FEDERAL AID IN FISH RESTORATION
STUDY G-I

INVENTORY AND CATALOGING

By: F.D. Van Hulle, J.B. Murray, S.L. Hammarstrom, D.A. Watsjold, L.A. Gwartney, F.T. Williams, S.W. Kubik and J.C. Riis

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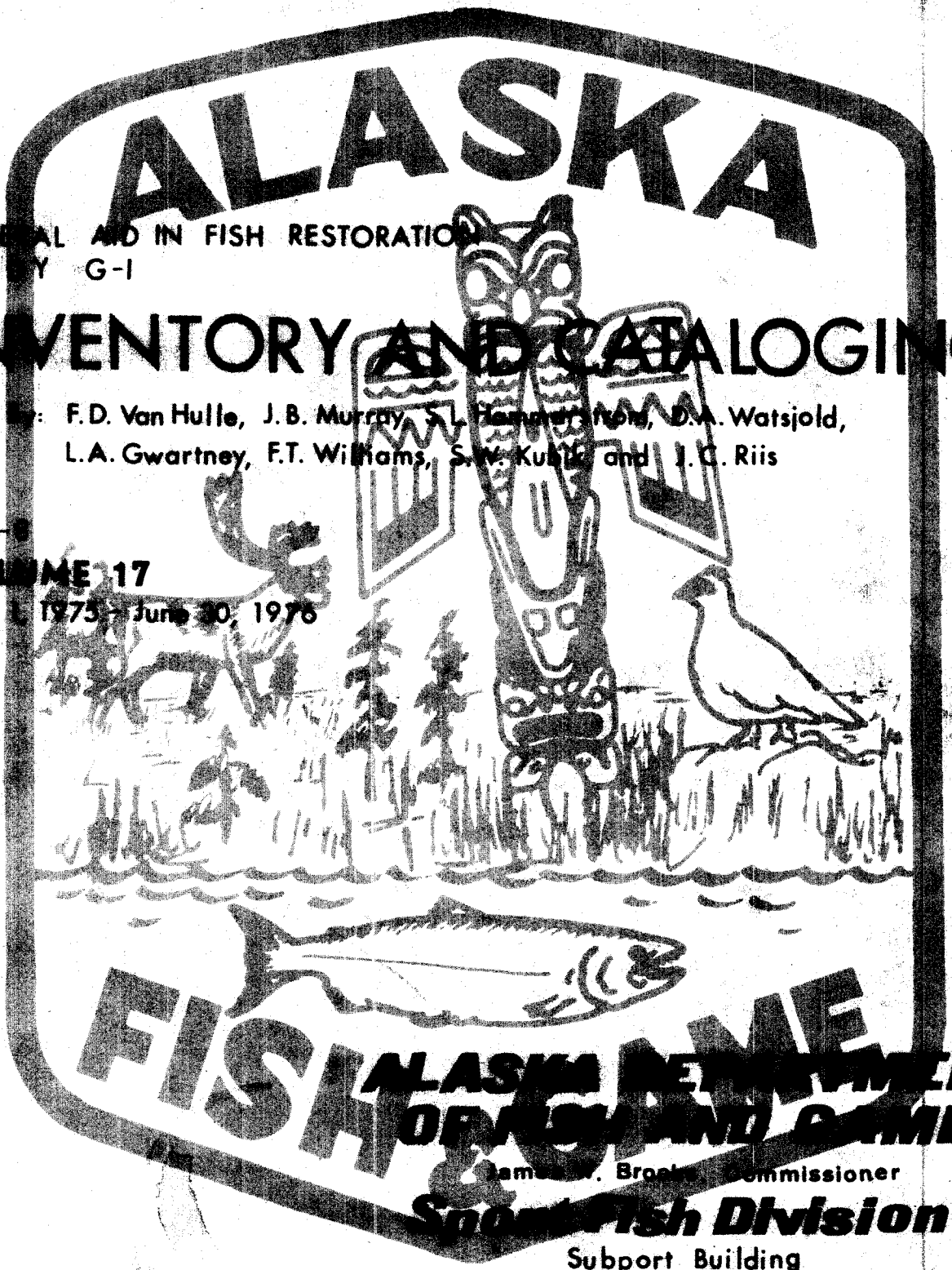

ALASKA DEPARTMENT OF FISH AND GAME
James W. Brooks, Commissioner
Sport Fish Division
Subport Building
JUNEAU, ALASKA

Volume 17 STUDY G-1

STATE OF ALASKA

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Annual Performance Report for

INVENTORY AND CATALOGING

by

F.D. Van Hulle, J. D. Murray, S.L. Hammarstrom, D.A. Watsjold, L.A. Gwartney, F.T. Williams, S.W. Kubik, and J.C. Riis

ALASKA DEPARTMENT OF FISH AND GAME
James W. Brooks, Commissioner

SPORT FISH DIVISION
Rupert E. Andrews, Director
W. Michael Kaill, Chief, Sport Fish Research

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska.

Project No.: F-9-8

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

Job No.: G-I-E Job Title: Inventory and Cataloging of the Sport Fish and Sport Fish Waters of the Bristol Bay Area.

Period Covered: July 1, 1975 to June 30, 1976.

ABSTRACT

The Bristol Bay area contains some of the best fishing waters within Alaska. Until the present, no creel census has been conducted to define effort and distribution of sport harvest for the entire area. A voluntary creel census was designed and implemented in 1975 to estimate the fishing pressure by fishing guides and air taxi operators in Bristol Bay.

A formal creel census was conducted by Department personnel, of sport anglers at Igiugig in the Kvichak River and on the Naknek River chinook salmon, Oncorhynchus tshawytscha (Walbaum), sport fishery. The Igiugig creel census documented this area as one of the major rainbow trout, Salmo gairdneri (Richardson) fishing areas in the system with 1,144 rainbows caught during the period June 11-September 25, 1975. The 1975 Naknek River sport harvest of chinook salmon is estimated at 427 fish.

Escapement estimates of chinook salmon were obtained by aerial surveys on the Naknek River, its tributaries, and the Branch River, a Kvichak River tributary. Escapements were near average in the Naknek system and the highest recorded since 1968 in the Branch River.

Rainbow trout spawning surveys were conducted on foot along Brooks River, Naknek River, Copper River, Dream Creek, Middle Talarik Creek and Lower Talarik Creek. Results are presented in tabular form.

BACKGROUND

The Bristol Bay area is fished by many professional guides and their clients in addition to other non-guided residents and non-residents. Regulations have been imposed which drastically reduce the sport harvest, however, no recent area-wide attempt has been made to estimate the recreational angler effort, distribution, or catch. Within the Naknek and Kvichak drainages estimates of catch and escapement of rainbow trout have been made on a regular basis, as has the chinook salmon harvest for the Naknek River.

Creel census surveys in the Lake Iliamna area (in addition to the Talarik Creek rainbow trout study) have been conducted at Copper River in 1972 and 1973, on the Newhalen River in 1974, and on the Kvichak River at Igiugig in 1975.

Estimates of sport caught chinook salmon in the Naknek River have been made since the early 1960's. Creel census designs have changed significantly over the years, based on fishing effort, money, and manpower. In all years except 1975, the military operated two fishing camps on the Naknek River which increased significantly the angling effort expended on the river. The camps were closed in 1975 and the 1975 harvest estimate reflects this closure.

Aerial escapement estimates of chinook salmon have been made annually in the Naknek River, its tributaries, and the Branch River, a major tributary to the Kvichak River. Counts over the past years have provided indexes to escapements of chinook salmon into the Naknek system and Branch River and, theoretically, something upon which management recommendations can be made. Similarly, both aerial and foot surveys have been made to develop indexes of rainbow trout below Naknek Lake, and several tributaries to Lake Iliamna.

RECOMMENDATIONS

1. Continue the voluntary creel census program with guides and air taxi operators utilizing the Bristol Bay area.

2. Conduct a creel census program on chinook salmon in the Naknek River.

3. Enumerate chinook salmon spawning stocks in the Naknek and Branch rivers and their tributaries.

4. Enumerate rainbow trout spawning stocks in selected streams within Bristol Bay.

5. Provide management recommendations for the sport fishing resources in these waters and direction for future studies.

OBJECTIVES

1. To determine the environmental characteristics of the existing or potential recreational fishing waters of the job area and to obtain estimates of existing and/or potential angler use and sport fish harvest.

2. To determine the magnitude of selected spawning stocks.

3. To provide management recommendations for sport fishing resources in these waters and direction for future studies.

TECHNIQUES USED

Voluntary Creel Census

As a first step, 71 guides and air taxi operators who most probably would fish Bristol Bay were contacted by mail and asked to cooperate in keeping daily catch records. A total of 35 responded favorably. Daily sport fish catch forms were printed in books and distributed. Figure 1 presents a page from these books. Books were distributed with instructions and were followed by two letters reminding guides that the data were needed. Expansion of Brooks River data was by simple ratio, assuming 60% of the anglers were contacted.

Formal Creel Census

The creel census conducted at Igiugig on the Kvichak was based on the assumption the interviewer could contact most anglers and observe those he did not contact. Expansion of creel census data into total estimates was accomplished by simple ratios between anglers checked and anglers observed. Species caught and kept were summarized by month for easy comparisons with similar data collected on other streams within the area.

The 1975 Naknek River chinook salmon creel census program was a modification of the 1971 creel census program (Siedelman and Cunningham, 1972). It was designed to estimate the catch of chinook salmon in the Naknek River, fisherman effort, and certain parameters of the chinook salmon population. It required the full time effort of one man between June 1-July 17 (the established fishing season) working six hours per day, six days per week. Table 1 presents the equations for the expansion of these data.

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P. O. Box 37 — King Salmon, Alaska 99613

DAILY SPORT FISH CATCH FORM

Date:_____ Guide, Firm, or Lodge:_____

Water Fished (exact as possible):_____

No. of Anglers:_____ Est. No. of Angler Hrs.:_____

Species	No. Kept	No. Released	Total
Rainbow Trout			
Arctic Grayling			
Arctic char/Dolly Varden			
Lake Trout			
Pike			
King Salmon			
Silver Salmon			
Others			

Comments:_____

FIGURE 1. A page from a daily catch booklet sent to guides in the Bristol Bay area, 1975.

Table 1. Naknek River Harvest Expansion Formulas, June 1-July 17, 1975.

Notation

F = total estimated fishermen

N_p = number of six-hour census periods, June 1 - July 17

N_c = number of census periods actually censused

H = total estimated angler-hours

K = total estimated king salmon catch

f_{ij} = number of fishermen counted in period i, count number j, $i = 1,\ldots,40$, $j = 1, 2$

h_i = total hours fished in period i by censused fishermen

A_i = number of fishermen censused in period i

k_i = number of king salmon caught and retained in period i

Equations and Calculations

Assuming a count of zero for the two missed census periods:

$$F = \frac{N_p}{2N_c} \sum_{i=1}^{N_c} \sum_{j=1}^{2} f_{ij}$$

$$= \frac{141}{2(40)} (835) = 1,472$$

$$H = \frac{F \sum_{i=1}^{N_c} h_i}{\sum_{i=1}^{N_c} A_i} = \frac{(1,472)\ (1,718.5)}{514} = 4,921$$

$$K = \frac{F \sum_{i=1}^{N_c} k_i}{\sum_{i=1}^{N_c} A_i} = \frac{(1,472)\ (149)}{514} = 427$$

Three time periods were selected to sample. These were:

I - 6 a.m. to 12 Noon
II - 12 Noon to 6 p.m.
III - 6 p.m. to 12 Midnight

Using a random numbers table, time periods were randomly assigned to the days between June 1-July 17. The days not sampled were also determined by random selection.

During each period, the following steps were taken:

1. By boat, a run was made from the Fish and Game dock to FAA rock, and downstream to Smelt Creek (Figure 2). The boats fishing and the number of fishermen per boat were counted, and the return trip was made. (Time - approximately one hour).

2. Each boat returning to the FAA or military dock was checked for number of fishermen, number of hours fished, and number of fish caught and kept. Each chinook retained was measured, sex was determined and scales were collected. (Time - approximately four hours).

3. Step one was repeated at the end of the sampling periods and recorded on the form. (Time - approximately one hour).

Escapement Surveys

Chinook salmon were estimated by aerial surveys. An observer, with a pilot trained in stream surveying, flew each tributary near the peak of spawning, and counted spawning chinook salmon. Chinook salmon were estimated in tens or hundreds in areas of large concentrations.

Spawning ground counts for rainbow trout were obtained by walking along the banks and observing the fish.

FINDINGS

Results

Voluntary Creel Census:

Through December, 1975, a total of 25 of the original 35 guides or air taxi operators contacted responded with complete or partial creel census data. Several of the larger fishing lodges did not return any census forms. Katmai National Monument personnel provided complete catch and effort data from fishermen at Brooks Camp, located on Naknek Lake.

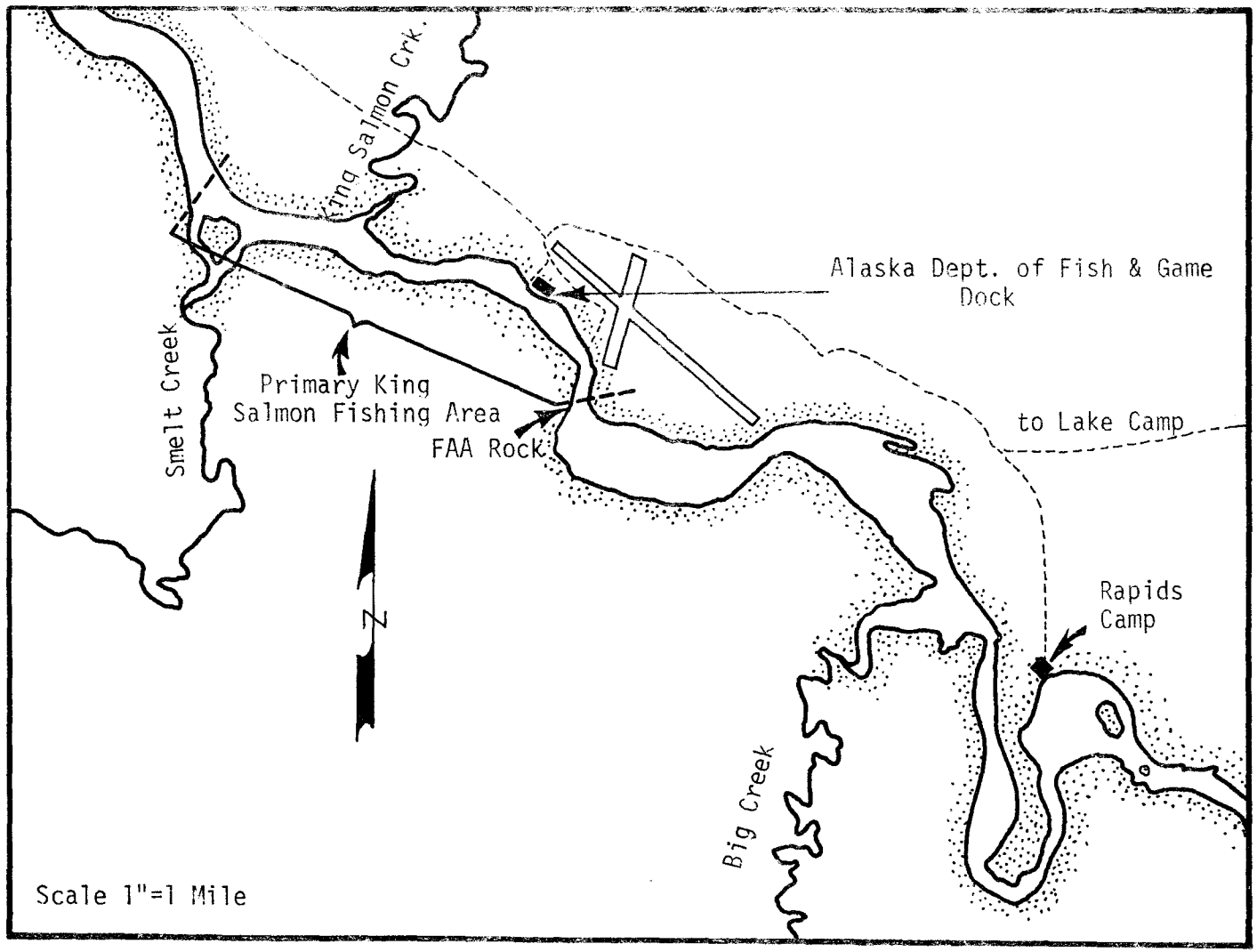

FIGURE 2. Naknek River at King Salmon.

Table 2 presents sport fish harvest data received through December, 1975, by river drainage, for harvest of rainbow trout, Salmo gairdneri (Richardson), Dolly Varden/Arctic char, Salvelinus alpinus (Linnaeus), and Arctic grayling, Thymallus arcticus (Pallas). Numbers of fish retained and released are recorded by species. The number of anglers and angler effort expended in 1975 is also presented. Tables 3 and 4 present data collected at Brooks Camp in Katmai National Monument from fishermen utilizing the camp as guests and fishing Brooks River between Brooks Lake and Naknek Lake.

Formal Creel Census:

At Igiugig on the Kvichak River, approximately 800 anglers fished 4,500 hours and caught 4,216 fish. Table 5 presents a breakdown of catch by species and month.

Approximately 75% of the angler effort was spent utilizing lures, 15% using flies, and 10% using both types of gear. Lure fishermen retained 71% of the rainbow trout caught, and the fly fishermen retained 51% of the rainbow trout they landed. Fly fishing for sockeye, Oncorhynchus nerka (Walbaum), salmon was seven times as effective as lure fishing. Two sockeye salmon per hour were caught on flies as opposed to 0.3 sockeye per hour on lures.

The 1975 Naknek River chinook salmon, Oncorhynchus tshawytscha (Walbaum), harvest between FAA rock and Smelt Creek (the major fishing area) was 427 fish. The total expanded number of fishermen and angler hours were 1,472 and 4,921, respectively.

Scale and fork lengths were collected from 99 chinook salmon during the season. Age and size composition is presented in Table 6.

Figure 3 presents a length frequency of chinook salmon measured during the season. Table 7 presents the number of fishermen checked, the hours they fished, and their catch by day. Table 8 presents the chinook salmon catch by time period and day. In addition to these data, we determined 51% of the fishermen were residents of Alaska and 49% were non-residents. Unlike past years when the Naknek River military recreational camps operated, 74% of the fishermen in 1975 were civilian, and 26% were military. Military fishermen in prior years have constituted approximately 90% of the total anglers.

Escapement Surveys:

Chinook salmon counts were obtained by aerial surveys for the Naknek River, its tributaries, and the Branch River during 1975. Tables 9 and 10 present these annual estimates since 1970 for the Naknek River, and since 1968 for the Branch River system. Escapements into Big Creek and Paul's Creek were near the five-year average, while King Salmon Creek was lower, and the main-stem Naknek River higher. The Branch River escapement estimates were the highest since 1968, with 6,600-8,000 chinook salmon observed in the system.

Table 2. A Summary of the Voluntary Daily Sport Fish Catch Forms Submitted by Fishing Guides by River Drainage, in the Bristol Bay Area, June-September, 1975.

Drainage	Tributary or Lake	Number of Anglers	Number of Angler Hours	Catch					
				Rainbow Trout		Grayling		Dolly Varden/Arctic Char	
				Retained	Released	Retained	Released	Retained	Released
Togiak	Togiak River	16	76	2	16	2	57	7	172
Wood River	Agulowak R.	22	86	2	28	6	37	7	47
	Agulukpak R.	14	33					5	73
	Little Togiak	5	15			4	5		
	Wood River Lakes	25	57	[illegible]	69	0	48	0	119
	Lynx Creek	2	4	[illegible]	4	0	6		
Nushagak	Nushagak R.	38	142	2	7	[illegible]	42	3	24
	Stuyahok R.	10	65	[illegible]	7	0	14	0	2
	Mulchatna R.	85	384	16	131	31	276	9	7
	Koktuli R.	28	125	5	21	3	145	10	9
Kvichak	Kijik Lake	26	92			9	185	0	2
	Chulitna R.	34	79			32	43		
	Tazimina R.	3	12	0	12				
	Newhalen R.	340	1,451	62	98	37	156	14	27
	Alexy Lake	21	85	0	2	0	25		
	Copper R.	162	890	17	1,060	4	16	50	229
	Belinda Cr.	14	85	10	11	0	2	3	7
	Upper Talarik	5	20		24				
	Lower Talarik	142	640	17	324	31	422	2	38
	Gibralter R.	110	476	18	177	2	6	3	16
	Iliamna R.	77	236	25	32	7	6	83	96
	Kokhanok R.	28	95	40	96	14	12		
	Kvichak R.	444	1,895	424	389	191	443	19	6
	Kvichak Tributaries	142	789	262	100	293	355	4	0
	Dream & SE Creeks	78	498	3	213	0	46		
Alagnak	Branch R. System	62	204	3	98	8	47	1	0
	Battle R.	59	378	9	131	2	41	0	2
	Morraine Cr.	33	209	70	77	0	8	0	2
Naknek	Brooks R. (excluding Brooks Camp)	45	289	13	62	0	29	0	0
	American R.	41	257	6	47	0	0	8	116
Becharof	King Salmon R.	4	20	0	14			0	6
	Ruth Lake	26	132			6	165	0	77
Ugashik	Ugashik	29	146			10	163	3	24

Table 3. A Summary of Angler Catch Data at Brooks Camp, 1975.

	Angler hours	Angler Days	Hrs./ Day	Number of Fish Caught**								Fish/ Day	Fish/ Hour	Rainbow/ Hour
				Rainbow	Grayling	D. Varden	Sockeye	Lk. Trout	Pike	Coho	Total			
June 21	9 (15)	3 (5)	3	0	2 (3)	0	0	0	0	0	2 (3)	2	0.22	0
June 22	177 (295)	29 (48)	6.1	25 (42)	12 (20)	0	0	13 (22)	3 (5)	0	53 (89)	1.8	0.30	0.14
June 29	486 (810)	111 (185)	4.4	86 (143)	30 (50)	1 (2)	105 (175)	35 (58)	0	0	257 (428)	2.3	0.53	0.18
July 6	729 (1215)	133 (222)	5.5	56 (93)	41 (68)	0	247 (412)	7 (12)	0	0	351 (585)	2.6	0.48	0.08
July 13	414 (690)	75 (125)	5.5	51 (85)	12 (20)	0	168 (280)	14 (23)	1 (2)	0	246 (410)	3.3	0.59	0.12
July 20	431 (718)	107 (179)	4.0	37 (62)	29 (48)	0	130 (217)	6 (10)	0	0	202 (337)	1.9	0.47	0.09
July 27	145 (242)	56 (93)	2.6	36 (60)	22 (37)	10 (17)	98 (163)	6 (10)	0	0	172 (287)	3.1	1.19	0.25
August 3	109 (182)	43 (72)	2.5	58 (97)	42 (70)	26 (43)	12 (20)	0	0	0	138 (230)	3.2	1.27	0.53
August 10	104 (173)	32 (53)	3.3	142 (237)	37 (62)	1 (2)	61 (102)	0	0	0	241 (403)	7.5	2.32	1.37
August 17	162 (270)	43 (72)	3.8	106 (177)	45 (75)	0	131 (218)	0	0	0	282 (470)	6.6	1.74	0.65
August 24	290 (483)	50 (83)	5.8	170 (283)	17 (28)	0	197 (328)	0	0	1 (2)	385 (641)	7.7	1.33	3.4
August 31	100 (167)	19 (32)	5.3	59 (98)	0	0	30 (50)	0	0	0	89 (148)	4.7	0.89	0.59
September 6	53 (88)	14 (23)	3.8	5 (8)	15 (25)	0	0	0	0	0	20 (33)	1.4	0.38	0.09
TOTAL	3209 (5348)	715 (1192)	4.6	831 (1385)	304 (506)	38 (64)	1179 (1965)	81 (135)	4 (7)	1 (2)	2438 (4064)	2.1	0.76	0.26

* Numbers in parenthesis () are expanded, while other numbers reflect direct observations.
** The expanded figure is based on contacting an estimated 60% of the anglers.

Table 6. A Summary of Fish Caught and Released at Brooks River Based on Voluntary Daily Sport Fish Forms, Summer of 1975.

Fish Species	Number Kept		Number Released		Percent Kept	Percent Released
	Observed	Projected*	Observed	Projected*		
Rainbow trout	134	223	697	1,162	16	84
Sockeye salmon	199	332	980	1,633	17	83
Arctic grayling	64	107	240	400	21	79
Lake trout	25	42	56	93	31	69
Dolly Varden	16	27	22	37	42	58
Northern pike	0	0	4	7	0	100
Silver salmon	0	0	1	2	0	100

* The projected figure is based on contacting an estimated 60% of the anglers.

Table 5. Numbers of Fish Caught and Retained on the Kvichak River, June 11-September 25, 1975.*

Number of:	June	July	August	September	Total
Rainbow Caught	114	98	509	423	1,144
Rainbow Kept	71	50	392	292	805
			Percent Retained		70
Grayling Caught	33	123	249	460	865
Grayling Kept	8	56	191	257	512
			Percent Retained		59
Dolly Varden Caught	10	0	1	12	23
Dolly Varden Kept	3	0	1	11	15
			Percent Retained		65
Sockeye Salmon Caught	0	2,162	22	0	2,184
Sockeye Salmon Kept	0	672	10	0	682
			Percent Retained		31

*Chinook salmon, silver salmon, pink salmon, and chum salmon catch was 60 fish.

Table 6. Age and Length Composition of 99 Chinook Salmon Collected From the Naknek River Sport Catch, 1975.

Ages	Sample Size	Percent Frequency	Average Fork Length
1.1	13	13	431 mm (17 inch)
1.2	46	46	584 mm (23 inch)
1.3	22	22	849 mm (33 inch)
1.4	13	13	977 mm (38 inch)
1.5	5	5	1,083 mm (42 inch)

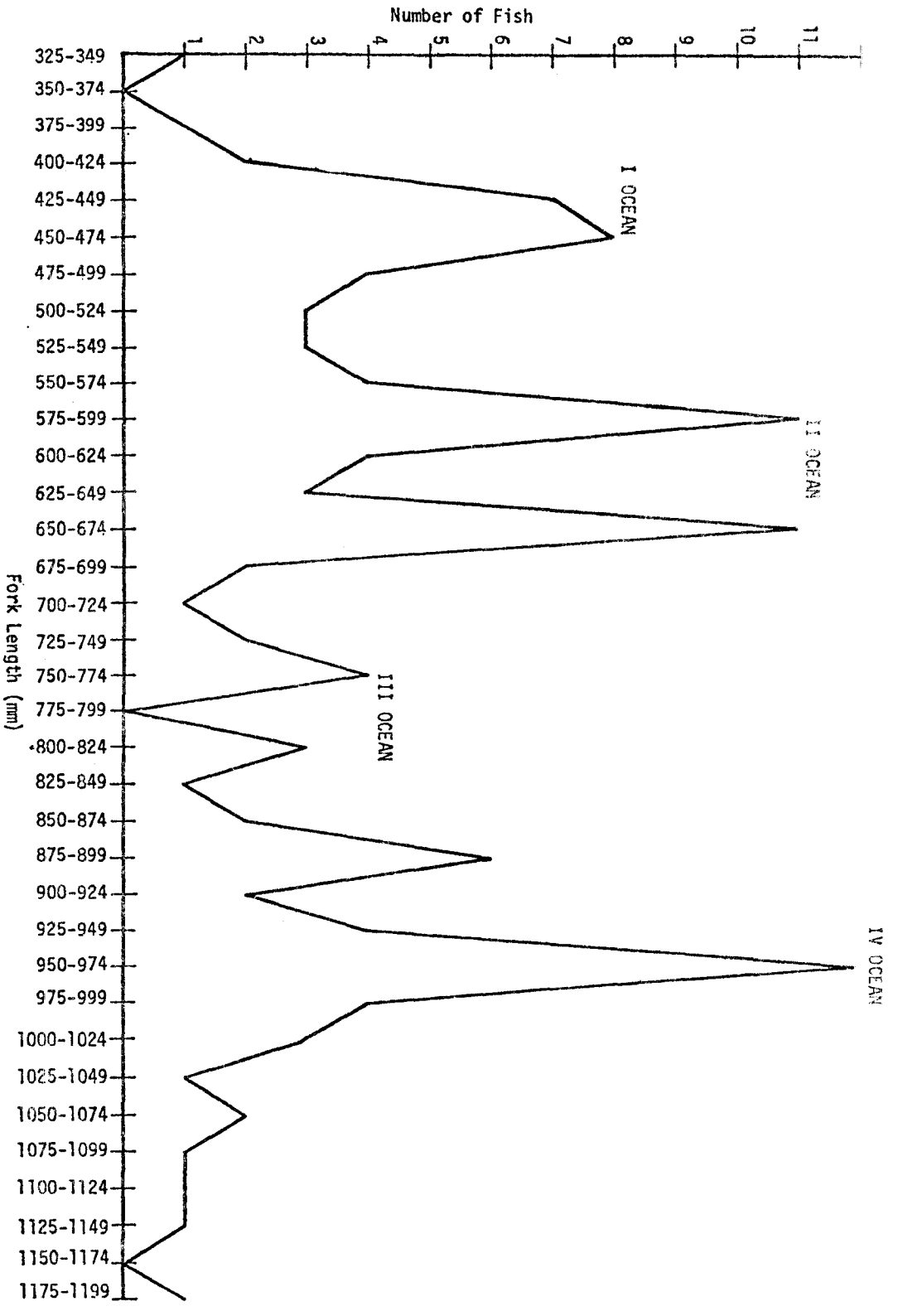

Figure 3. A Length Frequency of 115 Chinook Salmon Caught in the Naknek River, 1975, With Approximate Age Groups.

Table 7. Naknek River Chinook Salmon Creel Census Data, Collected June 2 - July 17, 1975.

Date	No. Fishermen Checked	No. Hours Fished	No. Chinook Kept
6/ 2/75	2	2	
6/ 3/75			
6/ 4/75	2	4	
6/ 5/75			
6/ 6/75			
6/ 7/75	2	3	
6/ 8/75	2	2	
6/ 9/75	7	21.5	1
6/10/75		21.5	
6/11/75			
6/12/75	9	20.5	1
6/13/75	4	9	
6/16/75	4	6.5	
6/17/75			
6/18/75	8	13	
6/19/75	4	13	
6/20/75	2	3	
6/21/75	18	44	2
6/22/75	11	39	
6/23/75	15	54	3
6/24/75	17	50.5	9
6/26/75	27	104	20
6/27/75	10	15	
6/28/75	2	4	
6/29/75	5	24	1
6/30/75	8	21.5	2
7/ 1/75	64	191.25	17
7/ 2/75	39	120.5	10
7/ 3/75	42	133.25	5
7/ 5/75	53	165.5	7
7/ 6/75	30	120.0	8
7/ 7/75	18	81.0	3
7/ 8/75	25	97.5	8
7/ 9/75	16	101	3
7/10/75	4	8	
7/12/75	17	85	18
7/13/75	12	44	5
7/15/75			
7/16/75	6	16	2
7/17/75	29	102	22
Total	514	1,740.00	149

Table 8. Chinook Salmon Caught by Sampling Period from the Naknek River, 1975.

Time Periods					
0600-1200		1200-1800		1800-2400	
Date	No. Fish	Date	No. Fish	Date	No. Fish
6/ 3	0	6/ 2	0	6/ 4	0
6/ 5	0	6/10	0	6/ 7	0
6/ 6	0	6/11	0	6/ 9	0
6/ 8	0	6/13	0	6/12	1
6/16	0	6/19	0	6/18	0
6/17	0	6/22	1	6/21	2
6/20	0	6/23	3	6/24	9
6/27	1	6/26	20	6/29	1
6/30	2	6/28	0	7/ 1	17
7/ 8	8	7/ 2	10	7/ 3	5
7/10	0	7/ 5	7	7/ 7	3
7/15	0	7/ 6	8	7/ 9	3
		7/12	18	7/13	5
	—	7/16	2	7/17	22
Total	11		69		68

Table 9. Chinook Salmon Escapement Estimates for the Naknek River System, 1970-1975.

Year	King Salmon Creek	Big Creek	Paul's Creek	Mainstem Naknek River
1970	260	1,600	No Count	2,500
1971	704	490	52	1,620
1972	1,224	1,060	156	351
1973	115	1,106	No Count	1,300-1,600
1974	600-800	1,200-1,300	250	400-500
1975	350-400	800-850	200-250	2,250-2,750
Average	560	1,055	171	1,479

Table 10. Chinook Salmon Escapement Estimates for the Alagnak (Branch) River System, 1968-1975.

Year	Estimated Escapement
1968	7,000-10,000
1969	5,000- 7,000
1970	4,600- 5,300
1971	1,400- 1,500
1972	2,200- 2,500
1973	800- 1,300
1974	1,600- 1,800
1975	6,600- 8,000

Rainbow trout spawning surveys were conducted on foot along Brooks River, Naknek River, Copper River, Dream Creek, and Middle and Lower Talarik creeks. Numbers of rainbow observed along with time of survey are presented in Table 11.

Discussion

Voluntary Creel Census:

The 1975 voluntary creel census may prove an effective means of estimating the effort and catch of guides in the area. As was suspected, most guides operate on a catch and release philosophy, retaining primarily old, large fish, probably for mounting. With better cooperation from guides utilizing particularly the Wood River-Tikchik areas, we will be able to estimate the total effort by guides and air taxi operators in 1976.

Formal Creel Census:

The Igiugig creel census provided data confirming this is the area in the Kvichak River system where the majority of rainbow trout are harvested. The Naknek River recreational harvest of chinook salmon, plus the estimated escapements to the tributary streams and the estimated subsistence harvest, suggest that 1975 was another typical chinook salmon season not unlike those of the previous five years (Table 12).

Escapement Surveys:

The results of rainbow trout surveys, with the exception of Copper River, have not been of much value in managing the fishery. Surveys have been limited to one or two surveys per spring due primarily to logistical limitations. Counts in the Copper River showed a drastic decline between 1972 (630 rainbow trout) and 1973 (102 rainbow trout). The two subsequent years' counts of 91 and 85 rainbow trout document this reduction with was due in part to sport fishing pressure in 1972.

Table 11. A Summary of Rainbow Trout Spawning Surveys for Several Streams in the Kvichak and Naknek Drainages During the Spring, 1975.

Date	Drainage	Stream	No. of Rainbow Trout	Approximate No. of Miles Surveyed
6/ 5/75	Naknek	Brooks River	88	1.0
5/25/75	Naknek	Naknek River	500	1.0
5/29/75	Kvichak	Copper River	85	11.5
6/ 7/75	Kvichak	Dream Creek	46	4.0
5/26/75	Kvichak	Middle Talarik	20	3.5
5/23/75	Kvichak	Lower Talarik	1,100	9.0

Table 12. Estimated Catch and Escapement of Chinook Salmon in the Naknek River System, 1969-1975.

Year	Estimated Sports Catch	Estimated Subsistence Harvest	Estimated* Escapement	Estimated Total Run**
1969	4,631	400	8,799	13,830
1970	2,730	300	4,360	7,390
1971	2,417	200	2,866	5,483
1972	1,668	400	2,791	4,859
1973	1,000	600	2,536	4,136
1974	1,700	900	2,600	5,200
1975	427	500***	3,580	4,507

* Includes all tributary streams surveyed.
** Excludes commercial harvest.
***Preliminary.

LITERATURE CITED

Siedelman, D.L. and Cunningham, P.D. 1972. Creel census of the sport fisheries in the Bristol Bay Drainage. Federal Aid in Fish Restoration, Annual Report of Progress, 1971-1972, Project F-9-4, 13 (G-IV-C) 183-197.

Prepared by:

Louis A. Gwartney
Fishery Biologist

Approved by:

s/Wm. Michael Kaill, Chief
Sport Fish Research

s/Rupert E. Andrews, Director
Sport Fish Division