Informational Leaflet 21

SALMON FORECAST STUDIES ON 1963 RUNS IN PRINCE WILLIAM SOUND

By:

Wallace H. Noerenberg
Division of Commercial Fisheries
Cordova, Alaska

January 1, 1963

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DEPARTMENT OF
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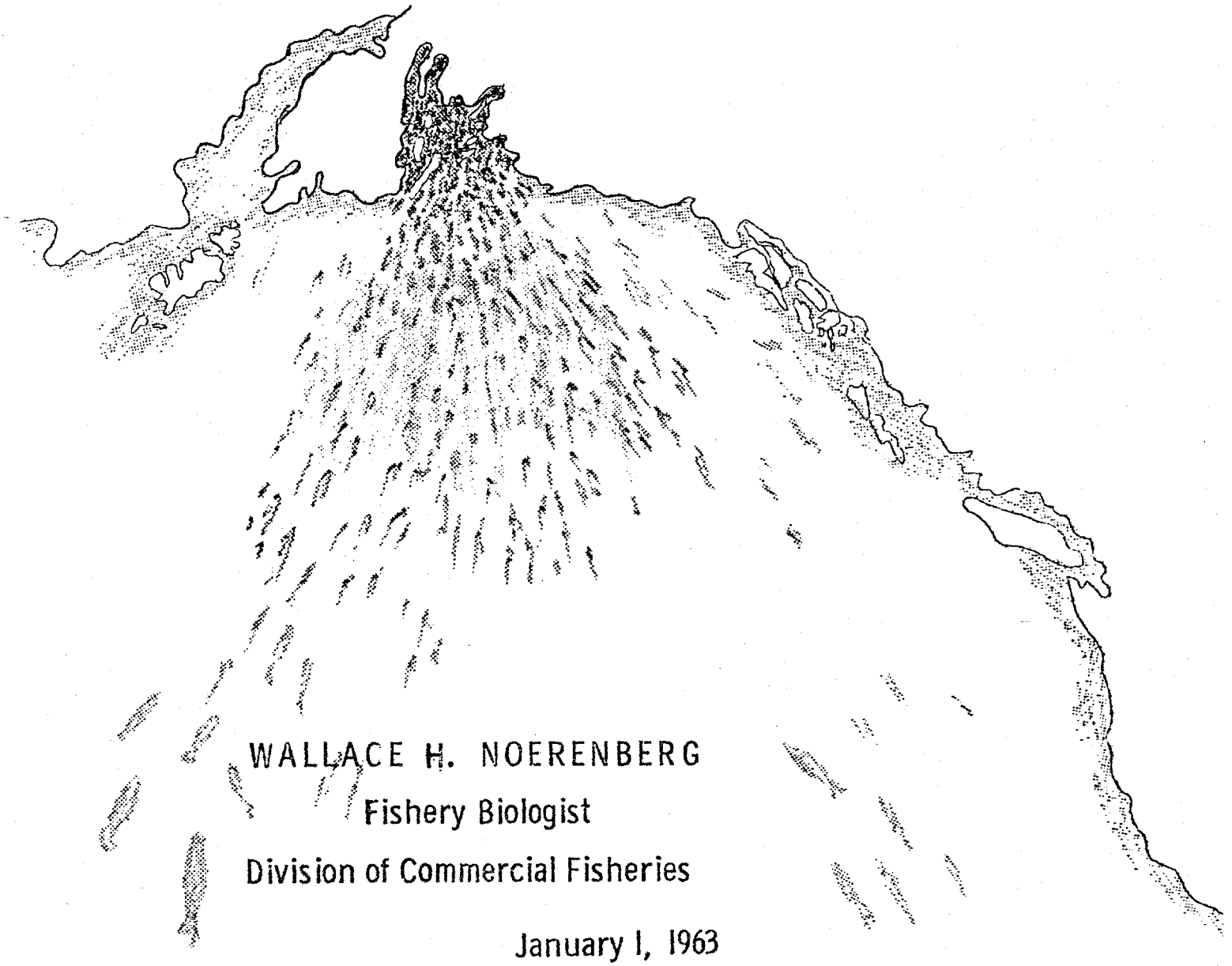

WALLACE H. NOERENBERG
Fishery Biologist
Division of Commercial Fisheries

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SALMON FORECAST STUDIES ON 1963 RUNS IN PRINCE WILLIAM SOUND

INTRODUCTION

Forecast of salmon runs provide immeasurable advantages to fishery management and industry. Maximum utilization of salmon resource with well planned conservation, but without severe economic losses in industry are the fruits of accurate forecasts. That forecasts may be feasible for many runs in the near future appears possible, even before we establish exact times and causes of mortalities affecting return. The Department of Fish and Game, with a moderate expenditure of money and effort between 1960 and the present, has gained much prior knowledge about the 1963 run of pink salmon, *Oncorhynchus gorbuscha* (Walbaum), returning to Prince William Sound.

Background, objectives, and methods of operation of current studies in Prince William Sound have been reported by Noerenberg (1961). Essentially we have attempted to monitor each cycle of pink salmon by obtaining an index to abundance at four stages in the life history: 1) spawning adults, 2) pre-emergent fry, 3) estuarine fry and 4) coastal fingerling. Determination of which stage is best for forecast is the long term objective.

Anticipating the pink salmon runs in 1962, escapement data over a 20-year period indicated a run of 3 to 10 million pinks, with 6.4 million the average expectation. Pre-emergent fry densities in the intertidal zones indicated better than average freshwater survival, with about 9 million pinks the best estimate of the return. Estuarine sampling found fry in varying densities around the Sound, but since 1961 was the first year of this work, no information was available to determine the significance of our data. The actual return in 1962 provided 6.8 million pinks to the industry and 2.0 million more were observed on the spawning grounds.

Forecasts for 1963 and immediately subsequent years should not be expected to give precise numbers due to the preliminary nature of our work, but should prove valuable if they correctly establish the general level (poor, fair, good) of the return runs.

I. SALMON RUNS AND ESCAPEMENT IN 1961

Pink salmon runs in the Sound in 1961 were not unusually large in total, but the 4.5 million total run was about twice as large as expected from average reproduction of escapements reported by the U.S. Fish and Wildlife Service. This caused severe problems in the local canning industry, which was almost totally unprepared to process a pink salmon catch.

Catches of pink, chum *O. keta* (Walbaum), and red salmon *O. nerka* (Walbaum) for the years 1920 to 1961 are shown in Figure 1. Final total catch by all gear in 1961 was: 2,298,218 pink salmon, 224,401 chum salmon, and 68,572 red salmon. Purse seining was restricted to Montague, Southeastern, and Eastern

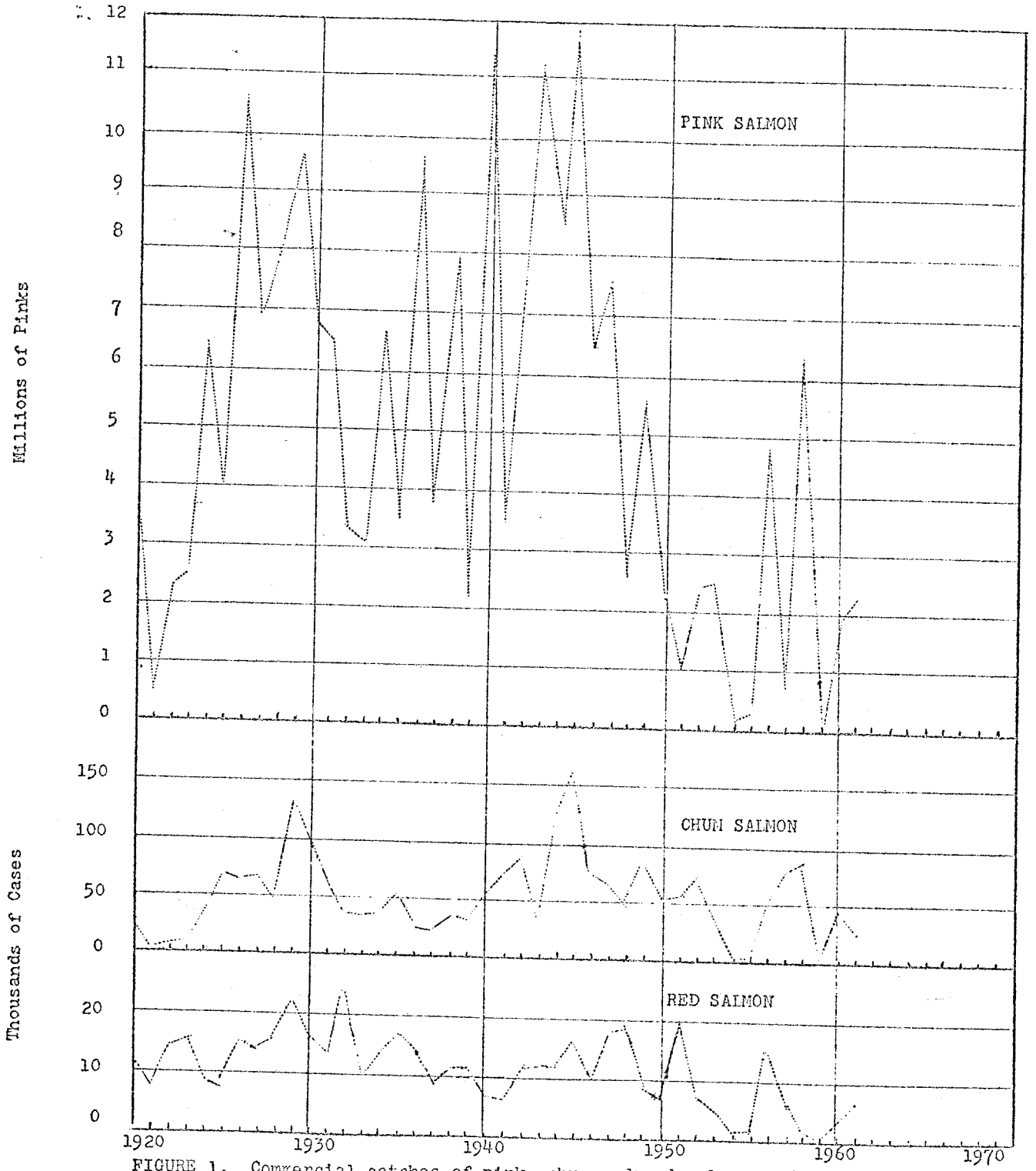

FIGURE 1. Commercial catches of pink, chum and red salmon in Prince William Sound from 1920 to 1961. Catches in years 1921, 1954, 1955 and 1959 are not indicative of abundance due to restrictions of economic or regulatory nature.

districts (see Figure 2), while most of the red salmon catch came from the small gill-net districts in the western Sound, Eshamy, and Coghill. July or early runs of pinks and chums were allowed to escape to their spawning grounds; purse seine fishery catches, taken from August 1 to 18, came entirely from late runs of pink and chum salmon.

PINK SALMON

Total escapement of pink salmon to Prince William Sound streams in 1961 was the greatest on record. Noerenberg (1961) reported records from 1924 to 1960 did not indicate any escapement of pinks exceeded 1.5 million. Extensive ground and aerial surveys in 1961 recorded 1,642,450 pinks in 80 major streams and 2,203,800 pinks in all 322 streams surveyed. As will be noted in Table 1, distribution of spawners among various districts was only fair; it was poorer than distribution of recent even-year escapements, but improved from recent odd-year escapements.

Pink stocks in Eastern and Southeastern management districts remained the strongest feature of the Sound escapement, contributing about 55 percent of the total. Runs to Montague Island streams were fair to good in abundance in 1961 (13% of total escapement); but elsewhere, despite fishery closures, good runs were restricted to a very few streams. In the Northern district, pink escapements were very poor except for one large early run to Wells Bay. Runs of pinks in the Northwestern district were spotty. Coghill River, Long Bay, and Pigot Bay streams had very large runs while elsewhere relatively few fish were in evidence; only a few hundred pinks spawned in all of Cochrane Bay. A near record escapement of pinks occurred in Eshamy Lagoon, but relatively few streams in the Southwestern district had significant runs.

Detailed counts by stream are shown in Appendix Table A. Seasonal totals for each stream were calculated as for 1960 escapements: weekly cumulative live counts covering all spawning were divided by a stream-life factor of 2.5 weeks, except in specific streams, as noted, where tagging has indicated a different factor.

Table 1. Prince William Sound pink salmon escapements, by management district, 1957-1961.

Management District	Totals for 80 Major Streams only: 1957	1958	1959	1960	1961	Total All Streams 1961	(No. of Streams)
EASTERN	60,570	240,130	122,700	384,590	518,370	706,780	(83)
NORTHERN	9,020	70,900	11,150	108,070	110,360	124,360	(37)
NORTHWESTERN	22,060	148,100	60,250	153,070	415,860	448,180	(47)
SOUTHWESTERN	1,780	41,350	6,850	82,000	60,150	134,510	(58)
MONTAGUE	5,850	29,900	21,500	124,810	173,690	289,290	(53)
SOUTHEASTERN	16,540	53,700	88,000	122,460	394,020	500,840	(44)
PWS TOTALS	115,870	584,080	310,450	975,000	1,672,450	2,203,800	(322)

Note: Northwestern district includes Coghill sub-district; Southwestern district includes Eshamy sub-district.

Source: FRI, U of W, 1957-1958; USFWS 1957-1959; ADF&G 1960-1961.

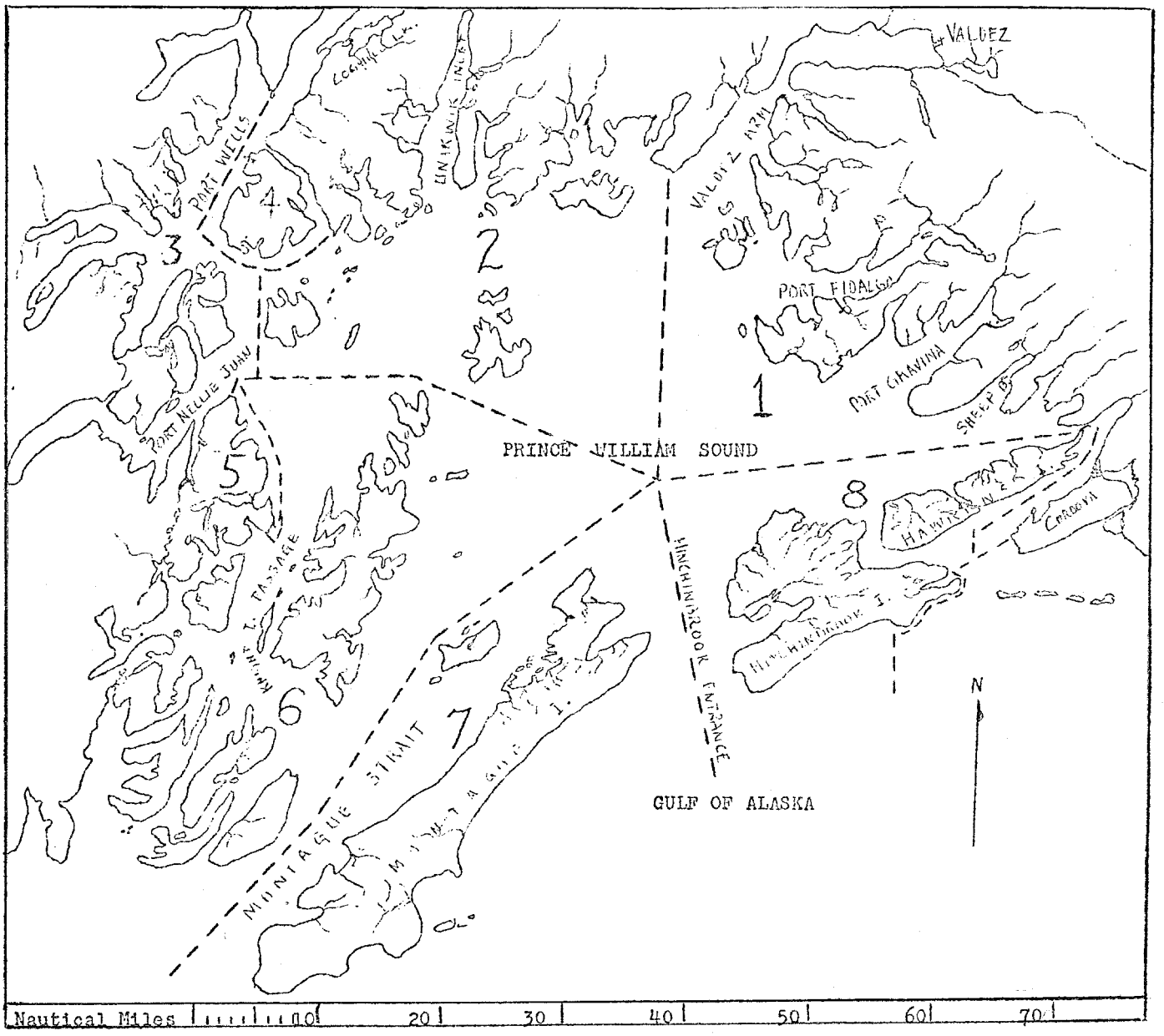

FIGURE 2. Management Districts in Prince William Sound.
1. Eastern 2. Northern 3. Northwestern 4. Coghill
5. Eshamy 6. Southwestern 7. Montague 8. Southeastern

Relative abundance of various seasonal elements of the 1961 escapement is compared in Figure 3 with those of 1957, 1959, and 1960 by plotting of weekly estimates of live pinks in the streams. Time of spawning in 1961 was significantly earlier than that noted in 1960, especially among early fish. This is in sharp contrast to timing of escapements in the early 1950's; Noerenberg (1955) noted odd-year runs of pink salmon were spawning much later than even-year runs during the period 1952-1955, with the most pronounced differences in early streams.

A most interesting aspect of Prince William Sound pink salmon runs has been the relative magnitude of intertidal spawners. Since 1952, when the Fisheries Research Institute, under industry sponsorship, began careful observations of the escapements, it has become clear that intertidal zone spawning is perhaps of greater importance in the Sound than in any other area. Noerenberg (1957) found that over 50 percent of pink spawners used areas below mean high tide in 4 out of 5 years from 1952 to 1956. Further, a distinct cyclic difference was found, with intertidal spawning far more important in even-years than in odd-years. Only 35 percent of observed pink salmon spawned in intertidal zones in 1961. Many areas 2 to 10 miles upstream where few fish have been observed for the past 10 years, were utilized heavily by 1961 pink salmon spawners.

As discussed in the following section on pre-emergent fry sampling, more favorable survival conditions apparently operated on spawn deposited above the tidal zone; deposition of a large part of spawn upstream will undoubtedly prove an important factor in governing both timing and size of the 1963 pink salmon run. The early runs and early parts of the middle and late runs should be the strongest segments of the total, with a sharp decline in catch in early August when intertidal fish begin to make up most of the run. Table 2 shows the variations in stream distribution from 1952 to 1961.

Table 2. Percentage of pink salmon spawners utilizing intertidal zones of Prince William Sound, 1952-1961.

Year	No. of Streams Observed	No. of Spawners Observed 1/	Percent of Spawners in Intertidal Zone
1952	69	111,000	72
1953	65	177,000	43
1954	80	658,000	72
1955	84	282,000	54
1956	84	660,000	75
1957	156	83,000	43
1958	186	584,000	76
1959	20	135,000	57
1960	192	896,000	77
1961	221	1,508,000	35

1/ Includes only that portion of escapement count committed to specific stream sections.

Source: 1952-1958, FRI, U of W Survey Reports; 1959, USFWS, Hobart Chum Report; 1960-1961, ADF&G

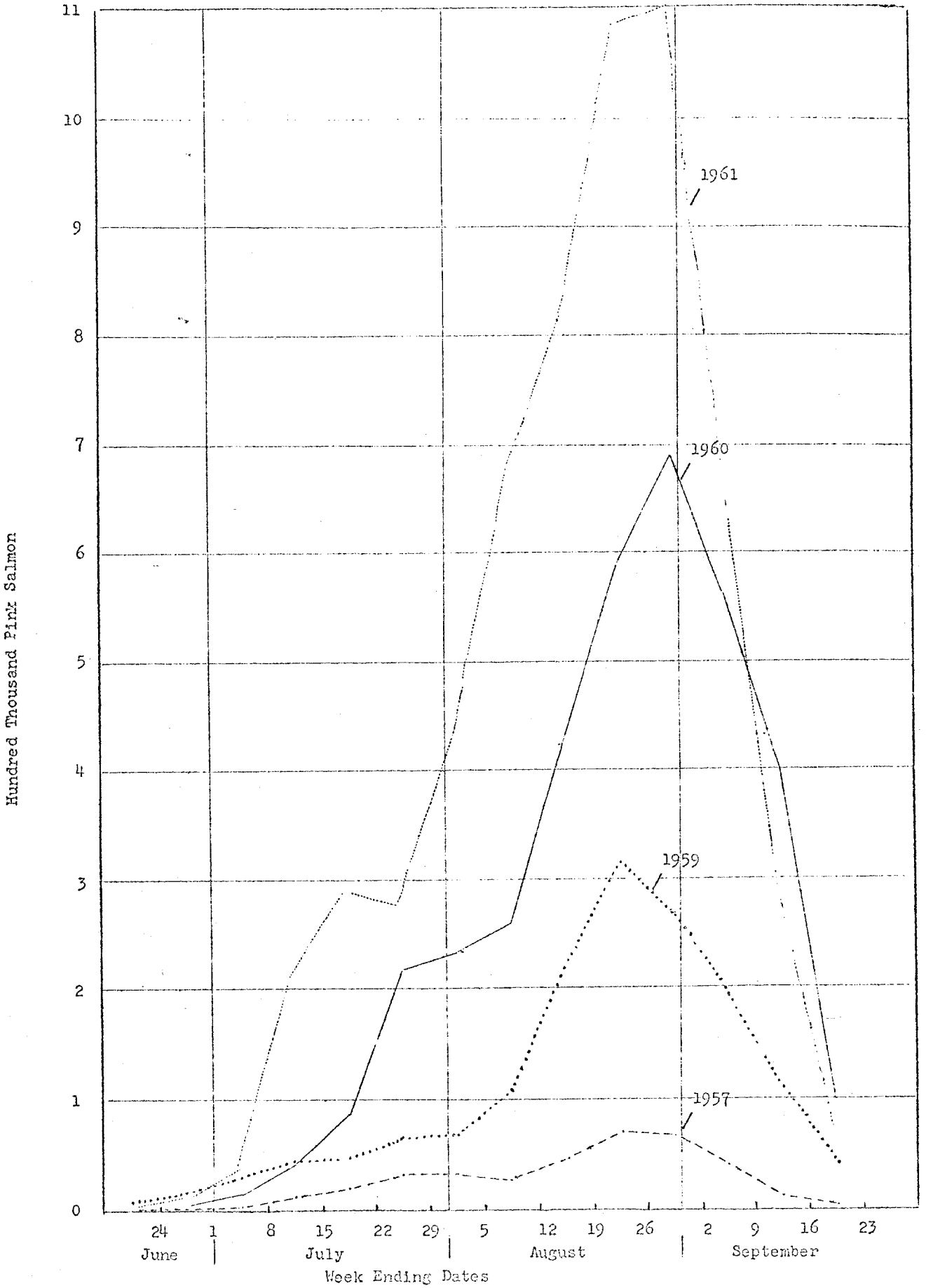

FIGURE 3. Weekly estimates of live pink salmon in streams of Prince William Sound in 1957, 1959, 1960 and 1961.

Escapement-return relationships for Prince William Sound pink salmon have been studied in some detail since 1957. Escapement data on 70 key streams for a 17-year period, 1940-1956, were reported by Bureau of Commercial Fisheries biologists (1958) as good indices to general magnitude of return runs. Noerenberg (1961) noted in similar data for even-years alone that variations in returns from given levels of escapement were quite extreme; at the middle part of escapement range, returns have ranged from very poor to very good. Thompson (1962) expressed serious doubts as to the validity of any escapement-return correlation in Pacific salmon. He points out that, except for very small escapements, variable mortality factors in subsequent stages of life probably are of greater significance in determining the return; since these mortalities occur randomly in relation to escapement magnitude, most or all of the possible influence of escapement magnitude is probably obscured.

Basic escapement-return data are given in Figure 4. Among other things, the following are noted about these data: 1) A great deal of variability in return is evident for all pst levels of escapement, 2) for escapements of less than 700,000, returns have all been relatively low, 3) for escapements of more than 700,000 returns have all been relatively high, and 4) we have no precedent for judging reproduction capabilities of so large an escapement as occurred in 1961; if any valid reproduction curve exists, it may level or decline with escapement indices above 1 million pinks. Thus we would expect a pink salmon run in 1963 in the range of observed large returns (4.7 to 12.9 million) and specifically near their average of 8.8 million.

The same data have been plotted in a different manner in Figure 5. This has been done to illustrate another characteristic of the escapement-return data for this area: that certain levels of return are just as well correlated with time or occurrence as with level of parent escapement. Ratios of return (number of pinks returning per observed spawner) show both odd-year and even-year stocks have had similar trends since 1939, although odd-year stocks exhibit much greater variability about the mean.

Further, the stability of the trend lines suggests that some environmental factor other than escapement size has governed the population levels of the returns. It is encouraging to note an upward trend in both stocks since 1956 and that an extremely sharp, downward break from this trend would have to occur if the 1963 run proves to be under 10 million pinks. It is also noted that the poorest ratios observed (1946, 1955) coincided with severe winters following spawning and that the winter of 1961-62 was one of the coldest in recent years.

In summary, our escapement data represents the longest series which may be useful in forecast. Observed escapement-return relationships reveal the 1963 pink salmon run should be relatively large, about 8.8 million pinks, given average survival, but with possible variations from 4.7 to 12.9 million. Most of the run should be destined for Eastern, Southeastern, and Montague district streams.

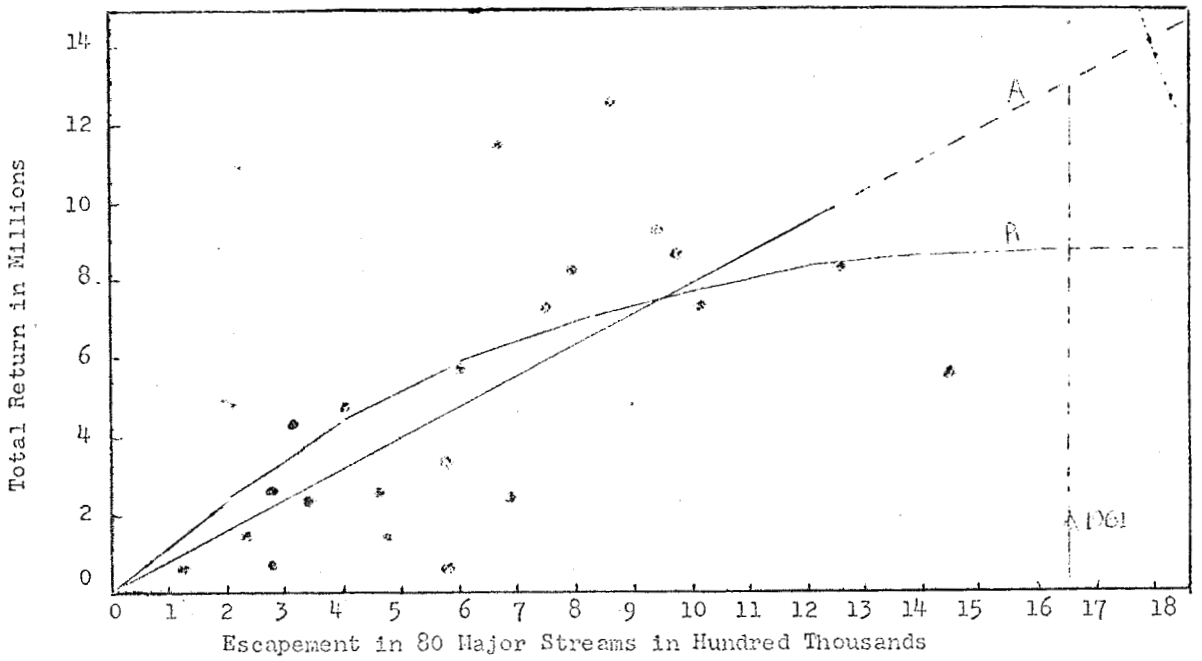

FIGURE 4. Escapement-return data, Prince William Sound pink salmon, 1939-1960. Line A: Least Square Line; Line B: Logistic Curve

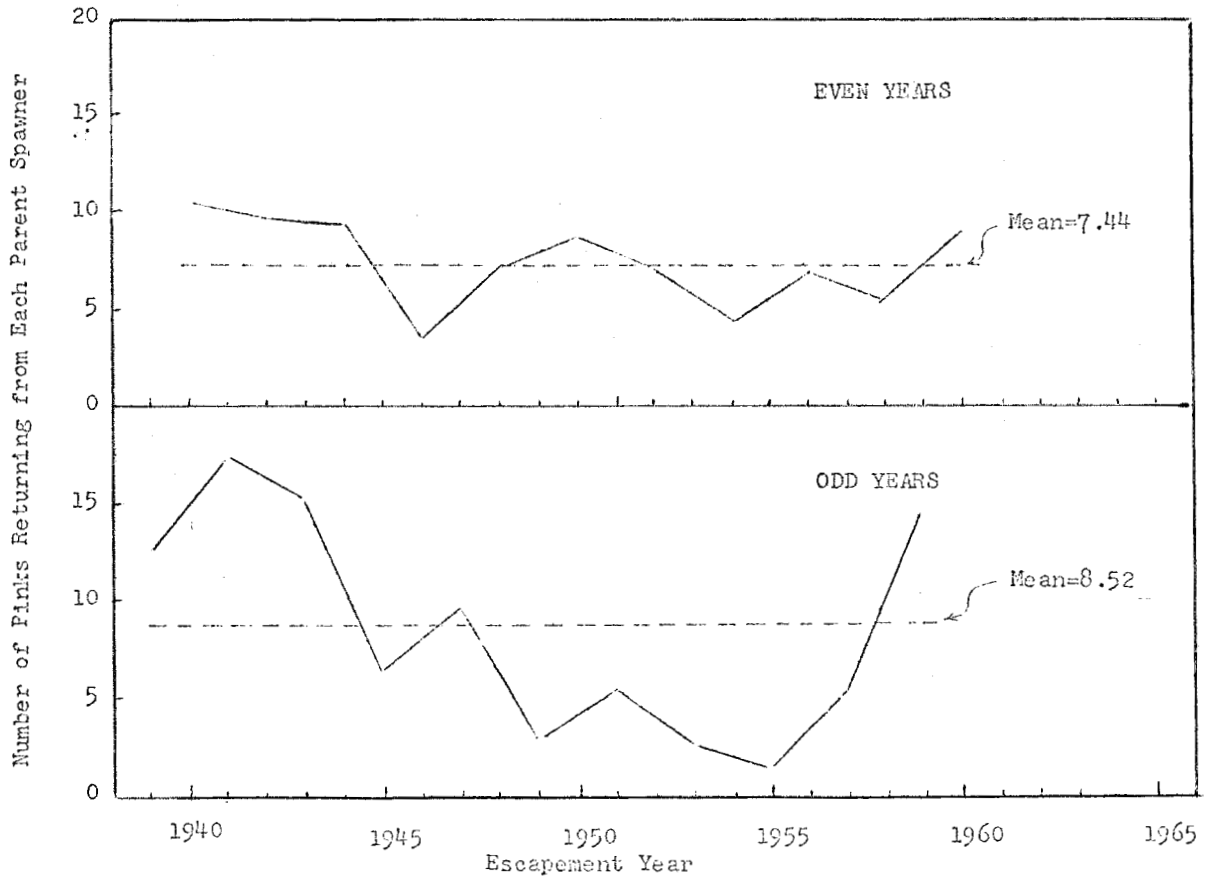

FIGURE 5. Ratios of total return runs and parent escapements in 80 major streams, Prince William Sound pink salmon, 1939-1960.

II. PRE-EMERGENT PINK SALMON FRY ABUNDANCE, SPRING OF 1962

Hydraulic sampling of salmon fry in stream gravels was continued in the spring of 1962 with only slight modifications from procedures described by Noerenberg (1961). An attempt was made to work in the same group of 29 streams sampled in 1961, but ice conditions in bays permitted sampling in only 23 of the 29 streams. Eight other streams were worked as alternates, making a total of 31 streams in the 1962 sample. Modifications in actual sampling were: 1.) A smaller sampling frame as used--3 square feet in area instead of the square yard area used in 1961, and 2) number of samples per stream was increased--about twice as many intertidal samples per stream and 5 times as many upstream zone samples as obtained in 1961. In all, 871 samples were obtained in 31 intertidal zones and 301 samples in 20 upstream zones in 1962.

Prince William Sound hydraulic sampling programs of the U.S. Fish and Wildlife Service in 1958 and 1959 have now been reported by Kirkwood (1962). Comparisons of these data and our 1961 data with that of 1962 has been through conversion of all data to densities of fry per square foot. As pointed out in the 1961 forecast report, selection of sample streams was on a different basis in 1958-59 than in 1961-62 and it therefore appears necessary to base forecast estimates which use 1958 and 1959 data on observations in major streams only. This has been done in Table 3. A listing of data from all streams is given in Appendix Table D.

Table 3. Prince William Sound results of sampling of pre-emergent pink salmon fry, 1958-1962, with estimates of 1963 return based on observed returns.

Year	No. of Streams	No. of Samples	Mean Fry Density per square foot	Ratio of Densities	Observed and Estimated Returns 1/
Intertidal Zone Sampling, Major Streams					
1958	7	90	1.82		601,000 (1959) 2/
1962	19	572	13.39	7.36	4,423,000 (1963)
1959	9	180	8.48		3,190,000 (1960)
1962	19	572	13.39	1.58	5,040,000 (1963)
1961	18	329	23.56		8,822,000 (1962)
1962	19	572	13.39	0.57	5,029,000 (1963)
Intertidal Zone Sampling, All Streams					
1961	29	494	26.52		8,822,000 (1962)
1962	31	871	13.64	0.51	4,499,000 (1963)
Upstream Zone Sampling, All Streams					
1961	12	58	31.61		8,822,000 (1962)
1962	20	301	18.62	0.59	5,205,000 (1963)

1/ Estimates for 1963 calculated directly from ratios of fry density and observed returns.
2/ Revised estimate of 1959 escapement; 365,000 used in previous report.

Three points should be made regarding the pre-emergent fry sampling program:

1) Of the four abundance checks being made on each pink salmon cycle, the hydraulic sampling is the most precise index to population densities at times and places where races are still segregated and, in fact, even relative numbers of early and late fish can be determined.

2) It is doubtful how comparable present sampling is with that conducted in 1958 and 1959, but all data collected thus far have shown very similar fry density-return abundance relationships. Forecasts for 1963 pinks vary only from 4.4 million to 5.2 million based on these indices.

3) To remain a good index of streams, hydraulic sampling must sample all important elements of the fry population each year. In 1958, 1959, and 1961, sampling evidently met this requirement. In 1962, sampling probably did not meet the requirement due to the following factors:

   a) A large and important section of the 1961 run deposited spawn well above tidal influences (see discussion on page 5).

   b) Heavy ice and snow prevented hydraulic sampling in many areas above intertidal zones.

   c) Differential mortalities between intertidal-lower stream egg and fry populations and those well upstream was indicated by evidence independent of hydraulic sampling.

The evidence that a differential mortality occurred is twofold: 1) At one important stream, Koppen Creek (#11) in Sheep Bay, a series of migrant-trap samples during May and June revealed a large outmigration (± 10 million pink fry) occurred from areas above the intertidal zone. At this same stream in March, hydraulic sampling revealed practically nothing survived the winter in either intertidal or lower upstream zones. Based on hydraulic sampling, an estimation of less than 1 million pink fry surviving to migratory stage in this stream would have been made. 2) Estuarine fry work at Sheep Bay and other places, dealing with all elements of the fry population, gave the optimistic view that large numbers of fry did survive to reach salt water.

In summary, hydraulic sampling of pre-emergent fry was precise in forecasting the 1962 adult run, which was primarily composed of intertidal spawners. But, in the 1963 forecast, it is only a useful index of the last portion of the late run which is dominated by intertidal spawners. Specifically the 1963 pink salmon catch can be expected to show signs of weakness soon after August 1, with firm regulatory measures probably necessary at that time to insure adequate escapement of the late section of the run. However, pre-emergent fry sampling can not be taken as good evidence that run entering the Sound in late June and throughout July will not be large. It appears probable that the forecast of 5 million pinks from this sampling has greatly underestimated the total 1963 return of pink salmon.

III. ESTUARINE FRY ABUNDANCE, SPRING OF 1962

Visual estimation of fry abundance in estuaries adjacent to important spawning streams was continued during May and June of 1962 as initiated at the same time in 1961. Weather conditions, which govern effectiveness of this work due to effect on visibility, were generally good in 1962, as in 1961. Two additional sample areas, in Port Valdez and College Fiord, were added to the group of seven localities sampled in 1961. In Table 4, estimates of pink salmon fry abundance are presented in terms of fry per naturical mile of shoreline, since size of sample area has varied slightly from survey to survey in both years. Chum salmon fry observed during the two years will not be significantly involved in the 1963 return runs and thus are not discussed in this paper.

Table 4. Prince William Sound estimates of pink salmon fry abundance in estuaries in 1961 and 1962.

			Mean fry per nautical mile, by survey period:					Ratios of
Estuary	Year	Mean Miles Sampled	May 1 - 9	May 10 - 19	May 20 - 29	May-June 30 - 9	June 10 - 19	Peak Estimates (62/61)
Sheep Bay	1961	9.0	1,825	21,175	19,267	1,500	1,700	2.89
	1962	8.9	2,326	27,147	61,105	35,631	5,924	
Galena Bay	1961	8.0	30,143		16,022		231	0.73
	1962	9.3	4,789		22,032		1,632	
Unakwik Inlet	1961	7.3	42,121		17,550		14,539	0.09
	1962	7.8	1,886		3,811		1,217	
Pigot Bay	1961	5.3	3,728		1,700		600	6.52
	1962	4.6	10,720		24,316		975	
Crab Bay (Elrington Passage)	1961	9.1	6,205		---		12,245	1.64
	1962	8.9	778		13,579		20,073	
Port Chalmers	1961	7.5	32,133		22,213		21,913	0.85
	1962	7.3	3,840		27,282		13,271	
Port Etches	1961	4.0	8,814		---		3,300	5.97
	1962	6.5	16,385		52,592		---	
Port Valdez	1962	5.7	5,025		6,564		---	---
College Fiord	1962	6.0	1,050		---		---	---
Totals 1/	1961	50.2		150,359 (Sum of Peak Counts)				1.40
	1962	53.3		211,211 " " " "				

1/ Not including Port Valdez and College Fiord data.

At present, significance of indices obtained in various estuaries is very doubtful. Adult runs of 1962 appeared to reflect to some degree relative abundance noted among fry populations in 1961. Highest densities in 1961 (30-40 thousand fry per mile), occurred at Unakwik Inlet, Galena Bay, and Port Chalmers. Adult runs at these places in 1962 were among the best in the Sound, but moderately large runs occurred at Pigot Bay and Port Etches, where 1961 fry densities appeared to be very low. It is possible that indices between bays are unrelated due to differences in physical character of environments and adaptation of various fry populations to these environments. Whether any part of this work will prove profitable in formulating forecasts must await further research.

Indications for 1963 runs based on this phase of work must be viewed with caution because of the foregoing factors. These indications are:

1) Early, late, intertidal, and upstream sections of the run have probably been measured with equal efficiency.

2) Peak counts in the bays occurred two to three weeks later in 1962 than in 1961. The effect on survival of later migration from streams is unknown.

3) Unlike results from pre-emergent sampling, relative gains in population densities were indicated in 4 of 7 estuaries and for the Sound as a whole.

4) In 1963, pink runs to Sheep Bay, Pigot Bay, and Port Etches will be very large; those at Galena Bay, Crab Bay, and Port Chalmers will be similar to good 1962 runs; and only the Unakwik Inlet run appears to be in extremely poor condition. It should also be noted that we could detect very little fry production from the huge Coghill River escapement of 1961 at either pre-emergent or estuarine stage. There are doubts about early runs in Port Valdez for the same reasons.

5) If 1963 pink runs do average 40% better than 1962 runs, as reflected by our sampling, the total run will be about 12.7 million pink salmon in 1963.

Condition of fry was monitored in both years by collection of length and body volume data at specific locations throughout the season. Figure 6 illustrates data collected in Sheep Bay. Fry migrating from the main stream in Sheep Bay were initially longer (due to larger eggs in adults) in 1962 than in 1961, but they were in poorer condition as indicated by volumetric data. This was undoubtedly due to delayed migration from the streams. Samples in the estuary revealed fry remained in poor condition for at least a month following migration from the streams.

IV. COASTAL FINGERLING SAMPLING PROGRAM

Initial attempts to establish the fourth phase of the abundance index program were made in 1962. A fine-mesh purse seine, 50 fathoms long and 8 fathoms deep,

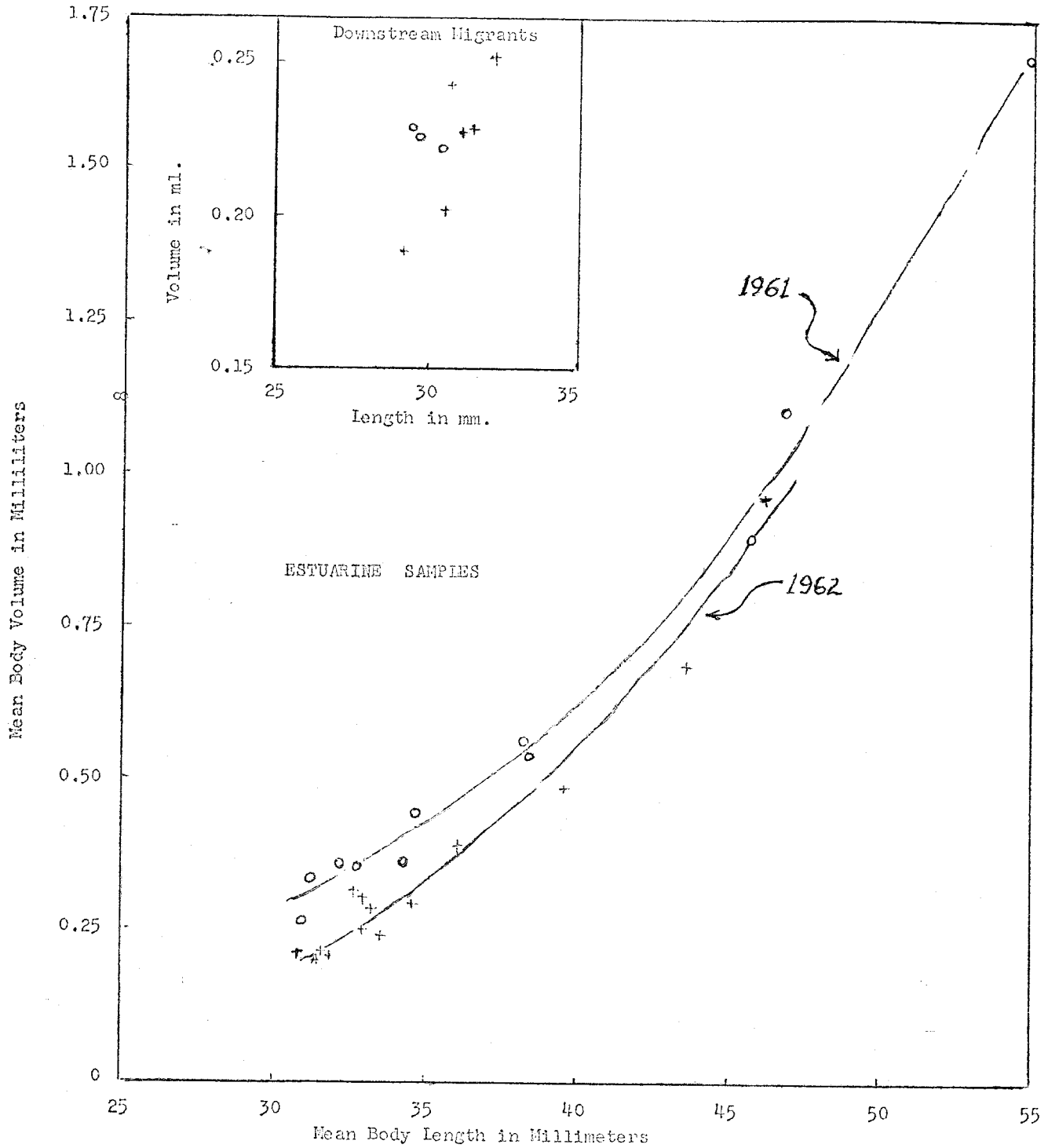

FIGURE 6. Length-volume relationship of pink salmon fry captured at stream mouth and in estuary, Sheep Bay, March-June 1961 and 1962.
o = 1961 samples + = 1962 samples

was fished at the outlets of the Sound, principally in Hinchinbrook Entrance, during three periods from mid-July to mid-August. Purse seine sets were made in a standard manner with regard to direction and time fished. Negative results on salmon fingerling were obtained in all but a few of the 40 sets made; in all only 11 pink, 34 chum, and 10 coho fingerling were caught. Adult salmon and a variety of other species such as herring, sandfish, greenling, rockfish, and stickleback were taken in relatively large numbers on most sets. The lack of fingerling at times and places fished can not be explained until we expand this program in future years.

V. SUMMARY OF PINK SALMON FORECAST INDICES FOR 1963

1) Approach to forecast has been fourfold, with attempts to obtain abundance indices at adult escapement, pre-emergent fry, estuarine fry, and coastal fingerling stages of each pink salmon cycle. Our long range objective is to find which of these indices is best for forecast.

2) Adult escapement indices are the longest series (22 years) with which to judge efficiency of forecast. Relationship of escapement to return has been generally poor, but small escapements have produced small to moderate runs and large escapements have until now produced moderate to large runs. Total escapement in 1961 (2.2 million) was larger than any previous year of record, but was poorly distributed among management districts. Estimation of the 1963 run on the basis of returns from other large escapements indicates the run should approximate 8.8 million, but may vary from 4.7 to 12.9 million pink salmon.

3) Adult spawning in 1961 was unusually early and an unusually small part (35 percent) of 1961 spawn was deposited in intertidal zones.

4) Pre-emergent fry indices represent the next longest series for use in forecast. Density of fry in stream gravels just prior to out-migration has been established in four recent years. Returns from the first three years of pre-emergent sampling have shown a direct relationship between fry density and return. Density in the spring of 1962 was below that observed in 1961 but above those of 1958 and 1959; a return in 1963 of about 5 million pinks is indicated. However, our sampling in all years has dealt primarily with intertidal zones; with a majority of spawn deposited above intertidal zones in 1961 and with evidence of much heavier mortality among intertidal stocks during the winter of 1961-62, it is reasonably certain that pre-emergent fry sampling has under-estimated the 1963 run.

5) Estuarine fry sampling has been accomplished for only two years, 1961 and 1962. Visual estimates adjacent to 7 major spawning areas averaged 40 percent larger in 1962 than in 1961; if this index proves valid, it forecasts a 1963 run of about 12.7 million pinks.

6) Coastal fingerling sampling was initiated in 1962 using a small-mesh purse seine in standardized tow hauls at the entrances of the Sound. Very few fingerling were taken at any time or place of fishing. Significance of the first year's work can not be estimated at this stage of our work.

7) While disagreements among the three indices regarding size of 1963 pink salmon run can not be fully resolved at this time, the following general statements can be made:

   a) The 1963 run will be at least of intermediate size with many indications that it will be of large size, approaching maximums in past years of more than 8 million pinks.

   b) Timing of the 1963 pink salmon run can be expected to be early, with fair fishing in some localities at least by July 1 and with very heavy fishing during the last two weeks of July. A sharp decline in catches can be expected in early August when intertidal stocks begin to make up most of the run.

   c) Most of the run will again be composed of pink salmon destined for Eastern, Southeastern, and Montague districts; moderate to poor runs will occur in streams of the Northern, Northwestern, and Southwestern districts except for a few isolated streams in Wells Bay, Pigot Bay, Culross Passage, Eshamy Lagoon, Dangerous Passage, and Crab Bay.

VI. ESCAPEMENT OF OTHER SPECIES, 1961

CHUM SALMON

Escapement of chum salmon in major streams is shown in detail in Appendix Table B. As with pink escapements, seasonal totals were calculated utilizing cumulative live counts, divided by a stream-life factor of 2.5 weeks. Table 5 gives comparative district escapements for years 1957-1961 for all streams observed. Approximately the same number of chum streams were observed in all years.

Table 5. Prince William Sound chum salmon escapements, by management district, 1958-1961.

Management District	1957	1958	1959	1960	1961	(No. of Streams with Chums, 1961)
EASTERN	161,540	42,380	35,150	92,100	117,950	(53)
NORTHERN	33,230	12,320	4,000	24,730	50,420	(28)
NORTHWESTERN	46,200	10,550	107,100	40,460	70,940	(34)
SOUTHWESTERN	5,280	4,410	1,300	4,800	4,750	(11)
MONTAGUE	9,680	6,960	3,500	16,780	34,380	(14)
SOUTHEASTERN	13,510	9,220	6,660	23,010	59,930	(18)
PWS TOTALS	269,440	85,840	157,650	201,880	338,370	(158)

Note: Northwestern district includes Coghill sub-district; Southwestern district includes Eshamy sub-district.

Source: FRI, U of W, 1957-1958; USFWS 1957-1959; ADF&G 1960-1961.

It is evident that the 1961 chum salmon escapement exceeded in total those of the preceding four years. This was due primarily to large gains in Northern, Montague, and Southeastern districts. Eastern district totals were down from high levels of 1957 due mostly to the comparative weakness of late escapements in Port Fidalgo and Port Valdez. The 1963 run will be derived primarily from escapements of 1959, which according to U.S. Fish and Wildlife Service records was one of the weakest in recent years; well over half of all observed spawners were in the Coghill River. Since survival of pink salmon was unusually high from 1959 spawning and since we note in Figure 1 that historically the periodicity of good chum runs has coincided with that of good pink runs, there is some reason for optimism in regard to the 1963 chum salmon run.

RED SALMON

Detailed counts from counting stations on Eshamy and Coghill Rivers, as well as survey counts from other red salmon systems are shown in Appendix Table C. District totals for 1960 and 1961 are summarized in Table 6. No reliable comparative data exists prior to 1960 for any red salmon system except Eshamy River.

Table 6. Prince William Sound red salmon escapements, by management district, 1960 and 1961.

Management district	Number of spawning streams	Estimated spawning escapement: 1960	1961
EASTERN	1	1,000	1,800
NORTHERN	3	100	6,100
COGHILL	2	145,000	43,600
NORTHWESTERN	1	4,000	5,000
ESHAMY	2	13,515	48,475
SOUTHWESTERN	2	3,000	4,900
MONTAGUE	1	No survey	500
PWS TOTALS	12	166,615	110,375

Source: ADF&G weir counts and aerial and ground surveys.

The decline in total red salmon escapement in the Sound in 1961 was due entirely to occurrences at Coghill River since nearly all other populations had apparent increases. A special drift-net season was provided for the Coghill run from June 12 - July 15. This marked the first attempt in modern history to harvest this run during early and middle periods of its occurrence; a small fleet of vessels took 12,961 reds between June 18 and July 15. From a counting tower installed at the head of the river, 8,709 red salmon were noted between June 4 and July 21, at which time large accumulations of pink salmon in the vicinity made further counts impossible. Peak ground survey counts around Coghill Lake indicated that at least 43,600 reds spawned there in 1961.

As expected from cyclic evidence in recent years, a relatively large run of reds appeared at Eshamy River in 1961. The Eshamy district gill net fishery harvested 53,133 reds between July 1 and August 18; 47,475 reds were counted through the weir below Eshamy Lake.

There is little basis for forecast of any Prince William Sound run of red salmon. The cyclic pattern in recent years at Eshamy has been fairly distinct (two good years, followed by three bad years), but this pattern was broken in 1962 when a good run was expected but did not materialize. Gill net catch in 1962 was 20,151 reds, escapement only 9,490 reds, but tagging has shown most of the seine catch during the unusually late 1962 season must be considered Eshamy fish also (about 16,000 reds). Thus, the 1962 run was about half the expected size. Escapement in 1958 was only 5,224 fish which greatly limits the chance for a large run of 5-year-olds in 1963. Essentially the only chance for a sizeable run in 1963 would be 6-year-olds from 1957 spawning; however, there is no evidence that a large run of 6-year-olds has ever occurred at Eshamy. Records for other systems in the Sound are insufficient to judge the character of cycles operating.

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APPENDIX

Appendix Table A. Live counts of pink salmon in the streams of Prince William Sound in 1961. Underlined counts are ground surveys; all others are aerial surveys. Detailed counts are given only for streams with 2000 or more fish; all lesser escapements are grouped under the heading "Other Streams." District and Season Totals contain interpolative data where surveys are lacking on certain weeks.

1. EASTERN DISTRICT

Stream Number	Stream or Bay Name	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
1	Hartney Creek						100			2000	3000				4440
4	Humpy Creek	0		5120	4350	5990	5700		1890	3490	3490				16010
7	Simpson Bay					0	0	0	20	2400					2400
7A-8	Simpson Bay	0		2590		490	400	200	400		3670				6700
11	Sheep Bay	1500			74080	12300	3000	2800	11740		24470	16200		800	107560
12	Sheep Bay	0		6070		2420	2000	8000	10370		31030	15350		4700	45980
14	Port Gravina				0	0	0	1500			7270				9510
15-17	Port Gravina				0	0		900	2050		3000				4780
18	Comfort Cove				0	200	500	9300	5000		10860	1970			14730
20	Beartrap Bay	0		0		470	500	1800	2000		4230	2500			6640
22	Gravina River				0	0	0	0			2000				2000
23	Olsen Bay	0		1900	3200	2100	5000	8200							46560
24	Olsen Bay	0	390	780	1040	790	900	2360		3780	9000				11820
25	N.Port Gravina			200	340	180	2350			3450	11470				14280
26	St.Matthews Bay			200	1150	840	240	650		12760	20830	20900			30830
28	Irish Cove			200	280	40	2000	5000	8500		15200				24890
29	Whalen Bay	500		2000	9770	2000	500		3890		5570				14550
31	Upper Port Fidalgo				110	100	0	0	2000		2440				3900
34-34A	Fish B.,Main Stream	300		2000	4710	800	1100	5000	7000		14880				26980
37	Cuter Fish Bay						0	0	800		3400				3920
39	Lagoon Ck,Landlocked B.	0		2600	3180	2100	1400	3600	3470		3370				10460
40	Boulder Bay					500	1000	500	200		1060				2140
41	Gladbough Ck,Ellamar					0	200	800	700		4380				6030
42	Turner Ck, Galena Bay					10	0	0	300		3800				4240
43	Millard Ck, Galena Bay			200	350	500	400	1000	1600		6500		750		7320
44	Duck River, Galena Bay	0			380	320	1000	5000	4880		12500		35050		41250
45	Indian Ck., Galena Bay	700		2000	9100	6340	9000	4000	5780		8480		2230		24590
46	Johnson Cove	0		500	770	600	500	0	430		2600				4360
47	Jack Bay	0		1000	3950	2050	1700	100	1810		4760				9750
48	Jack Bay	0		1100	4910	2420	2000	2000	2390		7800				14970

Appendix Table A. Continued

1. EASTERN DISTRICT (continued)

Stream Number	Stream or Bay Name	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
49	Jack Bay	0		0	0	0	0	0	1000		2110				2640
50	Jack Bay				110	1250	2000	100	1500		2960				5850
50D	Sawmill Ck.,P.Valdez			2300	1220	3710	1100		500		240				4090
51	Robe River			1800		900	800				10				2460
51C	Siwash Flats			100		5000	3710		1000		0				5120
51E	Siwash Creek				55460	15000	6430		6300		60				61060
51F	Crooked Creek			500		2000	1180		10		0				2380
52D	West Gold Creek	0		900	4050	2000	500		110		180				3200
53	Twin Falls Ck.,Sawmill B.			3200	2440	3500	3500		2600		6600	6560			16360
54	Stellar Ck.,Sawmill B.	300		9000	12110	14000	14000		9000		7490	7500			40240
Other Streams (39)		0	500	2600	2840	5660	4480	14830	12510	19410	22280	11450	2800	110	39790
District Total (83 streams)		8300	49140	163860	208500	96580	76940	112840	144550	241960	300390	217230	118030	28610	706780

2. NORTHERN DISTRICT

Stream Number	Stream or Bay Name	7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
58	East Arm, Long Bay	0		500	490	1200		300	700			1290			2990
65	Wells Bay	0		11000	18940	45000			10300			4580			69330
66	Cannery Ck., Unakwik Inlet					1500		5700	3670			11530			11980
67	Cowpen Ck., Unakwik Inlet					100		1000	2680						3310
69	Head of Jonah Bay					300		1700	5990	12000		2120			12440
74	Eaglek Bay				500			500	2500	1720		2640			4900
75	Eaglek Bay (glacial)					0		100	0	710		2580			2400
75A	Eaglek Bay (spring)							300	0	670		2780			2620
Other Streams (29)		0	0	100	100	0	400	1800	5810	8940	9550	6470	2400	0	14230
District Total (37 streams)		0	2000	11600	19530	48600	46700	36400	31650	40040	40050	34490	14400	3000	124200

3. NORTHWESTERN (AND COGHILL) DISTRICTS

Stream Number	Stream or Bay Name	7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
83	Coghill River	200	9100	27600		50000	150000	185000		90000		29500			195730 1/
86	Bettles Bay	0		0	0	200		4000		4850		640			[illegible]
89N	N. Pigot Bay	0		5000	11150	19000		32000		8650		2440			52900
89S	S. Pigot Bay	0		1500	9400	25000		40000		20130		5040			71230
91	Logging Camp Creek			0	5900	5000		6500		8420		1250			17910
92W	Blackstone Bay			100	560	100		1500		1480					2940
100	Main Stream, Long Bay	0			3000	25000		32000		43300		26410	13700		63900 1/

1/ Derived by dividing weekly totals by factor of 4.0 weeks as established by tagging data.

Appendix Table A. Continued

3. NORTHWESTERN (AND COGHILL) DISTRICTS (continued)

Stream Number	Stream or Bay Name	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
101A	Lower Culross Passage					0		300		3130		560			3200
102	Mink Harbor, P. Nellie Juan					40		3000		8300		1980			10330
104	Outer King's Bay					110		0		1950					2100
105	Outer King's Bay							500		3570					4430
111	E. Arm, McClure Bay							0	2650			2000			5180
Other Streams (35)		0	200	400	550	1100	1800	3850	6000	8430	6520	2400	450	0	12690
District Total (47 streams)		200	11800	35100	65560	125550	246800	309650	260000	[illegible]	141720	74520	23650	6500	448180

4. SOUTHWESTERN (AND ESHAMY) DISTRICTS

112C	N. Shore, Eshamy Lagoon							800					2000		3800
113	Eshamy River				20	30	140	2290	[illegible]	9510	13150	14600	10000		27260 1/
116	Lake Ck., Head Evan Bay				0	0	0		2100			5170			8110
116A	Outer Evan Bay				0	0	100		400			1160			2860
118	Jackpot River and Lakes					2000	3000		22000						25750 1/
120	S. Arm, Jackpot Bay				0	500	500		1500			2100			5640
122	Lake Ck., NW Chenega Is.					0		500	2200			4120			8730
123	Lagoon Ck., NW Chenega Is.					500		500	1500			1380			3950
133	Bainbridge Lake Creek					50			3500			4770			5580 1/
140	Upper Latouche Pass., Evans Is.					0	0	100	3000			2270			4630
141	Crab Bay, Evans Island					0	0	800	2000			6870			11070
141A	Anderson Cove, Sawmill Bay								100						6040
Other Streams (46)		0	0	0	100	280	100	[illegible]	[illegible]	[illegible]	[illegible]	9560	2500	0	21090
District Total (58 streams)		0	0	0	120	3360	5040	14690	49430	92190	119030	93800	36000	10500	134510

5. MONTAGUE DISTRICT

145	Macleod Harbor, W. Head					0	100	400	3000		17370				22350
145A	Macleod Harbor, W. Head					0	0		0		8130				8050
145D	Macleod Harbor, S. Clam Beach					0	0	500	1100		2470				3350
146	S. Hanning Bay					0	700	1000	7000		14700				20160
146A	N. Hanning Bay					0	500	1500	21000		19580				33430
146B-R	Middle Montague Shore					0	350	2500	9500						46140
147	S. of Port Chalmers				0	500	1500	2000	8000		4700				10080
148	S. of Port Chalmers				0	0	0	200	4500		5230				7890

1/ Derived by dividing weekly totals by factor of 4.0 weeks as established by tagging data.

Appendix Table A. Continued

5. MONTAGUE DISTRICT (continued)

Stream Number	Stream or Bay Name	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
150	Southern Port Chalmers			0		0	0	0	3000	10400	6600				9000
151	Port Chalmers			0		0	0	100	600	4600	5520				6330
152	Port Chalmers			0		0	0	200	500	4800	6000				6600
153	Port Chalmers			0		0	0	0	2500	7400	6250				8460
154	Port Chalmers			0		0	0	0	2000	9000	5670				8270
154A	Port Chalmers									2500	1550				2340
155	Bay N. of P. Chalmers					0	0	0		7500	8500				10200
155C	Stockdale Harbor					0	0	1000		9500	10700				12680
156	Rocky Bay					0	0	0		12000	17300				23720
156A	Rocky Bay					0	0	0			2950				3380
157	Head Of Zaikof Bay					0	0	0	0	4500	2800				3920
157C	SE Shore, Zaikof B.			0		0	0	0	0	5200	3700				4360
157D-E	Zaikof Bay			0					500	2500	1800				2520
158	Outer Zaikof Bay					0	0	0	500	2200	2800				3400
159	Outer Zaikof Bay					0	0	200	0	4000	2900				4040
170X	Green Island								1000			9160			12040
204	Nellie Martin River								4350						4540
Other Streams (10)		0	0	0	0	0	300	550	3450	9000	9610	5700	1500	0	12040
District Total (53 streams)		0	0	0	0	500	3450	11650	83500	182700	218830	154610	56000	12000	289290

6. SOUTHEASTERN DISTRICT

172	S. Side Port Etches					0	1500	4000	3000		8500				10920
173	S. Side Port Etches					0	0	100	500	2700	2550				2740
174	Garden Cove					0	0	500	800	4050	1630				2990
175	Head, P. Etches, Main Str.					0	2500	18000	20000	13300	10300				27240
176	Constantine Harbor					1000	4100	25000	35000	46000	34300				65160
177	IN Hinchinbrook Island					1100	25200	8000	14000		3130				24690
178	Juania Bay					300	0	3000	12000		7550				14220
179	Shelter Bay				0	200		500	2200		4300				4920
180	Anderson Bay					0	500	7000	3200	11750					14580
181	Anderson Bay					0	1000	6000	7000	12630					16250
182	Double Bay				0	0	0	3000	1500		2200				[illegible]
183	Double Bay				0	0	5000	30000	24000		32650				53450

Appendix Table A. Continued

6. SOUTHEASTERN DISTRICT (continued)

Stream Number	Stream or Bay Name	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
185	Head, Fish Bay					200	2000	15000	25000	29280	18000				39190
186	Hawkins Cutoff					300	3000	20000	12000	3500	8000				20320
187	Dan's Bay					0	1000	5000	5000		4300				8760
187A	Dan's Bay							3000	1400		3500				4640
187B	Dan's Bay							1000	1500		7000				6880
188	Boswell Bay, Lake Ck.										2500				2500
189	W.Side, Makaka Point					0	600	25000	30000	56100					69080
190	E.Side, Makaka Point					0	5000	10000	28000	35200	28580				51110
190B	W.Side, Outer Canoe Pass						0	500	1000	5420					5570
190C	W.Side, Outer Canoe Pass				0	0	0	3000	2500	4000	3500				6200
191	Upper Canoe Pass				0		0	1000	1500		2000				2700
191A	Whiskey Cove								3000						3000
191B	W. of Cedar Bay					0	0	0	500						2600
191C	W. of Cedar Bay					0	0	0	2000	2550					3220
191D	Cedar Bay					0	0	0	1000	3570					3830
191E	Cedar Bay					0	0	0	1500	2460					3380
192	Windy Bay					0	300		4700	5470					7590
192B	Orca Channel						0		1000	1740	2950				3080
193	Orca Channel					0	0		2000	2890	2750				3860
196	N. of Canoe Pass						0	0			1470				2190
Other Streams (12)		0	0	0	0	0	0	0	2170	4530	4100	1450	0	0	4900
District Total (44 streams)		0	0	0	0	3100	52200	192850	251270	330840	281740	102250	32750	5000	500840

Appendix Table A. Continued

Recapitulation of weekly pink salmon counts in 1961 by District

Number of Streams	District	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
83	Eastern	8300	49140	163860	208500	96580	76940	112840	144550	241960	300390	217230	118030	28610	706780
37	Northern	0	2000	11600	19530	48600	46700	38400	31650	40040	40050	34490	14400	3000	124200
47	Northwestern/Coghill	200	11800	35100	65560	125550	246800	309650	260000	205870	141720	74520	23650	6500	448180
58	Southwestern/Eskany	0	0	0	120	3360	5040	14690	49430	92190	119030	93800	36000	10500	134510
53	Montague	0	0	0	0	500	3450	11650	83500	182700	218830	154610	56000	12000	289290
44	Southeastern	0	0	0	0	3100	52200	192850	251270	330940	281740	102250	32750	5000	500840
322	Pr. Wm. Sd. Total	8500	62940	210560	293710	277690	431130	678080	820400	1093700	1101760	676900	280830	65610	2203800

Appendix Table B. Live counts of chum salmon in the streams of Prince William Sound in 1961. Underlined counts are ground surveys; all others are aerial surveys. Detailed counts are given only for streams with 2000 or more fish; all lesser escapements are grouped under the heading "Other Streams." District and Season Totals contain interpolative data where surveys are lacking on certain weeks.

1. EASTERN DISTRICT

Stream Number	Stream or Bay Name	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
11	Sheep Bay	1500		29190		3200	2000	500	710		980	400		150	37110
12	Sheep Bay	0		100		150	500		2000		3970	750		850	5420
20	Beartrap Bay	100		500		1570	2000	500			890	400			3540
29	Whalen Bay	100		2000	2650	390	200		150		190				2700
31	Upper Fidalgo				20	0	0		2040		1690				3440
32	Sunny Bay (glacial)						200		2200		2290				4060
32A	Sunny Bay (clear)						0		4100		0				4240
39	Lagoon Ck.,Landlocked B.	0		0	10	0	0	0	410		2820				2860
44	Duck River, Galena Bay	0		600	170	4300	6000		15000		8000		0		23230
49	Jack Bay	10		100		500	600		3000						3340
50	Jack Bay				10	1250	500		700		780				2110
51F	Crooked Creek			0		1500	600		900		350				2160
53	Twin Falls Ck.,Sawmill B.			100	0	0	200		200		3100				3540
Other Streams (40)		530	2360	5590	5940	5970	4440	3360	5070	6530	6240	3610	820	0	20200
District Total (53 streams)		2240	31310	38180	35830	18830	17240	24370	37100	36390	30700	15860	5320	1500	117950

2. NORTHERN DISTRICT

Stream Number	Stream or Bay Name	7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Total
58	E. Arm, Long Bay	50		900	300	500			1300			1710			4700
63	Cedar Bay	0		700	920	1300			380			160			2220
65	Wells Bay	300		5000	8080	10000			2030			730			17980
70B	Siwash Bay Flats(spring)					0			1000	3880		1100			3990
70C	Siwash Bay Flats(spring)					0			600	2670		1200			2910
72	Eaglek Bay								2500	1450					3460
73	Eaglek Bay					0			500	2190		100			4760
74	Eaglek Bay					0			1600	570		700			2150
Other Streams (20)		0	0	0	0	350	1020	2150	3230	4120	5060	3330	1350	0	8250
District Total (28 streams)		[illegible]	3800	6600	4700	12150	14130	14550	13140	18120	10510	9530	4500	500	[illegible]

Appendix Table B. Continued

3. NORTHWESTERN (AND COGHILL) DISTRICTS

Stream Number	Stream or Bay Name	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculate Season Tot
83	Coghill River	0		15000	11000	22000	32610			2200		0			49320
86	Bettles Bay	0		0	200	400	4000			1710		460			5350
89S	S. Pigot Bay	0		300	1060	1000				860		160			2670
Other Streams (31)		0	0	300	1910	2310	3600	5900	6940	6440	4750	1380	450	0	13600
District Total (34 streams)		0	5000	15600	14170	25710	39710	35800	20840	11210	6750	2000	550	0	70940

4. SOUTHWESTERN (AND ESHAMY) DISTRICTS

120	Jackpot Bay				500	690	1000		1000			160			2200
Other Streams (10)		0	10	50	100	210	180	560	1510	1440	1190	750	280	70	2550
District Total (11 streams)		0	110	250	600	900	1180	1560	2510	1940	1480	900	330	70	4750

5. MONTAGUE DISTRICT

146A	Hanning Bay				0	0	2000				200				2140
147	S. of Port Chalmers						300		10000	7000					13370
150	Port Chalmers		0	0	0	200	3000			11250	2100				10820
152	Port Chalmers		0	0	0	0				2000	1500				2580
Other Streams (10)		0	0	100	400	810	1560	2200	2210	2170	1860	1330	680	340	5470
District Total (14 streams)		0	0	100	430	910	4060	14700	21710	22920	10660	5680	3230	1540	34380

6. SOUTHEASTERN DISTRICT

172	S. Side Port Etches							500	1200		2500				3940
175	Port Etches					100		2000	1000		130				2260
176	Constantine Harbor					1400		3000	2000		5800				11060
178	Juania Bay					200		2000	3000		900				4020
179	Shelter Bay			5000	2200	3010		1500							8350
183	Anderson Bay							3000			6750				11080
186	Hawkins Cutoff, Fish Bay								4000	2000	3000				8340
187	Dan's Bay								2000						3420
Other Streams (10)		0	50	100	570	1150	1840	2300	3100	2830	3310	1930	950	520	7460
District Total (18 streams)		500	4200	5700	5470	9260	14330	18900	20300	18980	22880	16410	10630	4470	59930

Appendix Table B. Continued

Recapitulation of weekly chum salmon counts in 1961 by District

Number of Streams	District	Week Ending Date: 7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	Calculated Season Tota
53	Eastern	2240	31310	38180	35830	18830	17240	23470	37100	36390	30700	15860	5320	1500	117950
28	Northern	350	3800	6600	9300	12150	14120	14550	13140	18180	19510	9530	4300	500	50420
34	Northwestern/Coghill	0	5000	15600	14170	25710	39710	35800	20840	11210	6750	2000	550	0	70940
11	Southwestern/Eshamy	0	110	250	600	900	1180	1560	2510	1940	1480	900	330	70	4750
14	Montague	0	0	100	430	910	4060	14700	21710	22920	10660	5680	3230	1540	34380
18	Southeastern	500	4200	5700	5470	9260	14330	18900	20300	18980	22880	16410	10630	4470	59930
158	Pr. Wm. Sd. Total	3090	44420	66430	65800	67760	90640	108980	115600	109620	91980	50380	24360	8080	338370

Appendix Table C. Weekly red salmon escapement counts at Eshamy River weir, 1957-1961, Coghill River tower, 1961, and aerial and ground surveys of red salmon systems in Prince William Sound, 1961.

1. Weekly weir counts

	Eshamy River Weir:					Coghill Tower:
Week Ending:	1957	1958	1959	1960	1961	1961
June 9	--	--	--			10
16	--	--	--			154
23	--	--	--			361
30	--	--	--	52	2183	675
July 7	61	109	48	1256	1238	2774
14	418	136	323	1912	896	4198
21	31	878	131	1413	1064	537
28	180	465	350	1581	828	--
Aug. 4	152	595	598	1102	1229	--
11	80	726	2510	936	13974	--
18	1142	1121	1898	2257	10168	--
25	25561	766	1050	1700	6894	--
Sept. 2	17545	402	0	1008	6571	--
9	5488	26	--	598	937	--
16	1000	0	--	--	1493	--
Season Totals	51308	5224	6908	13815	47475	8709 1/

1/ Partial count of escapement, see survey of spawning grounds below.

2. Aerial and Ground Surveys of Red Salmon Spawning Grounds (ground surveys underlined).

District:		Survey Date:						Total
Stream No.	Stream Name	6/27	7/13	7/25-31	8/3-6	8/16-21	9/7	(Peak)
Eastern								
51	Robe Lake		500	800	1800			1800
Northern								
60	Billy's Hole		3050	3000		1000		3000
67	Cowpen Lake			0		100		100
68	Miner's Lake			500	3000			3000
Coghill								
77	Red Lake, Esther Pass			0				0
83	Coghill River & Lakes	300			33870	43600		43600
Northwestern								
100	Shrode Lake, Long B.	200		2800	5000		880	5000
Eshamy								
112	Gumboot Lakes	1000			0			1000
113	Eshamy River Weir							47475
Southwestern								
118	Jackpot Lakes			2900	300	1800		2900
133	Bainbridge Lakes			1900		2000		2000
Montague								
--	San Juan Lake			500				500
Total for Pr. Wm. Sd.								110375

Appendix Table D. Results of Preemergent Pink Salmon Fry Sampling in Intertidal and Upstream Zones in Various Stream Catagories, 1958-1962.

Stream Catagory	Year	No. of Str. Sampled	No. of Samples	Total Sq.Ft. Sampled	No. of Pink Fry	Mean Density (fry/sq.ft.)
1. Intertidal Zones						
Early Major	1958	2	27	243	497	2.0
	1959	2	40	360	5006	13.4
	1961	3	71	639	6403	10.0
	1962	3	106	318	6290	16.6
Middle Major	1958	3	41	369	903	2.4
	1959	3	60	540	799	1.5
	1961	4	71	639	16298	25.5
	1962	5	145	435	4242	9.8
Late Major	1958	2	22	198	81	0.4
	1959	4	80	720	7927	11.0
	1961	11	187	1683	47063	28.0
	1962	11	321	963	12448	12.9
Early Minor	1958	2	28	252	1	0.0
	1959	3	60	540	2001	3.7
	1961	3	45	405	12674	31.3
	1962	3	120	360	2424	6.7
Middle Minor	1958	2	21	189	9	0.1
	1959	11	133	1197	4252	3.6
	1961	3	54	486	12632	26.0
	1962	4	77	231	4663	20.2
Late Minor	1958	2	26	234	0	0.0
	1959	4	80	720	2393	3.3
	1961	5	66	594	22859	38.5
	1962	5	102	306	5565	18.2
All Streams	1958	13	165	1485	1491	1.0
	1959	28	453	4077	22378	5.5
	1961	29	494	4446	117929	26.5
	1962	31	871	2613	35632	13.6

Appendix Table D. Continued.

Stream Catagory	Year	No.of Str. Sampled	No. of Samples	Total Sq.Ft. Sampled	No. of Pink Fry	Mean Density (fry/sq.ft.)
2. Upstream Zones						
Early Major	1961	2	10	90	1929	21.4
	1962	2	40	120	3641	30.3
Middle Major	1961	3	18	162	5204	32.1
	1962	5	93	279	4528	16.2
Late Major	1961	4	20	189	6061	32.1
	1962	6	49	147	2216	15.1
Early Minor	1961	1	4	36	2262	62.8
	1962	1	10	30	885	29.5
Middle Minor	1961	0	0	0	--	--
	1962	3	30	90	4657	51.7
Late Minor	1961	2	5	45	924	20.5
	1962	3	21	63	887	14.1
All Streams	1961	12	58	522	16503	31.6
	1962	20	301	903	16814	18.6

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