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THE SALMON RESOURCE IN THE VICINITY
OF THE CHARIOT SITE IN 1960

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INTRODUCTION

The objectives of the United States Atomic Energy Commission project Plowshare for the development of peaceful applications of nuclear explosives have been discussed in information releases by the Commission (e.g., March 6, 1959; May 29, 1959). Project Chariot at Cape Thompson, northwest Alaska, is an integral part of the Plowshare program and is likewise discussed in the May (1959) release and in the introduction to several interim reports by members of the environmental program (see especially Alverson, Wilimovsky and Wilke, June 1960).

This paper provides an evaluation of the salmon runs in the vicinity of Cape Thompson under Phase III of the project environmental studies program.

Work in this second season was conducted from the base camp at Ogotoruk Creek near Cape Thompson from July 15 through August 31. Drs. Donaldson and Seymour assisted the author in the field program. The objective was to determine

the numbers, species, distribution and timing of the salmon runs in the vicinity of the project site. When practicable, information about the salmon runs farther from the site in the relatively unstudied section of the Arctic coast between northern Kotzebue Sound to Point Lay also was gathered (Figure 1).

From the 1959 studies it was apparent that salmon production in the vicinity of Project Chariot was negligible save for a small, virtually unexploited run of pink salmon Oncorhynchus gorbuscha to the Kukpuk River. However it was deemed advisable to extend the study over a period of several years in view of natural fluctuations in year-to year abundance. Evaluation based upon a single season of work would provide little idea of the variability in numbers which might occur.

EVALUATION METHODS

Evaluation of the salmon resource in the area was by boat and aeroplane, foot survey, interrogation of fishermen, hunters and informed local residents. Morphological and meristic studies were conducted to determine features such as age, size and sex ratio.

FIG. 1. The northwest coast of Alaska from Kotzebue Sound to Point Lay showing the location of Chariot Site and principal streams.

Population estimates in areas such as the Arctic coast of Alaska frequently can be obtained by conjunctive air and ground surveys. Good estimates can be made from relatively slow aircraft flying at heights of 200 to 400 feet above the streams. Except on small streams boat and foot surveys are seldom satisfactory for this purpose. The determination of species is not always possible by aerial surveys and in such instances a follow-up visit by foot or boat is necessary. Discussions with individuals familiar with the region and its resources frequently are helpful in extending and strengthening the information gained by air and foot surveys.

In 1960 the aircraft used for aerial surveys was a wheel-equipped Cessna 180. A collapsible Folbot and a 5-1/2 horse power outboard provided transportation on some of the larger rivers.

The Kukpuk and Noatak Rivers were surveyed both by boat and by air. Sections of the Wulik River were surveyed by boat and of the Pitmegea River by air.

Several small streams including Ogotoruk Creek at the site were visited on foot and by "weasel," an army vehicle equipped with tracks suitable for travel over tundra. These streams were checked frequently and throughout the period

when it was believed salmon might be present. Ogotoruk Creek was also under constant surveillance by many members of the Project's scientific staff. Singoalik River about 16 miles southeast of the site was visited on several occasions.

The following morphological and morphometric data were obtained from several samples: age, size, sex, weight, gill-raker counts, numbers of scales in the lateral line and vertebral counts.

Age data. Since chum salmon, Oncorhynchus keta, the dominant species in this area may return to the natal stream as mature, spawning fish at one of at least three ages, it is pertinent to determine the brood year of the individuals and the contribution of the various brood years to the spawning population. Abundance for two or three consecutive years may at times be associated with a single dominant brood year. In consequence of age studies cyclic patterns of high and low production may be recognized. From these patterns future levels of production may be predicted. In this study ages were determined from scale samples collected from live fish in the sea and both live and dead fish on the spawning grounds. Scales were obtained from chum salmon wherever practicable and prepared for analysis according to methods outlined by Koo (1955). Plastic impressions were made at the Fisheries

Research Institute Laboratory at the University of Washington in Seattle, and read by the author. Scale collections are seldom made from pink salmon, O. gorbuscha, since this species invariably matures at 2 years of age.

Size data was restricted to length measurements. These are important for determining relative growth by age, sex and area. Length was from mid-eye to hypural plate in spawned fish; to both hypural plate and tail fork in the case of fresh samples. Dual measurements on fresh fish permit a conversion from one measurement to the other and provide a basis for certain comparative pink salmon data presented here. All measurements were made with a steel tape laid along the lateral line of the fish. More sophisticated measurement techniques are generally desirable but were not practicable under the field conditions encountered.

Sex. Because of sexual dimorphism the samples were classified as to sex in order to establish a valid length-age relationship. Sex was determined by inspection of the gonads.

Weights were estimated to ounces by means of a spring-type Chatillon scale with a capacity of 10 pounds.

Counts of gill rakers, scales in the lateral line, vertebrae and certain other body parts are useful criteria for identification of species and for racial studies. Meristic

characters may be expected to vary with latitude and not infrequently within nearby areas. The counts were crosschecked by two independent readings.

Samples were obtained from the Kukpuk, Noatak and Wulik Rivers and from a gill net fished near the Chariot site. For the Kukpuk River, one sample of fresh fish also was provided at Point Hope by Mr. D. C. Foote. This was obtained by seining in the lower Kukpuk River with a gill net. The fish were to be used as dogfood. Mid-eye to tail-fork measurements for all fish and single scale samples from 20 fish of each sex were taken. Later in the month a sample of dead, spawned out fish from the river was measured. Most of the fish were found in the Eetiblaeruk region about ten miles above Maryatt lagoon (Figure 2). Although there were only a few chum salmon in the Kukpuk River several scale samples from these fish were also obtained. In December Mr. Foote forwarded a sample of scales from twelve autumn salmon caught in the Kukpuk River by Point Hope residents. The fish were taken between October 12 and 18.

On the Noatak River chum salmon predominated. A scale sample was obtained from the few dead fish that were present on August 22 and from live fish on August 26. The later sample was obtained by Messrs. Hilliard and Tash of the Arctic

FIG. 2. Kukpuk River drainage showing principal pink salmon spawning areas, 1959 & 1960.
(Eskimo names after Foote, 1960).

Health Research Center.

On the Wulik River pink salmon measurements and a few chum salmon scales were obtained during a reconnaissance by boat on August 16.

The sample from the Chukchi Sea at the Chariot Site was obtained by use of a 300-foot long cotton gill net of 5-1/4 inches stretch mesh and 60 meshes deep. The net was provided by D. L. Alverson, Base Director, North Pacific Exploration and Gear Research, Bureau of Commercial Fisheries (Seattle). The net was fished near shore when both weather and work schedule permitted (Figure 3).

RESULTS AND DISCUSSION

A. Enumeration, Distribution and Timing

1. Streams in the vicinity of Project Chariot.

The Kukpuk River entering the Chukchi Sea just northeast of Point Hope and the Singoalik River at Cape Seppings supported small salmon runs this year. The small streams entering the Chukchi Sea between Point Hope and Cape Seppings, and in the immediate vicinity of the Chariot Site, did not have salmon in 1960. Moreover, runs are not expected in other years because frost conditions probably preclude the establishment

FIG. 3. Location of gill nets, Chariot Site, 1960.

of salmon stocks in these small streams. As noted by Waller (U.S.G.S. interim report for 1959) flowing water probably ceased in Ogotoruk Creek about mid-December at the time that ".....the creek bed probably became frozen." As the eggs and young of salmon remain in the gravel during the winter months it is unlikely that they would survive, since they are not able to withstand temperatures much below freezing and must have flowing water in order to obtain oxygen.

The results of surveys in the local streams were as follows:

Kukpuk River. An aerial survey of the Kukpuk on August 2 gave an estimate of 2,600 live pink salmon. At that time many of the fish were schooled indicating that they had recently arrived in the river. It seemed likely from the pattern of distribution that more fish were in Maryatt Lagoon but not visible because of discolored water.

Unfortunately, heavy rains on August 9 and 10 resulted in flooding that made observations impractical at a time when the maximum number of salmon were in the river. Thus the assumption that some of the Kukpuk run was not counted on August 2 could not be verified.

A boat survey August 17-19 permitted verification of species of salmon in the stream and firsthand observations in

areas where fish had spawned. At this time there were very few live fish but dead fish were fairly abundant in the region from Kukpuk to Eetiblaeruk. Only two chums were seen, both alive. During this survey the lower mile and one-half of the Ipewik were surveyed but no salmon were seen.*

The results of surveys of the Kukpuk in July and August, 1960, appear below as Table 1.

Table 1. AERIAL AND GROUND SURVEYS OF KUKPUK RIVER, 1960

Date	Survey method and coverage	Surveyors	Conditions	Observations
July 16	Aerial - mouth to Ipewik confluence	Donaldson Pautzke** Smith	Good	No fish observed
July 23	Boat - head of Ogotoruk Valley to Ipewik confluence	Donaldson Smith	Very good	No salmon observed
August 2	Aerial - mouth to limit of migration	Smith	Good	2,600 pinks, about 50% spawning - none dead
August 17-19	Boat - mouth of Ipewik to Sulupogaktak Channel	Seymour Smith	Fair	Several hundred live pink - most dead were gone
August 30	Aerial - head of Ogotoruk Creek to mouth of river	Smith	Excellent	Less than 50 live fish

* Campbell and Curry of U.S.G.S. reported seeing several salmon at the confluence of the Ipewik and Kukpuk about August 6; however, it is considered most unlikely that significant numbers of fish reached this point.

** Clarence Pautzke, Deputy Commissioner of the Alaska Department of Fish and Game.

It is apparent from the foregoing that the peak of spawning of pink salmon occurred about August 10-15. The floods following the August 9-10 storm had disrupted the normal sequence of spawning and death, so some interpolation from the August 2 and August 16-19 observations is necessary. (In 1959 it appeared that the peak occurred about August 15.)

Distribution of Kukpuk salmon was similar in 1959 and 1960. In Figure 2 important spawning areas are plotted. No extensive spawning occurred above Ogsaghaek and principal concentrations in both years have been observed between Eetiblaeruk and Kukpuk. One place of very heavy spawning is immediately below the mouth of Daktaeluk Creek.

The sex ratio of pink salmon in the river is suggested by the per cent males in dead fish inspected during the August 17-19 boat trip. At that time 67 per cent of the dead were males.

Twelve Kukpuk salmon were scale-sampled in October by Mr. Foote. Nine of these proved to be silver, or coho salmon (Oncorhynchus kisutch); three were chums. Silver salmon have not previously been reported from this section of the coast, so far as is known.

Singoalik River. The total run to this small stream

was apparently twenty-five pink salmon that were observed on August 3. These were spawning within one mile of Singoalik lagoon with the principal activity immediately above the lagoon. On August 6 only twelve salmon were seen though conditions for observation were poor. On August 15, following the heavy rain, the only remaining fish were three dead males on a gravel bar near the lagoon. The presence of salmon in Singoalik River is of considerable interest because in that system they must leave the sea and enter brackish water considerably before they normally would.

Pink salmon may enter brackish water somewhat ahead of the time of spawning but usually they proceed directly to the spawning grounds and spawn once they are in the river. However, in the case of Singoalik, a self-sustaining run must enter the lagoon, not purely in response to the recognized progression of physiological changes in the fish, but also in accordance with the opening and closing of the lagoon by a gravel bar across the entrance. This barrier is controlled by the vicissitudes of sea and stream.

Opening of the lagoon usually follows a period of strong onshore (southerly) winds and is frequently accompanied by heavy rainfall. As the sea level outside rises

in response to the onshore winds, water percolating through the bar is dammed and the water level inside is raised until frequently a very large volume of water is impounded. If accompanied by heavy rainfall the rate of rise is increased in direct proportion to input, the size of the lagoon and the level of the water mass outside.

When the onshore wind relents the sea level drops and the impounded waters begin to cut a channel through the bar. The water rushes through the channel and soon cuts it to sea level. Then the forces in lagoon and ocean approach equilibrium and access to and from the lagoon is possible.

It is a matter of observation that these smaller streams seldom maintain open channels from lagoon to the sea for long. In the case of Ogotoruk Creek, following a period of high on-shore winds August 8-10, 1960, a swell height of more than four feet was recorded (U.S.G.S.). This was accompanied by heavy rains and the stream rose from a flow of a few feet per second to one of 700 c.f.s. (Reuben Kachedoorian, U.S.G.S., personal communication). As the storm subsided the lagoon broke open and on this occasion remained that way for about ten days.

Singoalik lagoon also opened after the August 8 storm for the first time in at least five weeks. On July 5

the lagoon was closed but the length of time previous to this date when the lagoon was open is not known. At any rate it is clear that Singoalik River salmon must have been in the lagoon for at least four weeks prior to spawning. (A single fish was caught in a gill net set in the lagoon near the outlet on July 21). Since the time and duration of the annual spring opening must be rather uncertain, it appears likely that the fish will gather outside the bar early in the spring and enter at the first, and, in some years, perhaps the only opportunity. In this case the fish able to enter in early July will remain in the lagoon until spawning time five to six weeks later. The alternative is that they gather outside the bar later in the season and wait for a chance opening whereby they may gain access to the river. The likelihood of such an alternative appears remote since there is no guarantee that the lagoon will open at all later. From 1959 and 1960 observations it appears that there is self-perpetuating pink salmon runs in both odd and even years and since pink salmon mature at two years of age the runs must have been successful in gaining entry each year at one time or another. Adaptation to the fairly dependable timing of the spring break-up as suggested here is perhaps unique in the recorded pattern of pink salmon spawning runs.

2. Streams "outside" the project area

Wulik River. Salmon were observed schooled in the ocean near Kivalina at the time of a flight by Dr. Donaldson on July 26. At that time a few salmon were also in the lagoon. Three weeks later, on August 16, the lower twelve miles of the river was surveyed by boat. By then spawning was complete though an occasional live pink salmon was seen. The numbers and distribution of live and dead carcasses suggested a total 1960 run of perhaps a thousand or more pinks but not more than a few hundred chums. It appeared that the major spawning took place from a point just above lagoon (tidal) influence and upstream for about five miles. There was no evidence of earlier spawning in the upper reaches of the section of river surveyed though suitable conditions prevailed throughout. A sex ratio from dead fish indicated 70 per cent males in the pink run.

Noatak River. Substantial numbers of salmon were being taken in set gill nets at Kotzebue on July 15, but it was not until July 24 that Ray Lewis, Wien airlines pilot, reported the first substantial showing of chum salmon in the lower Noatak River. Also on July 24 several project personnel were at the Kelly River 120 miles upstream and saw no salmon there. On August 1 a

second group of project personnel reported chums and possibly a school of red salmon, Oncorhynchus nerka. On August 21-22 a boat survey was conducted from the confluence of the Kelly River to the mouth of the Noatak on Kotzebue Sound, and it was apparent that a heavy run of chums was distributed throughout. Some spawning had begun in side channels above Noatak on August 21 but most fish were still schooled. (Only four dead were obtained for age and length determinations). Heaviest concentrations of fish were seen a few miles above the head of Seeveesuk Channel (Figure 4). Virtually all live fish were chums though some coho (or silver salmon), Oncorhynchus kisutch, were suspected among the schools observed in the lower river. Small numbers of pink carcasses had been washed ashore about five miles below Noatak village indicating an earlier run of that species.* Spawning facilities appeared excellent from Kelly River to Agashashok River. Below this point the principal bottom constituents were silt, sand and mud.

On August 23 a follow-up aerial survey of the Noatak was flown from two or three miles below Agashashok River to three or four miles above Noatak village. A thorough aerial survey

* From a personal communication with Mr. Alan Cooke, aide to Mr. Foote, it appears that principal pink salmon spawning takes place in (and perhaps below) the Eli River.

FIG. 4. Noatak River showing distribution of chum salmon, August 21-23, 1960.

of this river would be very time-consuming and expensive because the Noatak splits often and side channels meander for many miles before rejoining the main stream. However, an extremely large run of chums was evident and an estimate of 930,000 was reached. It was broken down as follows:

Below Agashashok River	10,000	(largely estimated from boat survey)
Agashashok to Noatak village	690,000	(nearly all schooled fish)
Noatak to Kelly River	230,000	(some spawning near Noatak)
	<hr/>	
Total	<u>930,000</u>	

This total does not take into account those salmon above the confluence of the Kelly, nor in the Kelly River itself. Local reports on the usual distribution on the upper river are in conflict. Some suggest an appreciable migration above the Kelly, others fix that stream as the approximate upper limit of migration.* Probably the distribution changes from year to year but it is clear that there were large numbers of chums in the vicinity of Kelly River as far as the upper limit of the survey on August 21.

Some indication of the size of past runs of fish to Noatak is provided in reports of the Alaska Fish and Fur Seal

* Mr. Cooke reports, "It is known that some of the fish (chums) get upriver at least as far as Nimiuktuk." The Nimiuktuk River enters the Noatak about ninety miles above the Kelly River.

Industries (Bower, 1912-1918). This publication reports the pack of the Midnight Sun Packing Company, which operated two small traps in the mouth of the river, and a cannery nearby. The pack in 1918 was the largest, at something over 2,600 cases of "dolly varden," which are listed "in excess of a small coho pack." At possibly fifteen or twenty fish per case something in the order of 50,000 fish may have been taken in the peak year. It is interesting to note that no other species of salmon is reported in this pack.

Pitmegea River. On August 19 this river was surveyed by air between the mouth and a small tributary about ten miles upstream. Visibility was good and despite the apparent suitability of this river for salmon production, none was observed. Peter Lent (Project Chariot Caribou Studies, University of Alaska) observed no salmon in this river during his frequent flights over it in 1960 (personal communication).

Kukpowruk and Kokolik Rivers. On August 15 Dr. Norman Wilimovsky flew over the lower reaches of these two northern rivers. He reports having seen no salmon though he specifically looked for them at that time (personal communication). However, Mr. Harold Little, Kotzebue resident and Chariot summer employee, occasionally guides hunters and fishermen

in this section of coast and believes that fish caught in the Kukporwuk on one occasion were salmon (personal communication).

Kobuk River. Ray Blastervold and Oscar Henry, residents of Kiana on the Kobuk and summer employees at the Chariot Site, report good runs of chums, some pinks and possibly a few red salmon production is on a level with that of the Noatak. Raleigh (1957) in a report on salmon utilization in the region found the Kobuk personal-use catch to be on the order of ten times that of the Noatak, and made up of chums, reds and kings.

B. Sampling

Three groups of data were collected from the 1960 samples: length frequency measurements of pink salmon from the Kukpuk and Wulik Rivers; age determinations of chum salmon primarily from the Noatak River but also including the Kukpuk and Wulik Rivers; measurements for racial studies of twenty-one chums, fourteen reds, nine pinks and one king salmon, Oncorhynchus tshawytcha, caught in gill nets fished in the Chukchi Sea at the Chariot Site.

1. Pink salmon stream sample data

The pink salmon length frequency data by sample are presented in Table 2 and Figure 5. A conversion factor can be

Table 2. Length frequencies of pink salmon: Kukpuk and Wulik Rivers, 1959-1960

Length interval (mm)	1960 Kukpuk River* seine catch		1959 Kukpuk River spawned fish		1960 Kukpuk River spawned fish		1960 Wulik River spawned fish		1959-1960 Combined samples	
	Male No.	Female No.	Male No.	Female No.	Male No.	Female No.	Male No.	Female No.	Male No.	Female No.
296-305			1	2.0					1	0.5
-315			0			1	5.5		0	1
-325			0			0		1	2.1	0
-335	1	1.2	0			1	5.5	0	1	0.5
-345	0		2	2.0	2	8.0	1	2.1	0	2
-355	4	5.1	5	10.0	1	4.0	2	4.1	2	5
-365	6	7.6	1	2.0	3	12.0	0	1	4.8	6
-375	9	11.4	4	8.0	5	20.0	7	14.6	4	10
-385	15	19.1	6	12.0	3	12.0	5	10.4	5	23
-395	10	12.7	3	6.0	2	8.0	12	25.0	2	23
396-405	8	10.1	2	4.0	5	20.0	4	8.3	3	13
-415	10	12.7	6	12.0	2	8.0	1	2.1	2	13
-425	7	8.9	6	12.0	1	4.0	2	9.5	17	8.3
-435	6	7.6	4	8.0	1	4.0	7	14.6	1	5
-445	0		3	6.0			1	4.8	25	12.2
-455	1	1.2	3	6.0			1	2.1	14	6.9
-465	1	1.2	1	2.0			3	6.3	1	1
-475	1	1.2	1	2.0			1	2.1	14	6.9
-485			2	4.0			1	4.8	5	2.5
-495							1	2.1	4	1.9
496-505							0		4	1.9
							2	4.1	4	1.9
							0		2	1.0
							1	2.1	3	1.5
Totals	79	100.00	37	100.00	50	100.00	27	100.00	18	100.00
									48	100.00
									21	100.00
									204	100.00
									101	101.00

* Measured as mid-eye to fork-of-tail. Converted to mid-eye to hypural plate by the formula,
 $Y = 1.110X - 4.816$.

FIG.5. Length frequencies of pink salmon from Chukchi Sea Coast, 1959 - 1960.

used to correct length measurements from mid-eye--hypural plate to mid-eye fork of tail. This conversion was calculated for pink salmon runs on the Alaska Peninsula but is considered satisfactory for the purposes of this study.* The combined length-frequency curve shown in Figure 6 should be representative of the length distribution of pink salmon on the Arctic Coast. Scales taken from Kukpuk and Singoalik pinks were examined for unusual growth patterns but none was evident.

2. Chum salmon stream sample data

Chum scales taken from Noatak, Wulik and Kukpuk samples are too few in number to provide a true picture of ages. However, three winter annuli were found on all scales, which means the fish were in their fourth year of life and belong to the 1956 brood year. It is pertinent to compare the age composition of chums taken by us in 1960 with age composition determined by investigators of the International North Pacific Fisheries Commission in the years 1956-1959. (I.N.P.F.C. - unpublished records). Scales taken from chum salmon in Kotzebue Sound showed four-year olds to dominate except in 1959. In that year the sample of ninety-six fish included sixty-six (69 per cent) three-year olds. These young fish were derived

* This can be verified by examination of the relationship of fork-length to hypural plate length of pinks taken at the site.

FIG. 6. Chukchi Sea Coast pink salmon, 1959-1960. Combined length frequencies.

from the 1956 brood year as were the four-year olds of 1960. This demonstrates how large runs in successive years may be derived from a single very successful brood year. Of particular interest is the extremely rapid rate of growth since the winter of 1959-1960, that is shown on the scales. This may be the result of particularly favorable conditions, e.g., abundant food, optimum water temperatures or other phenomena conducive to maximum growth rates.

3. Gill net catch data

Data obtained from salmon taken in the gill net and presented in Table 3. The number of specimens are few, but in view of the limited knowledge of salmon populations in this section of the coast these data are especially worthy of comment. In addition to the forty-five salmon recorded, ten others that had been washed out of the net by the storm of August 8-10 were recovered on the beach but in a condition unfit for measurement. The data for nine Arctic char Salvelinus alpinus that were caught in the gill nets also are included in Table 3.

It is significant to note that fish taken during the period August 8-13 were apparently moving up the coast. This was evidenced by the fact that in all determinable cases individuals

Table 3. Record of salmon and char obtained from Chariot Site gill net, August 1960.

Date	Species	Sex	Length (mm)		Age (3)	Weight	
			MEHYP (1)	MEFOT (2)		Pounds	Ounces
August 8	red	F	478	543	2.3(⁶ ₃)	5	9
	red	F	494	553	2.3(⁶ ₃)	5	9
	red	M	553	615	1.3(⁵ ₂)	9	0
	chum	F	499	553	-	6	3
	chum	M	578	640	3	11	8
	chum	M	551	611	3	9	15
	chum	F	553	598	3	8	7
	red	M	503	560	2.3(⁶ ₃)	6	6
	red	F	508	567	1.3(⁵ ₂)	6	10
	chum	F	490	545	3	5	14
	red	M	559	623	2.3(⁶ ₃)	8	13
	red	F	532	596	2.3(⁶ ₃)	6	4
	chum	F	480	534	3	5	13
	chum	F	503	562	3	6	6
	chum	F	523	579	3	8	0
	chum	F	469	521	3	5	0
	chum	M	509	567	3	6	15
	chum	F	492	545	3	5	13
	pink	M	429	471	(2)	4	0
	pink	M	433	479	(2)	4	0
	pink	M	415	460	(2)	3	3
	pink	M	394	432	(2)	2	7
	king	M	484	538	1.1(³ ₂)	5	5
August 9	chum	M	517	562	3	7	1
	chum	F	509	568	3	5	10
	chum	F	492	543	3	5	6

Table 3. (continued)

Gill rakers	Scales	Vertebral	Gonad wt.	Stomach contents
dorsal ventral	in 1. 1.	count	ounces	
20 + 15			10.5	1 sand lance
20 + 15			11.0	empty
23 + 15			-	1 sand lance
14 + 9			11.0	misc. - U.I.D.
15 + 9			-	" "
13 + 10			-	empty
14 + 8	129		11.0	misc. - U.I.D.
20 + 14	128		-	empty
24 + 13	131		7.0	empty
-			8.0	empty
22 + 15			-	10 sand lances
23 + 13			4.0	misc. - U.I.D.
14 + 9			12.0	misc. - U.I.D.
12 + 9			10.0	" "
13 + 10			13.0	" "
14 + 9			11.0	" "
12 + 9			-	" "
14 + 10			11.0	1 sand lance
19 + 12	195			12 sand lances; 2 cod
19 + 12				1 sand lance; 2 smelt
19 + 12				4 sand lances
17 + 13				empty
12 + 9	142 (47)	69	well developed (mature)	13 sand lances
15 + 9		66		empty
15 + 9	130 (35)	66	18.0	misc. - U.I.D.
12 + 9	135 (40)	68	10.0	empty

	red	F	541	601	-	7	10	22 + 15	137(42)	70	5.0	misc. - U.I.D.
	pink	M	405	448	(2)	3	3	19 + 12		68	-	
August 11	chum	F	490	546	3	4	15					
	chum	F	537	593	3	7	7	13 + 10				
	chum	F	540	605	3	7	10	13 + 10				
	chum	M	562	623	3	8	9	15 + 9				
	red	M	544	606	1.3(⁵ ₂)	8	0	13 + 9				
	pink	M	420	466	(2)	3	2	24 + 14				
	red	F	555	621	1.3(⁵ ₂)	8	12	16 + 10				
								21 + 15		67		7-8 U.I.D. small fish
August 12	chum	F	532	590		8	12					
	pink	M	401	438	(2)	3	8	12 + 10	128(33)	67	17.0	empty
	chum	F	555	616	3	7	13	19 + 14				1 smelt 90 mm long
	chum	M	537	592	3	7	0	11 + 9	134(38)	67	19.0	misc. - U.I.D.
	red	F	514	573	2.3(⁶ ₃)	5	15	14 + 8	131(37)	67		empty (parasites)
	pink	M	451	495	(2)	4	2	21 + 16	129(34)	66	12.0	" "
								18 + 14	192(03)	70		" "
August 13	red	F	497	554	2.3(⁶ ₃)	6	7					
								22 + 15		66	14.0	empty
August 27	red	M	563	622	2.3(⁶ ₃)	9	13					
								22 + 13			milt flowing	
August 28	red	F	524	586	2.3(⁶ ₃)	-						
	pink	M	368	406	(2)	2	3	22 + 14		68		empty
								17 + 12				empty
August 13	char	F		602		7	1					-
	char	M		558		4	8					-
	char	?		537		4	5					-
	char	?		565		4	14					-
August 28	char	F		670		10	0					
	char	F		653		8	8					empty
	char	M		631		9	3					empty
	char	M		510		4	11					empty
	char	F		511		5	7					empty

(1) Mid-eye -- hypural plate

(2) Mid-eye -- fork of tail

(3) Age in numbers of winter checks (annuli) on scales ; e.g., 2.3 means two winters in fresh water, three in salt water. A second system for aging red salmon uses a numeral with a numerical subscript. This system is followed in the second aging shown in this column.

struck the south side of the net. By contrast the fish taken August 27 and 28 struck from the north. Furthermore on the calm bright morning of August 20 several schools of large fish --presumably salmon-- were observed moving southward in shallow water in front of the site. On the preceding day Amos Lane, Point Hope resident and summer employee at the site, visited his village and noted that seine catches were of fish moving down the coast on the south side of the spit (personal communication). This is in contrast with the migration pattern observed and reported during the early part of the summer. Possibly these observations reflect a normal movement of Kotzebue Sound fish as they swim up the coast early in the season then return to make up part of the late runs to rivers such as the Noatak and Kobuk. Alternatively the later migrants may have been wandering fish. One red salmon taken August 27 showed high spawning coloration and had flowing milt, a condition expected of salmon that are only a few miles from their spawning grounds.

In order to relate the seine catch to some unit of effort the fishing time is presented in Table 4 as shackle-hours per 24-hour day. The complete net of 300 feet is considered one shackle and the time fished was obtained from the daily logs of Seymour and Smith.

Table 4. Shackle-days fishing time, 1960.

Date	Net feet	Hours fishing	Daily total (hours)
August 8	300	14	.6
" 9	300	10	.6
	100	14	
" 10	100	9	.4
	100	15	
" 11	100	9	.4
	250	7	
" 12	250	24	1.1
" 13	250	9	
" 27	250	2	.2
	150	8	
" 28	150	5	.1
Total			<u>3.4</u>

In assessing the catch per unit of effort it is important that the selective features of the 5-1/4 inch-mesh gill net are recognized. This mesh is probably near the optimum size for taking a cross section of the available species of salmon. However exceptionally large chums and reds and small pinks will frequently escape. This is borne out by the sex ratios in

Table 5. Pink salmon females are consistently smaller in girth than are males as spawning time is approached, and none was caught. In the case of the two other species the males are, generally, larger than the females and were not as susceptible to capture in this mesh size. If larger and smaller size mesh nets had been used a greater size range of salmon may have been sampled.

Table 5. Sex ratio of salmon taken by gill net at Project Chariot, August 1960.

<u>Species</u>	<u>Males</u>		<u>Females</u>		<u>Both</u>	
	<u>Number</u>	<u>Per cent</u>	<u>Number</u>	<u>Per cent</u>	<u>Number</u>	<u>Per cent</u>
Red	5	35	9	65	14	100
Chum	6	29	15	71	21	100
pink	9	100	0	0	9	100
King	1	100	0	0	1	100

The single king salmon taken August 9 was in its third year of life and had fully matured testes and would have been ready to spawn in 1960. It was 538 mm, or approximately 21 inches long by fork length measurement, a size expected of kings at the end of their second year of life in southeastern Alaska waters (Parker and Kirkness, 1950).

CONCLUSIONS

The 1960 data are summarized in three sections: (1) stream surveys in the vicinity of the site; (2) other stream surveys; and (3) gill net catches in the Chukchi Sea.

Streams visited in both 1950 and 1960 are sufficiently well understood that some conclusions may be drawn as to their productivity and the probable size of their future runs. Those streams visited only in one year require more study though some tentative conclusions may be drawn at this time. The sample from the ocean provided some insight into the size, age and movement of local salmon populations.

1. Stream surveys in the vicinity of Project Chariot.

Kukpuk River. About 4,000 pink salmon were present both in 1950 and 1960. This is probably the magnitude of run which may be expected in future years. Despite the fact that 1959 and 1960 were good chum years in the Kotzebue Sound area very few were seen in the Kukpuk. The contribution of chums to the Kukpuk salmon population is considered negligible though the possibility of a small late run is not entirely discounted. Most of the pink salmon may be expected to spawn in the lower part of the river between the Eskimo winter villages of

Eetiblaeruk and Ogsaghaek, and probably very few fish will migrate above Ogsaghaek. The spawning run occurs between July 25 and August 25, with the greatest numbers expected to spawn about August 10. It is apparent that the river supports some silver salmon. The size of the run of this species is not known though the absence of prior reports would suggest that it is small.

Eggs and larvae of the salmon will be in the gravel of the stream throughout the winter and probably until June or July each year, at which time the young salmon will migrate seaward.

Singoalik River. This stream supported less than fifty pinks, and no chums in 1959 or 1960, and it appears unlikely that a large run of either species will occur in any year. Spawning may be expected within a mile of the lagoon and peak spawning should occur about August 10. Fish may enter the lagoon as early as July 1, however.

It appears that neither Kukpuk nor Singoalik salmon play an important part in the economy of the region. The small seine fishery at Point Hope takes a few salmon each year but probably is motivated by the opportunity for good char fishing rather than by the salmon runs (Smith 1959 and 1960, personal log).

2. Other stream surveys

Wulik, Noatak and Pitmegea Rivers are included in this category. The information about the Kukpowruk, Utukok and Kobuk Rivers is too meager to be considered factual.

Wulik River. Probably from 1,000 to 3,000 pinks and a few hundred chums spawned in this river in 1960. The pink run apparently follows the pattern of the Kukpuk and Singoalik Rivers wherein fish enter late in July and spawning occurs during the first two weeks of August. Principal spawning appears to take place within five miles of the lagoon. Chums probably follow much the same pattern of distribution and timing.

Noatak River. This river supports a large run of chum salmon and a pink run of undetermined size. In 1960 a conservative estimate of the run was about one million fish. There are probably runs of two or perhaps three other species of Pacific salmon also, at least in some years.

The pink run appears to occur in early August, probably about the same time as those in other streams discussed. The chum run is in the river from mid-July through mid-September and possibly later. Peak spawning for chums is estimated to occur about September 10, and fish may be distributed through

the lower 200 miles of river at that time.

Pitmegea River. It is concluded that there were few, if any, salmon in Pitmegea in 1960.

Both the Wulik and Noatak Rivers sustain personal use salmon fisheries but the fishery for Noatak salmon, at Kotzebue and on the river, is much greater. Fish camps on the Noatak are located near Noatak Village and on the lower river.

3. Gill net catches, Chukchi Sea.

The ages of the chums in the gill net sample (also in the river samples) were all the same, four years. This is normally the dominant age group among the chum spawning populations in western Alaska though smaller numbers of 3- and 5-year olds are to be expected (Thorsteinson, Noerenburg and Smith. Fisheries Research Institute -- report in preparation).

The origin of the red salmon captured at the site is not known, but since individuals were all in advanced stages of maturity it is concluded that they were bound for local streams -- perhaps the Noatak and Kobuk Rivers. These were large fish having spent three winters in the ocean and either one or two winters in fresh water, that is, they were progeny of spawning runs in 1954 and/or 1955. The ages were as expected of reds along the western Alaska coast. A supposition about the movement of salmon in the Chukchi Sea is that there is a feeding

migration in a northwesterly direction during early August and a reverse migration toward Kotzebue Sound late in the month. In 1960 there was probably a substantial number of both red and chum salmon feeding along the coast between Kotzebue Sound and Point Hope, and it is now clear that all five species of Pacific salmon that are found along the North American coast frequent the waters as far north as Cape Thompson, at least.

RECOMMENDATIONS

Observations during two seasons on the number, species and distribution of salmon provide information upon which future runs can be forecast. However, salmon runs are subject to great natural fluctuations presumably caused by factors in the environment of an unpredictable nature. Because additional observations will markedly improve the accuracy of the forecasts an extension of the salmon program for several years is recommended.

Specific recommendations for 1961 are as follows:

1. An aerial survey of the Kukpuk River on July 30, August 10 and August 15. Reconnaissance by boat in the area and at the time indicated by the aerial surveys, probably from the mouth of the Ipewik to Maryatt Lagoon soon after the last aerial survey.

2. Foot surveys of Singoalik River August 1, August 11, and August 14, accompanied by a careful charting of the opening and closing of the lagoon to determine periods when fish have the opportunity to enter the lagoon.

3. Foot surveys of the lower two miles of Ogotoruk Creek and other small streams between it and Cape Seppings on or about August 12.

4. Aerial surveys of the Wulik, Kivalina, Pitmegea, Kukpowruk and Kokolik Rivers as near to August 10 as practicable, and of the Noatak on September 30.

5. Collection of fifty measurements of each sex of each species in as many streams as possible, and of as many scales (other than from pinks) as feasible.

6. Fish 150 feet of 5-1/4 or 5-1/2-inch mesh gill net in front of Chariot Site through as much of July and August as work schedule and weather permit. Scales and measurements should be taken from all salmon captured. Morphometric data such as that taken in 1960 will be useful in racial comparisons with fish from other areas.

7. Negotiate with responsible residents at important villages along this coast to encourage them to send scale samples from salmon caught late in the year.

LITERATURE CITED

- Alverson, Dayton L., Norman J. Wilimovsky, and Ford Wilke. 1960. A Preliminary Report on Marine Investigations of the Chukchi Sea - August 1959. Unpublished report of the U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Exploratory Fishing Gear Research Base, Seattle, Washington.
- Bower, Ward T. 1912-1918. U. S. Commissioner of Fisheries: Alaska Fish and Fur-Seal Industries, Salmon.
- International North Pacific Fisheries Commission. 1955. Annual Report for 1955. Vancouver, Canada. p. 45.
- Koo, Ted S. Y. 1950. Red Salmon of Bristol Bay, Alaska, as Revealed by a Study of their Scales. Thesis for Ph.D. degree, University of Washington Library.
- Parker, Robert R. and Walter Kirkness. 1950. Alaska Department of Fisheries. Biological Investigations. Annual Report for 1950.
- Raleigh, Robert F. 1957. Reconnaissance of Salmon Fisheries between Cape Newenham and Point Hope, Alaska, 1957. U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Alaska Region.
- Waller, R. M. 1960. "Ground-Water Conditions in the Vicinity of Project Chariot, Ogotoruk Creek, Northwestern Alaska." In Geologic Investigations in Support of Project Chariot in the Vicinity of Cape Thompson, Northwestern Alaska-- Preliminary Report. U. S. Dept. of the Interior Geological Survey. Report no. TEI-753.