

**OTOLITH THERMAL MARK RELEASE AND MASS-PROCESSING  
HISTORY IN ALASKA (USA), 1988-1998**

by

Harold J. Geiger and Kristen M. Munk

Alaska Department of Fish and Game  
CWT & Otolith Processing Lab  
P.O.Box 25526  
Juneau, Alaska, 99802  
United States

submitted to the

**North Pacific Anadromous Fish Commission**

by

United States of America

October 1998

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Geiger, H.J. and Munk, K.M. 1998. Otolith Thermal Mark Release and Mass-Processing History in Alaska (USA), 1988-1998 (NPAFC Doc. 368). Alaska Department of Fish and Game-CWT & Otolith Processing Lab, Box 25526, Juneau, Alaska, 99802, 9 p.

# OTOLITH THERMAL MARK RELEASE AND MASS-PROCESSING HISTORY IN ALASKA (USA), 1988-1998

Harold J. Geiger and Kristen M. Munk

## OTOLITH THERMAL MASS-MARKING AND RELEASES

Alaska's venture into use of the thermal marking of otolith technology was initiated in 1988 when thermal marking methods were still being pioneered. Two facilities: Solomon Gulch Hatchery operated by the Valdez Fisheries Development Association (VFDA) and Snettisham Central Incubation Facility (CIF) operated by the Alaska Department of Fish and Game (ADFG), began small-scale production marking to test the efficacy of thermal marking as a mass-marking tool. Solomon Gulch Hatchery did not thermal mark fish again till 1995, while Snettisham CIF continued thermal marking sockeye in agreement with a mandate issued by the US-Canada Transboundary River (TBR) Enhancement Project.

In 1989 and 1990, focused and small-scale experimental thermal marking was conducted by University of Alaska, Juneau Center for Fisheries and Ocean Science's staff at the Auke Creek Hatchery, operated by the National Oceanographic and Atmospheric Administration (NOAA) – National Marine Fisheries Service (NMFS) Auke Bay Laboratory. Otolith samples collected before, during, and after thermal marking monitored development of thermally induced otolith increments (thermal rings) as well as other natural growth patterning and responses (Munk and Smoker, 1990; unpub. data by author). This information, coupled with early guidelines for thermal marking and structuring of thermal mark codes were then applied by these same staff to a production marking effort at Gastineau Hatchery (operated by Douglas Island Pink and Chum, Inc.[DIPAC]) (Munk and Smoker, 1991; Munk et al, 1993; in prep).

Interest in thermal marking sockeye, pink, chum, coho, and chinook at hatchery facilities within Alaska has increased rapidly, with 13 hatcheries (Figure 1) expected to thermal mark an estimated 1 billion 1998 brood eggs and alevins. Thermal mark releases for 1993 to 1998, including thermal mark "RBr" codes and graphic depiction of thermal marks are presented in Table 1.

## OTOLITH MASS-PROCESSING HISTORY

Along with thermal mass-marking of salmon otoliths, the ADFG had a mandate to achieve concomitant ability to mass-process otoliths to afford fishery managers an inseason tool to discriminate and estimate stock contributions. In January 1991, the ADFG - Commercial Fisheries Division, initially staffed a laboratory to develop the ability to process otoliths on a production scale. This laboratory was specifically funded by the TBR enhancement project to process otoliths from adult sockeye returning through fisheries to coastal

Southeast Alaska and US-Canada trans-boundary rivers (Taku and Stikine Rivers). Otolith mark data which estimated the incidence of thermal marks in these fisheries were to be used inseason by fishery managers to manage the harvest of wild and thermal marked, or "enhanced" fish, and also to assess the achievement in meeting harvest sharing and escapement goals as set by the TBR Committee.

In summer of 1992 significant development of otolith mass-processing technique was made by ADFG Otolith laboratory staff by making use of the 1990 brood thermal marked pink salmon returning to Gastineau Hatchery. Though not actively used for inseason management of fisheries, these data were provided on a real-time basis to managers and researchers which could have enabled inseason management decisions. Development of technique included all aspects of otolith handling and data reporting currently still in use today. In 1993, a coordinated effort between ADFG & DIPAC Inc. documented a successful application of inseason otolith processing to 1991 brood thermal marked chum salmon returning to Gastineau Hatchery (Hagen, et al. 1993).

In 1994 the first significant returns to Southeast Alaska of TBR enhanced sockeye were sampled and processed for thermal marks. Over a 3 month period, data were reported for 9638 sockeye otoliths processed for thermal marks (data for 4476 otoliths were reported "inseason", i.e. well-within 8 work hours of receiving the samples), and with 6 discrete thermal mark patterns identified. Figure 2 charts the level of otolith processing for inseason management of fisheries in Southeast Alaska from 1993 to 1998. Contribution estimates and usage of data based on otolith thermal mark data from 1994-1997 collections are summarized in four reports from the Pacific Salmon Commission's Joint Technical Transboundary River Committee (1996, 1997, in press, and in prep, respectively).

In 1995, 100% (643 million) of Prince William Sound pink salmon hatchery production was thermal marked at 4 hatcheries and with 4 discrete thermal mark codes (Joyce et al. 1996). A focused study was undertaken to measure the ability of otolith readers to agree in classification of otolith patterns (not marked, mark A, mark B, etc). This study indicated high precision in classifying wild/not marked or thermal marked otolith patterns (Joyce et al. 1997). In 1997, these 1995 brood pink salmon returned to Prince William Sound. Otoliths were collected, processed at a second ADFG Otolith Processing lab site in Cordova, and data were used to manage both inseason commercial harvest and cost-recovery efforts by the cooperating hatcheries. Otolith specimens were second-read at the ADFG CWT & Otolith Processing Lab in Juneau to assure consistency in thermal mark identification.

Beginning in 1994, the NMFS-ABL collected otoliths from trawl bycatch (1994, Bering Sea), and from focused research cruises in the North Pacific from 1995-1998, as part of the "Offshore Carrying Capacity" (OCC) Project. The ADFG CWT & Otolith Processing Laboratory processed these otoliths and provided data indicating notable incidence of thermal marked salmon in these collections (Ignell et al, 1997; Farley and Munk, 1997 & 1998).

The volume of otoliths produced by the above assortment of projects has increased dramatically over the past several years. In combining this overall production into 3 areas -- management, quality control (second-reading "other lab" production), and research -- Figure 3 illustrates this growing capacity and potential of this technology.

## REFERENCES

- Farley, E.V., Jr. and K. M. Munk. 1997. Incidence of thermally marked pink and chum salmon in the coastal waters of the Gulf of Alaska. *Alaska Fishery Research Bulletin* 4(2):181-187
- Farley, E.V., Jr. and K. M. Munk. 1998. Incidence of thermally marked pink, chum, and sockeye salmon in the coastal waters of the Gulf of Alaska, 1997. (NPAFC Doc. 341) Auke Bay Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626. 18p.
- Hagen, P., K.M. Munk, B. Van Alen, and B. White. 1995. Thermal mark technology for inseason fisheries management: A Case Study. *Alaska Fishery Research Bulletin* 2(2):143-155.
- Ignell, S.E. C.M. Guthrie III, J.H. Helle, and K.M. Munk. 1997. Incidence of thermally marked chum salmon in the 1994-1996 Bering Sea pollock B-season trawl fishery. National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory, NPAFC Document 246. Juneau, Alaska.
- Joyce, T. L., D. G. Evans, K.M. Munk. 1996. Otolith marking of pink salmon in Prince William Sound hatcheries, 1995. Cordova, AK, Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, Restoration Project #95320C."
- Joyce, T.L., D.G. Evans, and K.M. Munk. 1997. Otolith marking of pink salmon in Prince William Sound hatcheries, 1996. *Exxon Valdez Oil Spill Restoration Project Annual Report* (Restoration Project 96188), Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Cordova, Alaska.
- Munk, K.M. and W.W. Smoker. 1990. Temperature-induced marks in otoliths of pink salmon embryos. JCFO 90-01. Juneau Center for Fisheries and Oceans Sciences, 11120 Glacier Highway, Juneau, Alaska 99801
- Munk, K.M. and W.W. Smoker. 1991. Temperature-induced mass-marking of pink salmon otoliths, production trial at Gastineau Hatchery. Final Report to Douglas Island Pink and Chum, Inc. JCFO 91-02 Juneau Center for Fisheries and Oceans Sciences, 11120 Glacier Highway, Juneau, Alaska 99801

- Munk, K.M., W.W. Smoker, D.R. Beard, and R.W. Mattson. 1993. A hatchery water-heating system and its application to 100% thermal marking of incubating salmon. *Progressive Fish-Culturist*. 55:284-288
- Munk, K. M. (in prep). Thermal Marking Manual: A guideline to the induction of thermal marks for the purpose of mass-marking hatchery stocks. Alaska Department of Fish and Game Special Publication.
- Transboundary Technical Committee (TTC). 1996. Pacific Salmon Commission Joint Transboundary Technical Committee estimates of transboundary river salmon production, harvest, and escapement, 1994. *Pacific Salmon, TCTR (96)-2*, Vancouver, British Columbia.
- TTC. 1997. Pacific Salmon Commission Joint Transboundary Technical Committee estimates of transboundary river salmon production, harvest, and escapement, 1995. *Pacific Salmon, TCTR (97)-2*, Vancouver, British Columbia.
- TTC. inpress . Pacific Salmon Commission Joint Transboundary Technical Committee estimates of transboundary river salmon production, harvest, and escapement, 1996. Pacific Salmon Commission, TCTR , Vancouver, British Columbia.
- TTC. inprep . Pacific Salmon Commission Joint Transboundary Technical Committee estimates of transboundary river salmon production, harvest, and escapement, 1997. Pacific Salmon Commission, TCTR , Vancouver, British Columbia.

TABLE 1. THERMAL MARK RELEASES IN ALASKA FROM 1993-1998.

BROOD YEAR	YEAR OF RELEASE	DAY/ MONTH/YE AR	SPECIES	AGENCY	FACILITY	FINAL RELEASE SITE	FINAL REARING TREATMENT	RELEASE DISPOSITION	SIZE AT RELEASE (g/mm)	TM ID (informal)	FORMAL TM ID	RBr	PREHATCH GRAPHIC	POSTHATCH GRAPHIC	MARK QUALITY	# TM RELEASED (actual)	
1993	1995		CHINOOK	DIPAC	Gastineau Hatchery	Gastineau Channel		smolt		DIPAC93	Gastineau Hatchery 93-CHINOOK(DIPAC)	2:1.5				187,210	
1993	1994	5/9-19/94	CHUM	DIPAC	Gastineau Hatchery	Gastineau/Sheep		fy	97.2.06	DIPAC93	Gastineau Hatchery 93-CHUM(DIPAC)	1:1.4,0r5			FAIR	58,250,847	
1993	1994		CHUM	DIPAC	Gastineau Hatchery	Kasnyku		fy		DIPAC93	Gastineau Hatchery 93-CHUM(DIPAC)	1:1.3			POOR-FAIR	9,369,856	
1993	1994	5/20/94	CHUM	NSRAA	Hidden Falls CIF	Kasnyku Bay		fy	1.5	Hidden Falls93	Hidden Falls CIF 93-CHUM(Hidden Falls)	1:1.3			POOR	33,155,175	
1993	1995		COHO	DIPAC	Gastineau Hatchery	Gastineau SWS		smolt		Gastineau 93	Gastineau Hatchery 93-COHO(Gastineau SWS)	1:1.5				1,033,844	
1993	1994		PINK	DIPAC	Gastineau Hatchery	Gastineau Channel		fy		DIPAC93	Gastineau Hatchery 93-PINK(DIPAC)	1:1.3(5)			POOR-FAIR	8,923,682	
1993	1995		SOCKEYE	ADF&G	Snettisham CIF	Speel Lake	freshwater	presmolt		Speel93	Snettisham CIF 93-SOCKEYE(Speel)	2:1.3,2.3,3.4+5			GOOD	149,000	
1993	1995		SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	freshwater	smolt		Speel Arm "FW"93	Snettisham CIF 93-SOCKEYE(Speel Arm "FW")	2:1.3,2.3,3.4+5			FAIR	507,000	
1993	1995		SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	saltwater	smolt		Speel Arm "SW"93	Snettisham CIF 93-SOCKEYE(Speel Arm "SW")	2:1.3,2.3,3.4+5			FAIR	353,000	
1993	1995		SOCKEYE	ADF&G	Snettisham CIF	Gilbert Bay	saltwater	smolt		Gilbert Bay93	Snettisham CIF 93-SOCKEYE(Gilbert Bay)	2:1.4,2.2,3.3+5			FAIR	204,000	
1993	1994	5/25/94	SOCKEYE	ADF&G	Snettisham CIF	Sweetheart		fy		Sweetheart93	Snettisham CIF 93-SOCKEYE(Sweetheart)	2:1.4,2.4			GOOD	1,739,605	
1993	1994	6/8/94	SOCKEYE	ADF&G	Snettisham CIF	Chiklat Lake		fy		Chiklat93	Snettisham CIF 93-SOCKEYE(Chiklat)	3:1.5,2.3+3.5			FAIR-GOOD	4,818,000	
1993	1994		SOCKEYE	ADF&G	Snettisham CIF	U. Tatsamenie		fy		U. Tatsamenie93	Snettisham CIF 93-SOCKEYE(U. Tatsamenie)	2:1.5			GOOD	520,947	
1993	1994		SOCKEYE	ADF&G	Snettisham CIF	Big Trapper		fy		Big Trapper93	Snettisham CIF 93-SOCKEYE(Big Trapper)	1:1.5+2.6			GOOD	916,083	
1993	1994		SOCKEYE	ADF&G	Snettisham CIF	Tahltan Lake(Canada)		fy		Tahltan93	Snettisham CIF 93-SOCKEYE(Tahltan)	1:1.6+2.5			GOOD	903,908	
1993	1994	6/4/94	SOCKEYE	ADF&G	Snettisham CIF	Tuya Lake (Canada)		fy		Tuya93	Snettisham CIF 93-SOCKEYE(Tuya)	1:1.4+2.5			GOOD	4,690,833	
1993	1995		SOCKEYE	CIAA	Trail Lakes Hatchery	Crooked Creek		smolt		CrookedCr93	Trail Lakes Hatchery 93-SOCKEYE(Crooked Creek)	1:1.4			GOOD	200,000	
1993	1995	5/12/95	SOCKEYE	CIAA	Trail Lakes Hatchery	Grouse Lake		smolt	10.1	Grouse93	Trail Lakes Hatchery 93-SOCKEYE(Grouse)	1:1.4			GOOD	83,000	
1993	1994		SOCKEYE	CIAA	Trail Lakes Hatchery	Chelatna		fy		Chelatna93	Trail Lakes Hatchery 93-SOCKEYE(Chelatna)	1:1.5			GOOD	1,330,000	
1993	1994	5/23/94	SOCKEYE	CIAA	Trail Lakes Hatchery	Packers Lake	fed	fy	0.17	Packers Lake93	Trail Lakes Hatchery 93-SOCKEYE(Packers Lake)	1:1.3			FAIR	2,779,000	
1993	1995		SOCKEYE	CIAA	Trail Lakes Hatchery	Grouse Lake		smolt		Grouse93	Trail Lakes Hatchery 93-SOCKEYE(Grouse)	1:1.3			GOOD	1,000,000	
1993	1994		SOCKEYE	CIAA	Trail Lakes Hatchery	Bear Lake		fy		Bear93	Trail Lakes Hatchery 93-SOCKEYE(Bear Lake)	2:1.4				170,000	
1993	1994		SOCKEYE	CIAA	Trail Lakes Hatchery	Hidden Lake		fy		Hidden93	Trail Lakes Hatchery 93-SOCKEYE(Hidden Lake)	1:1.2			POOR	1,800,000	
1994	1996	6/12,10/6/19	COHO	DIPAC	Gastineau Hatchery	Gastineau Channel		smolt	29.32/147.7	Gastineau 94	Gastineau Hatchery 94-COHO	1:1.4				863,474	
1994	1996	5/28-6/13/96	CHINOOK	DIPAC	Gastineau Hatchery	Gastineau Channel		smolt	25.4/141.3	Gastineau 94	Gastineau Hatchery 94-CHINOOK	2:1.4				312,119	
1994	1995	5/8-21/95	CHUM	DIPAC	Gastineau Hatchery	Gastineau Channel		fy	1.1-2.09	Gastineau 94	Gastineau Hatchery 94-CHUM	1:1.4			FAIR	82,343,380	
1994	1995		PINK	DIPAC	Gastineau Hatchery	Gastineau Channel		fy		Gastineau94	Gastineau Hatchery 94-PINK	3:1.4			GOOD	3,000,000	
1994	1995		PINK	DIPAC	Auke Cr Hatchery	Auke Cr		fy		Auke94	Auke Cr Hatchery 94-PINK	2:1.47			FAIR	633,000	
1994	1995	5/22/95	CHUM	NSRAA	Hidden Falls CIF	Kasnyku Bay		fed fry	1.72/61	Hidden Falls94	Hidden Falls CIF 94-CHUM	1:1.3			GOOD	37,035,400	
1994	1995		SOCKEYE	SSRAA	Beaver Falls CIF	Salmon Lake		fy		Beaver Falls CIF 94-SOCKEYE(Salmon Lake)	1:1.5,2.5				GOOD	373,204	
1994	1995		SOCKEYE	SSRAA	Beaver Falls CIF	Salmon Lake		pre-smolt		Beaver Falls CIF 94-SOCKEYE(Salmon Lake)	1:1.5,2.5+7				GOOD	67,425	
1994	1995		SOCKEYE	ADF&G	Snettisham CIF	Speel Lake	freshwater	presmolt		Speel94	Snettisham CIF 94-SOCKEYE(Speel)	2:1.3,2.2,3.3			GOOD	253,750	
1994	1996		SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	freshwater	smolt		Speel Arm "FW"94	Snettisham CIF 94-SOCKEYE(Speel Arm "FW")	2:1.3,2.2,3.4			GOOD	377,471	
1994	1996		SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	saltwater	smolt		Speel Arm "SW"94	Snettisham CIF 94-SOCKEYE(Speel Arm "SW")	2:1.3,2.2,3.3			GOOD	see comments	
1994	1995	10/31/95	SOCKEYE	ADF&G	Snettisham CIF	Crescent Lake		presmolt	3.7g	Crescent94	Snettisham CIF 94-SOCKEYE(Crescent)	2:1.4,2.2,3.3			GOOD	234,080	
1994	1996	5/31/96	SOCKEYE	ADF&G	Snettisham CIF	Gilbert Bay	saltwater	smolt	14.88	Gilbert Bay94	Snettisham CIF 94-SOCKEYE(Gilbert Bay)	2:1.4,2.2,3.3			GOOD	221,490	
1994	1995		SOCKEYE	ADF&G	Snettisham CIF	Chiklat Lake		fy		Chiklat94	Snettisham CIF 94-SOCKEYE(Chiklat)	1:1.5,2.3			GOOD	2,334,264	
1994	1995		SOCKEYE	ADF&G	Snettisham CIF	U. Tatsamenie		fy		U. Tatsamenie94	Snettisham CIF 94-SOCKEYE(U. Tatsamenie)	1:1.5			GOOD	897,500	
1994	1995		SOCKEYE	ADF&G	Snettisham CIF	Big Trapper		fy		Big Trapper94	Snettisham CIF 94-SOCKEYE(Big Trapper)	1:1.7			GOOD	773,375	
1994	1995		SOCKEYE	ADF&G	Snettisham CIF	Tahltan Lake(Canada)		fy		Tahltan94	Snettisham CIF 94-SOCKEYE(Tahltan)	1:1.6			GOOD	1,142,856	
1994	1995		SOCKEYE	ADF&G	Snettisham CIF	Tuya Lake (Canada)		fy		Tuya94	Snettisham CIF 94-SOCKEYE(Tuya)	1:1.4			GOOD	2,267,443	
1994	1995	6/5/95	SOCKEYE	CIAA	Trail Lakes Hatchery	Crooked Creek		fy	na	CrookedCr94	Trail Lakes Hatchery 94-SOCKEYE(Crooked Creek)	1:1.2			POOR		
1994	1995	6/18,10/13/95	SOCKEYE	CIAA	Trail Lakes Hatchery	Chelatna Lake	fed	fy	na	Chelatna94	Trail Lakes Hatchery 94-SOCKEYE(Chelatna)	1:1.5			GOOD	1,806,000	
1994	1995	6/18,10/13/95	SOCKEYE	CIAA	Trail Lakes Hatchery	Packers Lake	fed	fy	19-2.41	Packers Lake94	Trail Lakes Hatchery 94-SOCKEYE(Packers Lake)	1:1.2			POOR	1,552,000	
1994	1995	6/8/95	SOCKEYE	CIAA	Trail Lakes Hatchery	Bear Lake		smolt	na	Bear Lake94	Trail Lakes Hatchery 94-SOCKEYE(Bear Lake)	1:1.2			POOR	330,000	
1994	1995	6/18/95	SOCKEYE	CIAA	Trail Lakes Hatchery	Hidden Lake	unfed	fy	na	Hidden Lake94	Trail Lakes Hatchery 94-SOCKEYE(Hidden Lake)	1:1.4			GOOD	1,700,000	
1994	1996	6/1/95	COHO	CIAA	Trail Lakes Hatchery	Bear Lake	fed	fy	0.75	Bear Lake94	Trail Lakes Hatchery 94-COHO(Bear Lake)	1:1.2			POOR	509,000	
1994	1996	6/7/96	COHO	CIAA	Trail Lakes Hatchery	Bear Lake	fed	smolt	11.2	Bear Lake94	Trail Lakes Hatchery 94-COHO(Bear Lake)	1:1.2			POOR	75,000	
1995	1997	5/27/97	CHINOOK	NSRAA	Hidden Falls CIF	Kasnyku Bay	fed	smolt	38.3/146	Hidden Falls95	Hidden Falls CIF 95-CHINOOK(Hidden Falls)	1:1.4,2.4			GOOD	944,457	
1995	1997	5/21/97	CHINOOK	NSRAA	Medveje CIF	Medveje		smolt	40.3	Medveje H95	Medveje CIF 95-CHINOOK	1:1.3,2.4				1,052,995	
1995	1997	6/10/97	CHINOOK	DIPAC	Gastineau Hatchery	Juneau area		smolt	24.16	DIPAC95	Gastineau Hatchery 95-CHINOOK	2:1.5,2.3				581,459	
1995	1997	6/10/97	COHO	DIPAC	Gastineau Hatchery	Gastineau & Sheep Cr		smolt	17.92	DIPAC95	Gastineau Hatchery 95-COHO	1:1.5				1,001,453	
1995	1996	vol/4/96	CHUM	NSRAA	E. Port Camden (remote)	E. Port Camden	unfed	fy	vol. emerg.	E. Port Camden (remote)	E. Port Camden (remote) 95-CHUM	1:1.4,2.2				GOOD	944,000
1995	1996	5/17-24/96	CHUM	DIPAC	Gastineau Hatchery	Gastineau Channel		fy		DIPAC95	Gastineau Hatchery 95-CHUM	3:1.5			GOOD-FAIR	844,000	
1995	1996	5/18/96	CHUM	DIPAC	Gastineau Hatchery	Sheep Creek	netpen	fy	1.48	DIPAC95	Gastineau Hatchery 95-CHUM	1:1.5+2.4				GOOD	61,875,348
1995	1996	5/14/96	CHUM	DIPAC	Gastineau Hatchery	Boat Harbor		fy	0.7	DIPAC95	Gastineau Hatchery 95-CHUM	1:1.5+2.3				GOOD	19,569,902
1995	1996	5/22/96	CHUM	DIPAC	Gastineau Hatchery	Hidden Falls CIF		fy		Hidden Falls95	Hidden Falls CIF 95-CHUM	1:1.3,2.3				GOOD	8,536,780
1995	1996	5/11-24/96	PINK	NSRAA	Hidden Falls CIF	Kasnyku Bay		fy	1.52/55	Hidden Falls95	Hidden Falls CIF 95-CHUM	1:1.3,2.3				GOOD	49,715,678
1995	1996	5/11-24/96	PINK	PWSAC	Armin F. Koernig Hatchery	Sawmill Cove		fy	0.48	AKF95	Armin F. Koernig Hatchery 95-PINK	1:1.3,2.3			GOOD	108,636,977	
1995	1996	5/7-28/96	PINK	PWSAC	Cannery Creek Hatchery	Unakwik Inlet		fy	0.27	CKH95	Cannery Creek Hatchery 95-PINK	1:1.3,2.3				GOOD	140,441,172
1995	1996		PINK	DIPAC	Gastineau Hatchery	Gastineau Channel		fy	0.49	Gastineau95	Gastineau Hatchery 95-PINK	1:1.5			GOOD	8,743,899	
1995	1996	na	PINK	VFDA	Solomon Gulch Hatchery	Solomon Gulch Hatchery	fed	fy	197/34.2	Solomon Gulch95	Solomon Gulch Hatchery 95-PINK(Solomon Gulch)	1:1.6				GOOD	225,399,327
1995	1996	5/3,9,6/2/96	PINK	PWSAC	Wally H. Noerenberg Hatchery	Wally H. Noerenberg Hatchery		fy	3, 28, 1.13	WNH95	Wally H. Noerenberg Hatchery 95-PINK(WNH)	1:1.8				GOOD	169,508,993
1995	1996	5/19/96	SOCKEYE	SSRAA	Beaver Falls CIF	Virginia Lake		fy		Virginia Lake95	Beaver Falls CIF 95-SOCKEYE(Virginia Lake)	1:1.6,2.3				GOOD	1,207,867
1995	1996	5/16,10/18/96	SOCKEYE	SSRAA	Beaver Falls CIF	High Smith Lake		fy, presmolt	265/33.6 & 9	High Smith Lake95	Beaver Falls CIF 95-SOCKEYE(High Smith Lake)	1:1.6,2.3,3.2				GOOD	356,956
1995	1996	6/7,13/96	SOCKEYE	ADF&G	Snettisham CIF	Sweetheart Lake	unfed	fy	0.18	Sweetheart95	Snettisham CIF 95-SOCKEYE(Sweetheart)	1:1.4				728,798	
1995	1996	6/17-7/1/96	SOCKEYE	ADF&G	Snettisham CIF	Chiklat Lake	unfed	fy	0.14	Chiklat M195	Snettisham CIF 95-SOCKEYE(Chiklat M1)	1:1.5,2.3				2,691,311	
1995	1996		SOCKEYE	ADF&G	Snettisham CIF	Chiklat Lake		fy		Chiklat M295	Snettisham CIF 95-SOCKEYE(Chiklat M2)	1:1.5,2.3+3.3				see comment	
1995	1996	6/16-25/96	SOCKEYE	ADF&G	Snettisham CIF	U. Tatsamenie Lake	unfed	fy	0.11	U. Tatsamenie95	Snettisham CIF 95-SOCKEYE(U. Tatsamenie)	2:1.					

TABLE 1. THERMAL MARK RELEASES IN ALASKA FROM 1993-1998.

YEAR	YEAR OF RELEASE	DAY/ MONTH/YE	AR	SPECIES	AGENCY	FACILITY	FINAL RELEASE SITE	FINAL REARING TREATMENT	RELEASE DISPOSITION	SIZE AT RELEASE (g/mm)	TM ID (Informal)		RBR	PREHATCH GRAPHIC	POSTHATCH GRAPHIC	MARK QUALITY	# TM RELEASED (actual)
											TM ID (Informal)	FORMAL TM ID					
1995	1996	6/6/28	SOCKEYE	CIAA	Crooked Cr Hatchery	Chenik Lake	Chenik Lake	fed	fy	0.25	Chenik Lake95	Crooked Cr. Hatchery 95-SOCKEYE(Chenik Lake)	2:1.3			POOR	951,000
1995	1996	6/6/28	SOCKEYE	CIAA	Crooked Cr Hatchery	Paint River Lake	Paint River Lake	fed	fy	0.28	Paint River Lake95	Crooked Cr. Hatchery 95-SOCKEYE(Paint River Lake)	2:1.3			POOR	500,000
1995	1996	6/6/28	SOCKEYE	CIAA	Crooked Cr Hatchery	Urus Lake	Urus Lake	fed	fy	0.27	Urus Lake95	Crooked Cr. Hatchery 95-SOCKEYE(Urus Lake)	2:1.3			POOR	250,000
1996			CHINOOK	NSRAA	Hidden Falls CIF	Kasnyku Bay	Hidden Falls	fy	smolt		Hidden Falls96	Hidden Falls CIF 96-CHINOOK	1:1.4, 2.4 or 4.3				1,070,885
1996			CHINOOK	NSRAA	Medveje CIF	Medveje	Medveje	smolt	smolt		Medveje H96	Medveje CIF 96-CHINOOK	1:1.3, 2.4				1,119,512
1996	1998		CHINOOK	DIPAC	Gastineau Hatchery	Gastineau Hatchery	Gastineau Channel	fed	fy		DIPAC96	Gastineau Hatchery 96-CHINOOK	1:1.5				600,000
1996	1997	5/27/97	COHO	CIAA	Trail Lakes Hatchery	Bear Lake	Bear Lake	fed	fy		Bear Lake96	Trail Lakes Hatchery 96-COHO(Bear Lake)	1:1.2				448,700
1996	1998		COHO	DIPAC	Gastineau H	Gastineau Channel	Gastineau Channel	smolt	smolt		DIPAC96	Gastineau H. 96-COHO	1:1.4				825,000
1996	1997	vol4/97	CHUM	NSRAA	E Port Camden (remote)	E Port Camden	E Port Camden	unfed	vol. fy	na	E. Port Camden96	E. Port Camden (remote) 96-CHUM	1:1.4, 2.2				942,000
1996	1997	3/12,5/12-20	CHUM	DIPAC	Gastineau Hatchery	Sheep, Boat Harbor	Gastineau Channel	fed&unfed	fy	1.26	DIPAC96	Gastineau Hatchery 96-CHUM	1:1.6				80,784,337
1996	1997	5/21/97	CHUM	NSRAA	Hidden Falls CIF	Kasnyku Bay	Hidden Falls	fy	fy	1.75/62	Hidden Falls96	Hidden Falls CIF 96-CHUM	1:1.3, 2.4				37,544,876
1996	1997		CHUM	PWSAC	Armin F. Koerning Hatchery	Sawmill Cove	Sawmill Cove	fed	fy	1.84/59.1	AFK 96	Armin F. Koerning Hatchery 96-CHUM	1:1.4				8,524,584
1996	1997	5/30/97	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Lake Bay	Lake Bay	fed	fy, late	1.99	WNH late96	Wally H. Noerenberg Hatchery 96-CHUM(WNH late)	1:1.3, 2.2				35,710,930
1996	1997	5/8/97	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Lake Bay	Lake Bay	fed	fy, early	1.37	WNH early96	Wally H. Noerenberg Hatchery 96-CHUM(WNH early)	1:1.3, 2.4				34,252,642
1996	1997	5/20/97	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Port Chalmers	Port Chalmers	fed	fy, early	1.86	Port Chalmers early96	Wally H. Noerenberg Hatchery 96-CHUM(Port Chalmers early)	1:1.6, 2.2				6,549,947
1996	1997	5/31/97	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Port Chalmers	Port Chalmers	fed	fy, late	2.17	Port Chalmers late96	Wally H. Noerenberg Hatchery 96-CHUM(Port Chalmers late)	1:1.6, 2.2				10,722,528
1996	1997	5/27-6/13/97	PINK	PWSAC	Armin F. Koerning Hatchery	Sawmill Cove	Sawmill Cove	fed	fy, late	1.22/50.2	AFK late96	Armin F. Koerning Hatchery 96-PINK(AFK late)	1:1.4				35,308,253
1996	1997	5/17-26/97	PINK	PWSAC	Armin F. Koerning Hatchery	Sawmill Cove	Sawmill Cove	fed	fy, early	4741.2	AFK early96	Armin F. Koerning Hatchery 96-PINK(AFK early)	1:1.4+2.3				18,256,356
1996	1997	5/7-26/97	PINK	PWSAC	Cannery Creek Hatchery	Cannery Creek	Cannery Creek	fy	fy	26/35	CCH 96	Cannery Creek Hatchery 96-PINK	1:1.3, 2.3 or 2.4				136,838,852
1996	1997	5/11/97	PINK	PWSAC	Wally H. Noerenberg Hatchery	Lake Bay	Lake Bay	early rel	fed fy	0.35	WNH early96	Wally H. Noerenberg Hatchery 96-PINK(WNH early)	1:1.8				75,874,783
1996	1997	6/7/97	PINK	PWSAC	Wally H. Noerenberg Hatchery	Lake Bay	Lake Bay	late rel	fed fy	1.51	WNH late96	Wally H. Noerenberg Hatchery 96-PINK(WNH late)	1:1.8+2.3				30,565,673
1996	1997	4/23,5/31/98	PINK	VFDA	Solomon Gulch Hatchery	Solomon Gulch Hatchery	Solomon Gulch Hatchery	fy	fy	387/39.58	Solomon Gulch96	Solomon Gulch Hatchery 96-PINK	1:1.6				188,862,084
1996	1997	5/12/97	PINK	DIPAC	Gastineau Hatchery	Gastineau Channel	Gastineau Channel	fy	fy	0.55	Gastineau H.96	Gastineau Hatchery 96-PINK	1:1.4				5,901,486
1996	1997	5/19/97	SOCKEYE	SSRAA	Beaver Falls CIF	Hugh Smith Lake	Hugh Smith Lake	fed	fy	24/3.02	Hugh Smith Lake96	Beaver Falls CIF 96-SOCKEYE(Hugh Smith Lake)	1:1.6, 2.2				572,547
1996	1998	6/12/98	SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	Speel Arm	freshwater/fg	smolt	9.61/98.3	Speel Arm late/fg96	Snettisham CIF 96-SOCKEYE(Speel Arm late/fg)	1:1.3, 2.4				1,580,886
1996	1998	5/20/98	SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	Speel Arm	sal/water/fg	smolt	9.5/98	Speel Arm early/fg96	Snettisham CIF 96-SOCKEYE(Speel Arm early/fg)	1:1.3, 2.3				1,484,145
1996	1998	6/10/98	SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	Speel Arm	freshwater/sm	smolt	5.48/83.1	Speel Arm late/sm96	Snettisham CIF 96-SOCKEYE(Speel Arm late/sm)	1:1.4, 2.3				1,298,987
1996	1998	5/19/98	SOCKEYE	ADF&G	Snettisham CIF	Speel Arm	Speel Arm	sal/water/sm	smolt	8.06/85.25	Speel Arm early/sm96	Snettisham CIF 96-SOCKEYE(Speel Arm early/sm)	1:1.4, 2.4				1,275,781
1996	1997	6/30-7/3/97	SOCKEYE	ADF&G	Snettisham CIF	Chilkat Lake	Chilkat Lake	unfed	fy	0.161	Chilkat 96	Snettisham CIF 96-SOCKEYE(Chilkat)	1:1.5, 2.3				3,038,171
1996	1997	6/16-27/97	SOCKEYE	ADF&G	Snettisham CIF	U. Tatzamenie Lake	U. Tatzamenie Lake	unfed	fy	0.171	U. Tatzamenie96	Snettisham CIF 96-SOCKEYE(U. Tatzamenie)	1:1.5				3,940,933
1996	1997	6/16-27/1997	SOCKEYE	ADF&G	Snettisham CIF	U. Tatzamenie Lake	U. Tatzamenie Lake	unfed	fy	0.171	U. Tatzamenie96	Snettisham CIF 96-SOCKEYE(U. Tatzamenie)	1:1.5+2.3				3,940,933
1996	1997	6/16/97	SOCKEYE	ADF&G	Snettisham CIF	Tahltan Lake(Canada)	Tahltan Lake	unfed	fy	0.14	Tahltan96	Snettisham CIF 96-SOCKEYE(Tahltan)	1:1.7 (2xcheck)				2,247,730
1996	1997	6/24/97	SOCKEYE	ADF&G	Snettisham CIF	Tuya (Canada)	Tuya	unfed	fy	0.141	Tuya96	Snettisham CIF 96-SOCKEYE(Tuya)	1:1.4				2,610,838
1996	1997	6/9/97	SOCKEYE	CIAA	Trail Lakes Hatchery	Tustumena Lake	Tustumena Lake	fed	fy	15-26	Tustumena96	Trail Lakes Hatchery 96-SOCKEYE(Tustumena)	1:1.2				6,013,000
1996	1997		SOCKEYE	CIAA	Trail Lakes Hatchery	Tustumena Lake	Tustumena Lake	smolt	smolt		Tustumena smolt96	Trail Lakes Hatchery 96-SOCKEYE(Tustumena smolt)	1:1.2				POOR
1996	1997	6/26/97	SOCKEYE	CIAA	Trail Lakes Hatchery	Packers Lake	Packers Lake	fed	fy	0.28	Packers 96	Trail Lakes Hatchery 96-SOCKEYE(Packers)	1:1.3 (2?)				246,570
1996	1997	10/2/97	SOCKEYE	CIAA	Trail Lakes Hatchery	Packers Lake	Packers Lake	presmolt	smolt	2.34	Packers presmolt96	Trail Lakes Hatchery 96-SOCKEYE(Packers presmolt)	1:1.3				HOPELESS
1996	1997	10/2/97	SOCKEYE	CIAA	Trail Lakes Hatchery	Packers Lake	Packers Lake	smolt	smolt		Packers smolt96	Trail Lakes Hatchery 96-SOCKEYE(Packers smolt)	1:1.3				FAIR
1996	1997	5/28/97	SOCKEYE	CIAA	Trail Lakes Hatchery	Bear Lake	Bear Lake	fed	fy	0.34	Bear Lake96	Trail Lakes Hatchery 96-SOCKEYE(Bear Lake)	1:1.2				POOR-FAIR
1996	1997	5/18/97	SOCKEYE	CIAA	Trail Lakes Hatchery	Hidden Lake	Hidden Lake	unfed	fy	0.08	Hidden Lake96	Trail Lakes Hatchery 96-SOCKEYE(Hidden Lake)	1:1.4 (5?)				1,501,000
1996	1997	5/27/97	COHO	CIAA	Trail Lakes Hatchery	Bear Lake	Bear Lake	fed	fy	0.63	Bear Lake96	Trail Lakes Hatchery 96-COHO(Bear Lake)	1:1.2(2xcheck)				448,700
1997			CHINOOK	NSRAA	Hidden Falls CIF	Kasnyku Bay	Hidden Falls	fy	smolt		Hidden Falls97	Hidden Falls CIF 97-CHINOOK					
1997			CHINOOK	NSRAA	Medveje CIF	Medveje	Medveje	recirc warm	smolt		Medveje 97	Medveje CIF 97-CHINOOK	1:1.3, 2.2+3.3				
1997			CHINOOK	NSRAA	Medveje CIF	Medveje	Medveje	recirc cold	smolt		Medveje 97	Medveje CIF 97-CHINOOK	1:1.3, 2.4				
1997			CHINOOK	DIPAC	Gastineau Hatchery	Gastineau Channel	Gastineau Channel	smolt	smolt		DIPAC97	Gastineau Hatchery 97-CHINOOK					
1997	1998		COHO	DIPAC	Gastineau Hatchery	Gastineau Channel	Gastineau Channel	smolt	smolt		DIPAC97	Gastineau Hatchery 97-COHO	1:1.4				
1997	1998		CHUM	DIPAC	Gastineau Hatchery	Gastineau Channel	Gastineau Channel	fy	fy		Gastineau 97	Gastineau Hatchery 97-CHUM	1:1.5				49,155,000
1997	1998		CHUM	DIPAC	Gastineau Hatchery	Amalga Harbor	Amalga Harbor	fy	fy		Amalga97	Gastineau Hatchery 97-CHUM(Amalga97)	1:1.5				24,247,000
1997	1998		CHUM	DIPAC	Gastineau Hatchery	Boat Harbor	Boat Harbor	fy	fy		Boat Harbor97	Gastineau Hatchery 97-CHUM(Boat Harbor97)	1:1.5+2.4				7,000,000
1997	1998		CHUM	DIPAC	Gastineau Hatchery	Limestone	Limestone	fy	fy		Limestone97	Gastineau Hatchery 97-CHUM(Limestone97)	1:1.5+2.3				14,000,000
1997	1998		CHUM	NSRAA	Hidden Falls CIF	Kasnyku	Hidden Falls	fy	fy		Hidden Falls97	Hidden Falls CIF 97-CHUM	1:1.3, 2.3				37,809,253
1997	1998		CHUM	PWSAC	Armin F. Koerning Hatchery	AFK	AFK	fy, late	large	1.4-1.5	AFK 97	Armin F. Koerning Hatchery 97-CHUM	1:1.4, 2.2				10,121,106
1997	1998	5/13/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	WNH	WNH	fy, early	fy	1.73-2.09	WNH97early	Wally H. Noerenberg Hatchery 97-CHUM(WNH97early)	1:1.3-2.2				GOOD
1997	1998	5/20/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	WNH	WNH	fy, late	fy	1.92-2.23	WNH97late	Wally H. Noerenberg Hatchery 97-CHUM(WNH97late)	1:1.3-2.4				GOOD
1997	1998	8/28/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	WNH	WNH	fy, late	fy	1.84-2.26	WNH97late	Wally H. Noerenberg Hatchery 97-CHUM(WNH97late)	1:1.3-2.4				GOOD
1997	1998	4/15/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Port Chalmers	Port Chalmers	fy, early	fy	0.7	PortChalmers97early	Wally H. Noerenberg Hatchery 97-CHUM(PortChalmersearly)	1:1.2, 2.3				GOOD
1997	1998	5/7/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Port Chalmers	Port Chalmers	fy, early	fy	1.33-1.77	PortChalmers97early	Wally H. Noerenberg Hatchery 97-CHUM(PortChalmersearly)	1:1.2-2.3				GOOD
1997	1998	4/15/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Port Chalmers	Port Chalmers	fy, early	fy	0.7	PortChalmers97early	Wally H. Noerenberg Hatchery 97-CHUM(PortChalmersearly)	1:1.3-2.5				GOOD
1997	1998	5/7/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Port Chalmers	Port Chalmers	fy, early	fy	1.33-1.77	PortChalmers97early	Wally H. Noerenberg Hatchery 97-CHUM(PortChalmersearly)	1:1.3-2.5				GOOD
1997	1998	5/7/98	CHUM	PWSAC	Wally H. Noerenberg Hatchery	Port Chalmers	Port Chalmers	fy, late	fy	1.33-1.43	PortChalmers97late	Wally H. Noerenberg Hatchery 97-CHUM(PortChalmerslate)	1:1.2-2.4				GOOD
1997	1998	5/7/98	PINK	PWSAC	Wally H. Noerenberg Hatchery	AFK (Sawmill Bay)	AFK	fy, early	fy	34-49	AFK 97	Wally H. Noerenberg Hatchery 97-PINK(AFK 97)	1:1.4				66,682,987
1997	1998	5/23/98	PINK	PWSAC	Wally H. Noerenberg Hatchery	AFK (Sawmill Bay)	AFK	fy, late	large	1.1-1.2	AFK 97	Wally H. Noerenberg Hatchery 97-PINK(AFK 97)	1:1.4+2.3				19,142,357
1997	1998	5/24/98	PINK	PWSAC	Wally H. Noerenberg Hatchery	AFK (Sawmill Bay)	AFK	fy, late	large	1.2-1.23	AFK 97	Wally H. Noerenberg Hatchery 97-PINK(AFK 97)	1:1.4+2.4				20,148,891
1997	1998	5/6-29/98	PINK	PWSAC	Cannery Creek Hatchery	CCH (Unakwik Inlet)	CCH	fy	fy	28-42	CCH 97	Cannery Creek Hatchery 97-PINK	1:				

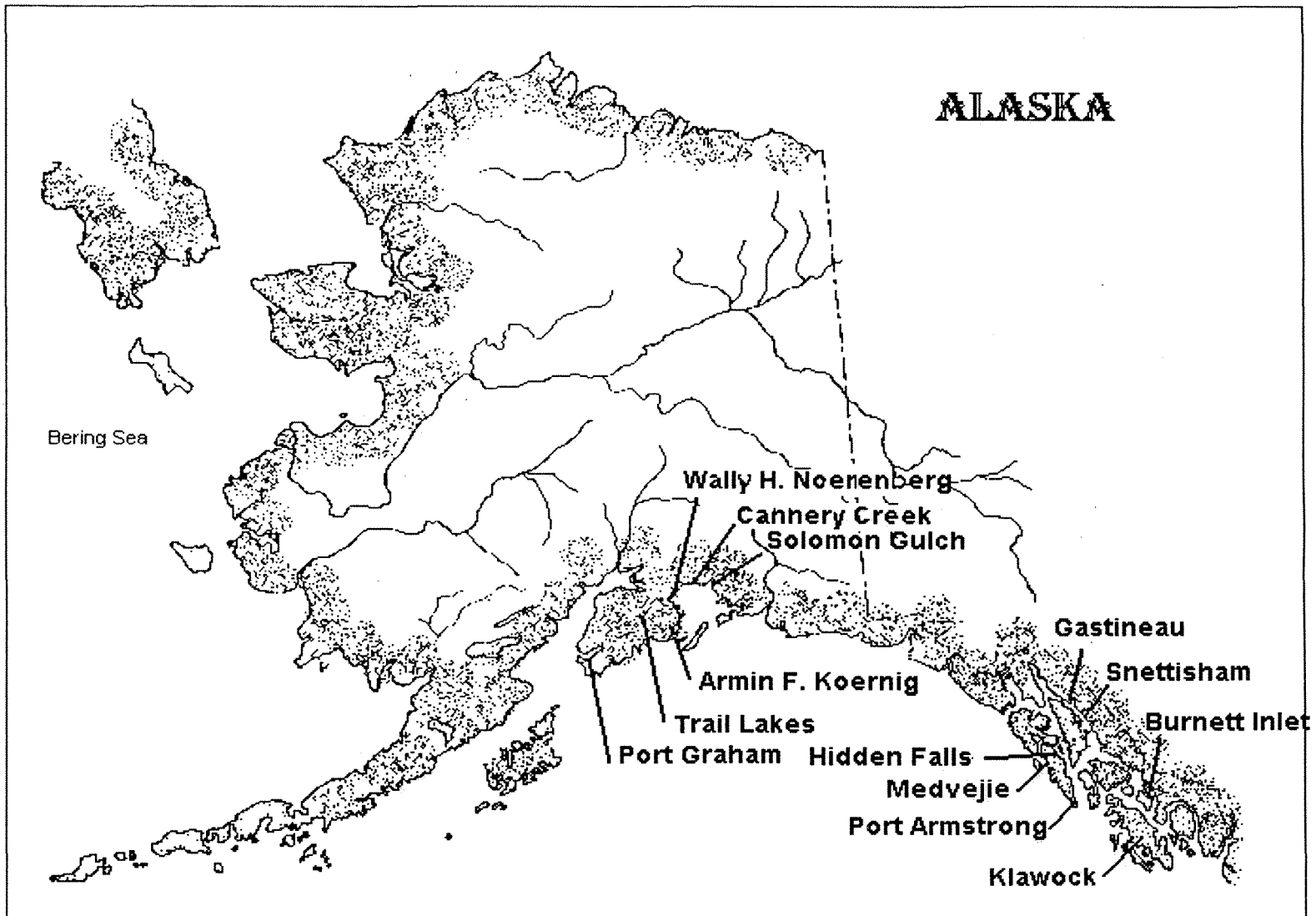


Figure 1. Hatchery facilities in Alaska to thermal mark 1998 brood pink, chum, sockeye, chinook, and coho salmon.



## # OTOLITHS PROCESSED FOR MANAGEMENT OF FISHERIES IN SOUTHEAST ALASKA

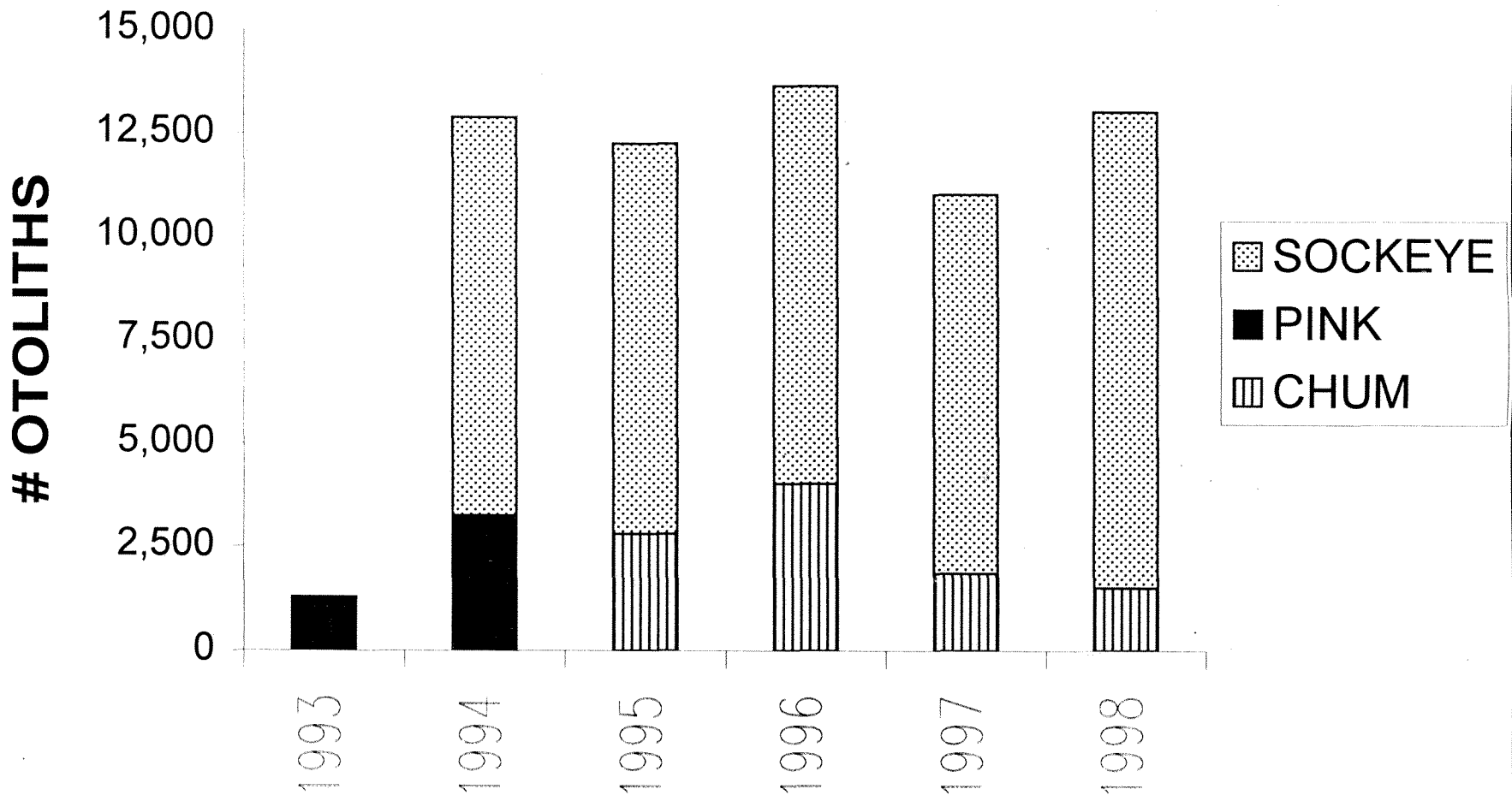


FIGURE 2. Volume of sockeye, pink, and chum otoliths processed for management of Southeast Alaska fisheries, 1993-1998.

# # OTOLITHS EVALUATED FOR THERMAL MARKS

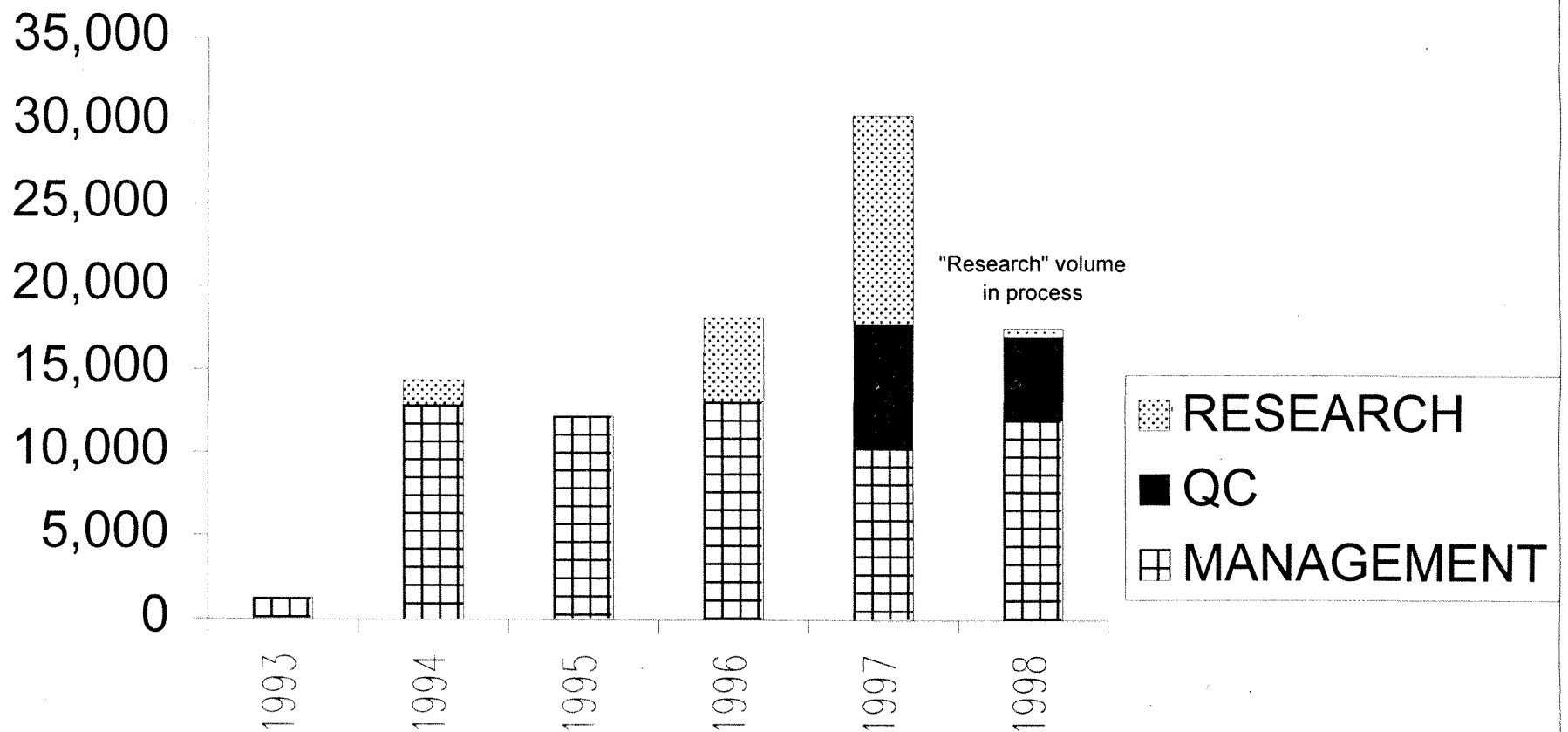


FIGURE 3. Volume of otoliths processed for thermal marks at the ADFG - CWT Otolith Processing Lab, 1993-1998 (does not include 2nd within-lab reading).