

Fishery Data Series Number 98-4

Age, Sex and Length Distributions of
Chinook Salmon Escapement Samples from the
Goodnews, Kanektok and Togiak Rivers,
Togiak National Wildlife Refuge, Alaska, 1997

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United States Department of the Interior
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Togiak National Wildlife Refuge

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Age, Sex and Length Distributions of Chinook Salmon Escapement Samples from the Goodnews, Kanektok and Togiak Rivers, Togiak National Wildlife Refuge, Alaska, 1997

ABSTRACT - Chinook salmon *Oncorhynchus tshawytscha* escapement sampling for age, sex and length (ASL) was conducted by U.S. Fish and Wildlife Service field crews on the Goodnews, Kanektok and Togiak Rivers within the Togiak National Wildlife Refuge (Refuge) in 1997. A total of 487 chinook salmon carcasses were sampled. Scale impressions were used to determine fish ages. Seven different age designations were determined ranging from age 1.2 to 1.5 and 2.2 to 2.4. Most fish sampled lived one winter in fresh water after hatching. After out-migration most chinook salmon from these systems spent 4 years in the ocean environment before returning to spawn in their 6th year (age 1.4). Maximum ages observed were 1.5 and 2.4. Although these are relatively small sample sizes for most rivers, this collection of chinook salmon escapement samples provides recent published age, sex and length composition data for Refuge waters.

INTRODUCTION

The Togiak National Wildlife Refuge (Refuge) encompasses approximately 4.7 million acres in southwest Alaska (Figure 1). Fourteen major drainages ranging in area from 130 to 5,200 km² (50 to 2,000 mi²) flow from the Refuge into Bristol and Kuskokwim Bays. Each drainage terminus is located in one of four commercial fishery management districts. One of the primary objectives of the Refuge is to conserve fish and wildlife populations and habitat in their natural diversity.

Although the Alaska Department of Fish and Game (ADFG) has primary management authority over commercial fisheries activities to ensure an adequate spawning escapement, the U.S. Fish and Wildlife Service (Service) works cooperatively with ADFG in collecting pertinent data which can assist in better management. To monitor long term health of individual salmon runs, forecast future runs, or evaluate escapement goals, it is necessary to sample both the harvest and spawning escapement.

The Alaska Department of Fish and Game samples commercial catches of chinook *Oncorhynchus tshawytscha*, sockeye *O. nerka*, chum *O. keta* and coho *O. kisutch* salmon from the main commercial fishing districts (Quinhagak, Goodnews, Togiak, and Nushagak) along the Refuge coastline. Currently ADFG collects escapement samples from live chinook salmon through the fish weir on the Middle Fork of the Goodnews River and from salmon species migrating past the counting tower on the Kanektok River (Francisco et al. 1995; Menard and Caole, in prep.). No chinook salmon are collected from the Togiak River drainage. Increasing budget restraints over the last fifteen years have eliminated all other chinook salmon escapement sampling programs

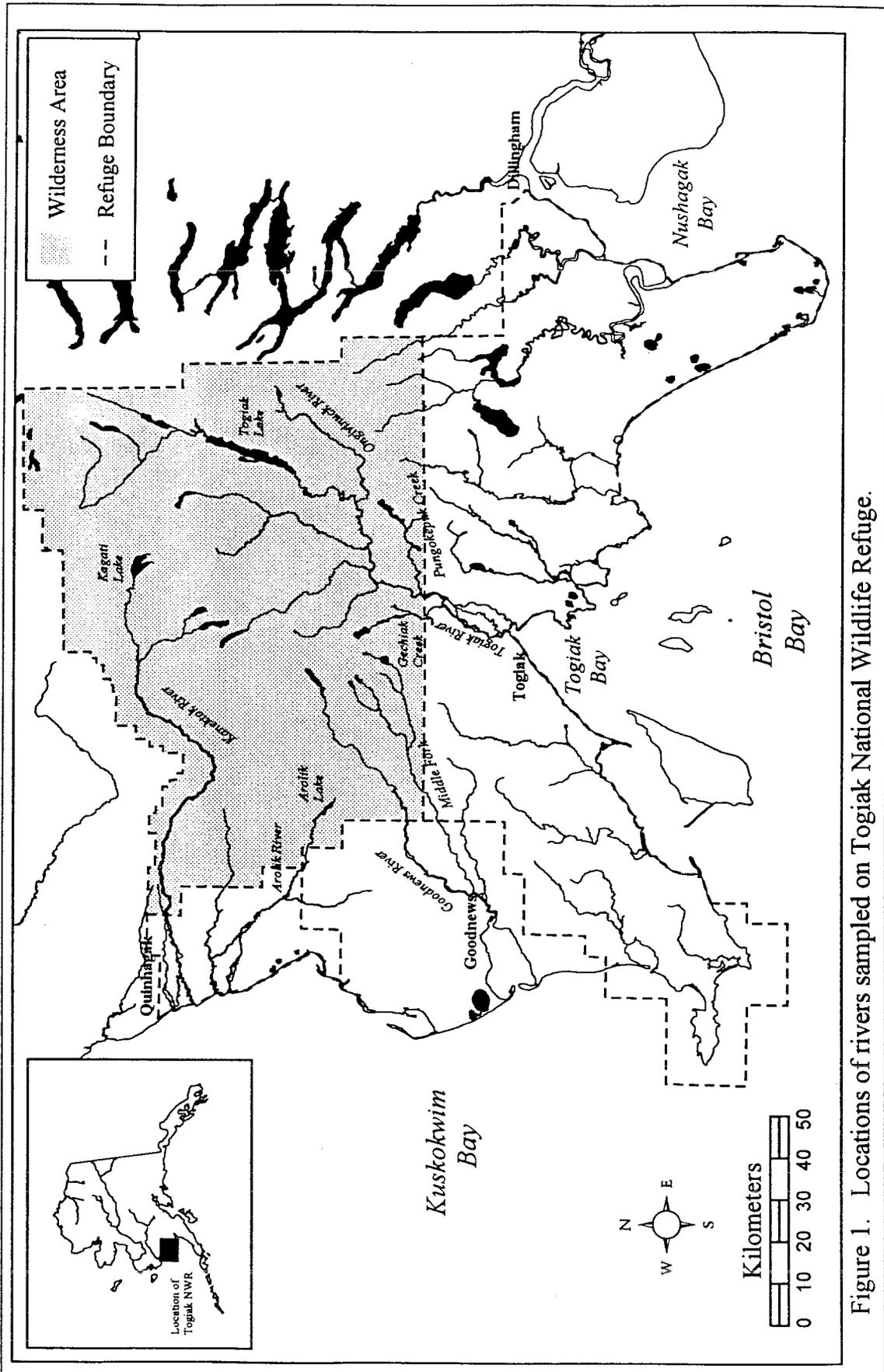


Figure 1. Locations of rivers sampled on Togiak National Wildlife Refuge.

ADFG conducted within the Refuge. Previously the Alaska Department of Fish and Game collected age, sex and length (ASL) data from live chinook salmon escapement from both the Kanektok and Middle Fork Goodnews Rivers. These collections were made using gillnets and beach seines on the Kanektok River from 1981 to 1987 as part of a side scan sonar project (Molyneaux and DuBois 1996). In 1997, escapement samples were collected with beach seines on the Kanektok River during the operation of a counting tower as a joint project with the Native Village of Kwinhagak (Menard and Caole, in prep.). On the Middle Fork Goodnews River, ASL samples were collected with beach seines from 1981 to 1990 as part of a counting tower project and from 1991 to 1996 with a live trap in a weir that replaced the counting tower (Molyneaux and DuBois 1996).

Since 1992, the Togiak Refuge has collected age, sex and length data from chinook salmon escapement from the Togiak, Kanektok and Goodnews Rivers and in other small rivers in conjunction with resident fish inventory and public use management programs (Lisac and MacDonald 1995; MacDonald 1996; MacDonald 1997). Chinook salmon escapement was sampled in 1997 from the Arolik, North Fork Goodnews, Kanektok, and Togiak Rivers (Figure 1). Samples were also collected from the Ongivinuck River, Gechiak and Pungokepuk Creeks, which are tributaries to the Togiak River.

This report documents data collected during 1997.

The objectives of this report are to:

1. Document the age, sex and length composition of the escapement component of chinook salmon returns to Refuge rivers targeted by commercial fisheries.
2. Compile this data on an annual basis and make available to resource managers in a standard format archived in the State Research and Technical Services (RTS) system.

METHODS

Refuge personnel sampled chinook salmon carcasses encountered along various Refuge rivers from July 28 to September 2. Samples from the Kanektok, North Fork Goodnews, and Togiak Rivers were collected by River Rangers on an opportunistic basis. Samples the Arolik and Ongivinuck Rivers and from Gechiak and Pungokepuk Creeks were collected opportunistically during short duration fisheries surveys. During annual staff training and orientation, field crews are taught correct scale collection, length measurement, and recording techniques. The goal is to collect as many samples as possible throughout the season. Ideally, a target of 210 chinook salmon in numerous, separate time strata throughout the season would be collected (Molyneaux and DuBois 1996). However, run timing, water levels and field crew time commitment to other duties severely affect the availability of salmon carcasses for sampling.

Standard age, sex and length sampling as outlined in Clutter and Whitesel (1956) and previously reported in MacDonald (1997) are followed. Lengths are measured from mid-eye to fork of tail

and recorded to the nearest millimeter. Sex is determined using external morphologic characteristics (Morrow 1980). Scales are collected on gum cards or in coin envelopes. Data are recorded on ADFG Standard Age Weight Length Mark-Sense Data Forms (Version 1.1) (ADFG 1990). Data forms are optically scanned by ADFG Research and Technical Services to produce an electronic data file. Each data set is assigned a file number which corresponds to the State fisheries management area, the species sampled, and the year of collection (Heineman 1989a). Electronic data sets are archived and available from RTS and the Refuge (Appendix A). Scale impressions are archived with the Togiak National Wildlife Refuge.

Scale ages are determined from acetate impressions and reported using the European system of age designation. The number of winters the fish spent in fresh water (not counting the winter the egg was in the gravel) is shown as an Arabic numeral followed by a dot, then the number of winters the fish spent in the ocean. Therefore, a salmon of age 1.3 spent 1 winter in fresh water after hatching and 3 winters in the ocean; the fish is four years old and is in its fifth year when it returns to spawn (Mosher 1969).

Completed data sets are analyzed using the crosstabulation program BBXPEXE (Heineman 1989b) which produces unweighted estimates of mean length and percentage by age group, and the associated standard error estimates (Riffe 1994). Summary tables of results for the Goodnews, Kanektok and Togiak Rivers are presented here as Tables 1-3. Rivers with sample sizes less than 20 fish are provided in the text.

RESULTS

A total of 484 chinook salmon carcasses were sampled from the Kanektok River (275), Goodnews River (103), and Togiak River drainage (106) (Appendix A). The Togiak River drainage data set includes 29 samples from tributaries to the Togiak River and 77 samples collected from the main Togiak River. An additional sample of 3 carcasses was collected from the Arolik River. Ages were determined for 468 samples. The other 19 samples were either regenerated scales or rejected as unreadable. Twelve samples were successfully aged but lacked a corresponding sex determination or length measurement and are not included in the sample.

Summary tables present the age distribution, mean length by age group and sex for the North Fork Goodnews and Kanektok Rivers and the Togiak River drainage (Tables 1-3). Too few samples were collected from the Arolik River to provide any meaningful analysis.

From the Goodnews River the predominant age classes were 1.3 (13%), 1.4 (59%) and 1.5 (17%) for the 103 chinook escapement samples collected. Fish spending one year in fresh water ranged in age from 1.2 to 1.5 and accounted for 96% of the sample. Approximately 3% of the chinook salmon sampled spent 2 years in fresh water before going to sea and returned as age 2.2 to 2.4 adults. The remaining 1% of the fish were unreadable scales. Females accounted for 55% of the sample and had a mean length of 804 mm while males accounted for 45% of the sample and had a

Table 1. Mean lengths (mm) of chinook salmon by sex and age group from escapement samples collected from the North Fork Goodnews River, Alaska, 1992, 1994 - 1997.

Year	Sample Dates	Sample Size	Sex	Percent	Age Class										
					Unknown	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	
1992	8/6-8/20	233	M	59%	Mean Length	768	512	639	763	884	884	607	579	800	970
					Std. Error	37.17	22.92	27.65	14.47	17.75	67.66	57.82	53.37		
					Range	500-1040	375-660	460-940	575-1070	650-1030	520-740	425-690	690-1070		
					Sample Size	17	12	24	45	24	3	4	7	1	
			F	41%	Mean Length	866	590	760	864	869	907	775	886		
					Std. Error	7.82		140.00	9.64	6.63	19.22	75.00	17.12		
					Range	810-905		620-900	780-955	800-1025	885-945	700-850	815-960		
					Sample Size	16	1	2	20	44	3	0	2	8	
1994	8/8-8/16	88 ¹	M	44%	Mean Length	826	540	686	795	920	935	920	940		
					Std. Error	41.03		26.35	23.00	32.20					
					Range	655-935		635-830	640-1000	855-1035					
					Sample Size	7	1	7	14	6	1	0	1	1	
			F	56%	Mean Length	856		817	788	852	860				
					Std. Error	18.21		2.50	17.52	12.27	7.64				
					Range	705-970		815-820	650-855	740-925	845-870				
					Sample Size	14	0	2	12	18	3	0	0	0	
1995	7/16-8/26	89 ¹	M	51%	Mean Length	784		661	713	927					
					Std. Error	29.66		25.19	28.13	10.90					
					Range	716-954		611-748	657-840	823-1044					
					Sample Size	8	0	5	6	26	0	0	0	0	
			F	49%	Mean Length	841		739	864	869	967				
					Std. Error	19.03		80.50	38.00	8.25					
					Range	754-928		659-820	826-902	798-971					
					Sample Size	8	0	2	2	30	1	0	0	0	

¹ Sample sizes do not equal number of fish due to samples of unknown sex or unknown length.

-- continued --

Table 1. Mean lengths (mm) of chinook salmon by sex and age group from escapement samples collected from the North Fork Goodnews River, Alaska, 1992, 1994 - 1997 (page 2 of 2).

Year	Sample Dates	Sample Size	Sex	Percent	Age Class																
					Unknown	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4							
1996	8/5-8/20	100	M	61%	735	594	757	861	943												
					100.09	19.68	10.55	21.86	34.86												
					478-989	539-632	643-865	707-1015	855-1052												
					5	4	29	18	5	0	0	0	0	0	0	0	0	0	0	0	0
1997	7/28-8/25	103 ¹	M	45%	660	568	689	897	878												
					100.09	23.97	52.12	12.83	24.55												
					478-989	505-665	275-845	760-1010	830-910												
					5	6	10	23	3	0	1	0	1	0	1	0	1	0	1	0	1
1997	7/28-8/25	103 ¹	F	55%	774	580	743	867	890												
					100.09	41.77	9.26	7.96													
					697-816	660-790	690-960	830-945													
					1	3	3	35	14	0	0	0	0	0	0	0	0	0	0	0	0

¹ Sample sizes do not equal number of fish due to samples of unknown sex or unknown length.

Table 2. Mean lengths (mm) of chinook salmon by sex and age group from escapement samples collected from the Kanektok River, Alaska, 1992 - 1997.

Year	Sample Dates	Sample Size	Sex	Percent	Age Class																
					Unknown	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4							
1992	7/30-8/21	243 ¹	M	61%	Unknown	548	611	772	892	939	675	800	942								
					Mean Length	33.79	32.31	15.91	9.49		51.93	80.50									
					Std. Error	552-1025	542-555	505-881	620-960	610-1021	532-913	720-881									
					Range	15	2	11	32	73	6	2	1								
1993	7/29-8/10	256	M	54%	Unknown	0	2	10	59	4	2	1	2								
					Mean Length	848	600	851	852	902	529	845	859								
					Std. Error	25.17	47.50	16.36	8.15	12.30	46.00										
					Range	655-938	553-648	767-922	602-962	876-935	483-575	843-875									
1994	8/8-8/16	365 ¹	M	59%	Unknown	831	605	771	888	987	730										
					Mean Length	26.69	36.40	11.36	10.28	34.99											
					Std. Error	655-965	500-860	640-970	670-1050	880-1100											
					Range	13	0	10	53	56	6	1	0	0							
1995	7/28-8/15	150	M	47%	Unknown	823	742	770	877	550	867	852									
					Mean Length	13.18	25.53	8.51	14.49		18.28	35.48									
					Std. Error	550-1055	565-920	595-935	740-1005		810-925	625-1010									
					Range	71	0	16	77	25	1	5	9								
1996	7/28-8/15	150	M	47%	Unknown	841	550	700	913												
					Mean Length	45.82	16.95	20.15	9.34												
					Std. Error	519-1033	516-570	648-787	740-1016												
					Range	14	0	3	6	48	0	0	0	0							
1997	7/28-8/15	150	M	47%	Unknown	843	581	911	882	874	851										
					Mean Length	24.86	38.00	19.78	7.61	5.24											
					Std. Error	631-947	543-619	882-949	638-987	864-882											
					Range	15	0	2	3	54	3	0	0	2							

¹ Sample sizes do not equal number of fish due to samples of unknown sex or unknown length.

-- continued --

Table 2. Mean lengths (mm) of chinook salmon by sex and age group from escapement samples collected from the Kanektok River, Alaska, 1992 - 1997 (page 2 of 2).

Year	Sample Dates	Sample Size	Sex	Percent	Age Class																				
					Unknown	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4											
1996	7/28-8/12	150	M	50%	912	523	758	907	950																
					Mean Length	22.59	15.93	18.08	30.49																
					Std. Error	740-1005	453-605	510-890	760-1020	738-1042															
					Range	6	6	33	18	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			F	50%	857	829	861	917																	
					Mean Length	14.37	28.98	7.52	11.36																
					Std. Error	750-942	785-907	770-965	837-980																
					Range	15	4	4	39	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1997	7/28-8/30	275 ¹	M	41%	662	573	718	890																	
					Mean Length	58.83	11.26	35.65	11.03																
					Std. Error	490-749	447-670	493-889	630-1043																
					Range	4	28	12	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
			F	59%	878	781	882	900																	
					Mean Length	12.06	4.42	12.15																	
					Std. Error	845-956	764-990	799-1062																	
					Range	8	0	1	118	26	0	0	0	0	0	0	0	0	0	0	0	0			

¹ Sample sizes do not equal number of fish due to samples of unknown sex or unknown length.

mean length of 742 mm. Males were predominantly age 1.3 and 1.4 while females were predominantly age 1.4 and 1.5.

From the Kanektok River the predominant age class was 1.4 (67%) for the 275 chinook escapement samples collected. Fish spending one year in fresh water ranged in age from 1.2 to 1.5 and accounted for 92% of the sample. Approximately 3% of the chinook salmon sampled spent 2 years in fresh water before going to sea and returned as age 2.2 to 2.4 adults. The remaining 5% of the fish were unreadable scales. Females accounted for 59% of the sample and had a mean length of 865 mm while males accounted for 41% of the sample and had a mean length of 690 mm. Males and females were predominantly age 1.4.

From the Togiak River the predominant age classes were 1.3 (23%) and 1.4 (41%) for the 106 chinook escapement samples collected. Fish spending one year in fresh water ranged in age from 1.2 to 1.5 and accounted for 92% of the sample. Approximately 2% of the chinook salmon sampled spent 2 years in fresh water before going to sea and returned as age 2.3 and 2.4 adults. The remaining 6% of the fish were unreadable scales. Females accounted for 41% of the sample and had a mean length of 801 mm while males accounted for 59% of the sample and had a mean length of 779 mm. Males were predominantly age 1.3 while females were predominantly age 1.4.

DISCUSSION AND RECOMMENDATIONS

Run timing, water levels and field crew time commitment to other duties can severely affect the availability of salmon carcasses for sampling. Work schedules for field crews would need to be more flexible to concentrate on sampling when carcasses are most plentiful if collection of these samples is determined to be beneficial to fisheries managers.

Predominant scale ages found in these samples (1.3 and 1.4) match ages for other Bristol and Kuskokwim Bay areas. Chinook salmon from the 1995 commercial catch from Togiak Bay had high numbers of age 1.2 (34%) and age 1.4 (45%) fish (Menard 1997). Most chinook salmon return to the Kuskokwim Bay area at age 1.5, 1.4, 1.3 or 1.2 (Francisco et al. 1995). In 1995 age 1.4 chinook salmon made up the majority (57%) of the samples from the Quinhagak commercial catch while chinook salmon ages 1.2 (49%) and 1.4 (38%) made up the majority of the Goodnews Bay commercial catch (Molyneaux and DuBois 1996). In addition, escapement samples at the Middle Fork Goodnews River weir were predominantly age 1.4 (67%) and escapement samples from the counting tower on the Kanektok River were ages 1.2 (49%) and 1.4 (40%) (Menard and Caole, in prep.).

Using opportunistic collection of scales and data from chinook salmon carcasses may bias results to larger fish, underestimate ages and show a higher proportion of females than might actually be comprised in the spawning population (Dunaway 1997; Bev Cross, personal communication). Large chinook salmon are easily visible when washed up on gravel bars or in shallow water while small chinook salmon may blend in with carcasses of other salmon or may be more likely to be carried away by the current and missed in the sample. This may cause higher proportions of older age fish and a larger mean length by age group being reported. Male chinook salmon tend to drift

downstream in a moribund condition after spawning, while females tend to die near their redds (McPherson et al. 1996). Male chinook salmon may be flushed further downstream and potentially missed during sampling.

Aging scales from chinook salmon carcasses may also be a source of bias. Scale reabsorption by salmon during their migration and spawning make it difficult to determine the total age of the fish (Mosher 1969). Salmon carcasses would tend to have maximum reabsorption. Length at age data from our escapement sampling was considerably higher than length at age data from Kuskokwim Bay rivers documented by ADFG (Molyneaux and DuBois 1996) but similar to length at age data from the Togiak River (Menard 1997). The range of ages was very similar between the samples we collected and the escapement and commercial catches from the Goodnews, Kanektok and Togiak Rivers. However, length at age data we collected was approximately 30 mm larger than ADFG's data. It appears that samples collected from weir sites and commercial catches from the Goodnews and Kanektok Rivers would have less scale reabsorption and would better represent the true length at age of the population. Since fork length is less likely to be effected by reabsorption it may be more beneficial to collect sex and length data and extrapolate ages based upon commercial catch and escapement monitoring projects in areas where no escapement sampling is occurring.

Although collecting scales from chinook salmon carcasses may be the only economical method for determining the age and sex composition of escapement where no other monitoring tool is available, processing the scales is expensive and time consuming. The utility of this sampling effort to managers needs to be assessed. Continuing this data base will become increasingly useful in monitoring the commercial fisheries, ensuring viable spawning escapement, and for evaluating escapement goals. If chinook salmon escapement can be monitored when fish enter the river system, as in the Kanektok and Goodnews escapement monitoring projects, it may become unnecessary for the Refuge to continue to collect scales from carcasses. Continuation of this sampling effort is dependent on Togiak Refuge public use survey programs for the Kanektok, Goodnews, and Togiak Rivers and on fishery surveys throughout the Refuge.

The following recommendations would seek to reduce these stated biases and achieve larger sample sizes if this program is continued: (1) concentrate efforts on the larger river systems; (2) allow field crews a flexible work schedule to concentrate on escapement sampling when carcasses are most plentiful (1 - 20 August); (3) identify all salmon carcasses for species to ensure all size ranges of chinook salmon are sampled; (4) dissect chinook salmon carcasses to determine sex of the fish when in doubt; (5) search a variety of habitats for carcasses; (6) spread sampling effort out over the course of spawning and availability of carcasses to collect a representative sample of the spawning escapement; and (7) address potential biases in the age composition from the carcass samples by collecting otoliths to verify scale ages and to determine if scale reabsorption is a factor in aging the scales.

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APPENDIX A

Appendix Table A1. Sample location, size and data file name for chinook salmon escapement samples collected and analyzed by Togiak NWR, 1992-1997.¹

<u>River</u>	<u>Number of Fish</u>		<u>RTS Data File</u>
	<u>Sampled</u>	<u>Aged</u>	<u>Number</u>
Arolik River			
1994	45	28	V0880BA4
1995	17	13	V0880BA5
1996	15	13	V0880BC6
1997	3	3	V0880BAA
Gechiak Creek			
1994	18	16	T1400BA4
1995	5	4	T1400BA5
1997	13	13	T1400BAA
North Fork Goodnews River			
1992	233	200	V0040BA2
1994	88	66	V0040BA4
1995	89	73	V0040BA5
1996	100	94	V0040BA6
1997	103	102	V0040BAA
Kanektok River			
1992	243	213	V0030BB2
1993	256	230	V0030BE3
1994	365	243	V0030BC4
1995	150	121	V0030BA5
1996	150	129	V0030BA6
1997	275	263	V0030BAA
Matogak River			
1996	3	3	T1540BA6
Ongivinuck River			
1997	5	4	T1310BAA
Osviak River			
1996	4	4	T1550BD6

¹ Sample sizes may not equal those analyzed in report due to unknown sex or unknown length.

Appendix Table A1. Sample location, size and data file name for chinook salmon escapement samples collected and analyzed by Togiak NWR, 1992-1997.¹ (continued)

<u>River</u>	<u>Number of Fish</u>		<u>RTS Data File Number</u>
	<u>Sampled</u>	<u>Aged</u>	
Pungokebuk Creek			
1995	2	2	T1320BA5
1997	11	10	T1320BAA
Togiak River			
1992	7	6	T0060BB2
1994	108	77	T0060BA4
1997	77	73	T0060BAA

¹ Sample sizes may not equal those analyzed in report due to unknown sex or unknown length.

