Informational Leaflet 23

FORECAST OF BRISTOL BAY RED SALMON RUN IN 1963

By:

Alaska Department of Fish and Game

Bureau of Commercial Fisheries

and

Fisheries Research Institute

January 17, 1963

STATE OF ALASKA
WILLIAM A. EGAN - GOVERNOR

DEPARTMENT OF
FISH AND GAME
WALTER KIRKNESS - COMMISSIONER
SUBPORT BUILDING, JUNEAU

Informational Leaflet #23

ALASKA DEPARTMENT OF FISH AND GAME

William A. Egan, Governor — Walter Kirkness, Commissioner

FORECAST OF BRISTOL BAY RED SALMON RUN IN 1963

January 17, 1963

Compiled jointly by the

Alaska Department of Fish and Game
U. S. Bureau of Commercial Fisheries
Fisheries Research Institute

Published by the State of Alaska, Department of Fish and Game - Juneau

INTRODUCTION

This forecast for the 1963 Bristol Bay red salmon run was prepared jointly by the Alaska Department of Fish and Game, the U.S. Bureau of Commercial Fisheries, and the Fisheries Research Institute of the University of Washington.

The scientists who have participated in the analysis of the data include the following: Mr. Wilbur Church, Mr. Donald B. Siniff, and Dr. Howard D. Tait of the Alaska Department of Fish and Game; Dr. C.J. DiCostanzo and Dr. George Y. Harry, Jr. of the Auke Bay Laboratory of the Bureau of Commercial Fisheries; Mr. Robert French, Mr. R.A. Fredin, and Mr. Sueto Murai of the Seattle Office of the Bureau of Commercial Fisheries; Dr. Robert L. Burgner, Mr. Allan C. Hartt, Dr. Ted S.Y. Koo, Dr. Ole Mathisen, and Dr. William F. Royce of the Fisheries Research Institute. Many others have joined in the collection of data and preliminary analysis.

Dr. Howard D. Tait served as editor and assembled this material in its present form.

METHODS OF FORECAST

These are scientific forecasts of the expected return to the major rivers in each fishing district of Bristol Bay, and are based on the best information available. A variety of data is available on these rivers which provides bases for several separate estimates of the size of returning runs.

1. Analysis based on the parent cycle catch, escapement, or both. This is believed to be the least reliable in Bristol Bay because the age of return of red salmon varies from 4 to 6 years, and because of the highly variable fresh water and salt water mortality.

2. Smolt outmigration and return relationship. In the major rivers of Bristol Bay, indices of the number of smolts migrating to sea have been obtained for several years. These data are subject to sampling errors and the variations in salt water mortality.

3. Early returns of certain year groups. Bristol Bay salmon commonly spend two years or three years in the ocean and the relation of the return after three years to the return after two years may be used for forecasting in certain situations.

4. Abundance of immature salmon at sea. Abundance indices of the immature red salmon in the vicinity of the eastern and central Aleutian Islands have been obtained for several years. These data have been obtained independently from two sources: (1) the catches of purse seine vessels operating south of the Aleutian Islands where the immature red salmon pass in very large numbers during the mid summer, and (2) by gill net vessels operated over a somewhat larger area of the North Pacific Ocean in the central Aleutian Islands.

FORECASTS BY RIVERS BASED ON PARENT CYCLE ESCAPEMENTS AND SMOLT ABUNDANCE

Our first step in the forecast is to bring together the data from cycle analysis or outmigration of smolts for each of the major rivers.

Nushagak System

The Nushagak escapement enters three major spawning areas: Wood River, Igushik River, and the Tikchik Lakes. Data on escapement to each of these areas are available since 1946, but the commercial catch from Nushagak Bay cannot be separated directly into parts bound for the separate rivers. Therefore, the annual percentage of each system's escapement has been applied to the catch and the total run to each spawning system estimated for the last eleven years.

Wood River

Indices of the outmigrations of smolts have been obtained to the Wood River system since 1951. These have had a rather variable relation with the return because of varying marine mortality, but enough data are available to permit a regression analysis. Original data are transformed to logarithm scales to simplify presentation and to help satisfy certain requirements for statistical analysis. (Figure 1 and Figure 2). The expected return in 1963 and 1961 seaward migration is 1,500,000 adult reds; from the 1960 seaward migration, 600,000. Thus, a total return to the Wood River system of 2,100,000 fish is expected on the basis of the smolt index-adult return relationship.

Tikchik Lakes

The forecast for the Tikchik system is based on escapement-return relationships. This is shown in Table 1.

The data show evidence of a 5-year cycle in the Tikchiks. Recent dominant years of the cycle were 1953 and 1958. Logical continuation of the cycle will make 1963 another dominant year. A better than average return of this system of about 300,000 fish is expected in 1963. Unlike other rivers of the Nushagak, 3-ocean fish are expected to dominate the run.

Igushik Lakes

The Igushik system forecast is also based on escapement-return relationships (Table 2).

The expected total return is about 700,000 fish, of which 500,000 are expected to be 2-ocean fish. The return of this age group will come from the largest escapement to the Igushik system in recent years.

Returns of recent years suggest the appearance of a 4-year cycle in the Igushik run. 1955 and 1959 were both dominant years. If the high production of the

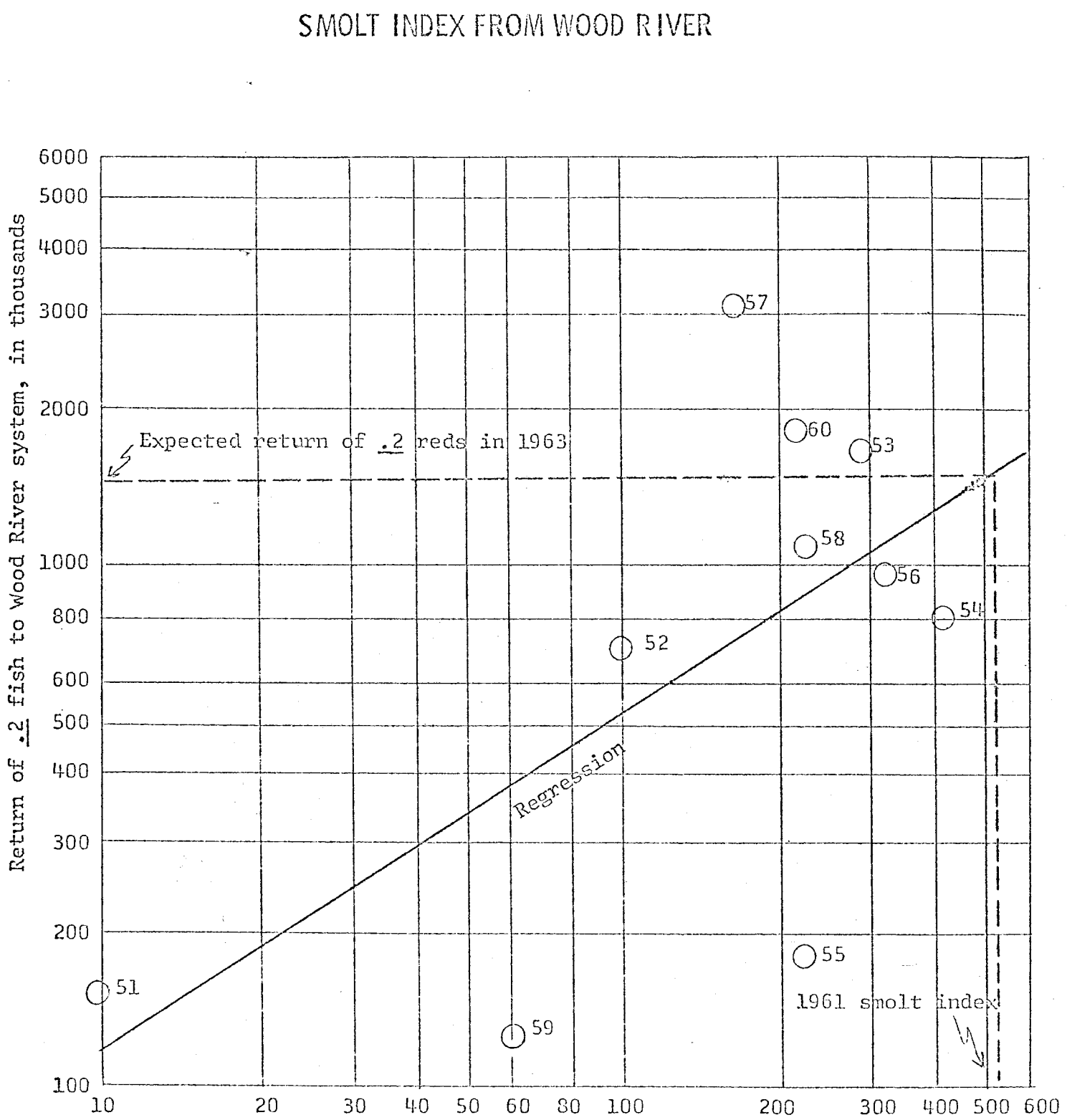

Figure 1. Relationship between Wood River smolt index and return of .2 reds to Wood River. Years indicate years of seaward migration (on log-log scale).

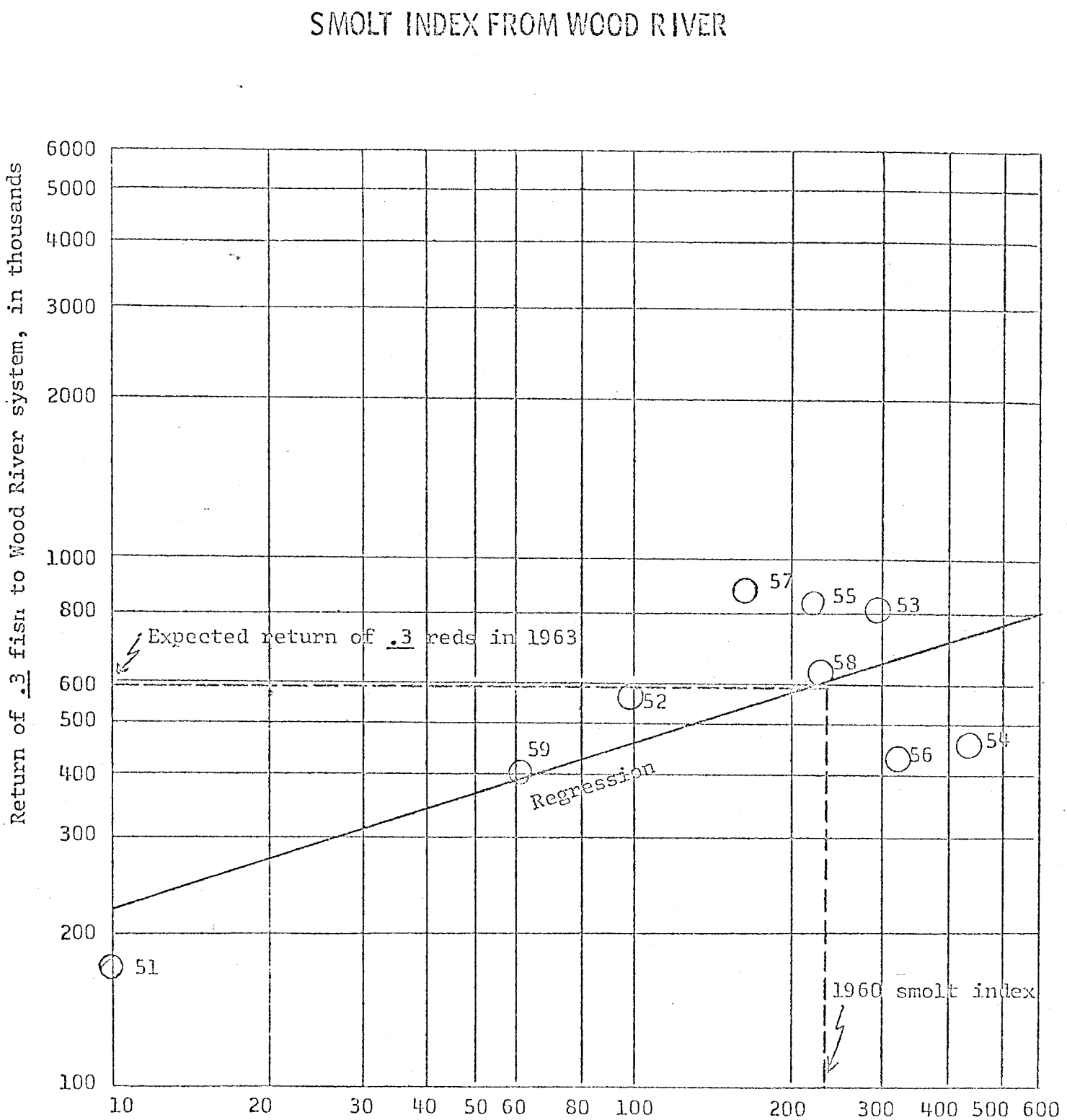

Figure 2. Relationship between Wood River smolt index and return of .3 reds to Wood River. Years indicate years of seaward migration (on log-log scale).

Table 1. Tikchik Lakes - escapement and returns.

YEAR	ESCAPEMENT	4-YR. RETURN	5-YR. RETURN
1950	42,000	7,000	10,000
1951	39,000	13,000	53,000
1952	38,000	7,000	97,000
1953	189,000	39,000	312,000
1954	29,000	45,000	47,000
1955	16,000	5,000	63,000
1956	30,000	206,000	122,000
1957	67,000	5,000	19,000
1958	196,000	75,000	(261,000)
1959	49,000	(19,000)	

Geometric means of return per spawner after 4 years is .389 and after 5 years is 1.334. 1963 forecast is shown in parenthesis.

Table 2. Igushik Lakes - escapement and returns.

YEAR	ESCAPEMENT	4-YEAR RETURN	5-YR. RETURN
1950	75,000	80,000	250,000
1951	40,000	525,000	620,000
1952	150,000	170,000	190,000
1953	100,000	55,000	125,000
1954	80,000	40,000	375,000
1955	500,000	610,000	570,000
1956	400,000	290,000	427,000
1957	130,000	15,000	32,000
1958	107,000	22,000	(194,000)
1959	644,000	(494,000)	

Geometric means of return per spawner after 4 years is .767 and after 5 years is 1.809. 1963 forecast is shown in parenthesis.

cycle year continues, the 1963 return may very well exceed the predicted numbers.

Naknek-Kvichak Fishing Area

The largest red salmon run in Alaska enters the Kvichak River system which together with the smaller Naknek and Alagnak systems receives the runs going through this fishing area.

The best information available on which to base a forecast are the indices of the outmigration of smolts which have been obtained since 1955. The 1963 Kvichak run will come from the smolt migrations of 1960 and 1961. The indices and the return of adults after two and three years in the ocean are shown in Table 3. Note the very low smolt index of 1961. The geometric mean of the return per index point multiplied by the year group index provides an estimate for the coming year. Thus, the expected return of fish after two years in the ocean from the index of 1961 is approximately 282,000; after three years in the ocean from the index of 1960 it is approximately 1,366,000.

Branch River

There is little information upon which to base a forecast of the 1963 Branch (Alagnak) River red salmon run. Total runs and escapement data are available for the years 1955-1962 (Table 4). The few age composition data available indicate a dominance of age group 4_2 red salmon in the returns (approximately 75 percent).

The total run and escapement data suggest that the Branch River run follows a 4-year cycle with two years of poor production followed by two years of high production. It is to be noted (Table 4) that the 1962 season marked the second successive year of poor production.

The 1963 run is expected to derive from the escapements of 1958 and 1959: 91,000 and 820,000 respectively (Table 4). If it can be assumed that the Branch River cycle will continue to be in evidence, we might expect a larger than average run in 1963--one approaching a 1,000,000 fish total. Because of the high escapement of 1959 and the predominance of 4_2 fish in the returns, the run is expected to consist primarily of 2-ocean fish.

Naknek River

Indices of smolt abundance have been obtained annually for the Naknek River since 1956. These have been compared with actual returns after two and three years in the ocean (Table 5).

Application of the geometric mean rates of return to the indices of 1961 and 1960 results in a forecast of 343,840 2-ocean red salmon and 686,400 3-ocean red salmon for the 1963 season.

Egegik River

The 1963 forecast for the Egegik River is again based on the average return-escapement relationship (Figure 3).

Table 3. Kvichak River - smolt index and return of adults in thousands of fish.

Year	Smolt index	Return after two years: Return of - .2's	Return after two years: Return per index point	Return after three years: Return of -.3's	Return after three years: Return per index point
1955	11.2	2,171	193.84	632	56.43
1956	3.3	438	132.73	88	26.67
1957	1.3	853	656.15	630	484.62
1958	100.0	22,083	220.83	5,520	55.20
1959	85.9	5,308	61.79	1,331	15.49
1960	23.8	3,067	128.87	(1,366)	*57.41
1961	1.6	(282)	*175.98		

* Geometric mean

Estimated return in 1963 is shown in parenthesis.

Table 4. Total run and escapement (in thousands) Branch River 1955-1962.

Year	Total run	Escapement
1955	809	166
1956	1,307	785
1957	283	125
1958	197	91
1959	1,166	820
1960	2,090	1,241
1961	279	90
1962	155	91
Mean run and escapement	785	426

Table 5. Naknek River smolt indices and adult return.

Year	Smolt Index	Return after 2 years		Return after 3 years	
		Thousands of fish	Thousands per index point	Thousands of fish	Thousands per index point
1956	60	277	4.62	415	6.92
1957	30	2,821	94.03	1,357	45.23
1958	100	590	5.90	1,045	10.45
1959	116	35	0.30	715	3.58
1960	66	747	11.32	(686.40)	* 10.40
1961	56	(343.84)	*6.14		

* Geometric mean of return per index point.

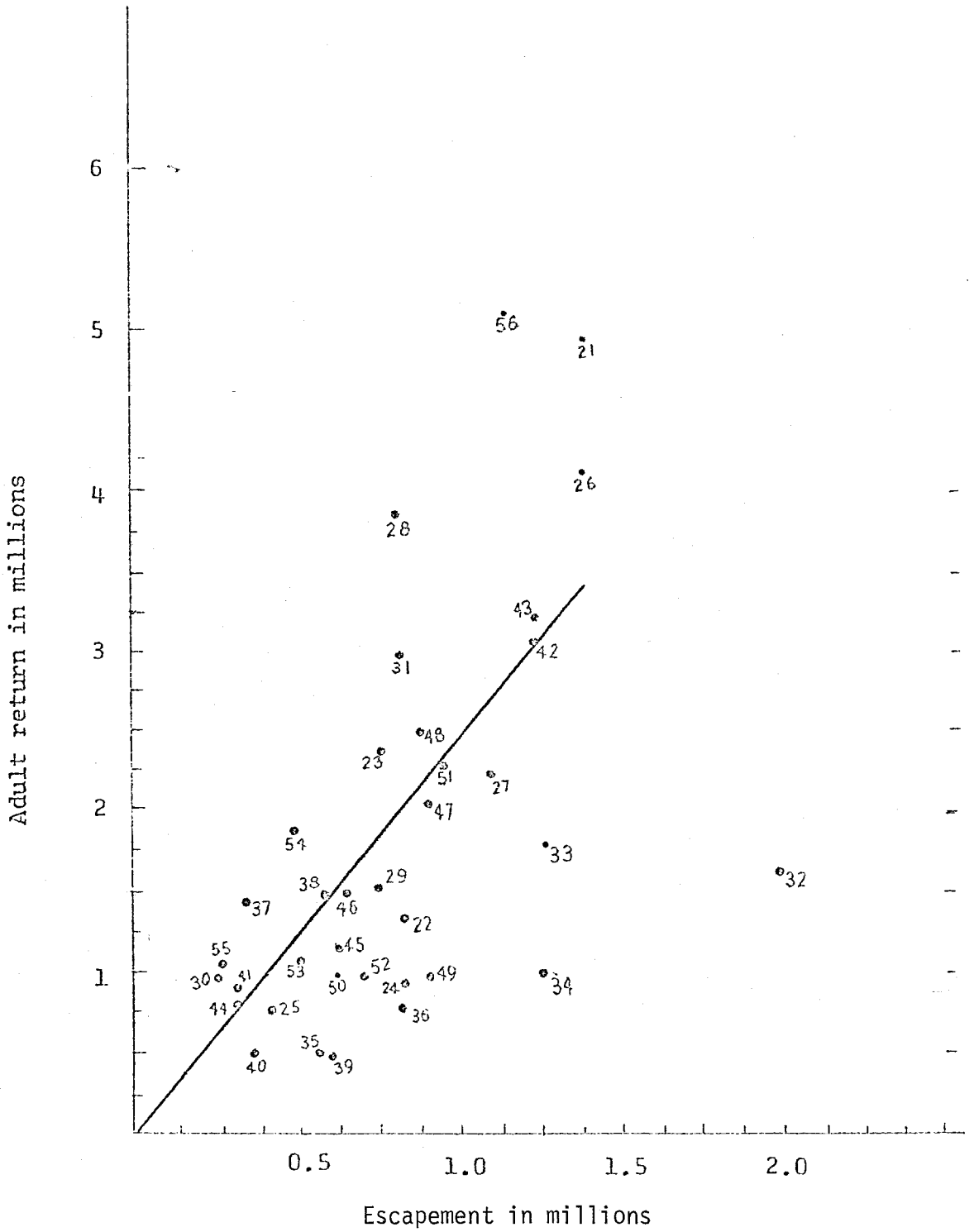

Figure 3. Relation of escapement to return: Egegik River Red Salmon

The 1963 run will consist of 4-year fish arising from the 1959 escapement, 5-year fish from the 1958 escapement, 6-year fish from the 1957 escapement, and 7-year fish from the 1956 escapement; the estimated return by age groups is given in Table 6. The bulk of the return is expected to consist of 3-ocean red salmon; 700,000 as against 300,000 2-ocean fish.

Ugashik River

Indices of smolt abundance are available for the Ugashik River for the years 1956 through 1961. However, only the indices from 1958 on are comparable and these are used as a basis for estimating 1963 adult returns (Table 7). The returns per index point indicates that approximately 450,000 red salmon might be expected from the 1961 smolt migration and 320,000 from the 1960 smolt migration.

ABUNDANCE OF YOUNG SALMON AT SEA

Purse Seine Catch Data

The abundance and age composition of immature red salmon at sea as indicated by the purse seine catches south of Adak Island has shown a striking relationship to the abundance and age composition of the following year's run to Bristol Bay. Seining has been conducted in June, July, and August each year since 1956 and there are sufficient data to allow a mathematical study of the relation of the average seine catches to the runs in Bristol Bay.

A basic assumption underlying the use of this index is that we are obtaining a representative sample from the flow of immature reds through the index area. The evidence from the direction of catch of the purse seines and from the width of the column of fish passing Adak Island suggests that a large proportion of the immature Bristol Bay red salmon present in the sea travel past Adak during the summer months. Hence if an index of the number of salmon in this flow is obtained, it should be representative of the numbers in the Bristol Bay stock.

Sampling off Adak has usually been in an area about 12 miles offshore, and it appears that this place is in the main path of immature red salmon in most years. But in 1957 the main body of the run was apparently further offshore, (according to the distribution found by research vessels using gill nets) and thus we obtained an abnormally low index value that year.

Table 8 shows the pertinent figures for the years 1956-1963.

Note that former estimates of the Japanese high seas catch of Western Alaska salmon have been altered for all years. Therefore the figures shown in Table 8 are somewhat different than those given in past years' forecast tables. In the past the method of estimating the Japanese take of Western Alaska salmon varied from year to year. Accumulated experience now suggests that the areas and dates shown in Table 9 yield more realistic figures. As may be seen by comparing Table 8 with earlier forecast data (Informational Leaflet No. 14, ADF&G, April 1962) the revision increases the estimate of the total Western Alaska run for all years except 1960 which shows a decrease. As a result, index values are now altered, and the 1963 forecast is based on an average of the new index values.

Table 6. Estimated returns from brood years 1956-1959.

Egegik System

Brood Year	Escapement in thousands	Estimated return in thousands[1]	Estimated return by age groups-1963 returns[2]					
			4_2	5_2	5_3	6_3	6_4	7_4
1956	1,100	2,660						190
1957	390	950				440	30	
1958	250	600		70	170			
1959	1,070	2,440	100					

1 Determined from data in Figure 3.

2 Based on average age composition as follows: 4_2, 4 percent; 5_2, 12 percent; 5_3, 28 percent; 6_3, 46 percent; 6_4, 3 percent; 7_4, 7 percent.

Table 7. Ugashik smolt indices and adult returns.

Year	Smolt Index	Return after 2 years		Return after 3 years	
		Thousands of fish	Thousands per index point	Thousands of fish	Thousands per index point
1958	100.00	2,855.7	28.6	613.3	6.1
1959	41.98	131.8	3.1	122.1	2.9
1960	76.49	379.8	5.0	(321.3)	* 4.2
1961	59.60	(453.0)	* 7.6		

* Geometric mean rate of return

Table 8. Average catch/seine set of immature red salmon south of Adak Island compared with following year's return to Bristol Bay, with 1963 estimate based on 1962 index of immatures.

Year of catch at sea	Average catch/set (index points)			Year of B. B. catch	"Bristol Bay" Red run (millions) 1/			Millions of salmon per "Index Point"	
	.1	.2	All ages		.2	.3	All ages	.2	.3
1955	--	--	--	1956	23.4	4.5	27.9	--	--
1956	16.4	29.2	45.6	1957	4.8	15.3	20.1	0.29	0.52
1957 2/	4.3	1.7	6.0	1958	4.0	3.7	7.7	0.93 2/	2.18 2/
1958	38.7	3.3	42.0	1959	13.1	3.1	16.2	0.34	0.94
1959	126.1	14.5	140.6	1960	36.3	5.5	41.8	0.29	0.38
1960	12.9	28.6	41.5	1961	8.2	17.8	26.0	0.64	0.62
1961	19.7	4.1	23.8	1962 3/	8.9	3.9	12.8	0.45	0.95
1962	20.4	10.4	30.8	1963 3/	(8.2)	(7.1)	(15.3)	(0.40)	(0.68)

1/ Western Alaska catches from INPFC Statistical Yearbooks, plus estimated Japanese high seas catch of Alaskan reds. Age breakdown based on weighted samples of Bristol Bay commercial catches and escapements where available (ADF, FWS, FRI). Four-winter fish included with three-winter fish.

2/ 1957 data not used because it was apparently biased by greater offshore distribution of salmon in index area.

3/ 1962 commercial catch not yet final. 1963 estimates based on average of 1956, 1958, 1959, 1960, and 1961 index rates (1957 excluded).

Table 9. Total red salmon runs to "Western Alaska" 1956-1962 (as used for forecast).

Year	CATCH (in thousands)			% of .2 age fish in B.B. catch	ESCAPEMENT (in thousands)			% of .2 age fish in B.B. escap.	TOTAL RUN TO W. ALASKA (in thousands)			
	W. Alaska Dist. Incl. Yukon Kuskokwim & Aleutians	Japanese High seas catch of B.B. reds 1/	Total catch of W. Alaska reds		Bristol Bay (Togiak Nush., N.K. Egegik Ugashik)	N. Side Alaska Penn. Yukon Kusk. & Aleut. 2/	Total Escap. in W. Alaska		% of .2 age fish in total run	.2	.3	Total
1956	10,252	4,987	15,239	72	12,483	216	12,699		84	23,400	4,538	27,938
1957	6,631	8,446	15,077	25	4,693	355	5,048		24	4,820	15,305	20,125
1958	3,460	1,321	4,781	52	2,423	474	2,897		52	3,990	3,688	7,678
1959	5,249	2,186	7,435	86	8,132	641	8,773		81	13,100	3,108	16,208
1960	14,411	4,276	18,687	77	22,386	707	23,093	95 3/	87	36,280	5,500	41,780
1961	12,307	7,039	19,346	28	6,200	393	6,593	42	32	8,170	17,769	25,939
1962	(5,154) 4/	(1,600) 4/	(6,754) 4/	70	5,718	(375) (estimate)	6,093	68	69	8,880	3,967	12,847
1963												

Sources: - Catches 1956-1961 - INPFC stat. yearbooks; 1962, ADF&G mimeo table.

- Ages in catch 1956 - 1960 - ADF&G, FWS, & FRI unpublished (compiled by Fredin). 1961-1962 data compiled from ADF, FWS, & FRI unpublished.
- Escapements 1956 - 1961 - ADF, FWS, & FRI tables (Lib. STB 77). 1962 - ADF&G mimeo tables.
- Ages in escapements - ADF, FWS, & FRI tables, unpublished.
- Ages in total run 1956 - 1959 - compiled by Fredin from ADF&G, FWS, & FRI data. 1960-1962 from ages in catch and escapement already cited.

1/ Includes high seas catch in areas E. of 170° E during May & June and E. of 175° July 1-30 for years 1956-1959. Same for 1960-1962 except July 1-10 instead of 1-30.

2/ Escapement arbitrarily estimated as same as catch (catch from INPFC stat. yearbook).

3/ Nushagak and Naknek-Kvichak only.

4/ 1962 catches include estimate of 375,000 for Yukon, Kuskokwim, N. Side Alaska Pen., & Aleutians. Japanese catch based on preliminary unofficial figure.

The Adak purse seine sampling in 1962 indicates that the expected return of 2-ocean red salmon in 1963 is 8.2 million and the expected return of 3-ocean red salmon is 7.1 million. Thus the total expected return; as interpreted from these data is 15.3 million red salmon[1].

High Seas Gill Net Catches

Another approach to forecasting the 1963 red salmon run to Bristol Bay is based on salmon catches by means of gill nets in the high seas. The basis of the forecast is the same as in past years in that the catch per unit of effort of immature red salmon in the summer season of a year provides indices of abundance for correlating with returning Bristol Bay runs the following year.

In 1962, 16 sets were made in the Aleutian Islands index area during July and August. This index area is roughly bounded by the island chain and 50 N. latitude and from 170 W. to 173 E. longitude. The catches of immature red salmon in the index area this year were marked by their abundance. Relatively large catches were made throughout the area of both 1 winter-at-sea and 2 winters-at-sea red salmon.

Tables 10 and 11 and Figures 4 and 5 present the data upon which the forecast is based. Since only 4 sets were made at the periphery of the index area in 1955, catches for that season were not included in the computations. As noted the forecast by this method calls for 24.6 million red salmon of which 13.0 will be 2 "winter" fish and 11.6 will be 3 "winter" fish.

Alternate procedures of 1) adjusting the catch data for percentages of Asian fish taken in the index area, 2) adjusting the data for percentages of 1 winter-at-sea fish returning as 2 "winter" fish, and 3) adjusting the catches for the years 1956-61 to correspond to catches in specific areas fished in 1962 did not materially change the forecast. Different forecasts can be derived by considering different times and areas of gillnet sampling and relating these abundance indices to returns one year later. While catches of immature red salmon were relatively high in 1962, they were especially high in the western area (west of 180° longitude). In that area, the catch of .1 and .2 immature reds was the highest since 1955. By eliminating the western area and considering only the eastern part of the index area, the forecast becomes about 22 million reds; and in considering only the July 16 - August 15 time period for all years, about 21 million fish.

Size of Fish Expected

An estimate of the size of fish expressed in number of fish per case is presented in Table 12.

---

[1] A regression of catch/seine set on the return to Bristol Bay 1 year later was plotted and yielded a comparable estimate of 8.3 million 2-ocean year fish and 6.7 3-ocean year fish.

Table 10. Basic catch data - index area 1955-62, red salmon.

Year	Number of sets	Number in small mesh	Number of shackles of 2-1/2"-3-1/4"	Catch per shackle	Number in large mesh	Number of shackles of 4-1/2"-5-1/4"	Catch per shackle	Total unadjusted catch per shackle
1-Winter-At-Sea-Fish								
1955	4	16	16	1.000	3	32	.094	1.094
1956	9	157	51	3.078	2	99	.020	3.098
1957	21	263	168	1.565	17	329	.052	1.617
1958	16	275	128	2.148	12	256	.047	2.195
1959	10	1179	80	14.738	72	280	.329	15.067
1960	24	483	192	2.516	29	672	.043	2.559
1961	22	258	176	1.466	19	616	.031	1.497
1962	16	921	185	4.978	45	313	.144	5.122
2-Winter-At-Sea-Fish								
1955	4	7	16	.438	16	32	.500	.938
1956	9	30	51	.588	358	99	3.616	4.204
1957	21	72	168	.429	951	329	2.891	3.320
1958	16	10	128	.078	175	256	.684	.762
1959	10	62	80	.775	1205	280	4.304	5.079
1960	24	264	192	1.375	2933	672	4.365	5.740
1961	22	31	176	.176	857	616	1.391	1.567
1962	16	122	185	.659	1319	313	4.214	4.873

Table 11. Bristol Bay run (in millions).

Year	2 winter-at-sea fish	3 winter-at-sea fish	All ages
1956	23.4	4.5	27.9
1957	4.8	15.3	20.1
1958	4.0	3.7	7.7
1959	13.1	3.1	16.2
1960	36.3	5.5	41.8
1961	8.2	17.8	26.0
1962	8.9	3.9	12.8

Note: Data extracted from Table 9. 1962 commercial catch data not yet final.

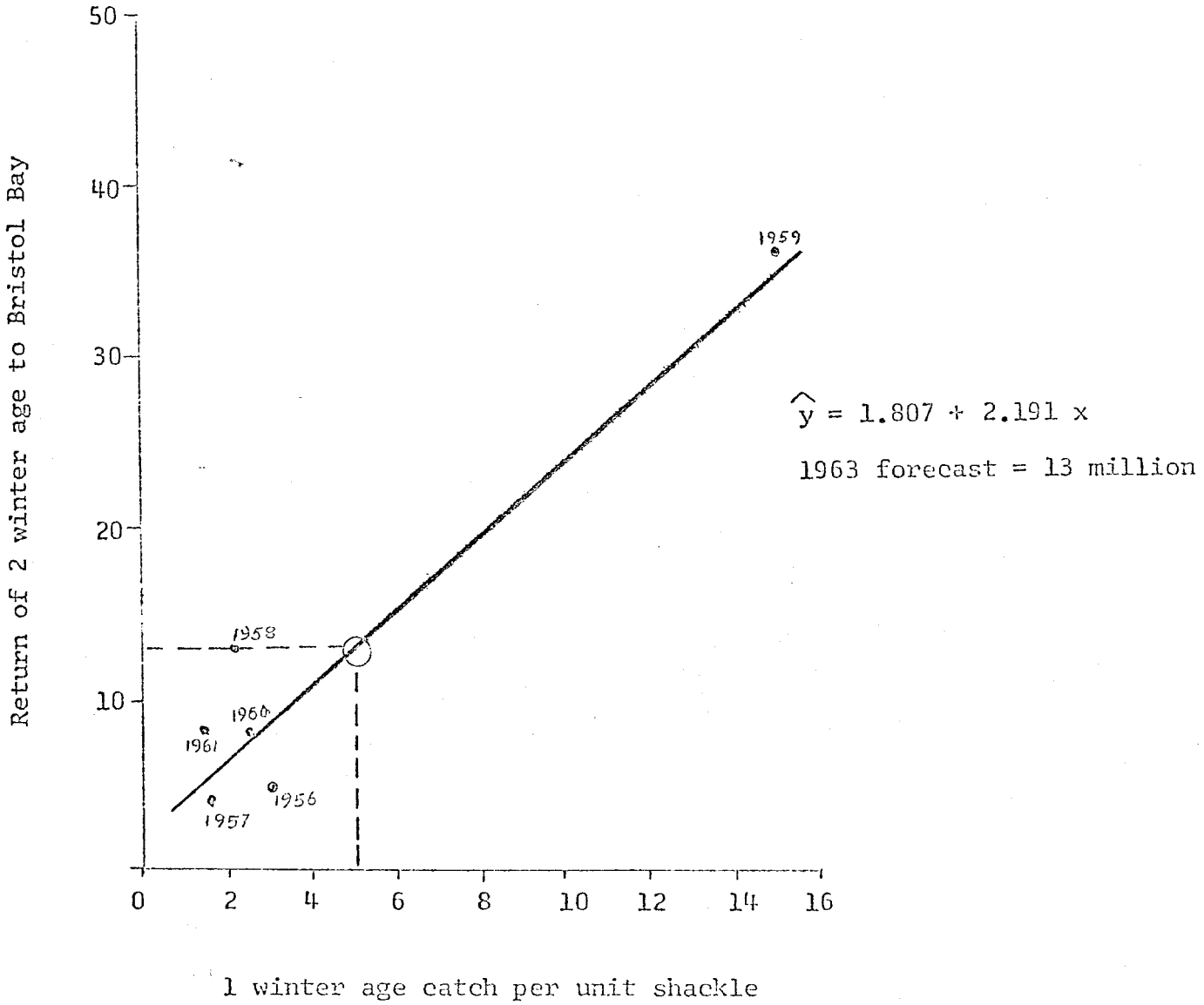

Figure 4. Regression of returns of red salmon on the catch per unit shackle - 1 winter age.

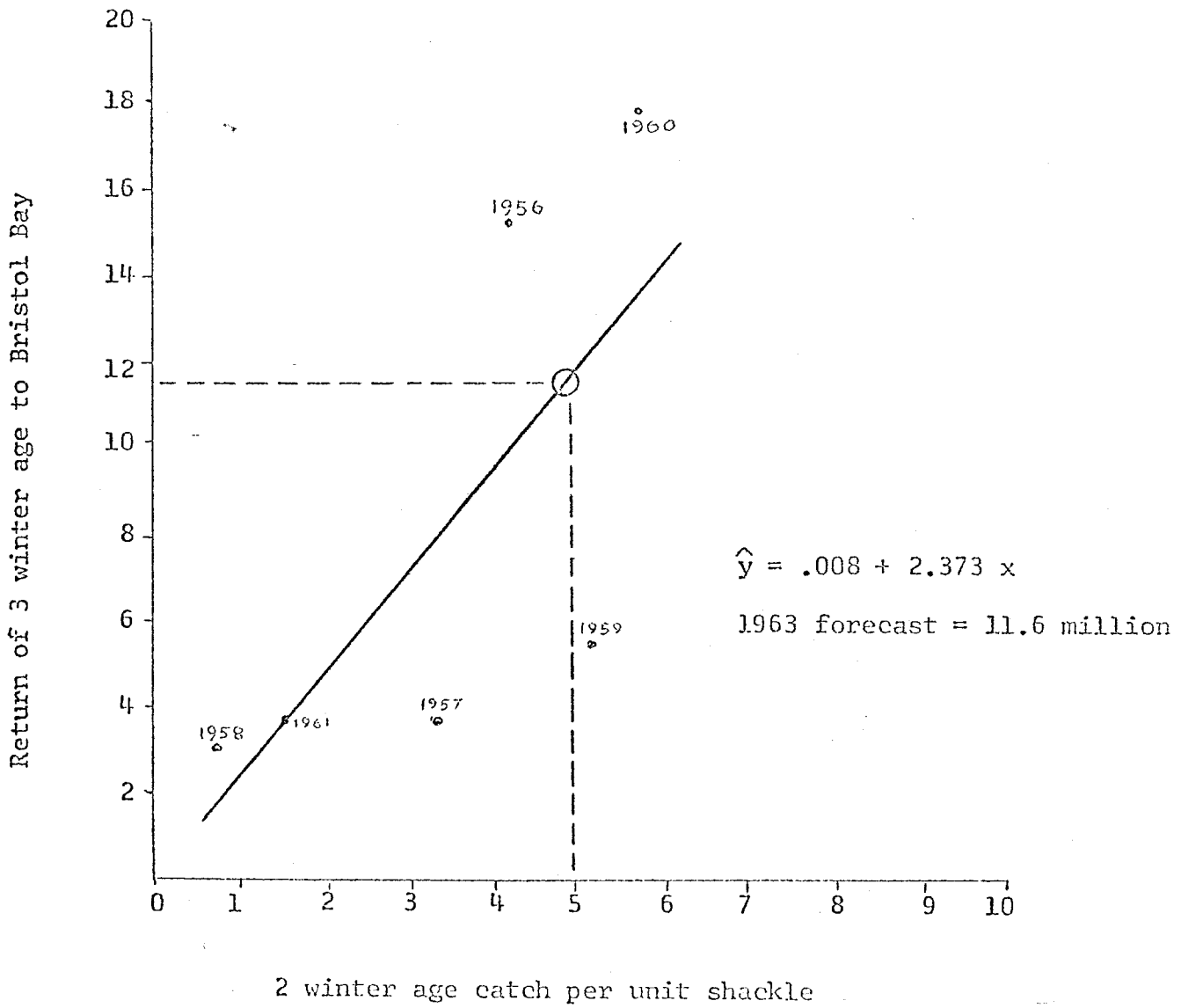

Figure 5. Regression of returns of red salmon on the catch per unit shackle - 2 winter age.

Table 12. Percentage of .1 immature red salmon in seine catches south of Adak Island compared with following year's percentage of .2 reds in Bristol Bay catch, 1956-1962, and resultant fish/case.

Year of Catch At Sea	Percentage .1 Reds At Sea	Year of Bristol Bay Catch	Percentage .2 Reds Bristol Bay 1/	Fish per Case 2/
1955	----	1956	72	13.6
1956	36.0	1957	25	10.9
1957	72.0	1958	52	10.8
1958	92.1	1959	86	13.5
1959	89.7	1960	77	14.5
1960	31.1	1961	28	11.8
1961	87.2	1962	70	12.5
1962	66.3	1963	(57)	(12.5) 3/

1/ From weighted samples of Bristol Bay catches, Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, and Fisheries Research Institute, unpublished.

2/ Figures obtained from a sample of Bristol Bay canneries from each district, but since some canneries canned fish originating in several districts, weighting was only approximate.

3/ Estimate for 1963 is based on a line fitted to data by eye.

SUMMARY OF BRISTOL BAY FORECAST FOR 1963

The data from the preceding smolt indices, cycle analysis, and high seas operations are brought together in Table 13. The smolt indices and cycle analysis indicate an expected return in 1963 of 4.1 million after two years in the ocean, plus 4.5 million after three years in the ocean, or a total of 8.6 million.

The independent estimates from high seas operations show totals of both age groups of 24.6 million from the gill netting and 15.3 million from the purse seining.

To these two sources of data may be added a third method which applies only to the return after three years in the ocean. This is the ratio of the return after three years to the preceding two year return for Bristol Bay as a whole. Data are available since 1956 and the ratio has averaged .60. With the 1962 return after two years in the ocean, estimated at 8.9 million, this indicates an expected 1963 return of about 5.3 million 3-ocean-year fish.

We are unable to reconcile our forecast derived from high seas gill net sampling and high seas seining with the estimates derived from the freshwater work. This is because of the great uncertainty regarding Japanese fishing effort on the high seas and their probable catch of Bristol Bay red salmon in 1963. We wish to emphasize to the users of this forecast that the inadequacy of information about Japanese catch and fishing effort precludes accurate forecasts of the run to the Bay.

Referring to Table 13, note that the forecast by Method 1 utilizing the cycle analysis and smolt indices represents an estimate of the number of fish returning to Bristol Bay rivers. It does not include any high seas catch by Japan and does not include fish returning to streams in Western Alaska other than Bristol Bay. The high seas sampling (Method 2) provides an estimate of the total population of Western Alaska red salmon present in Aleutian waters at the time of sampling, and these estimates have been related to the total Western Alaska catch including estimates of the Japanese catch in each year.

In a case such as this where the size of the run is somewhat uncertain because of wide spread estimates obtained by different methods, the high seas catch by Japan must be conservative in the area of intermingling. However, we must assume that the Japanese, in any case, will take approximately one million fish and the available run into Bristol Bay will be correspondingly less.

We are puzzled by the disparity in the estimates obtained from high seas gill net sampling and the estimates derived by high seas seining and the freshwater work. The facts are that the research vessels caught relatively large numbers of the immature salmon throughout the gill netting area, and as yet we do not fully understand the significance or reliability of the gill net sampling. However, we have no reason to reject the method and we have no basis for determining which method is the most accurate. Our only recourse is to average the several methods even though this means adding one estimate which includes any Japanese catch to another estimate which does not include any Japanese catch. This was done in the summary Table 13.

Table 13. Summary of forecast of Bristol Bay red salmon run in 1963 (in millions of fish).

	Ocean Age .2		Ocean Age .3		Total	Basis
Method 1.						
Igushik	.5		.2		.7	cycle analysis
Wood	1.5		.6		2.1	smolts
Tikchik	.02		.26		.3	cycle analysis
Total Nushagak	2.0		1.1		3.1	
Kvichak	.3		1.4		1.7	smolts
Alagnak (Branch)	.8		.2		1.0	cycle analysis
Naknek	.3		.7		1.0	smolts
Total Naknek-Kvichak	1.4		2.3		3.7	
Egegik	.3		.7		1.0	cycle analysis
Ugashik	.5		.3		.8	smolts
TOTAL BRISTOL BAY	4.2		4.4		8.6	
Method 2.						
High Seas Seining	8.2		7.1		15.3	
High Seas Gillnetting	13.0		11.6		24.6	
Method 3.						
Ratio of .3/.2	---		5.3			
Average (all methods)	8.5	+	7.1	=	15.6	

As indicated therein, the total return of 2-ocean fish, after averaging the several methods of forecasting, is 8.5 million red salmon. Similarly, the expected total number of 3-ocean fish is 7.1 million red salmon. The two estimates combined give an expected total run to Bristol Bay of 15.6 million red salmon. Of course, the averaging of the three methods gives double the weight to the high seas sampling.

Because of the above mentioned difficulty with estimating Japanese catch and fishing effort, and because of the disparity in estimates obtained by the different methods, we feel that it is impossible to forecast distribution of the 15.6 million fish to the various fishing districts of Bristol Bay.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203 or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-6077, (TDD) 907-465-3646, or (FAX) 907-465-6078.