AUKE CREEK WEIR
2004 ANNUAL REPORT

Operations, Fish Counts, and Historical Summaries

by

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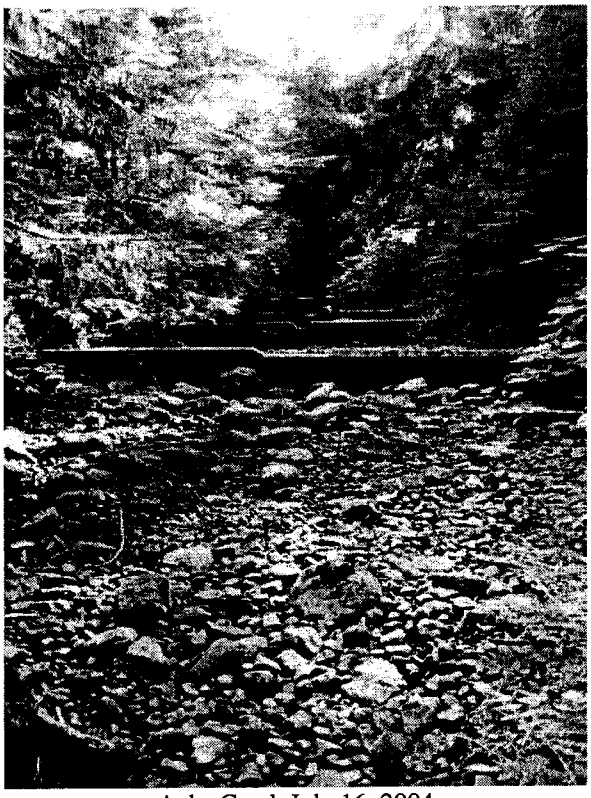

Auke Creek July 16, 2004

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Table of Contents

Auke Creek Weir 2004 Annual Report 1
Figure 1. Daily, 2004, and average, 1962-2003, water temperatures in Auke Creek 2
Figure 2. Dates of ice-out on Auke Lake, and the trend over all years 2

Pink Salmon 3
Figure 3. Number of wild pink salmon fry at Auke Creek. 3
Figure 4. The 2004 and 1972-2003 average emigration of pink salmon at Auke Creek 3
Figure 5. Median emigration dates of pink salmon at Auke Creek, and trend line across years. 4
Figure 6. Number of wild pink salmon adults at Auke Creek, 1967-68 and 1971-2004. 4
Figure 7. Median immigration dates of pink salmon at Auke Creek 4
Table 1. Number of wild and hatchery pink salmon fry and adults at Auke Creek 5

Sockeye Salmon 6
Figure 8. Number of sockeye salmon smolts leaving Auke Lake, 1980-2004 6
Figure 9. Median emigration dates of sockeye salmon smolts at Auke Lake 6
Figure 10. Daily emigration of sockeye salmon leaving Auke Lake, 2004 6
Figure 11. Number of age-1 and -2 sockeye smolts leaving Auke Lake, by brood year 6
Figure 12. Average weight of age-1 and -2 sockeye smolts leaving Auke Lake, by emigration year 7
Figure 13. Proportion of age-2 sockeye salmon smolts, by brood year, leaving Auke Lake 7
Figure 14. Total annual biomass of sockeye salmon smolts leaving Auke Lake 7
Figure 15. Number of sockeye salmon smolts produced per brood year spawner at Auke Lake 8
Figure 16. Wild and hatchery sockeye salmon adults at Auke Creek. 8
Table 2. Wild and hatchery sockeye salmon smolts and adults at Auke Creek 9

Chum Salmon 10
Table 3. Chum salmon fry and adults at Auke Creek 10

Coho Salmon 11
Figure 17. Number of coho salmon smolts at Auke Creek, 1980-2004. 11
Figure 18. Median emigration dates of coho salmon at Auke Creek, 1980-2004. 11
Figure 19. Daily emigration of coho salmon at Auke Creek, 2004. 11
Figure 20. Coho salmon jacks at Auke Creek, 1971-2004 12
Figure 21. Weir counts and fishery harvests of Auke Creek coho salmon adults 12
Figure 22. Ocean survival of coho salmon smolts from Auke Creek 12
Table 4. Number of Auke Creek coho salmon smolts, jacks, and adults. 13

Dolly Varden char 14
Figure 23. Emigrant Dolly Varden char at Auke Creek 14
Figure 24. Migration of Dolly Varden char at Auke Creek, 2004 14
Figure 25. Median emigration dates of Dolly Varden char at Auke Creek,1970, 1980-2004 14
Figure 26. Fork lengths of Dolly Varden char emigrants at Auke Creek, 2004 14
Table 5. Number of Dolly Varden char migrants at Auke Creek, 1970, and 1980-2004. 15

Cutthroat and Steelhead trout 16
Figure 27. Number of emigrant cutthroat trout at Auke Creek. 16
Figure 28. Average and 2004 daily emigrations of cutthroat trout at Auke Creek 16
Figure 29. Median emigration dates of cutthroat trout at Auke Creek 16
Figure 30. Fork lengths of cutthroat trout emigrants at Auke Creek, 2004 16
Table 6. Number of cutthroat trout migrants at Auke Creek 17

Chinook Salmon 18
Figure 31. Number of chinook salmon at Auke Creek 18
Table 7. Number of chinook salmon at Auke Creek, 1987-2004. 18
Appendices 19
Appendix 1. Emigrant wild salmonids at Auke Creek, 1961-2004 19
Appendix 2. Immigrant salmonids at Auke Creek weir, 1963-2004 20
Appendix 3. Daily water temperatures at Auke Creek, 2004 21
Appendix 4. Dates of ice-out on Auke Lake 22
Appendix 5. Monthly totals and daily counts of emigrant salmonids at Auke Creek, 2004 23
Appendix 6. Monthly totals and daily counts of immigrant salmonids at Auke Creek, 2004 25

Auke Creek streambed July 9-24, 2004.

Auke Creek Weir 2004 Report

The Auke Lake system has endemic populations of pink, chum, sockeye and coho salmon, and supports populations of Dolly Varden char char and cutthroat and steelhead trout. The National Marine Fisheries Service (NMFS), and its' predecessor agency, U.S. Bureau of Commercial Fisheries, began salmon research at Auke Creek, near Juneau, Alaska, in 1961. There are emigrant and immigrant counts of several species for the last four decades (Appendices 1 and 2). Pink salmon fry populations in Auke Creek were estimated annually, 1972-79, and counted at Auke Creek weir since 1980. Fyke nets were used to estimate sockeye salmon smolts leaving Auke Lake, and estimates are available for some years between 1961 and 1979. Total smolt counts are available since 1980. Chum salmon fry were counted annually since 1985. Coho salmon smolt estimates were made in 1976, 1977, and 1979, and the total coho smolt emigration was counted since 1980. Dolly Varden char and cutthroat trout were counted in 1970, and since 1980. Steelhead emigrants were counted since 1990. Weir counts of sockeye salmon adults at Auke Creek began in 1963; pink and chum salmon were counted 1967-68, and all salmon were counted since 1971. Chinook salmon returned to Auke Creek since 1987 as a result of releases of juveniles from other hatcheries. Immigrant Dolly Varden char and cutthroat and steelhead trout were counted since 1997.

Auke Creek has been the site of many research projects on wild and hatchery salmonids. The present weir at Auke Creek was constructed in 1980, and provided the capability to capture all emigrant and immigrant salmonids. Annual operation and maintenance costs associated with Auke Creek Research Station are provided by NMFS through the salmon research program of Auke Bay Laboratory. Projects at Auke Creek between 1971 and 1983 operated under several cooperative agreements. An interagency cooperative agreement relating to Auke Creek weir was established in 1983 between the NMFS, University of Alaska-Fairbanks (UAF), and Alaska Department of Fish and Game (ADF&G). The agreement provides the authority to jointly fund a full-time person to assist with the operation of the fish counting weir at Auke Creek. The primary objective is to operate the weir on a daily basis and maintain the long-term data collections on migrant salmonids. The agreement was revised in December 2000, and is in effect through October 2005. Auke Creek weir usually operates from early March through late October. A report of fish counts from daily weir operation, and other information related to salmonid research involving the facilities at the weir is prepared each year. The annual fish count data are available in the Auke Creek data file at the NMFS Auke Bay Laboratory. Data collected on specific projects outside the scope of the cooperative agreement are usually not included in the annual report. Those data may be available from project investigators or their respective agencies. No fish were released from Auke Creek hatchery in 2004. All chinook and most chum salmon adults captured in 2004 were strays from other hatcheries. Nine pink/chum adult hybrids were captured at Auke Creek weir in 2004.

The emigration weir at Auke Creek was operated from March 2 through June 30 and captured pink, sockeye, chum, and coho salmon, Dolly Varden char, and cutthroat and steelhead trout leaving Auke Creek. All fish were counted and released. The first emigrants, pink and chum salmon fry, were captured March 3. Coho salmon smolts and cutthroat trout were marked and tagged during emigration.

The immigration weir was installed June 30 to capture salmonids entering Auke Creek. The weir was modified to capture small immigrants, specifically cutthroat and steelhead trout, Dolly Varden char, chinook salmon mini-jacks, and coho salmon juveniles. Before 1997, small fish passed through the adult weir panels and were not counted. Aluminum plates, 0.3 x 46 x 91 cm, with 1.3 x 10 cm horizontal slots were placed on the bottom half of the lowest weir panels to prevent passage of small fish. Small fish were captured in two trout traps attached to the upstream side of the weir. The

main weir and trout traps were lined with heavy plastic mesh, 6mm openings, to prevent passage of small fish. Salmon adults cannot enter the trout traps because of the small entrance openings. In accordance with the annual operation plan, various personnel assisted with the counting and processing of fish at the weir. Weir operations ended October 26, and the weir was removed from operation.

Water temperature in Auke Creek was measured daily at the weir site. Water temperatures were above average from early February through mid October, and near average for the rest of the year (Figure 1, Appendix 3). Overall, 2004 was the second warmest water-year on record for Auke Creek. Stream flows were low during March and April, and decreased steadily throughout May and June. Flow from Auke Lake was extremely low in July and August, except from July 28-August 2, and after August 27. Stream flow in Auke Creek was measured in mid July at < 4 lpm. Surface temperatures of Auke Lake were >20°C for several weeks. Immigrations were delayed because of low stream flow and high water temperatures. There were no floods during the time the weir was operating this year.

Ice conditions on Auke Lake were within the range observed in other years. Auke Lake was ice free on April 5, 2004. The average ice free date for Auke Lake is April 18 (Figure 2, Appendix 4). Auke Lake was frozen over in late December 2003 and was about 95% frozen by December 27, 2004.

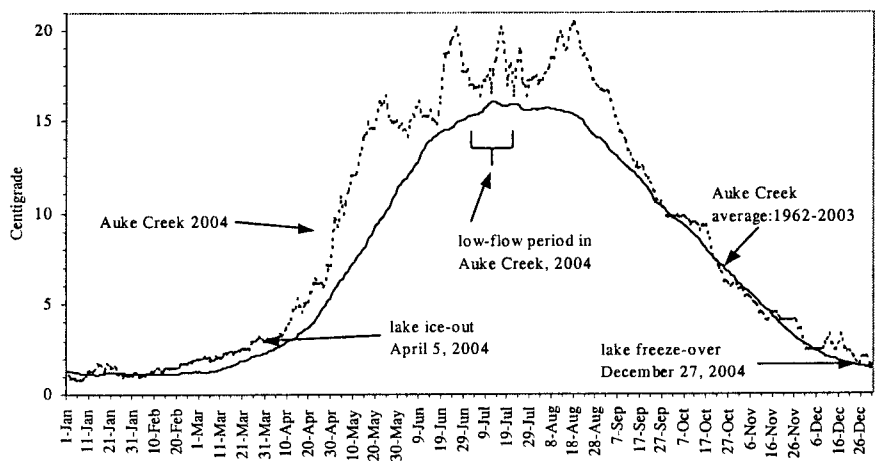

Figure 1. The 2004 and average, 1962-2003, daily water temperature in Auke Creek, and dates of ice out and freeze-over at Auke Lake.

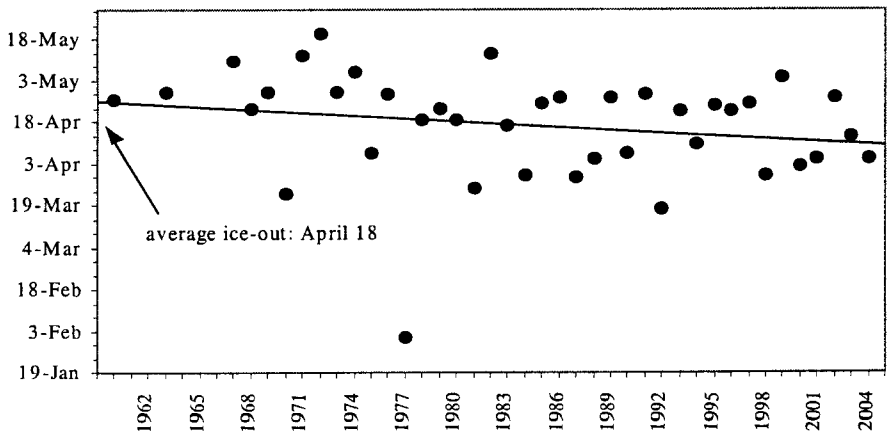

Figure 2. Dates of ice-out on Auke Lake, and trend line over all years.

Pink Salmon

Pink salmon spawn throughout the Auke Lake system mainly in Auke Creek and tributaries to Auke Lake and in the intertidal area downstream from the weir site. There are distinct runs of pink salmon in August and September, referred to as the early and late runs, in both the even and odd numbered years. Before 1963, Auke Creek upstream from the weir was mainly small rock and boulder substrate on bedrock, and there was probably limited area for spawning salmon. Spawning channels built in the upper reach of Auke Creek in 1963 provided about 1,000 m^2 of spawning area. The original streambed substrate was removed down to bedrock during channel construction. The channels were created by a series of 20x20cm timbers bolted together to form dams about 1 m high. The timbers were buttressed from the downstream side by concrete-filled sandbags. Each dam was filled with washed rock, mostly 5-10cm cobbles, purchased locally. Since 1963, floods washed large amounts of the cobbles out of the channels, and the streambed is reverting to bedrock and small boulder substrate. The streambed downstream from the weir is intertidal, and is mainly boulders, broken shale, and smaller gravel on bedrock. There are no complete counts of pink salmon at Auke Creek before the channels were built. Before the first return of hatchery pink salmon in 1973 the average adult run was about 2,600 fish.

Pink salmon fry populations were estimated in Auke Creek from 1972-80 by hydraulic censuses in the freshwater and intertidal areas. Weir counts of fry leaving the freshwater area began in 1980, and the hydraulic censuses stopped. The accuracy of hydraulic censuses of fry populations in Auke Creek is not known. The cobble and boulder substrate in Auke Creek makes it difficult to efficiently operate hydraulic sampling equipment, and the confidence intervals of fry estimates are large. The hydraulic censuses showed the average estimates and confidence intervals of freshwater and intertidal populations were 137,000 ± 60,000, and 63,000 ± 29,000.

In 2004, a total of 169,568 pink salmon fry were counted during the emigration from the freshwater area, about 50,000 more than the 1973-2003 average (Table 1). This was the second highest number of odd-year brood fry, and only the hydraulic census estimate of the 1973 brood, the census was conducted in spring 1974, was higher. The average fry emigration for all years is 116,732 (Figure 3). The fry emigration was above average daily numbers through late April, after which the numbers decreased rapidly. A total of 22,950 fry emigrated in March, most fry emigrated in April, 146,337 fish, and 281 left in May (Figure 4, Appendix 5). No wild fry were marked or tagged in 2004. No hatchery fish were produced.

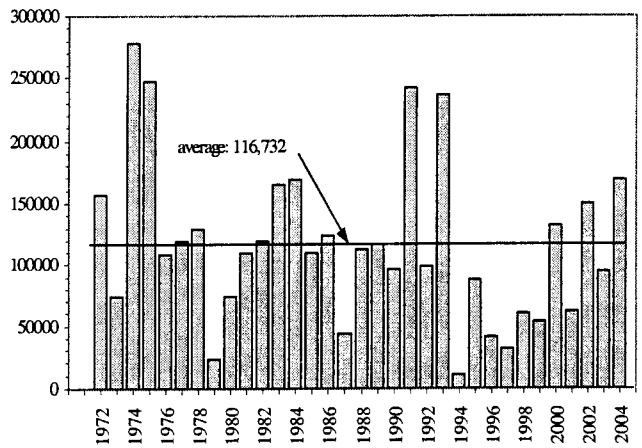

Figure 3. Number of wild pink salmon fry at Auke Creek.

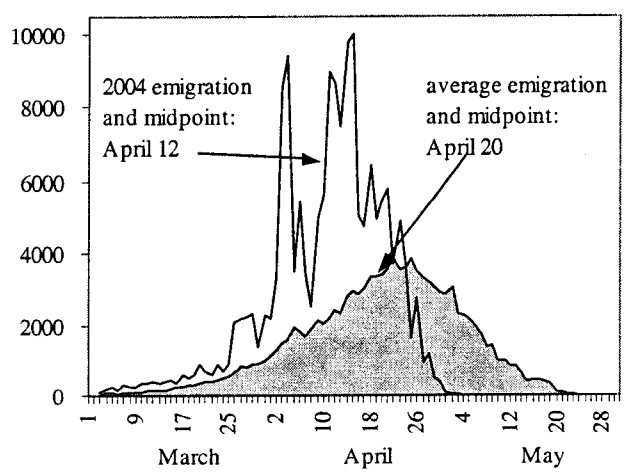

Figure 4. The 2004 and 1973-2003 average emigration of pink salmon at Auke Creek.

There is a trend over the last three decades for Auke Creek pink salmon fry to emigrate earlier in the year, and the 2004 emigration followed that trend (Figure 5). The median date of the 2004 emigration was April 12. The earliest emigration was April 2, 1998 and the latest May 7, 1982.

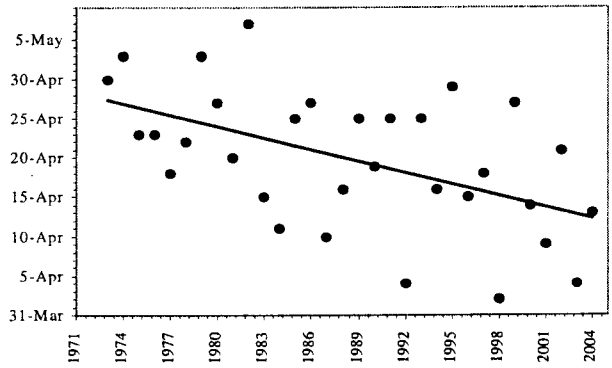

Figure 5. Median emigration dates of pink salmon at Auke Creek, and the trend line over all years.

No hatchery fish were released from Auke Creek hatchery in 2004. Pink salmon were reared in many hatchery projects at Auke Creek, and fry were released annually from 1972-2000, except for 1994 and 1996. (Table 1). Enhancement experiments produced most of the pink salmon leaving Auke Creek during the first decade of hatchery experience, and returning hatchery fish were released to spawn in Auke Creek through 1984 and in 1996. Several genetic projects released small numbers of fry beginning in the mid-1980s, and all of these fry were to have been fin marked. Adults from genetic projects were not knowingly released in Auke Creek.

Pink salmon adults were counted at Auke Creek in 1967 and 1968, and annually since 1971. In 2004, 6,802 pink salmon adults were captured at Auke Creek weir (Table 1, Figure 6). The 2004 immigration of was below average for Auke Creek wild fish, 7,528 adults, although it was 38% greater than the 2002 parent brood.

In 2004, 36 pink salmon adults were captured in late July, and most entered Auke Creek during the first week of September after being held out of the creek by an August drought that lasted until the 27th. The run was compressed in time this year, and nearly 90% of the pinks entered Auke Creek in the 12 days between August 27 and September 7 (Appendix 6). Pre-spawning mortality in Auke Creek was high. Estimates from weir carcasses showed that approximately 50% of the females died before spawning. It was difficult to determine the timing of early and late spawners this year because of the overlap in run time caused by the drought. Based on sex ratio and slight decrease in daily counts, August 31 was considered the end of the early run, although there was not much certainty in that determination. The early run was 2,234 (1,092 males and 1,142 females) and the late run 4,568 (2,110 males and 2,450 females). The late September component of the run is almost gone. During the 1960's and 1970's it was not unusual to have hundreds of fish enter the creek daily through late September. Estimated return of pink salmon based on the fry counted at Auke Creek weir in 2003 is 7%.

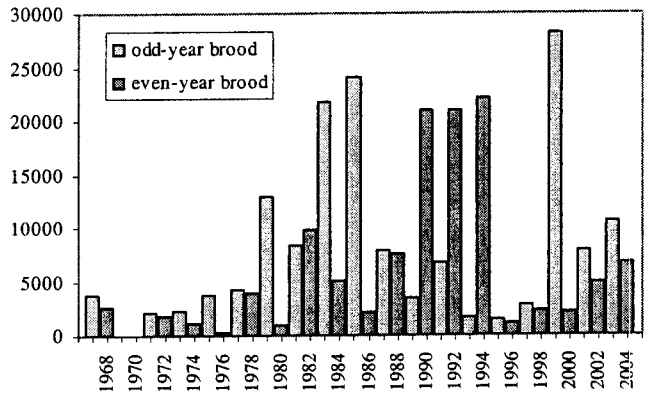

Figure 6. Number of wild pink salmon adults at Auke Creek, 1967-68 and 1971-2004.

In 2004 the median date of pink salmon immigration was September 3, however the early and late median dates were less than a week apart. From 1967-1981 the average immigration was September 7, and since 1982 the average is August 27 (Figure 7).

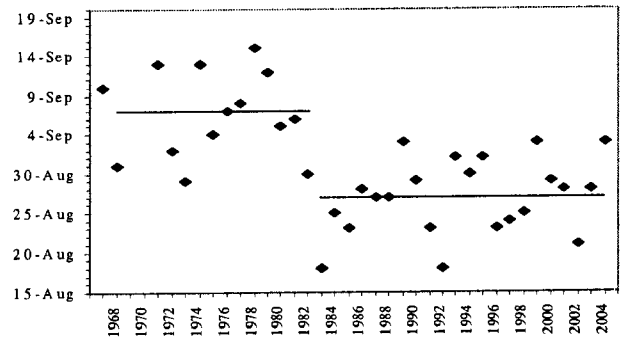

Figure 7. Median immigration dates of pink salmon at Auke Creek. The lines are the averages of the periods.

Table 1. Number of wild and hatchery pink salmon fry and adults at Auke Creek.

	pink salmon fry			pink salmon adults		
Year	wild	hatchery	total	wild	hatchery	total
1967				3,761		3,761
1968				2,638		2,638
1969						
1970						
1971				2,091		2,091
1972	157,189	186,674	343,863	1,768		1,768
1973	73,900	493,769	567,669	2,262	2,686	4,948
1974	277,624	1,014,338	1,291,962	1,139	5,121	6,260
1975	247,091	1,075,870	1,322,961	3,806	10,455	14,261
1976	108,195	259,837	368,032	334	2,191	2,525
1977	119,442	498,161	617,603	4,328	11,520	15,848
1978	129,714	264,216	393,930	3,972	14,438	18,410
1979	23,270	499,813	523,083	12,922	6,081	19,003
1980	74,047	177,619	251,666	924	19,264	20,188
1981	110,552	175,827	286,379	8,432	6,018	14,450
1982	119,548	134,843	254,391	9,831	827	10,658
1983	164,784	39,777	204,561	21,855	2,972	24,827
1984	169,552	98,930	268,482	5,115	156	5,271
1985	110,001	101,296	211,297	24,124	2,193	26,317
1986	123,887	5,165	129,052	2,089	216	2,305
1987	43,502	16,562	60,064	7,902	12	7,914
1988	113,061	66,376	179,437	7,574	566	8,140
1989	116,870	38,976	155,846	3,461	1,555	5,016
1990	96,651	80,014	176,665	20,983	823	21,806
1991	242,772	64,137	306,909	6,653	225	6,878
1992	98,447	29,086	127,533	20,972	1,129	22,101
1993	237,073	22,879	259,952	1,688	8	1,696
1994	11,603		11,603	22,167	366	22,533
1995	88,197	774,589	862,786	1,548		1,548
1996	41,359		41,359	1,155	3,219	4,374
1997	31,092	40,074	71,166	2,774		2,774
1998	60,785	39,834	100,619	2,267	612	2,879
1999	53,533	40,000	93,533	28,127	1,970	30,097
2000	132,075	40,000	172,075	2,181	310	2,491
2001	61,504		61,504	7,857	466	8,323
2002	150,149		150,149	4,928		4,928
2003	95,132		95,132	10,580		10,580
2004	169,568		169,568	6,802		6,802
mean	116,732	232,543	306,995	7,528	3,533	10,178

Sockeye Salmon

Auke Lake sockeye salmon spawn in the larger tributaries and on submerged gravel beds in the lake. The production of sockeye smolts from Auke Lake was first estimated in 1961 at 90,816, the highest on record. From 1964 through 1979, wild smolt estimates ranged from 8,862 to 65,242. However, the pre-1980 smolt estimates lack continuity and some are known to be incomplete. Based on the pre-1980 adult counts, it is obvious there has been a significant decrease in the number of smolts since the 1960s and early 1970s. Since 1980, the entire smolt population was counted at Auke Creek weir, and the number of wild smolts ranged from 1,619 to 33,616. Hatchery-reared sockeye juveniles stocked in Auke Lake in 1974-1975 and 1987-1989 contributed to the smolt emigrations in 1975-77 and 1988-91. Sockeye enhancement from 1988-1992 included the release of age-zero (under-yearling) smolts reared in the hatchery at Auke Creek and net pens in Auke Bay.

In 2004, a total of 21,106 sockeye smolts emigrated from Auke Lake. The average number of wild smolts produced in Auke Lake, 1980-2004, is 17,264 (Figure 8, Table 2).

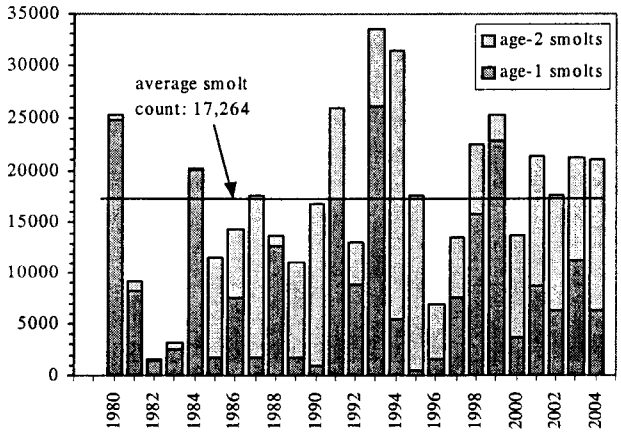

Figure 8. Number of sockeye salmon smolts leaving Auke Lake, 1980-2004.

Sockeye salmon emigration began in late April, 10 smolts, 20,989 emigrated in May, and 107 emigrated in June (Appendix 5). Emigration midpoint was May 15, 8 days earlier than average (Figure 9). Age-2 smolts migrated earlier than the age-1's, median dates May 14 and May 19 (Figure 10). All sockeye salmon smolts in 2004 were from natural spawning.

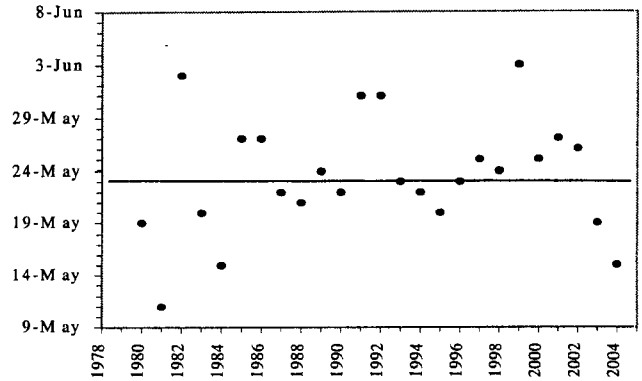

Figure 9. Median emigration dates of sockeye salmon smolts at Auke Lake. The line is the average.

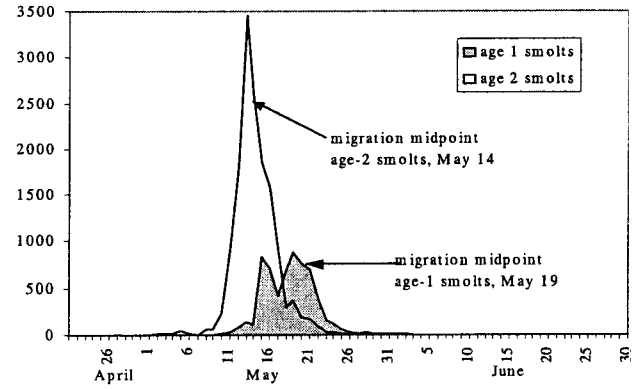

Figure 10. Daily emigration of sockeye salmon at Auke Lake, 2004. Daily numbers are not stacked in figure.

Scale analysis revealed that 30% of the 2004 smolts, 6,292 fish, were age-1 (2002 brood), and 70%, 14,814 fish, age-2 (2001 brood). The 2001 brood has completed the freshwater phase of its' life history, and produced a total of 26,232 smolts, nearly 10,000 fish above the 24-year average of 17,639 (Figure 11). The 2002 brood has produced only age-1 smolts; the age-2 smolts will emigrate in 2005.

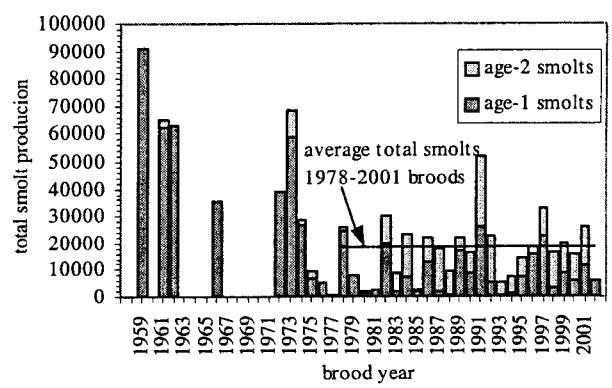

Figure 11. Number of age-1 and -2 sockeye smolts, by brood year, leaving Auke Lake.

Average size of age-1 and -2 sockeye salmon smolts from Auke Lake in 2004 were quite different from each other. Age-1 smolts averaged 81 mm and 4.5 gm, and age-2 smolts were 111 mm and 11.2 gm. The averages for age-1 and -2 sockeye smolts from Auke Lake are 76 mm and 3.7 gm and 106 mm and 11.5 gm.

Over the last 4 decades there was a trend of increasing size of sockeye smolts at Auke Lake (Figure 12). This trend is most noticeable in the average weights. For the periods 1961-1980, 1981-1990, and 1991-2004, age-1 smolts averaged 2.4, 4.3, and 4.3 gm, an 87% average gain between the first and second periods, and no change between second and third. The heaviest age-1 smolts, 6.8 gm, were in 1998. There were few age-2 smolts produced from 1961-1980, and the average was 4.5 gm. For the 1981-1990 and 1991-2004 periods, age-2 smolts averaged 9.5 and 16.8 gm. Average weight of age-2 smolts increased 111% between the 1961-1980 and 1981-1990 periods, and 77% between the 1981-1990 and 1991-2004 periods. From 1980 through 2004, the weight of age-1 and -2 sockeye smolts, estimated from linear regression lines of annual average weights, increased 0.8 and 3.7%/yr.

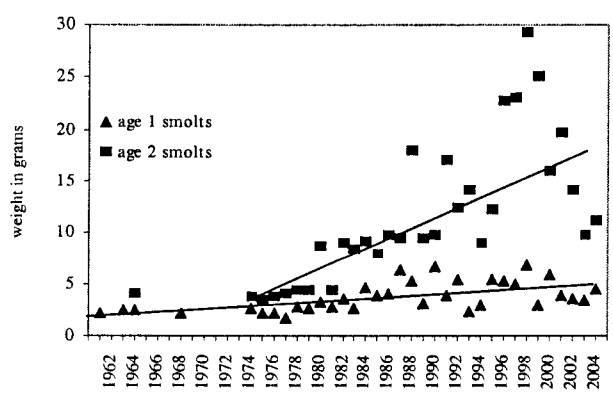

Figure 12. Average weight of age-1 and -2 sockeye salmon smolts leaving Auke Lake, by emigration year. The lines are linear trends for each age group.

There is a trend of increasing proportion of age-2 smolts produced from each brood year of Auke Lake sockeye salmon. Before 1980, age-2 smolts represented <5% of brood year production, and some broods produced no age-2 smolts. Since the 1980 brood year, the average proportion of age-2 smolts has reached 54% of the total brood year production (Figure 13).

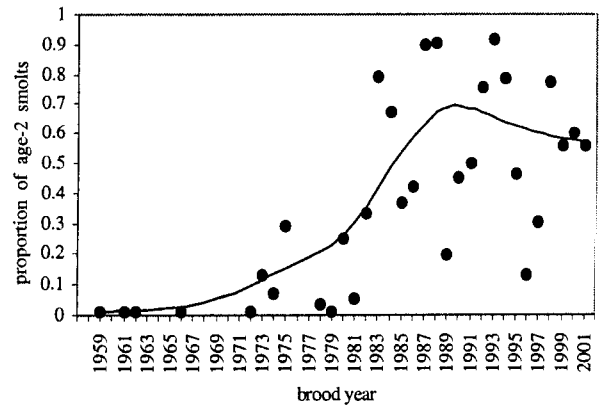

Figure 13. Proportion of age-2 sockeye salmon smolts leaving Auke Lake, by brood year. The line represents the trend smoothed by local regression.

Total biomass-zooplankton models indicate Auke Lake has the capacity to produce about 350 kg of smolts annually. The total biomass of sockeye smolts (estimated total weight of all smolts in a migration year) from Auke Lake in 2004 was 194 kg. This was greater than the average of 149 kg for Auke Lake smolts for the years data are available (Figure 14). The 2004 smolt biomass was above average because of the increase in number of age-2 smolts.

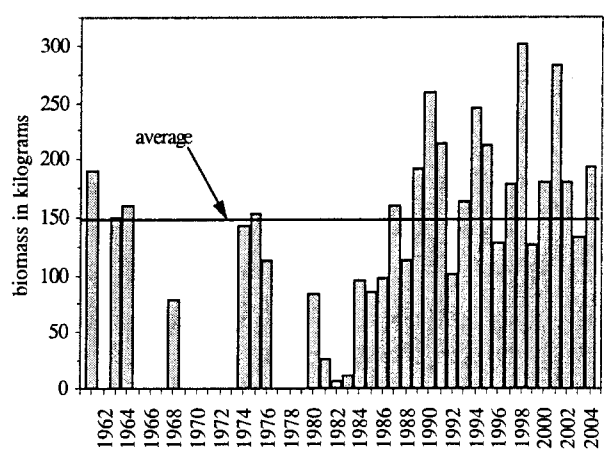

Figure 14. Total annual biomass of sockeye salmon smolts leaving Auke Lake.

One measure of freshwater survival, the number of smolts produced per spawner, indicates that for Auke Lake sockeye, 1978-2001 brood years, only 7 broods produced 10 or more smolts per spawner, and the average over the last 24 broods is 8 smolts (Figure 15). The 2001 brood produced a total of 6.6 smolts per spawner. The 2002 brood produced 2.2 age-1 smolts per spawner; however, that production is expected to increase when the age-2 smolts emigrate in 2005.

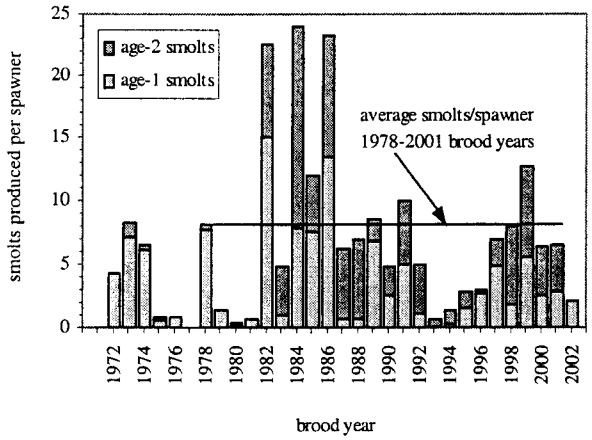

Figure 15. Number of sockeye salmon smolts produced per brood year spawner at Auke Lake. The 2002 brood will produce age-2 smolts in 2005.

Sockeye salmon adults were counted annually at Auke Creek since 1963. From 1963 through 1981 sockeye escapements averaged about 7,000 adults, nearly 3 times greater than since 1982 (Figure 16). During the late 1970s the escapements declined, and, since 1982, the average return of wild fish was about 2,500. Sockeye enhancement research at Auke Creek hatchery, which used Auke Lake sockeye from the 1973-1974 and 1986-1991 broods, boosted subsequent escapements. Progeny from enhancement programs produced 4,600 and 18,000 adult sockeye to the Auke Creek escapements in 1977-1980 and 1990-1995, respectively. No hatchery sockeye have returned to Auke Creek since the enhancement program ended in 1995.

In 2004, 2,958 adult and 20 jack sockeye salmon returned to Auke Creek. The adult run was greater than the average wild run since 1982, but less than the historical average for all years, 4,567 adults. Most sockeye adults, 2,761 fish, migrated upstream in July (Appendix 6). Estimated survival, smolt to weir recovery of adults, for 2004 returns was 14%.

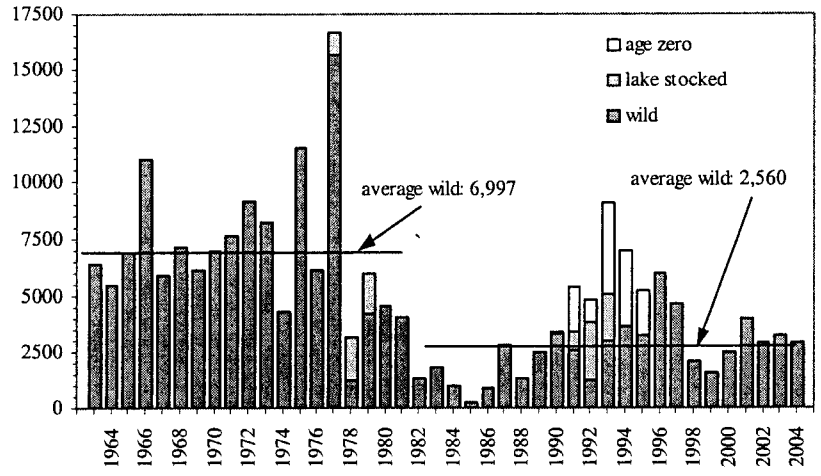

Figure 16. Wild and hatchery sockeye salmon adults at Auke Creek. Hatchery fish were produced from lake stocked fry and age zero smolts at Auke Creek.

Table 2. Wild and hatchery sockeye salmon smolts and adults at Auke Creek. (stocked and age-0 are hatchery reared).

	smolts				adults			
Year	wild	stocked	age-0	total	wild	stocked	age-0	total
1961	90,816			90,816				
1962								
1963					6,391			6,391
1964	65,242			65,242	5,465			5,465
1965					6,889			6,889
1966					10,986			10,986
1967					5,909			5,909
1968	35,737			35,737	7,164			7,164
1969					6,131			6,131
1970					7,034			7,034
1971					7,673			7,673
1972					9,166			9,166
1973					8,259			8,259
1974	15,399			15,399	4,371			4,371
1975	59,370	10,001		69,371	11,461			11,461
1976	35,769	8,585		41,513	6,153			6,153
1977	8,862	450		9,312	15,683	1,000		16,683
1978				8,291	1,271	1,906		3,177
1979					4,291	1,731		6,022
1980	25,299			25,299	4,564			4,564
1981	9,183			9,183	4,089			4,089
1982	1,619			1,619	1,334			1,334
1983	3,170			3,170	1,805			1,805
1984	20,251			20,251	975			975
1985	11,747			11,747	240			240
1986	14,500			14,500	952			952
1987	17,598			17,598	2,847			2,847
1988	13,812	4,992	36,500	55,304	1,337			1,337
1989	11,187	17,879	34,290	63,356	2,508			2,508
1990	16,983	11,567	49,949	78,499	3,295	88		3,383
1991	25,872	115	138,007	163,994	2,583	832	2,009	5,425
1992	13,248		57,077	70,325	1,267	2,541	1,045	4,853
1993	33,616			33,616	2,988	2,077	4,048	9,113
1994	32,009			32,009	3,696		3,296	6,993
1995	17,857			17,857	3,221		2,040	5,261
1996	7,069			7,069	5,995			5,995
1997	13,856			13,848	4,671			4,671
1998	22,496			22,496	2,068			2,068
1999	25,244			25,249	1,571			1,571
2000	13,699			13,699	2,480			2,480
2001	21,428			21,428	3,963			3,963
2002	17,594			17,594	2,882			2,882
2003	21,154			21,154	3,239			3,239
2004	21,106			21,106	2,958			2,958
mean[1]	17,264				4,567			5,106

[1]Mean number of wild smolts is from 1980-2004.

Chum Salmon

It is not known if chum salmon are native to Auke Creek or were originally strays from other local systems. Probably few chum salmon were ever produced in the Auke Lake system, although adults were observed in all spawning areas, including the intertidal. Chum salmon adults were counted at Auke Creek in 1967 and 1968, and since 1971. The average run to Auke Creek before NMFS enhancement experiments was 20 adults. Chum salmon fry were observed during the 1972-1976 emigrations, but were not counted. In 1976, NMFS started chum salmon enhancement projects, and examined the use of a small population for brood stock development, marine survival of juveniles, and age heritability. Hatchery chum salmon fry were released in 1977-1984, and 1986. All hatchery fry, except in 1984, were marked by ventral fin clip, or adipose fin clip and coded wire tag. No adults were released in Auke Creek from 1976-1983, and none spawned in the intertidal area. In those years all chum adults were captured and spawned for hatchery incubation, thus, no wild fry were captured at Auke Creek from 1977-1984. Since 1994, most or all chum salmon adults at Auke Creek were strays from releases of Macaulay hatchery juveniles at Amalga Harbor and other release sites.

In 2004, 1,425 chum salmon fry and 3,211 adults were counted and released at Auke Creek (Table 3). About 65% of the fry emigrated in March, about three weeks earlier than the pink salmon (Appendix 5). The midpoint of emigration was March 26. Based on run timing and number of chum salmon adults, it was suspected that most of the adults were strays from Macaulay hatchery releases. Before 1994, chum salmon in Auke Creek immigrated after mid August, usually during the last week of August and early September. In 2004, the 16 chum salmon that entered Auke Creek after the third week of August were counted as Auke Creek fish.

Table 3. Chum salmon fry and adults at Auke Creek.

	fry		adults			
Year	wild	Auke C. hatchery	strays[1]	Auke C. hatchery	Auke C. wild	total
1967					78	78
1968					76	76
1969						
1970						
1971					10	10
1972					47	47
1973					27	27
1974					5	5
1975					10	10
1976					16	16
1977	0	12,195			24	24
1978	0	18,446			17	17
1979	0	20,049		13	4	17
1980	0	2,491		113	5	118
1981	0	67,236		103	6	109
1982	0	54,134		231	20	251
1983	0	41,742		302	8	310
1984	0	58,452		1,888	29	1,917
1985	7,198			1,704	148	1,852
1986	825	20,725		1,342	50	1,392
1987	14,039			1,824	60	1,884
1988	8,091			1,053	140	1,193
1989	13,750			166	138	304
1990	1,916				270	270
1991	759				174	174
1992	4,783				130	130
1993	47				121	121
1994	137		736		132	868
1995	5		1,262		65	1,327
1996	4,981		6,700		81	6,781
1997	8,307		444		4	448
1998	735		225		22	247
1999	1,269		340		46	386
2000	1,337		4,344		100	4,444
2001	23,372		562		26	588
2002	1,959		1,567		20	1,587
2003	5,373		1,555		23	1,578
2004	1,425		3,195		16	3,211
mean	5,015	32,830	1,903	794	60	884

[1]Estimated Macaulay hatchery-reared chums that strayed to Auke Creek.

Coho Salmon

Coho salmon spawn in the tributaries to Auke Lake and in the upper 100-m of Auke Creek. Juvenile rearing occurs in Auke Lake and probably most of the watershed, although the exact areas are not known. Total smolt numbers were estimated in 1976, 1977, and 1979, the first years when smolts were adipose fin clipped and tagged with coded wires (Table 4). Smolts were not counted or tagged in 1978. The total coho smolt emigration was counted since 1980. In 1976, 1977, and 1979 the total number of smolts was estimated from the return of jacks and adults from each smolt cohort. In the return years 1976-1980 there were marked and unmarked coho salmon from Auke Creek, and strays from enhancement projects in the Juneau area. The number of Auke Creek smolts was estimated after determining the number of marked and unmarked stray jacks and adults at the weir, and subtracting the latter two from the total immigration. The number of unmarked, Auke Creek smolts was estimated from the ratio of marked smolts and marked and unmarked jacks and adults of Auke Creek origin. Coho adults were counted in 1967, and since 1971. Before 1980, low-height weirs captured salmon adults at Auke Creek. Those weirs were often under water during floods, and some pre-1980 data may be incomplete. Coho salmon were spawned for hatchery incubation, 1978, 1980-1984, and 1996-1997, and all fish were tagged with coded wires and marked with an adipose and ventral fin clip to distinguish them from wild smolts. All hatchery coho jacks and adults with the double fin marks were killed when they returned to Auke Creek.

There is a trend of decreasing coho salmon smolt production at Auke Lake. A total of 4,581 coho salmon smolts left Auke Lake in 2004 (Figure 17). The highest total smolt count was 10,022 in 1980; the average total count is 6,117 (Table 4). In 2004, 4,572 smolts were tagged with coded wires and marked by adipose fin clip. Average sizes of age-1 and -2 smolts were 107 mm and 12 gm and 123 mm and 17 gm. Samples collected throughout the run revealed that 1,856 smolts were age-1 (2002 brood) and 2,725 were age-2 (2001 brood). Total production of smolts from the 2001 brood was 4,764 fish, and the average production of the 1978-2001 broods is 5,934 smolts.

Coho smolts began emigration during the first week of May, and the emigration midpoint was May 16. The average emigration midpoint of coho smolts at Auke Creek is May 20 (Figure 18). Emigration of age-1 smolts was later than age-2 smolts, and emigration midpoints of age-1 and -2 smolts were May 22 and May 14 (Figure 19).

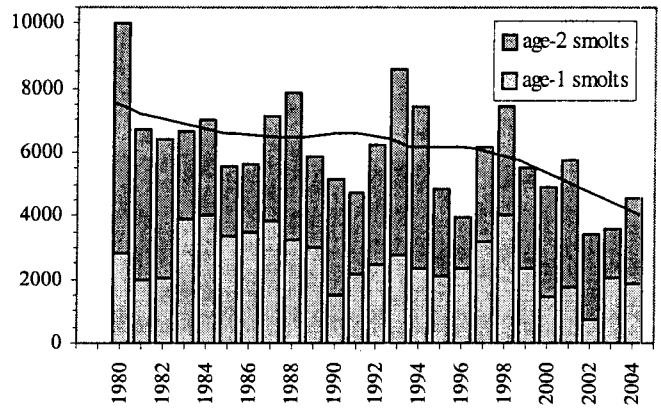

Figure 17. Number of coho salmon smolts at Auke Creek, 1980-2004. The line is the trend smoothed by local regression.

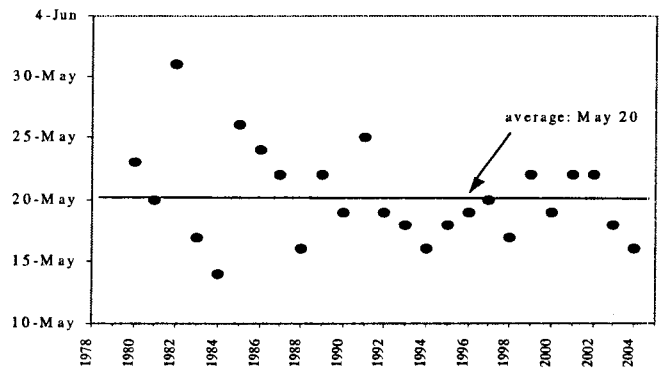

Figure 18. Median emigration dates of coho salmon at Auke Creek, 1980-2004.

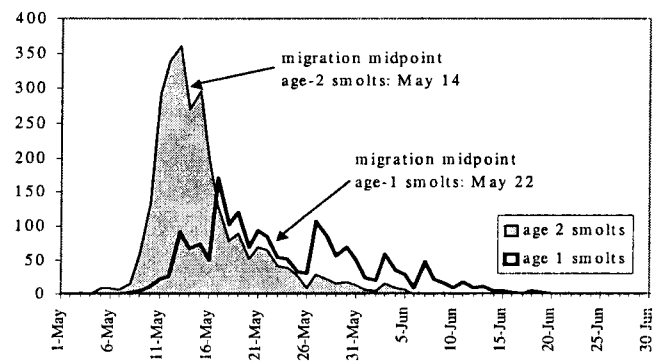

Figure 19. Daily emigration of coho salmon at Auke Creek, 2004. Numbers are not stacked in figure.

The 2004 immigration of coho salmon at Auke Creek included adipose marked and unmarked jacks and adults, and totaled 226 jacks and 416 adults. The jack run was about 60 fewer than average (Figure 20). The adult run was 300 fish fewer than average, and one of the lowest on record (Figure 21). A total of 210 jacks and 412 adults were adipose fin marked, both less than average (Table 4). Most jack and adult coho salmon entered Auke Creek before the end of September. Coded wire tags were collected from carcasses recovered at the weir. All tags were from the Auke Lake stock of coho salmon. The origin of the 4 unmarked jacks and 16 unmarked adults is not known. Immigration of the marked fish was earlier than the unmarked. Most marked fish entered Auke Creek before the last week of September, and the unmarked fish did so from late September through October.

Harvest of coho salmon from Auke Creek was determined from recovery of coded wire tags in commercial and sport fishery port sampling programs. In 2004, the harvest of Auke Creek coho salmon was estimated at 320 adults, a 43.7% harvest rate. Average harvest and harvest rate of Auke Creek coho salmon is 495 adults and 42%.

Total survival of the coho salmon smolts tagged at Auke Creek in 2003 was 26.9% (jacks returned in 2003 and adults in 2004). Survival was estimated from the number of smolts marked at Auke Creek, and the number of marked jacks and adults at the weir and adults in the fishery. Total survival was the combined return of jacks 6.2% (returned in 2003), adults at the weir 11.7%, and adults harvested 9.1% (Figure 22, Table 4). The survival to jacks was the second highest on record. Combined survival to adults, weir plus fishery (excluding jacks), was 20.7%, slightly above the 20% average for Auke Creek.

Some smolts return as jacks the same year they emigrate at Auke Creek. In 2004, the 210 marked jacks at Auke Creek represented a survival of 4.6%; slightly above average of 4.1% (Table 4).

In 2004, immigrant coho salmon juveniles were intentionally captured at Auke Creek weir. A total of 90 were caught and examined for missing adipose fin. One fish was fin clipped and had a coded wire tag. The fish was from Chilkat River, near Haines, from a group of 7,000 coho juveniles tagged and released on or before May 29, 2004. The fish was 147 mm and 38.9 gm when captured at Auke Creek weir on September 10, 2004.

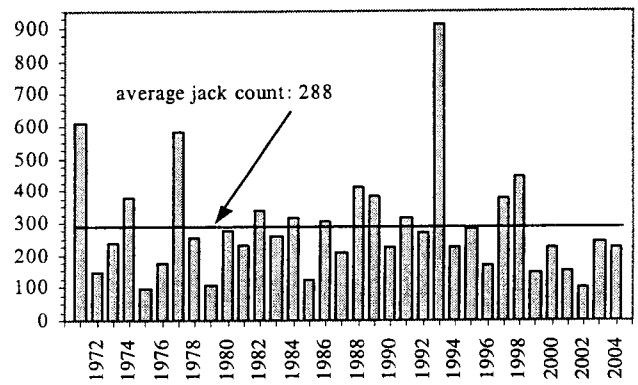

Figure 20. Coho salmon jacks at Auke Creek, 1971-2004.

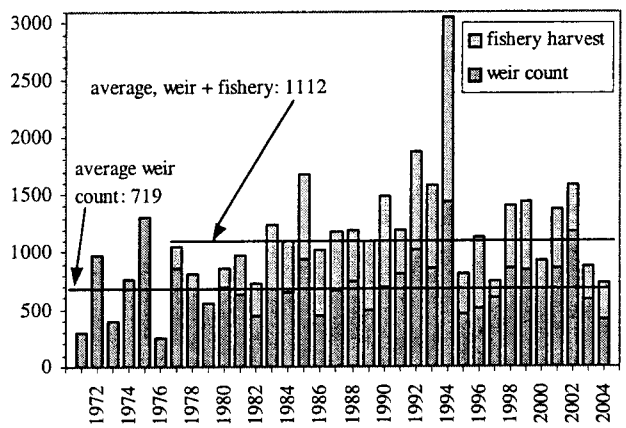

Figure 21. Weir counts and fishery harvest of Auke Creek coho salmon adults.

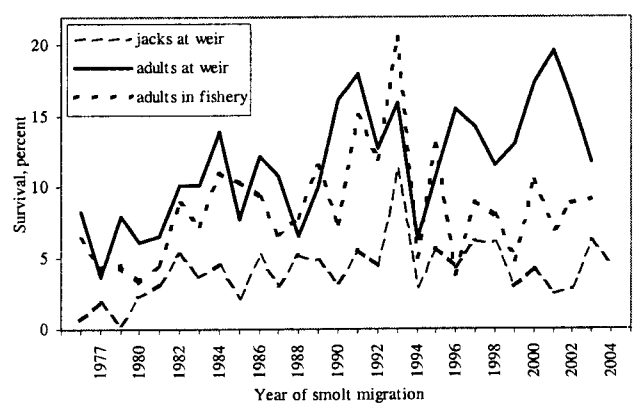

Figure 22. Ocean survival of coho salmon smolts from Auke Creek. Survivals are for tagged fish by year of emigration. The lines are not stacked in the figure.

Table 4. Annual numbers of Auke Creek coho salmon smolts, jacks, and adults. Smolt data are total number and number released with coded wire tags. Weir recoveries are total number and number of tagged jacks and adults. Adults recovered in the fishery are tagged fish. Survival data are for tagged smolts by year of smolt migration, e.g., smolts tagged in 1976 returned as jacks in 1976 and as adults in 1977.

	smolts		total at weir		tagged fish recovered			ocean survival, %			
year	total	tagged	jack	adult	jacks weir	adults weir	adults fishery	jacks weir	adults weir	adults fishery	total
1971			608	308							
1972			146	967							
1973			238	399							
1974			379	768							
1975			98	1,310							
1976[1]	10,772	2,992	176	262	21			0.7	8.2	6.3	15.2
1977[1]	18,686	3,038	583	868	59	246	189	1.9	3.7	4.3	9.9
1978			256	683		112	131				
1979[1]	9,419	3,872	107	566	12			0.3	7.9	4.4	12.6
1980	10,022	9,821	276	698	226	306	170	2.3	6.0	3.4	11.7
1981	6,721	6,372	231	646	203	592	330	3.2	6.5	4.6	14.3
1982	6,445	6,245	338	447	335	417	292	5.4	10.1	8.7	24.2
1983	6,631	6,115	261	694	224	630	545	3.7	10.0	7.3	21.0
1984	7,012	6,751	315	651	304	614	444	4.5	13.9	11.0	29.4
1985	5,601	5,545	122	942	118	937	741	2.1	7.7	10.3	20.1
1986	5,666	5,502	307	454	288	429	570	5.2	12.1	9.3	26.7
1987	7,166	6,883	212	668	206	668	511	3.0	10.7	6.5	20.2
1988	7,888	7,751	412	756	406	736	445	5.2	6.5	7.8	19.5
1989	6,911	6,819	386	502	329	502	604	4.8	9.9	11.5	26.3
1990	5,132	5,020	225	697	165	678	785	3.3	16.1	7.4	26.8
1991	5,764	5,671	317	820	314	808	371	5.5	18.0	15.1	38.6
1992	6,262	6,106	271	1,020	271	1,020	855	4.4	12.7	12.0	29.1
1993	8,103	7,844	910	859	876	774	730	11.2	16.0	20.6	47.8
1994	7,416	7,255	229	1,437	212	1,253	1,618	2.9	6.3	5.0	14.2
1995	4,869	4,798	283	460	269	455	360	5.6	10.7	13.0	29.4
1996	3,962	3,919	168	515	168	515	626	4.3	15.5	3.8	23.5
1997	6,207	6,080	381	609	376	606	148	6.2	14.2	8.8	29.2
1998	7,430	7,379	449	862	447	862	538	6.1	11.5	8.0	25.5
1999	5,491	5,123	149	845	149	845	589	2.9	13.0	4.8	20.7
2000	4,891	4,862	227	683	206	666	244	4.2	17.3	10.4	32.0
2001	5,742	5,687	153	865	142	842	506	2.5	19.6	7.1	29.1
2002	3,434	3,401	104	1,176	97	1,112	402	2.9	16.2	8.8	27.9
2003	3,574	3,534	244	585	219	551	300	6.2	11.7	9.1	26.9
2004	4,581	4,572	226	416	210	412	320	4.6			
mean	6,117		288	719	245	651	495	4.1	11.6	8.5	24.1

[1]- total smolt count estimated, not all smolts were captured and estimated numbers are not included in averages.

Dolly Varden Char

The Auke Lake system is important for spawning, rearing, and over-wintering Dolly Varden char in the Juneau area. Emigrants were counted in 1970 and since 1980, but spawner numbers and smolt production are not known. Emigrants were marked or tagged in 1970, 1980, 1983, and 1990, and marked fish were observed in subsequent years. Marked fish captured at Auke Creek, 1998-2000, were probably marked at Windfall Lake in 1997.

Auke Creek Dolly Varden char abundance is in a decreasing trend that began in 1996 (Figure 23). The 2004 emigration of 3,955 Dolly Varden at Auke Creek was the lowest since 1985, and less than the average of 6,214 (Table 5). Little emigration occurs in March, only 6 left Auke Lake during March 2004 (Figure 24). Daily counts never exceeded 50 fish until the last week of April, and 85% of the run occurred between April 27 and May 11 (Appendix 5). The midpoint of emigration was May 3, and the average midpoint for all years is May 8 (Figure 25). Dolly Varden were sampled daily throughout the emigration by measuring the length of every tenth fish. Larger fish emigrated earlier, and average length decreased weekly from 360 mm to 138 mm during the main part of the emigration (Figure 26). Overall, the average length of emigrants was 244 mm. All fish were checked for marks or tags, none were found.

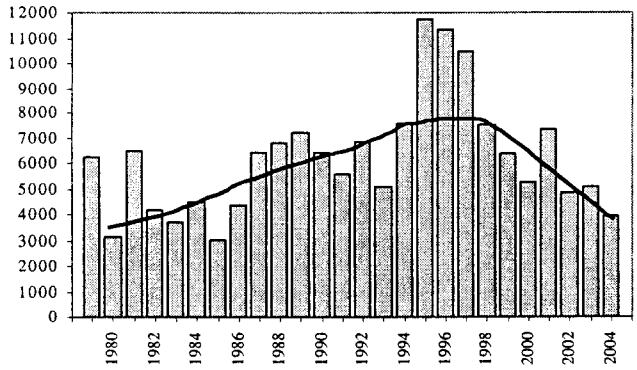

Figure 23. Emigrant Dolly Varden char at Auke Creek. The curved line is the abundance trend smoothed by local regression.

Immigrant Dolly Varden were counted at Auke Creek since 1997. A total of 2,564 Dolly Varden were captured at the upstream weir in 2004. The average number of Dolly Varden immigrants at Auke Creek, 1997-2004 is 4,276 (Table 5). The immigration was slowed or stopped by high water temperatures and droughts in July and August (Appendix 6).

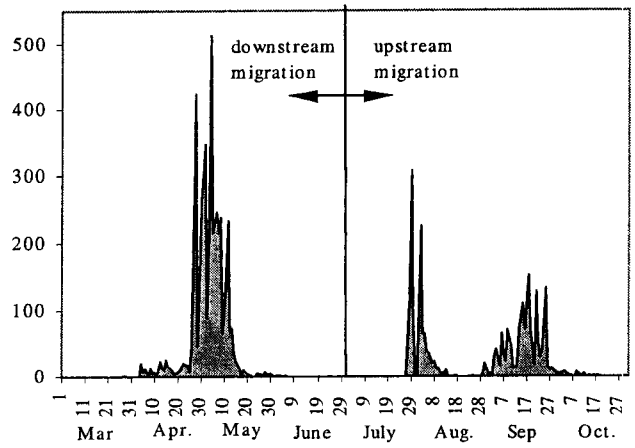

Figure 24. Migration of Dolly Varden at Auke Creek, 2004.

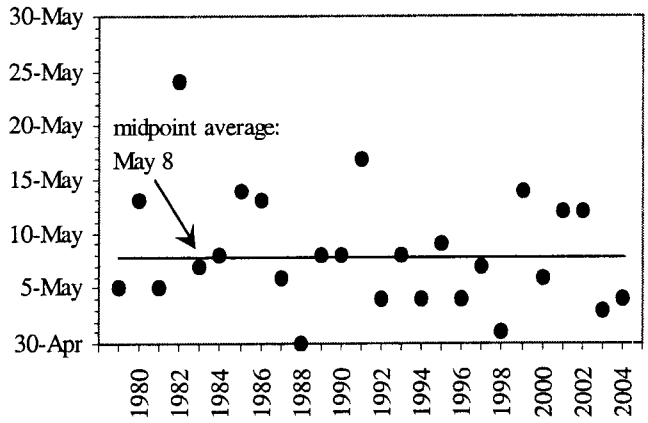

Figure 25. Median emigration dates of Dolly Varden at Auke Creek, 1970, and 1980-2004.

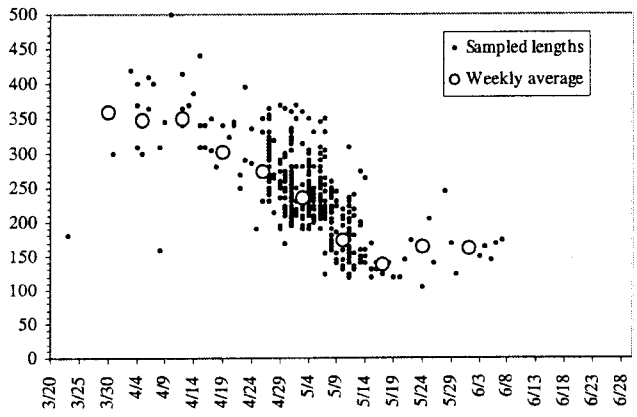

Figure 26. Fork length of Dolly Varden emigrants at Auke Creek, 2004.

Table 5. Number of Dolly Varden migrants at Auke Creek, 1970, and 1980-2004 (weir mortalities = mort)

	emigrants				immigrants
year	total	unmarked	marked	mort	total
1970[1]	6,249	0	6,007	242	
1980[1]	3,132	92	2,928	112	
1981	6,461	5,776	685	0	
1982	4,172	3,929	222	21	
1983[1]	3,718	2,131	1,587	0	
1984	4,512	4,229	283	0	
1985	3,052	3,006	46	0	
1986	4,351	4,351	0	0	
1987	6,444	6,420	2	21	
1988	6,770	6,770	0	0	
1989	7,230	7,155	2	73	
1990[1]	6,426	2,318	4,107	0	
1991	5,559	4,631	881	47	
1992	6,839	6,715	110	14	
1993	5,075	5,064	7	4	
1994	7,604	7,600	4	0	
1995	11,728	11,728	0	0	
1996	11,323	11,323	0	0	
1997	10,506	10,506	0	0	5,705
1998[2]	7,532	7,440	70	22	4,993
1999[2]	6,393	6,377	16	0	4,709
2000[2]	5,254	5,248	6	0	3,665
2001	7,356	7,356	0	0	4,249
2002	4,858	4858	0	0	4,341
2003	5,067	5,067	0	0	3,978
2004	3,955	3,955	0	0	2,564
mean	6,214				4,276

[1] Years Dolly Varden were marked and\or tagged at Auke Creek
[2] Marked Dolly Varden recovered but not marked at Auke Creek

Cutthroat and Steelhead Trout

Little was known of the life history of cutthroat trout in the Auke Lake system before the start of tagging programs in 1994 and lake population estimates in 1998. It is apparent that Auke Lake cutthroat trout have the most complex life history of any fish in the system. Recent studies at Auke Creek and Auke Lake have produced world class information on these fish. Anecdotal information suggests the pre-1960 population of cutthroat trout in Auke Lake was larger than it is now. Emigrant cutthroat trout were counted in 1970 and since 1980. Immigrants were counted since 1997. Mature emigrants were spawned in 1981, 1982, 1985, 1986, 1991, and 1993 for hatchery incubation. The resulting progeny were fin marked and released in Auke Lake, and hatchery fish were seen in subsequent years (Table 6).

Auke Creek cutthroat trout emigrants are in a decreasing trend that began in 1996 (Figure 27). A total of 136 emigrant cutthroat trout were counted in 2004, less than the average 250. In 2004, most cutthroat emigrated in May (Figure 28, Appendix 5), and midpoint of emigration was May 10. The average emigration date is May 16. All cutthroat were examined for a missing adipose fin and dye marks on the ventral, pectoral or anal fins. Fish missing the adipose fin were electronically checked for a passive integrated transponder (PIT) tag. A total of 37 cutthroat trout were missing their adipose fin when they left Auke Lake this year: 24 were recaptures from previous emigrations (1 tagged in 2001, 5 in 2002, and 18 in 2003), and 13 were recaptures from tagging in Auke Lake (6 tagged in 2002, and 7 in 2003). The 99 unmarked fish were marked by excision of the adipose fin, and tagged with a numbered PIT tag, then released. All cutthroat trout emigrants were measured for fork length. The larger fish emigrated earlier than smaller ones. The average weekly size during the main part of the emigration decreased from about 285 mm to about 245 mm (Figure 29). Average length of emigrant cutthroat trout in 2004 was 261 mm.

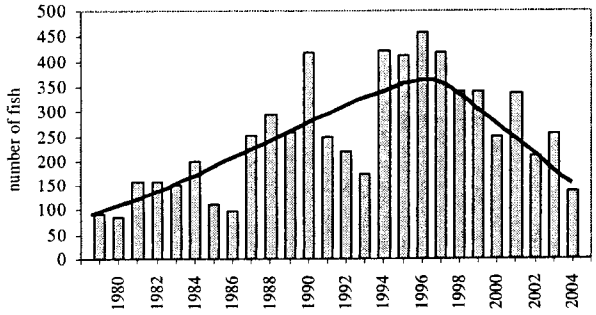

Figure 27. Number of emigrant cutthroat at Auke Creek. The line is the abundance smoothed by local regression.

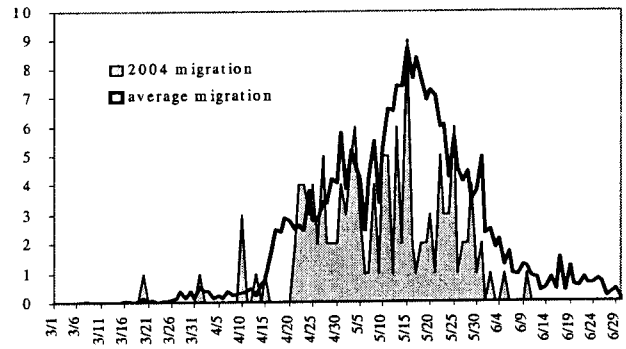

Figure 28. Average and 2004 daily emigrations of cutthroat trout at Auke Creek.

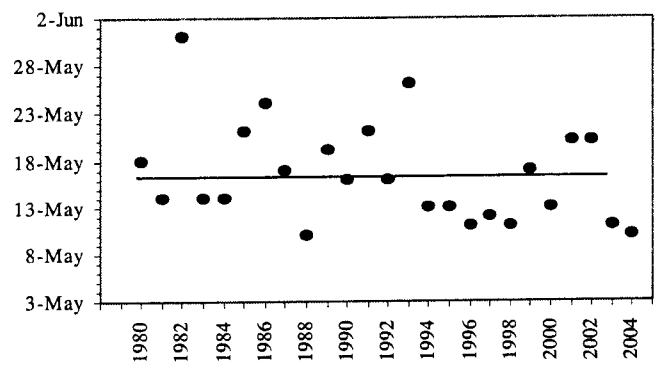

Figure 29. Median emigration dates of cutthroat trout at Auke Creek. The line is the average date: May 16.

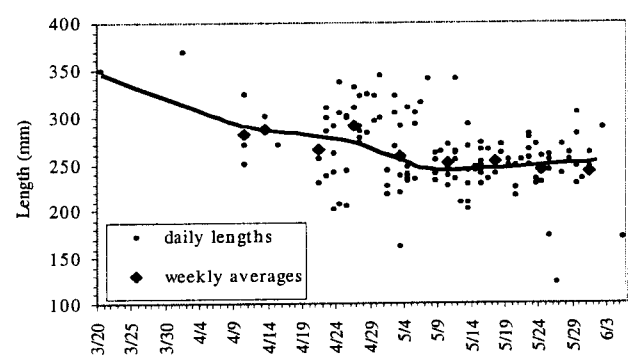

Figure 30. Fork lengths of cutthroat trout emigrants at Auke Creek, 2004. The line is the trend line across all points.

In 2004 there were 91 immigrant cutthroat trout at Auke Creek, about 40% of average. No cutthroat immigrated in July or August, 75 did so in September, and 16 in October (Appendix 6). All were examined for adipose fin marks and PIT tags before release. A total of 25 immigrants were missing the adipose fin and had a PIT tag, and 66 were unmarked. Estimates of marine residence, seasonal growth, and growth rate were made from individual PIT tagged immigrants captured in 2004. Seasonal growth and growth rate were estimated for the period between emigration and immigration. The average marine residence of tagged cutthroat trout in 2004 was 132 days, range 114-152 days. Average growth was 65 mm, range 39-101 mm, and average growth rate was 0.44 mm/day, range 0.31-0.73 mm/day.

Steelhead trout juveniles were captured at Auke Creek in 2004. Four emigrants were captured during the middle two weeks of May, and their fork lengths ranged from 195-232 mm. Two steelhead trout immigrants were captured in Auke Creek in 2004. None of the steelhead were marked or tagged.

Table 6. Number of cutthroat trout migrants at Auke Creek.

	emigrants			immigrants			
	wild	hatchery	total	adipose mark	no mark	not checked	total
1970	90		90				
1980	85		85				
1981	157		157				
1982	157		157				
1983	150	78	228				
1984	198	104	302				
1985	112	49	161				
1986	99	39	138				
1987	251	691	942				
1988	294	396	690				
1989	258	152	410				
1990	417	89	506				
1991	250	23	273				
1992	219	7	226				
1993	174	16	190				
1994	422	9	431				
1995	412	58	470				
1996	459	140	599				
1997	418	82	500	213	254		467
1998	340	34	374	164	196	1	361
1999	340	11	351	118	79	8	205
2000	249	1	250	37	68		105
2001	337		337	106	122		228
2002	210		210	89	152		241
2003	254		254	28	98	3	129
2004	136		136	25	66		91
mean	250		326				228

Chinook Salmon

Chinook salmon are not native to the Auke Lake system. Chinook captured at Auke Creek are hatchery fish from releases of juveniles in the Juneau area, including Auke Bay near the mouth of Auke Creek. These releases began as a 3-year coöperative study in 1986 to examine survival and homing and straying of hatchery chinook. The original study plan and fish transport permit required that all chinook be killed when they entered Auke Creek. This was to prevent the possible chinook-sockeye disease interactions, particularly infectious hematopoietic necrosis virus. The project continues under an arrangement between Sport Fish Division, ADF&G, and Douglas Island Pink and Chum Incorporated. Juveniles were released near Auke Creek in 2004.

At Auke Creek, chinook are captured at the weir, and classified as mini-jacks or adults based on size. All mini-jacks are males, ≤ 250 mm fork length, that mature and return to fresh water the same year they were released as smolts. Adults are >250 mm and remain at large for one year or more. All chinook are killed at the weir. As agreed at the 2003 annual meeting, chinook were not examined for marks or tags in 2004.

In 2004, the immigration of chinook adults at Auke Creek was restricted by the low stream flow and high temperatures during July and August. A total of 46 chinook salmon adults and 232 mini-jacks were captured at the weir (Table 7). The number of chinook adults was the second lowest at Auke Creek (Figure 28). Most chinook adults were captured between August 28 and September 6 (Appendix 6). All chinook were killed and offered to local charities.

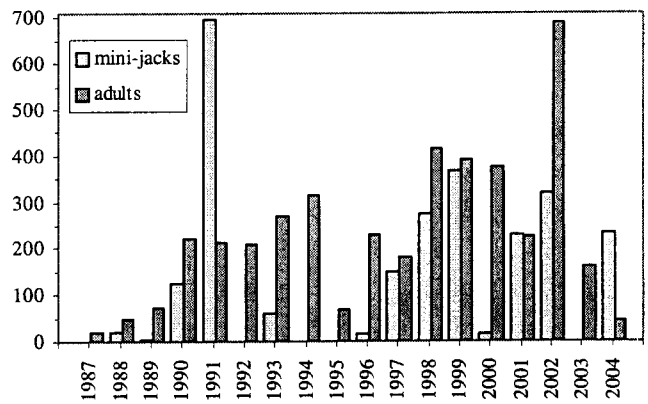

Figure 31. Number of chinook salmon at Auke Creek.

Table 7. Number of chinook salmon at Auke Creek, 1987-2004. Mini jacks returned the same year of smolt release, and adults are 1-ocean or older. Fish were not sampled for fin marks after 2002.

	mini-jacks			adults		
year	marked	unmarked	total	marked	unmarked	total
1987				19		19
1988	15	6	21	50		50
1989		4	4	53	21	74
1990	36	91	127	132	89	221
1991	239	460	699	96	117	213
1992		1	1	52	158	210
1993	22	40	62	62	210	272
1994	1	1	2	91	223	314
1995		1	1	20	49	69
1996	1	15	16	87	143	230
1997	23	126	149	42	141	183
1998	45	231	276	69	347	416
1999	41	326	367	49	343	392
2000		15	15	36	341	377
2001	21	207	228	28	196	224
2002	20	299	319	72	616	688
2003			0			162
2004			232			46
mean	42	122	148	60	214	231

Appendix 1. Emigrant wild salmonids at Auke Creek, 1961-2004. The sockeye and coho salmon averages are for 1980-2004, and chums 1985-2004.

Year	Sockeye Salmon Smolts	Pink Salmon Fry	Chum Salmon Fry	Coho Salmon Smolts	Dolly Varden	Cut-throat trout	Steel-head trout
1961	90,816						
1964	65,242						
1965							
1966							
1967							
1968	35,737						
1969							
1970					6,249	90	
1971							
1972		157,189					
1973		73,900					
1974	15,399	277,624					
1975	59,370	247,091					
1976	35,769	108,195		10,772			
1977	8,862	119,442	0	18,686			
1978		129,714	0				
1979		23,270	0	9,419			
1980	25,299	74,047	0	10,022	3,132	85	
1981	9,183	110,552	0	6,721	6,461	157	
1982	1,619	119,548	0	6,445	4,172	157	
1983	3,170	164,784	0	6,631	3,718	150	
1984	20,251	169,552	0	7,012	4,512	198	
1985	11,747	110,001	7,198	5,601	3,052	112	
1986	14,500	123,887	825	5,666	4,351	99	
1987	17,598	43,502	14,039	7,166	6,444	251	
1988	13,812	113,061	8,091	7,888	6,770	294	
1989	11,187	116,870	13,750	6,911	7,230	258	
1990	16,983	96,651	1,916	5,132	6,426	417	6
1991	25,872	242,772	759	5,764	5,559	250	12
1992	13,248	98,447	4,783	6,262	6,839	219	10
1993	33,616	237,073	47	8,103	5,075	174	5
1994	32,009	11,603	137	7,416	7,604	422	8
1995	17,857	88,197	5	4,869	11,728	412	26
1996	7,069	41,359	4,981	3,963	11,323	459	24
1997	13,856	31,092	8,307	6,207	10,506	418	9
1998	22,496	60,785	735	7,430	7,532	340	15
1999	25,244	53,533	1,269	5,491	6,393	340	5
2000	13,699	132,075	1,337	4,891	5,254	249	6
2001	21,428	61,504	23,372	5,742	7,356	337	8
2002	17,594	150,149	1,959	3,434	4,858	210	15
2003	21,154	95,132	5,373	3,574	5,067	254	4
2004	21,106	169,568	1,425	4,581	3,955	136	4
average	17,264	116,732	5,015	6,117	6,214	250	10

Appendix 2. Immigrant salmonids at Auke Creek, 1963-2004. Hatchery fish are included: sockeye 1977-79, 1989-95; pink 1973-94, 1996, 1998-2001; chum 1979-91, 1994-2004; chinook, all years.

Year	Sockeye salmon	Pink salmon	Chum salmon	Coho salmon	Chinook salmon	Dolly Varden	Cut-throat	Steel-head
1963	6,391							
1964	5,465							
1965	6,889							
1966	10,986							
1967	5,909	3,761	78					
1968	7,164	2,638	76					
1969	6,131							
1970	7,034							
1971	7,673	2,090	10	308				
1972	9,166	1,768	47	967				
1973	8,259	4,948	27	399				
1974	4,371	6,260	5	768				
1975	11,461	14,261	10	1,310				
1976	6,153	2,525	16	262				
1977	16,683	15,848	24	868				
1978	3,177	18,410	17	683				
1979	6,022	19,003	13	566				
1980	4,564	20,187	118	698				
1981	4,089	14,450	109	646				
1982	1,334	10,658	251	447				
1983	1,805	24,827	310	694				
1984	975	5,271	1,927	651				
1985	240	26,317	1,852	942				
1986	952	2,305	1,392	454				
1987	2,827	7,914	1,884	668	19			
1988	1,337	8,140	1,093	756	50			
1989	2,508	5,016	304	502	74			
1990	3,383	21,806	270	697	221			
1991	5,425	6,878	174	820	213			
1992	4,853	22,101	130	1,020	210			
1993	9,113	1,696	121	859	272			
1994	6,993	22,533	868	1,437	314			
1995	5,261	1,548	1,327	460	69			
1996	5,995	4,374	6,781	515	230			
1997	4,671	2,774	444	609	183	5,705	467	
1998	2,068	2,879	247	862	416	4,993	361	
1999	1,571	30,097	386	845	392	4,709	205	3
2000	2,480	2,491	4,444	683	377	3,665	105	4
2001	3,959	8,323	588	865	224	4,249	228	11
2002	2,882	4,928	1,587	1,176	688	4,341	241	3
2003	3,239	10,580	1,578	585	162	3,978	129	0
2004	2,958	6,802	3,211	416	46	2,564	91	2
average	5,105	10,178	881	719	231	4,276	228	4

Appendix 3. Daily water temperatures at Auke Creek, 2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.1	1.2	2.0	3.2	9.7	14.5	17.0	17.0	16.6	9.8	5.8	2.5
2	0.9	1.1	2.1	3.1	9.3	14.5	17.0	17.2	16.6	9.8	5.8	2.5
3	0.9	1.0	2.1	3.1	9.6	14.2	16.8	17.3	16.2	9.9	5.4	2.5
4	0.9	1.0	2.1	3.0	10.9	15.0	16.8	17.6	15.7	9.9	5.4	2.5
5	0.9	1.0	2.0	3.2	10.0	15.3	16.9	17.9	15.3	9.8	5.4	2.5
6	0.8	1.2	1.9	3.4	10.7	15.2	16.4	18.0	14.8	9.8	5.1	2.5
7	0.8	1.3	2.0	3.3	11.3	15.7	17.2	18.4	14.4	9.7	5.0	2.5
8	0.9	1.4	2.1	3.7	11.6	16.1	17.2	18.5	14.3	9.5	5.0	2.5
9	1.1	1.4	2.1	3.7	12.0	15.5	17.5	18.9	14.0	9.4	4.6	2.8
10	1.3	1.5	2.1	3.9	12.1	15.2	17.8	19.6	13.8	9.5	4.6	3.1
11	1.4	1.5	2.1	4.2	12.2	15.2	16.5	19.9	13.5	9.5	4.5	3.3
12	1.4	1.3	2.3	4.7	12.7	15.2	17.8	19.7	13.2	9.4	4.2	2.8
13	1.4	1.3	2.3	4.9	13.5	15.6	18.4	19.0	12.9	9.0	4.2	2.5
14	1.7	1.4	2.3	5.4	14.2	15.1	19.4	19.0	12.6	9.3	4.6	2.5
15	1.6	1.5	2.4	4.9	14.3	15.0	20.2	19.6	12.7	9.4	4.6	2.8
16	1.7	1.5	2.3	4.7	14.9	14.8	19.9	20.3	12.4	9.3	4.6	3.3
17	1.3	1.5	2.4	4.9	14.6	15.5	18.7	20.5	12.5	8.9	4.5	3.0
18	1.5	1.5	2.5	5.1	14.6	16.3	17.0	20.5	12.4	8.5	4.3	2.5
19	1.7	1.5	2.5	5.2	14.6	18.0	18.0	19.8	12.0	7.7	4.2	2.4
20	1.5	1.5	2.6	5.7	15.1	18.7	18.1	19.0	11.9	7.4	4.2	2.4
21	1.5	1.7	2.6	6.2	16.1	18.8	16.4	18.6	11.6	7.0	4.2	2.1
22	1.6	1.7	2.6	6.5	15.9	19.4	17.8	18.7	11.2	7.0	4.2	2.0
23	1.5	1.7	2.6	6.3	16.1	19.6	18.9	18.3	11.1	6.8	4.2	1.9
24	1.3	1.7	2.9	6.2	16.4	20.0	18.8	17.9	10.7	6.2	4.2	1.6
25	1.1	1.8	2.9	6.2	15.7	20.2	17.0	17.8	10.5	6.3	4.2	1.7
26	1.0	1.8	3.1	6.0	15.0	19.8	16.9	17.3	10.6	6.2	4.0	2.0
27	1.1	1.9	3.1	6.4	14.9	18.6	16.4	17.0	10.3	6.0	3.6	2.0
28	1.1	2.0	3.2	7.2	14.9	17.8	17.3	16.9	10.1	6.1	3.7	2.0
29	1.1	2.0	3.0	7.2	15.0	17.7	17.3	16.7	9.9	6.2	2.8	1.7
30	1.1		3.0	8.5	14.7	17.8	17.4	16.7	9.8	6.1	2.5	1.6
31	1.2		3.1		14.8		17.4	16.7		5.8		1.7
Ave.	1.2	1.5	2.5	5.0	13.5	16.7	17.6	18.4	12.8	8.2	4.4	2.4

Appendix 4. Dates of ice-out on Auke Lake.

year	date	year	date	year	date
1960	April 26	1980	April 19	2000	April 2
1961		1981	March 26	2001	April 6
1962		1982	May 14	2002	April 28
1963	April 29	1983	April 18	2003	April 14
1964		1984	March 29	2004	April 5
1965		1985	April 26		
1966		1986	April 28		
1967	May 11	1987	March 30		
1968	April 23	1988	April 5		
1969	April 30	1989	April 28		
1970	March 24	1990	April 8		
1971	May 13	1991	April 29		
1972	May 20	1992	March 18		
1973	April 30	1993	April 23		
1974	May 7	1994	April 11		
1975	April 8	1995	April 25		
1976	April 28	1996	April 22		
1977	February 1	1997	April 26		
1978	April 20	1998	March 31		
1979	April 24	1999	May 5		

average for all years: April 18

Appendix 5. Monthly totals and daily counts of emigrant salmonids at Auke Creek, 2004.

	pink salmon fry	coho salmon smolts	sockeye salmon smolts	chum salmon fry	Dolly Varden	cutthroat trout	steelhead trout
March	22,950	0	0	904	6	1	0
April	146,337	3	10	470	1,179	36	0
May	281	4,213	20,989	45	2,757	96	3
June	0	365	107	6	13	3	1
total	169,568	4,581	21,106	1,425	3,955	136	4
March 1							
2							
3	114			7			
4	174			10			
5	248			15			
6	165			12			
7	289			44			
8	263			34			
9	226			22			
10	345			39			
11	325			23			
12	390			50			
13	360			47			
14	403			35			
15	451			33			
16	330			30			
17	611			42			
18	512			38			
19	619			23			
20	889			27		1	
21	700			31			
22	599			44			
23	916			41	1		
24	702			41			
25	867			20			
26	2079			34			
27	2168			38	1		
28	2234			32	2		
29	2313			37			
30	1383			20	1		
31	2275			35	1		
April 1	2157			27		1	
2	3305			36			
3	8588			44	1		
4	9421			45	22		
5	3541			20	9		
6	5451			21	12		
7	3454			18	2		
8	2532			7	14		
9	4998			19	4		
10	5655			13	7	3	
11	8969			37	1		
12	8675			21	23		
13	7492			25	14	1	
14	9815			17	10		
15	10017			27	27	1	
16	5054			13	16		
17	4742			17	11		
18	6422			16	6		
19	4946			8	6		
20	5521			5	9		
21	5793			9	11	2	
22	3739			0	21	4	
23	4917		1	2	18	4	
24	3680			2	18	3	
25	1653		1	2	9	4	
26	2771			1	44	2	
27	926	1	3	1	423	5	

	pink salmon fry	coho salmon smolts	sockeye salmon smolts	chum salmon fry	Dolly Varden	cutthroat trout	steelhead trout
Apr. 28	1195	1		7	47	2	
29	508		2	5	132	2	
30	400	1	3	5	262	2	
May 1	122	1	8	2	347	4	
2	52		12	5	90	3	
3	25	2	9	0	209	5	
4	19	1	21	3	512	6	
5	17	10	42	3	216	3	
6	18	9	19	1	247	1	
7	13	6	3	0	217	1	
8	6	16	67	2	240	4	
9	1	63	67	1	66	1	
10	2	143	237	4	101	5	
11	3	314	931	1	235	5	1
12	0	365	1849	1	69	1	
13	0	453	3605	0	74	6	
14	1	336	2688	3	36	2	
15	1	371	2693	1	24	9	
16	0	247	2296	0	13	2	
17	1	298	1329		3	1	
18	0	181	1004		10	2	1
19		210	1258	1	7	2	
20		121	951		4	3	
21		163	863		2	1	
22		150	487		1	5	
23		96	186	3	0	3	
24		92	155		5	3	
25		59	68	1	4	6	1
26		39	32		2	1	
27		135	26	1	9	2	
28		108	39	10	6	2	
29		72	21	1	3	4	
30		89	10	1	5	1	
31		63	13			2	
June 1		29	15	3	3		1
2		26	28	1	3	1	
3		73	8		2		
4		45	8	2	1		
5		35	5		2	1	
6		9	7		1		
7		48	5		1		
8		22	4				
9		15	4				
10		8	4			1	
11		17	4				
12		8	0				
13		10	4				
14		4	0				
15		5	3				
16		3	2				
17			1				
18		5	3				
19		2	1				
20		1	1				
21		0	0				
22							
23							
24							
25							
26							
27							
28							
29							
30							
total	169,568	4,581	21,106	1,425	3,955	136	4

Appendix 6. Monthly totals and daily counts of immigrant salmonids at Auke Creek, 2004. Hatchery reared chum and chinook salmon are included.

	Sockeye salmon adults	Pink salmon adults	chum salmon adults	coho salmon adults	chinook salmon adults	Dolly Varden	cutthroat trout	steelhead trout
July	2,761	36	2,222	0	2	509	0	0
August	108	2,198	985	0	16	569	0	1
Sept.	89	4,568	4	380	28	1,424	75	1
Oct.	0	0	0	36	0	62	16	0
total	2,958	6,802	3,211	416	46	2,564	91	2
July 1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28	2,454	12	466		1	115		
29	231	11	944		1	307		
30	68	9	759			86		
31	8	4	53			1		
Aug. 1	4	0	117			0		
2	17	13	605		2	227		
3	2	0	107			66		
4	6	3	60			67		
5	6	0	53			39		1
6	0	0	21			38		
7	6	1	8			22		
8			2			24		
9						12		
10						14		
11						5		
12	1					5		
13	10	1	1			10		
14						3		
15	1					1		
16								
17						2		
18								
19								
20								
21								
22								
23								
24								

	Sockeye salmon adults	Pink salmon adults	chum salmon adults	coho salmon adults	chinook salmon adults	Dolly Varden	cutthroat trout	steelhead trout
Aug. 25	1	12				2		
26								
27	9	447	2			1		
28	15	496	2		1			
29	21	517	2		1	5		
30	9	438	5		6	22		
31		270			6	4		
Sept. 1	2	133			2	4		
2		178			2	2		
3	30	1,500	2		6	31		
4	31	1,270	1	1	7	41		
5	7	342			5	17		
6	2	386			4	67		
7	1	206				33		
8	1	85				23		
9		53			2	71		
10	1	44				47		
11		39				13		
12		69				12		
13		74	1			15		
14	8	53		63		71		
15	2	83		41		110	10	
16	2	24		19		72		
17		11		37		120		
18		6		3		152		
19		6		10		68		
20		2		1		18	5	
21		4		71		129	19	
22	2			36		49	14	
23				27		29	9	1
24				10		41	3	
25				28		133	8	
26				17		17	2	
27				7		11	2	
28				6		13	1	
29						10	1	
30				3		5	1	
Oct. 1				2		5	2	
2				3		5		
3				2		9	3	
4				5		7	1	
5						3		
6						2	1	
7						1	2	
8								
9				6		8	2	
10				2		2	1	
11				1		2	1	
12				1		6		
13				8		1		
14				4		3		
15				2				
16						2	1	
17						1		
18						2	1	
19								
20								
21								
22								
23						1	1	
24						1		
25						1		
26								
27								
28								
29								
30								
31								
total	2,958	6,802	3,211	416	46	2,564	91	2