

Informational Leaflet

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RED SALMON SPAWNING GROUND SURVEYS IN THE NUSHAGAK AND TOGIAK DISTRICTS, BRISTOL BAY,

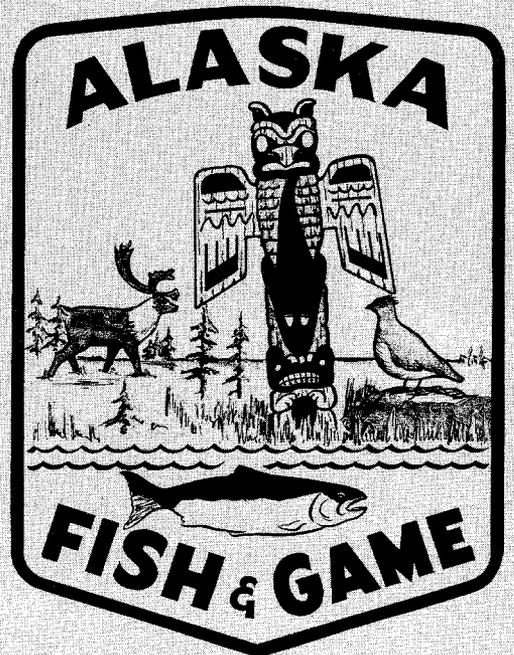
1966

By:

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RED SALMON SPAWNING GROUND SURVEYS IN THE NUSHAGAK
AND TOGIAC DISTRICTS, BRISTOL BAY, 1966

By

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INTRODUCTION AND BACKGROUND

Accurate determination of red salmon (Oncorhynchus nerka) spawning escapement and distribution on the spawning grounds in the Nushagak and Togiak districts has been obtained on a continuing and comparable basis since 1946. In 1966, both aerial and ground surveys were conducted for the seventh year under the direction of the Alaska Department of Fish and Game.

The purpose of the survey program is to provide accurate estimates of abundance and distribution of red salmon in the various important spawning areas. Estimates of total escapement of red salmon to most systems are obtained at tower counting sites located on the main stem of the rivers. In systems where counting towers are not situated, aerial surveys are used to determine spawning escapements as well as distribution. Distribution of fish on the spawning grounds is an important factor in the determination of optimum escapement requirements and utilization levels of escapement, as well as evaluation of the effect of fishing regulations.

Seven major spawning systems in the Nushagak and Togiak districts were included in the survey. Figures 1 and 2 show the main spawning systems surveyed. Detailed maps of each area are available in the 1965 report (Nelson, 1966).

AERIAL SURVEY METHODS

Total red salmon escapement to Wood River, Igushik River, Tikchik Lakes, Togiak Lakes and the Nushagak-Mulchatna River system were esti-

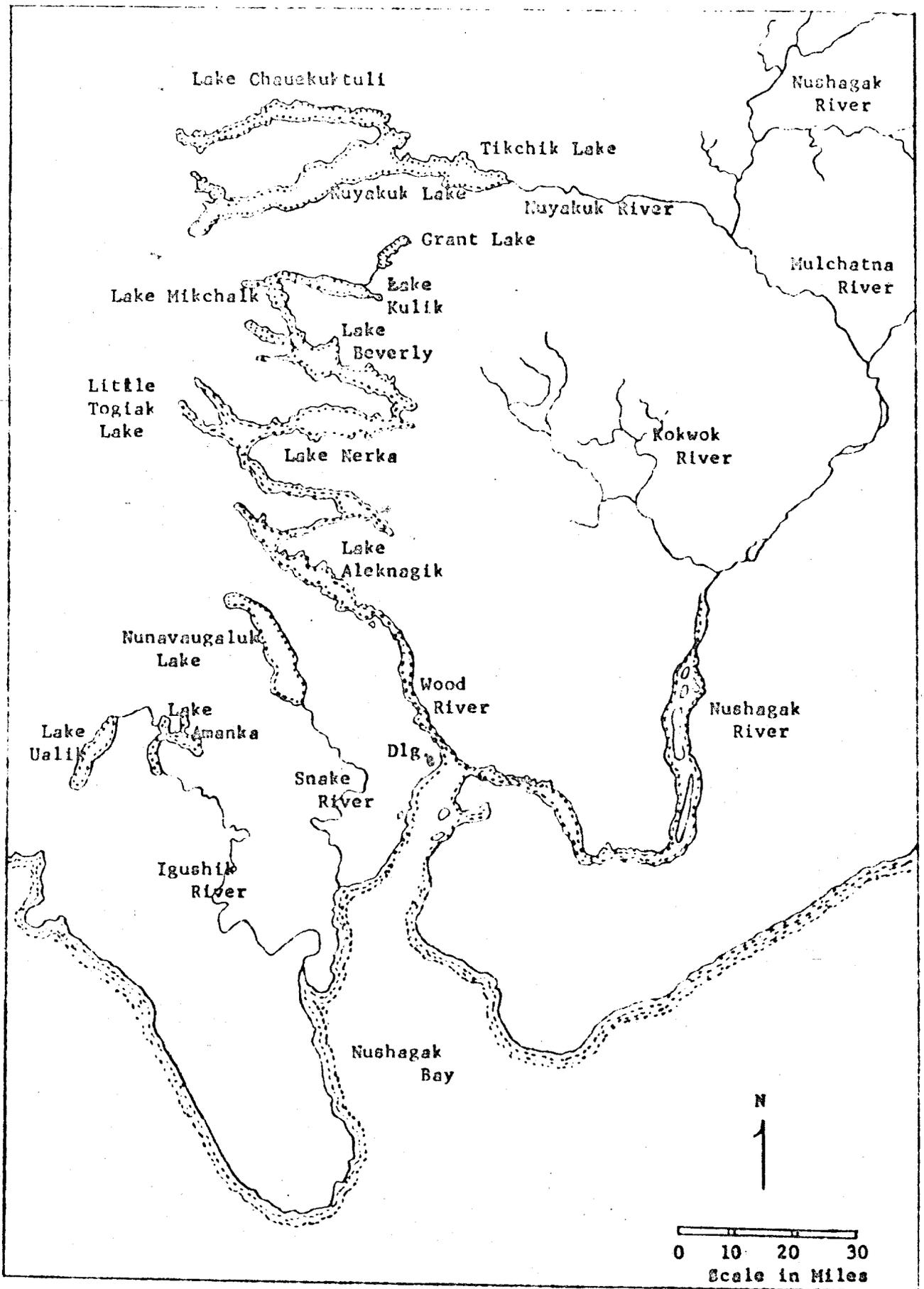


Figure 1. Nushagak District, Bristol Bay, Alaska

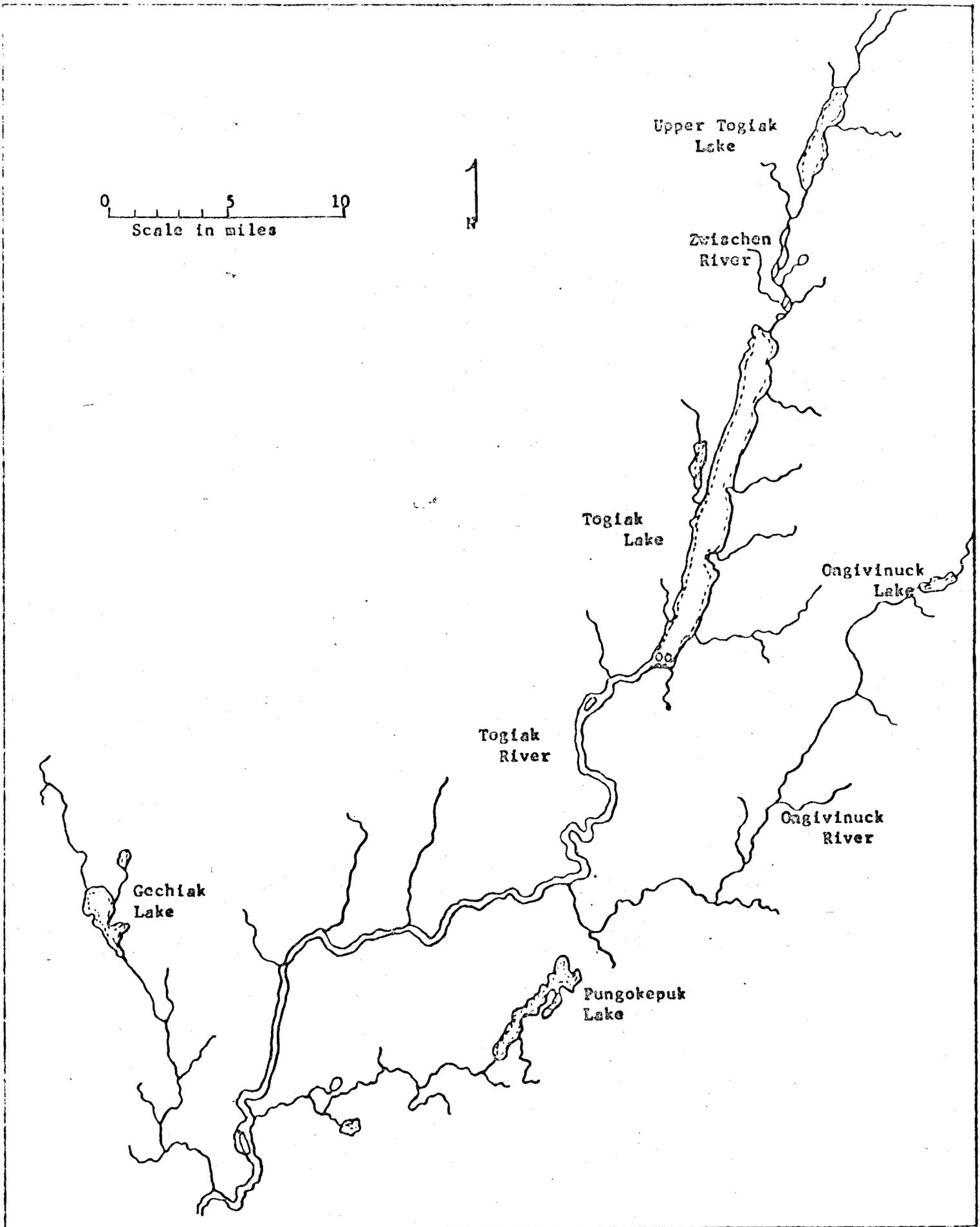


Figure 2. Togiak River System, Bristol Bay, Alaska

mated by the tower counting method. The tower location on the Nushagak-Mulchatna River system enabled an accurate total estimate of spawners to this large drainage for the first time. Although 50,200 red salmon were counted past this tower, adverse weather and water conditions precluded aerial estimates of the spawning grounds. Climatic conditions were favorable during the remainder of the aerial survey program.

Escapements to Lake Nunavaugaluk and Kulukak River systems and tributaries of the Togiak River were estimated by aerial surveys.

Supplemental ground counts by personnel of the Fisheries Research Institute of the University of Washington and the Alaska Department of Fish and Game provided useful comparisons with aerial estimates.

Total population estimates by area were again derived by employing the chain-link index method. A complete discussion of this method as well as other methods employed in the surveys can be found in Nelson 1966 and 1965.

Tables 1-5 list peak spawning ground estimates from all areas within each lake and river system. The reliability and accuracy of the chain-link method (Nelson, 1965, 1966) was again tested by comparing total population estimates before revision with tower enumeration figures (Table 8). The sum of major spawning population estimates in the Nushagak and Togiak districts was 7.2 percent less than known (from tower counts) total populations during 1966. In addition, estimates of separate, major spawning populations averaged a -4.4% deviation from counting tower estimates. The under-estimate in both cases is probably due to the fact that aerial and/or ground surveys generally cannot cover all possible spawning areas.

NUSHAGAK DISTRICT

Wood River Lakes

Peak aerial estimates of red salmon for the Wood River Lakes in 1965 and 1966, and peak estimate ratios for these two years are shown in Table 1. Preliminary population estimates and estimates adjusted to the tower count total are shown in Table 6.

The 1966 escapement of 1,208,700 red salmon to the Wood River Lakes

contributed 74 percent of the total Nushagak district escapement and was the largest escapement since 1959 (Table 6).

Most noteworthy were the very large returns to the Agulowak (176,000) and Agulukpak (110,000) Rivers as both rivers received over 100,000 spawners for the second straight year. The 1962 brood year was expected to be the dominant year class, however, a large return of 5-year old fish to the Wood River system (51 percent) and the unexpected large returns to the Agulowak and Agulukpak Rivers from the 1961 brood year produced record returns in both rivers.

Red salmon runs to Lake Aleknagik and Nerka were the largest since 1956 and 1960, respectively (Table 6). Lake Beverly accounted for 22 percent of the system escapement while Lakes Mikchalk and Kulik were disappointing with far fewer spawners than these areas were capable of supporting (Table 6).

Beach spawning areas of importance in the Wood River Lakes were N-4 - N-6 Beach and Anvil Bay of Lake Nerka; D Slough Beach of Little Togiak Lake and Hardluck Bay, Silver Horn and B-12 beaches of Lake Beverly (Table 1).

Creek spawning populations were good, namely Eagle, Hansen and Ice Creeks of Lake Aleknagik and Pick Creek of Lake Nerka (Table 1).

Spawning in rivers between lakes accounted for 28 percent of the escapement to the Wood River Lakes, while 54 percent were beach spawners (Table 11).

Fifty percent of the total escapement was accounted for by peak aerial estimates in the Wood River Lakes in 1966 (Table 9 and 10).

Igushik Lakes

Peak aerial estimates of red salmon for the Igushik Lakes in 1965 and 1966, and peak estimate ratios for these two years are shown in Table 2. Preliminary population estimates and estimates adjusted to the tower count are shown in Table 6.

The 1966 escapement of 206,400 red salmon to the Igushik Lakes contributed 13 percent of the total Nushagak district escapement (Table 6).

As in the past, the Kathlene River, Ongoke River, Francis Creek and westshore beaches of Lake Ualik were the most important spawning areas in 1966 (Table 2).

Distribution of spawners in the three major types of spawning areas is shown in Table 11. The exceptionally large return to the Ongoke River, which is classified as a creek spawning area, resulted in the highest creek spawning percentage in 8 years of observation (Table 11).

Forty-five percent of the total escapement was accounted for by peak aerial estimates in the Igushik Lakes system (Tables 9 and 10).

Lake Nunavaugaluk (Snake River Lake)

Peak aerial estimates of red salmon for Lake Nunavaugaluk in 1965 and 1966, and peak estimate ratios for these two years are shown in Table 3.

The 1966 escapement of 4,500 red salmon to Lake Nunavaugaluk is based solely on aerial surveys and constituted .3 percent of the total Nushagak district escapement in 1966 (Table 6).

Over half the fish spawned on the east side of the lake, showing no preference for any particular area there. Fish were similarly dispersed on the west side of the lake along the beaches suitable for spawning.

Tikchik Lakes

Peak aerial estimates of red salmon for the Tikchik Lakes in 1965 and 1966, and peak estimate ratios for these two years are shown in Table 4. Preliminary population estimates and estimates adjusted to the tower count are shown in Table 6.

The 1966 escapement of 161,000 red salmon to the Tikchik Lakes constituted 10 percent of the total Nushagak district escapement (Table 6).

The single most important spawning area was the Tikchik River, while other important areas were Cow Creek and Allen River Beach (Table 4).

Distribution of spawners was almost evenly divided between creeks,

beaches and rivers (Table 11). Forty-five percent of the total escapement was accounted for by peak aerial estimates in the Tikchik Lakes system, comparing favorably with past years for this area (Tables 9 and 10).

Nushagak-Mulchatna River System

With the establishment of a counting tower on the Nushagak-Mulchatna system, for the first time in 1966, it was planned to compare aerial estimates with tower counts. However, due to adverse weather and water conditions, aerial surveys were not conducted on the Nushagak-Mulchatna system in 1966.

The 1966 escapement of 50,200 red salmon to the Nushagak-Mulchatna system contributed 3 percent of the total Nushagak district escapement (Table 6).

TOGIAC DISTRICT

Togiak Lakes

Peak aerial estimates of red salmon for the Togiak Lakes in 1965 and 1966, and peak estimate ratios for these two years are shown in Table 5. Preliminary population estimates and estimates adjusted to the tower count are shown in Table 7.

The 1966 escapement of 91,100 red salmon to the Togiak Lakes constituted 74 percent of the total Togiak district escapement (Table 7).

Spawning ground distribution did not differ markedly from that of 1965 when the majority of fish spawned on lake beaches. Fifty-one percent of the total fish were accounted for by peak aerial estimates (Tables 9 and 10).

Togiak Tributaries

Peak aerial estimates of red salmon for the Togiak tributaries in 1965 and 1966, and peak estimate ratios for these two years are shown in Table 5.

The 1966 escapement of 13,100 red salmon to the Togiak tributaries, which is based solely on aerial surveys, constituted 11 percent of the total Togiak district escapement (Table 7).

Kulukak River System

Peak aerial estimates of red salmon for the Kulukak River system in 1965 and 1966, and peak estimate ratios for these two years are shown in Table 5.

The 1966 escapement of 18,800 red salmon to the Kulukak River system is based solely on aerial surveys. Red salmon escapement into the Kulukak system accounted for 15 percent of the total Togiak district escapement (Table 7).

SUMMARY

1. The Alaska Department of Fish and Game continued aerial survey of red salmon spawning grounds in the Nushagak and Togiak districts for the seventh straight year.
2. Red salmon escapement to the Wood River Lake was 1,208,700 and represented 74 percent of the total Nushagak district escapement.
3. Large escapements of over 100,000 spawners were accounted for in the Agulowak and Agulukpak Rivers for the second straight year.
4. Peak aerial estimates in the Wood River Lakes accounted for 50 percent of the total escapement.
5. Red salmon escapement to the Igushik Lakes system totaled 206,400, representing 13 percent of the total Nushagak district escapement. Peak aerial estimates accounted for 45 percent of the total escapement, which compares closely with past years.
6. Only .3 percent, or 4,500 red salmon, of the Nushagak district escapement entered Lake Nunavaugaluk (Snake River Lake).
7. The escapement of 161,000 red salmon to the Tikchik Lakes system was 10 percent of the total Nushagak district escapement. Forty-five percent

of the fish were accounted for by peak aerial estimates.

8. An escapement of 50,200 red salmon was enumerated for the first time by a counting tower on the Nushagak River system. Adverse weather and water conditions prohibited aerial surveys.
9. The escapement of 91,100 red salmon to the Togiak Lakes represented 74 percent of the total system escapement. Peak aerial estimates accounted for 51 percent of the counted escapement.
10. The Togiak tributaries and Kulukak River system received escapements of 13,100 and 18,800 red salmon, respectively.

LITERATURE CITED

Nelson, Michael L. 1965. Red Salmon Spawning Ground Surveys in the Nushagak and Togiak Districts, Bristol Bay, 1963. Alaska Department of Fish and Game, Informational Leaflet 61, p. 24.

----- . 1966. Red Salmon Spawning Ground Surveys in the Nushagak and Togiak Districts, Bristol Bay, 1965. Alaska Department of Fish and Game, Informational Leaflet 84, p. 40.

APPENDIX

Table 1. Comparison of Peak Red Salmon Spawning Ground Estimates in the Wood River Lakes, 1965-66.

Area	1965		1966		Ratio 1966/1965
	Date	No. Est.	Date	No. Est.	
WOOD RIVER LAKES					
Wood River	8/30	2,960	8/19	5,600	1.89
<u>LAKE ALEKNAGIK:</u>					
Mission Creek	8/13	130	8/ 6	250	
Eagle Creek	8/23	500	8/ 6	3,730	
Hansen Creek	8/ 1	3,620	8/ 6	10,000	
Happy Creek	8/ 6	2,470	8/ 6	3,400	
Bear Creek	8/ 5	3,650	8/ 6	3,100	
Yako Creek	8/ 1	920	8/ 6	1,500	
Whitefish Creek	8/23	200	8/ 6	1,800	
Whitefish Creek Lake	8/23	200	8/ 6	350	
Ice Creek	8/10	11,300	8/ 6	10,400	
Sunshine Creek	8/23	490	8/12	3,650	
Northshore Creeks	8/23	60	8/ 6	1,650	
Northshore Beaches	8/30	2,690	8/31	3,930	
Southshore Beaches	8/30	1,020	8/31	2,770	
Yako Beach	8/30	<u>100</u>	8/31	<u>3,600</u>	
LAKE ALEKNAGIK TOTAL		27,350		50,130	1.83
Agulowak River and Lower River Bay	8/30	140,000	8/31	150,000	1.07
<u>LAKE NERKA:</u>					
Feno Creek	8/14	1,620	8/12	3,500	
Upper River Bay, N.W.	8/23	400	9/ 1	1,000	
Upper River Bay, S.E.	8/30	3,500	9/ 1	5,250	
Allah Creek Beach	8/30	1,990	9/ 1	4,750	
Ross Creek-Pike Creek	8/30	0	9/ 1	0	
Pike Creek		2,000	8/12	8,200	
Stovall Creek	8/22	2,590	8/12	9,900	
Stovall Lake	8/23	200	8/19	100	
Bear Creek	8/23	400	8/12	1,100	
Bear Creek Lakes	8/23	100	8/19	100	
Teal Creek	8/23	40	8/ 6	4,700	
River Bay-N4 Beach	8/30	540	9/ 1	1,300	
N4-N6 Beach	8/30	6,370	9/ 1	10,900	
Pick Creek Beach	8/30	1,110	9/ 1	850	

Table 1. (Continued)

Area	1965		1966		Ratio 1966/1965
	Date	No. Est.	Date	No. Est.	
Pick Creek	8/15	7,500	8/12	11,500	
Elva Creek Beach	8/23	1,100	9/ 1	1,740	
Elva Creek	8/23	100	8/12	700	
Anakuk Arm	8/30	860	9/ 1	970	
Anakuk Arm-Ott's Bay	8/30	200	9/ 1	1,520	
Ott's Bay	8/30	900	9/ 1	1,400	
Ott's Bay-Agulukpak R.	8/30	0	9/ 1	730	
Kema Creek	8/21	3,230	8/12	3,300	
Kema Creek Lake	8/23	0	8/19	150	
Hidden Lake Creek	8/20	990	8/12	1,000	
Hidden Lake	8/23	800	8/19	550	
Anvil Bay	8/30	12,910	9/ 1	35,200	
Anvil Bay-Elbow Pt.	8/23	2,970	9/ 1	5,370	
Elbow Pt.-Lynx Creek	8/30	1,960	9/ 1	5,380	
Lynx Creek-Teal Creek	8/30	210	9/ 1	470	
Lynx Creek	8/23	900	8/12	1,900	
Lynx Lake	8/30	<u>7,500</u>	9/ 1	<u>4,100</u>	
LAKE NERKA TOTAL		63,010		127,630	2.03
Little Togiak River	8/23	8,000	8/19	9,000	1.13
<u>LITTLE TOGIAK LAKE:</u>					
A Creek	8/19	10	8/12	100	
B Creek	8/19	0	8/12	0	
C Creek	8/19	170	8/19	250	
Little Togiak Creek	8/23	700	9/ 1	100	
Northshore Beaches	8/23	3,260	9/ 1	2,130	
Southshore Beaches	8/30	2,120	9/ 1	1,530	
D Slough Beach	8/30	<u>15,000</u>	9/ 1	<u>12,500</u>	
LITTLE TOGIAK LAKE TOTAL		21,260		16,610	.78
Agulukpak River	8/30	120,000	8/31	100,000	.83
<u>LAKE BEVERLY:</u>					
Hardluck Bay	8/30	15,350	9/ 1	20,500	
Sam's Beach	8/30	550	9/ 1	2,000	
Golden Horn	8/30	860	9/ 1	4,090	
Silver Horn	8/30	4,440	9/ 1	44,850	
B-12 Beach	8/30	1,300	9/ 1	14,900	

Table 1. (Continued)

Area	1965		1966		Ratio 1966/1965
	Date	No. Est.	Date	No. Est.	
B-9 Beach	8/30	40	9/ 1	4,300	
Anniversary Bay	8/30	0	9/ 1	30	
Tsun Creek	8/30	1,100	9/ 1	1,500	
Moose Creek	8/18	1,660	8/19	4,000	
Hope Creek	8/23	200	8/19	2,700	
Hope Creek Lake	8/23	200	8/19	250	
Miscellaneous		<u>80</u>		<u>400</u>	
LAKE BEVERLY TOTAL		25,780		99,520	3.86
Peace River	8/21	5,300	8/19	12,000	2.26
<u>LAKE MIKCHALK:</u>					
Narrows	8/23	2,000	9/ 1	1,200	
Northshore Beaches	8/30	30	9/ 1	4,000	
Southshore Beaches	8/30	<u>5,000</u>	9/ 1	<u>400</u>	
LAKE MIKCHALK TOTAL		7,030		5,600	.80
Wind River	8/21	1,800	9/ 1	2,400	1.33
<u>LAKE KULIK:</u>					
K5 Creek-Grant R.	8/30	70	9/ 1	120	
Grant River-K11 Creek	8/30	250	9/ 1	4,900	
K11 Creek-K10 Creek	8/30	1,430	9/ 1	3,750	
K10 Creek-K4 Creek	8/30	1,860	9/ 1	7,000	
K4 Creek-K2 Creek	8/30	1,120	9/ 1	1,550	
Southshore Beaches	8/30	1,410	9/ 1	3,620	
K1 Creek	8/23	1,700	9/ 1	100	
K2 Creek	8/23	<u>100</u>	9/ 1	<u>500</u>	
LAKE KULIK TOTAL		7,940		21,540	2.71
Grant River	8/21	<u>5,400</u>	8/19	<u>7,600</u>	1.41
WOOD RIVER LAKES TOTAL		435,830		607,630	

Table 2: Comparison of Peak Red Salmon Spawning Ground Estimates in the Igushik Lakes, 1965-66.

Area	1965		1966		Ratio 1966/1965
	Date	No. Est.	Date	No. Est.	
IGUSHIK LAKES					
Igushik River		200	8/ 6	0	
<u>LAKE AMANKA:</u>					
Longarm Creek	8/17	2,600	8/ 6	3,500	
Middle Creek	8/17	200	8/ 6	600	
South Creek	8/17	160	8/ 6	1,800	
Amanka Beaches	8/17	<u>1,120</u>	8/31	<u>900</u>	
LAKE AMANKA TOTAL		4,080		6,800	1.67
<u>KATHLENE RIVER:</u>					
Lower River	8/17	6,400	8/12	14,500	
Upper River	8/17	7,600	8/12	10,500	
Ongoke River	8/17	<u>7,100</u>	8/ 6	<u>28,200</u>	
KATHLENE RIVER TOTAL		21,100		53,200	2.52
<u>LAKE UALIK:</u>					
Frances Creek	8/17	6,300	8/ 6	9,100	
Westshore Creeks	8/17	1,800	8/ 6	450	
Westshore Beaches	8/27	40,000	8/31	19,360	
Eastshore Creeks	8/17	420	8/ 6	0	
Eastshore Beaches	8/17	<u>6,600</u>	8/31	<u>3,000</u>	
LAKE UALIK TOTAL		55,120		31,910	.58
=====					
IGUSHIK LAKES TOTAL		80,500		91,910	

Table 3. Comparison of Peak Red Salmon Spawning Ground Estimates in Lake Nunavaugaluk, 1965-66.

Area	1965		1966		Ratio 1966/1965
	Date	No. Est.	Date	No. Est.	
LAKE NUNAVAUGALUK					
Snake River	8/17	200		0	.00
<u>LAKE NUNAVAUGALUK:</u>					
Snake River--Eagle Cr.	9/11	1,660	8/31	520	
Eagle Creek	8/17	60	8/ 6	120	
Eagle Creek Lake	8/17	120	8/ 6	0	
Westshore Beaches	9/11	2,550	8/31	1,120	
Killian Creek	8/17	1,600	8/12	530	
Eastshore Beaches	9/11	890	8/31	480	
East Creek	8/17	100	8/ 6	20	
Southshore Beaches	8/17	<u>500</u>	8/31	<u>0</u>	
LAKE NUNAVAUGALUK TOTAL		7,480		2,790	.37
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LAKE NUNAVAUGALUK SYSTEM TOTAL		7,680		2,790	

Table 4. Comparison of Peak Red Salmon Spawning Ground Estimates in the Tikchik Lakes, 1965-66.

Area	1965		1966		Ratio 1966/1965
	Date	No. Est.	Date	No. Est.	
TIKCHIK LAKES					
Nuyakuk River					0
<u>TIKCHIK LAKE:</u>					
Creek A	8/21	360	8/15	2,400	
Creek B	8/21	10,000	8/15	2,600	
Creek C	8/21	<u>200</u>	8/ 8	<u>100</u>	
TIKCHIK LAKE TOTAL		10,560		5,100	.48
<u>TIKCHIK RIVER:</u>					
Tikchik River	8/21	13,200	8/15	28,600	
Cow Creek	8/21	<u>1,800</u>	8/15	<u>10,000</u>	
TIKCHIK RIVER TOTAL		15,000		38,600	2.57
<u>NUYAKUK LAKE:</u>					
Northshore Beaches	8/28	4,510	9/ 3	1,370	
Southshore Beaches	8/28	13,320	9/ 3	2,680	
Portage Arm	8/28	1,180	9/ 3	230	
Mirror Bay	8/28	19,600	9/ 3	2,150	
Rapids	8/21	<u>750</u>	8/ 8	<u>1,200</u>	
NUYAKUK LAKE TOTAL		39,360		7,630	.19
<u>LAKE CHAUEKUKTULI:</u>					
Creek No. 1	8/21	100		0	
Allen River Beach	8/28	24,500	8/15	18,400	
Allen River	8/21	320	8/ 8	650	
Northshore Beaches	8/28	4,640	9/ 3	1,870	
Southshore Beaches	8/28	<u>310</u>	9/ 3	<u>110</u>	
LAKE CHAUEKUKTULI TOTAL		29,870		21,030	.70
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TIKCHIK LAKES TOTAL		94,790		72,360	

Table 5: Comparison of Peak Red Salmon Spawning Ground Estimates in the Togiak District, 1965-66.

Area	1965		1966		Ratio 1966/1965
	Date	No. Est.	Date	No. Est.	
TOGIAC LAKES					
Togiak River	8/20	160	9/ 3	200	1.25
<u>TOGIAC LAKE:</u>					
Outlet--Jondik Creek		700	9/ 3	340	
Jondik Creek	8/20	1,550	8/11	1,100	
Jondik Cr.-Bruin Cr.		4,000	9/ 3	2,010	
Bruin Cr.-Middle Pt.		1,500	9/ 3	2,300	
Middle Pt.-Sunday Cr.		15,000	9/ 3	14,030	
Northshore Beaches		2,000	9/ 3	1,350	
Westshore Beaches		1,500	9/ 3	2,890	
West Creek	8/24	500	8/11	500	
West Lake	8/24	200	8/11	400	
TOGIAC LAKE TOTAL		26,950		24,920	.92
Zwischen River	8/20	10,470	8/11	8,900	.85
<u>UPPER TOGIAC LAKE:</u>					
Zwischen R.-Budole Cr.		2,500	9/ 3	5,110	
Budole Cr.-Upper Togiak Cr.		2,000	9/ 3	5,800	
Northshore Beaches		500	9/ 3	630	
Makoo Creek & Ponds		100	9/ 3	150	
Upper Togiak Creek		200	9/ 3	0	
Westshore Beaches		250	9/ 3	270	
UPPER TOGIAC LAKES TOTAL		5,550		11,960	2.15
TOGIAC LAKES TOTAL		43,130		45,980	
TOGIAC TRIBUTARIES					
<u>TOGIAC TRIBUTARIES:</u>					
Gechiak Lake	8/24	1,780	8/11	3,110	1.75
Ongivinuk Lake	8/29	1,600	8/16	1,970	1.23
Pungokepuk Lake	8/20	290	8/11	730	2.52
Miscellaneous		0	8/11	0	
TOGIAC TRIBUTARIES TOTAL		3,670		5,810	

Table 5. (Continued)

Area	1965		1966		Ratio
	Date	No. Est.	Date	No. Est.	1966/1965
KULUKAK RIVER SYSTEM					
<u>KULUKAK RIVER SYSTEM:</u>					
Kulukak River	8/20	950	8/11	0)	2.50
Kulukak Lake	8/20	730	8/11	4,200)	
Tithe Creek Ponds	8/20	<u>5,600</u>	8/11	<u>4,300</u>	.77
KULUKAK SYSTEM TOTAL		7,280		8,500	

Table 6. Total Population Estimates of Red Salmon in the Nushagak District,
1965-66.

Area	1965	Ratio 1966/1965	1966	1966	Percent of	Percent of
	Total Pop. Adj. Est.		Preliminary Estimate	Total Pop. Adj. Est.	Total Pop. Adj. Est.	Nushagak District Total
<u>WOOD RIVER LAKES</u>						
Wood River	5,400	1.89	10,206	11,500	.95	.71
Lake Aleknagik	49,200	1.83	90,036	100,000	8.27	6.13
Agulowak River	165,000	1.07	176,550	176,000	14.56	10.79
Lake Nerka	176,100	2.03	357,280	410,000	33.92	25.14
Little Togiak River	14,000	1.13	15,820	16,000	1.32	.98
Little Togiak Lake	26,500	.78	20,670	22,200	1.84	1.36
Agulukpak River	130,800	.83	108,564	110,000	9.10	6.75
Lake Beverly	60,600	3.86	233,916	260,000	21.51	15.94
Peace River	6,600	2.26	14,916	16,000	1.32	.98
Lake Mikchalk	10,500	.80	8,400	10,000	.83	.61
Wind River	2,500	1.33	3,325	4,000	.33	.25
Lake Kulik	19,700	2.71	53,387	60,000	4.97	3.68
Grant River	<u>8,300</u>	1.41	<u>11,703</u>	<u>13,000</u>	<u>1.08</u>	<u>.80</u>
WOOD RIVER LAKES TOTAL	675,200		1,104,773	1,208,700	100.00	74.12
<u>IGUSHIK LAKES</u>						
Igushik River	400		0	0	.00	.00
Lake Amanka	10,000	1.67	16,700	16,700	8.09	1.03
Kathlene River	48,600	2.52	122,472	120,500	58.38	7.39
Lake Ualik	<u>121,800</u>	.58	<u>70,644</u>	<u>69,200</u>	<u>33.53</u>	<u>4.24</u>
IGUSHIK LAKES TOTAL	180,800		209,816	206,400	100.00	12.66
<u>LAKE NUNAVAUGALUK</u>						
Snake River	300		0	0	.00	.00
Lake Nunavaugalik	<u>11,700</u>	.37	<u>4,440</u>	<u>4,500</u>	<u>100.00</u>	<u>.27</u>
LAKE NUNAVAUGALUK TOTAL	12,000		4,440	4,500	100.00	.27

Table 6. (Continued)

Area	1965 Total Pop. Adj. Est.	Ratio <u>1966/1965</u>	1966 Preliminary Estimate	1966 Total Pop. Adj. Est.	Percent of Total Pop. Adj. Est.	Percent of Nushagak District Total
<u>TIKCHIK LAKES</u>						
Tikchik Lake	27,300	.48	13,104	15,100	9.38	.92
Tikchik River	26,200	2.57	67,334	74,500	46.27	4.57
Nuyakuk Lake	88,800	.19	16,872	24,900	15.47	1.53
Lake Chauekuktuli	<u>60,800</u>	.70	<u>42,560</u>	<u>46,500</u>	<u>28.88</u>	<u>2.85</u>
TIKCHIK LAKES TOTAL	203,100		139,870	161,000	100.00	9.87
NUSHAGAK-MULCHATNA SYSTEM TOTAL	<u>28,200</u>			50,200		3.08
NUSHAGAK DISTRICT TOTAL	1,099,200		1,458,899	1,630,800		100.00

Table 7. Total Population Estimates of Red Salmon in the Togiak District, 1965-66.

Area	1965 Total Pop. Adj. Est.	Ratio 1966/1965	1966 Preliminary Estimate	1966 Total Pop. Adj. Est.	Percent of Total Pop. Adj. Est.	Percent of Togiak District Total
<u>TOGIAK LAKES</u>						
Togiak River	300	1.25	375	400	.44	.33
Togiak Lake	54,300	.92	49,956	48,000	52.69	39.02
Zwischen River	22,700	.85	19,295	19,000	20.86	15.45
Upper Togiak Lake	<u>11,100</u>	2.15	<u>23,865</u>	<u>23,700</u>	<u>26.01</u>	<u>19.27</u>
TOGIAK LAKES TOTAL	88,400		93,491	91,100	100.00	74.07
<u>TOGIAK TRIBUTARIES</u>						
Gechiak Lake	4,100	1.75	7,175	7,200	54.96	5.86
Ongivinak Lake	3,300	1.23	4,059	4,100	31.30	3.33
Pungokepuk Lake	700	2.52	1,764	1,800	13.74	1.46
Miscellaneous	<u>-</u>		<u>0</u>	<u>0</u>	<u>.00</u>	<u>.00</u>
TOGIAK TRIBUTARIES TOTAL	8,100		12,998	13,100	100.00	10.65
<u>KULUKAK SYSTEM</u>						
Kulukak River	1,800)		0	0	.00	.00
Kulukak Lake	1,800)	2.50	9,000	9,000	47.83	7.31
Tithe Creek Ponds	<u>12,700</u>	.77	<u>9,779</u>	<u>9,800</u>	<u>52.17</u>	<u>7.97</u>
KULUKAK SYSTEM TOTAL	16,300		18,779	18,800	100.00	15.28
TOGIAK DISTRICT TOTAL	<u>112,800</u>		<u>125,268</u>	<u>123,000</u>		<u>100.00</u>

Table 8. Comparison of Total Population Estimates of Red Salmon and Population Estimates Derived by the Chain-Link Index in the Nushagak and Togiak Districts, 1960-66.

Year	Total Pop. Est. by Tower Counts	Est. Total Pop. by Chain-Link Index	Error	
			No. of Fish	Percent
<u>WOOD RIVER LAKES</u>				
1960	1,016,100	1,063,873	+ 47,773	+ 4.7
1961	460,700	451,774	- 8,926	- 1.9
1962	873,900	937,304	+ 63,404	+ 7.3
1963	721,400	752,265	+ 30,865	+ 4.3
1964	1,076,100	1,024,410	- 51,690	- 4.8
1965	675,200	657,102	- 18,098	- 2.7
1966	1,208,700	1,104,773	- 103,927	- 8.6
			Average	- .2
<u>IGUSHIK LAKES</u>				
1960	495,100	515,538	+ 20,438	+ 4.1
1961	294,300	265,112	- 29,188	- 9.9
1962	15,700	17,955	+ 2,255	+ 14.4
1963	92,200	89,319	- 2,881	- 3.1
1964	128,500	125,578	- 2,922	- 2.3
1965	180,800	174,809	- 5,991	- 3.3
1966	206,400	209,816	+ 3,416	+ 1.7
			Average	+ .2
<u>LAKE NUNAVAUGALUK</u>				
1960	16,600	16,182	- 418	- 2.5
1961	4,900	5,270	+ 370	+ 7.6
1962	1,800	1,738	- 62	- 3.4
1963	38,000	33,602	- 4,398	- 11.6
1964	12,400	17,350	+ 4,950	+ 39.9
			Average	+ 6.0
<u>TIKCHIK LAKES</u>				
1960	145,000	150,241	+ 4,741	+ 3.6
1961	79,800	87,730	+ 7,930	+ 9.9
1962	37,900	45,263	+ 7,363	+ 19.4
1963	166,600	225,194	+ 58,594	+ 35.2
1964	103,200	102,095	- 1,105	- 1.1
1965	203,100	192,790	- 10,310	- 5.1
1966	161,000	139,870	- 21,130	- 13.1
			Average	+ 6.4

Table 8. (Continued)

Year	Total Pop. Est. by Tower Counts	Est. Total Pop. by Chain-Link Index	Error	
			No. of Fish	Percent
<u>TOGIAC LAKES</u>				
1961	95,500	104,879	+ 9,379	+ 9.8
1962	47,400	47,160	- 240	- .5
1963	102,400	116,059	+ 13,659	+ 13.3
1964	95,600	95,189	- 411	- .4
1965	88,400	87,969	- 431	- .5
1966	91,100	93,491	+ 2,391	+ 2.6
			Average	+ 4.1
<u>TOTAL</u>				
1960	1,673,300	1,745,834	+ 72,534	+ 4.3
1961	935,200	914,765	- 20,435	- 2.2
1962	976,700	1,049,420	+ 72,720	+ 7.4
1963	1,120,600	1,216,439	+ 95,839	+ 8.6
1964	1,415,800	1,364,622	- 51,178	- 3.6
1965	1,147,500	1,112,670	- 34,830	- 3.0
1966	1,667,200	1,547,950	-119,250	- 7.2
			Average	+ .6

Table 9. Comparison of Total Population of Red Salmon with Sum of Peak Survey Estimates in the Nushagak and Togiak District, 1966.

Area	Total Pop. Est. by Tower Count	Sum of Peak Survey Estimates	Peak Accounted for by Peak Est.
Wood River Lakes	1,208,700	607,630	50.27
Igushik Lakes	206,400	91,910	44.53
Tikchik Lakes	161,000	72,360	44.94
Togiak Lakes	<u>91,100</u>	<u>45,980</u>	<u>50.47</u>
TOTALS	1,667,200	817,880	49.06

Table 10. Comparison of Total Population of Red Salmon by Tower Counts with Sum of Peak Survey Estimates in the Nushagak and Togiak Districts, 1953-66.

Year	Percent Accounted for by Peak Survey Estimates				
	Wood River	Igushik River	Lake Nunavaugaluk	Tikhik Lakes	Togiak Lakes
1953	30.09	-	-	-	-
1954	24.19	-	-	-	-
1955	37.45	-	-	-	-
1956	38.56	-	-	-	-
1957	52.68	-	-	-	-
1958	46.03	53.26	-	-	-
1959	46.54	41.71	-	29.37	-
1960	47.39	43.55	48.25	31.33	40.48
1961	63.59	39.23	52.45	34.31	44.45
1962	49.71	48.66	51.11	41.50	44.09
1963	55.28	47.18	45.47	55.47	49.94
1964	49.85	46.11	63.71	49.88	49.90
1965	64.55	44.52	-	46.67	48.79
1966	<u>50.27</u>	<u>44.53</u>	<u>-</u>	<u>44.94</u>	<u>50.47</u>
Geometric Mean	45.50	45.29	51.88	40.74	46.77

Note: Percent accounted for by peak survey estimates are derived only on systems with tower counts.

Table 11. Percentage Distribution of Red Salmon Spawners in Three Major Types of Spawning Areas in the Nushagak and Togiak Districts, 1959-1966.

Year	Spawning Area			Total Pop. Est. by Tower Counts
	Creeks	Beaches	Rivers	
<u>WOOD RIVER LAKES^{1/}</u>				
1959	32.75	50.30	16.95	2,209,300
1960	27.37	55.50	17.13	1,016,100
1961	11.43	32.31	56.26	460,700
1962	23.97	65.23	10.80	873,900
1963	12.15	68.48	19.37	721,400
1964	18.88	64.02	17.10	1,076,100
1965	40.61	11.11	48.28	675,100
1966	<u>16.45</u>	<u>54.88</u>	<u>28.67</u>	<u>1,208,700</u>
Average ^{2/}	20.99	44.67	23.12	1,030,100
<u>IGUSHIK LAKES^{3/}</u>				
1959	34.30	48.20	17.50	643,800
1960	35.50	52.90	11.60	495,100
1961	39.34	34.54	26.12	294,300
1962	43.40	31.55	25.05	15,700
1963	6.21	44.81	48.98	92,200
1964	27.59	38.57	33.84	128,500
1965	23.08	59.28	17.64	180,800
1966	<u>47.49</u>	<u>27.20</u>	<u>25.31</u>	<u>206,400</u>
Average ^{2/}	28.12	40.83	23.66	257,100
<u>LAKE NUNAVAUGALUK</u>				
1959	41.70	57.60	0.70	140,000 ^{4/}
1960	44.30	50.70	5.00	16,600
1961	24.12	71.99	3.89	4,900
1962	29.35	63.04	7.61	1,800
1963	22.69	76.13	1.18	38,000
1964	20.89	78.48	0.63	12,400
1965	22.92	74.48	2.60	12,000 ^{4/}
1966	<u>24.01</u>	<u>75.99</u>	<u>0.00</u>	<u>4,500^{4/}</u>
Average ^{2/}	27.67	67.76	1.54	28,800

Table 11. (Continued)

Year	Spawning Area			Total Pop. Est. by Tower Counts
	Creeks	Beaches	Rivers	
<u>TIKCHIK LAKES^{5/}</u>				
1959	24.10	37.90	38.00	48,900
1960	19.40	53.10	27.50	145,500
1961	11.19	49.63	39.18	79,800
1962	9.49	64.66	25.85	37,900
1963	19.69	29.95	50.36	166,600
1964	5.59	87.22	7.19	103,200
1965	11.20	71.50	17.30	203,100
1966	<u>20.87</u>	<u>37.05</u>	<u>42.08</u>	<u>161,000</u>
Average ^{2/}	13.74	50.82	26.98	118,300
<u>TOGIK LAKES</u>				
1959	12.80	82.59	4.61	178,700 ^{4/}
1960	12.30	74.56	13.14	162,800
1961	15.89	69.97	14.14	95,500
1962	11.39	54.64	33.97	47,400
1963	4.35	84.03	11.62	102,400
1964	3.14	89.94	6.92	95,600
1965	5.45	69.90	24.65	88,400
1966	<u>3.81</u>	<u>76.40</u>	<u>19.79</u>	<u>91,100</u>
Average ^{2/}	7.31	74.47	13.55	107,700
TOTAL ^{2/}	17.50	54.20	12.53	

1/ River spawning category includes the Narrows on Lake Mikchalk.

2/ Geometric mean.

3/ Ongoke River population included in creek spawning category.

4/ Aerial survey estimates.

5/ Rapids between Nuyakuk Lake and Lake Chauekuktuli is included in river spawning category.

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