

STATE OF ALASKA

*Jay S. Hammond, Governor*



Annual Performance Report for

INVENTORY AND CATALOGING OF THE SPORT  
FISH AND SPORT FISH WATERS IN  
SOUTHWESTERN ALASKA

by

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VOLUME 19  
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## RESEARCH PROJECT SEGMENT

State: Alaska Name: Sport Fish Investigations  
of Alaska

Project No.: F-9-10

Study No.: G-I Study Title: INVENTORY AND CATALOGING

Job No.: G-I-B Job Title: Inventory and Cataloging  
of the Sport Fish and Sport  
Fish Waters in Southwestern  
Alaska

Period Covered: July 1, 1977 through June 30, 1978.

## ABSTRACT

An 11,200 hectare area on Afognak Island was found to contain 31 lakes with natural populations of Dolly Varden, Salvelinus malma (Walbaum); threespine stickleback, Gasterosteus aculeatus, Linnaeus; rainbow trout, Salmo gairdneri Richardson; coho salmon, Oncorhynchus kisutch (Walbaum); sockeye salmon, O. nerka (Walbaum); and sculpin, Cottus sp.

Nineteen lakes and five Kodiak Island streams were sampled to assess survival, growth trends and species composition of rainbow trout; coho salmon; Dolly Varden, chinook salmon, O. tshawytscha (Walbaum); and Arctic grayling, Thymallus arcticus (Pallas). Additional data on stream flow, temperature, dissolved oxygen, hardness, total alkalinity and pH are presented.

A total of 8,436 chinook salmon, 1,265 steelhead and 18,501 coho salmon passed upstream through Karluk Lagoon weir and 1,163 spawned steelhead (from 1976) passed downstream. Seven of 259 tagged steelhead kelts returned to the weir from 4 to 14 weeks after migrating to salt water and 42.7% of the fish sampled during the fall immigration were repeat spawners. A total count was not obtained for coho and steelhead.

Float trip surveys August 13 and 14 of Dog Salmon (Frazer) and Karluk rivers accounted for 59% (121) and 41% (3,270) of the known chinook salmon escapements. Most of the chinook in Dog Salmon River (n=100) were observed above the falls where 90% of the known run was enumerated through a fish pass over the falls.

Harvest data for 1976 and 1977, as determined through a series of postal questionnaires and creel censuses, are presented. Current harvest rates appear commensurate with the numbers of fish available. Postal surveys were not meaningful in determining sport fish harvest estimates except

when conducted immediately after the fishery; even so, biases of over 2.60 were observed and a creel census was necessary to find and interpret the bias.

Age and length analysis of 531, sport caught Buskin River Dolly Varden, indicated that approximately 15.7% were Age IV, 39.8% Age V, 29.1% Age VI, 13.4% Age VII, 1.1% Age VIII and 0.8% Age IX of the fish harvested during the spring outmigration from Buskin Lake.

Chinook salmon (n=133,109) stocked in Lake Rose Tead during June grew at a similar rate but were slightly larger than age 0.0 natural coho. These chinook should smolt in 1978 and return as adults in 1981 and 1982.

## BACKGROUND

The primary objective of Sport Fish Division projects in Region IV is to optimize the survival and growth of resident and stocked game fish and to maintain the natural runs of anadromous fish.

Region IV is the Kodiak-Afognak Island group and the Alaska Peninsula, south of a line from Cape Douglas to Port Heiden, including the Aleutian Islands. The Kodiak complex is approximately 200 km long by 120 km wide and the Alaska Peninsula section is 1,600 km long extending 800 km into the Bering Sea. The area is mountainous with numerous bays, lakes and streams containing anadromous and resident fish. Much of the area has not been surveyed so the total number of fish producing waters is unknown. Kodiak Island has over 1,000 miles of coastline, over 1,000 lakes (4 hectares or larger in size), and 229 known anadromous fish streams.

The fish stocking program was initiated in 1953 and has continued to the present; however, in order to develop more successful programs, numerous lakes have been chemically rehabilitated and various fish species have been stocked at differential rates. Different sizes of fish have been tested, and various habitat conditions have been studied to optimize growth and survival.

The physical and biological condition of lakes on northeast Kodiak Island has been examined in some detail and the results of these observations are shown in the annual Federal Aid in Fish Restoration Reports 1953-1977. Priority for research, stocking, and general survey work has been centered on the areas of intensive sport fishing effort and on areas where specific data is required to evaluate anticipated land use programs or development activities. Past stream research has centered on waters with steelhead, rainbow trout, coho salmon and chinook salmon; however, increased fishing effort indicates that these studies should be intensified. This report presents specific stream temperature, flow, water chemistry and related data which will form the basis for identifying programs to

determine carrying capacity and areas of critical habitat for salmon, Dolly Varden and trout.

The Federal Aid in Fish Restoration report for the Kodiak area from 1953 to present depicts specific data concerning the size, age and growth of coho, Dolly Varden, chinook, sockeye, and steelhead, S. gairdneri Richardson, from the Kodiak area. Additional data concerning harvest rates and spawning escapement are presented.

These data form the foundation for most management decisions concerning sport fish regulations and land use activities in Region IV.

#### RECOMMENDATIONS

1. Creel census on Buskin and Pasagshak rivers should be continued as needed.
2. The postal survey should be modified and continued annually.
3. The fish producing waters on Afognak Island that will remain as public waters following total implementation of the Alaska Native Claims Settlement Act should be surveyed and cataloged.
4. The survival, growth, and quality of fishing produced by various races and species of stocked fish should be evaluated.
5. The Karluk Lagoon weir should be maintained until approximately November 15, 1978, and the affect of this weir on steelhead movements and survival should be evaluated.
6. Weir sites on one lake and one non-lake stream system on northeastern Kodiak Island should be selected and a study developed to determine the salmonid carrying capacity of these waters.
7. Basic surveys of the chinook populations in the vicinity of Cold Bay should be initiated.

#### OJECTIVES

1. To determine the physical, chemical and biological characteristics of existing and potential sport fishing streams and lakes in the Kodiak area.
2. To establish magnitude, distribution, timing, yearly fluctuations and angler harvest of sport fish populations on Kodiak Island, Afognak Island, and areas of concern to sport fisheries management on the Alaska Peninsula.
3. To investigate, evaluate, and develop plans for the enhancement of anadromous and resident fish stocks.

## TECHNIQUES USED

Techniques described by Murray and Van Hulle (1976) were used in lake surveys, gillnet sampling, age analysis, determination of fish size, escapements, and fish harvest estimates.

Minnow traps with 6.4 mm mesh screens were used to determine the presence of rearing fish in Afognak Island waters, and 3.2 mm mesh traps were used in Kodiak Island waters. The traps were baited with salmon eggs, placed in areas where good catches could be expected, and fished from 3 to 24 hours.

Fish caught in the traps were anesthetized, counted and 25% to 50% of all Dolly Varden and coho salmon were measured. All rainbow/steelhead, sockeye salmon, chum salmon and chinook salmon were measured and sampled for age. A scale sample was removed from every tenth coho, and every tenth Dolly Varden was sacrificed for otolith removal until 50 fish had been sampled. No attempt was made to statistically sample sculpin or stickleback for age and length data. All fish released were placed near their site of capture.

Steelhead kelts were caught in front of the Karluk Lagoon weir by hook and line and seine then tagged and sampled for age-growth data without the aid of anesthetic. Floy Mark II tagging guns were used to insert sequentially numbered, green, anchor tags under the dorsal fin in such a manner that the tag anchor passed through the fin pterygiophores and remained as the applicator was withdrawn. All tagged fish were released downstream from the weir after tagging.

Age designations of anadromous salmon are coded for brevity as discussed by Koo (1962). For steelhead the letter "S" is used to designate a spawning check. Because Kodiak steelhead typically return to the streams in the fall and spawn in the spring, it also denotes an additional year of age. The age of land-locked salmon and other resident game fish are designated by Roman numerals.

Temperatures of Kodiak Island streams were monitored with Ryan Model H-15 recording thermographs placed near the stream terminus, above tidal influence. An additional thermograph was placed below Buskin Lake.

A 0.31 meter Surber Stream Sampler and 0.23 meter drift nets were used to collect aquatic insect samples from five Kodiak Island streams. Problems, relating mainly to time and difficulty in species identification, precluded the analysis of these data from inclusion in this report.

Flow was determined by the formula (Manning, 1890):

$$Q = A \cdot \frac{1.486}{n} \cdot R^{2/3} \cdot s^{1/2}$$

where

Q = discharge in cu. ft. per sec. = design discharge.

A = cross-sectional area of flow in sq. ft.

n = coefficient of roughness.

R = hydraulic radius = mean depth.

s = slope, or ratio of the vertical fall to the length.

Cross-sectional area of flow (A) and the stream bed area (well above high water mark) were measured at highway bridge crossings. Height of stream flow was measured bimonthly from the top of respective bridges to determine cross-sectional area of flow throughout the year.

Gurley flow reading were conducted concurrently with initial area measurements to determine n (coefficient of roughness):

$$n = \frac{1.486 \cdot R^{2/3} \cdot s^{1/2}}{\text{velocity (f/s)}}$$

Buskin River Dolly Varden were sampled from angler creels for length data during regular creel census days. Daily harvest estimates were computed and the number of fish equalling 10% of the preceeding day's harvest were sampled. All fish were measured (FL) in millimeters.

The estimated number of Dolly Varden needed for size-age analysis was determined by arranging 1975 Dolly Varden length data (n=671) in a length frequency diagram and separating out hypothetical age classes by breaks in the frequency graph. Sample size for each age class, based on  $\pm 3$  mm error of the mean, was determined by statistical formula (Cochran & Snedecor, 1967):

$$n = \frac{fQ^2}{L^2}$$

n = sample size

Q<sup>2</sup> = sample variance

Computed sample sizes were then increased 10% to allow for unreadable otoliths.

From June 7 to 13, 133,109 chinook salmon (0.90 grams per fish) were introduced into Lake Rose Tead.

## FINDINGS

### Results

#### Lake and Stream Surveys:

The Afognak Island study area (Figure 1) encompassed 11,200 hectares and was found to contain 24 fish producing and seven barren lakes. Dolly Varden, Salvelinus malma (Walbaum); threespine stickelback, Gasterosteus aculeatus Linnaeus; and sculpin, Cottus sp., were observed in most waters; however, rainbow trout, Salmo gairdneri Richardson, were found in Gretchen Creek, Lake No. 13476 and Saposia Creek. Coho salmon, Oncorhynchus kisutch (Walbaum), were present in all streams lacking physical barriers and sockeye salmon, O. nerka (Walbaum), were found rearing in Gretchen Creek. During 1,036 trap hours Gretchen Creek produced 137 Dolly Varden, 79 rainbow trout, 18 coho salmon and 2 sockeye salmon.

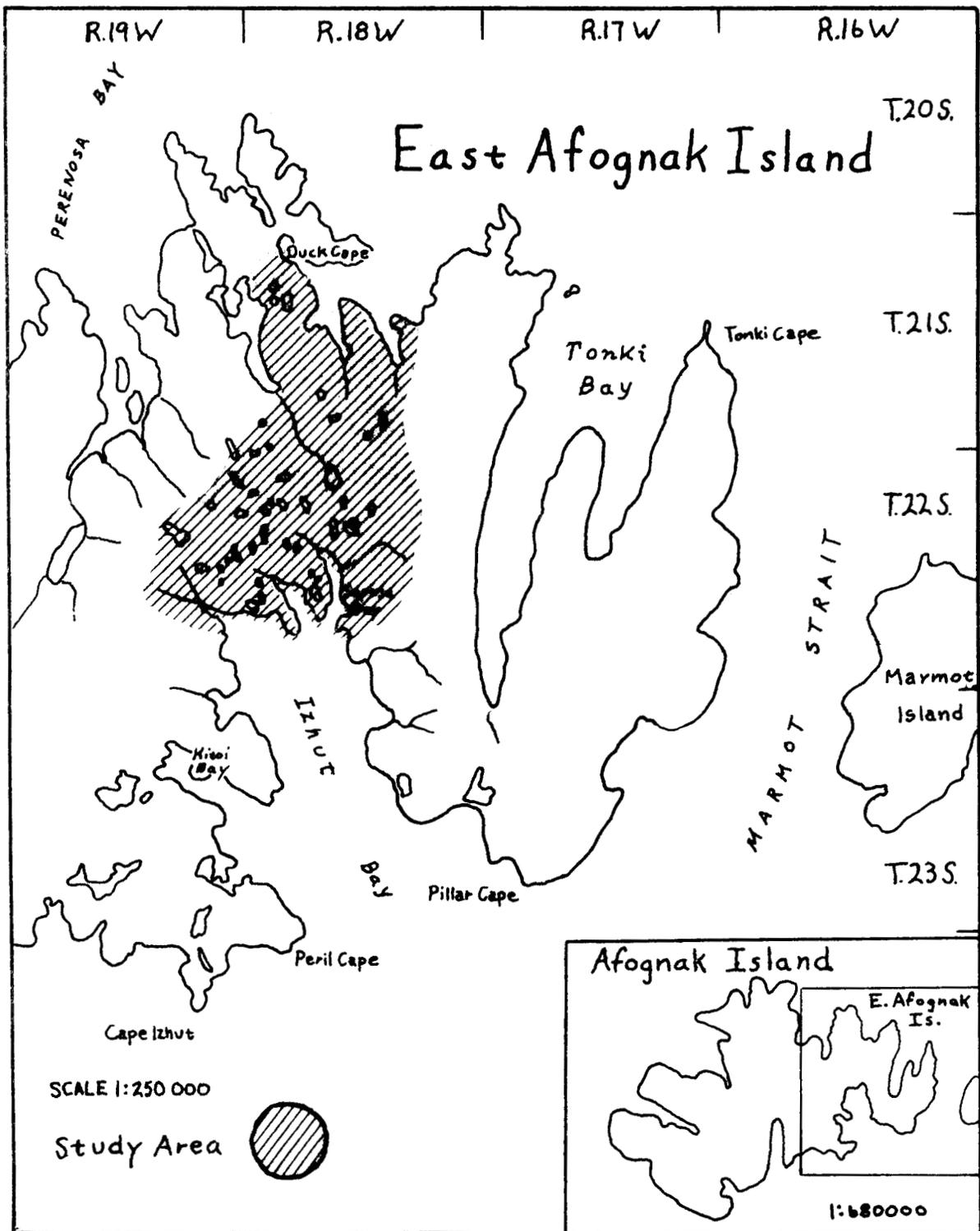


Figure 1. Location of Lakes Surveyed on Afognak Island, 1977.

Fish sampling, temperature and morphometric data for Afognak Island lakes are presented in Table 1. Table 2 presents age and size data for all fish sampled and Table 3 shows the stomach content of 270 Dolly Varden taken from the lakes within the study area.

Relative growth and survival of fish in 19 Kodiak lakes as determined by gill nets are presented in Table 4.

Table 5 shows temperature patterns and Table 6 presents dissolved oxygen, hardness, alkalinity and pH for Buskin River, Salonie Creek, Olds River, American River and Roslyn Creek. Flow data are presented for these streams in Figures 2 through 4.

#### Sport Fish Harvest Estimates:

Due to delays in computer programing, 1976 sport fish harvest estimates were deleted from the F-9-9 Project Completion Report by Murray and Van Hulle (1977). These data are presented in Table 7, and harvest data for 1977 are shown in Tables 8 and 9.

Table 10 presents the age, length and sex of 261 angler caught Dolly Varden sampled during the May fishery on Buskin River. Table 11 incorporates these data with the lengths of 270 unaged Dolly Varden to show the number and age composition of fish caught during the spring outmigration from Buskin Lake.

#### Assessment and Inventory of Anadromous Fish Populations:

From May 13 (weir installed) until October 8 (weir removal) an estimated 8,436 chinook salmon, O. tshawytscha (Walbaum), 18,501 coho salmon and 1,265 steelhead, were passed upstream through the Karluk Lagoon weir. From May 30 through August 7 approximately 1,163 steelhead kelts were passed downstream. These data, by weekly time periods, are presented in Table 12. Table 13 shows the size, age and sex composition of 259 steelhead kelts (which were also tagged), and Table 14 presents similar data on immigrant steelhead.

The size, age and sex composition of Karluk chinook salmon, as determined by sampling angler retained fish, is presented in Table 15. The 245 fish sample represents 60.0% of the total fish harvested and 2.9% of the estimated immigration.

On August 13, 3,270 (39%) chinook salmon which had passed through the weir (n=8,396), were enumerated during a one day float trip survey.

Approximately 121 chinook were observed during a float trip survey on Dog Salmon River (Frazer Lake outlet) August 10, 1977. Most of the fish (75-100) were schooled at the lake outlet while 21 were observed between the main falls and turbulent water halfway down the river. The lower river was not surveyed due to rough water (rapids) which made counting impossible.

Table 1. Summary of Morphometric and Fish Sampling Data for Afognak Island Lakes, 1977.

Lake No. & Location	Survey Date	Surface Water °C	Elev. m	Surface Area Ha.	Max. Depth m	Trap Hours	Net Hours	Fish* Species	Number Fish Captured	Fish Length (mm)	
										Range	Mean
13496 T22S,R19W,Sec.14	8/04	14.0	161.7	48.2	27.1	0.0	20.3	DV	14	120-452	300
13494 T22S,R19W,Sec.13	6/16	18.5	5.3	10.1	15.3	0.0	24.0	DV	18	115-215	157
13482-A T22S,R19W,Sec.18	7/17	19.0	69.2	3.6	3.4	19.5	0.0	None			
13484 T22S,R18W,Sec.19	7/18	19.0	25.9	4.8	8.2	0.0	19.0	DV	3	182-382	253
13485 T22S,R18W,Sec.19	7/18	19.0	24.4	6.6	18.9	0.0	19.5	DV SB	8	190-337	288
13473 T22S,R18W,Sec.6	6/25	11.0	106.8	8.1	7.9	0.0	22.8	DV	18	123-265	184
13474 T22S,R18W,Sec.7	6/07	12.5	106.8	7.7	22.0	0.0	20.3	DV	7	204-293	267
13480 T22S,R18W,Sec.17	6/27	18.0	106.8	4.0	9.5	0.0	15.5	SB			
13488 T22S,R18W,Sec.21	7/13	18.0	47.9	12.9	18.6	0.0	26.5	DV	14	135-244	193
13490-A T22S,R18W,Sec.26	7/14	18.0	222.6	3.8	4.9	6.0	0.0	None			

Table 1. Continued. Summary of Morphometric and Fish Sampling Data for Afognak Island Lakes, 1977.

Lake No. & Location	Survey Date	Surface Water °C	Elev. m	Surface Area Ha.	Max. Depth m	Trap Hours	Net Hours	Fish* Species	Number Fish Captured	Fish Length (mm)	
										Range	Mean
13482 T22S,R18W,Sec.18	6/26	19	106.8	4.8	6.1	0.0	21.7	SB			
13497 T22S,R19W,Sec.15	10/5	13	170.8	6.1	19.5	0.0	16.0	DV	34	186-290	226
13489 T22S,R18W,Sec.22	7/14	19	50.3	4.8	9.5	0.0	24.5	None			
13490 T22S,R18W,Sec.26	7/14	19	106.8	3.8	8.8	0.0	20.0	None			
13495 T22S,R19W,Sec.14	10/5	14.5	106.8	6.6	11.3	0.0	22.5	DV	21	112-290	202
						4.0	0.0	DV	59	72-163	109
								SS	5	90-102	96
								CD	3		
13481	6/28	19	48.8	3.8	12.2	0.0	15.5	DV	10	194-360	241
13486-87 T22S,R18W,Sec.20	7/14	18	45.8	15.4	9.2	0.0	22.3	DV	29	188-380	268
						26.0	0.0	DV	1		162
								SB	3		
								CD	3		

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Table 1. Continued. Summary of Morphometric and Fish Sampling Data for Afognak Island Lakes, 1977.

Lake No. & Location	Survey Date	Surface Water °C	Elev. m	Surface Area Ha.	Max. Depth m	Trap Hours	Net Hours	Fish* Species	Number Fish Captured	Fish Length (mm)	
										Range	Mean
13476-A T22S,R18W,Sec.9	6/25	15	106.8	2.6	4.3	60.0		None			
13477 T22S,R18W,Sec 9	6/23	12	76.3	6.0	9.2	0.0	23.5	DV	21	140-345	196
						23.2	0.0	DV	2	86-91	89
13478 T22S,R18W,Sec.9	6/23	12.5	99.1	2.5	4.6	0.0	43.2	DV	18	134-203	171
13555 T21S,R19W,Sec.1	8/23	12.0	24.4	8.5	**	0.0	24.0	DV	**		
13554 T21S,R19W,Sec.1	8/23	12.0	15.3	3.8	**	10.0	0.0	SB	**		
13603 T20S,R18W,Sec.29	8/23	11.0	76.2	4.3	**	0.0	24.0	None	**		
13550 T21S,R18W,Sec.29	8/20	11.0	74.7	4.4	**	0.0	20.0	DV	**		
								SS			
								SB			
						40.0	0.0	DV			
								SB			
								SS			

Table 1. Continued. Summary of Morphometric and Fish Sampling Data for Afognak Island Lakes, 1977.

Lake No. & Location	Survey Date	Surface Water °C	Elev. m	Surface Area Ha.	Max. Depth m	Trap Hours	Net Hours	Fish* Species	Number Fish Captured	Fish Length (mm)	
										Range	Mean
13493 T22S,R192,Sec.12	8/05	16	184.5	8.3	20.1	0.0	21.0	None			
13491 T22S,R19W,Sec.1	6/26	17	106.8	13.6	11.3	0.0	21.8	DV	18	162-315	229
						18.5	0.0	DV	38	75-181	106
								CD	1		75
13474-A T22S,R18W,Sec.7	6/26	17	76.2	4.3	7.6	20.0	0.0	CD	19		
13483 T22S,R18W,Sec.7	6/27	19	54.9	13.1	11.0	0.0	21.0	DV	53	132-261	203
13475 T22S,R18W,Sec.8	6/23	17	106.8	4.5	4.6	0.0	20.0	None			
						51.0	0.0	DV	35	71-195	106
13476 T22S,R18W,Sec.9	6/23	12	48.8	8.9	11.6	0.0	23.0	RT	3	163-200	176
								DV	47	126-268	198
						15.3	0.0	RT	1		160
								DV	3	94-135	113

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Table 1. Continued. Summary of Morphometric and Fish Sampling Data for Afognak Island Lakes, 1977.

Lake No. & Location	Survey Date	Surface Water °C	Elev. m	Surface Area Ha.	Max. Depth m	Trap Hours	Net Hours	Fish* Species	Number Fish Captured	Fish Length (mm)	
										Range	Mean
13552 T21S,R18W,Sec.34	8/21	19.0	141.8	13.2	**		20.0	CD	**		

- \* DV = Dolly Varden  
 SB = Threespine Stickleback  
 SS = Coho Salmon  
 CD = Sculpin Cottos sp.  
 RT = Rainbow Trout  
 \*\* Field Data Missing

Table 2. Age and Lengths of Rainbow Trout, Dolly Varden and Coho Salmon Captured From Afognak Island Waters, 1977.

Rainbow Trout				Dolly Varden				Coho Salmon			
Age	n	Length (mm)		Age	n	Length (mm)		Age	n	Length (mm)	
		$\bar{x}$	+S.D.			$\bar{x}$	+S.D.			$\bar{x}$	+S.D.
I	13	66.1	10.1	III	12	149	31.4	0.0	19	60.1	6.1
II	66	104.9	16.0	IV	13	192	17.5	1.0	33	94.5	11.8
III	5	156.2	13.8	V	21	224	26.5	2.0	18	101.6	16.9
				VI	13	256	23.6				
				VII	5	320	14.7				

Note:

All Dolly Varden from lakes in Table 1.  
 Age 0.0 coho from Gretchen Creek, Age 1.0 and 2.0  
 Coho from Silver Creek (T21S,R18W,Sec.20) 8/21/77  
 All rainbow trout from Gretchen Creek (T21S,R18W,Sec.30) 6/4/77

Table 3. Stomach Content of Dolly Varden Captured from Afognak Island Lakes, 1977.

Stomach Content	Frequency of Occurrence	Percent* Occurrence in Feeding Fish
Fish Material:		
Stickleback	10	4.5
Unidentifiable Fish Remains	19	8.6
Insect:	130	58.6
Mollusks:		
Gastropods	74	53.3
Bivalves	48	21.6
Miscellaneous:		
Leeches & Worms	5	2.3
Seeds and Spruce Needles	7	3.2
Unidentified Material	14	6.3
Number Empty = 48 Number Feeding = <u>222</u> Total Examined = 270		

\* Percentage Occurrence =  $\frac{\text{Number of Fish containing a specific food item}}{\text{Number of fish with food in stomach}}$

Table 4. Sampling Summary of Kodiak Management Lakes, 1977.

Lake Name & Location	Sampling Data						History						
	Date Sampled	* Species	Number	Age	Length (mm) $\bar{x}$ $\pm$ SD		Weight (g) $\bar{x}$ $\pm$ SD		Catch/ Net Hr.	Date Stocked	Total Number	Per kg	Per ha
Abercrombie T27S, R19W Sec. 15	8/8	GR	18	II	228	30.8	143	54.0	0.77	6/26/75	50,000	Fry	6,608
		RT	12	0	102	4.5	13	1.7	0.51	6/21/77	2,391(E)	1,097	316
		RT	21	II	196	24.7	102	14.1	0.89	7/21/75	3,700(W)	3,968	489
		RT	5	III	308	48.7	376	164.5	0.21	6/20/74	3,700(W)	3,194	489
Aurel T28S, R21W Sec. 36	8/10	GR	1	I	118		110		0.03	NR or migrant from Cicely Lake			
		GR	23	II	210	11.6	115	11.8	0.61	"	"	"	"
		RT	7	I	101	4.8	13	2.1	0.18	8/04/76	1,500(O)	2,436	247
		RT	1	II	238		147		0.03	7/13/75	1,500(E)	589	247
	RT	1	III	393		851		0.03	6/20/74	3,000(W)	3,194	494	
Barry Lagoon T31S, R19W Sec. 33	8/15	SS	8	III	372	25.3	527	123.2	0.11	6/20/74	20,000	2,522	388
		SS	38	II	225	19.3	124	18.0	0.53	7/18/75	14,400	740	280
		SS	35	I	105	4.4	14 (n=35)		0.49	6/23/76	15,000(O)	969	291
		DV	10	III-VIII	279	63.2	258 203.8		0.14	NR			
Bull T31S, R20W Sec. 35	8/15	RT	54	I	134	40.6	33 (n=54)		1.26	8/03/76	3,300(O)	2,436	820
		RT	6	III	381	56.8	.558 138.5		0.14	6/20/74	3,000(W)	3,194	746
Caroline T28S, R21W Sec. 35	8/10	GR	15	II	245	10.2	176	25.2	0.76	6/26/75	10,000	Fry	3,744
		RT	11	I	105	6.7	15	3.0	0.56	8/04/76	1,300(O)	502	484
		RT	1	III	203		98		0.05	6/21/74	1,300(W)	658	484
Dolgoi T28S, R19W Sec. 12	8/23	RT	1	0	94				0.02	6/21/77	3,592(E)	2,354	172
		DV	1	IV	340		340		0.02	NR			
		DV	2	V	374	2.1	567	43.1	0.04	NR			
		DV	2	VI	410	15.6	724	60.1	0.04	NR			

Table 4. Continued. Sampling Summary of Kodiak Management Lakes, 1977.

Lake Name & Location	Sampling Data							History						
	Date Sampled	* Species	Number	Age	Length (mm)		Weight (g)		Catch/ Net Hr.	Date Stocked	Total Number	Per kg	Per ha	
					$\bar{x}$	$\pm$ SD	$\bar{x}$	$\pm$ SD						
Genevieve T28S, R20W Sec. 10	8/8	RS	11	2.0	181	9.4	80	12.2	0.23	NR				
		SS	2	2.0	192	23.3	84	36.8	0.04	NR				
		SS	20	1.0	102	4.3	24	1.3	0.42	NR				
		RT	1	III	330		477		0.02	6/20/74	9,500(W)	3,194	499	
		RT	1	II	182		87		0.02	7/21/75	7,800(W)	3,984	410	
		RT	5	I	100	6.8	12	2.9	0.10	8/02/76	5,200(O)	2,436	272	
		DV	1	III	315		33		0.02	NR				
		DV	2	II	208	7.8	100	21.9	0.04	NR				
Horseshoe T28S, R20W Sec. 35	8/24	RT	2	II	223	24.7	142	31.8	0.04	7/18/75	1,600(E)	588	823	
		RT	2	I	149	12.7	43	7.8	0.04	8/03/76	1,600(O)	2,436	823	
		RT	26	0	113	6.7	18(n=26)		0.57	6/22/77	1,245(E)	1,097	640	
Lilly Pond T28S, R20W Sec. 27	8/9	RT	14	II	202	32.7	123	58.8	0.67	7/18/75	2,000(E)	583	625	
Lee T28S, R21W Sec. 36	8/9	RT	2	III	356	9.9	536(n=1)		0.06	6/20/74	2,800(W)	3,194	483	
		RT	3	0	106	7.5	15	4.5	0.09	6/21/77	2,800(E)	1,097	483	
		SS	2	0	106	2.1	14	1.4	0.06	6/21/77	Intro. with RT			
		DV	3	NA	212	48.1	120	73.5	0.09	NR				
Long Lake T27S, R20W Sec. 11	8/23	GR	4	I	191	4.9	74	5.7	0.16	6/25/76	25,000	Fry	1,714	
		GR	14	II	251	9.1	172	14.0	0.58	10/75	1,258	441	1,714	
		RT	3	I	119	6.0	20	4.1	0.13	8/05/76	2,700(O)	2,436	186	
		RT	2	II	211	1.4	113	3.5	0.08	7/21/75	5,300(W)	3,984	363	
		RT	4	III	311	22.7	353	78.5	0.16	6/24/74	5,400(W)	3,194	371	
Lupine T21S, R20W Sec. 35	8/15	RT	1	III	440		880		0.04	6/20/74	1,500(W)	330	495	
		RT(W)	18	II	208	17.5	103	23.9	0.81	7/18/75	750(W)	1,807	250	
		RT(E)	8	II	215	16.3	113	21.2	0.34	7/18/75	750(E)	267	250	
		RT	19	0	110	7.8			0.85	6/22/77	1,489(E)	1,097	491	

Table 4. Continued. Sampling Summary of Kodiak Management Lakes, 1977.

Lake Name & Location	Sampling Data								History				
	Date Sampled	* Species	Number	Age	Length (mm) $\bar{x}$ $\pm$ SD		Weight (g) $\bar{x}$ $\pm$ SD		Catch/ Net Hr.	Date Stocked	Total Number	Per kg	Per ha
Margaret T28S, R20W Sec. 11	8/8	RT(E)	2	III	203	34.4	108	40.3	0.04	6/21/74	800(E)	331	250
		RT(W)	4	III	160	46.2	59	34.1	0.08	6/21/74	800(W)	3,194	250
		DV	1	III	169		56		0.02	NR			
Mayflower T29S, R20W Sec. 23	8/16	DV	4	III	194	38.2	87	40.8	0.12	NR			
		DV	5	IV	256	18.4	180	35.9	0.15	NR			
		DV	1	V	287		244		0.03	NR			
		DV	1	VI	366		467		0.03	NR			
		SS	18	II	114	6.9	19.9 (n=50)		0.55	7/18/75	1,000	740	198
		SS	32	I	108	4.3			0.97	6/23/76	983	969	194
Orbin T28S, R20W Sec. 31	8/9	RT	2	III	311	1.4	404	32.5	0.10	Migrant from Beaver Pond			
		DV	1	IV	214		109		0.05	NR			
		DV	6	III	127	3.8	21	1.3	0.29	NR			
		SS	62	I	103	5.5	14 (n=62)		3.00	6/23/76	3,000	1,227	492
Pony T29S, R19W Sec. 36	8/16	SS	4	III	231	22.5	161	52.0	0.09	6/20/74	1,600	2,522	276
		SS	42	II	182	14.3	66	15.1	0.99	7/18/75	1,600	740	276
		SS	6	I	140	18.3	33	15.1	0.14	6/22/76	1,595	969	275
Southern T28S, R19W Sec. 14	8/23	SS	9	II	197	27.2	83	35.5	0.38	7/21/75	3,000	740	423
		SS	25	I	98	20.3	13 (n=25)		1.04	6/23/76	3,000	969	423
Summit T30S, R20W Sec. 31	8/28	SS	65	II	176	22.1	63	17.0	0.67	NR			
		RT	4	IV	254	27.6	153	46.5	0.04	7/09/73	7,400(W)	575	250
		DV	49	II	130	6.4	22	2.8	0.50	NR			
		DV	7	III	201	10.1	79	8.4	0.07	NR			
		DV	1	IV	254		172		0.01	NR			
		DV	10	VI	366	23.3	481	102.7	0.10	NR			
		DV	10	VII	425	21.1	711	124.4	0.10	NR			

Table 4. Continued. Sampling Summary of Kodiak Management Lakes, 1977

Lake Name & Location	Sampling Data						History				
	Date Sampled	* Species	Number	Age	Length (mm) $\bar{x}$ $\pm$ SD	Weight (g) $\bar{x}$ $\pm$ SD	Catch/ Net Hr.	Date Stocked	Total Number	Per kg	Per ha
Tanignak	8/23	RT	15	IV	381    28.9	684    162.9	0.30	6/25/73	6,500	341	540
T28S, R19W		RT	1	II	219	126	0.02	7/21/75	6,500(E)	588	540
Sec. 3		DV	1	I	230	124	0.02	NR			

GR = Grayling  
 RT = Rainbow Trout  
 DV = Dolly Varden  
 RS = Sockeye Salmon  
 SS = Coho Salmon  
 (W) = Winthrop, Washington Strain  
 (E) = Ennis, Montana Strain  
 NA = Not Aged  
 NR = Natural Reproduction  
 $\bar{x}$  = Mean  
 SD = Standard Deviation  
 Age = Roman Numeral = Resident Fish  
       Arabic Number = Anadromous Fish (Ex. 2.0)  
 (n= ) Indicates that fish were weighed as a group.  
       S.D. was not calculated.  
 (O) = Green River, Oregon strain

Table 5. Temperature Data for Five Kodiak Streams as Determined by Ryan Recording Thermograph June 13, 1977 through February 28, 1978.

Temp°C	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Total *
<u>Stream: Lower Buskin River</u>										
TU **	154.0	352.5	306	180.5	153.0	27.5	-13. ***	11.5	2.0	1187.0
High	12.5	16.5	13.5	10.0	8.0	4.0	0.0	1.0	0.0	16.5
Low	6.0	9.0	8.5	4.0	3.0	0.0	-0.5	-0.5	0.0	- 0.5
Mean	8.6	11.4	9.9	5.8	4.9	0.9	-0.4	0.3	0.6	
<u>Stream: Upper Buskin River</u>										
TU	145.0	376.5	316	301.0	200.0	30.0	0.0	10.2	10.4	1389.1
High	11.1	15.5	13.5	14.5	9.0	3.5	0.0	0.8	1.0	15.5
Low	11.1	10.0	9.0	6.5	3.5	-1.0	0.0	0.0	0.0	-1.0
Mean	8.5	12.1	10.2	10.0	6.5	1	0.0	0.3	0.4	
<u>Stream: American River</u>										
TU	86.0	191.0	198	174.0	156.0	126.0	87.0	105.9	89.2	1213.1
High	9.5	10.0	9.0	8.5	7.0	4.4	4.4	4.4	4.4	10.0
Low	3.0	4.0	5.0	4.0	3.5	3.3	0.0	1.7	0.0	0.0
Mean	4.8	6.2	6.4	5.8	5.0	4.2	2.8	3.4	3.2	
<u>Stream: Olds River</u>										
TU	119.5	282.0	279.5	235.5	158.8	86.5	81.0	67.0	46.5	1356.3
High	13.0	14.5	12.0	11.0	8.0	4.5	4.0	4.0	3.0	14.5
Low	5.0	8.0	7.0	5.0	2.0	2.0	2.0	1.0	1.0	1.0
Mean	7.0	9.1	9.0	7.9	5.1	2.9	2.6	2.2	1.7	
<u>Stream: Roslyn Creek</u>										
TU	151.0	306.0	298	255.0	171.0	43.0	10.0	48.5	43.5	1326.0
High	15.0	16.0	13.0	12.0	8.0	4.0	1.5	3.0	3.0	16.0
Low	5.0	8.5	8.0	3.5	3.0	-0.5	0.0	0.0	0.0	-0.5
Mean	8.9	9.9	9.6	8.5	5.5	1.4	0.3	1.6	1.5	
<u>Stream: Salonie Creek</u>										
TU	80.5	162.5	192.5	171.5	153.5	95.0	69.0	85.5	83.0	1093.0
High	8.0	8.0	9.0	8.0	7.0	4.0	4.0	4.0	4.0	9.0
Low	3.0	4.0	4.0	4.0	4.0	1.0	2.0	0.0	0.0	0.0
Mean	4.5	5.2	6.2	5.7	5.0	3.17	2.2	2.8	3.0	

\* Negative temperatures are considered 0 temperature units and therefore not deducted from total temperature units.

\*\* TU = Temperature Units

\*\*\* Temperature was below 0.

Table 6. Water Characteristics of Five Kodiak Streams Sampled Monthly June, 1977-February 1978.

<u>Stream</u>	<u>Dissolved Oxygen</u> (ppm)		<u>Total Hardness</u> (ppm)		<u>Total Alkalinity</u> (ppm)		<u>pH</u>	
	<u>Mean</u>	<u>Range</u>	<u>Mean</u>	<u>Range</u>	<u>Mean</u>	<u>Range</u>	<u>Mean</u>	<u>Range</u>
American	11.8	11.0-13.0	11.5	8-16	22.2	20-24	6.2	6.2-6.3
Buskin	12.0	10.5-13.0	11.0	10-14	19.2	18-22	6.2	5.6-6.4
Olds	11.3	7.0-13.5	9.8	8-10	19.2	16-22	6.2	6.2-6.3
Roslyn	11.9	10.0-13.5	7.8	6-12	13.0	10-16	6.3	6.2-6.3
Salonie	11.6	11.0-12.5	22.9	12-32	24.0	16-30	6.2	5.6-6.4

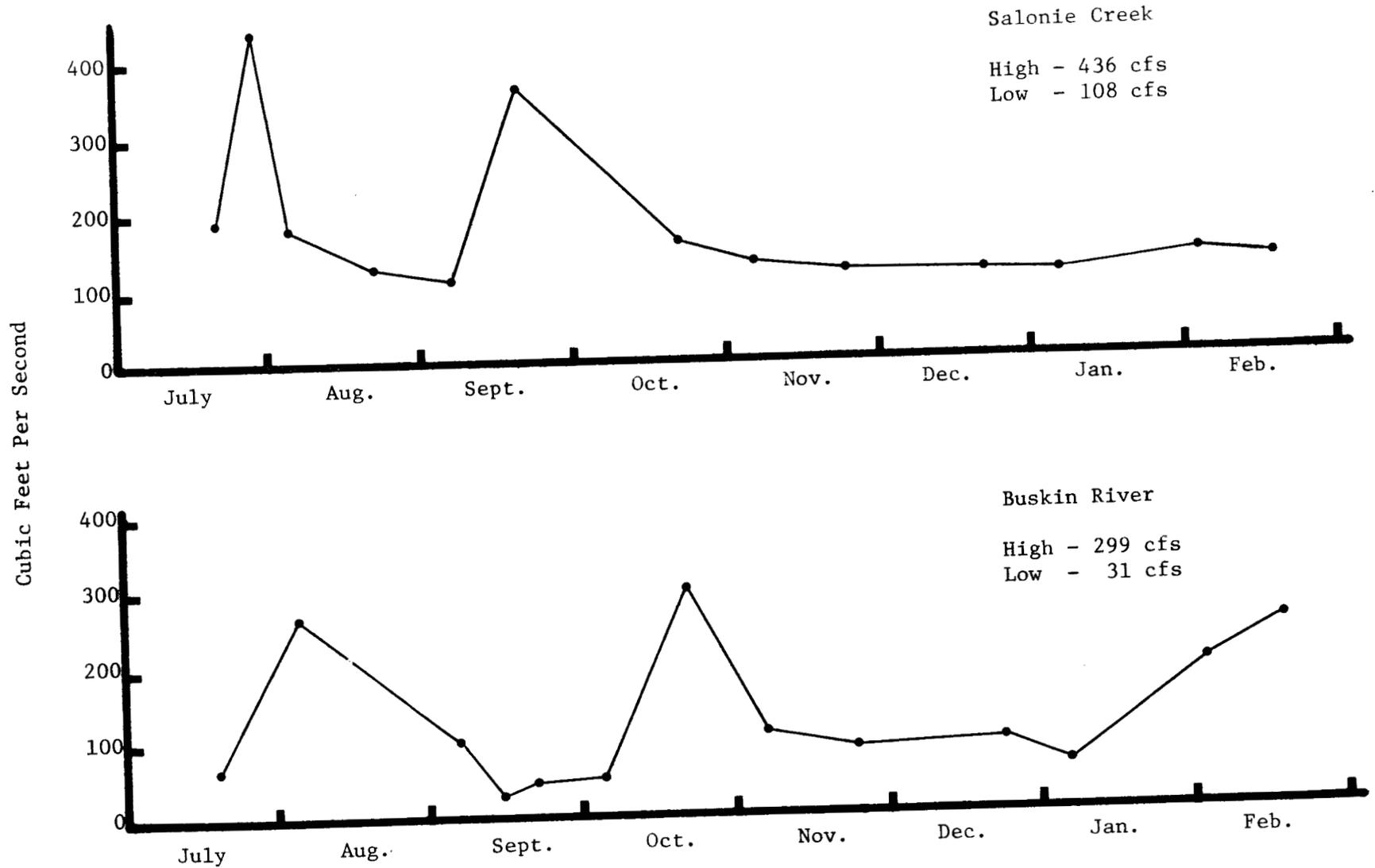


Figure 2. Flow Readings for Salonie Creek and Buskin River July, 1977 through February, 1978.

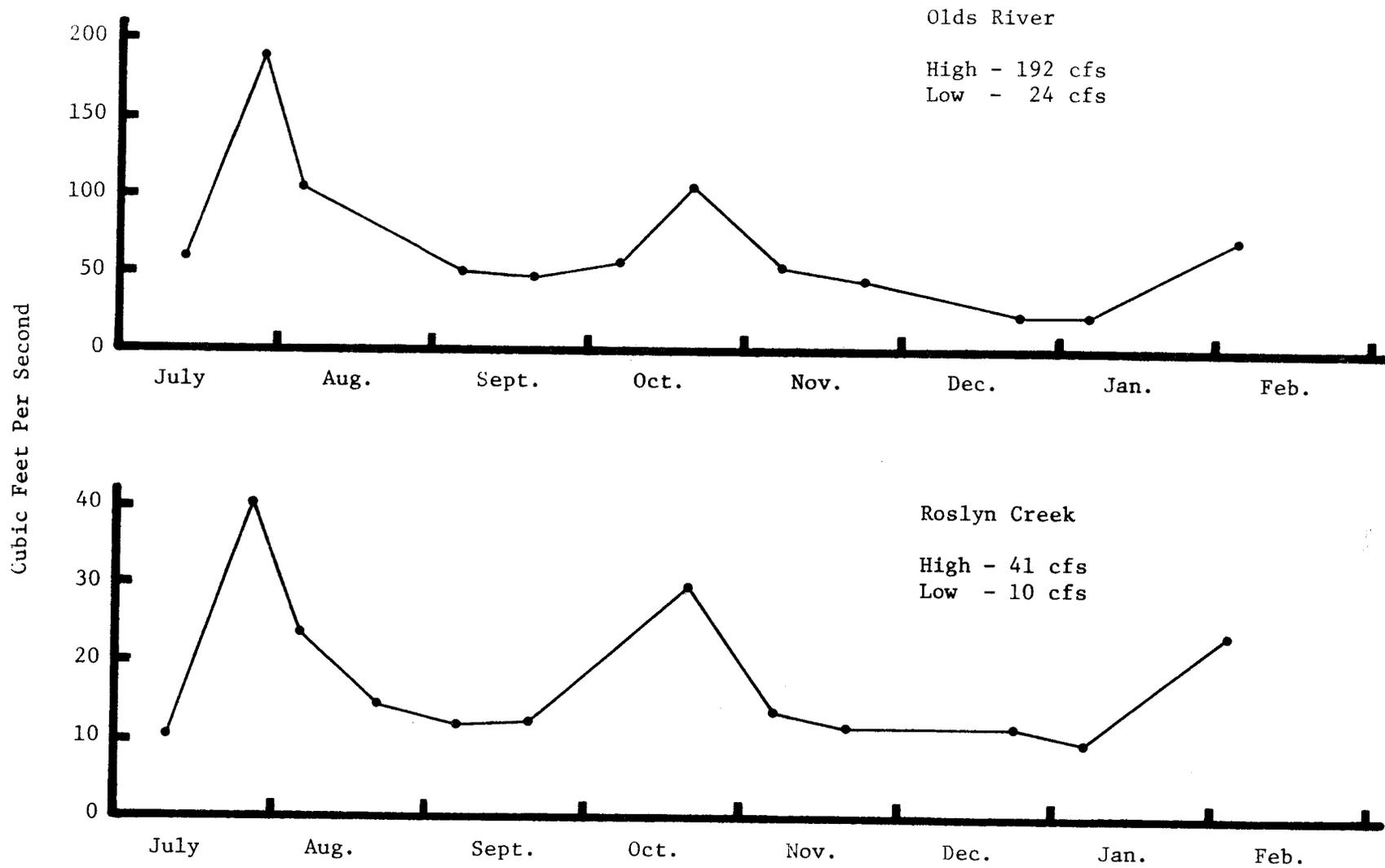


Figure 3. Flow Readings for Roslyn Creek and the Olds River July, 1977 through February, 1978.

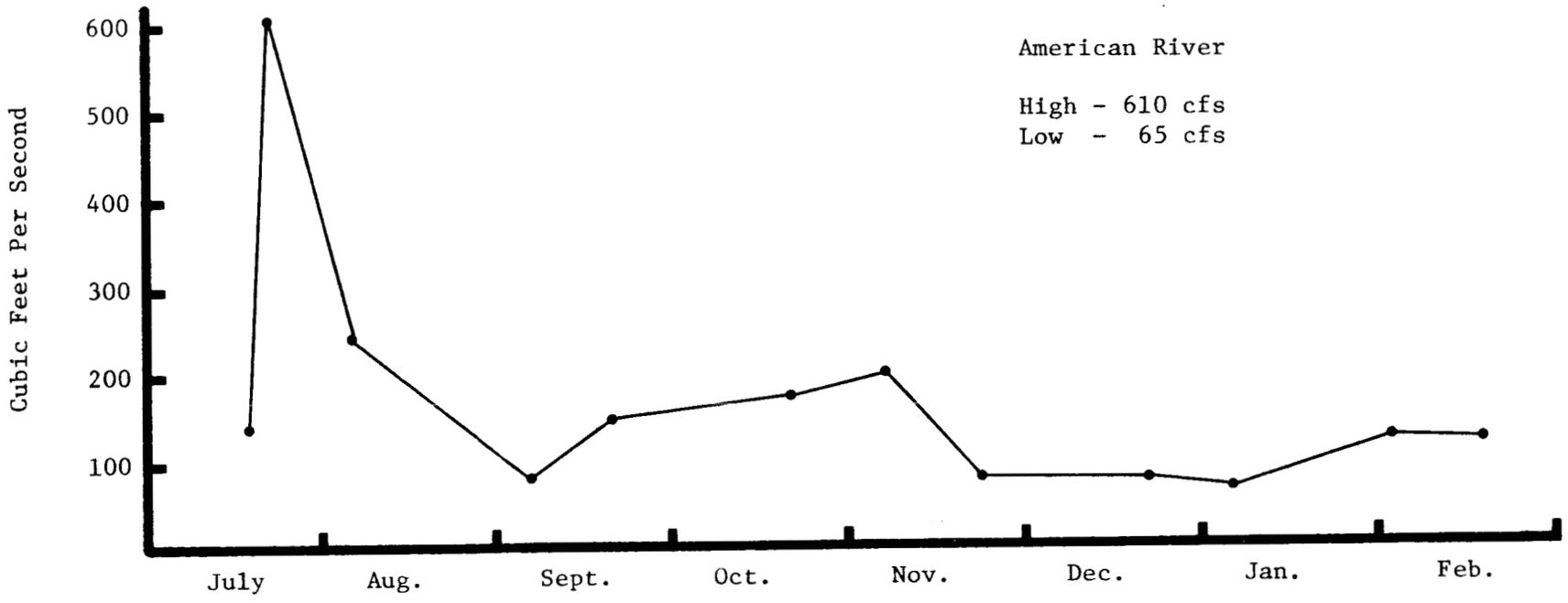


Figure 4. Flow Readings for American River July 1977 through February 1978.

Table 7. Dolly Varden and Coho Salmon Harvest Estimates for Kodiak Roadside Streams and Beaches as Determined by a Postal Survey and Adjusted by 1977 Buskin River Creel Census.

River	Spring DV		Coho Salmon	
	1976	1977	1976	1977
American			156	84
Buskin	8,202	8,567*	2,424	750*
Kalsin			150	0
Olds			47	0
Pasagshak	1,789	997	2,197	252
Roslyn			250	16
Saltery	1,581	457	641	380
Salonie			0	0
Saltwater Beaches	1,728	1,220	577	145
Other Streams	<u>901</u>	<u>420</u>	<u>453</u>	<u>580</u>
Total	14,201	11,661	6,895	2,207

\* Creel Census Estimate

Table 8. Buskin River Sport Fish Harvest Estimates as Determined by a Creel Census and Two Postal Surveys, 1977.

Species	Creel Estimate			Fish Per Trip	Postal Estimate	
	Angler Group		Total Fish		Angler Group	
	Kodiak* No.Fish	Other** No.Fish			Kodiak* No.Fish	Bias***
Dolly Varden						
Spring	7,593	974	8,567	1.79	13,736	1.81
Fall	1,474	436	1,910	0.16		
Season	9,067	1,410	10,477	0.61	5,228	0.58
Pink Salmon	3,886	617	4,503	0.37	2,368	0.61
Coho Salmon	648	102	750	0.06	1,308	2.0
Chum Salmon	0	0	0	0	29	29.0
Sockeye Salmon	NE	NE	NE	NE	221	NE
<u>Effort</u>	<u>Angler Trips</u>		<u>Total</u>		<u>Angler Trips</u>	<u>Bias</u>
Spring	3,361	1,431	4,792		8,869	2.64
Fall	9,897	2,369	12,266			
Season	13,258	3,800	17,058		5,473	0.41

\* Anglers that purchased a sport fishing license in Kodiak.  
 \*\* Anglers not required to have a sport fishing license or those that purchased a license out of Kodiak.  
 \*\*\*  $\frac{\text{Postal Estimate}}{\text{Creel Estimate}}$

Spring = January 1 - June 5  
 Fall = July 14 - October 7  
 NE = No estimate

Table 9. Creel Census Estimates from Karluk River, Akalura Creek and Dog Salmon Creek, 1977.

Area	Number of Anglers	Total Days	Total Hours	Steelhead***		Rainbow Rel.	Trout Ret.	Dolly Rel.	Varden Ret.	Coho		Chinook		Sockeye		Pink	
				Rel.	Ret.					Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.
Akalura Cr.	35		826	0	0	0	0	786	80	17	55	0	0	44	16	156	22
Dog Salmon R.	0	0	0														
Karluk Lagoon**	118	480	2,422	329	10	28	10	0	0	0	0	338	248	15	11		
Karluk Portage	148	363	1,408	3	1	11	15	33	28	0	0	119	126	5	14		
Expanded Data*		<u>76</u>	<u>345</u>	<u>30</u>	<u>1</u>	<u>4</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>0</u>	<u>0</u>	<u>41</u>	<u>34</u>	<u>2</u>	<u>2</u>		
Karluk Total	266	919	4,175	362***	12	43	27	36	31	0	0	498	408	22	27		
Olga Creek	0	0	0														

\* Total hours fished, fish released and fish retained were interpolated for 76 uncensused angler days.

\*\* Includes all float trip anglers.

\*\*\* Steelhead spring data only. All but 15 steelhead were caught by Department personnel for tagging.

Rel. = Released  
Ret. = Retained

Table 10. Age, Length and Sex of Sport Caught, Outmigrant Dolly Varden From Buskin River, May, 1977.

Age	Male			Female			Sex Unknown*			All Samples			% Age Composition
	n	$\bar{x}$	$\pm$ S.D.	n	$\bar{x}$	$\pm$ S.D.	n	$\bar{x}$	$\pm$ S.D.	n	$\bar{x}$	$\pm$ S.D.	
IV	18	239	18.3	16	250	16.6	7	250	25.3	41	245	19.2	15.7
V	40	297	35.3	52	290	31.4	12	303	33.6	104	294	33.1	39.8
VI	30	344	30.8	40	334	26.9	6	316	36.9	76	337	29.9	29.1
VII	16	379	49.4	15	360	40.3	4	324	26.9	35	364	45.9	13.4
VIII	2	443	38.9	1	349					3	411	60.5	1.1
IX	2	541	57.2							2	541	57.2	0.8
	<hr/>			<hr/>			<hr/>			<hr/>			<hr/>
	108			124			29			261			99.9

\* Anglers had removed testis or ovaries prior to sampling.

Table 11. Estimated Number of Sport Caught Dolly Varden By Age Class From Buskin River, May, 1977.

Sample Type	Number and Percent Fish/Age Class						Total
	IV	V	VI	VII	VIII	IX	
Otolith & Length	41	104	76	35	3	2	261
Length only*	<u>43</u>	<u>110</u>	<u>71</u>	<u>41</u>	<u>4</u>	<u>1</u>	<u>270</u>
Total	84	214	147	76	7	3	531
Percent	15.8	40.3	27.7	14.3	1.3	0.6	100.0
Number Harvested**	1,354	3,453	2,373	1,225	111	51	8,567

\* Unaged DV were separated into 5 mm size groups and the number per group was multiplied by the percent of occurrence of aged fish in an identical size grouping.

\*\* Total harvest per age class = (Percent of Sample Per Age Class)  
(Calculated Total Harvest)

Table 12. Summary of Chinook, Coho and Steelhead Enumerated Through Karluk Lagoon Weir, 1977.

Period	Chinook		Down SH**			Up SH		Coho	
	No.	%	No.	%	Mort.	No.	%	No.	%
5/13-5/15	16	0.2							
5/16 <sup>*</sup> -5/22	73	0.9							
5/23-5/29	105	1.2							
5/30-6/05	1,234	14.6	18	1.5					
6/06-6/12	2,247	26.6	96	8.3					
6/13-6/19	2,047	24.3	181	15.6					
6/20-6/26	1,360	16.1	151	13.0					
6/27-7/03	674	8.0	453	39.0	2				
7/04-7/10	265	3.1	238	20.5	1				
7/11-7/17	198	2.4			4				
7/18-7/24	100	1.2	4	0.3	2				
7/25-7/31	47	0.6	14	1.2	2			2	0.0
8/01-8/07	22	0.3	8	0.7	1			16	0.1
8/08-8/14	8	0.1			4	4	0.3	15	0.1
8/15-8/21	16	0.2			9	12	0.9	21	0.1
8/22-8/28	13	0.2			10	42	3.3	162	0.9
8/29-9/04	5	0.1			3	37	2.9	112	0.6
9/05-9/11	2	0.0			2	112	8.9	3,039	16.4
9/12-9/18	4	0.1			3	274	21.7	3,847	20.8
9/19-9/25					2	227	17.9	4,323	23.4
9/26-10/3					2	519	41.0	6,889	37.2
10/4-10/8						38	3.0	75	0.4
	8,436	100.2	1,163	100.1	47	1,265	99.9	18,501	100.0

\* Weir washed out May 17 and was replaced on June 1. An estimated 335 chinook moved up stream during this period.

\*\*= Down Steelhead.

August 15 foot count estimate of 3,720 chinook in river = Weir counted 8,394. Tagged steelhead returned = 7 (7/18, 8/18, 8/19, 9/22, 9/23, 9/25, 9/27).

Table 13. Size, Age and Sex Composition of Steelhead Kelts Tagged at Karluk Lagoon from June 13 to July 10, 1977.

Age	Brood* Year	Males				Females				Total	
		n	%	Length (mm) $\bar{x}$	$\pm$ S.D.	n	%	Length (mm) $\bar{x}$	$\pm$ S.D.	n	%
2.1S	1972	44	40.7	584	41.4	27	17.9	535	29.4	71	27.4
3.1S	1971	19	17.6	597	30.3	9	6.0	587	32.1	28	10.8
4.1S	1970	2	1.9	603	31.8					2	0.8
2.2S	1971	11	10.2	615	30.0	51	33.8	666	25.9	62	23.9
3.2S	1970	8	7.4	701	60.2	24	15.9	687	43.1	32	12.4
2.1SS	1971	7	6.5	695	56.4	19	12.6	722	16.3	26	10.0
3.1SS	1970	6	5.6	749	71.6	4	2.6	683	56.3	10	3.9
2.2SS	1970	7	6.5	746	29.4	1	0.7	736		8	3.1
3.2SS	1969	1	0.9	841		1	0.7	803		2	0.8
2.1SSS	1970					6	4.0	753	45.8	6	2.3
3.1SSS	1969	3	2.8	805	38.5	2	1.3	766	54.4	5	1.9
2.2SSS	1969					5	3.3	763	39.5	5	1.9
3.2SSS	1968					2	1.3	702	57.2	2	0.8
		108	100.1			151	100.1			259	100.0

\* Year adults returned to stream.

Table 14. Size, Age and Sex Composition of Immigrant Steelhead Sampled at Karluk Lagoon Weir from August 8 to October 3, 1977.

Age	Brood* Year	Males				Females				Sex Unknown**				Total	
		n	%	Length(mm)		n	%	Length(mm)		n	%	Length(mm)		n	%
				$\bar{x}$	$\pm$ S.D.			$\bar{x}$	$\pm$ S.D.			$\bar{x}$	$\pm$ S.D.		
2.1	1973	8	27.6	553	31.9	5	13.5	611	48.0	10	33.3	546	29.9	23	24.0
2.2	1972	7	24.1	642	32.4	20	54.1	668	30.0	5	16.7	688	39.2	32	33.3
2.1S	1972	9	31.0	717	54.8					1	3.3	700		10	10.4
3.1S	1971	1	3.4	752										1	1.0
2.2S	1971	3	10.3	788	56.5	10	27.0	732	41.2	12	40.0	738	29.4	25	26.0
3.2S	1970	1	3.4	781		2	5.4	700	0.7	2	6.7	760	29.0	5	5.2
		<u>29</u>	<u>99.8</u>			<u>37</u>	<u>100.0</u>			<u>30</u>	<u>100.0</u>			<u>96</u>	<u>99.9</u>

\* Brood Year = Year adults returned to stream.

\*\* Secondary sex characteristics were not pronounced.

Table 15. Age, Sex and Fork Length of Angler Caught Chinook Salmon  
From Karluk River, 1977.

Age	Male Length (mm)				Female Length (mm)				Other*	Total	%**
	n	%**	$\bar{x}$	$\pm$ SD	n	%**	$\bar{x}$	$\pm$ SD	n	n	
1.0	4	4.9	461	59.1						4	1.7
1.1	2	2.4	631	5.1	2	1.7	660	0.0	3	7	3.0
1.2	8	9.8	694	38.9	5	4.3	691	11.1	4	17	7.4
1.3	31	37.8	870	70.6	49	42.6	870	73.3	11	91	39.4
1.4	37	45.1	1012	69.5	59	51.3	943	65.4	16	112	48.5
Regenerate Scale	7				7				0	<u>14</u>	
										245	

\* Other = Samples without length and/or sex data.

\*\* % Age Composition = age class  $\div$  ageable fish per category.

Escapement surveys for 17 northeastern Kodiak Island streams (Table 16) indicated 369,450 pink salmon, O. gorbuscha (Walbaum), 52,750 chum salmon, O. keta (Walbaum), 33,254 sockeye salmon, and 2,439 cohos spawned.

Table 17 presents species composition, size, and age data for fish sampled at Lake Rose Tead, American River, Buskin River, Olds River, Salonie Creek, Roslyn Creek and Sargent Creek in 1977.

## DISCUSSION

### Lake and Stream Surveys

The lakes surveyed on Afognak Island (Figure 1 and Table 1) contained age VII Dolly Varden (n=5) that averaged 320 mm; however, the majority (age V and VI) ranged from 197 to 280 mm and averaged 236 mm.

Food habits, as determined by stomach analysis (Table 3) of gillnet captured fish, indicate Dolly Varden seldom feed on threespine stickleback but primarily feed on mollusks and insects.

By June and July the surface lake temperatures were approximately 19°C. This suggests that removal of vegetative cover along lake shorelines and stream banks by logging may increase water temperatures to a level unsuitable for salmonid rearing and survival. The amount of cover required to prevent excessive temperature increases will have to be assessed for each system and formulated into logging plans.

Gretchen Creek is the primary rearing area for rainbow trout in the Laura Lake system as shown by the 83 samples described in Table 2. This was also indicated by 1971 and 1973 sampling (Murray and Van Hulle, 1974) of Laura Lake, Gretchen Lake and Gretchen Creek.

Mean catch per net hour of stocked coho was 1.30; grayling, Thymallus arcticus (Pallas), 0.70; and rainbow trout age class I and older was 0.35 in managed lakes (Table 4). Dolly Varden, which occur naturally in seven of the lakes, averaged 0.30 fish per hour. These data indicate fewer pan sized trout are available to anglers than are coho and grayling under similar stocking and rearing conditions. The waters are either marginal for trout, or hatchery and stocking modifications are needed. Trout occur naturally in the area and the low survival appears to be related to the strain of fish available from the hatcheries. Murray and Van Hulle (1977) indicated better survival of Winthrop, Washington trout compared to Ennis, Montana trout to age class I. This observation is also reflected in the 1977 netting data. Margaret, Bull and Lupine Lakes were stocked in 1975 with equal ratios of Ennis (588/kg) and Winthrop (1,807/kg) trout. Winthrop trout were placed in Abercrombie, Genevieve and Long lakes; and Ennis trout went into 10 other lakes. A total of 18,950 Winthrop and 19,950 Ennis trout, were stocked in 1975. Catch per unit of effort of both strains to age II was poor (0.13/net hr.); however, the Winthrop stock produced 61% of the age II trout caught in 1977. Lupine produced 18 Winthrop and 8 Ennis trout and Abercrombie produced 21 Winthrop fish. No age II trout

were taken from Bull or Margaret lakes. These data indicate that survival of trout in Kodiak lakes is related to the brood stocked, and survival may be increased by using a strain more suited to Kodiak conditions.

The first chemical and physical data collected to correlate Kodiak stream conditions with annual fish production is presented in Tables 5 & 6 and Figures 2, 3, and 4. The chemical parameters fluctuated within a narrow range for each system and showed minor differences between the systems. For instance, pH was about 6.2 all year. Total hardness tests ( $\text{CaCO}_3$ ) indicated very soft (0-60 ppm, U.S.G.S.) water, and alkalinity never exceeded 30 ppm for any system. Dissolved oxygen levels (7.0-13.5) were adequate for salmon survival. Temperature and flow fluctuated in a seasonal manner within the systems, and each system had distinct flow rates and temperature regimes. These data show differences which are best left uninterpreted until comprehensive stream surveys are completed and specific survival information on game fish existing within these ecosystems is analysed.

#### Sport Fish Harvest Estimates (1977)

Buskin River creel census provided data on angler use and sport fish harvest and was used to check the postal survey. Dolly Varden (n=10,477) pink salmon (n=4,503) and coho (n=750) harvests were commensurate with previous estimates (Murray and Van Hulle 1974 and 1975). Catch per unit of effort, fish size, and escapement as presented in Table 8 & 16 indicate healthy fish populations. The chum harvest (n=0) was commensurate with observed escapements while the pink salmon harvest (n=4,503) was low in relation to escapement (54,000). Sport coho catch probably would have exceeded 750 fish; however, low stream flow and clear water inhibited angler success as fish were easily frightened.

Postal surveys did not appear meaningful in determining sport fish harvest estimates except when conducted immediately after the fishery. Even so, a creel census was necessary to determine the bias between estimates. A comparison of 1977 biases for Buskin River (Table 8) indicates a 0.61 difference for pink salmon and a 0.58 seasonal difference for Dolly Varden. Also, a negative bias (0.41) was reported for seasonal angler trips during 1977. Consequently, biases did not follow a positive trend, as assumed. The 1977 postal estimate reported fewer angler trips during the entire season (n=5,473) than for the spring (n=8,869); therefore, it was impossible to estimate the fall effort by subtraction. Considering the above discrepancies, harvest as determined by postal survey and adjusted by Buskin biases are reported for spring Dolly Varden and coho salmon during 1976 and 1977.

The blanket creel censuses conducted at four fish counting facilities on southwest Kodiak Island yielded complete use and harvest estimates for respective areas except for Karluk River where the census was completed through September. Sport fish harvest and effort for all species (Table 9) was low in relation to numbers of fish; in fact, less than 1976 estimates, except for Karluk River. Since only Karluk Lagoon was censused in 1976, lagoon data were used for comparative analysis. Fishing

Table 16. Peak Salmon Escapement Estimates, N.E. Kodiak Island, 1977.

System	Chum Salmon		Coho Salmon		Pink Salmon		Sockeye Salmon	
	Date	Escpmt***	Date	Escpmt*	Date	Escpmt***	Date	Escpmt.
American			10/28 & 11/07	113	8/30	51,900		NA
Buskin	9/02	2,000	11/01	1,070	8/21	54,000	8/30	3,254
Chiniak	NC		10/07	115	9/02	2,700		NA
Hurst	8/30	12,150	10/31	34	8/30	33,000		NA
Kalsin	NC		10/05	84	NC			NA
Monashka	NC		10/25	18	8/21	3,800		NA
Myrtle					9/02	11,000		NA
Olds	7/17	400	10/05	309	9/02	41,000		NA
Pasagshak	NC				7/29	100		NA
Pillar	9/02	1,000	10/25	23	8/28	4,850*		NA
Roslyn	9/02	1,000	10/07	183	9/02	4,200		NA
Russian	9/02	4,000	10/25	15	9/02	12,000		NA
Salonie	9/02	2,000	10/25	200	9/02	6,000		NA
Saltery	8/30	30,000	10/31	250	8/30	144,000	7/19	30,000
Sargent	9/02	200	10/25	25	9/02	300		NA
Twin	NC				9/02	500		NA
#410	NC				7/29	100		NA
TOTAL		52,750		2,439		369,450		33,254

\* Foot Survey  
 \*\* Boat Survey  
 \*\*\* Aerial Survey

NC = No Count  
 NA = Not Applicable

effort (480 man days) doubled in 1977 at Karluk Lagoon; however, fewer number of all species (except chinook salmon) were retained by sport anglers. A total of 408 chinook were harvested while 498 were released. Data for the fall steelhead fishery was not collected.

A total of 261 ageable Buskin Dolly Varden otoliths, with sex and length data was obtained from sport caught, outmigrant Dollies and an additional 270 fish were also measured. Table 11 is based on a 3.04% (261/8,567) sample of aged fish and a 6.19% (261 + 270/8,567) length sample of the entire sport caught population.

#### Sport Fish Harvest Estimates (1976)

Sport fish harvest estimates for northeast Kodiak Island as determined by postal questionnaires are presented for spring Dolly Varden and coho salmon. Harvests for other species were omitted due to discrepancies in Buskin River creel census estimates and the postal estimate.

A total of 14,201 spring Dolly Varden and 6,895 coho salmon were harvested in 1976 from northeastern Kodiak Island (Table 7). The largest catches for both species came from Buskin and Pasagshak rivers with Buskin River producing 8,202 Dolly Varden and 2,424 coho, and Pasagshak River 1,789 Dolly Varden and 2,197 coho salmon.

#### Assessment and Inventory of Anadromous Fish Populations

Karluk River chinook migrations peaked June 6 to 12 with a total run of 8,436 fish. The run was exceeded only in 1934 when 9,581 chinook passed the weir. Frazer River chinook (n=205) spawned mainly in the area between the lake and the steep pass. This area has the best spawning conditions for chinook in the Frazer system and the steep pass count should serve as an index and valid indicator of chinook entering the system.

Similar problems with delayed steelhead kelt movement past Karluk weir were observed as described by Van Hulle and Murray (1977); however, the return of seven (2.7%) of the 259 kelts tagged in June indicates survival of fish delayed by the weir. Also, 42.7% (41/96) of the immigrant steelhead sampled at the weir from August 8 through October 8 were repeat spawners. These fish probably negotiated the weir the preceding spring. Steelhead may have moved past the weir site prior to installation (May 13) or during the washout from May 17 to June 1; however downstream movement was not observed by weir attendants during this period. The major upstream movement of steelhead and coho occurred simultaneously in September. Individually these fish were easily recognized; however, when large numbers of both species moved through the gates, differentiation was difficult.

The tendency was to count questionable fish as coho salmon as they were more numerous. Therefore, steelhead misidentified as coho may have increased the coho count and reduced the steelhead count. Species differentiation became easier as the season progressed and coho assumed their secondary spawning characteristics. The number of coho and steelhead

passing the weir during early October dropped drastically; however, the stream level was far below the observed normal. Additional steel-head and coho undoubtedly entered the river after October 8.

Minnow trap sampling in 6 Kodiak streams indicated similar growth patterns for rearing fish. Buskin River and Lake Rose Tead produced the largest fish per age class and also had more species of rearing fish (Table 17). Chinook were captured in July, August and September near the June release areas and had increased in size from 50.3 mm to about 72.3 mm from July through December.

#### ACKNOWLEDGEMENT

We gratefully acknowledge the assistance and cooperation of the Kodiak Commercial Fisheries Division, United States Forest Service, National Marine Fisheries Service and the United States Coast Guard.

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Table 17. Population Characteristics of Rearing Fish in Seven Kodiak Area Waters as Defined by Minnow Traps, 1977.

Location & Date	Species*	Age	n	Length(mm)		Trap Hours
				$\bar{x}$	$\pm$ S.D.	
American River 05/19/77	SS	1.0	112	66.6	8.5	781.5
		2.0	31	91.1	7.8	
	DV	2.0	296	70.5	7.3	
		3.0	84	94.1	7.2	
		4.0	54	126.3	10.2	
S+b		1				
0/7/6/77	SS	0.0	35	36.9	3.5	600.0
		1+.0	24	68.0	6.7	
		2+.0	14	83.6	4.4	
	DV	0.0	10	30.0	2.8	
		1+.0	164	64.7	4.5	
		2+.0	188	81.3	6.8	
	DS	0.0	22	42.3	1.7	
		S+b		2		
	Buskin River 07/14/77	SS	0.0	128	43.8	
1+.0			124	69.8	12.7	
2+.0			40	104.6	13.5	
DV		2+.0	88	82.0	14.1	
		3+.0	64	118.7	20.8	
		4+.0	8	177.0	7.1	
SH		0+.0	1	58.0		
		1+.0	20	81.0	7.1	
S+b			4			
SC			50	95.0	16.1	
09/01/77	SS	0+.0	143	62.4	7.5	120.0
		1+.0	7	107.4	16.6	
	DV	1+.0	13	65.2	11.2	
		2+.0	2	113.0	16.9	
	SH	0+.0	21	46.0	4.4	
		1+.0	3	85.3	2.5	
	S+b		48			
	SC		239			
Lake Rose Tead 05/04/77	SS	0.0	2	39.5	4.8	1968.0
		1.0	7	72.1	14.7	
	SC		26			
	S+b		1			
	RS		2	32.5	0.7	

Table 17. Continued. Population Characteristics of Rearing Fish in Seven Kodiak Area Waters as Defined by Minnow Traps, 1977.

Location & Date	Species*	Age	n	Length(mm)		Trap Hours
				$\bar{x}$	$\pm$ S.D.	
07/12/77	SS	0+.0	399	47.8	11.6	600.0
	KS	0+.0	76	50.3	2.3	
	DV		117	93.1	16.0	
	RS	0+.0	6	31.0	0.7	
	SC		42			
	S+b		2			
08/25/77	SS	0+.0	412	55.5	9.7	234.0
	KS	0+.0	30	62.0	5.2	
	DV		62	90.2	12.6	
12/1/77	SS	0+.0	81	55.3	8.2	5.0
	KS	0+.0	4	72.3	3.3	
	RS	0+.0	1	54.0		
Roslyn Creek 06/28/77	SS	0.0	35	42.0	4.4	720.0
		1+.0	235	70.0	15.0	
		2+.0	86	83.9	5.7	
	DV	1+.0	77	71.5	3.8	
		2+.0	94	84.3	6.7	
		3+.0	66	118.3	9.7	
		4+.0	6	147.4	7.9	
	CS	0.0	1	67.0		
	SC		23	75.0	21.1	
Olds River 06/30/77	SS	0.0	4	40.0		600.0
		1+.0	136	66.9	6.1	
		2+.0	68	76.9	6.6	
	DV	1+.0	96	68.2	5.7	
		2+.0	64	85.1	7.1	
		3+.0	20	113.5	7.8	
Salonie Creek 07/08/77	SS	0.0	11	39.5	3.9	
		1+.0	38	64.0	7.7	
		2+.0	14	80.6	3.3	
	DV	0.0	3	39.9		
		1+.0	132	68.7	5.8	
		2+.0	96	88.4	8.4	
		3+.0	123	112.9	7.0	
	SC		9	53.2	2.2	

Table 17. Continued. Population Characteristics of Rearing Fish in Seven Kodiak Area Waters as Defined by Minnow Traps, 1977.

Location & Date	Species*	Age	n	Length(mm)		Total Hours
				$\bar{x}$	$\pm$ S.D.	
Sargent Creek 04/01/77	SS	1.0	5	53.2	2.2	
		2.0	7	98.2	16.0	
	DV	1.0	3	60.3	8.5	
		2.0	10	95.8	3.5	
		3.0	36	116.8	9.6	
		4.0	22	131.1	6.4	
	S+b		3			
	SC		21			

- \* SS = Coho Salmon  
 DV = Dolly Varden  
 S+b = Ninespine Stickleback, Pungitius pungitius (Linnaeus)  
 DS = Chum Salmon  
 SH = Steelhead Trout  
 SC = Slimy Sculpin, Cottus cognatus Richardson  
 RS = Sockeye Salmon  
 KS = Chinook Salmon

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