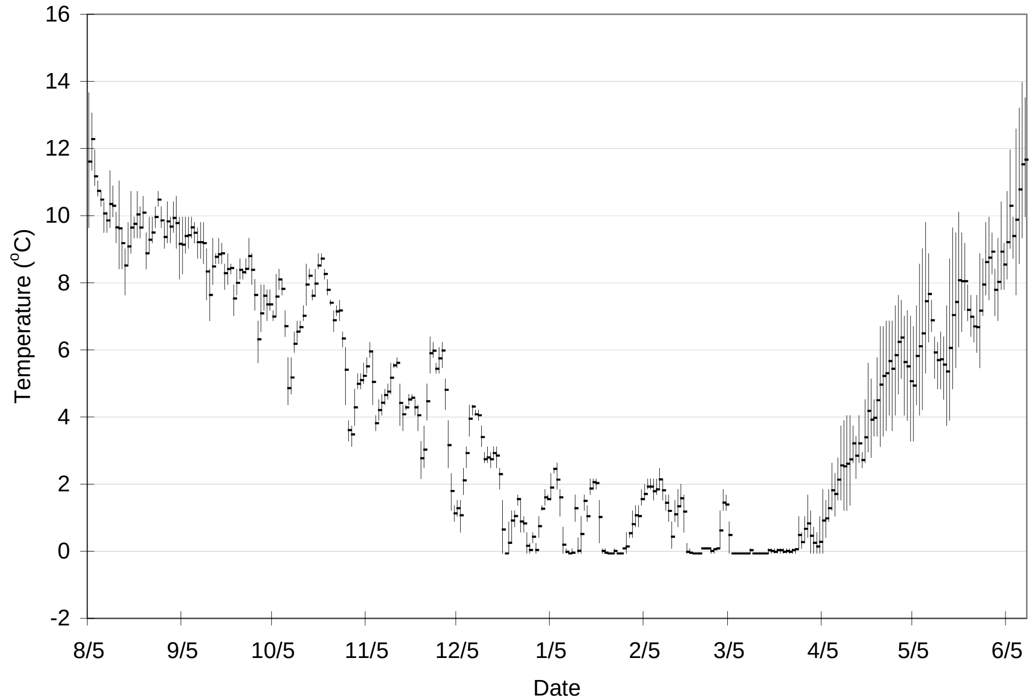


Figure 15. Daily maximum, minimum, and average stream temperatures at the lower end of Pavlof Lake's main inlet stream, August 5, 2002 to June 11, 2003.

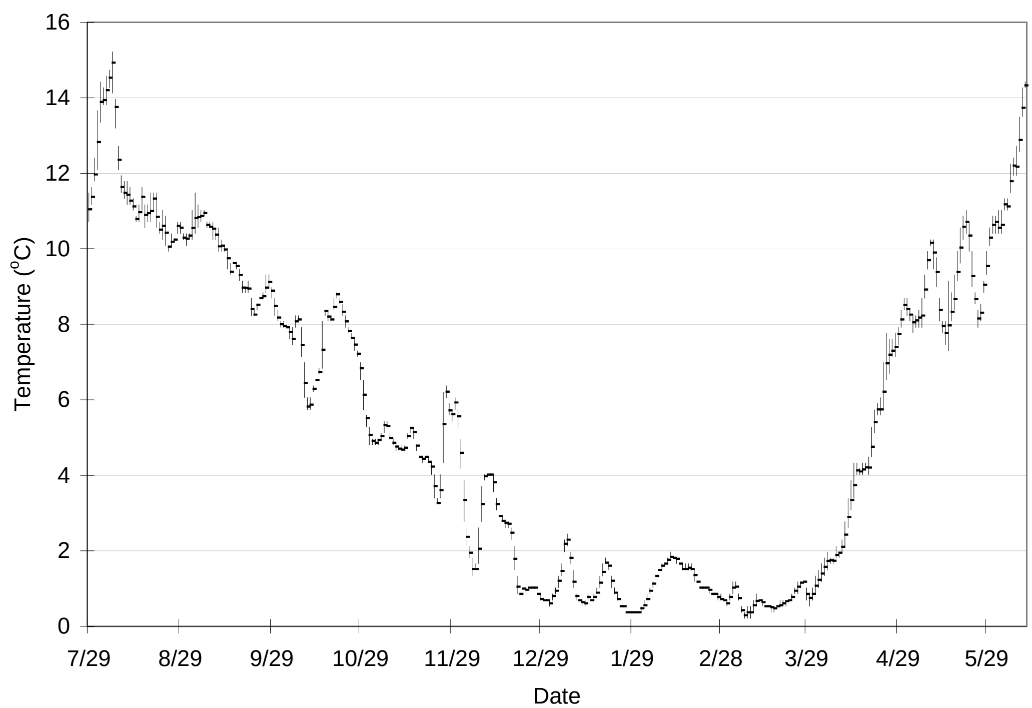


Figure 16. Daily maximum, minimum, and average stream temperatures at the top of the fishpass at the outlet of Pavlof Lake, July 29, 2002 to June 11, 2003.

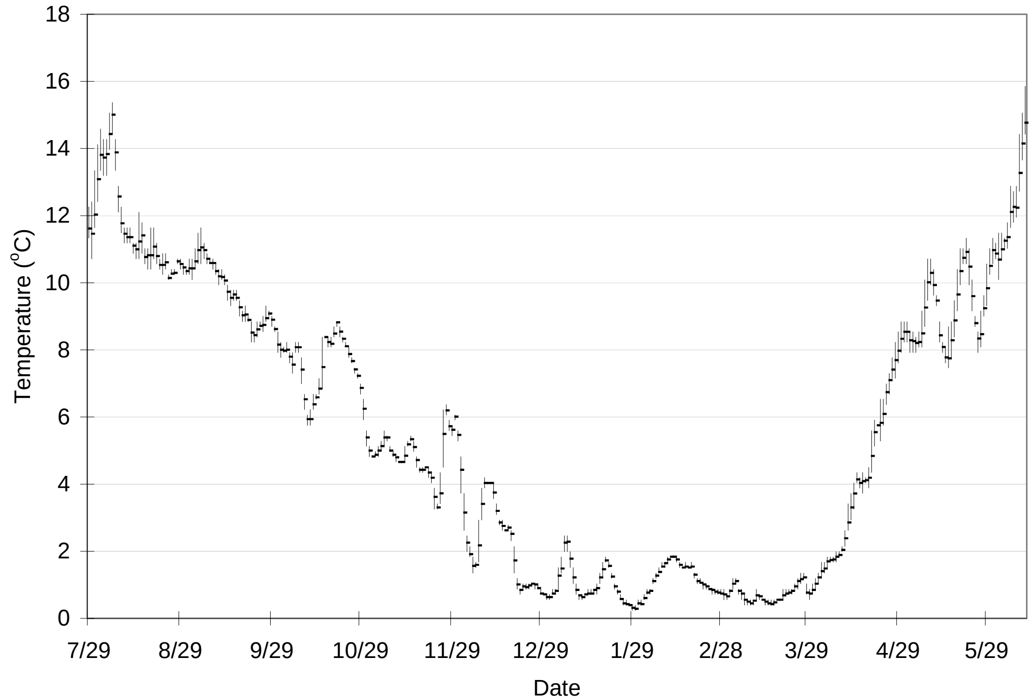


Figure 17. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Pavlof Lake, July 29, 2002 to June 11, 2003.

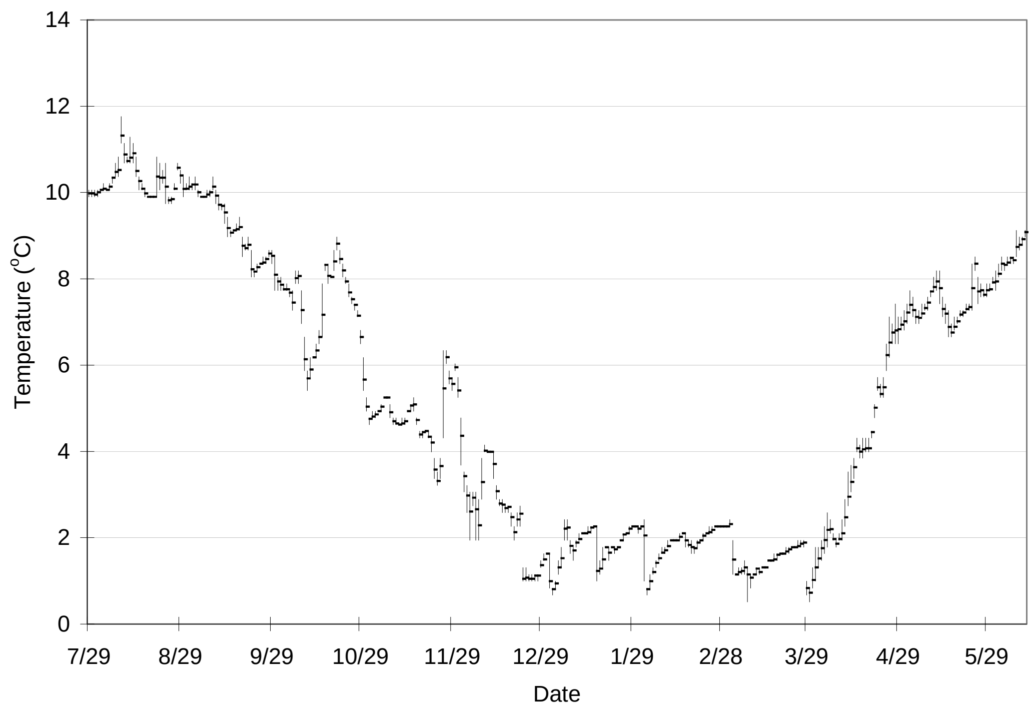


Figure 18. Daily maximum, minimum, and average temperature at a depth of 5 m at Station A in Pavlof Lake, July 29, 2002 to June 11, 2003.

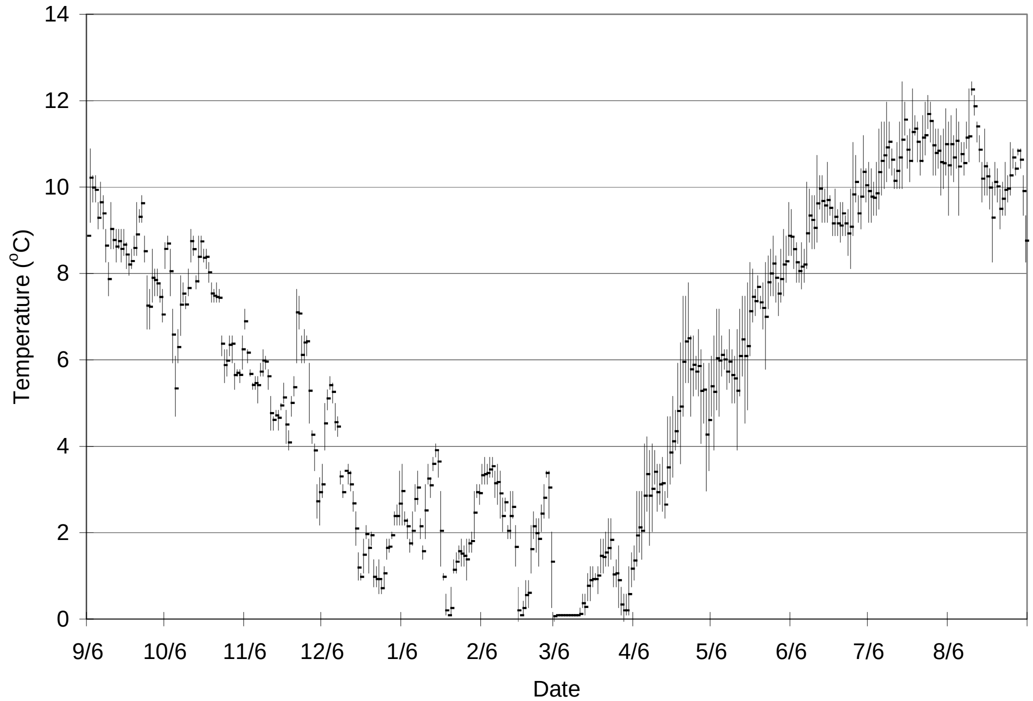


Figure 19. Daily maximum, minimum, and average stream temperatures at the lower end of the main inlet “index” stream that enters into the east side of Hoktaheen Lake, September 6, 2002 to September 5, 2003.

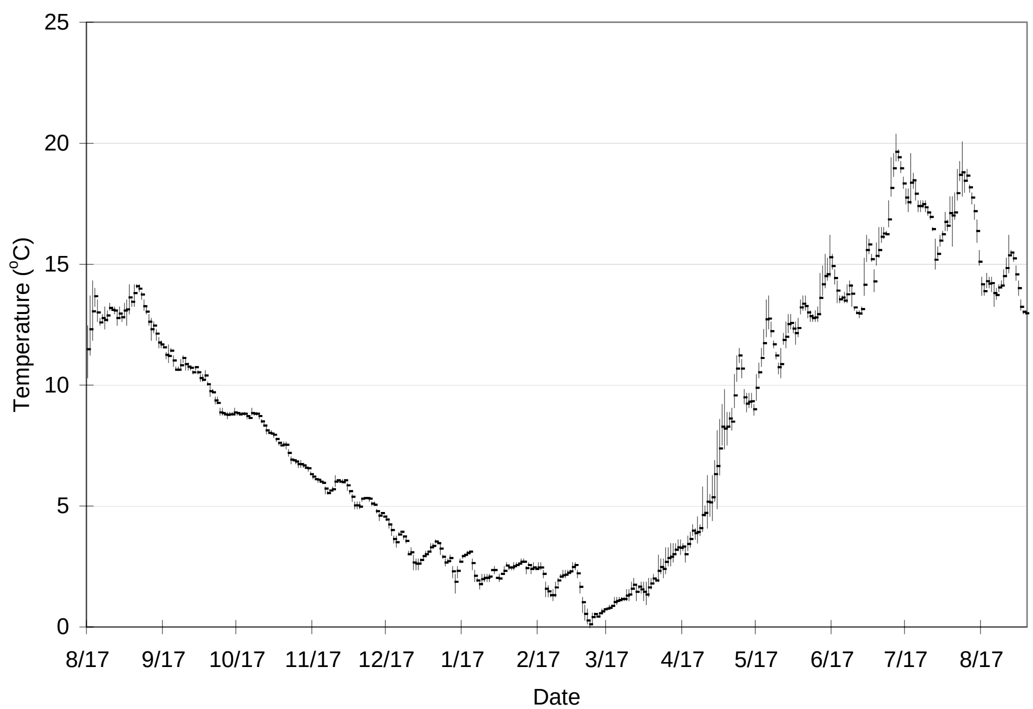


Figure 20. Daily maximum, minimum, and average stream temperatures at the top of the outlet stream from upper Hoktaheen Lake, August 17, 2002 to September 4, 2003.

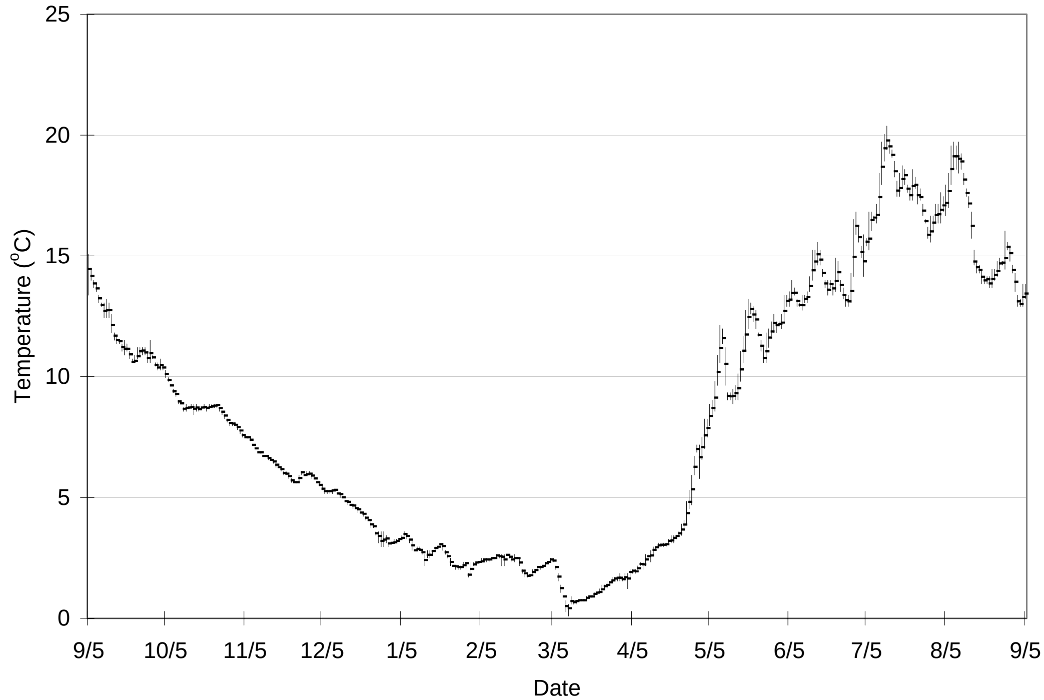


Figure 21. Daily maximum, minimum, and average temperature at a depth of 1 m at Station A in Hoktaheen Lake, September 5, 2002 to September 5, 2003.

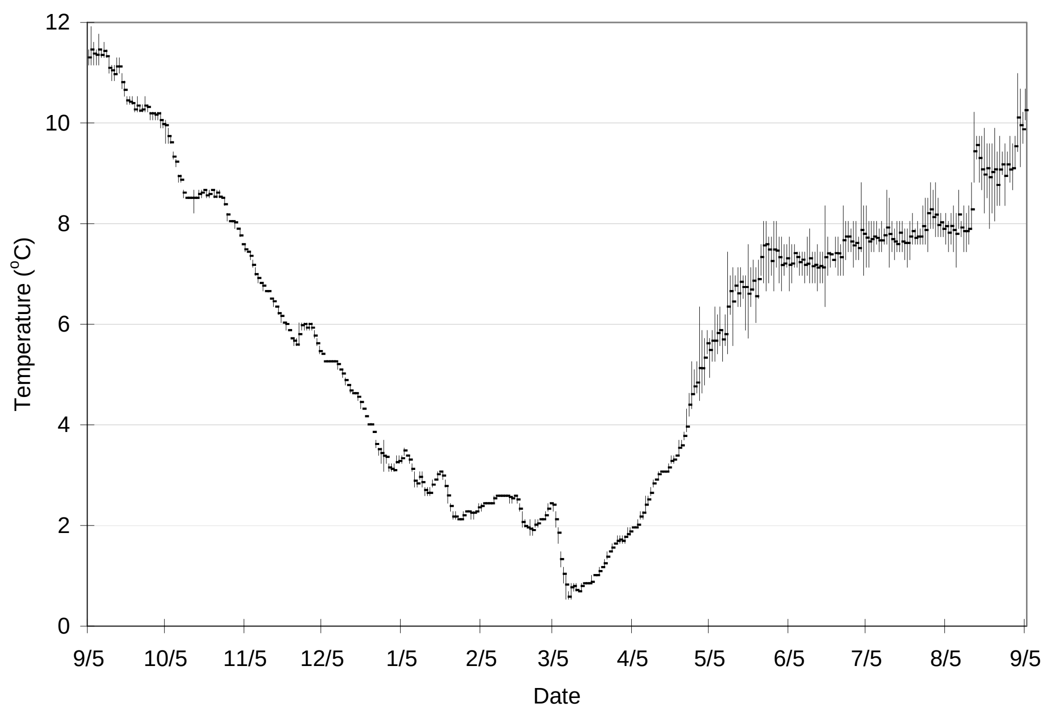


Figure 22. Daily maximum, minimum, and average temperature at a depth of 10 m at Station A in Hoktaheen Lake, September 5, 2002 to September 5, 2003.

Table 40. Average monthly water temperatures (˚C) in the inlet stream, outlet stream, and lake, Neva, Pavlof, and Hoktaheen, August through December, 2002.

		System		
Period	Location	Neva	Pavlof	Hoktaheen
August	Inlet	8	10	-
	Outlet	15	12	-
	Lake @ 1 m	15	12	-
	Lake @ 5 m	-	10	-
	Lake @ 10 m	-	-	-
	Lake @ 13 m	6	-	-
September	Inlet	7	9	9
	Outlet	12	10	12
	Lake @ 1 m	13	10	12
	Lake @ 5 m	-	9	-
	Lake @ 10 m	-	-	11
	Lake @ 13 m	6	-	-
October	Inlet	6	7	8
	Outlet	9	7	9
	Lake @ 1 m	9	7	9
	Lake @ 5 m	-	7	-
	Lake @ 10 m	-	-	9
	Lake @ 13 m	7	-	-
November	Inlet	5	5	6
	Outlet	6	5	7
	Lake @ 1 m	6	5	7
	Lake @ 5 m	-	5	-
	Lake @ 10 m	-	-	7
	Lake @ 13 m	6	-	-
December	Inlet	3	2	3
	Outlet	4	2	4
	Lake @ 1 m	4	2	5
	Lake @ 5 m	-	3	-
	Lake @ 10 m	-	-	5
	Lake @ 13 m	4	-	-
Sept. to Dec.	Inlet	5	6	6
	Outlet	8	6	8
	Lake @ 1 m	8	6	8
	Lake @ 5 m	-	6	-
	Lake @ 10 m	-	-	8
	Lake @ 13 m	6	-	-

Secondary Production

The seasonal mean density (number m^{-2}) of zooplankton from vertical tows at Stations A and B in Neva, Pavlof, and Hoktaheen Lakes was 218,000, 1,000, and 283,000 (Tables 41, 42, and 43). The weighted biomass (mg m^{-2}) was 476, 1, and 618, respectively (Tables 41, 42, and 43). The seasonal mean density and weighted biomass of zooplankton at Neva Lake drops to 159,000 number m^{-2} and 402 mg m^{-2} when results from the May 23 sample from Station A is included (Table 44). Daphnia dominated the samples from Neva Lake and Cyclops and Bosmina dominated the samples from Pavlof and Hoktaheen Lakes. The density and biomass of zooplankton in Pavlof Lake was extremely low.

Table 41. Density, size, and biomass of zooplankton in Neva Lake, July to August, 2002.

	Zooplankton Density (no. m^{-2})					Mean Wet Length (mm)				Seasonal Weighted Biomass	
	Date					Date			Weighted Length		
Taxa	26-Jul	25-Aug	05-Oct	Mean	%	26-Jul	25-Aug	05-Oct	(mm)	(mg m^{-2})	%
Station A:											
Cyclops	12,067	22,754	18,339	17,720	10%	0.76	1.09	0.80	0.92	53	12%
Ovig. Cyclops	200	0	1,358	519	0%	1.12		1.02	1.03	2	0%
Bosmina	9,509	32,603	6,792	16,301	9%	0.34	0.40	0.43	0.39	23	5%
Ovig. Bosmina	2,038	679	2,377	1,698	1%	0.50	0.51	0.50	0.50	4	1%
Daphnia l.	74,036	182,034	145,695	133,922	72%	0.85	0.67	0.65	0.70	281	66%
Ovig. Daphnia l.	11,207	5,094	23,434	13,245	7%	1.12	1.03	0.92	0.99	60	14%
Copepod nauplii	7,132	0	0	2,377	1%						
Total	116,189	243,164	197,995	185,783						422	
Tow Depth (m)	15.0	15.0	15.0								
Station B:											
Cyclops	64,952	21,905	29,801	38,886	16%	0.90	0.89	0.64	0.83	94	18%
Ovig. Cyclops	5,519	0	1,274	2,264	1%	1.15		1.00	1.12	10	2%
Bosmina	20,377	41,263	18,085	26,575	11%	0.39	0.39	0.46	0.41	40	8%
Ovig. Bosmina	5,519	509	7,132	4,387	2%	0.49	0.49	0.48	0.48	10	2%
Daphnia l.	109,102	193,327	190,525	164,318	66%	0.76	0.69	0.63	0.68	330	62%
Ovig. Daphnia l.	8,490	1,019	26,235	11,915	5%	1.15	0.97	0.83	0.91	45	8%
Copepod nauplii	7,217	0	0	2,406	1%						
Total	221,176	258,023	273,052	250,750						529	
Tow Depth (m)	15.0	14.0	15.0								
Average of Stations A and B				218,267						476	

Table 42. Density, size, and biomass of zooplankton in Pavlof Lake, May to August, 2002.

	Zooplankton Density (no. m^{-2})					Mean Wet Length (mm)				Seasonal Weighted Biomass	
	Date					Date			Weighted Length		
Taxa	May-24	Jul-29	Aug-27	Mean	%	May-24	Jul-29	Aug-27	(mm)	(mg m^{-2})	%
Station A:											
Diaptomus	0	0	10	3	0%			0.80	0.80	0.01	1%
Cyclops	453	1,218	25	565	73%	0.59	0.45	0.55	0.49	0.44	67%
Ovig. Cyclops					0%						
Bosmina	51	275	10	112	14%	0.43	0.30	0.32	0.32	0.10	16%
Ovig. Bosmina	0	5	0	2	0%						
Daphnia l.	36	36	0	24	3%	0.83	0.60		0.72	0.05	8%
Ovig. Daphnia l.	5	0	0	2	0%						
Daphnia g.	5	0	0	2	0%	1.82			1.82	0.03	4%
Chydorinae	0	36	71	36	5%		0.28	0.28	0.28	0.02	4%
Copepod nauplii	0	82	0	27	4%						
Total	550	1,652	116	773						0.66	
Tow Depth (m)	6.0	5.5	5.5								
Station B:											
Diaptomus											
Cyclops	107	586	0	231	15%	0.66	0.46		0.49	0.18	14%
Ovig. Cyclops											
Bosmina	5	3,698	20	1,241	80%	0.34	0.31	0.31	0.31	1.07	80%
Ovig. Bosmina	0	102	0	34	2%		0.38		0.38	0.05	3%
Daphnia l.	0	15	0	5	0%		0.48		0.48	0.00	0%
Ovig. Daphnia l.											
Daphnia g.											
Holopedium	5	5	5	5	0%	0.50		0.70	0.60	0.02	1%
Chydorinae	15	56	36	36	2%	0.29	0.26	0.25	0.26	0.02	2%
Copepod nauplii											
Total	132	4,462	61	1,552						1.34	
Tow Depth (m)	6.0	4.0	4.5								
Average of Stations A and B				1,162						1.00	

Table 43. Density, size, and biomass of zooplankton in Hoktaheen Lake, May to September, 2002.

	Zooplankton Density (no. m^{-2})						Mean Wet Length (mm)					Seasonal	
	Date						Date				Weighted Length	Weighted Biomass	
Taxa	May-24	Aug-20	Sep-06	Sep-17	Mean	%	May-24	Aug-20	Sep-06	Sep-17	(mm)	(mg m^{-2})	%
Station A:													
Cyclops	86,942	91,696	167,091	74,121	104,963	46%	0.85	0.72	0.73	0.75	0.76	208	46%
Ovig. Cyclops	0	3,057	2,547	764	1,592	1%		1.14	1.17	1.18	1.16	8	2%
Bosmina	6,962	278,485	64,442	79,980	107,467	48%	0.50	0.45	0.45	0.47	0.45	208	46%
Ovig. Bosmina	0	4,415	509	1,528	1,613	1%	0.56	0.59	0.57	0.56	0.58	5	1%
Daphnia l.	5,264	340	509	1,528	1,910	1%	0.79	0.99	0.89	0.69	0.79	5	1%
Ovig. Daphnia l.	1,528	0	0	509	509	0%	1.02		1.01	0.90	0.99	2	1%
Daphnia g.	849	1,698	1,528	509	1,146	1%	1.70	1.58	1.65	1.52	1.62	15	3%
	0	0	0	255	64	0%		2.29			2.32	2	0%
Holopedium	0	0	255	509	191	0%			1.00	0.96	0.97	1	0%
Copepod nauplii	25,811	0	0	0	6,453	3%							
Total	127,356	379,691	236,881	159,703	225,908							454	
Tow Depth (m)	44.0	43.0	47.5	46.0									
Station B:													
Cyclops	52,437	230,769	225,420	134,997	160,906	47%	0.70	0.78	0.77	0.75	0.76	325	42%
Ovig. Cyclops	0	1,019	2,123	3,396	1,635	0%		1.17	1.18	1.19	1.18	8	1%
Bosmina	4,415	109,017	340,041	219,902	168,344	50%	0.48	0.39	0.55	0.53	0.52	427	55%
Ovig. Bosmina	204	764	4,245	3,396	2,152	1%	0.58	0.53	0.55	0.57	0.56	6	1%
Daphnia l.	6,792	1,783	8,449	1,698	4,681	1%	0.75	0.68	0.83	0.76	0.78	13	2%
Ovig. Daphnia l.	747	255	0	425	357	0%	1.05	0.91		0.99	1.01	2	0%
Daphnia g.	136	0	0	0	34	0%	1.82				1.82	1	0%
	68	0	0	0	17	0%	2.34				2.34	0	0%
Copepod nauplii	5,977	0	0	0	1,494	0%							
Total	70,776	343,607	580,278	363,814	339,619							782	
Tow Depth (m)	13.0	15.0	14.0	15.0									
Average of Stations A and B					282,763							618	

Table 44. Density, size, and biomass of zooplankton in Neva Lake, May to August, 2002.

	Zooplankton Density (no. m^{-2})						Mean Wet Length (mm)					Seasonal	
	Date						Date				Weighted Length	Weighted Biomass[b]	
Taxa[a]	May-23	Jul-26	Aug-25	Oct-05	Mean	%	May-23	Jul-26	Aug-25	Oct-05	(mm)	(mg m^{-2})	%
Station A:													
Cyclops	37,878	12,267	22,754	19,697	23,149	15%	0.63	0.77	1.09	0.82	0.80	55	14%
Bosmina	3,918	11,547	33,282	9,169	14,479	9%	0.42	0.37	0.40	0.45	0.40	29	7%
Daphnia l.	35,918	85,243	187,128	169,129	119,355	75%	0.52	0.89	0.68	0.69	0.71	319	79%
Copepod nauplii		7,132	0	0	2,377	1%							
Total	77,714	116,189	243,164	197,995	159,360							402	
Tow Depth (m)	13.0	15.0	15.0	15.0									

[a] The number of ovigerous and non-ovigerous individuals of each taxa are added together for the July, Aug., and Oct. samples.

[b] The biomass estimates for the May 23 sample were Cyclops = 54.72, Bosmina = 6.52, and Daphnia = 34.52 mg m^{-2}.

DISCUSSION

This was a good first year for the project. Project objectives were accomplished with few exceptions. This was the first season of fisheries technician work for the crew from the Hoonah Indian Association. Extra time was put into learning about field and sampling procedures. Crewmembers participated in Forest Service's aviation, radio, firearm, and bear safety training. Record keeping, work scheduling, and scale sampling are areas that need improvement for 2003. Mark-recapture data forms need to be revised so there are recovery fields for each mark type.

No changes are needed to the design, location, installation, or operation of the weir and trap on Neva Creek. Weir personnel know that rainfall triggers the sockeye salmon to migrate especially after mid-summer periods of low flows. The floating wall tent at Pavlof also worked well. It was easy to set up and provided comfortable and convenient housing for up to four individuals. Future platforms should be designed with the tent frame supports flush with the floor so that it would be easier to winterize the platform with a tarp (as shown in Appendix B.1).

Our ability to index the sockeye escapement into these systems would have been improved if we had been able to complete three or more mark-recapture trips to each index area. At least three trips are needed for an open population Jolly-Seber estimate of the total number of sockeye spawning in an index area (Seber 1982; Conitz and Cartwright 2003a). Sockeye salmon were found to spawn in two main spawning areas at both Neva and Hoktaheen. This effectively doubles the mark-recapture effort needed in each lake to index as high a proportion of the observed escapement as possible. The two abundance estimates we got in each of the two index areas in each lake in 2002 are useful for indexing escapements; however, completing additional trips to each index area will be an emphasis for 2003.

We did not know what the timing or distribution of sockeye migration or spawning was at Neva or Pavlof so extra effort was put into searching for fish and figuring out how best to capture them. At Neva, we found sockeye spawning and available for mark-recapture indexing in the main inlet stream index area from mid-August to mid-September and in the beach index area from late August through November. At Pavlof, sockeye salmon were catchable with a beach seine in and off the mouth of the main inlet stream from late-July through mid-August. The earlier run timing and spawning timing of the main inlet stream spawners at Neva and Pavlof relates to the colder water temperatures at these locations (Table 40).

We were able to build on last year's experiences at Hoktaheen for the timing of our trips (Conitz and Cartwright 2002a). Unfortunately, we were a little early on our first trip, August 19-21, and weather delays forced cancellation of a late September trip. Based on our observations of fish timing in 2002, the crew should continue index mark-recapture sampling in Pavlof Lake's main inlet stream through mid-August then move to mark-recapture sampling at Hoktaheen for most of September. Mark-recapture should begin in Hoktaheen Lake's main inlet stream index area and end in the outlet index area with an overlap in areas sampled in mid-September. Four flights to Hoktaheen Lake were turned back due to weather this summer. We circled the lake on two of the flights under clear, sunny weather but localized downdrafts ("cat paw" winds) were too strong and unpredictable to safely land and take off. Keeping a crew at Hoktaheen for most of September should reduce flight costs and weather delays and, most importantly, improve our ability to collect multiple mark-recapture estimates in the inlet and outlet index areas. We observed how heavy rainfall and high water events flushed the sockeye salmon out of the main inlet streams in each of these lakes. This emphasizes the importance of completing as much mark-recapture sampling as possible when fish and weather cooperate.

This project obtained the first estimates on record of the sockeye salmon escapement into Neva and Pavlof Lakes. The Neva sockeye escapement of 4,951 (3,738 adults and 1,213 jacks) was higher than anticipated as was the abundance and duration of beach spawning. Only 36 sockeye salmon were reported in the subsistence/personal use harvest (Figure 3) and project personnel only documented a harvest of 44 fish (Table 19). Actual subsistence/personal use harvest was probably higher but the total exploitation rate, including sport and commercial fisheries, was probably less than 15%. The Neva sockeye run appears healthy given the probable low exploitation rates in recent years, the natural condition of the watershed, the relatively small size of the lake, the abundance of inlet stream and beach spawning from August through November, the high proportion of age-1.- fish (95%), third highest zooplankton biomass of the 15 Southeast Alaska sockeye rearing lakes sampled in 2002 (Table 45); and the highest percentage of Cladoceran zooplankton (75% *Daphnia*; a preferred prey species for sockeye fry; Koenings and Burkett 1987). Alaska Department of Fish and Game managers recognized the good health of the Neva sockeye run and increased daily and annual subsistence/personal use sockeye harvest limits from 10 fish in 2002 to 25 fish in 2003.

Table 45. Comparison of zooplankton biomass and percent *Daphnia* among 15 sockeye rearing lakes in Southeast Alaska, 2002 (from Conitz and Cartwright 2003b).

Lake	Seasonal Mean Biomass (mg m^{-2})	*Daphnia* as % of Total Biomass
Hoktaheen	618	3
Sitkoh	569	33
Neva	476	75
Tumakof	454	0
Kanalku	419	33
Luck	312	6
Kook	311	16
Klag	222	2
Salmon Bay	195	8
Kutlaku	130	27
Thoms	119	6
Hetta	47	10
Falls	29	2
Gut Bay	21	6
Pavlof	1	5

Results from Pavlof suggest that the sockeye production is small and at capacity in this small, shallow lake. The extremely low zooplankton density (a seasonal biomass of 1 mg m^{-2}) was the lowest observed for any lake (Table 45; John Edmundson, ADF&G, Statewide Limnology Lab, personal communication, 2003). Barto and Cook (1999) also concluded that the sockeye rearing capacity is limited. Increasing harvests and reducing escapements might increase returns a little. Pavlof has not been listed on ADF&G's subsistence/personal use harvest permits.

Escapement index results suggest that the Hoktaheen sockeye escapement was a little higher in 2002 than in 2001. The index of sockeye salmon in the main inlet stream was 660 on September 3-4, 2001 and 737 on September 5-6, 2002. The pooled Peterson estimate between the September 3-4 and 19-20 trips in 2001 was 745 compared to 1,254 between the September 5-7 and 17-18 trips in 2002. I am reluctant to assess the status of Hoktaheen sockeye salmon based on these results since there is little historical basis for comparison. Project results from the next two years will help with this assessment. The capacity of the lake to rear sockeye fry looks good. Hoktaheen Lake had the highest seasonal mean biomass of zooplankton (618 mg m^{-2}) of the 15 lakes sampled in 2002; however, *Daphnia* comprised only three percent of the zooplankton biomass (Table 45).

If future funding supports only one sockeye survey trip to each lake a year, these project findings suggest that you would want to visit Pavlof in early August, Hoktaheen in early September, and Neva in early October. Fortunately, this project continues for two more years, 2003 and 2004, and recommendations for how to best index or estimate escapements can wait till then.

CONCLUSIONS

Project objectives are appropriate and attainable. This year's results, and project results from the next two years, are needed to understand current escapement levels and the adequacy of these escapements for maintaining healthy runs and meeting subsistence needs.

RECOMMENDATIONS

1) Continue project using the revised Objectives with the exception noted in 2) below.
2) Change Objective #5 to "Estimate the distribution of spawning sockeye salmon in the Pavlof Lake system using radio tags."
3) Continue making improvements to mark-recapture study design and data forms.
4) Plan to work at Hoktaheen for most of September. Equip the camp at Hoktaheen with a small wall tent and heater and equip the boat with a small outboard.

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A number of ADF&G folks were instrumental to the success of this project. Meg Cartwright and Jan Conitz helped administratively, technically, and logistically. Their guidance with analysis and reporting was particularly helpful. Renate Riffe helped with limnology supplies, procedures, and sampling. Richard Bloomquist, Mark Olsen, and Iris Frank aged and tabulated our much less than perfect collection of scale, sex, and length samples. Malcolm McEwen and Bert Lewis of ADF&G did the juvenile sampling fieldwork and data analysis at Hoktaheen Lake. John Edmondson and the ADF&G Soldotna Limnology Lab crew processed most of the zooplankton samples. Lastly, Wayne Lonn's work at the Neva Creek weir was outstanding, his years of experience with salmon projects was apparent and appreciated.

Thanks to USFS biologists Mark Laker and Lance Lerum for bathemetric mapping of Neva Lake and assisting with the limnological studies. Juneau Ranger District employees Julie Laker, Dan Schultz, and Kevin Brownlee helped put in the Pavlof Lake camp and Pete Schneider and Julie Laker worked a long weekend at the Neva Creek weir. The Hoonah Ranger District staff was extremely helpful with preseason safety training, logistics, and in response to a safety incident at Pavlof Lake. We found Libby Dougan and the Sitka Dispatch office's professionalism especially reassuring with this bush flying-intensive project.

Ward Cove Packing's Gary Moore, Dave McLean, and Bruce Gordon helped with accommodations and other logistics at Excursion Inlet.

Thanks to the Southeast Regional Advisory Council and the Federal Subsistence Board for associating the importance of these sockeye systems with the funding needed to keep them healthy. Finally, we wish to thank the Hoonah-area residents who rely on the wise stewardship of these salmon resources.

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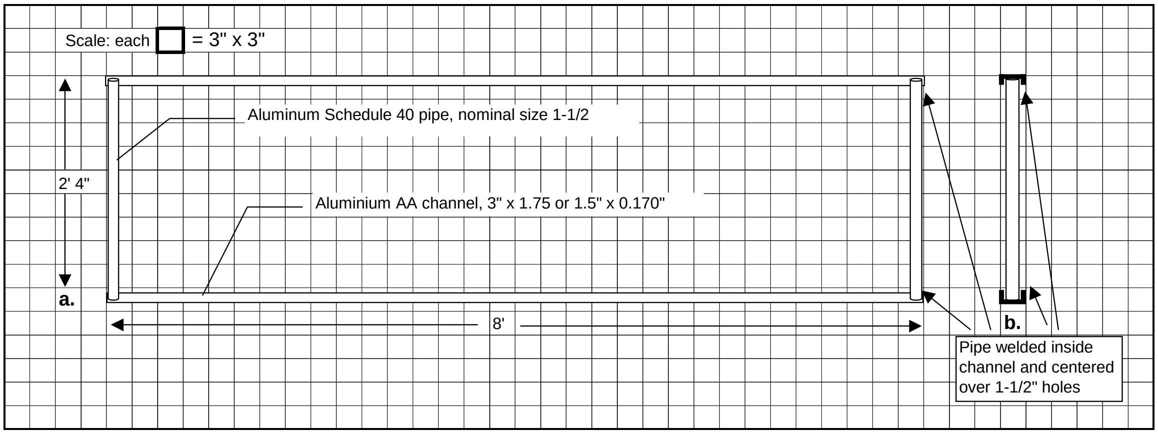
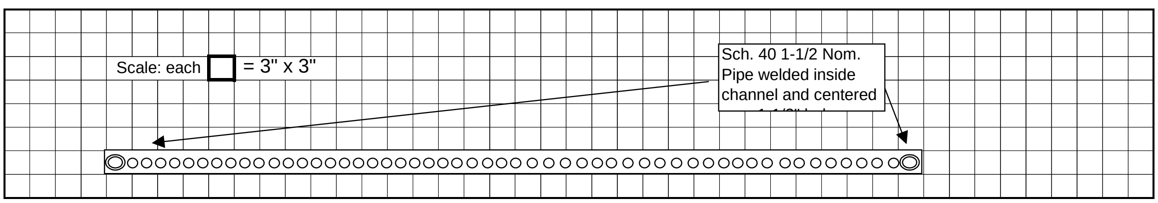
APPENDICES

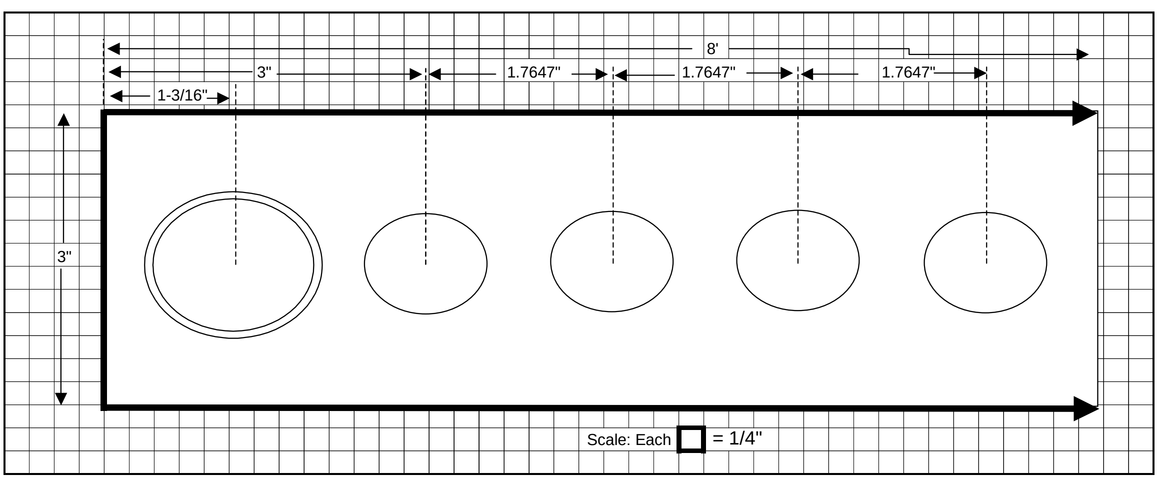
Appendix A. Weir and trap design.



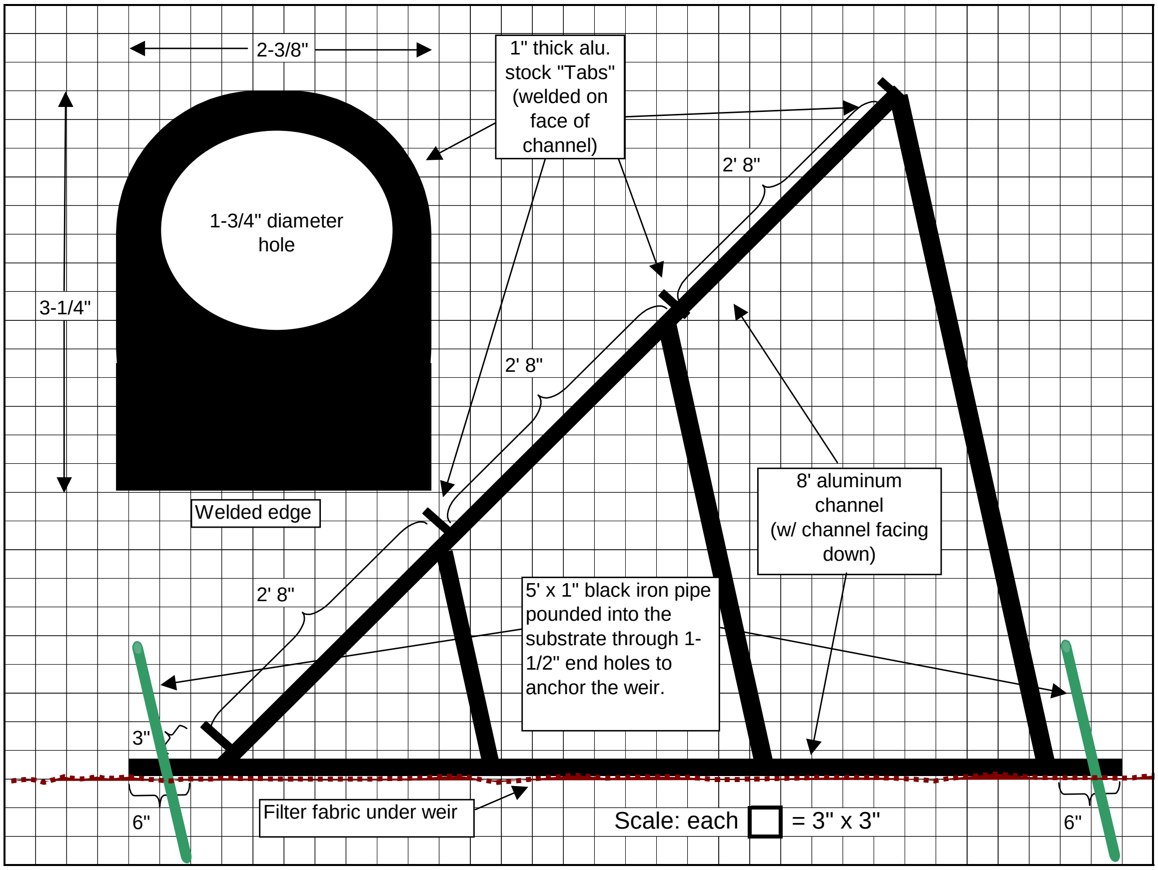
Appendix A.1. Side view (a.) of 8’ weir panel with two 1-1/2” end holes and fifty-two 1-1/8” picket holes and end view (b.) of all the 8’ x 2’4” weir panels. The 8’ trap panels are identical except they are 2’ high instead of 2’4” high.



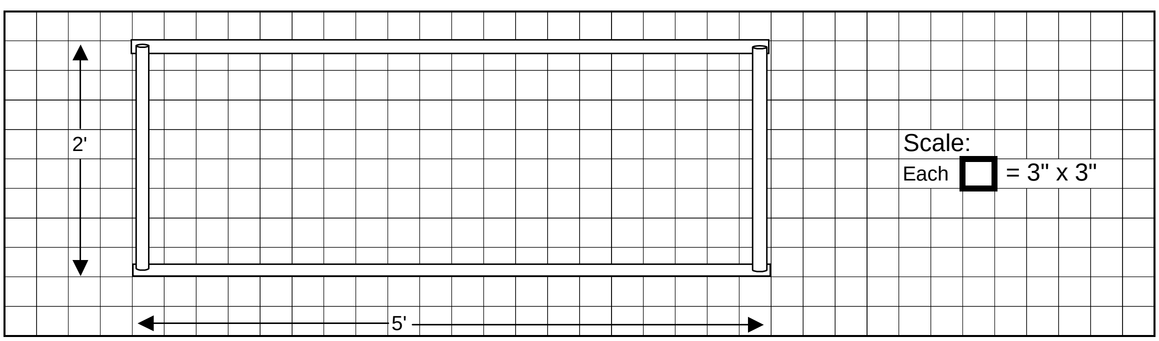
Appendix A.2. Top (or bottom) view of 8’ weir or trap channel or panel with the two 1-1/2” end holes and fifty-two 1-1/8” picket holes. A 5’ trap channel or panel has the two 1-1/2” end holes and thirty-one 1-1/8” picket holes.



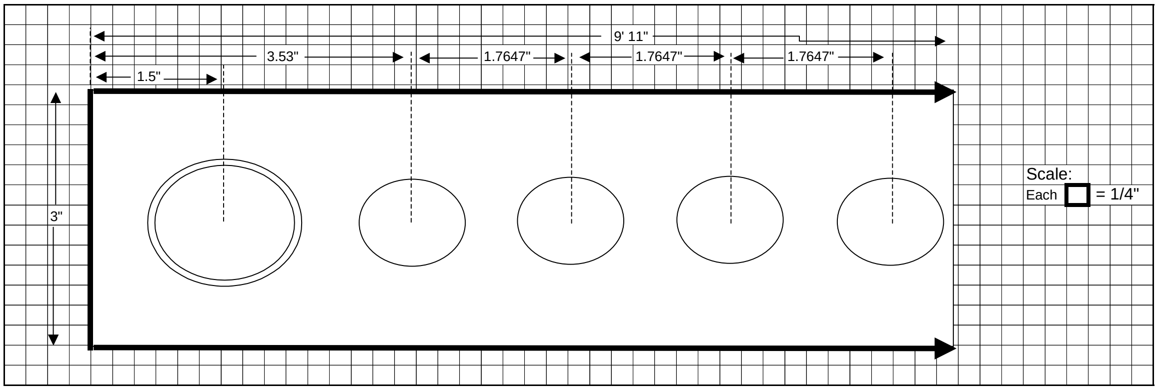
Appendix A.3. View of the end of an 8’ channel showing one of the 1-1/2” end holes and four of the fifty-two 1-1/8” picket holes.



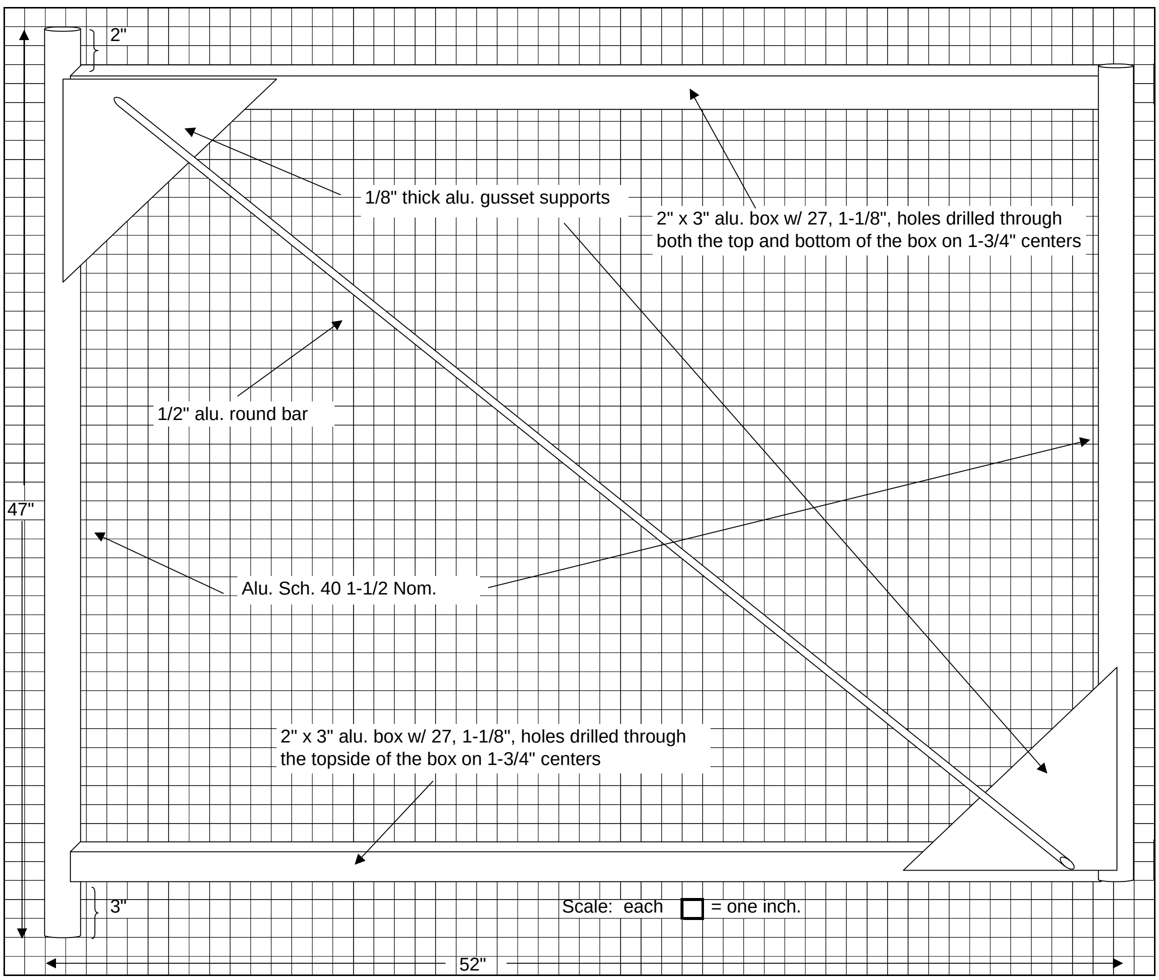
Appendix A.4. Weir bipod constructed from 3" x 1-3/4" aluminum AA channel.



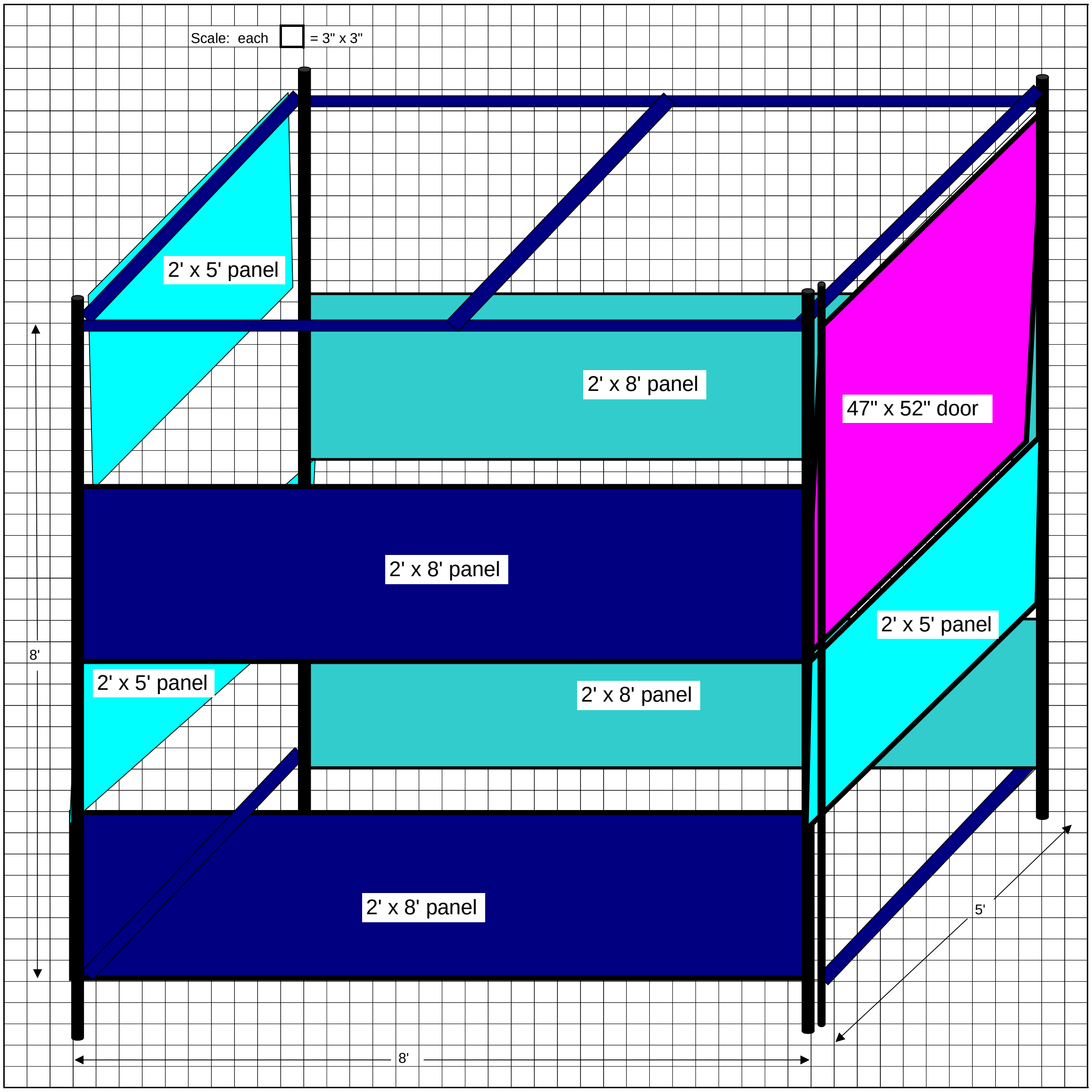
Appendix A.5. Side view of 5' trap panel.



Appendix A.6. View of the end of an 5' trap channel or panel showing one of the 1-1/2" end holes and four of the thirty-one 1-1/8" picket holes.

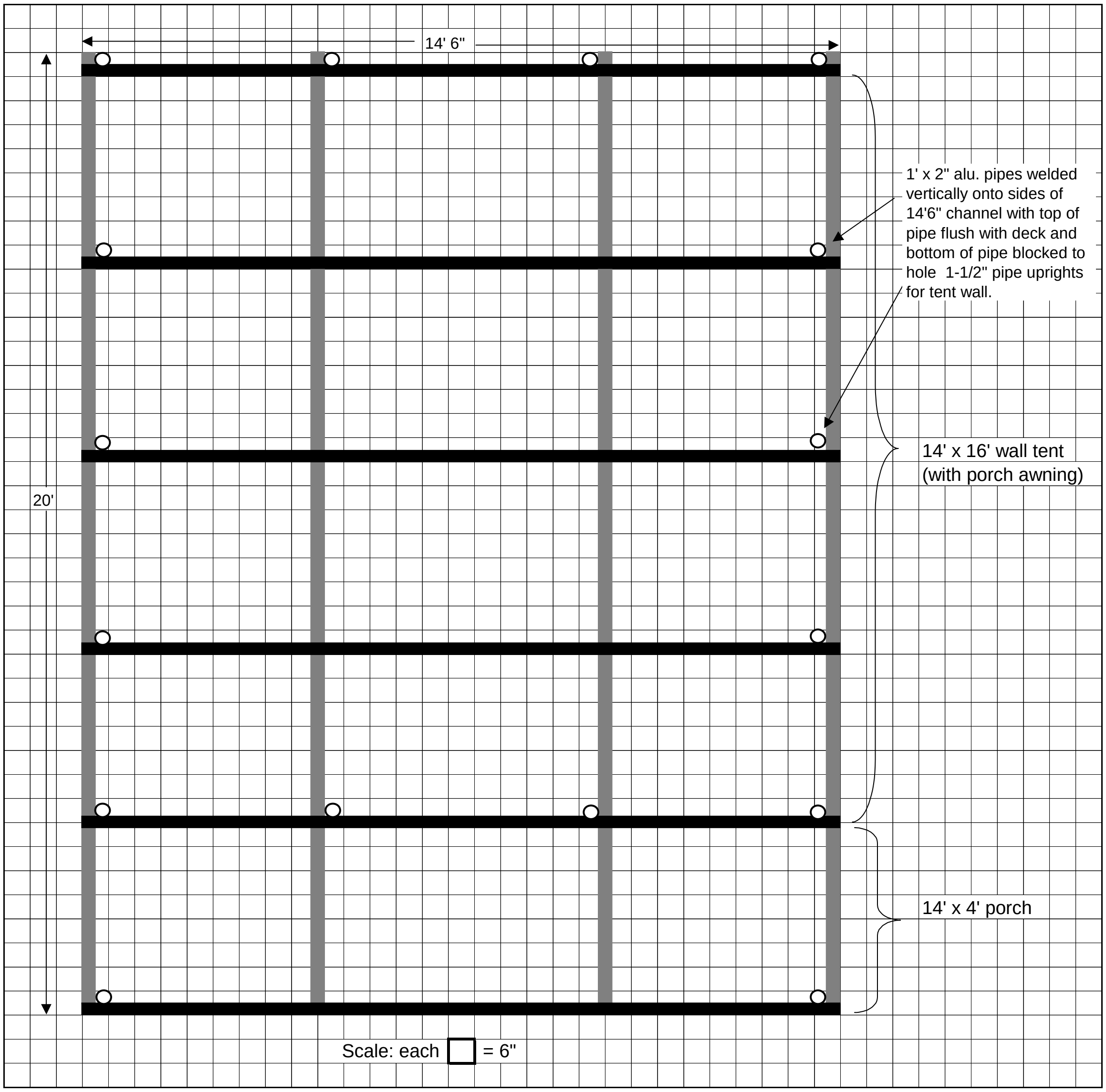


Appendix A.7. Trap door viewed from front.

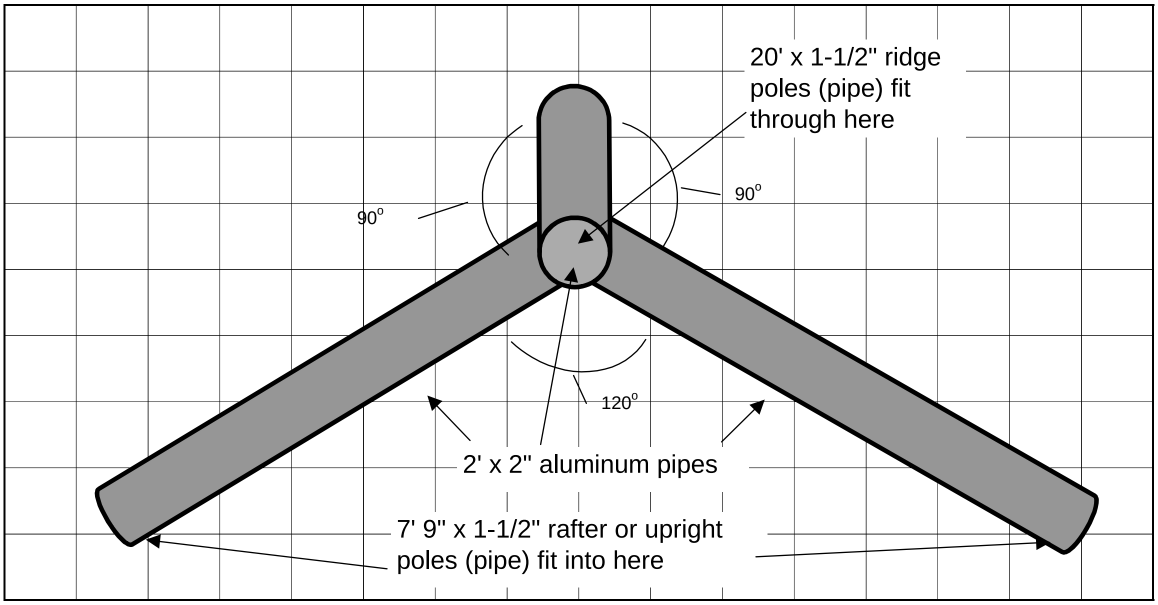


Appendix A.8. 3-D view of 5’ x 8’ x 8’ trap.

Appendix B. Floating wall tent design.



Appendix B.1. Platform for floating wall tent.



Appendix B.2. Pole connectors for wall tent.

a)

b)

Appendix B.3. Pictures of the floating wall tent: a) front view of the tent under construction; and b) rear view of the tent at anchor in the outlet slough of Pavlof Lake.

Appendix C. Daily weir count data and weekly sockeye age, sex, and length data from the Neva Creek weir, 2002.

Appendix C.1. Detailed Neva Creek weir counts, 2002.

	Weather and Stream Measurements:[a]					Sockeye Counted:			Sockeye Finclipped:				
Date	Weather	Water Level (cm)	Air Temp (°C)	Therm-ometer Water Temp (°C)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped
6/4	rain	45.0	10.0	13.0		0	0	0		0		0	
6/5	showers	46.0		12.0		0	0	0		0		0	
6/6	overcast	46.5		12.0		0	0	0		0		0	
6/7	clear	45.5		12.0		0	0	0		0		0	
6/8	overcast	42.5	11.0	12.0		0	0	0		0		0	
6/9	rain	42.0	12.0	12.5		0	0	0		0		0	
6/10	showers	45.0	12.0	13.0		1	0	1	left axillary	0	0%	0	
6/11	overcast	45.0	12.0	12.0		0	0	0		0	0%	0	
6/12	partly cloudy	44.5	11.0	12.0		0	0	0		0	0%	0	
6/13	clear	43.0	12.0	13.0		0	0	0		0	0%	0	
6/14	clear	41.0	14.0	14.0		0	0	0		0	0%	0	
6/15	clear	40.0	15.0	16.0		0	0	0		0	0%	0	
6/16	clear	39.5	14.0	16.0		0	0	0		0	0%	0	
6/17	partly cloudy	39.0	13.0	15.0		1	0	1	left axillary	1	50%	0	
6/18	overcast	39.0	11.0	15.0		2	0	2	left axillary	1	50%	0	
6/19	showers	38.0	10.0	14.0		0	0	0		0	50%	0	
6/20	showers	38.0	10.0	14.0		1	0	1	left axillary	0	40%	0	
6/21	overcast	36.0	10.5	14.0		0	0	0		0	40%	0	
6/22	partly cloudy	35.0	12.0	14.0		1	0	1	left axillary	1	50%	0	
6/23	rain	33.5	14.0	15.0		1	0	1	left axillary	0	43%	0	
6/24	rain	32.5	12.5	15.0		0	0	0		0	43%	0	
6/25	rain	35.0	12.0	14.0		0	0	0		0	43%	0	
6/26	showers	36.0	12.0	14.5		1	0	1	left axillary	1	50%	0	
6/27	overcast	35.5	12.0	14.0		62	0	62	left axillary	40	63%	0	
6/28	partly cloudy	35.0	12.0	14.0		35	0	35	left axillary	0	42%	0	
6/29	overcast	33.0	12.0	15.0		0	0	0		0	42%	0	
6/30	showers	32.5	13.0	15.0		31	0	31	left axillary	22	49%	0	
7/1	showers	31.0	13.0	15.0		188	0	188	left axillary	97	50%	0	
7/2	rain	31.5	10.0	14.0		333	7	340	l. axil. & dorsal[c]	169	51%	4	57%
7/3	showers	37.0	9.0	14.0		52	2	54	dorsal	19	50%	1	56%
7/4	showers	39.5	10.0	14.0		28	0	28	dorsal	18	50%	0	56%
7/5	overcast	40.5	11.0	13.5		83	1	84	dorsal	42	50%	1	60%
7/6	overcast	40.0	11.0	13.5		12	0	12	dorsal	3	50%	0	60%
7/7	clear	39.0	11.0	14.0		11	3	14	dorsal	7	50%	3	69%
7/8	overcast	37.0	14.0	15.0		8	0	8	dorsal	2	50%	0	69%
7/9	showers	35.5	12.0	15.0		18	3	21	dorsal	8	50%	2	69%
7/10	rain	34.0	11.0	15.0		8	0	8	dorsal	4	50%	0	69%
7/11	showers	34.0	11.0	14.5		11	0	11	dorsal	6	50%	0	69%
7/12	overcast	32.0	11.5	14.5		9	2	11	dorsal	4	50%	1	67%
7/13	rain	30.5	11.0	14.5		0	4	4	dorsal	0	50%	2	64%
7/14	showers	32.0	11.0	14.0		28	9	37	dorsal	15	50%	4	58%
7/15	overcast	37.0	12.0	14.0		22	18	40	dorsal	12	50%	8	53%
7/16	showers	34.5	12.0	14.5		11	10	21	dorsal	7	50%	4	51%
7/17	showers	32.5	11.0	14.5		4	6	10	dorsal	2	50%	3	51%
7/18	overcast	31.5	12.0	14.5		28	15	43	dorsal	19	51%	8	51%
7/19	overcast	30.0	12.0	15.0		35	17	52	dorsal	12	50%	7	49%
7/20	overcast	29.0	12.0	15.0		1	4	5	dorsal	1	50%	2	50%
7/21	rain	28.0	13.0	15.0		0	2	2	dorsal	0	50%	1	50%
7/22	showers	29.0	13.0	15.0		13	18	31	left ventral	12	51%	17	56%
7/23	overcast	28.5	14.0	15.5		1	3	4	left ventral	0	50%	0	55%
7/24	rain	30.0	14.0	15.5		190	49	239	left ventral	89	50%	20	51%
7/25	rain	31.5	12.0	15.0		79	24	103	left ventral	40	50%	12	51%
7/26	showers	42.5	11.0	14.5		247	26	273	left ventral	124	50%	14	51%
7/27	showers	44.0	12.0	14.5	14.6	81	13	94	left ventral	41	50%	8	52%
7/28	showers	43.5	10.5	14.0	14.3	94	16	110	left ventral	46	50%	4	50%
7/29	overcast	42.0	11.0	14.0	14.1	25	14	39	left ventral	11	50%	6	50%
7/30	partly cloudy	40.0	12.0	14.5	14.4	15	8	23	left ventral	14	50%	7	51%
7/31	overcast	38.0	12.5	15.0	14.9	25	24	49	left ventral	8	50%	9	50%

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Appendix C.1. (page 2 of 4).

	Number of Other Species Counted:							
Date	Adult Coho[b]	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden	Comments
6/4	0		0	0	0	0	0	Weir fish tight at 1100 hour.
6/5	0		0	0	0	0	0	
6/6	0		0	0	0	0	0	
6/7	0		0	0	0	0	0	
6/8	0		0	0	0	0	0	
6/9	0		0	0	0	0	0	
6/10	0		0	0	0	0	0	
6/11	0		0	0	0	0	0	
6/12	0		0	0	0	0	0	
6/13	0		0	0	0	0	0	
6/14	0		0	0	0	0	0	
6/15	0		0	0	0	0	0	
6/16	0		0	0	0	0	0	
6/17	0		0	0	0	0	0	
6/18	0		0	0	0	0	0	
6/19	0		0	0	0	0	0	
6/20	0		0	0	0	0	0	
6/21	0		0	0	0	0	0	
6/22	0		0	0	0	0	0	
6/23	0		0	0	0	0	0	
6/24	0		0	0	0	0	0	
6/25	0		0	0	0	0	0	
6/26	0		0	0	0	0	0	
6/27	0		0	0	0	0	0	
6/28	0		0	0	0	0	0	
6/29	0		0	0	0	0	0	
6/30	0		0	0	0	0	0	
7/1	0		0	0	0	0	0	
7/2	0		0	0	0	0	0	
7/3	0		0	0	0	0	0	Fish reportedly passed uncounted by non-project person.
7/4	0		0	0	0	0	0	
7/5	0		0	0	0	0	0	
7/6	0		0	0	0	0	0	
7/7	0		0	0	0	0	0	
7/8	0		0	0	0	0	0	
7/9	0		0	0	0	0	0	
7/10	0		0	0	0	0	0	
7/11	0		0	0	0	0	0	
7/12	0		0	0	0	0	0	
7/13	0		0	0	0	1	0	
7/14	0		0	0	0	0	1	
7/15	0		0	0	0	0	1	
7/16	0		0	0	0	0	0	
7/17	0		0	0	0	0	0	
7/18	0		0	0	0	0	11	
7/19	0		0	0	0	0	6	
7/20	0		0	0	0	0	5	
7/21	0		0	0	0	0		
7/22	0		0	0	0	0	16	
7/23	0		0	0	0	0	4	
7/24	0		0	0	0	0	6	
7/25	0		0	0	0	0	8	
7/26	0		0	0	0	0	5	
7/27	0		0	1	0	0	9	
7/28	0		0	0	0	0	18	
7/29	0		0	0	0	0	11	
7/30	0		0	0	0	0	12	
7/31	0		0	1	0	3	10	

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Appendix C.1. (page 3 of 4).

	Weather and Stream Measurements:[a]					Sockeye Counted:			Sockeye Finclipped:				
Date	Weather	Water Level (cm)	Air Temp (^oC)	Therm-ometer Water Temp (^oC)	Data Logger Water Temp (oC)	Adults	Jacks	Total	Finclip Used (Adipose +)	Adults	Cum. % Adults Clipped	Jacks	Cum. % Jacks Clipped
8/1	clear	36.0	13.0	15.0	15.2	49	47	96	left ventral	28	50%	22	49%
8/2	clear	34.0	13.0	16.0	15.9	12	13	25	left ventral	2	50%	9	50%
8/3	partly cloudy	30.5	12.0	16.0	16.0	3	5	8	left ventral	2	50%	3	50%
8/4	clear	28.5	13.5	17.0	16.2	3	14	17	left ventral	2	50%	7	50%
8/5	clear	27.0	12.5	16.5	16.5	32	32	64	left ventral	15	50%	15	50%
8/6	overcast	25.5	13.0	17.0	16.8	3	4	7	left ventral	2	50%	2	50%
8/7	rain	27.0	12.0	16.0	16.5	10	13	23	left ventral	6	50%	6	50%
8/8	showers	38.5	13.0	16.0	16.0	297	64	361	left ventral	147	50%	32	50%
8/9	showers	42.0	12.5	15.5	15.7	176	30	206	left ventral	85	50%	10	49%
8/10	overcast	42.0	13.0	15.0	15.2	92	54	146	left ventral	50	50%	30	49%
8/11	overcast	40.5	12.0	15.0	15.1	74	42	116	left ventral	37	50%	24	50%
8/12	rain	44.0	14.0	14.5	14.8	177	29	206	left ventral	89	50%	15	50%
8/13	showers	58.0	12.5	14.0	14.3	25	12	37	left ventral	12	50%	5	50%
8/14	overcast	56.5	12.5	14.0	14.0	26	9	35	left ventral	16	50%	5	50%
8/15	clear	52.5	11.0	14.0	14.3	38	42	80	left ventral	21	50%	17	49%
8/16	overcast	48.0	13.0	14.5	14.6	26	15	41	left ventral	22	51%	8	50%
8/17	overcast	44.0	10.5	13.5	14.0	33	19	52	left ventral	12	50%	4	49%
8/18	showers	41.5	11.0	13.5	13.8	54	20	74	left ventral	6	50%	20	50%
8/19	overcast	42.0	12.0	14.0	13.8	24	21	45	left ventral	16	50%	16	51%
8/20	overcast	36.0	12.0	13.5	14.0	22	18	40	left ventral	22	50%	1	50%
8/21	overcast		13.5		13.5	31	25	56	left ventral	7	50%	1	48%
8/22	overcast	36.5	13.0	13.0	13.4	54	25	79	left ventral	31	50%	14	49%
8/23	showers	37.5	11.5	13.0	13.5	39	8	47	left ventral	20	50%	3	49%
8/24	overcast	37.5	11.0	13.0	13.4	15	14	29	left ventral	10	50%	2	48%
8/25	showers	35.5	12.0	13.0	13.2	20	20	40	left ventral	4	50%	20	49%
8/26	overcast	33.5	12.0	13.0	13.2	16	11	27	left ventral	16	50%	11	50%
8/27	rain	34.0	12.5	13.0	13.4	19	16	35	left ventral	17	50%	10	50%
8/28	rain	39.5	12.0	13.5	13.4	28	12	40	left ventral	14	50%	6	50%
8/29	rain	41.0	12.5	13.0	13.4	17	10	27	left ventral	4	50%	5	50%
8/30					13.2						50%		50%
8/31		40.5		13.0	13.2	43	23	66	left ventral	28	50%	8	50%
9/1					13.1	16	10	26	left ventral	11	51%	10	50%
9/2					12.7	45	35	80	left ventral	25	51%	23	51%
9/3					13.1	13	14	27	left ventral	9	51%	10	51%
9/4					13.1	22	9	31	left ventral	15	51%	6	51%
9/5					13.4						51%		51%
9/6					13.4						51%		51%
9/7					13.2						51%		51%
9/8					13.1						51%		51%
9/9		34.5		12.0	12.9	6	9	15	left ventral	0	51%	6	51%
9/10		33.5		12.5	12.7	28	7	35	left ventral	12	51%	5	51%
9/11					12.6	0	5	5	left ventral	0	51%	3	51%
9/12					12.7	5	0	5	left ventral	5	51%	0	51%
9/13					12.6	4	9	13	left ventral	4	51%	9	52%
9/14					12.4	3	0	3	left ventral	3	51%	0	52%
9/15					12.1	1	11	12	left ventral	1	51%	0	51%
Total						3,397	1,074	4,471		1,726		551	

[a] The water temperature was recorded by the data logger at 0800 hour, all other observations were made about 0900 hour.

[b] Some jack coho salmon are likely included in these counts prior to 31 August.

[c] Thirty three adult sockeye salmon were given the left axillary clip and 136 the dorsal clip. All jacks were dorsal clipped.

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Number of Other Species Counted:

Date	Adult Coho[b]	Jack Coho	Total Coho	Pink	Chum	Cutthroat	Dolly Varden	Comments
8/1	0		0	0	0	0	1	
8/2	0		0	0	0	0	1	
8/3	0		0	0	0	0	0	
8/4	0		0	0	0	0	0	
8/5	0		0	0	0	0	2	
8/6	0		0	0	0	1	0	
8/7	0		0	0	0	0	0	
8/8	0		0	0	0	0	7	
8/9	2		2	1	0	0	1	
8/10	1		1	5	0	0	10	
8/11	1		1	2	0	0	7	
8/12	7		7	9	0	3	79	
8/13	2		2	4	0	0	4	
8/14	8		8	4	1	0	10	
8/15	13		13	1	0	0	5	
8/16	4		4	3	1	0	4	
8/17	10		10	0	0	0	16	
8/18	19		19	0	0	0	2	
8/19	5		5	1		1	0	
8/20	6		6	0	0	0	3	
8/21	5		5	2	0	0	3	
8/22	57		57	4	0	1	3	
8/23	39		39	10	0	0	1	
8/24	41		41	11	0	0	0	
8/25	18		18	0	0	0	0	
8/26	12		12	1	0	0	1	
8/27	12	4	16	5	0	0	0	
8/28	47		47	22	0	0	3	
8/29	49		49	6	0	1	0	Pickets pulled at 0930 hour.
8/30								Pickets re-installed at 1700 hour.
8/31	16	23	39					
9/1	10	16	26					
9/2	33	8	41					Pickets pulled at 1730 hour.
9/3	12	10	22					Pickets re-installed at 1145 hour.
9/4	20	6	26					Pickets pulled at 1745 hour.
9/5								
9/6								
9/7								
9/8								
9/9								Pickets re-installed at 1730 hour.
9/10	9	4	13	0	0	1	0	
9/11	9	3	12	5	0	0	0	
9/12	5	2	7	0	0	0	0	
9/13	12	9	21	0	0	0	0	
9/14	9	0	9	0	0	0	0	
9/15	3	0	3	0	0	0	1	Pickets pulled for season at 1400hour.
Total	496	85	581	98	2	12	287	

Appendix C.2. Age composition of sockeye salmon in the Neva Lake escapement, by sex and period, 2002.

	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
June 9 - 29									
Male									
Sample Size			5		4	2	1		12
Percent			17.9		14.3	7.1	3.6		42.9
Std. Error			6.3		5.8	4.2	3.1		8.2
Escapement			18		15	8	4		45
Female									
Sample Size			7		9				16
Percent			25.0		32.1				57.1
Std. Error			7.1		7.7				8.2
Escapement			26		34				60
All Fish									
Sample Size			12		13	2	1		28
Percent			42.9		46.4	7.1	3.6		100.0
Std. Error			8.2		8.2	4.2	3.1		
Escapement			44		49	8	4		105
June 30 - July 6									
Male									
Sample Size		2	37		19				58
Percent		1.5	27.4		14.1				43.0
Std. Error		1.0	3.6		2.8				4.0
Escapement		14	253		130				397
Female									
Sample Size			39		37	1			77
Percent			28.9		27.4	0.7			57.0
Std. Error			3.6		3.6	0.7			4.0
Escapement			267		253	7			527
All Fish									
Sample Size		2	76		56	1			135
Percent		1.5	56.3		41.5	0.7			100.0
Std. Error		1.0	4.0		3.9	0.7			
Escapement		14	520		383	7			924
July 7 - 13									
Male									
Sample Size		6	5		4	1			16
Percent		17.1	14.3		11.4	2.9			45.7
Std. Error		4.9	4.5		4.1	2.2			6.4
Escapement		14	12		9	2			37
Female									
Sample Size			9		10				19
Percent			25.7		28.6				54.3
Std. Error			5.6		5.8				6.4
Escapement			21		23				44
All Fish									
Sample Size		6	14		14	1			35
Percent		17.1	40.0		40.0	2.9			100.0
Std. Error		4.9	6.3		6.3	2.2			
Escapement		14	33		32	2			81

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	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
July 14 - 20									
Male									
Sample Size		13	6		3				22
Percent		44.8	20.7		10.3				75.9
Std. Error		8.8	7.2		5.4				7.6
Escapement		105	48		24				177
Female									
Sample Size			7						7
Percent			24.1						24.1
Std. Error			7.6						7.6
Escapement			56						56
All Fish									
Sample Size		13	13		3				29
Percent		44.8	44.8		10.3				100.0
Std. Error		8.8	8.8		5.4				
Escapement		105	104		24				233
July 21 - 27									
Male									
Sample Size		32	27		16	1		1	77
Percent		23.0	19.4		11.5	0.7		0.7	55.4
Std. Error		3.2	3.0		2.5	0.6		0.6	3.8
Escapement		172	145		86	6		5	414
Female									
Sample Size			35		24	1		2	62
Percent			25.2		17.3	0.7		1.4	44.6
Std. Error			3.3		2.9	0.6		0.9	3.8
Escapement			188		129	5		11	333
All Fish									
Sample Size		32	62		40	2		3	139
Percent		23.0	44.6		28.8	1.4		2.2	100.0
Std. Error		3.2	3.8		3.5	0.9		1.1	
Escapement		172	333		215	11		16	747
July 28 - August 3									
Male									
Sample Size	1	17	15		19				52
Percent	1.3	22.4	19.7		25.0				68.4
Std. Error	1.2	4.3	4.1		4.4				4.7
Escapement	5	78	69		87				239
Female									
Sample Size			14		10				24
Percent			18.4		13.2				31.6
Std. Error			4.0		3.5				4.7
Escapement			64		47				111
All Fish									
Sample Size	1	17	29		29				76
Percent	1.3	22.4	38.2		38.2				100.0
Std. Error	1.2	4.3	5.0		5.0				
Escapement	5	78	133		134				350

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Appendix C.2. (page 3 of 4)

	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
August 4 - 10									
Male									
Sample Size		11	16		10	1			38
Percent		16.7	24.2		15.2	1.5			57.6
Std. Error		4.4	5.1		4.3	1.5			5.9
Escapement		137	200		125	12			474
Female									
Sample Size			17		9	2			28
Percent			25.8		13.6	3.0			42.4
Std. Error			5.2		4.1	2.0			5.9
Escapement			213		112	25			350
All Fish									
Sample Size		11	33		19	3			66
Percent		16.7	50.0		28.8	4.5			100.0
Std. Error		4.4	5.9		5.4	2.5			
Escapement		137	413		237	37			824
August 11 - 17									
Male									
Sample Size		19	10		5				34
Percent		38.8	20.4		10.2				69.4
Std. Error		6.7	5.6		4.2				6.4
Escapement		219	116		58				393
Female									
Sample Size			11		3	1			15
Percent			22.4		6.1	2.0			30.6
Std. Error			5.8		3.3	2.0			6.4
Escapement			127		35	12			174
All Fish									
Sample Size		19	21		8	1			49
Percent		38.8	42.9		16.3	2.0			100.0
Std. Error		6.7	6.8		5.1	2.0			
Escapement		219	243		93	12			567
August 18 - 24									
Male									
Sample Size		4	3		2	3			12
Percent		23.5	17.6		11.8	17.6			70.6
Std. Error		10.4	9.3		7.9	9.3			11.1
Escapement		87	65		44	65			261
Female									
Sample Size			2		2	1			5
Percent			11.8		11.8	5.9			29.4
Std. Error			7.9		7.9	5.7			11.1
Escapement			44		43	22			109
All Fish									
Sample Size		4	5		4	4			17
Percent		23.5	29.4		23.5	23.5			100.0
Std. Error		10.4	11.1		10.4	10.4			
Escapement		87	109		87	87			370

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	Brood Year and Age Class								
	2000	1999	1998	1998	1997	1997	1996	1996	
	0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
August 25 - Sept. 21									
Male									
Sample Size		12	7	1	3				23
Percent		37.5	21.9	3.1	9.4				71.9
Std. Error		8.5	7.3	3.1	5.1				7.9
Escapement		279	164	24	71				538
Female									
Sample Size			6		2	1			9
Percent			18.8		6.3	3.1			28.1
Std. Error			6.9		4.3	3.1			7.9
Escapement			141		47	24			212
All Fish									
Sample Size		12	13	1	5	1			32
Percent		37.5	40.6	3.1	15.6	3.1			100.0
Std. Error		8.5	8.6	3.1	6.4	3.1			
Escapement		279	305	24	118	24			750
Combined Periods (Percentages are weighted by period escapements)									
Male									
Sample Size	1	116	131	1	85	8	1	1	344
Percent	0.1	22.4	22.0	0.5	13.1	1.9	0.1	0.1	60.1
Std. Error	0.1	2.0	1.9	0.5	1.5	0.7	0.1	0.1	2.2
Escapement	5	1,105	1,090	24	649	93	4	5	2,975
Female									
Sample Size			147		106	7		2	262
Percent			23.2		14.6	1.9		0.2	39.9
Std. Error			1.9		1.4	0.8		0.1	2.2
Escapement			1,147		723	95		11	1,976
All Fish									
Sample Size	1	116	278	1	191	15	1	3	606
Percent	0.1	22.4	45.2	0.5	27.7	3.8	0.1	0.3	100.0
Std. Error	0.1	2.0	2.3	0.5	1.9	1.0	0.1	0.2	
Escapement	5	1,105	2,237	24	1,372	188	4	16	4,951

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Appendix C.3. Length composition of sockeye salmon in the Neva Lake escapement, by sex and period, 2002.

		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
June 9 - 29										
Male	Avg. Length			500		558	538	585		533
	Std. Error			8.4		12.3	7.5			10.3
	Sample Size			5		4	2	1		12
Female	Avg. Length			514		564				543
	Std. Error			6.4		7.8				8.2
	Sample Size			7		9				16
All Fish	Avg. Length			508		562	538	585		538
	Std. Error			5.3		6.4	7.5			6.4
	Sample Size			12		13	2	1		28
June 30 - July 6										
Male	Avg. Length		353	506		562				519
	Std. Error		17.5	3.6		6.2				6.2
	Sample Size		2	37		19				58
Female	Avg. Length			510		562	515			535
	Std. Error			3.5		3.6				3.9
	Sample Size			39		37	1			77
All Fish	Avg. Length		353	508		562	515			528
	Std. Error		17.5	2.5		3.2				3.5
	Sample Size		2	76		56	1			135
July 7 - 13										
Male	Avg. Length		358	507		556	540			465
	Std. Error		5.3	13.0		12.0				22.6
	Sample Size		6	5		4	1			16
Female	Avg. Length			514		566				541
	Std. Error			8.4		4.7				7.6
	Sample Size			9		10				19
All Fish	Avg. Length		358	511		563	540			506
	Std. Error		5.3	6.9		4.7				12.7
	Sample Size		6	14		14	1			35
July 14 - 20										
Male	Avg. Length		357	505		583				428
	Std. Error		4.5	6.6		3.3				19.6
	Sample Size		13	6		3				22
Female	Avg. Length			519						519
	Std. Error			6.6						6.6
	Sample Size			7						7
All Fish	Avg. Length		357	512		583				450
	Std. Error		4.5	4.9		3.3				16.6
	Sample Size		13	13		3				29

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		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
July 21 – 27										
Male	Avg. Length		359	514		567	490		580	461
	Std. Error		3.6	3.8		5.8				10.4
	Sample Size		32	27		16	1		1	77
Female	Avg. Length			511		567	530		568	535
	Std. Error			3.4		4.2			12.5	4.4
	Sample Size			35		24	1		2	62
All Fish	Avg. Length		359	512		567	510		572	494
	Std. Error		3.6	2.5		3.4	20.0		8.3	6.8
	Sample Size		32	62		40	2		3	139
July 28 - August 3										
Male	Avg. Length	380	358	510		568				481
	Std. Error		5.7	6.2		5.9				13.1
	Sample Size	1	16	15		19				51
Female	Avg. Length			511		570				535
	Std. Error			4.0		8.5				7.3
	Sample Size			14		10				24
All Fish	Avg. Length	380	358	510		568				498
	Std. Error		5.7	3.7		4.8				9.6
	Sample Size	1	16	29		29				75
August 4 - 10										
Male	Avg. Length		375	519		563	510			489
	Std. Error		7.9	2.4		7.3				12.7
	Sample Size		11	16		10	1			38
Female	Avg. Length			505		567	525			526
	Std. Error			4.0		4.8	15.0			6.2
	Sample Size			17		9	2			28
All Fish	Avg. Length		375	512		565	520			505
	Std. Error		7.9	2.7		4.4	10.0			8.0
	Sample Size		11	33		19	3			66
August 11 - 17										
Male	Avg. Length		370	509		563				439
	Std. Error		5.5	9.1		11.5				14.5
	Sample Size		19	10		5				34
Female	Avg. Length			503		577	525			519
	Std. Error			6.5		1.5				9.2
	Sample Size			11		3	1			15
All Fish	Avg. Length		370	506		569	525			464
	Std. Error		5.5	5.4		7.3				11.7
	Sample Size		19	21		8	1			49
August 18 - 24										
Male	Avg. Length		351	524		570	519			473
	Std. Error		11.8	12.9		20.0	24.5			27.5
	Sample Size		4	3		2	3			12
Female	Avg. Length			513		573	538			542
	Std. Error			2.5		32.5				16.9
	Sample Size			2		2	1			5
All Fish	Avg. Length		351	519		571	524			493
	Std. Error		11.8	7.6		15.6	18.0			21.2
	Sample Size		4	5		4	4			17

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		Brood Year and Age Class								
		2000	1999	1998	1998	1997	1997	1996	1996	
		0.1	1.1	1.2	2.1	1.3	2.2	1.4	2.3	Total
August 25 - Sept. 21										
Male	Avg. Length		371	508	402	548				437
	Std. Error		5.2	6.5		6.5				16.1
	Sample Size		12	7	1	3				23
Female	Avg. Length			499		570	515			517
	Std. Error			7.8		5.0				11.4
	Sample Size			6		2	1			9
All Fish	Avg. Length		371	504	402	557	515			460
	Std. Error		5.2	5.0		6.7				13.5
	Sample Size		12	13	1	5	1			32
Combined Periods (Lengths weighted by period escapements)										
Male	Avg. Length	380	363	511	402	563	507	585	580	473
	Std. Error		2.0	1.8		2.6	10.1			4.6
	Sample Size	1	115	131	1	85	8	1	1	343
Female	Avg. Length			508		568	523		568	529
	Std. Error			1.6		2.0	4.5		12.5	2.1
	Sample Size			147		106	7		2	262
All Fish	Avg. Length	380	363	510	402	565	518	585	572	493
	Std. Error		2.0	1.2		1.6	5.6		8.3	3.0
	Sample Size	1	115	278	1	191	15	1	3	605