

PILLAR CREEK HATCHERY ANNUAL MANAGEMENT PLAN, 1998

By

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**PILLAR CREEK HATCHERY ANNUAL MANAGEMENT PLAN
EXECUTIVE SUMMARY, 1998.**

New Projects for 1998: NONE

Cost Recovery Harvests for 1998: NONE

Sockeye Salmon Adult Returns, Stocking, and Egg-Take Goals (1999 Stocking Goals), 1998:

Project (Brood stock)	Projected 1998 Enhanced Return	Planned 1998 Stocking	Goals	
			1998 Eggs	1999 Juveniles
Hidden Lake (A.L.)	13,000	250,000	600,000	400,000 F+PS
Little Waterfall Lake (A.L.)	28,000	300,000	600,000	350,000 PS
Crescent Lake (A.L.)	14,000	400,000	500,000	400,000 F
Little Kitoi Lake (A.L.)	18,000	0	0	0
Afognak Lake (A.L.)	9,000 ^a	550,000	0	0
Sorg Lake (A.L.)	0	0	0	0
Malina Lake (M.L.)	15,000 ^a	450,000	800,000	500,000 F+PS
Laura Lake (L.L.)	7,000 ^a	0	800,000	500,000 F+PS
Spiridon Lake (S.L.)	255,000	3,500,000	8,000,000	6,000,000 F
Ruth Lake (S.L.)	0	0	400,000	300,000 F

Coho Salmon Adult Returns, Stocking, and Egg-Take Goals (1999 Stocking Goals), 1998:

Mayflower (B.L.)	195	13,000	15,000	13,000
Island (B.L.)	675	45,000	53,000	45,000
Dark (B.L.)	225	15,000	18,000	15,000
Mission (B.L.)	368	24,500	29,000	24,500
Potato Patch (B.L.)	285	19,000	22,000	19,000
Southern (B.L.)	105	7,000	8,000	7,000
Pony (B.L.)	63	4,200	5,000	4,200
Total Road System	1,916	127,700	150,000	127,700
Science/Ed Projects	9	600	3,000	600

Brood stocks: A.L - Afognak Lake; M.L. - Malina Lake; L.L. - Laura Lake; S.L. - Sallery Lake; B.L. - Buskin Lake.

Life stage: F - Fry or Fingerlings; PS - Presmolt

^a does not refer to total run; only the portion that is a result of enhancement (stocking).

Summary of active sockeye salmon FTP's (for 1997 egg takes) issued by KRAA for Pillar Creek Hatchery 1998 stocking:

Project Name FTP Number	Issue Date	Expiration Date	Purpose
Afognak Egg take 88A-1021	08/01/88	9/15/97	Allows egg take of 10,000,000 green eggs at Afognak Lake; incubation and rearing at PCH, and release of the resultant fry into Afognak Lake.
Hidden Lake 97A-0017	04/1/91	12/31/96	Allows the release of up to 2,700,000 Afognak Lake stock fry, incubated and reared at PCH into Hidden Lake.
Hidden Lake 97A-0075	08/31/97	08/31/98	Allows the release of up to 150,000 Afognak Lake stock presmolt, incubated and reared at PCH into Hidden Lake.
Little Waterfall 97A-0076	08/31/97	08/31/98	Allows the release of up to 200,000 Afognak Lake stock presmolt, incubated and reared at PCH into Little Waterfall Lake.
Crescent Lake 91A-0022	04/1/91	12/31/97	Allows the release of up to 1,700,000 Afognak Lake stock fry, incubated and reared at PCH into Crescent Lake.
Little Kitoi Lake 96A-0069	09/1/96	12/31/02	Allows the release of up to 150,000 Afognak Lake stock presmolt, incubated and reared at PCH into Little Kitoi Lake.
Sorg Lake 94A-0037	08/1/94	7/31/99	Allows the release of up to 150,000 Afognak Lake presmolt, incubated and reared at PCH into Sorg Lake
Malina Egg take 96A-0070	01/01/97	12/31/02	Allows egg take of 1,500,000 green eggs at Malina Lake, incubation and rearing at PCH, and release of progeny into Malina Lake.
Malina Lake 96A-0071	09/17/96	12/31/02	Allows the release of up to 250,000 Malina Lake stock fingerling, incubated and reared at PCH into Malina Lake.
Malina Lake 97A-0078	08/31/97	08/31/98	Allows the release of up to 200,000 Malina Lake stock presmolt, incubated and reared at PCH into Malina Lake.
Laura Lake 93A-0113	08/01/93	12/31/98	Allows egg take of 1,500,000 green eggs at Laura Lake, incubation and rearing at PCH, and release of progeny into Laura Lake.
Saltery Eggtake 97A-0071	08/31/97	08/31/98	Allows egg take of 9,800,000 green eggs at Saltery Lake, incubation and rearing at PCH, and release of progeny into Spiridon and Ruth Lakes.
Spiridon Lake 97A-0072	08/31/97	08/31/98	Allows the release of up to 7,000,000 Saltery Lake stock fry, incubated and reared at PCH into Spiridon Lake.
Ruth Lake 97A-0073	08/31/97	08/31/98	Allows the release of up to 300,000 Saltery Lake stock fry, incubated and reared at PCH into Ruth Lake.

Bold denotes expired FTP's or those that will expire in 1998.

Summary of active coho salmon FTP's (for 1997 egg takes) issued to KRAA for Pillar Creek Hatchery 1998 stocking:

Project Name FTP Number	Issue Date	Expiration Date	Purpose
Buskin Eggtake 93A-0105	09/15/93	12/31/03	Allows eggtake of 150,000 green eggs at Buskin Lake; incubation and rearing at PCH, and release of the resultant fry in 5 anadromous and 2 landlocked systems in Chiniak Bay.
Mayflower 93A-0106	09/15/93	12/31/03	Allows the release of up to 13,000 Buskin Lake stock fry, incubated and reared at PCH into Mayflower Lake.
Island 93A-0107	09/15/93	12/31/03	Allows the release of up to 45,000 Buskin Lake stock fry, incubated and reared at PCH into Island Lake.
Dark 93A-0108	09/15/93	12/31/03	Allows the release of up to 15,000 Buskin Lake stock fry, incubated and reared at PCH into Dark Lake.
Mission 93A-0109	09/15/93	12/31/03	Allows the release of up to 24,500 Buskin Lake stock fry, incubated and reared at PCH into Mission Lake.
Potato Patch 93A-0110	09/15/93	12/31/03	Allows the release of up to 19,000 Buskin Lake stock fry, incubated and reared at PCH into Potato Patch Lake.
Pony 93A-0111	09/15/93	12/31/03	Allows the release of up to 4,200 Buskin Lake stock fry, incubated and reared at PCH into Pony Lake.
Southern 93A-0111	09/15/93	12/31/03	Allows the release of up to 7,000 Buskin Lake stock fry, incubated and reared at PCH into Southern Lake.
Buskin 94A-0038	03/30/94	02/28/99	Allows eggtake of 3,000 green eggs at Buskin Lake incubation and rearing at PCH, and transport of the resultant fry to Kodiak area schools for science/education projects, and release of resultant fry into Potato Patch Lake or fry may be sacrificed.
P-98-002	01/01/98	12/31/98	Allows the rearing of up to 50 Buskin Lake stock eggs and release of any resultant fry into Potato Patch Lake, eggs will be acquired from PCH.
P-98-010	01/07/98	12/31/98	Allows the rearing of up to 200 Buskin Lake stock eggs and release of any resultant fry into Potato Patch Lake, eggs will be acquired from PCH.
P-98-052	02/27/98	12/31/98	Allows the rearing of up to 100 Buskin Lake stock eggs and release of any resultant fry into Potato Patch Lake, eggs will be acquired from PCH.
P-98-051	02/24/98	12/31/98	Allows the rearing of up to 100 Buskin Lake stock eggs and release of any resultant fry into Potato Patch Lake, eggs will be acquired from PCH.

Pillar Creek Hatchery Annual Management Plan sockeye salmon calendar of events, 1997-1999.

Species	1997						1998						1999													
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	October
Afognak Lake Brood Stock																										
Hidden		0.45 M Egg												0.25 M Presmolt												
													0.6 M Egg											0.15 M Fry	0.25 M Presmolt	
Waterfall		0.5 M Egg												0.3 M Presmolt												
													0.6 M Egg													0.35 M Presmolt
Crescent		0.6 M Egg									0.4 M Finger															
													0.5 M Egg											0.4 M Finger		
Little Kitoi																										
Sorg																										
Afognak		0.8 M Egg										0.5 M Finger	0.05 M Presmolt													
Malina Lake Brood Stock																										
Malina		0.7 M Egg											0.2 M Fry	0.25 M Presmolt												
													0.8 M Egg											0.3 M Fry	0.2 M Presmolt	
Laura Lake Brood Stock																										
Laura													0.8 M Egg											0.3 M Fry	0.2 M Presmolt	
Saltery Lake Brood Stock																										
Spiridon		4.7 M Egg									3.5 M Fry															
														8.0 M Egg										6.0 M Fry		
Ruth														0.4 M Egg										0.3 M Fry		

Pillar Creek Hatchery Annual Management Plan coho salmon calendar of events, 1997-1999.

Species	1997						1998						1999														
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	October	
Buskin Lake Brood Stock																											
Mayflower				<u>15,000 Egg</u>							<u>13,000 Fry</u>					<u>15,000 Egg</u>							<u>13,000 Fry</u>			<u>15,000 Egg</u>	
Island				<u>53,000 Egg</u>							<u>45,000 Fry</u>					<u>53,000 Egg</u>							<u>45,000 Fry</u>			<u>53,000 Egg</u>	
Dark				<u>18,000 Egg</u>							<u>15,000 Fry</u>					<u>18,000 Egg</u>							<u>15,000 Fry</u>			<u>18,000 Egg</u>	
Mission				<u>29,000 Egg</u>							<u>24,500 Fry</u>					<u>29,000 Egg</u>							<u>24,500 Fry</u>			<u>29,000 Egg</u>	
Potato Patch				<u>22,000 Egg</u>							<u>19,000 Fry</u>					<u>22,000 Egg</u>							<u>19,000 Fry</u>			<u>22,000 Egg</u>	
Southern				<u>8,000 Egg</u>							<u>7,000 Fry</u>					<u>8,000 Egg</u>							<u>7,000 Fry</u>			<u>8,000 Egg</u>	
Pony				<u>5,000 Egg</u>							<u>4,200 Fry</u>					<u>5,000 Egg</u>							<u>4,200 Fry</u>			<u>5,000 Egg</u>	
Science/Ed				<u>3,000 Egg</u>							<u>2,600 Fry</u>					<u>3,000 Egg</u>							<u>2,600 Fry</u>			<u>3,000 Egg</u>	

INTRODUCTION

Pillar Creek Hatchery (PCH) was constructed in 1990 as a cooperative project between the Alaska Department of Fish and Game (ADF&G) and Kodiak Regional Aquaculture Association (KRAA). The facility is located on the Kodiak road system about seven miles north of the City of Kodiak (Figure 1 and 2). PCH was designed to increase salmon production for Kodiak Island seiners and set gill-net fishers by enhancing barren-lake systems with juvenile sockeye salmon and to a lesser extent, juvenile coho salmon. In addition, hatchery programs were expected to supplement wild stocks to rehabilitate depleted runs. PCH has the capacity to incubate 20 million salmon eggs and rear up to 16 million juveniles of all life stages (fry, fingerlings, presmolt and smolt). The facility is operated by funds provided by KRAA.

The primary project facilitated by PCH is the stocking of sockeye salmon fry into Spiridon Lake. This project utilizes Spiridon Lake as a fry nursery area to produce smolt, which (after leaving the lake) return as adults to provide a common property sockeye salmon fishery. Initial limnology investigations indicate that the optimum rearing capacity of the lake is about 11 million sockeye salmon fry. A conservative stocking strategy has been adopted in order to minimize the impacts of rearing juvenile salmon on the standing crop of macrozooplankton. Thus, the current stocking level is between 5 and 7 million fry. The brood stock in the initial development stage of the project was late-run Upper Station sockeye salmon. A portion of eggs collected at Upper Station were incubated and reared to presmolt and smolt at Kitoi Bay Hatchery (KBH; Hall et al. 1997). These juveniles were released at Little Kitoi Lake and estuary to develop a brood source at the KBH for the Spiridon Lake project. The 1994 Hatchery Management Plan was amended to change the brood source for the project to Saltery Lake sockeye for an interim period until the brood source goals were attained at Little Kitoi Lake. This brood source change (ADF&G 1994) was approved by the U.S. Fish and Wildlife Service (FWS) for one year. In 1995, Upper Station sockeye salmon were, again, used for brood stock. To date the sockeye run to Little Kitoi has not provided sufficient salmon for brood stock. Further research by ADF&G and the FWS indicated that Saltery stock would be preferential for Spiridon Lake stocking (Honnold 1997; Clevenger et al. 1997). The run timing of Saltery Lake sockeye is about three weeks earlier than late-run Upper Station sockeye stock. The brood stock requirements at KBH are expected to be easier to achieve using the Saltery stock since adults are expected to return after the peak of the chum salmon run and before the peak of the pink salmon run (Figure 3). The approval to use Saltery Lake stock for Spiridon Lake was granted in 1997 by the Commissioner of ADF&G, representatives of the FWS, the Kodiak Regional Planning Team, and KRAA. Saltery Lake stock will continue to be the brood source for the Spiridon Lake project in 1998.

Saltery Lake sockeye have also been stocked into Ruth Lake since 1996 (falls on this system prevent fish entry into the lake; Figure 1) and were scheduled to be used for stocking the lake in 1998. However, egg collection at Saltery Lake in 1997 was less successful than planned and will result in fewer late-run fry to outstock in 1998. Spiridon Lake will be the priority stocking location in 1998; Ruth Lake will not be stocked. Stocking of Jennifer Lakes (Figure 1) with sockeye salmon will be discontinued in 1998 to simplify the evaluation of Saltery stock brood stock development at KBH. Little Kitoi Lake will be stocked with Saltery Lake sockeye salmon from KBH to develop a

brood source; replacing Upper Station late-run as the primary stock for brood stock development (Hall et al. 1997).

PCH also provides early-run sockeye salmon fry for stocking several barren lakes in the Kodiak area. Hidden, Little Waterfall, and Crescent Lakes will be stocked with Afognak Lake sockeye salmon juveniles in 1998 (Figure 1). Lake enrichment has been conducted at Little Waterfall Lake since 1993 and is scheduled to continue in 1998. Little Kitoi Lake is a candidate for lake fertilization as a result of removal of a layer of hydrogen sulfide that had comprised a substantial portion of the lower hypolimnion in the lake. This layer of hydrogen sulfide was presumed to be a result of salt water intrusion from a tsunami wave that occurred during the 1964 earthquake. Little Kitoi Lake will not be stocked with early-run fry in 1998 to simplify brood stock development (Hall et al. *in press*). Afognak Lake sockeye eggs had a greater over-winter survival at PCH than expected in 1992, 1994, 1996, and 1997. The resultant number of fry exceeded the overall stocking capacity of the barren lakes as identified in AMP's for those years. The AMP's designated Afognak Lake as a contingency stocking location in the event that extra fry resulted from exceptional survival at PCH. Thus, fry were stocked back into Afognak Lake to avoid excess stocking levels at the barren systems, which are quite sensitive to grazing effects (on zooplankton) by juvenile sockeye. Afognak Lake has maintained a stable zooplankton population since 1990, when lake enrichment began (G. Kyle, ADF&G-retired, Soldotna, personal communication), as well as increased adult production during this period. The addition of nutrients (lake fertilization funded by KRAA) will continue in 1998. Egg to fry survival, again, appears higher than expected in 1998, and may result in up to 550,000 excess juveniles to stock into Afognak Lake. We propose continuing the use of Afognak Lake as a contingency stocking location for these fry in 1998 (as approved in the 1997 AMP). The proposed Afognak Lake egg-take goals for 1998 (stocking in 1999) will be adhered to in order to avoid the need to stock excess fry into the lake in 1999. We propose that the lake remain a contingency stocking site for 1999; however, if excess fry are produced, they will be proportioned among the barren lakes (Hidden, L. Waterfall, and Crescent) first to avoid the need to stock Afognak Lake. Barren lake stocking will be dependent upon sufficient zooplankton abundance as indicated by inseason limnological data analysis. Afognak Lake will continue to be fertilized whenever excess fry are stocked into the lake.

Sockeye stocking in conjunction with lake fertilization began at Malina Lake in 1991-1992 to rehabilitate this depleted early run (Figure 1). Malina Lake eggs are collected each year, incubated at PCH, and juveniles (fry or fingerling, and presmolt) stocked into the lake. The lake is responding to fertilization; however, zooplankton density and biomass estimates have resulted in reduced actual stocking levels compared to planned stocking levels (Clevenger et al. 1996). That is, the maximum number of juveniles stocked has been ~ 500,000 compared to the planned >1 million fry. The stocking level is expected to remain at ~ 500,000 in 1998 and 1999. Natural wild stock recruitment based on escapement levels will also be considered to determine the appropriate stocking level in 1999.

Laura Lake has also been fertilized and supplemented with sockeye fry of Laura Lake origin to rehabilitate the (early) run (Figure 1). Egg takes at this system have not attained goals due to difficulty in locating brood fish. As a result of not attaining the goals, the stocking level has not exceeded 200,000 juveniles. In 1996 and 1997, sockeye salmon eggs were not collected at Laura

Lake due to adequate adult escapement. In 1998, we propose an egg take to provide for stocking Laura Lake in 1999; however, the number of eggs collected will be determined by the adult escapement and may be reduced or discontinued inseason if adequate natural spawners return. Lake enrichment is scheduled for 1998.

Buskin River coho salmon were reared at PCH from 1995 - 1997 to provide fry for road system stocking to enhance sport fishing opportunities (Figure 2). In addition, Buskin River coho salmon eggs were used for several classroom incubation programs in Kodiak area schools. Prior to 1995, Little Kitoi and Monashka Creek coho were used for these programs, respectively. The use of Buskin River (Chiniak Bay stock) coho was recommended by the ADF&G genetics staff because stocking locations are in the Chiniak Bay area. In 1998 and 1999, we propose continuing these coho stocking programs using Buskin River coho as the brood source.

Since PCH is a relatively new facility, this management plan will continue to evolve in an effort to bring the egg numbers up to maximum incubation capacity. There are many factors that have, and will continue to bring changes to this document. Inseason lake productivity assessment may result in adjustments to stocking densities in order to maintain optimal stocking levels. This plan does not contain any new stocking proposals for 1999; however, ongoing investigations may result in new proposals in the future.

1998 SOCKEYE SALMON RELEASES

Table 1 describes 1997 sockeye egg takes, planned releases in 1998, projected returns in 2001 and 2002, and the status of Fish Transport Permits (FTP). The stocking levels for 1998 may be adjusted inseason after limnological analysis of zooplankton data collected at each lake and/or because of rearing limitations at PCH (i.e. how many juvenile fish of each life stage can be cultured). Appendix A describes the planning process for development of stocking levels, and includes the 1997 Annual Management Plan (AMP) limnology recommendations, and final planned stocking levels. The projected stocking levels in this plan have been modified in some instances from the final planned levels as result of changes in fry survival. Appendices B - G list PCH egg takes: past, present, and proposed.

All sockeye will be transported by air as fed fry, fingerling, or presmolt to the remote lakes specified. Stocking of fed fry and fingerlings will correspond to the timing of each lake's plankton bloom (as determined by inseason limnology sampling). Fry and fingerlings will be released at the lake surface. Presmolt will be released by air dropping in late October or early November, just prior to lake freeze up to minimize the likelihood of plankton cropping.

Early-Run Sockeye Salmon: Afognak Lake Donor Stock

Hidden, Little Waterfall, and Crescent Lakes are projected to be stocked in 1998 with 250,000, 300,000, and 400,000 juveniles, respectively. These levels are consistent with the 1997 PCH AMP

and prior Fish Transport Permits (Clevenger et al. 1997) with the exception of Hidden Lake which has been reduced due to a decline in zooplankton abundance. Little Kitoi and Sorg Lakes will not be stocked with early-run sockeye in 1998. As previously mentioned, increased survivals may result in excess early-run juveniles. These fish (<600,000) will be stocked into Afognak Lake in 1998. Fish releases are not projected for Afognak Lake in 1999; however, the lake may be used as an alternate release site for Afognak Lake salmon (destined for other projects) in 1999 (Figure 3; Appendix H). These releases will only occur if excess fry are produced that can not be stocked at their intended release site as a result of inseason limnology analysis. A total of ~ 1.5 million enhanced early-run (Afognak Lake stock-1997 brood year) juveniles will be stocked in 1998.

Adult returns from enhanced early-run (Afognak Lake brood stock) stocking in 1998 are projected (based on survivals summarized in Appendix I) to be ~105,000 fish. Of these, ~45,000 will return in 2001 and 60,000 in 2002. The largest return (38,000) is expected at Little Waterfall Lake and the smallest at Crescent Lake (16,000). Approximately, 31,000 and 20,000 enhanced adults are expected to return to Hidden Lake and Afognak Lake, respectively. The run timing of these returns should be similar to Afognak Lake sockeye salmon (brood source), with runs beginning in late May, peaking in mid June, ending by early July (Figure 4a). This run timing affinity has been observed at terminal harvest areas at both Foul Bay (Hidden Lake) and Waterfall Bay (L. Waterfall Lake) in 1995 through 1997 (Figure 4b). Similar timing has been reported at Settler Cove (Crescent Lake run; D. Prokopowich, ADF&G, Kodiak, personal communication).

Early-Run Sockeye Salmon: Malina Lake Donor Stock

In 1998, juvenile sockeye stocking projections for Malina Lake will be slightly less than the 1997 AMP planned levels with ~ 200,000 fingerlings and 250,000 presmolt stocked (Table 1).

Adult returns as a result of rehabilitation (stocking in 1998) efforts of this early-run stock are expected to be ~31,000 sockeye. The age of return has, on average, been 55% two ocean and 45% three ocean fish. Thus, ~18,000 adults are expected to return in 2001 and 13,000 adults in 2002. The Malina Lake sockeye run timing is similar to the Afognak Lake stock with fish first appearing at the weir in early June (the weir is located several miles from salt water and adults have been observed one week earlier at the stream terminus) and peaking by mid June (Figure 5); however, there also appears to be a second peak in early July. A small portion of escapement occurs throughout the remainder of July and into August; the weir is removed by mid August.

Late-Run Sockeye Salmon: Saltery Lake Donor Stock

Saltery Lake sockeye salmon juveniles will be stocked into Spiridon Lake in 1998. The 1998 stocking estimate for Spiridon Lake of 3.5 million sockeye fry is 50% less than planned (7 million) when drafting the 1997 AMP (Clevenger et al. 1997). This was due to not achieving the 1997 egg-take goal for Spiridon Lake stocking.

The 1998 stocking goal for Ruth Lake was 300,000 Saltery Lake sockeye fry. Eggs were not collected in 1997 due to lack of available brood stock; thus, no fry are available for stocking in 1998.

It is projected that 140,000 adults will return in 2001 and 2002 as result of fry stocking in Spiridon Lake; 35,000 (25% two ocean) in 2001 and 105,000 (75% three ocean) in 2002. The run timing of these fish should be similar to Saltery Lake sockeye, with the initial run beginning in late June, peaking in mid to late July, and ending in mid August (Figure 6a).

Overall, in 1998 we expect PCH to stock ~ 2.0 million early-run sockeye juveniles, producing ~136,000 adults; ~ 3.5 million late-run sockeye juveniles, producing ~140,000 adults. This equates to a grand total of ~ 5.5 million juvenile sockeye stocked and production of ~ 276,000 adults.

For the above projects, the majority of FTP's are being renewed with the completion of the Hatchery Basic Management Plan. FTP applications will be submitted by KRAA to the ADF&G permitting coordinators in Juneau for review and approval by the Commissioner of ADF&G. Approval is expected in advance of all egg takes and stocking in 1998 and 1999.

1998 COHO SALMON RELEASES

Table 2 describes 1997 coho salmon egg takes, 1998 planned releases, projected adult returns in 2000 and 2001, and the status of FTP's.

In June, coho fry will be transported from PCH by a truck-mounted transport tank to each stocking location, except for Southern Lake where fry will be transported via float plane.

Coho Salmon : Buskin River Donor Stock

Approximately 128,000 coho salmon fry are expected to be released at seven lakes located near the Kodiak Island road system. These lakes include: Mayflower (13,000), Island (45,000), Dark (15,000), Mission (24,500), Potato Patch (19,000), Southern (7,000), and Pony (4,200) Lakes. A small number of Buskin River coho salmon eggs will be used for educational programs in the local schools within the Kodiak Island Borough school system. There are normally about eight school teachers with Fish Resource Permits that allow the use of up to 250 eggs each from this stock. Eggs incubated in classroom incubators will be released (~600 fry) into Potato Patch Lake under the supervision of the PCH Manager. The exception to this may be Old Harbor, Ouzinkie, Akhiok, and Port Lions schools in which resultant fry, (if they apply for and receive a Fish Resource Permit for a classroom incubation project), will be destroyed. This type of Fish Resource Permit must be renewed annually.

Adults returning in 2000 and 2001 are expected to number ~1,950, with the majority (1,700) returning in 2000. Run timing should be similar to Buskin River coho, with fish returning in mid August, peaking in early September, and declining by late September.

Permits (FTP) are valid for all coho road system stocking locations until 12/31/03. All of the school project (scientific educational) permits expire 12/31/98 and new permits will be required annually.

1999 SOCKEYE SALMON RELEASES

Table 3 describes 1998 sockeye egg takes, planned releases in 1999, projected returns in 2002 and 2003, and the status of Fish Transport Permits (FTP). The stocking levels for 1999 may be adjusted inseason as a result of limnological analysis of zooplankton data collected at each lake and rearing limitations at PCH (i.e. how many of each life stage could be cultured). Appendix H describes the planning process for the development of 1999 stocking levels. The 1999 stocking levels may be further modified from the planned levels once eggs are collected in 1998 to account for differing egg to fry survivals or unattained egg-take goals. Appendices B - G list PCH egg takes: past, present, and proposed.

All sockeye will be transported by air as fed fry, fingerling, or presmolt to the remote lakes specified. Stocking of fed fry and fingerlings will correspond to the timing of each lake's plankton bloom (as determined by inseason limnology sampling). Fry will be released at the lake surface. Pre-smolt will be released by air dropping in late October or early November, just prior to lake freeze up to minimize the likelihood of plankton cropping.

Early-Run Sockeye Salmon: Afognak Lake Donor Stock

The stocking levels of early-run Afognak Lake fry planned for 1999 are as follows: Hidden Lake - 150,000 fry and 250,000 presmolt; Little Waterfall Lake - 350,000 presmolt; and Crescent Lake - 400,000 fry. Fish releases are not projected for Afognak Lake in 1999; however, the lake may be used as an alternate release site for Afognak Lake juvenile sockeye salmon if stocking densities are reduced for other projects due to inseason limnology analysis. Limnological monitoring will continue in 1998 and 1999 to determine if stocking Afognak Lake is an option for excess fry. A total of ~ 1.2 million enhanced early-run (Afognak Lake stock) juveniles will be stocked in 1999. Egg-take goals will be based upon the level escapement available for brood stock collection (see Escapement Goal section).

Adult returns (from enhanced early-run stocking in 1999) are projected (based on survivals summarized in Appendix C) to be ~ 97,000 fish. Of these, ~ 42,000 will return in 2002 and 55,000 in 2003. The largest returns (~44,000) are expected at Waterfall Bay (Little Waterfall Lake) and the smallest return at Settler Cove (Crescent Lake; 16,000). Hidden Lake returns are expected to be approximately 31,000 sockeye. The run timing of these returns should be similar to Afognak Lake sockeye salmon (brood source), with runs beginning in late May, peaking in mid June and ending

by early July (Figure 4a). This run timing has been observed at both Foul Bay (Hidden Lake) and Waterfall Bay (Little Waterfall Lake) in 1995 through 1997 (Figure 4b) as a result of stocking of Afognak Lake fry.

Early-Run Sockeye Salmon: Malina Lake Donor Stock

Juvenile sockeye stocking plans for Malina Lake in 1999 are the same as the 1997 AMP levels of 500,000 (300,000 fry and 200,000 presmolt) juveniles. This level is based on the current plan for stocking the lake in 1998 (as a result of limnological analysis of the zooplankton population) and depends on the level of escapement in 1998. The lower escapement goal is 10,000, mid-point goal is 15,000, and the upper escapement goal is 20,000 sockeye salmon (Table 4). In 1998, if escapement is less than or equal to 7,500 (75% of lower goal), an egg take will proceed (see Rehabilitation Criteria and Escapement Goal sections). The egg-take and fry stocking goal may be reduced based on the escapement level (sliding egg-take goal based on projected recruitment from the escapement level) and lake productivity (zooplankton abundance and biomass). Stocking at this level may also be contingent upon continued lake fertilization in 1999. If fertilization ends, fry stocking may be reduced or discontinued in lieu of presmolt stocking.

Adult returns as result of rehabilitation (stocking in 1999) efforts of this early-run stock are expected to be ~29,000 sockeye. The age of return has, on average, been 55% two ocean and 45% three ocean fish. Thus, ~ 17,000 adults should return in 2002 and ~ 12,000 in 2003. The Malina Lake sockeye run returns similarly to the Afognak Lake stock with fish first appearing at the weir in early June (the weir is located several miles from salt water and adults have been observed one week earlier at the stream terminus) and peaking by mid June (Figure 5); however, there also appears to be a second peak in early July. A small portion of escapement occurs throughout July and into August; the weir is pulled by mid August.

Early-Run Sockeye Salmon: Laura Lake Donor Stock

We propose 500,000 juvenile sockeye be stocked in Laura Lake in 1999; 300,000 fry and 200,000 presmolt. Eggs were not collected at Laura Lake in 1996 and 1997 because the escapement of adult sockeye met the upper escapement goal (40,000; Table 4). The mid-point goal (optimum escapement) is 30,000 (Honnold and Edmundson 1993) and the lower goal is 20,000 sockeye. In 1998, if escapement is less than or equal to 15,000 (75% of lower goal), an egg take will proceed (see Rehabilitation Criteria and Escapement Goal sections). The egg-take and fry stocking goal may be reduced based on the escapement level (sliding egg-take goal based on projected recruitment from the escapement level) and lake productivity (zooplankton abundance and biomass). Similar to Malina, if lake enrichment is discontinued at Laura Lake in 1999, then fry stocking numbers may need to be reduced and only presmolt stocked. The lake's zooplankton density and biomass will be monitored in 1998 and 1999 to determine if adjustments to the stocking plan are warranted.

Adult returns as a result of rehabilitation (stocking in 1999) efforts of this early-run stock are expected to be ~26,000 sockeye adults in 2002 (10,400) and 2003 (15,600). Laura Lake sockeye

runs begin in early June and peak by mid June (Figure 7). A small portion of escapement occurs in July and early August.

Late-Run Sockeye Salmon: Saltery Lake Donor Stock

We propose that approximately 6 million Saltery Lake sockeye fry be stocked into Spiridon Lake and 300,000 into Ruth Lake in 1999. This represents an increase of 2.5 million fry from 1998 for Spiridon Lake and 300,000 fry for Ruth Lake. The stocking goal for Spiridon Lake in 1998 was 7 million fry; however, the egg take (1997) resulted in only enough eggs for stocking 3.5 million fry in the lake; no fry were available for stocking Ruth Lake in 1998. The 1999 stocking level is contingent upon the stability of the food base (zooplankton) in the lakes. If any negative response is observed in the lake's zooplankton community as result of 1998 stocking levels the proposed 1999 stocking levels will be reduced. Inseason monitoring of the zooplankton community will be conducted in 1998 and 1999 and seasonal trends will be analyzed prior to the Saltery Lake egg take. The final stocking plan will be determined in August 1998. Egg-take goals will be based upon the level of escapement available for brood stock collection (see Escapement Goal section).

Approximately 240,000 and 12,000 adults are expected to return as result of stocking of Spiridon and Ruth Lakes, respectively, in 2002 and 2003. These fish are projected to have similar run timing as Saltery Lake sockeye, with the initial run beginning in late June, peaking in mid to late July and ending in mid August (Figure 6a).

To summarize, in 1999 we expect PCH to stock ~ 2.2 million early-run sockeye, producing ~ 152,000 adults; ~ 6.3 million late-run sockeye juveniles, producing ~ 252,000 adults. This equates to a grand total of ~ 8.5 million juvenile sockeye stocked from brood year 1998; which is expected to produce a total return of ~ 404,000 adults.

For the above projects, FTP's are currently being renewed for the Hatchery Basic Management Plan and will be effective for a period of five years. Applications for these permits will be submitted by KRAA to the ADF&G permitting coordinators in Juneau for review and approval by the Commissioner of ADF&G. Approval is expected in advance of all egg takes and stocking. These projects are considered on going with adjustments being requested as knowledge of each system increases.

1999 COHO SALMON RELEASES

Table 5 describes 1998 coho salmon egg takes, 1999 planned releases, projected adult returns in 2001 and 2002, and the status of FTP's.

In June, coho fry will be transported from PCH by a truck-mounted transport tank to each stocking location, except for Southern Lake where fry will be transported via float plane.

Coho Salmon : Buskin River Donor Stock

Approximately 128,000 coho salmon fry are expected to be released into seven lakes located near the Kodiak Island road system. These lakes include: Mayflower (13,000), Island (45,000), Dark (15,000), Mission (24,500), Potato Patch (19,000), Southern (7,000), and Pony (4,200) Lakes. A small number of Buskin River coho salmon eggs will be used for educational programs in the local schools within the Kodiak Island Borough school system. There are currently eight school teachers with Fish Resource Permits that allow use of up to 250 eggs each from this stock. Eggs incubated in classroom incubators will be released (~600 fry) into Potato Patch Lake under the supervision of the PCH Manager. Fish Resource Permits may also be issued to remote schools (Old Harbor, Ouzinkie, Akhiok, and Port Lions) where the resultant fry will be destroyed. Buskin River egg-take goals will be based upon the level escapement available for brood stock collection (see Escapement Goal section).

Adults returning in 2001 and 2002 are expected to number ~1,900, with the majority (1,700) returning in 2000. Run timing should be similar to Buskin River coho, with fish returning in mid August, peaking in early September, and declining by late September.

Permits (FTP) are valid for all road system stocking locations until 12/31/03; school classroom incubation projects with Fish Resource Permits will be renewed annually.

SOCKEYE SALMON HARVEST AND MANAGEMENT

The 1998 estimated sockeye salmon run to systems as a result of PCH stocking (in conjunction with lake enrichment at Afognak, Malina, Laura, L. Waterfall, and Laura Lakes) is projected as follows (Honnold 1998, unpublished report):

Early Run	Lake Type	1998 Enhanced Sockeye Run
Hidden Lake	barrier lake	13,000; range 8,000-19,000
Crescent Lake	barrier lake	14,000; range 8,000-20,000
L. Waterfall Lake	barrier lake	28,000; range 17,000-39,000
L. Kitoi Lake	barrier lake	18,000; range 11,000-26,000
Afognak Lake	brood stock source	9,000; range 4,000-13,000
Malina Lake	rehabilitation project	15,000; range 8,000-23,000
Laura Lake	rehabilitation project	7,000; range 3,000-10,000

Note: Total run to Little Kitoi Lake is projected at 56,000 sockeye; estimates of total runs (enhanced production plus wild production) to anadromous systems (Afognak, Malina, Laura Lakes) are not available.

Late Run	Lake Type	1998 Enhanced Sockeye Run
Spiridon Lake	barrier lake	255,000; range 153,000-357,000
Jennifer Lake	barrier lake	7,000; range 4,000-11,000

Hidden, Crescent, Little Waterfall, Little Kitoi, Spiridon, and Jennifer Lakes are barrier systems without native salmon runs. All sockeye returning to these systems are available for harvest. Afognak, Malina, and Laura Lakes have anadromous salmon runs; hatchery produced fish will intermingled with wild fish. Using an average exploitation rate of 60% (Chapman 1986) we would expect 5,400 Afognak Lake, 9,000 Malina Lake, and 4,200 Laura Lake sockeye to be harvested as result of hatchery production, the remainder would go toward escapement goals. Directed fisheries on Afognak, Malina, and Laura Lakes sockeye salmon runs will only occur if escapement goals are achieved. *Note: The 1998 run to Spiridon Lake (Telrod Cove) may be 123,000 (range 74,000-172,000) if marine age parallels Saltery Lake sockeye stock which are predominantly 3-ocean fish. The above forecast is based on the majority of the run being 2-ocean fish as has been observed when large smolt are released (age-1. Spiridon smolt are typically ~ 9-10 grams and over 100 millimeters in size; Honnold 1997).*

Release Site: Hidden Lake

The Foul Bay (Hidden Lake) harvest strategy is designed to allow for the harvest of sockeye salmon returning to Foul Bay produced from the Hidden Lake enhancement project and to provide for the protection of wild salmon stocks returning to or passing through the Northwest Afognak Section of the Afognak District (Figure 8).

Hidden Lake sockeye runs will be harvested in special openings in the Foul Bay Terminal Harvest Area (THA; Figure 9). Fishing time directed at returning sockeye salmon is expected to occur prior to the arrival of pink salmon in late July. The minimum escapement goal for Hidden Lake Creek is 3,000 pink salmon (KNWR 1992). The fishery directed at Hidden Lake returns is not expected to impact this goal. There is no escapement requirement for sockeye salmon in Hidden Creek as the lake is inaccessible due to a large barrier falls. The sockeye salmon harvest is expected to occur primarily in the Foul Bay THA, however, some sockeye salmon may be harvested in the Northwest Afognak Section (Figure 8). Sockeye salmon harvested between July 6th and July 25th will count towards the 15,000 fish threshold level as indicated in the North Shelikof Strait Sockeye Salmon Management Plan (5 AAC 18.363, ADF&G 1996). Wild sockeye salmon systems are not present within Foul Bay, thus, all sockeye harvested in the Foul Bay THA are attributed to the Hidden Lake enhancement project.

The Environmental Assessment of this project (Hidden Lake is part of Kodiak National Wildlife Refuge) required a sockeye salmon escapement of ~10% of the total run into Hidden Creek for Brown Bear food (KNWR 1991) This escapement requirement was discontinued in 1996; thus, all returning sockeye salmon are available for harvest (no brood stock requirements). The THA,

addressed in this management plan, will be used to harvest sockeye salmon runs produced from stocking of Hidden Lake.

The Foul Bay THA will address that area of Foul Bay east of 152° 47.12' West longitude. By regulation, the legal gear type for the THA is seine gear only.

When a harvestable surplus of enhanced sockeye salmon are documented in the THA, continuous fishing periods will be announced by ADF&G (beginning the 9 June). A weir has been deployed since 1995 to assure that the majority of Hidden Lake sockeye salmon would be harvested in the common property fishery. The ADF&G Genetics staff has expressed concern that the weir could cause fish to stray to nearby streams (Thorsheim Creek; stream number 403) and intermingle with wild sockeye stocks (J. Seeb, ADF&G, Anchorage, personal communication). Specifically, straying may increase substantially if returns arrive prior to the initial fishery opening on 9 June and are not allowed to escape into Hidden Lake Creek. In addition, fish that are not caught after 9 June may also stray since the weir will impede their migration into fresh water. Straying rates have not been evaluated for the project. Prior to installation of the weir in 1996, approximately 400 sockeye salmon escaped into Hidden Lake Creek (~ 1.2 kilometers distance from weir to barrier falls). Large build ups of sockeye have not been observed in any years in front of the weir either before or during the commercial fishery.

The ADF&G Genetics staff has recommended that the barrier weir not be used to impede returning sockeye salmon to reduce the risks of straying. We propose that the barrier weir be installed in Hidden Lake creek again in 1998 and that the straying rate of any early returns (prior to the June 9 fishery opening) and any fish not being harvested during the fishery be assessed. Currently, a proposal for this evaluation and an operation plan are being drafted. Initial plans include using the unique scale pattern (Honnold et al. *in press*) of the returning adults as a mark to identify Hidden Lake sockeye. This scale pattern is similar to that observed for Spiridon Lake sockeye where freshwater growth patterns enable easy identification of returning adults for run reconstruction (Nelson and Swanton 1997). We propose collecting scales from the nearest (~ 8-10 kilometers) sockeye salmon system to Foul Bay (Hidden Lake Creek), Thorsheim Lake (stream number 251-301), and using scale pattern analysis to identify any straying Hidden Lake sockeye. Thorsheim Lake sockeye are also an early-run stock with similar timing to the Hidden Lake returns. Thorsheim Lake sockeye will be collected at a weir or beach seined in the lake prior to entry into the spawning tributaries. This data will provide information on the number of sockeye that stray from Foul Bay when the weir is operated to prevent escapement. The barrier weir will not be installed at Hidden Lake Creek unless the ADF&G Genetics staff approves this straying research project. If the research proposal is not approved or if it is approved but not funded, then the barrier weir will not be installed. KRAA has indicated that they will fund this research in 1998.

ADF&G recognizes that some incidental harvest of natural stocks (Thorsheim Lake sockeye) could occur in this area while the fishery is managed to harvest the enhanced Hidden Lake sockeye salmon. The Department intends, however, to prevent jeopardizing the escapement of wild salmon stocks. To avoid harvest of wild stocks and target Hidden Lake sockeye salmon, the Department may need to adjust the size of the THA opened to commercial fishing. Scale patterns and ages

analysis of harvest samples have indicated minimal incidental harvest (< 2%) to date (C. Hick, ADF&G, Kodiak, personal communication).

Release Site: Crescent Lake

The purpose of the Crescent Lake stocking project is to provide enhanced sockeye salmon for harvest as they return to Settler Cove (Crescent Lake) and adequate protection for escapements of wild salmon, including Barabara Lake sockeye salmon (stream number 333) and other stocks migrating in the area (Figure 10).

The harvest of Crescent Lake sockeye salmon is expected to occur during normal fishing periods targeting early-run sockeye, pink, and chum salmon in the Central Section (statistical areas 259-36, 259-37, 259-38) of the Northwest Kodiak District (Figure 8). Special openings are not expected to occur within the THA (Settler Cove; Figure 10). The fishery opens in the Central Section of the Northwest Kodiak District on June 9 for 33 hours and again on June 14 and often remains open until July 10 (depending on the run strength of early-run Karluk Lake sockeye). In 1995 and 1996, this fishing time was sufficient to harvest all Crescent Lake returns. The THA will be opened in 1998 if large numbers of sockeye are not harvested during fishery openings in the above mentioned fishing districts and are observed in the Settler's Cove area. Brood stock collection is not required for this project so all fish will be available for harvest. A barrier net is not necessary for this project since natural barriers prevent salmon access to the lake and villagers of Port Lions utilizes all inriver escapement for subsistence purposes. Straying is not a concern for this project since fish are allowed unimpeded access to freshwater and are all harvested.

Release Site: Waterfall Lakes

The Waterfall Bay harvest strategy will allow for the harvest of enhanced sockeye salmon returning to Waterfall Bay and provide safe guards to assure that escapement goals for wild salmon stocks are met.

The sockeye salmon harvest is expected to occur in the Perenosa Bay statistical area of the Northwest Afognak Section (Figure 8). A THA is required to provide for an orderly harvest of enhanced sockeye which have migrated past the traditional commercial fishing areas of the Perenosa Bay area (Figure 11). Since escapement and brood stock are not required all returning enhanced sockeye salmon will be available for harvest. When a harvestable surplus of enhanced sockeye salmon is documented in the THA, continuous fishing periods will be announced by the Department (beginning the 9 June). A barrier seine has been deployed in the estuary just outside the terminus of Little Waterfall Creek since 1995 to assure that all Waterfall Lake sockeye salmon would be harvested. The ADF&G Genetics staff has expressed concern that the barrier seine could cause fish to stray to nearby (~ 8-12 kilometers) streams (Paul's and Portage Creeks; stream numbers 251-831 and 251-825) and intermingle with wild sockeye stocks in the event that the run arrives prior to the initial fishery opening on 9 June. In addition, fish that are not caught after 9 June may also stray to other areas if they are not allowed to escape into Little Waterfall creek. Straying

has not been documented by field staff at Paul's or Portage Creeks or other nearby systems; however, in 1996, prior to installation of the weir, approximately 6,000 sockeye salmon escaped into Little Waterfall creek and congregated at the first barrier falls ~ 0.5 kilometers upstream. These fish moved in and out of the creek on the tides and many were eventually caught in the commercial fishery.

The ADF&G Genetics staff has indicated that the barrier seine should not be used to impede returning sockeye salmon to reduce the risks of straying. We propose that the barrier net be installed again in 1998 and that the straying rate of any early returns (prior to the June 9 fishery opening) and those fish not being harvested during the fishery be assessed. Currently, a proposal for this evaluation and an operation plan are being drafted. Initial plans include using the unique scale pattern (D. Kaplan, ADF&G, Kodiak, personal communication) of the returning adults as a mark to identify Little Waterfall Lake sockeye. This scale pattern is similar to that observed for Spiridon Lake sockeye where freshwater growth patterns enable easy identification of returning adults for run reconstruction (Nelson and Swanton 1997). We propose collecting scales from the nearest sockeye salmon systems to Waterfall Bay, Portage Lake and Paul's/Laura Lake sockeye salmon, and using scale pattern analysis to identify any straying Little Waterfall Lake sockeye. Portage and Paul's/Laura Lake sockeye are also early-run stocks with similar timing to the Little Waterfall Lake returns. Portage and Paul's/Laura Lake sockeye will be collected at a weir or beach seined in the lakes prior to entry into the spawning tributaries. This data will provide information on the number of sockeye that stray from Waterfall Bay when the barrier net is operated to prevent escapement. The barrier net will not be installed at Waterfall Bay unless the ADF&G Genetics staff approves this straying research project. If the research proposal is not approved or if it is approved but not funded, then the barrier net will not be installed. KRAA has indicated that they will fund this research in 1998.

The Waterfall Bay THA will address all waters seaward of the stream terminus of stream number 251-822 (58°23'57" N.latitude, 152°30'12" W.longitude) that are within a one nautical mile arc. By regulation, the legal gear type for the THA is seine gear only.

ADF&G recognizes that some incidental harvest of wild salmon stocks (Portage and Paul's Lakes) could occur in this area while the fishery is managed to harvest the enhanced Waterfall Lake sockeye salmon. The Department intends, however, to prevent jeopardizing the escapement of wild salmon stocks. To avoid harvest of natural stocks and target Waterfall Lake sockeye salmon, the Department may need to adjust the size of the terminal area opened to commercial fishing. Wild stocks that could potentially be in the Waterfall Bay THA include Pauls (Laura) and Portage Lake sockeye stocks that have similar run timing as the Waterfall stock; all three lakes are located in Perenosa Bay (Figure 11). Scale patterns and ages analysis of harvest samples have indicated minimal incidental harvest (< 2%) to date (C. Hicks, ADF&G, Kodiak, personal communication).

Release Site: Little Kitoi Lake

The 1998 Little Kitoi Lake sockeye run will be harvested incidentally during sockeye and chum salmon fisheries in the Kitoi Bay, Izhut, and Duck Bay Sections of the Afognak District (Figure 8).

The harvest management strategy is described in the 1998 Kitoi Bay Hatchery AMP (*in press*). The LKL fish pass will remain closed to provide for commercial fishing within Little Kitoi Bay. Fish that are not harvested will be collected in freshwater at the fish pass compound and donated to charities to eliminate the potential for straying. The early sockeye run should begin in late May and continue through June (Figure 4). Commercial fishing time should occur in early June to coincide with the early part of the chum salmon run which is comprised of a high proportion of males. Additional openings may occur in the Kitoi Bay area depending upon the sockeye and chum salmon run strength and the progress of chum salmon brood stock collection. Currently, sockeye brood stock collection is not required for this project, and all sockeye returning to Kitoi Bay will be available for harvest during the brood stock transition period (late-run Upper Station stock to late-run Saltery Lake stock; ~1998-2000).

Release Site: Afognak Lake

The 1998 Afognak Lake run is likely to exceed the upper escapement goal (60,000; Table 4) and provide for commercial fishing beginning on 9 June. The enhanced portion of the run, as a result of PCH supplemental stocking, will be harvested during normal fishing periods in the Southeast Afognak Section (Figure 8). Approximately, 1,060 sockeye salmon will be required in 1998 for brood stock for fry stocking projects at Hidden, Little Waterfall, and Crescent Lakes. An escapement enumeration weir is operated at Afognak River from late May through early September to ensure adequate escapement prior to the egg take (see Escapement Goal section).

Release Site: Malina Lake

The 1998 Malina Lake run may provide the minimum escapement requirement (10,000; Table 4); however, is not expected to result in a substantial commercial harvest. A portion of the run, as a result of PCH supplemental stocking, will be harvested during normal fishing periods in the Southwest and to a lesser extent in the Northwest Sections of the Afognak District (Figure 8). If a harvestable surplus occurs at Malina Lake and it appears that optimum escapement levels (lower goal - 10,000; mid-point goal - 15,000; upper goal - 20,000) will be exceeded, inseason closed water adjustments for Malina Lakes systems will occur. Approximately, 530 sockeye salmon may be required for brood stock in 1998 if egg-take criteria are met as determined by the escapement level (see Escapement Goal section). A salmon enumeration weir will be operated at the Malina Lake (lower lake) outlet from late May through early August to ensure adequate escapement prior to an egg take.

Release Site: Laura Lake

If the 1998 sockeye salmon run is projected to exceed the optimum goal (30,000; Table 4) at the Laura Lake system, the surplus sockeye will be harvested during normal fishing periods in the Perenosa Bay area of the Northwest Afognak District (Figure 8). Inseason closed water adjustments in Paul's Bay may occur if it appears that minimum escapement levels (20,000) will not be reached.

Approximately, 530 sockeye salmon may be required for brood stock in 1998 if egg-take criteria are met as determined by the escapement level (see Escapement Goal section). A salmon enumeration weir will be operated at the Paul's Lake (Laura Lake is upstream of Paul's Lake) outlet from late May through early September to ensure adequate escapement prior to an egg take.

Release Site: Spiridon Lake

In 1995 the Department reduced the size of the Spiridon Bay THA opened to commercial fishing to avoid harvest of natural stocks and/or target more discretely on Spiridon Lake sockeye salmon (Figure 12). As the fishery evolves, additional adjustments may be necessary.

The Spiridon Bay harvest strategy is designed to allow for the harvest of enhanced sockeye salmon returning to Spiridon Lake (Telrod Cove; Figure 12) and to provide adequate protection for escapements of wild salmon stocks returning to streams in the area (Spiridon River sockeye, pink, chum, and coho salmon; stream number 401). The original intent of this enhancement project was for the harvest of the returning enhanced salmon to occur in traditional commercial fishing areas of the Northwest Kodiak District during openings directed to harvest Karluk Lake sockeye and west-side pink and chum salmon stocks (Figure 8). A THA, however, is required to provide for an orderly harvest of enhanced sockeye which have migrated past the traditional commercial fishing areas of the Northwest Kodiak District. A series of falls prevents salmon from entering Spiridon Lake and a barrier seine has been used since 1995 to prevent sockeye salmon from entering Telrod Creek and to provide for increased availability for harvest. The ADF&G Genetics staff believes that the barrier seine may cause fish to stray to nearby streams (Spiridon River) and intermingle with wild salmon stocks. The effect of the barrier net on straying has not been documented; in 1994 when the barrier net was not installed, ~ 5,000 sockeye were observed below the first barrier falls ~ 0.5 kilometers upstream. The fishery in the THA was not open continuously (6 hour openings) in 1994 when the initial return of Spiridon Lake bound fish occurred; fish likely escaped during fishery closures. A portion of these fish were eventually harvested since they moved in and out of the creek. The fishery in the THA has been open continuously since 1995 as soon as the first sockeye returned.

The barrier net can not be installed at Telrod Cove unless the ADF&G Genetics staff approves a comprehensive straying research project. If such a research proposal is not approved or if it is approved but not funded, then the barrier net can not be installed. Currently, an evaluation is being planned for Hidden and Little Waterfall Lake enhanced sockeye returns in 1998 to assess the impact of barrier weir/nets to influence straying to wild sockeye salmon systems. This type of evaluation for Spiridon Lake sockeye would be problematic due to the low numbers of sockeye that escape into the nearest wild salmon system (Spiridon River). Enumeration and sampling of these fish would be difficult unless a weir were installed. KRAA has indicated that they prefer not to incur additional cost for evaluation of the Spiridon Lake enhancement project at this time. Consequently, we propose that the barrier net not be installed in 1998 and that foot survey estimates be used to evaluate the number of sockeye salmon that escape into Telrod Creek. Stream markers should be set in the location where the barrier seine was previously deployed to assure that

intertidal habitat is not disturbed. Straying research may be proposed in the future to enable use of the barrier net if substantial sockeye escape the commercial fishery in 1998.

In 1995, by emergency order regulation and in 1996 by normal regulation (5 AAC 18.366; ADF&G 1996), the Spiridon Bay THA, was reduced in size to include all waters of Telrod Cove north of a line extending from Stream Point at 57° 39' 00" N. latitude, 153° 38' 30" W. longitude, to the opposite shore at 57° 38' 48" N. latitude, 153° 37'42" W. longitude. When a harvestable surplus of enhanced sockeye salmon is documented in the THA, a continuous fishing period will be announced by the Department. Terminal harvest openings will be coordinated, if possible, to occur at the beginning of fishing periods scheduled for management sections in the Northwest Kodiak District. By regulation, the legal gear type for the THA is seine gear only.

ADF&G recognizes that some incidental harvest of wild stocks could occur in this area while the fishery is managed to harvest the enhanced Spiridon Lake sockeye salmon. The Department intends, however, to prevent jeopardizing the escapement of wild salmon stocks; specifically those that return to Spiridon River. Brood stock for this project were collected at Saltery Lake in 1994 on an experimental basis; in 1997 this stock was approved as the primary brood source for the project. The run timing of Saltery Lake stock sockeye is approximately three weeks earlier than the previous brood source (late-run Upper Station sockeye). Therefore, returns in 1998 are expected to begin in late June and extend until mid-September as result of the overlap of the two brood stocks. Harvest management will begin in late June when the field camp will be opened for monitoring the run and will continue until the run is over in September.

Release Site: Jennifer Lake

The 1998 Jennifer Lake run will be harvested incidentally during pink and coho salmon fisheries in the Kitoi Bay, Izhut Bay, and Duck Bay Sections of the Afognak District (Figure 8). The harvest management strategy is described in the 1998 Kitoi Bay Hatchery AMP (*in press*).

Jennifer Lake is not anadromous; a barrier falls prevents salmon migration into the lake; however, they may enter freshwater into the outlet creek. Brood stock will not be collected in 1998 and all salmon will be available for harvest.

The run timing is expected to be similar to the late-run sockeye returns to the Kitoi area (Figure 3b).

General Conditions of Harvest Management, 1998

The primary objective of PCH is to provide salmon for common property fisheries. It is recognized that a joint effort among ADF&G and KRAA is necessary to continue the operation of the hatchery at full production levels.

The ADF&G Kodiak Area Management Biologist will manage the overall fishery based on runs of wild stocks. Enhanced sockeye salmon are expected to be harvested incidental to fisheries targeting

other stocks unless otherwise specified in terminal harvest areas or when simple closed waters adjustments at terminal areas are announced.

When brood stock are taken from spawning systems with established escapement requirements, the number of fish used will not reduce the wild salmon spawning population below the minimum escapement goals for that system (see Escapement Goal section).

It is the goal of KRAA to develop a late-run brood stock for egg takes at Little Kitoi Lake (Hall et al. *in press*). Little Kitoi Lake will be stocked with Saltery Lake presmolt each year, beginning in 1999, to provide annual returns to the lake by 2001 and 2002. Eggs from these adults will provide juveniles for stocking Spiridon and Ruth Lakes.

Terminal Harvest Area Description , Conditions, and Harvest Strategies: Enhanced Runs

THA's will be used as a management tool for harvesting sockeye salmon runs at Spiridon (Telrod Cove), Hidden (Foul Bay), and Waterfall (Waterfall Bay) Lakes in 1998. The Settler Cove (Crescent Lake) THA may be used if excess sockeye salmon are observed in Settler Cove; however, the majority of the harvest is expected to occur during normal fishing periods in the Central Section of the Northwest Kodiak District.

PCH does not require Special Harvest Areas (SHA) for cost recovery harvests at this time. There may be situations that arise that will require cost recovery of salmon in the above areas (economic, brood stock, or price dispute considerations); therefore, KRAA has proposed that the THA's should also be designated as SHA's (KRAA *in press*).

Cost recovery fisheries in the THA's (proposed SHA's) that utilize barrier nets/weirs have been suggested as a mechanism to reduce the potential for straying in the event that a large number of the enhanced early-run sockeye return prior to the initial commercial net fishery on 9 June or if price disputes delay fishing effort on 9 June and thereafter. Consequently, if large numbers of sockeye return before 9 June or if commercial net fishing activities do not occur within 48 hours of the initial announced fishery opening on any enhanced sockeye build up, KRAA will implement one of the following options, at their discretion, to reduce the risk of straying: 1) the barrier nets/weirs used to prevent excessive stream escapement and provide a build up of sockeye for harvest will be removed to allow free access to fresh water; natural barriers will prevent lake access. When fishing activity commences the barrier net will be re-installed. 2) Cost recovery fisheries will be initiated and conducted so they are consistent with normal common property daily harvest level expectations for system specific forecasted returns. Fishing effort will correspond with the on site estimates of run strengths. KRAA will administer harvest operations in a similar manner as was implemented for the Kitoi Bay special cost recovery project in 1989. In that instance, as many fish as possible were harvested in as short a period as feasible to maintain an orderly fishery. KRAA is in the process of drafting a detailed plan for implementation of cost recovery fisheries for their enhancement projects (L. Malloy, KRAA, Kodiak, personal communication). KRAA funded ADF&G crews will be located at each cost recovery site to monitor and document that the fisheries are implemented to address straying concerns.

Enhanced sockeye salmon returning to Spiridon Lake will be harvested in the west side pink salmon fishery and in special openings in Telrod Cove (THA). A run of 255,000 sockeye salmon is projected for 1998 (123,000 if returns mirror the 3-ocean dominant Saltery Lake stock); none are expected to be necessary for brood stock, escapement, or cost recovery (all should be available for harvest). Cost recovery may be an option in the future in a portion of the THA or the entire THA. The designation of a SHA has been proposed by KRAA (KRAA *in press*).

Harvest information will be monitored through the ADF&G fish harvest ticket information collected from each buyer. Scale samples will be taken from 240 adult fish per week (600 total) from the Telrod Cove openings. A total of 600 scale samples will be collected per week either at the Port of Kodiak or from the commercial catch from the westside Kodiak Districts in a coordinated effort between Development and Research Sections of ADF&G. These samples provide age composition and scale pattern identification of Spiridon Lake bound sockeye and are used to determine what components of the sockeye harvests in the Northwest Kodiak District (Uganik Bay, Uyak Bay) and Southwest Afognak District are Spiridon Lake fish.

Hidden Lake sockeye salmon will be harvested in the Foul Bay THA. A run of 13,000 sockeye salmon is projected for 1998; none are expected to be necessary for brood stock, escapement, or cost recovery (all should be available for harvest). The run timing and location of the fishery (THA) provides for an isolated harvest of returning adults; thus, providing a high level of certainty in project harvest contribution.

Waterfall Lake sockeye salmon will be harvested during normal commercial fishing periods in Perenosa Bay and in the Waterfall Bay THA. A run of approximately 28,000 sockeye salmon is projected for 1998; none are expected to be necessary for brood stock, escapement, or cost recovery (all should be available for harvest). The run timing and location of the fishery (THA) provides for an isolated harvest of returning adults; thus, providing a high level of certainty in project harvest contribution.

Harvest information from salmon runs at Foul and Waterfall Bays will be monitored through the ADF&G fish harvest ticket information collected from each buyer. Scale samples will be collected by Development section personnel from 240 adult fish per week (600 total) at each location during normal fishing periods. These samples provide age composition and baseline scale pattern data of the sockeye bound for each project location and are used to verify project harvest contribution.

Crescent Lake sockeye salmon runs will be harvested in the Central Section of the Northwest Kodiak District. Special openings in the Settler Cove (Crescent Lake) THA are not anticipated. A run of 14,000 sockeye salmon is projected in 1998; none will be needed for brood stock, escapement, or cost recovery (all will be available for harvest).

Harvest information from the sockeye salmon run at Crescent Lake will be monitored through the ADF&G fish harvest ticket information collected from each buyer. Currently, a scale sampling program is not planned in 1998. The project harvest contribution is provided by assigning all THA catch as Crescent Lake produced sockeye. The run timing and location of the fishery (THA)

provides for an isolated harvest of returning adults; thus, providing a high level of certainty in project harvest contribution. Subsistence harvest is assigned through the ADF&G subsistence use reporting system. In addition, Port Lions residents provide estimates of the harvest to the ADF&G through interviewing of community members participating in the fishery.

Other Harvest Areas Description , Conditions, and Harvest Strategies: Enhanced Runs

Little Kitoi Lake early-run and Jennifer Lake late-run sockeye salmon will be harvested in the Kitoi, Izhut and Duck Bay Sections of the Afognak District incidentally during the common property salmon fishery. A run of 18,000 early-run and 7,000 late-run sockeye salmon are projected to return in 1998 as result of lake stocking at these sites; all of the returning salmon (Upper Station origin) will be available for harvest. Brood stock escapements are not required until the year 2001 or 2002 (depending on whether the majority return after two or three years ocean residence) when sockeye of Saltery stock are be expected to return to Kitoi Bay.

Harvest information from these sockeye salmon runs will be monitored through the ADF&G fish ticket harvest information collected from each buyer. An adult sampling program will be conducted in 1998 to identify each stock by scale pattern analysis. In addition, a portion of the early-run fish stocked in Little Kitoi Lake were finclipped prior to release; the harvest of adult sockeye returning to Little Kitoi Lake will be examined for finclips and apportioned to estimate the early and late runs.

Harvest Areas Description , Conditions, and Harvest Strategies: Rehabilitated Runs

The 1998 Afognak Lake run will be harvested during normal fishing periods in the Southeast Section of the Afognak District.

The 1998 Malina Lake run will be harvested in the Southwest and to a lessor extent in the Northwest Sections of the Afognak District.

If a harvestable surplus of sockeye salmon occurs at Laura Lake, they will be harvested during normal fishing periods in the Perenosa Bay area of the Northwest Afognak Section.

Sockeye salmon from Afognak Lake will be required for brood stock in 1998 and may be required from the Malina and Laura Lakes stocks if escapements at each are below threshold levels and require continued rehabilitation and collection of eggs (See Below).

REHABILITATION CRITERIA

ADF&G staff from the Westward Region developed preliminary criteria in 1998 to assist hatchery operators and biologists with planning for rehabilitation projects. These criteria are intended to

determine when a sockeye salmon system may be a candidate for a rehabilitation program. The policy also defines when a system under-going rehabilitation should be considered restored; thus, ending active restoration work (fertilization, stocking, etc.).

The following criteria were established: A sockeye salmon system may be a candidate for rehabilitation work when escapement is less than 75% of the minimum goal for four years during a six year period. Meeting this criteria does not mandate a rehabilitation project; however, indicates that the system should be considered for rehabilitation feasibility assessment. A minimum of one, and preferably two years, of pre-rehabilitation assessment should be conducted to determine the appropriate options for restoration. Stocking projects should only include site-specific releases (egg take from the system and juveniles released back into the same system) and continue for no more than two consecutive life cycles (~ 8-10 years). This stocking period allows for initial low stocking numbers during the first few years when egg-take goals are not met due to not finding adequate brood stock or when escapement levels allow very small egg takes. A system will be considered restored when 75% or more of the mid-point escapement goal is reached four years during a six year period, as long as escapement is not less than 75% of the lower goal for two consecutive years during the six years.

For example, Malina Lake sockeye salmon stock would be considered restored when escapement levels were \geq to 11,250 ($15,000 \cdot 0.75$) for four years during a six year period as long as the escapement was not $<$ 7,500 ($10,000 \cdot 0.75$) for two consecutive years during the six years. Paul's/Laura Lake sockeye salmon stock would be restored when escapement levels were \geq to 22,500 ($30,000 \cdot 0.75$) for four years during a six year period as long as the escapement was not $<$ 15,000 ($20,000 \cdot 0.75$) for two consecutive years during the six years.

The primary rationale for these criteria is to provide guidelines to determine when a rehabilitation program is needed. Specifically, to define (for a given system) a level of escapement which may not provide adequate recruitment of juveniles, and in turn, may continue to reduce production over the long term. The time periods outlined are meant to correspond with the average life cycle of sockeye salmon stock. If less than 75% of the lower escapement goal is not being reached for a life cycle, then declining returns from this recruitment level would be expected to continue indefinitely without restoration work. This same rationale applies to when a system is considered restored. If the mid-point escapement goal is reached for one sockeye life cycle, then it is reasonable to assume that recruitment will be sufficient to enable future production at levels to meet escapement goals and provide for a harvestable surplus of fish.

Malina and Laura Lakes have been fertilized annually since 1991 and 1993, respectively, as part of a rehabilitation strategy to re-establish sockeye salmon stocks to levels in which escapement goals will be met and surplus fish will be available for harvest. In addition, as part of this restoration program, juvenile sockeye salmon were backstocked into Malina Lake, from 1992-1997 and into Laura Lake from 1994-1996. These rehabilitation programs were initiated using different criteria than identified in this plan (Clevenger et al. 1997); the new criteria described above will be used to determine the end points for restoration projects.

ESCAPEMENT GOALS, BROOD STOCK REQUIREMENTS, AND EGG-TAKE CRITERIA, 1998

Early and late-run sockeye salmon biological escapement goals (BEG), minimum escapement goals allowing for egg takes, and projected brood numbers proposed by PCH in 1998 are described in Table 4.

Egg-take criteria for enhancement projects (outstocking at barriered lakes) were established prior to initial egg takes to assist hatchery operators in planning brood stock collection from a particular sockeye salmon system (Honnold and Clevenger 1995; Clevenger et al. 1996; Clevenger et al. 1997). These criteria apply to the Afognak Lake early-run brood stock and the Saltery Lake late-run brood stock and were designed to protect and maintain these sockeye salmon runs.

The lower range of the Biological Escapement Goal (BEG) for Afognak Lake is 40,000 sockeye salmon (Malloy and Prokopowich 1992; Brennan et al. 1996). Approximately 50% of the escapement in excess of the minimum goal (40,000) will be available for brood stock collection. Eggs will not be collected if escapement is less than 40,000 salmon. Afognak Lake is the early-run sockeye salmon brood source for 1998 egg takes to provide fry for stocking at Hidden, L. Waterfall, and Crescent Lakes in 1999. A total of ~1,060 Afognak Lake sockeye salmon will be required in 1998 for PCH enhancement projects.

Egg-take criteria were established prior to the initial egg takes at Malina and Laura Lakes in 1991 and 1993, respectively, to assure protection of these sockeye salmon stocks. These criteria are described in Honnold and Clevenger (1995); Clevenger et al. (1996); and Clevenger et al. (1997). Egg-take criteria for rehabilitation projects were revised by ADF&G in 1998 to clarify and fine-tune guidelines for hatchery operators to assist with planning stocking projects. Specifically, when planning for a sockeye salmon egg take at a particular system for rehabilitation of that stock the following criteria will be followed: if escapement is less than 10% of the lower (minimum) goal, an egg take will not be allowed. Escapement levels in excess of 10% of the lower (minimum) goal up to 75% of the mid-point goal will allow an egg take. Fifty percent (50%) of the escapement within this range may be used for brood stock.

For example, if sockeye salmon escapement at Malina Lake is $> 1,000$ ($10,000 \cdot 10$) but $< 11,250$ ($15,000 \cdot 75$), then an egg take could proceed. If the escapement is 5,000, then 2,500 (50%) could be used for brood stock. Similarly, if sockeye salmon escapement at Paul's/Laura Lake is $> 2,000$ ($20,000 \cdot 10$) but $< 11,250$ ($15,000 \cdot 75$), then an egg take could proceed. If the escapement is 5,000, then 2,500 (50%) could be used for brood stock.

A total of 530 Malina Lake and 530 Laura Lake sockeye salmon may be required in 1998 for these rehabilitation projects.

Saltery Lake sockeye replaced Upper Station as the late-run brood source in 1997 for fry stocking at Spiridon and Ruth Lakes (barriered systems). In addition, this stock (1997 BR) will be used to stock Little Kitoi Lake (April presmolt) in 1999 for sockeye brood stock development at Kitoi Bay

Hatchery (Hall et al. *in press*). Approximately 4,600 Saltery Lake sockeye salmon will be necessary in 1998 for brood stock to continue the Spiridon and Ruth Lakes projects. The lower range of the BEG for Saltery Lake is 20,000 sockeye salmon (Malloy and Prokopowich 1992; Brennan et al. 1996). Approximately 50% of the escapement in excess of the minimum goal (20,000) will be available for brood stock collection. Eggs will not be collected if escapement is less than 20,000 salmon.

Buskin River coho salmon are used for Kodiak road system stocking and for school incubation projects. Approximately 100 adult coho salmon will be needed for brood stock in 1998. The lower range of the escapement goal for the system is 5,300 coho salmon. Thus, 50% of the escapement over 5,300 is available for brood collection. Brood collection will not occur if the escapement falls below the minimum goal.

ADDITIONAL MEASURES FOR WILDSTOCK PROTECTION

Genetics Policy

Currently, the ADF&G Genetics policy is being revised (D. Moore, ADF&G, Anchorage, personal communication). The present policy is designed to assure that stocking projects do not negatively impact the genetic integrity of wild stocks (McGee 1995). The policy addresses three primary areas: 1) *stock transport*; 2) *protection of wild stocks*; and 3) *maintenance of genetic variance*.

Stock transport concerns include interstate, inter-regional, and regional transport. The latter applies to PCH programs and specifies that the donor stocks must be phenotypically matched to the environment at the stocking site and to management goals. Water chemistry, temperature profiles, time of spawning, and fry emergence should be matched with the hatchery environment. Also, the distance of transport should be considered - the longer the distance, the greater risks of straying and the likelihood of poor results.

All stocks transported for PCH projects are local Kodiak Island stocks (Afognak, Malina, Laura, and Saltery Lakes; Figure 1) and have been approved in the past for transport by the FTP process. Afognak Lake stocks are used for enhancement at systems on Afognak Island; Malina Lake stock is used for rehabilitation at Malina Lake; Laura Lake stock is used for rehabilitation at Laura Lake; and Saltery Lake stock is used for enhancement at Spiridon Lake and Ruth Lake.

Protection of wild stocks emphasizes that the hatchery fish straying and intermingling with wild stocks should be minimized. Unique or significant wild stocks should be identified to determine sensitive areas of movement. Rehabilitation and enhancement of significant stocks can only be conducted by stocking of indigenous progeny; gametes can only be removed, raised at a hatchery, and returned to the donor system with one generation of separation. Also, some drainage's should be considered gene reservoirs and only stocked with indigenous progeny and a conservative sliding egg-take removal schedule applied. Lastly, fish releases where no interaction with, or impact on significant stocks and are not for the purpose of development, enhancement or rehabilitation of a

stock will not be restricted by genetic concerns (release for terminal harvest or in landlocked lakes).

The PCH stocking programs have addressed straying of hatchery fish and intermingling with wild fish by proper imprinting of juveniles to lake systems. When concerns that imprinting may have not been sufficient (age-0 sockeye releases at Little Kitoi Bay), marking programs have been conducted to identify potential straying to wild stock systems (Hall et al. 1997; Hall et al. *in press*). Returning adults from barriered lake stocking projects (Hidden, Waterfall, Crescent, Spiridon, Ruth Lakes) are harvested in terminal harvest areas where continuous fishing occurs from the start to the end of the runs. Previously, (1995-1997) barrier nets/weirs have been used to prevent escapement and assure total harvest of the runs. The barrier nets will be installed in 1998 and we propose that nearby systems (see Sockeye Harvest and Management section) be monitored for any straying, which could occur if the runs return early or if some fish are not harvested during commercial fishing periods. The only exception may be at Telrod Cove (Spiridon Lake THA) where we propose discontinuing the use of a barrier net if a straying evaluation is determined to not be feasible (Spiridon River is the nearest system but the sockeye run may be too small to evaluate). Each of the THA's have terminal streams where any escaping sockeye salmon can enter and proceed upstream (when barrier nets/weirs are not in place) to reduce straying risks. Cost recovery may be considered in the future to provide for harvest of fish that may return prior to the initial fishery opening on 9 June or during commercial fishery price disputes. The wild stocks nearest each enhancement project are as follows: Spiridon River salmon - Spiridon Lake project; Thorsheim Lake sockeye salmon - Hidden Lake project; Paul's/Laura and Portage Lakes sockeye salmon - L. Waterfall Lake project; and Barbara Lake sockeye salmon - Crescent Lake project.

Malina and Laura Lake sockeye salmon rehabilitation projects are stocked with progeny from indigenous stocks. Gametes are removed, incubated and reared at PCH, and returned to the donor systems as juveniles the following year.

Maintenance of genetic variation and diversity among and within hatcheries and from donor stocks states that a single donor stock cannot be used to establish or contribute to more than three hatchery stocks. Also, off-site release for terminal harvest rather than development or enhancement of a stock do not apply if such releases are selected so that they do not impact significant wild stocks, wild stock sanctuaries or other hatchery stocks. Lastly, a minimum effective population (N_e) of 400 should be used for brood stock development; and to ensure that all segments of the run have the opportunity to spawn, sliding egg-take scales for donor stock transplants will not allocate more than 90% of any segment of the run for brood stock. Note: currently, the Principal Geneticist recommends that the minimum number of spawning pairs used for an egg take should be \geq to 120 fish or 60 pair for a population of ~ 1,000 fish; the number of fish/pairs decreases with a decrease in the population size (J. Seeb, ADF&G, Anchorage, personal communication).

The PCH program will abide by this policy when collecting eggs and stocking juveniles in 1998 and 1999. Afognak Lake sockeye salmon early-run donor stock will be used for outstocking at barren lakes (Hidden, Waterfall, and Crescent Lakes) to continue production of adults for terminal harvest in THA's. Afognak Lake will be used as a contingency stocking location for excess Afognak Lake fry in 1998 that resulted from higher fry survivals than anticipated as well as due to

the results of limnological studies at the outstocking sites that indicated zooplankton populations will not support the planned number of juveniles. Future use of Afognak Lake for contingency stocking will only occur if the stocking capacity of the barren lakes is reduced substantially inseason as a result of the limnology studies. Egg takes at Afognak Lake will be conservative to enable achieving stocking goals at the barren lakes and to avoid the production of excess juveniles that would require contingency stocking. The limnology studies at Afognak Lake will aid in determining the appropriate number of juveniles that may be stocked if, due to unplanned inseason circumstances, excess fry are produced. Sallery Lake sockeye salmon late-run stock will be used to stock Spiridon and Ruth Lakes to continue terminal harvests of adults. Malina and Laura Lake sockeye salmon stocking (egg takes) are dependent upon the escapement levels at each system and whether egg-take criteria are met (see preceding section). The adults used at each of the four brood stock collection sites will be selected from all segments of the runs when possible. Limnological studies will also determine stocking levels if escapements suggest continued rehabilitation is needed. Lastly, genetic baseline data have been collected from all prior and ongoing donor stocks to enable future identification of adults if concerns arise that have not been adequately addressed (Appendix J).

Policies and Guidelines for Health and Disease Control

The State of Alaska Pathology Review Committee has developed a long range goal to prevent dissemination of infectious finfish (and shellfish) disease within or outside the borders of Alaska (McGee 1995). This goal is intended to protect stocks without constraining aquaculture or stock renewal programs. The policy and guidelines do not advocate transplanting wild finfish stocks between geographic zones in attempt to minimize risk of transporting disease from one zone to another. In addition, this policy includes hatchery stocks in order to be consistent with the Genetics policy. Some exceptions may be made on a case by case basis.

The specific criteria to control disease transmission for hatchery operations apply to: A) Wild fish transplants - transplant of adult fish to a watershed barren of a salmonids, transplant of juvenile fish to a watershed barren of salmonids, transplant of adults, juveniles or eggs to a watershed containing other significant stocks of salmonids, transplants to a hatchery; B) Brood stock screening for egg takes - egg takes at a hatchery, egg takes at a site remote from a hatchery; C) Disease history of juvenile fish prior to release at the hatchery sites, returns to system of origin, to barren systems, to systems with other significant stocks of salmonids, and remote salt water releases for terminal fisheries; D) Transfer between hatcheries of eggs and fish. The specific disease considerations for the above (A-D) include sampling recommendations and disease criteria are listed in **Section C (pages 16-31) of the Hatchery Program and Protection of Wild Salmon in Alaska: Policies and Regulations** (compiled by McGee 1995).

The ADF&G also has a policy for sockeye salmon culture for hatchery operations to limit the hatchery mortality caused by Infectious Hematopoietic Necrosis Virus (IHNV; McGee 1995). *This policy addresses hatchery water supplies, species mix within a hatchery, equipment, supplies, and personnel movement, egg-take procedures, isolation of stocks, incubation and rearing, and transplanting of sockeye salmon.*

The above policies and guidelines have been followed by PCH and will continue to be applied in 1998 and 1999. Appendix K describes the historical sockeye salmon disease screening sampling efforts and results for KMA donor stocks.

SPECIAL STUDIES/RESEARCH

Spiridon Lake sockeye salmon run reconstruction will be conducted using scale pattern analysis. Stock identification is required to quantify the Spiridon Lake sockeye component of the catch because multiple stocks migrate along Kodiak's westside. The number of Spiridon Lake sockeye salmon commercially harvested in the NW and SW Kodiak Districts from 1994-1996 were estimated using a unique freshwater scale pattern (Nelson and Barrett 1994; Nelson and Swanton 1996b). Approximately 387,000 Spiridon Lake sockeye salmon were harvested in 1996. The 1997 run reconstruction is incomplete at this writing and is due for completion in May 1998. The contribution of Spiridon Lake sockeye salmon to the 1998 westside commercial fishery (NW and SW Kodiak Districts) will be estimated and reported on by December 31, 1998. Funding for this project will be provided by KRAA.

Smolt abundance will be estimated and samples collected for age and condition during their emigration from Spiridon Lake and Malina Lakes as a check on stocking density and to assist with run forecasts. Smolt will also be sampled for condition and age at all other systems stocked with juvenile sockeye salmon. Lake sampling will be conducted to evaluate zooplankton abundance and water quality parameters. The majority of lakes will be monitored by tow netting and hydroacoustics to evaluate juvenile sockeye population trends.

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Table 1. Sockeye salmon egg takes (1997), planned releases (1998), projected returns (2001-2002), and fish transport permits (FTP), Kodiak Management Area.

Lake	Egg take		Releases ^a			Adult Returns ^b			FTP			
	eggs	adults	Number	size (g)	Date	2001	2002	Total	Number	Expires	Maximum No.	Life Stage
Early Run (ER) : Donor Stock Afognak Lake									88A1021	9/15/97	10,000,000	G.Eggs/Fry
Hidden	450,000	300	0	0.50	June	0	0	0	91A0017	12/31/96	2,700,000	Fry
			250,000	12.5	October	12,500	18,750	31,250	97A0075	8/31/98	150,000	Presmolt
L.Waterfall ^c	500,000	350	300,000	12.50	October	16,875	20,625	37,500	97A0076	8/31/98	200,000	Presmolt
Crescent	600,000	400	400,000	0.50	June	7,200	8,800	16,000	91A0022	12/31/97	1,700,000	Fry
L.Kitoi	0	0	0	12.50	October	0	0	0	96A0069	12/31/02	150,000	Presmolt
Sorg	0	0	0	4.0-12.5	August;October	0	0	0	94A0037	7/31/99	150,000	Presmolt
			0	>12.5	May	0	0	0	New FTP Required			Smolt
Afognak ^c	800,000	550	500,000	<4.0	July	6,375	8,625	15,000	88A1021	9/15/97	10,000,000	G.Eggs/Fry
			50,000	12.50	October	2,150	2,850	5,000	New FTP Required			Presmolt
Total:	2,350,000	1,600	1,500,000			45,100	59,650	104,750				
Early Run: donor stock Malina Lake									96A0070	12/31/02	1,500,000	G.Eggs
Malina ^c	700,000	470	200,000	2.00	July	3,450	2,550	6,000	96A0071	12/31/02	250,000	Fingerling
			250,000	12.50	October	14,375	10,625	25,000	97A0078	8/31/98	200,000	Presmolt
Total:	700,000	470	450,000	15		17,825	13,175	31,000				
Late Run (LR): donor stock Saltery Lake									97A0071	8/31/98	9,800,000	G.Eggs
Spiridon	4,700,000	2,700	3,500,000	0.25	June	35,000	105,000	140,000	97A0072	8/31/98	7,000,000	Fry
Ruth	0	0	0	0.25	June	0	0	0	97A0073	8/31/98	300,000	Fry
Total:	4,700,000	2,700	3,500,000			35,000	105,000	140,000				
Total ER:	3,050,000	2,070	1,950,000			62,925	72,825	135,750				
Total LR:	4,700,000	2,700	3,500,000			35,000	105,000	140,000				
Grand Total:	7,750,000	4,770	5,450,000			97,925	177,825	275,750				

^a Expected releases in 1998 are based upon current estimates of juveniles in PCH and lake capacity per 1997 limnology data.

^b Returns are based on standard juvenile to adult survival assumptions (Appendix C) and adult age compositions observed to date for escapement and harvests.

^c Stocking levels are contingent on continued lake enrichment in 1998.

Table 2. Coho salmon egg takes (1997), planned releases (1998), projected returns (2000, 2001), and fish transport permits (FTP), Kodiak Management Area.

Lake	Egg take ^a		Releases			Adult Returns ^b		FTP			
	eggs	adults	Number	size	Date	2000	2001	Number	Expires	Maximum No.	Life Stage
Mayflower			13,000					93A0106	12/31/03	13,000	Fry
Island			45,000					93A0107	12/31/03	45,000	Fry
Dark			15,000					93A0108	12/31/03	15,000	Fry
Mission			24,500					93A0109	12/31/03	24,500	Fry
Potato Patch			19,000					93A0110	12/31/03	19,000	Fry
Southern			7,000					93A112	12/31/03	7,000	Fry
Pony			4,200					93A111	12/31/03	4,200	Fry
Total Road System	150,000	100	127,700			1,720	190	93A0105	12/31/03	150,000	G.Eggs
Scientific Ed.	3,000	2	600			8	1	94A0038	2/28/99	3,000	G.Eggs
								P98002	12/31/98	50	Fry
								P98010	12/31/98	200	Fry
								P98051	12/31/98	100	Fry
								P98052	12/31/98	100	Fry

^a Donor stock: Buskin River; assume 85% egg-to-fry survival.

^b Assume 90% of adults return as age 1.1 fish; 10% as age 2.1 fish (Len Schwarz, personal communication).

Table 3. Proposed sockeye salmon egg takes (1998), planned releases (1999), projected returns (2002-2003), and fish transport permits (FTP), Kodiak Management Area.

Lake	Egg take		Releases			Adult Returns ^a			FTP			
	eggs	adults	Number	size (g)	Date	2002	2003	Total	Number	Expires	Maximum No.	Life Stage
Early Run (ER): donor stock Afognak Lake									<i>New FTP Required</i>			
Hidden	600,000	400	150,000	0.50	June	2,400	3,600	6,000	New FTP Required			
			250,000	12.5	October	12,500	18,750	31,250	New FTP Required			
L. Waterfall	600,000	400	350,000	12.50	October	19,688	24,062	43,750	New FTP Required			
Crescent	500,000	260	400,000	0.50	June	7,200	8,800	16,000	New FTP Required			
Afognak ^b									New FTP Required			
Total:	1,700,000	1,060	1,150,000			41,788	55,212	97,000				
Early Run: donor stock Malina Lake									<i>96A0070</i>	<i>12/31/02</i>	<i>1,500,000</i>	<i>G.Eggs</i>
Malina	800,000	530	300,000	0.50	June	5,175	3,825	9,000	New FTP Required			
			200,000	12.50	October	11,500	8,500	20,000	New FTP Required			
Total:	800,000	530	500,000			16,675	12,325	29,000				
Early Run: donor stock Laura Lake									<i>New FTP Required</i>			
Laura	800,000	530	300,000	0.50	June	2,400	3,600	6,000	New FTP Required			
			200,000	12.50	October	8,000	12,000	20,000	New FTP Required			
Total:	800,000	530	500,000			10,400	15,600	26,000				
Late Run (LR): donor stock Saltery Lake									<i>New FTP Required</i>			
Spiridon ^c	8,000,000	4,460	6,000,000	0.30	July	60,000	180,000	240,000	New FTP Required			
Ruth	400,000	180	300,000	0.25	May	3,000	9,000	12,000	New FTP Required			
Total:	8,400,000	4,640	6,300,000			63,000	189,000	252,000				
Total ER:	3,300,000	2,120	2,150,000			68,863	83,137	152,000				
Total LR:	8,400,000	4,640	6,300,000			63,000	189,000	252,000				
Grand Total:	11,700,000	6,760	8,450,000			131,863	272,137	404,000				

^a Returns are based on standard juvenile to adult survival assumptions (Appendix C) and adult age compositions observed to date for escapement and harvests.

^b If egg-fry survivals are greater than expected, excess fry may be stocked into Afognak Lake (donor system) if limnology analysis limits stocking the excess fry into the barren lakes; contingent upon continued lake enrichment.

^c Saltery Lake has been the primary brood source since 1997.

^d Analysis of inseason zooplankton trends may reduce egg-take goals and stocking numbers.

Table 4. Biological escapement goals, egg-take criteria, and projected brood numbers required for 1998 sockeye salmon egg takes.

Donar Stock ^a	Biological Escapement Goal Range	Egg-take Criteria		Brood Stock Required
		Allowable Escapement Range	Allowable Proportion Within Range	
Afognak Lake	40,000-60,000	>40,000	50%	1,060
Malina Lake	10,000-20,000	1,000 - 11,250	50%	530
Laura Lake	20,000-40,000	2,000 - 15,000	50%	530
Saltery Lake	20,000-40,000	>20,000	50%	4,637

^a Afognak Lake is the early-run brood source for enhancement projects at Hidden, Waterfall, and Crescent Lakes. Malina and Laura lakes are depressed anadromous early-run systems being rehabilitated. Saltery Lake is the late-run brood source for enhancement projects (barriered lakes) at Spiridon and Ruth Lakes.

Table 5. Proposed coho salmon egg takes (1998), planned releases (1999), projected returns (2001,2002), and fish transport permits (FTP), Kodiak Management Area.

Lake	Egg take ^a		Releases			Adult Returns ^b		FTP			
	eggs	adults	Number	size	Date	2000	2001	Number	Expires	Maximum No.	Life Stage
Mayflower			13,000					93A0106	12/31/03	13,000	Fry
Island			45,000					93A0107	12/31/03	45,000	Fry
Dark			15,000					93A0108	12/31/03	15,000	Fry
Mission			24,500					93A0109	12/31/03	24,500	Fry
Potato Patch			19,000					93A0110	12/31/03	19,000	Fry
Southern			7,000					93A112	12/31/03	7,000	Fry
Pony			4,200					93A111	12/31/03	4,200	Fry
Total Road System	150,000	100	127,700			1,720	190	93A0105	12/31/98	150,000	G.Eggs
Scientific Ed.	3,000	2	600			8	1	New FTP Required	New FTP Required	New FTP Required	

^a Donor stock: Buskin River; assume 85% egg-to-fry survival.

^b Assume 90% of adults return as age 1.1 fish; 10% as age 2.1 fish (Len Schwarz, personal communication).

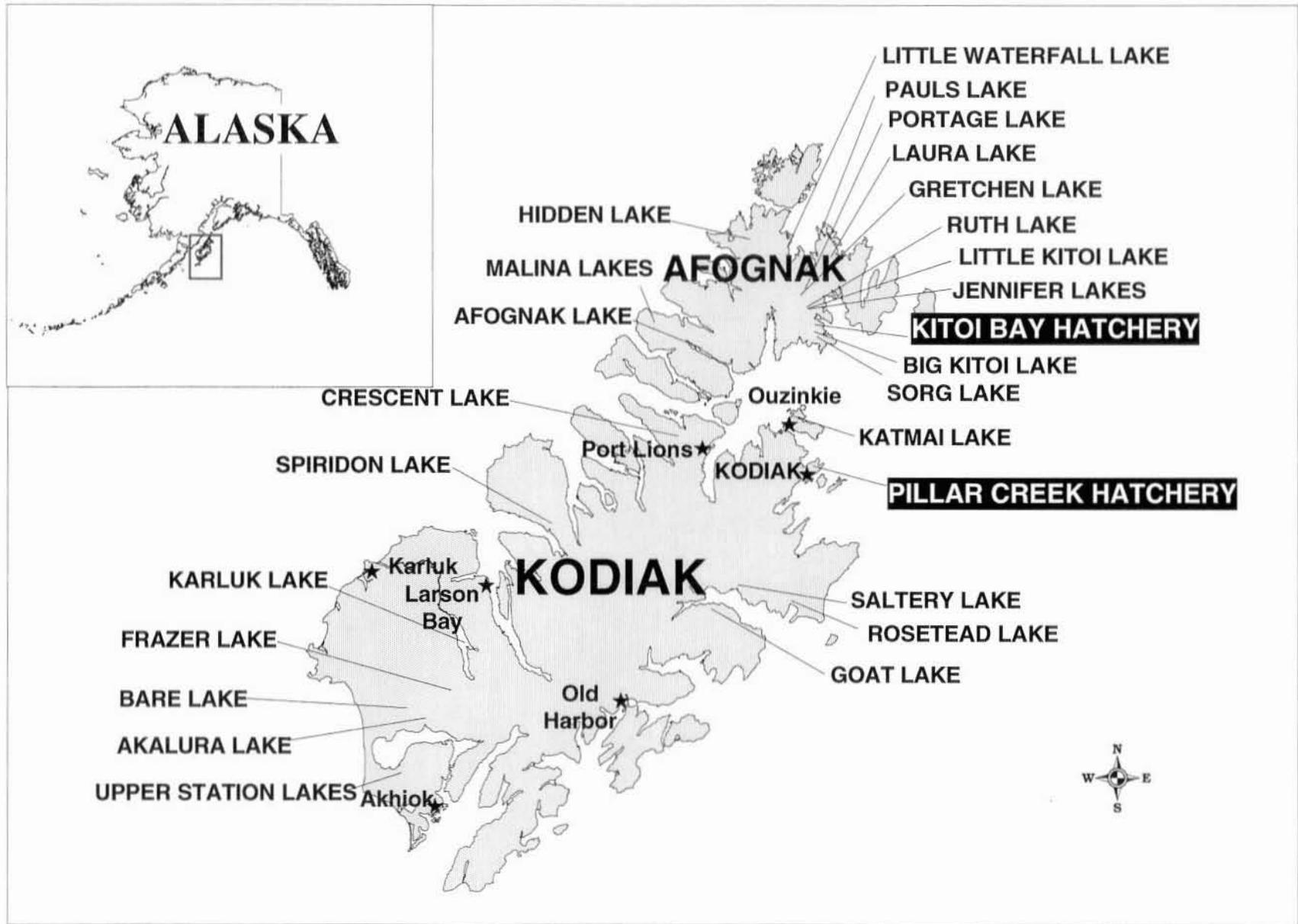


Figure 1. Locations of sockeye salmon enhancement and rehabilitation projects on Kodiak and Afognak Islands, 1951-1998.

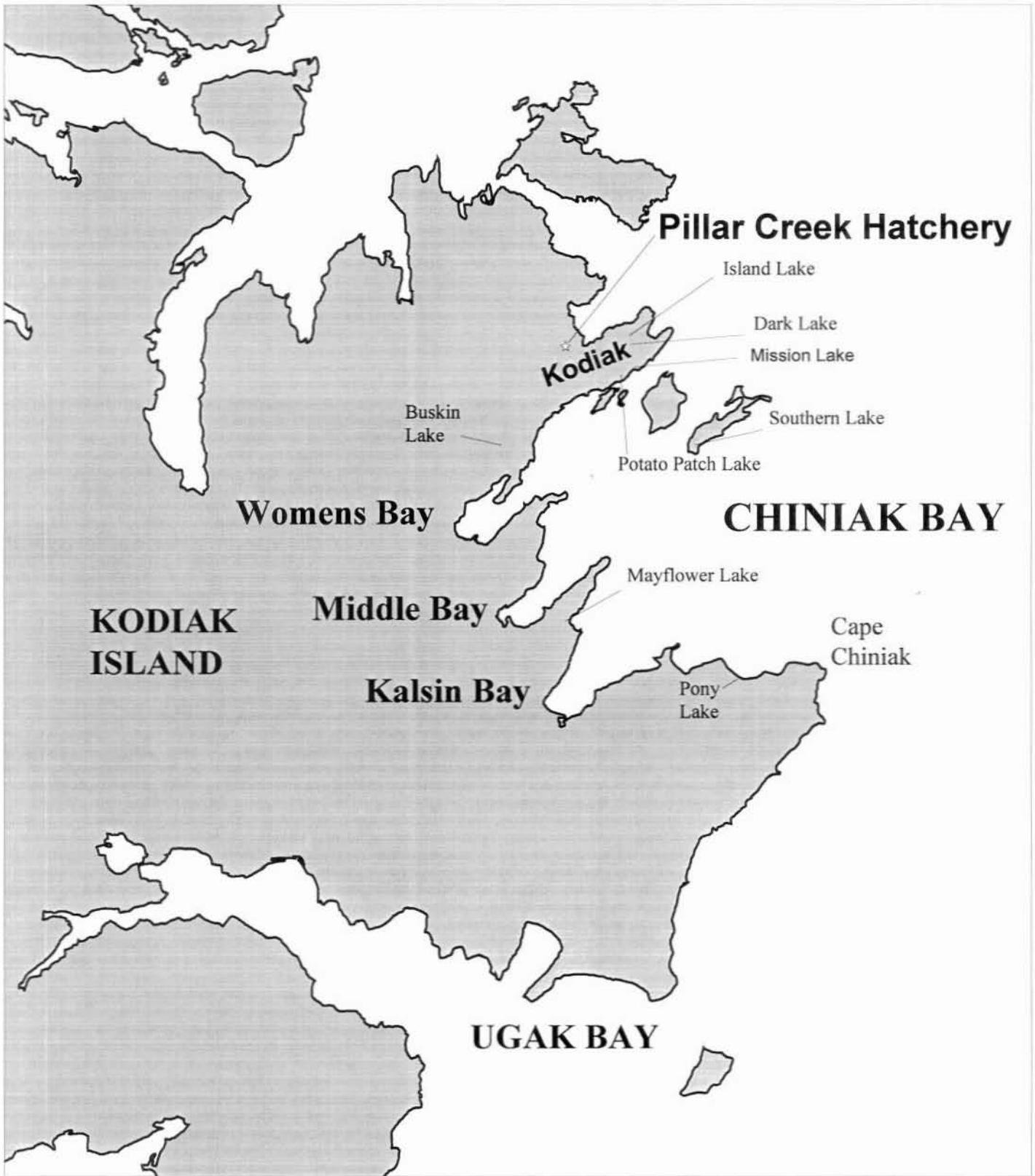


Figure 2. Locations of Kodiak Island road system lakes stocked with coho salmon.

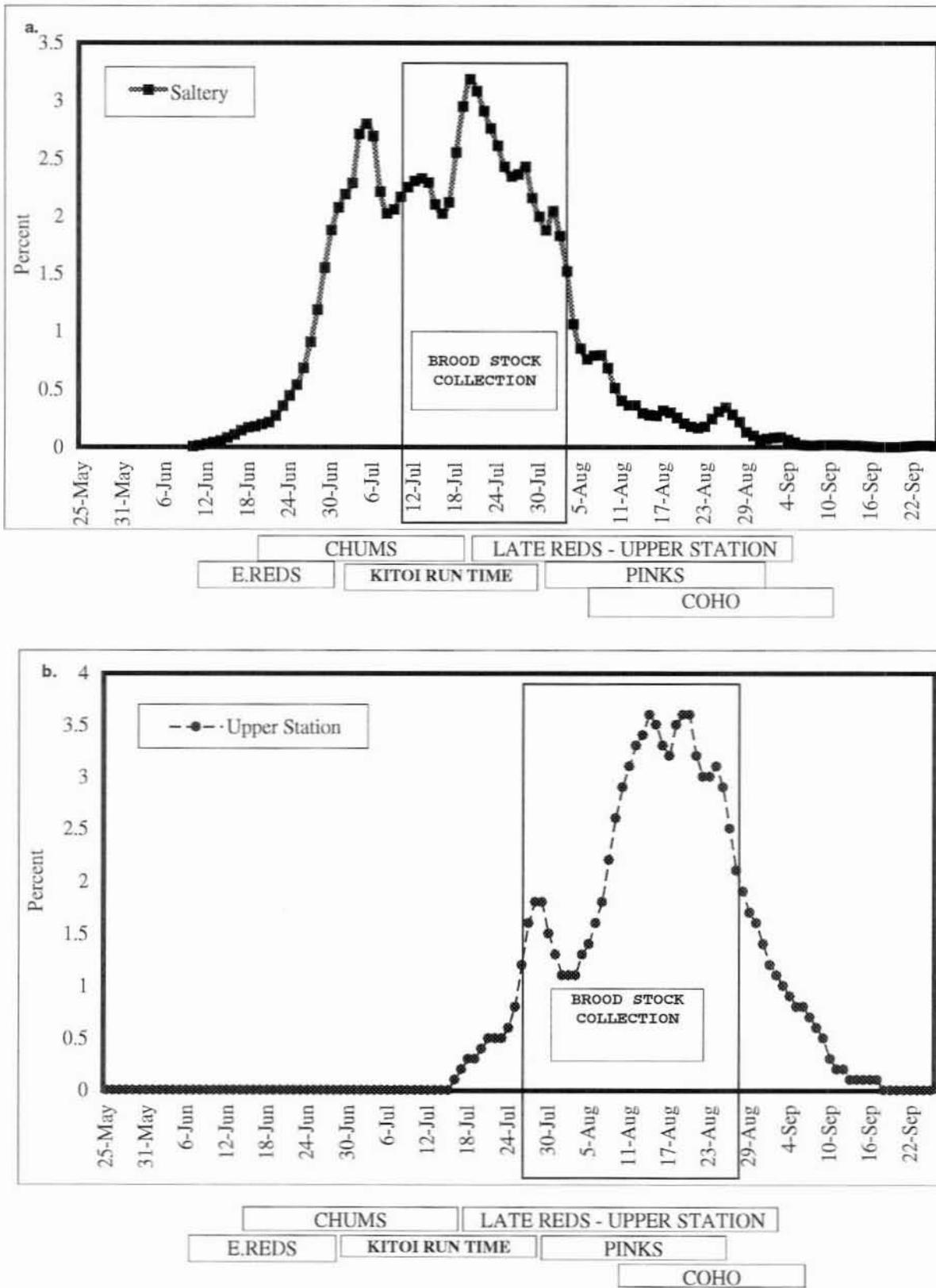


Figure 3. The run timing of salmon stocks in the Kitoi Bay Terminal Harvest Area compared to the late run Saltery sockeye salmon broodstock collection (a) and late run Upper Station sockeye salmon broodstock collection (b).

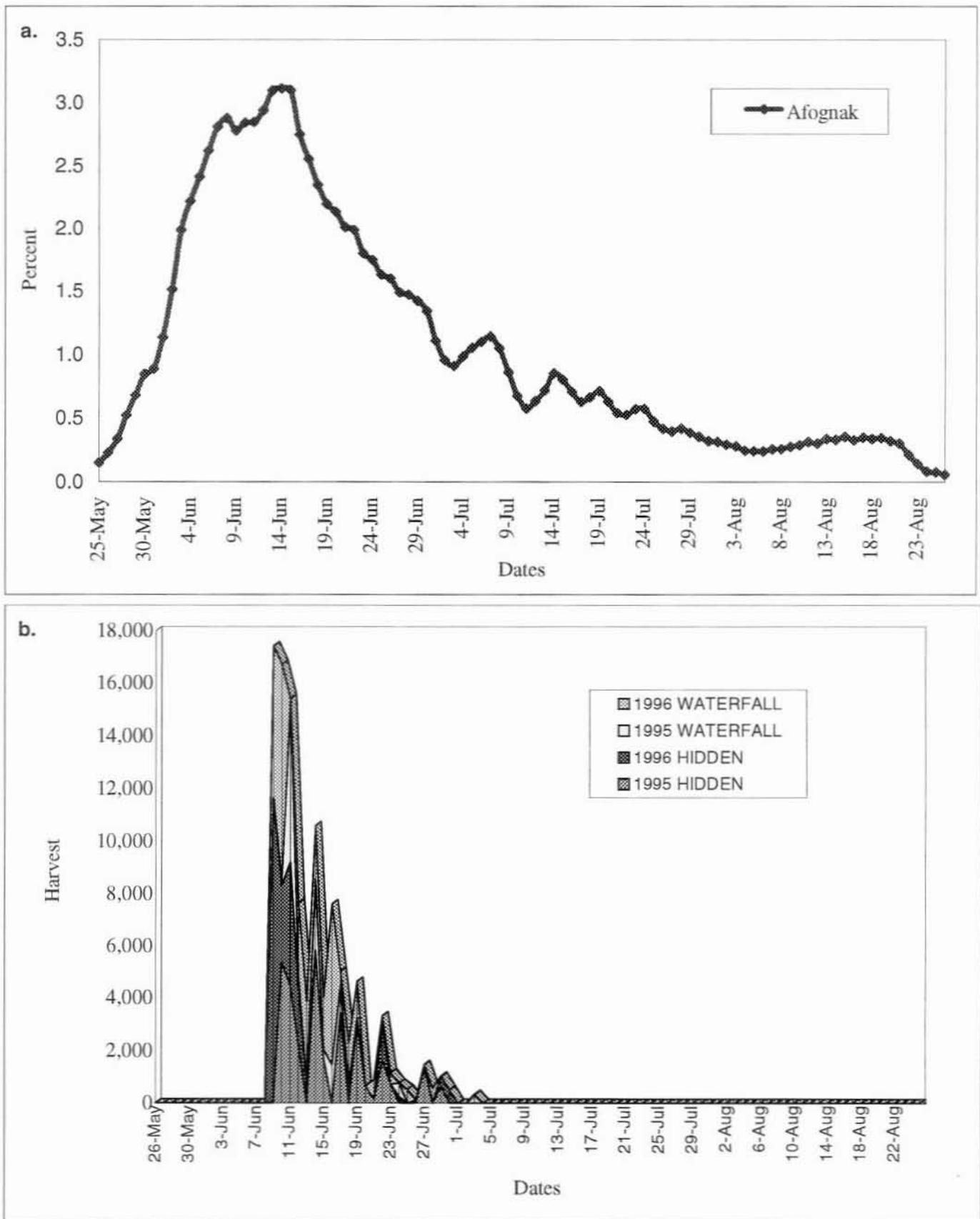


Figure 4. The post June Afognak Lake (AL) escapement has a large component of sockeye age 1.1, 1.2 and 2.1 that are not readily accessible for brood stock (Nelson and Swanton 1996b). The compressed harvest (b) as compared to the brood stock run timing (a) can be attributed to the brood stock selection and the timing of fishing periods in the terminal harvest areas.

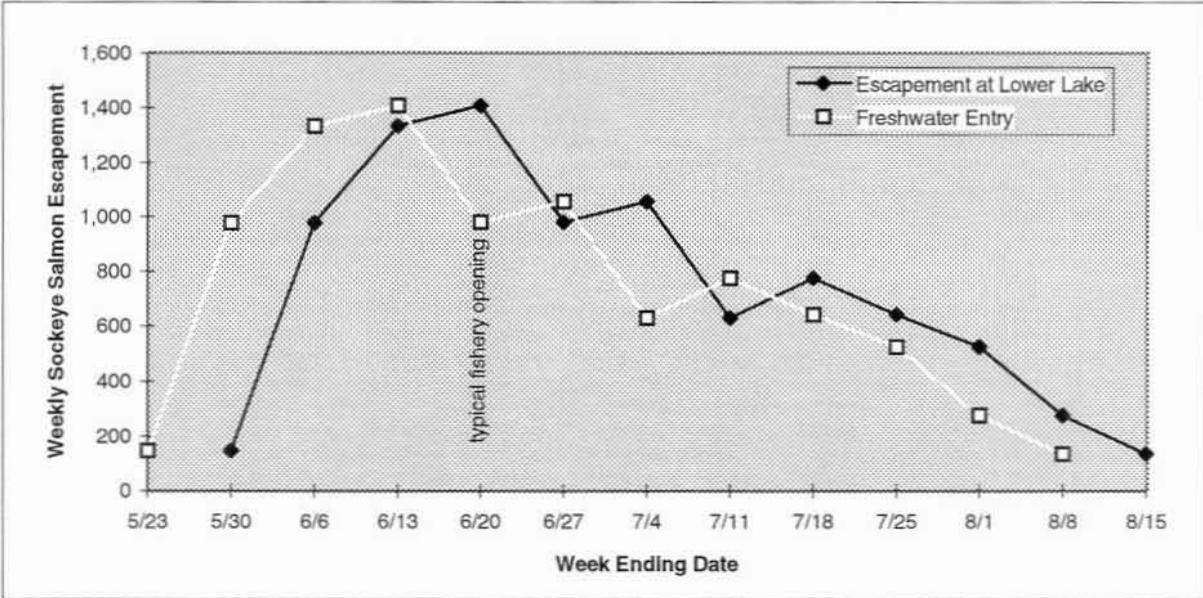


Figure 5. Malina Lake sockeye salmon escapement timing at the lower lake outlet and estimated time of freshwater entry, averaged by week, 1992-1997.

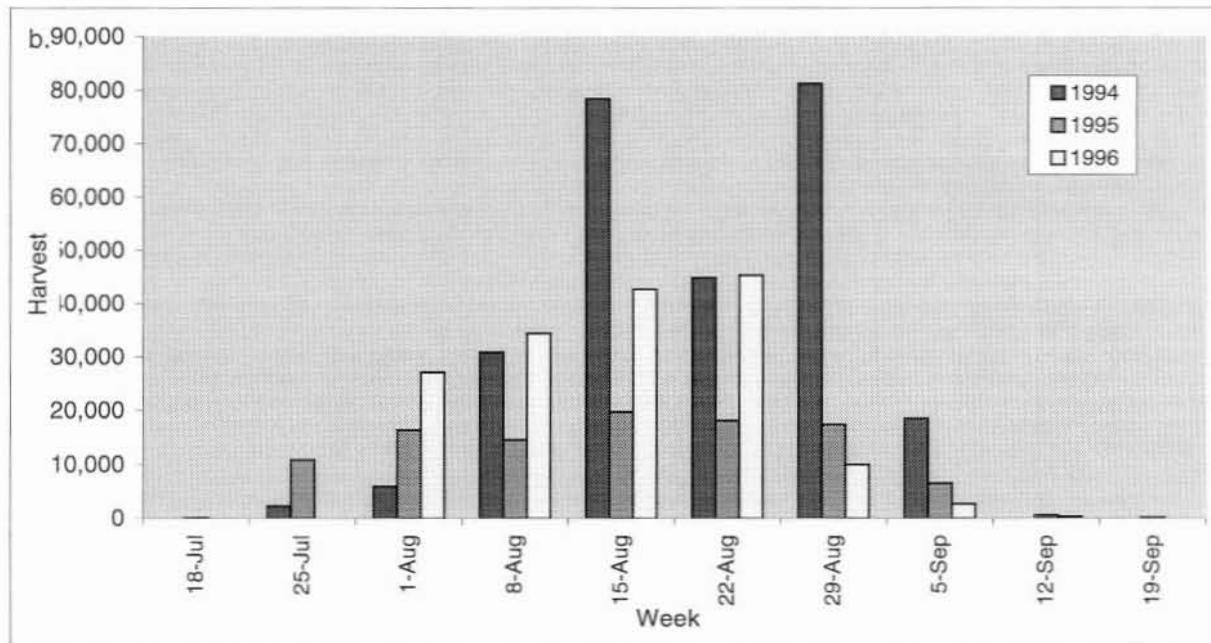
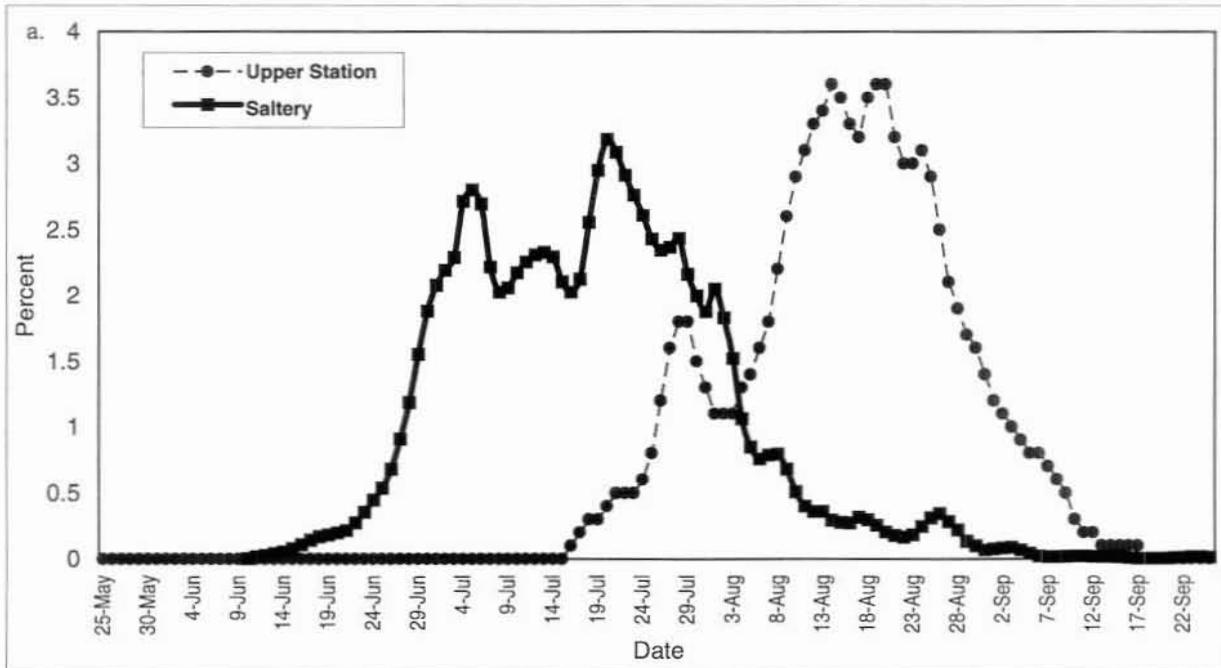


Figure 6. Sockeye salmon escapement timing into Upper Station and Saltery Lakes (a), and commercial harvest timing of Spiridon bound sockeye, 1994 - 1996 (b).

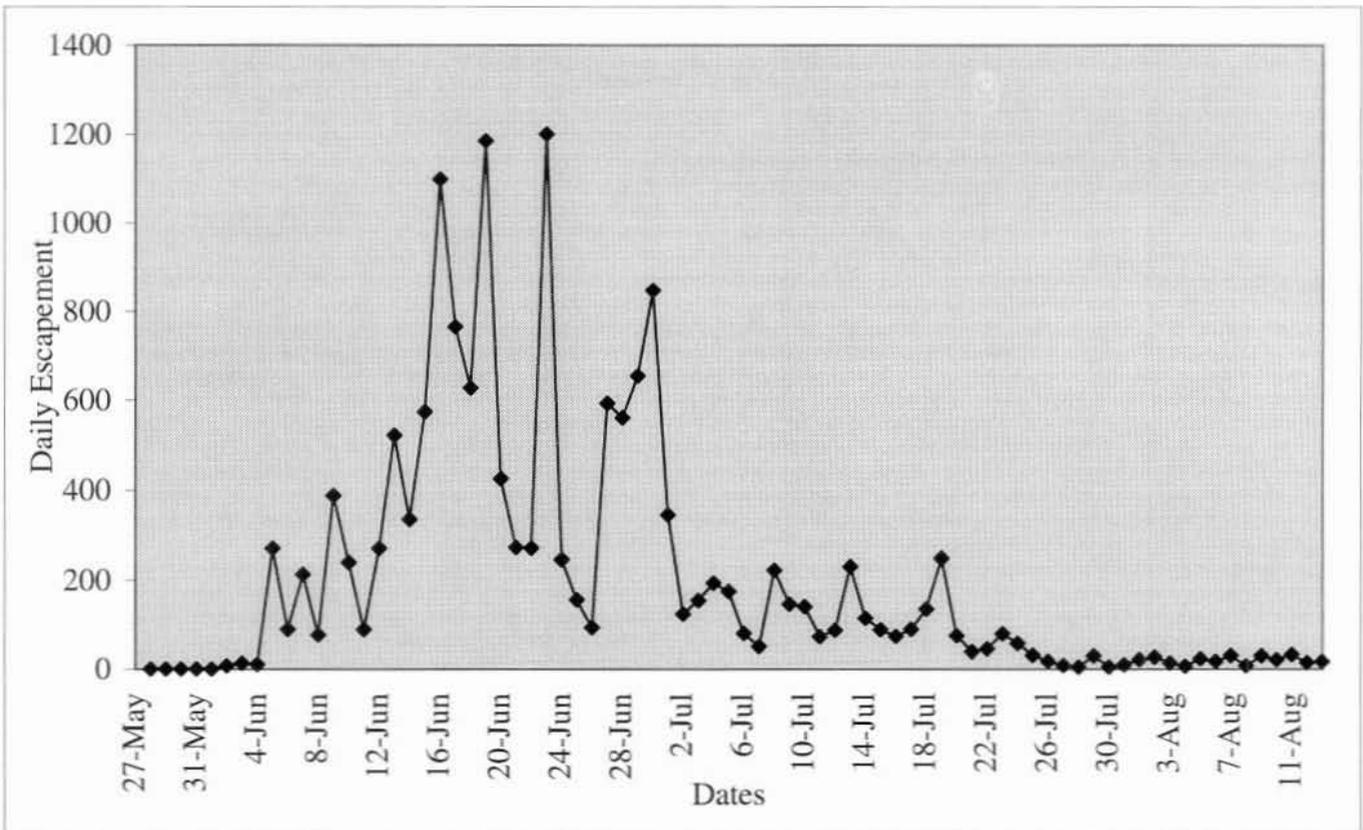


Figure 7. Laura Lake sockeye salmon escapement timing averaged by day, 1987 -1996.

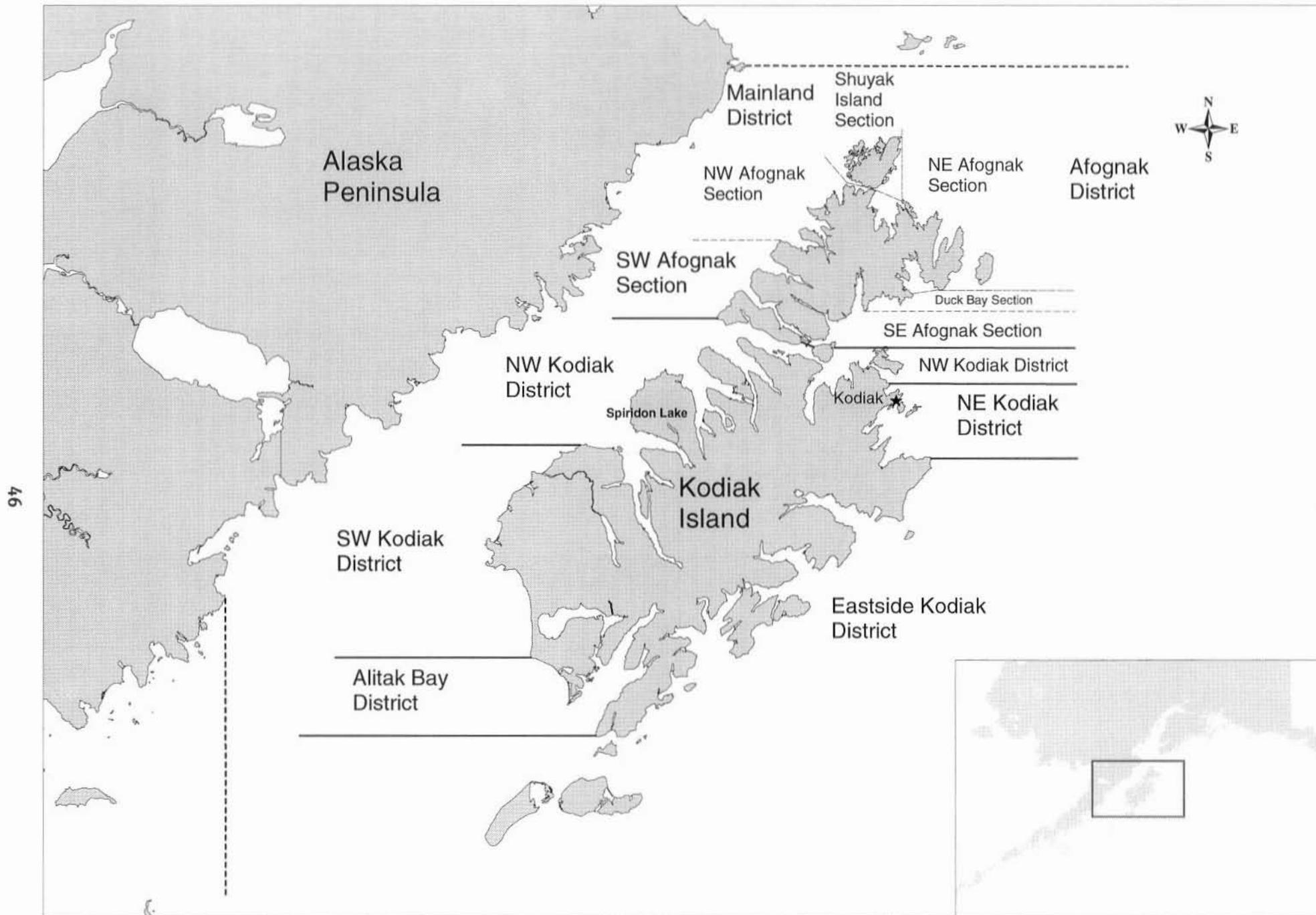


Figure 8. Map of the Kodiak Management Area depicting commercial fishing districts and selected sections.

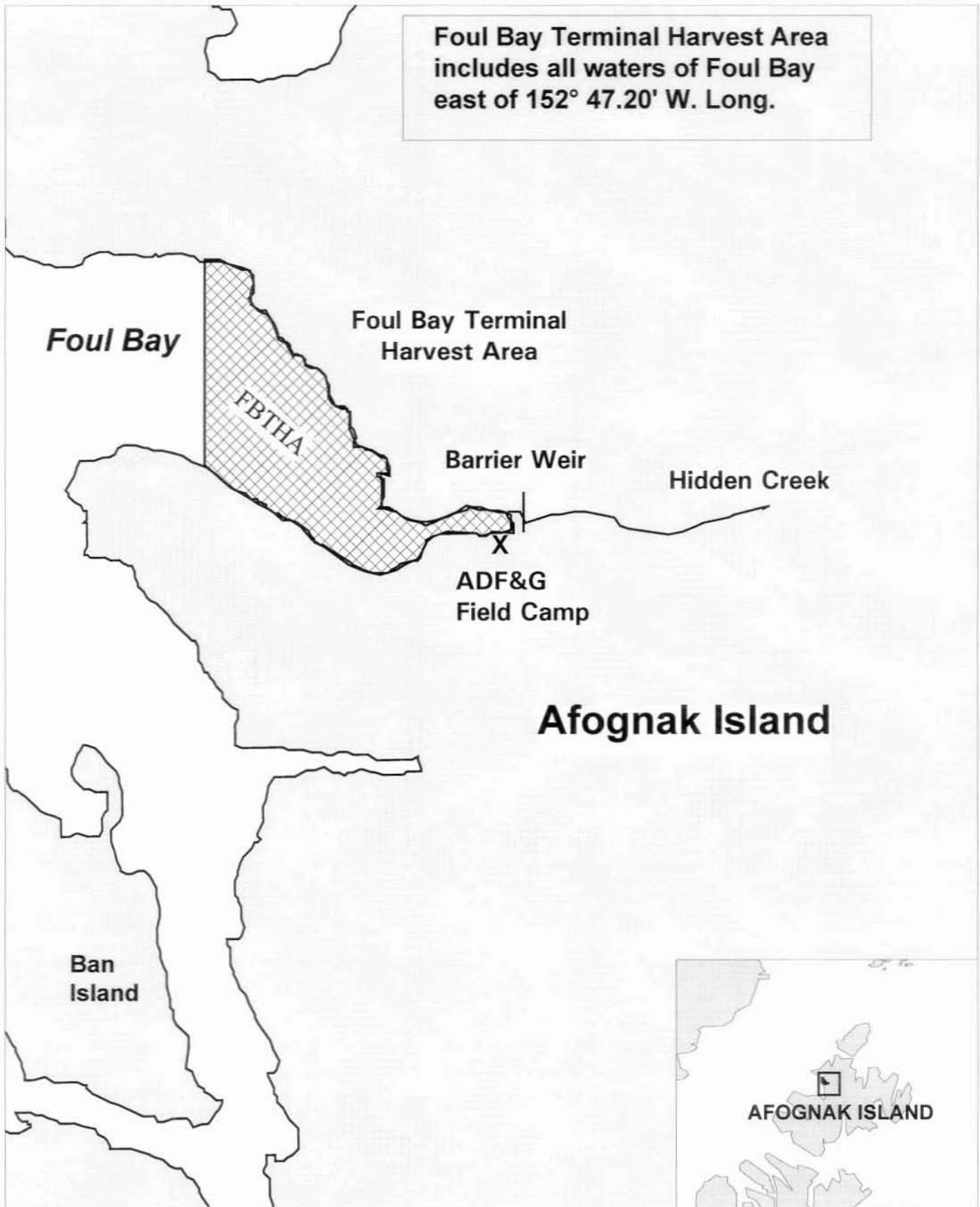


Figure 9. Foul Bay (Hidden Lake) Terminal Harvest Area (FBTHA) boundaries, ADF&G camp and barrier weir location, 1997.

Settler Cove Terminal Harvest Area includes all waters of Settler Cove west 152 50' 80" W. Long.

Kodiak Island

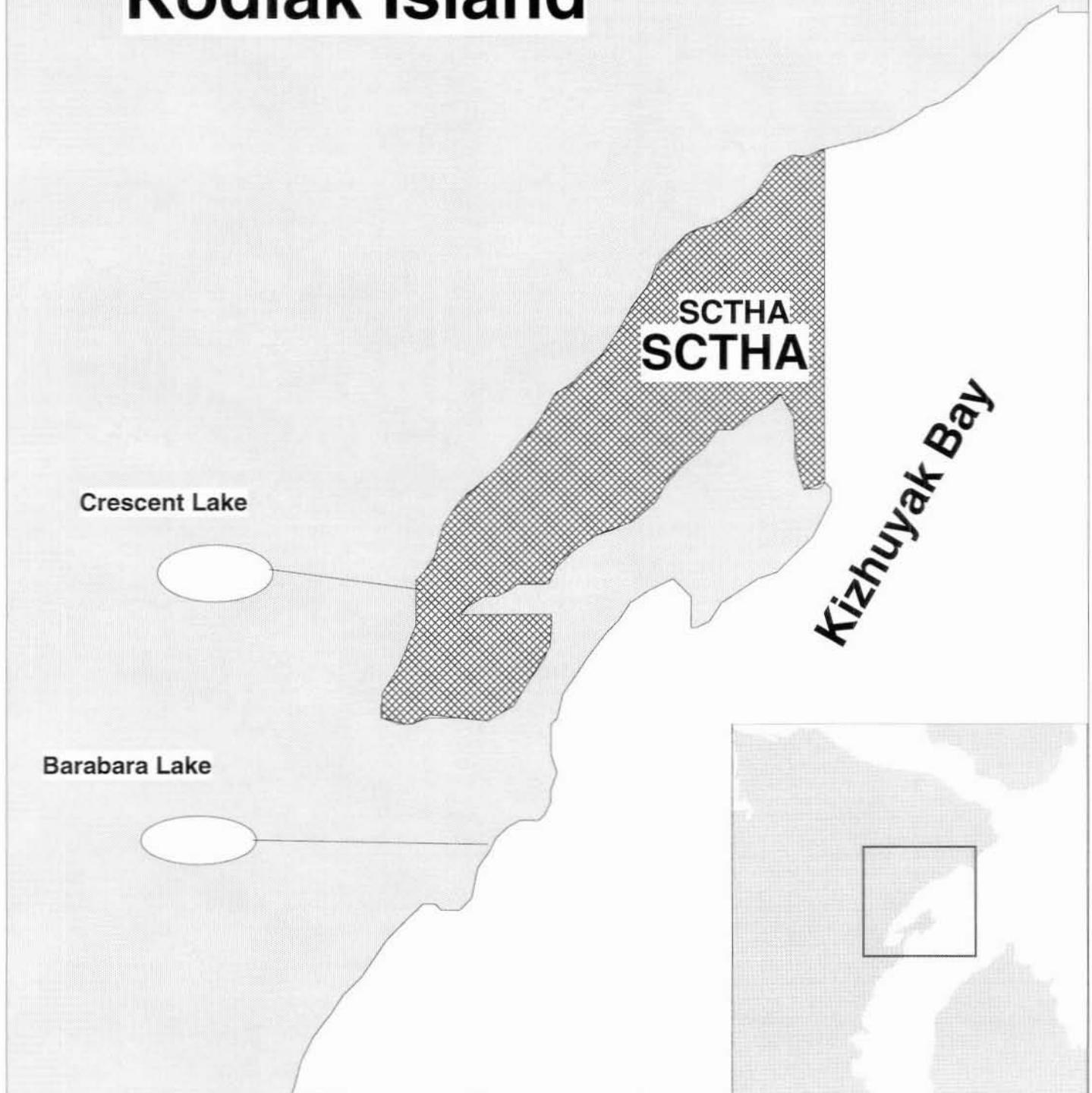


Figure 10. Settler Cove (Crescent Lake) Terminal Harvest Area (SCTHA) boundaries in Kizhuyak Bay, 1997.

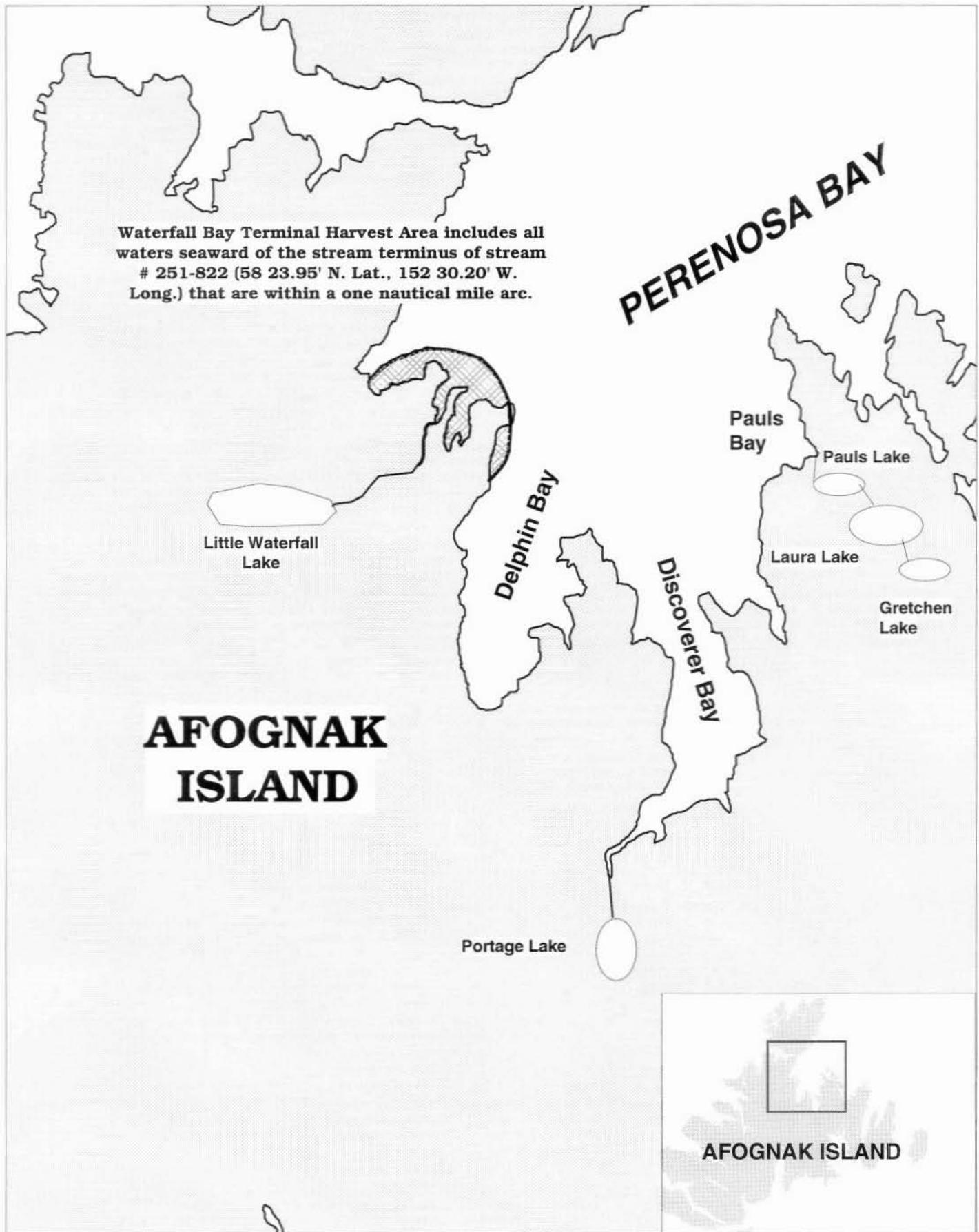


Figure 11. Waterfall Bay (Little Waterfall Lake) Terminal Harvest Area, 1997.

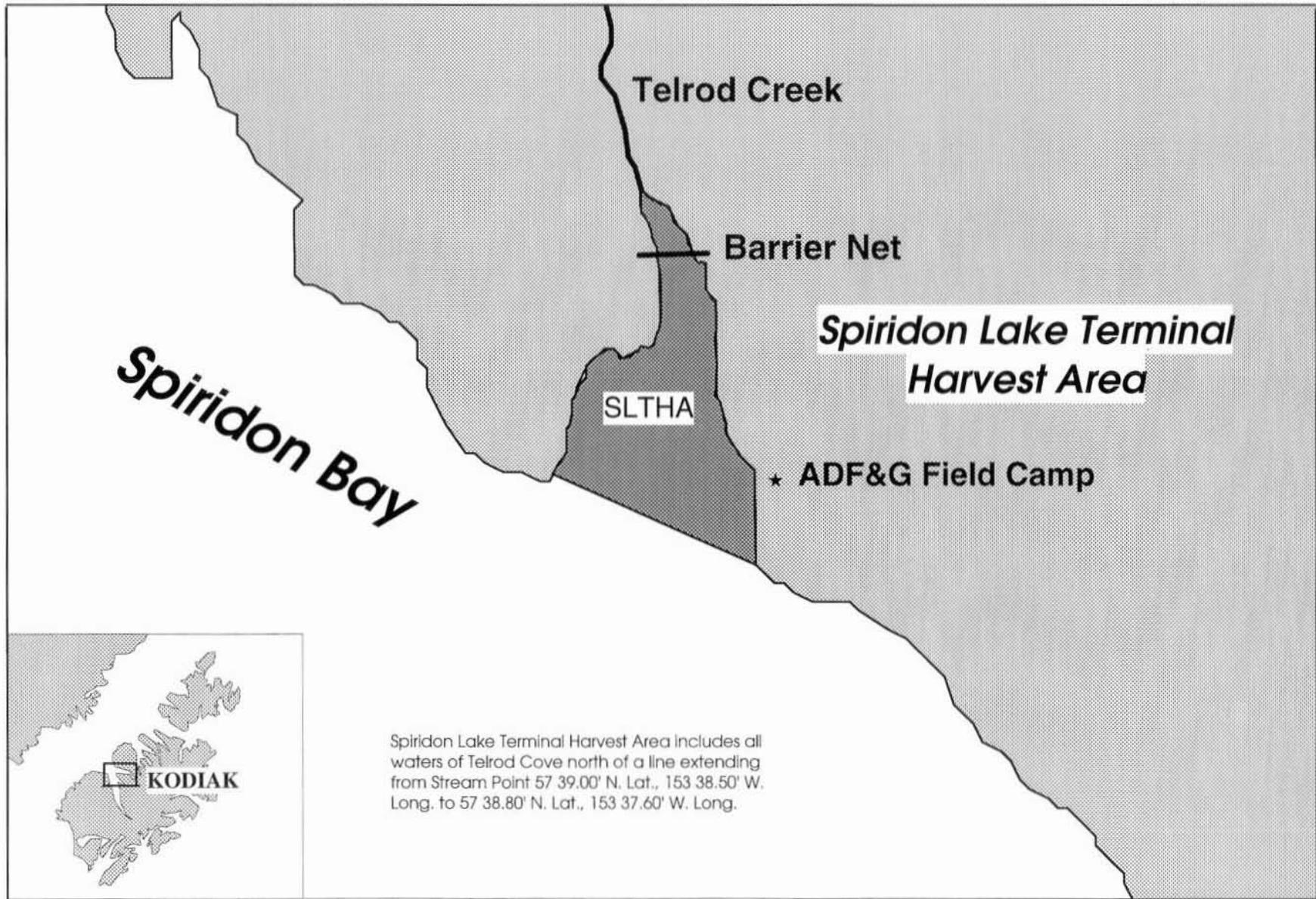


Figure 12. Spiridon Lake (Telrod Cove) Terminal Harvest Area (SLTHA), ADF&G camp and barrier net location in Telrod Cove, 1997.

APPENDIX

Appendix A. Kodiak Area sockeye salmon stocking plan, (1997 egg take) 1998.

Lake	Brood Source	1998 Sockeye Salmon Stocking Plan for Pillar Creek and Kitoi Bay Hatcheries						
		Limno Recom. ^a end season	Pillar Creek(PC); Kitoi Bay (KB)		Limno Recom. ^a in season	Final Plan ^c	Limno Recom. ^a end season	Pillar Creek(PC); Kitoi Bay (KB)
		1996 (3/7/97)	1997 AMP ^b (3/15/97)		1997(8/1/97)	1997 (8/10/97)	1997 (3/12/98)	1998 AMP (3/15/98)
Hidden (PC)	Afognak	0.25 fry 0.15 ps	0.25 fry (0.3g) 0.15 ps (12.5 g)	0.25 fry (0.3g) 0.15 ps (12.5 g)	0.25 fry (0.3g) 0.15 ps (12.5 g)	0.0 fry (0.3g) 0.25 ps (12.5 g)	0.0 fry (0.3g) 0.25 ps (12.5 g)	
L. Waterfall (PC) ^d	Afognak	0.1-0.2 ps	0.3 ps (12.5 g)	0.3 ps (12.5 g)	0.3 ps (12.5 g)	pending	0.3 ps (12.5 g)	
Crescent (PC)	Afognak	0.5 fry	0.4 fry (0.25 g)	0.4 fry (0.25 g)	0.4 fry (0.25 g)	pending	0.4 fry (0.25 g)	
Jennifer (PC)	Afognak	0.5-0.75 fry	0.5 fry (0.2 g)	0.5 fry (0.2 g)	0.5 fry (0.2 g)	-	0.0 fry (0.2 g)	
Sorg (PC)	Afognak	0.125 ps	0.150 ps (12.5 g) 0.1 smolt (>12.5 g)	0.150 ps (12.5 g) 0.1 smolt (>12.5 g)	0.0 ps (12.5 g) 0.0 smolt (>12.5 g)	- -	0.0 ps (12.5 g) 0.0 smolt (>12.5 g)	
Afognak (PC) ^{d,e}	Afognak	0.5 fry	0	0.0	0.0	pending	0.5 fry (<4.0g) 0.05 ps (12.5 g)	
Malina (PC) ^d	Malina	0.2-0.3 ps	0.3 fry (0.3 g) 0.2 ps (12.5 g)	0.3 fry (0.3 g) 0.2 ps (12.5 g)	0.3 fry (0.3 g) 0.2 ps (12.5 g)	pending pending	0.2 fry (0.2 g) 0.25 ps (12.5 g)	
Laura (PC)	Laura	0.1 ps	0.3 fry (0.3 g) 0.2 ps (12.5 g)	0.0 fry (0.3 g) 0.0 ps (12.5 g)	0.0 fry (0.3 g) 0.0 ps (12.5 g)	- -	0.0 fry (0.3 g) 0.0 ps (12.5 g)	
Spiridon (PC)	Saltery	5.0-7.0 fry	7.0 fry (0.2-0.4g)	6.0-7.0 fry (0.2-0.4g)	7.0 fry (0.2-0.4g)	4.0 fry (0.2-0.4g)	3.5 fry (0.2-0.4g)	
Ruth (PC)	Saltery	0.2-0.3 fry	0.3 fry (0.3 g)	0.3 fry (0.3 g)	0.3 fry (0.3 g)	pending	0.0 fry (0.3 g)	
L. Kitoi (KB)	Saltery	0.2 ps	0.3 ps (6.0 g)	0.3 ps (6.0 g)	0.3 ps (6.0 g)	0.3 ps (6.0 g)	0.3 ps (6.0 g)	
L.Kitoi estuary.(KB)	Saltery	-	0.75 s (10.0 g)	0.75 s (10.0 g)	0.75 s (10.0 g)	-	0.0 s (10.0 g)	

ps=presmolt; s=smolt

Early-run brood stocks: Afognak, Malina, and Laura Lakes

Late-run brood stocks: Saltery Lake

^a Limnology staff made recommendations after analysis of zooplankton density and biomass until inseason 1997, thereafter, recommendations have been made by Kodiak ADF&G Development staff.

^b See Clevenger et al. (1997).

^c Final plan is made prior to early run (August) and late run (September) eggtakes in conjunction with in season zooplankton data analysis.

^d 1998 stocking level is based on continued lake enrichment in 1998.

^e Approved for use as contingency stocking location in the event of excess Afognak fry (higher survivals) in 1998; thereafter, will only be used if all other options are exhausted.

Appendix B. Upper Station sockeye salmon egg takes: past and present.

Brood Year	Adults	Eggs (millions)	Facility	No. Stocked and Year (millions)	Stocking Location
1988	120	0.2	KBH	0.144 - 1989	Kitoi Bay
1989	3,000	5.0	PCH/KBH	0.249 - 1990 1.313 - 1990 0.579 - 1990	Spiridon Lake L. Kitoi Bay L. Kitoi Lake
1990	3,700	4.5	PCH	3.300 - 1991	Spiridon Lake
		1.5	KBH	1.250 - 1991	L. Kitoi Bay
1991	3,800	4.0	PCH	2.200 - 1992	Spiridon Lake
		2.3	KBH	1.463 - 1992	L. Kitoi Bay
1992	6,816	9.8	PCH	4.246 - 1993	Spiridon Lake
		1.9	KBH	0.052 - 1993 0.327 - 1994 0.180 - 1993	L. Kitoi Lake L. Kitoi Bay Jennifer Lake
1993	5,551	7.8	PCH	5.676 - 1994 0.370 - 1994	Spiridon Lake Jennifer Lake
		2.0	KBH	1.673 - 1994	L. Kitoi Bay
1994	120	0.3	PCH	0.000 - 1995 0.200 - 1995	Spiridon Lake Jennifer Lake
	120	0.3	KBH	0.000 - 1995 0.267 - 1995 0.000 - 1996	L. Kitoi Bay L. Kitoi Lake L. Kitoi Bay
1995	3,668	7.3	PCH	4.844 - 1996 0.000 - 1996	Spiridon Lake Jennifer Lake
	0	0.7	KBH	0.000 - 1995 0.000 - 1996 0.587 - 1997	L. Kitoi Bay Jennifer Lake L. Kitoi Bay
1996	4,810	9.8	PCH	6.700 - 1997 0.458 - 1997	Spiridon Lake Jennifer Lake
	0	0.0	KBH	0.000 - 1996 0.000 - 1997	L. Kitoi Bay Jennifer Lake
1997 ^a	0	0.0	PCH	0.000 - 1998 0.000 - 1998	Spiridon Lake Jennifer Lake
	0	0	KBH	0.000 - 1998 0.000 - 1998	L. Kitoi Bay Jennifer Lake

^a Additional egg takes are not planned.

Appendix C. Afognak Lake sockeye salmon egg takes: past, present, and proposed.

Brood Year	Adults	Eggs (millions)	Facility	No. Stocked and Year (millions)	Stocking Location
1991	2,076	2.6	PCH	0.260 - 1992 0.399 - 1992 0.589 - 1992 0.464 - 1992 0.182 - 1992	Hidden Lake Crescent Lake Waterfall Lakes Afognak Lake L. Kitoi Bay
1992	1,890	2.7	PCH	0.555 - 1993 0.202 - 1993 0.205 - 1993	Hidden Lake Crescent Lake Waterfall Lakes
1993	2,169	3.4	PCH	0.250 - 1994 0.314 - 1994 0.150 - 1994 0.183 - 1994 0.004 - 1995 0.098 - 1995	Hidden Lake Crescent Lake Waterfall Lakes L. Kitoi Lake L. Kitoi Lake L. Waterfall LK
1994	1,190	1.8	PCH	0.099 - 1995 0.090 - 1995 0.100 - 1995 0.000 - 1995 0.000 - 1995 0.113 - 1995	Hidden Lake Crescent Lake Waterfall Lakes Sorg Lake Ruth Lake L. Kitoi Lake
1995	1,440	1.8	PCH	0.391 - 1996 0.427 - 1996 0.082 - 1996 0.146 - 1996 0.051 - 1996 0.528 - 1996	Hidden Lake Crescent Lake Waterfall Lakes Sorg Lake L. Kitoi Lake Afognak Lake
1996	1,700	2.6	PCH	0.455 - 1997 0.432 - 1997 0.247 - 1997 0.000 - 1997 0.126 - 1997 0.328 - 1997	Hidden Lake Crescent Lake Waterfall Lakes Sorg Lake L. Kitoi Lake Afognak Lake
1997	1,600	2.4	PCH	0.250 - 1998 0.400 - 1998 0.300 - 1998 0.000 - 1998 0.000 - 1998 0.550 - 1998	Hidden Lake Crescent Lake Waterfall Lakes Sorg Lake Jennifer Lake Afognak Lake
1998	1,060	1.7 ^a	PCH	0.400 - 1999 0.350 - 1999 0.400 - 1999 0.000 - 1999	Hidden Lake L. Waterfall Lake Crescent Lake Afognak Lake ^b

^a Actual egg take to be determined no later than August 15, 1998 pending limnology results.

^b Contingency stocking location in the event there are excess fry as result of higher than projected egg-to-fry survivals or reduced stocking at other systems due to limnology assessment..

Appendix D. Malina Lake sockeye salmon egg takes: past, present, and proposed.

Brood Year	Adults	Eggs (millions)	Facility	No. Stocked and Year (millions)	Stocking Location
1991	120	0.15	PCH	0.085 - 1992	Malina Lake
1992	1,005	1.5	PCH	0.318 - 1993	Malina Lake
1993	644	0.9	PCH	0.547 - 1994	Malina Lake
1994	350	0.5	PCH	0.054 - 1995	Malina Lake
1995	400	0.59	PCH	0.426 - 1996	Malina Lake
1996	454	0.80	PCH	0.390 - 1997	Malina Lake
1997	470	0.7	PCH	0.450 - 1998	Malina Lake
1998	530	0.8 ^a	PCH	0.500 - 1999	Malina Lake

^a Final egg-take goal will be determined after inseason limnological evaluation and depending upon escapement level.

Appendix E. Laura Lake sockeye salmon egg takes: past, present, and proposed.

Brood Year	Adults	Eggs (millions)	Facility	No. Stocked and Year (millions)	Stocking Location
1993	218	0.3	PCH	0.117 - 1994	Laura Lake
1994	53	0.06	PCH	0.016 - 1995	Laura Lake
1995	170	0.2	PCH	0.182 - 1996	Laura Lake
1996 ^a	0	0	PCH	0.000 - 1997	Laura Lake
1997 ^a	0	0.0	PCH	0.000 - 1998	Laura Lake
1998	530	0.8 ^b	PCH	0.500 - 1999	Laura Lake

^a Escapement goal achieved.

^b Final egg-take number will be determined inseason after limnological evaluation and escapement level is determined.

Appendix F. Sallery Lake sockeye salmon egg takes: past, present, and proposed.

Brood Year	Adults	Eggs (millions)	Facility	No. Stocked and Year (millions)	Stocking Location
1994	4238	7.6	PCH	4.599 - 1995	Spiridon Lake
1995	122	0.2	PCH	0.150 - 1996	Ruth Lake
1996	103	0.2	PCH	0.147 - 1997	Ruth Lake
1997	2700	4.0	PCH	3.500 - 1998 0.000 - 1998	Spiridon Lake Ruth Lake
			KBH	0.250 - 1999	L. Kitoi Lake
1998	4640	8.4 ^a	PCH	6.000 - 1999 0.300 - 1999	Spiridon Lake Ruth Lake
			KBH	0.300 - 2000	L. Kitoi Lake

^a Final egg-take number will be determined inseason after limnological evaluation and escapement level is determined.

Appendix G. Buskin River coho salmon egg takes: past, present, and proposed.

Brood Year	Adults	Eggs	Facility	No. Stocked No. Stocked and Year	Stocking Location
1993	102	153,000	PCH	136,200 - 1994	Kodiak Road system lakes
1994	68	101,000	PCH	76,140 - 1995	"
1995	85	120,000	PCH	28,000 - 1997	"
1996	100	152,000	PCH	148,200 - 1997	"
1997	102	153,000	PCH	128,300 - 1998	"
1998	102	153,000	PCH	128,300 - 1999	"

Appendix H. Kodiak Area sockeye salmon stocking plan, (1998 egg take) 1999.

Lake	Brood Source	1999 Sockeye Salmon Stocking Plan for Pillar Creek and Kitoi Bay Hatcheries					
		Limno Recom. ^a end season 1997 (3/7/98)	Pillar Creek(PC); Kitoi Bay (KB) 1998 AMP ^b (3/15/98)	Limno Recom. ^a in season 1998(8/1/98)	Final Plan ^c 1998 (8/10/98)	Limno Recom. ^a end season 1998 (3/12/99)	Pillar Creek(PC); Kitoi Bay (KB) 1999 AMP (3/15/99)
Hidden (PC)	Afognak	0.15 fry (0.3g) 0.25 ps (12.5 g)	0.15 fry (0.5g) 0.25 ps (12.5 g)				
L.Waterfall (PC)	Afognak	pending	0.35 ps (12.5 g)				
Crescent (PC)	Afognak	pending	0.4 fry (0.5 g)				
Afognak (PC) ^d	Afognak	pending	0				
Malina (PC)	Malina	pending	0.3 fry (0.5 g) 0.2 ps (12.5 g)				
Laura (PC)	Laura	pending	0.3 fry (0.5 g) 0.2 ps (12.5 g)				
Spiridon (PC)	Saltery	6.0 fry (0.2-0.4g)	6.0 fry (0.2-0.4g)				
Ruth (PC)	Saltery	pending	0.3 fry (0.3 g)				
L. Kitoi (KB) ^e	Saltery	0.3 ps (6.0 g)	0.5 ps (6.0 g)				
L.Kitoi estuary.(KB)	Saltery	-	0.0 s (10.0 g)				

ps=presmolt; s=smolt

Early-run brood stocks: Afognak, Malina, and Laura Lakes

Late-run brood stocks: Saltery Lake

^a Limnology staff made recommendations after analysis of zooplankton density and biomass until inseason 1997, thereafter, recommendations have been made by Kodiak ADF&G Development staff.

^b See Table 3.

^c Final plan is made prior to early run (August) and late run (September) eggtakes in conjunction with in season zooplankton data analysis.

^d Approved for use as contingency stocking location in the event of excess Afognak fry (higher survivals) in 1998; thereafter, will only be used if all other options are exhausted.

^e 1999 stocking level may be contingent on lake enrichment in 1999.

Appendix I. Sockeye salmon and coho salmon fry survival assumptions used to estimate returns for Pillar Creek Hatchery.

Life History Stage Size (g)	System	
	Barren	Anadromous
Fry 0.3 g	4.0%	2.0%
Fingerling 1.5 g	6.0%	3.0%
Pre-smolt 5.0 - 12.5 g	12.5%	10.0%
Smolt >12.5 g	15.0%	15.0%
Coho fry	NA	1.5%

Appendix J. Genetic samples collected from adult sockeye salmon from Kodiak and Afognak Island Lakes.

Area/Lake	Samples Collected Month/Year	Sample Size	Harvest Timing	Samples Analyzed
<i>Afognak Island</i>				
Afognak	August 1993	100	Early	No
Laura	August 1994	100	Early	No
Little Kitoi	September 1993	100	Late	No
Malina	August 1993	100	Early	No
<i>Kodiak</i>				
Frazer	July-August 1996	900	Early	Yes ¹
	July-August 1997	400	Early	Yes ¹
Karluk	1978-1981	560	Early	Yes ²
		437	Late	Yes ²
Little River	July 1997	100	Early	No
Saltery	September 1994	100	Late	Yes ³
Uganik	July 1997	100	Early	No
Upper Station	September 1993	100	Early	Yes ³
		100	Late	Yes ³

¹ Forrest R. Bowers, ADF&G, Kodiak, personal communication.

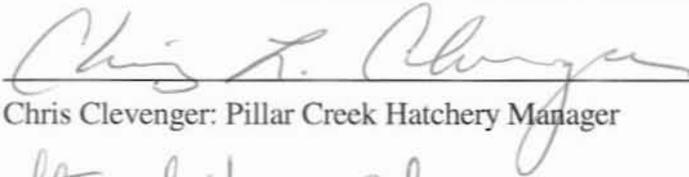
² Wilmot, R.L. and C.L. Burger. 1985. Genetic Differences among Populations of Alaskan Sockeye Salmon. *Transaction of the American Fisheries Society* 114:236-243.

³ Honnold, S.G. 1997. The Results of Sockeye Salmon *Oncorhynchus nerka* Stocking into Spiridon Lake on the Kodiak National Wildlife Refuge: Juvenile and Adult Production, Commercial Harvest, and Ecosystem Effects, 1987-1996. Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Regional Information Report 4K97-47. Kodiak.

Appendix K. Number sampled and incidence of Infectious Hematopoietic Necrosis Virus (IHNV) from Kodiak and Afognak area sockeye salmon adults, 1987-1997.

Year Sampled	Lake Stock	IHNV	
		Number	Percent
1987	Afognak	3/59	5%
1988	Afognak	0/60	0%
1993	Afognak	0/60	0%
1997	Afognak	0/60	0%
1990	Malina	0/62	0%
1993	Malina	0/51	0%
1997	Malina	0/60	0%
1993	Paul's	26/60	43%
1988	Sitkalidak	0/60	0%
1991	Rose Tead	0/53	0%
1991	Frazer	44/60	73%
1992	Little Kitoi	24/62	39%
1993	Little Kitoi	43/64	67%
1992	Karluk	58/60	97%
1987	Upper Station	12/58	21%
1988	Upper Station	28/60	47%
1989	Upper Station	46/63	73%
1993	Upper Station (upper lake)	31/56	55%
1993	Upper Station (lower lake)	24/59	41%
1986	Saltery	20/60	34%
1994	Saltery	55/60	92%
1995	Saltery	13/39	33%
1996	Saltery	47/66	71%
1997	Saltery	60/65	92%

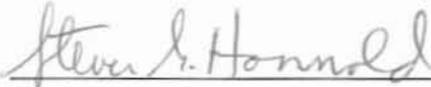
PILLAR CREEK HATCHERY 1998 AMP: SIGN-OFF



Chris Clevenger: Pillar Creek Hatchery Manager

5-7-98

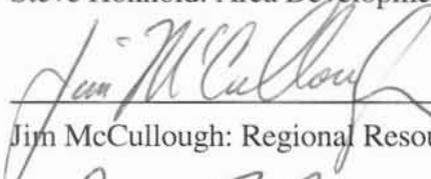
Date



Steve Honnold: Area Development Biologist, CFM&D

5/7/98

Date



Jim McCullough: Regional Resource-Development Biologist, CFM&D

7 May 1998

Date



Dave Prokopowich: Area Management Biologist, CFM&D

5/7/98

Date



Wayne Donaldson: Regional Management Biologist, CFM&D

5/8/98

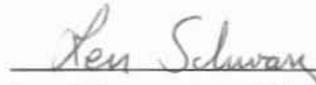
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Pete Probasco: Regional Supervisor, CFM&D

5/8/98

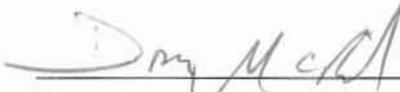
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Len Schwarz: Area Biologist, Sport Fish

5/8/98

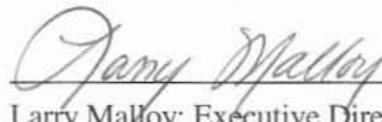
Date



Doug McBride: Sport Fish Regional Supervisor

5/12/98

Date



Larry Malloy: Executive Director, KRAA

5-8-98

Date

The 1998 Hatchery Management Plan for PCH is hereby approved:



Robert Bosworth: Deputy Commissioner, ADF&G

5.13.98

Date

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**PROPOSAL TO AMEND 1998 PILLAR CREEK HATCHERY MANAGEMENT
PLAN**

ADULT REMOVAL CRITERIA FOR SALTERY LAKE EGG TAKE

INTRODUCTION

Pillar Creek Hatchery (PCH) was constructed in 1990 as a cooperative project between the Alaska Department of Fish and Game (ADF&G) and Kodiak Regional Aquaculture Association (KRAA).

The primary project facilitated by PCH is the stocking of sockeye salmon fry (5 to 7 million) into Spiridon Lake. Initially, late-run Upper Station sockeye salmon brood stock was used for the Spiridon Lake project. Upper Station sockeye juveniles were also stocked into Little Kitoi Lake and estuary to develop a brood source that would return to Kitoi Bay Hatchery (KBH). Adults returning were to be used for egg collection for the Spiridon Lake project, eventually ending the need for egg takes at Upper Station.

The 1994 Hatchery Management Plan was amended to change the brood source for the project to Sallery Lake sockeye for an interim period until the brood source goals were attained at Little Kitoi Lake. This brood source change was approved by the U.S. Fish and Wildlife Service (FWS) for one year. In 1995, Upper Station sockeye salmon were, again, used for brood stock. To date the sockeye run to Little Kitoi has not provided sufficient salmon for brood stock. Further research by ADF&G and the FWS indicated that Sallery stock would be preferable for Spiridon Lake stocking (Honnold 1997; Clevenger et al. 1997). The run timing of Sallery Lake sockeye is about three weeks earlier than late-run Upper Station sockeye stock. The brood stock requirements at KBH are expected to be easier to achieve using the Sallery stock since adults are expected to return after the peak of the chum salmon run and before the peak of the pink salmon run. The approval to use Sallery Lake stock for Spiridon Lake was granted in 1997 by the Commissioner of ADF&G, representatives of the FWS, the Kodiak Regional Planning Team, and KRAA.

Sallery Lake stock will continue to be the brood source for the Spiridon Lake project in 1998. Also, Little Kitoi Lake will be stocked with Sallery Lake sockeye salmon to develop a brood source at KBH, replacing Upper Station late-run as the primary stock for brood stock development. Currently, Sallery Lake sockeye salmon escapement is projected to reach ~25,000 in 1998 (just within the BEG range of 20,000 – 40,000). Egg-take goals will require ~3,600 sockeye for brood stock. Egg-take criteria, as outlined in the 1998 PCH Annual Management Plan (AMP) would, however, allow only 2,500 adults for brood stock.

Consequently, ADF&G proposes that the 1998 PCH AMP egg-take criteria be amended to allow the Sallery Lake sockeye brood stock goal of 3,600 adults to be met. This change is based upon: 1) the importance of the ongoing sockeye salmon brood stock development program at Little Kitoi Lake; 2) the preliminary indications that the existing biological escapement goal (BEG) for Sallery Lake sockeye salmon may be too high; 3) zooplankton biomass has been impacted by over-escapement events at Sallery Lake that have occurred in four of the last seven years; 4) egg-take criteria are flexible and vary from hatchery to hatchery and project to project in other regions of Alaska; and 5) minimal loss of wild production and substantial enhanced production would result from removal of brood stock in 1998.

ORIGINAL PLAN (Honnold et al. 1998)

ESCAPEMENT GOALS, BROOD STOCK REQUIREMENTS, AND EGG-TAKE CRITERIA, 1998

Saltery Lake sockeye salmon biological escapement goal (BEG), minimum escapement goal allowing for an egg take, and projected brood numbers by PCH in 1998 are described in Table 1.

Egg-take criteria for enhancement projects (outstocking at barriered lakes) were established prior to initial egg takes to assist hatchery operators in planning brood stock collection from a particular sockeye salmon system (Honnold and Clevenger 1995; Clevenger et al. 1996; Clevenger et al. 1997). These criteria apply to the Afognak Lake early-run brood stock and the Saltery Lake late-run brood stock and were designed to protect and maintain these sockeye salmon runs.

Saltery Lake sockeye replaced Upper Station as the late-run brood source in 1997 for fry stocking at Spiridon and Ruth Lakes (barriered systems). In addition, this stock (1997 BR) will be used to stock Little Kitoi Lake (April presmolt) in 1999 for sockeye brood stock development at Kitoi Bay Hatchery (Hall et al. 1998). Approximately 4,600 Saltery Lake sockeye salmon will be necessary in 1998 for brood stock to continue the Spiridon and Ruth Lakes projects. The lower range of the BEG for Saltery Lake is 20,000 sockeye salmon (Malloy and Prokopowich 1992; Brennan et al. 1996). Approximately 50% of the escapement in excess of the minimum goal (20,000) will be available for brood stock collection. Eggs will not be collected if escapement is less than 20,000 salmon.

PROPOSED CHANGES TO PLAN

ESCAPEMENT GOALS, BROOD STOCK REQUIREMENTS, AND EGG-TAKE CRITERIA, 1998

Saltery Lake sockeye salmon biological escapement goal (BEG), minimum escapement goal allowing for an egg take, and revised brood numbers by PCH in 1998 are described in Table 2.

Egg-take criteria for enhancement projects (outstocking at barriered lakes) were established prior to initial egg takes to assist hatchery operators in planning brood stock collection from a particular sockeye salmon system (Honnold and Clevenger 1995; Clevenger et al. 1996; Clevenger et al. 1997). These criteria apply to the Afognak Lake

early-run brood stock and the Saltery Lake late-run brood stock and were designed to protect and maintain these sockeye salmon runs.

*Saltery Lake sockeye replaced Upper Station as the late-run brood source in 1997 for fry stocking at Spiridon and Ruth Lakes (barriered systems). In addition, this stock (1997 BR) will be used to stock Little Kitoi Lake (April presmolt) in 1999 for sockeye brood stock development at Kitoi Bay Hatchery (Hall et al. 1998). The lower range of the BEG for Saltery Lake is 20,000 sockeye salmon (Malloy and Prokopowich 1992; Brennan et al. 1996). **Approximately 30% to 80% (55% mid-point) of the escapement in excess of the minimum goal (20,000) will be available for brood stock collection. The number of adults needed for brood stock may change in-season, depending on the stocking levels as determined by inseason limnology data.** Eggs will not be collected if escapement is less than 20,000 salmon. Approximately 4,600 Saltery Lake sockeye salmon were projected to be necessary in 1998 for brood stock to continue the Spiridon, Ruth and Little Kitoi Lakes projects. **This projection has been revised to 3,600 as result of limnological analyses of Spiridon, Ruth, and Little Kitoi Lakes.***

JUSTIFICATION

1. The continuation of the ongoing sockeye salmon brood stock development program at Little Kitoi Lake is important.

The first juveniles of Saltery Lake origin will be released in Little Kitoi Lake in 1999 (Hall et al. 1998). Egg takes are scheduled to continue at Saltery Lake each year until 2002 to develop a sockeye run at Little Kitoi Lake in sufficient numbers to sustain brood stock collection. Eggs collected from this run will provide juveniles for continuing the Spiridon and Ruth Lakes enhancement projects. Brood stock from Saltery Lake will not be needed once the run is developed at Little Kitoi Lake. The initial adult returns will occur in 2001 and 2002 and may reduce or eliminate the Saltery Lake brood stock requirements. However, if insufficient brood stock is procured in 1998, then the need to utilize wild stocks from Saltery Lake will continue past 2001. The current allowable number of adults may reduce juvenile releases for this program.

2. The biological escapement goal (BEG) for Saltery Lake sockeye salmon may be too high.

The BEG range for Saltery Lake sockeye salmon is 20,000 to 40,000. This goal was developed in 1988, based upon historical escapements, which produced larger than average runs and, to a lesser extent, spawning habitat evaluations. However, more recent, but preliminary analysis of limnological data collected at Saltery Lake indicates that this goal may be too high to support sustained sockeye runs.

The average euphotic volume (EV) for the lake is $9.49 \times 10^6 \text{ m}^3$, which equates to 9.5 EV units (Koenings and Burkett 1987). EV units can be used as an index of primary production (EV model), enabling between-lake comparisons of sockeye salmon production potential, especially useful for lakes impacted by organic stain and turbidity

(Koenings and Kyle 1997). The EV model is used by many ADF&G managers to define escapement goals for sockeye nursery lakes. The sockeye escapement goal for Saltery Lake, when applying this model, would be approximately 10,000 to 15,000 fish.

In addition, sockeye salmon smolt biomass has been shown to be a function of zooplankton biomass (Koenings and Kyle 1997). This model estimates the sockeye smolt biomass expected from a measured standing crop of zooplankton when lake rearing area is used to capacity. Saltery Lake is ranked 12 (mean 1994-1997 = 509 mg per m²) of the 38 Kodiak and Afognak Island lakes assessed for zooplankton biomass. Smolt production from this zooplankton biomass level is projected to be ~ 236,000 smolt. Using a mean smolt-to-adult survival range of 12% to 23% and a harvest rate of 65% (Koenings and Burkett 1987), ~ 28,000 to 54,000 adults would return to the system, of which, 18,000 to 35,000 would be available for harvest and 10,000 to 19,000 would escape into the lake.

These analyses are preliminary; however, the Saltery Lake BEG appears high and indicates that using 3,600 adults (including an additional 1,100 more than the 2,500 currently allowed) for brood stock in 1998 would not impact production.

3. Zooplankton biomass has been impacted by over-escapement events that have occurred at Saltery Lake in four of the last seven years.

Sockeye escapements exceeded the upper BEG (40,000) in 1991, and from 1993 – 1995. Escapements were almost double the goal in 1993 (77,000) and ~ 40% higher than the goal in 1994 (59,000-4,200 brood stock=54,800). Zooplankton biomass declined by 78% from 1995 (1053 mg per m²) to 1996 (221 mg per m²). This indicates excessive grazing by juvenile sockeye salmon in years following these high escapement levels. Escapement was just over the upper goal in 1995 (44,000) and neared the upper goal in 1996 (35,000). Zooplankton recovered slightly in 1997 (461 mg per m²); however, biomass levels were still 56% less than 1995 levels. This indicates that the BEG range may be too high and that lower escapements may enable Saltery Lake to maintain a stable zooplankton population, thus, stable sockeye runs. The removal of brood stock in 1998 would not impact production and may well benefit the lake's rearing environment by reduction of grazing on the zooplankton community.

4. Egg-take criteria are flexible and vary from hatchery to hatchery and project to project in other regions of Alaska.

The proposed change in the egg-take criteria for PCH enhancement projects provides a variable proportion (30%-80%) of the allowable escapement for use as brood stock. This change in the criteria provides flexibility for brood stock use, which is more suitable when using stocks with variable escapements. The ADF&G (1980) developed guidelines for adult removal for egg-takes, which required the first 20% of the escapement to be allowed to enter spawning grounds (B. Wilbur, ADF&G, personal communication, Juneau). Approximately, 60-80% of the remaining 80% of the escapement would be

available for egg-takes. This equates to ~ 50%-70% of the escapement for spawning and 30%-50% for egg-takes. Other hatcheries in Alaska have adopted similar flexibility in egg-take criteria. For example, Trail Lakes Hatchery uses egg-take criteria for their Hidden Lake (A) and Big Lake (B) Enhancement projects as follows:

A)	<u>Escapement</u>	<u>Adults Available for Brood Stock</u>
	≤ 1,600	0
	≥ 1,600	80% of those exceeding 1,600
B)	<u>Escapement</u>	<u>Adults Available for Brood Stock</u>
	≤ 12,500	0
	≥ 12,500 ≤ 25,000	up to 40% of those exceeding 12,500
	> 25,000	up to 5,000 fish plus any fish in excess of 25,000

5. Minimal loss of wild production and substantial enhanced production would result from the removal of sockeye salmon brood stock in 1998.

The potential loss of future wild sockeye salmon production as a result of removal of 3,600 adults from Saltery Lake will be minimal (in fact, as described under item 3, productivity may benefit). Using the original egg-take criteria, 2,500 adults would be allowed for removal for brood stock purposes in 1998. An additional 1,100 adults would be needed to reach the 1998 goal for brood stock. Production from these adults if allowed to spawn in the Saltery Lake system is estimated to be ~ 5,000 sockeye salmon (assumptions: 50% sex ratio; 3000 fecundity; 10% survival to fry; 3% survival to adults). Enhanced production from these adults is estimated to be ~ 140,000 sockeye salmon (assumptions: 66% sex ratio; 3000 fecundity; 80% survival to fry; 8% survival to adults).

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SIGN-OFF

**AMENDMENT TO THE 1998 PILLAR CREEK HATCHERY MANAGEMENT
PLAN**

Chris Clevenger: Pillar Creek Hatchery Manager Date

Steve Honnold: Area Development Biologist, CFM&D Date

Jim McCullough: Regional Resource Development Biologist, CFM&D Date

Dave Prokopowich: Area Management Biologist, CFM&D Date

Wayne Donaldson: Regional Management Biologist, CFM&D Date

Pete Probasco: Regional Supervisor, CFM&D Date

Len Schwarz: Area Biologist, Sport Fish Date

Doug McBride: Sport Fish Regional Supervisor Date

Larry Malloy: Executive Director, KRAA Date

The amended 1998 Hatchery Management Plan for PCH is hereby approved:

Robert Bosworth: Deputy Commissioner, ADF&G Date

Table 1. Biological escapement goal, egg-take criteria, and projected brood numbers required for 1998 Sallery Lake sockeye salmon egg take.

Biological Escapement	Egg-take Criteria		Brood Stock
	Allowable Escapement Range	Allowable Proportion Within Range	
Goal Range	Escapement Range	Within Range	Required
20,000-40,000	>20,000	50%	4,637

^a Sallery Lake is the late-run brood source for enhancement projects (barriered lakes) at Spiridon and Ruth Lakes.

Table 2. Biological escapement goal, projected 1998 escapement, proposed PCH egg-take criteria, and revised brood stock numbers for 1998 Saltery Lake sockeye salmon egg take.

Biological Escapement Goal Range	Projected 1998 Escapement	Egg-take Criteria			Brood Stock Required Revised 8/98
		Escapement	Adults Available for Brood Stock		
			Range(30%-80%)	Mid-Point (55%)	
20,000-40,000	~25,000	>20,000	1,500-4,000	2,750	3,600 ^b

^a Saltery Lake is the late-run brood source for enhancement projects (barriered lakes) at Spiridon, Ruth, and Little Kitoi Lakes.

^b Optimal egg take goal (6 million) would require 3,600 brood stock (includes 166 adults for L.Kitoi stocking); 2,500 is minimum adults needed to continue the brood stock development at L. Kitoi and the Spiridon Lake enhancement project.