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FORECAST OF 1967 PINK AND CHUM SALMON RUNS IN PRINCE WILLIAM SOUND

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INTRODUCTION

Previous forecast reports (Noerenberg, 1961, 1963, 1964 and Roys, 1965, 1966) have discussed in detail the alevin sampling program and escapement calculations pertaining to Prince William Sound pink salmon runs. Therefore only the results of this field work will be presented in this report.

The 1966 pink salmon run in Prince William Sound was expected to be in the neighborhood of 6.3 million ± 2.4 million. The actual run in 1966 was 4.0 million (36.5% error in forecast) or only one hundred thousand above the lower range of 3.9 million. However, a 36.5 percent in forecast error is not acceptable to management or the industry. The paramount question was what caused this error?

Perhaps the alevin index upon which the forecast was based in 1966 was not comparable to indices obtained prior to the spring of 1965. This possibility did exist because spawning distributions changed considerably as a result of the tremendous upheaval and subsidence of the land associated with the earthquake of March 27, 1964. In the uplifted zone spawners moved downstream, and in the subsided zone spawners moved upstream. The 1966 forecast, however, was based on the results of sampling conducted in the pre-earthquake spawning areas only and this index should have reflected densities commensurate with spawning distribution changes. The new spawning area created in the uplifted zone yielded a very low index and was not utilized in the 1966 forecast.

Perhaps estuarine and/or ocean mortality was higher than had occurred since the alevin program began? Detailed analysis of the returning runs to the uplifted, subsided, and normal zones when related to alevin indices in the respective zones revealed that: (1) the normal zone index actually reflected the returning run (comparable in strength to 1964) to that area, (2) the subsided zone index indicated a run below 1964 which occurred in 1966, and (3) the uplifted zone index, however, indicated a return stronger than 1964 but the run returned approximately 30% below expectations. If estuarine and ocean mortality were responsible,

why would fry in the uplifted zone be affected at different rates than in the subsided or normal zones? Fragmentary evidence had suggested a delayed outmigration of fry in the uplifted zone, but a number of streams in this zone apparently received strong returns.

The most logical explanation of the error in the forecast and return may be found in the sampling program conducted the spring of 1965. Forty-five streams were sampled that spring, but only fifteen had been sampled in a comparable manner in either 1964 or 1963. Of the twenty-five streams sampled in the uplifted zone nine of them received sampling similar to previous year's (Table 1) programs. In the subsided and normal zones three were sampled each spring following the even-year spawning. There was no problem in the spring of 1965 in sampling in the normal, subsided or the new intertidal zone of the uplifted streams but considerable difficulty was experienced in sampling 13 of the 25 streams in the pre-earthquake upstream spawning beds, particularly in those areas of greatest uplift (ice and snow cover). The data when weighted may have yielded an inaccurate alevin index, an index that did not reflect the true upstream density in the uplifted zone.

If the data obtained from the 1965 sampling program was responsible for the error, then a standard list of streams and comparable samples from these streams should point out this error.

In this forecast report, the odd-year escapements by district and timing will be examined, followed by various analyses of the alevin indices, in order to arrive at the best estimate of the 1967 Prince William Sound pink salmon run. The chum salmon forecast will also be presented.

PINK SALMON ESCAPEMENT IN 1965

The 1965 total pink salmon escapement index was approximately 976,000 which represents a 57.7% reduction from the escapement noted in 1961 (Table 2 and 3). Timing of this escapement was considerably later than that observed in 1961 or 1963 as shown in Figure 1. This is probably a reflection of the operation of the fishery in 1965 as the season closed on August 3rd, thus protecting the late runs. This depression is also a partial reflection of reduced production levels of certain early streams devastated by tsunamies. Spawning beds of several streams in Valdez Arm, Port Wells and Port Nellie Juan were scoured or mudded over. Escapement levels of the principal early and middle-run streams in the Northwestern and Coghill (except Coghill River) districts and in the Eastern district were very low compared to those observed in either 1961 or 1963 (Figure 2). Approximately 50% of the late escapement in the Northwestern district in 1963 and again in 1965 was in one system, Shrode Creek. In 1961 the escapement in this system made up only 20% of the late-run estimate. The middle-run escapements in the Eastern district were at a relatively low level with the exception

Table 1. Number of streams sampled each year, by post-earthquake zone, in Prince William Sound.

Sampling Year	Uplifted	Subsided	Normal	Total
1961	14	3	5	22
1962	18	5	9	32
1963	23	7	9	39
1964	17	5	7	29
1965	25	10	10	45
1966	23	9	7	39
Comparable Streams and Samples Each Zone				
Odd-year cycle	8	3	5	16
Even-year cycle	9	3	3	15

Table 2. Comparison of pink salmon escapement and returns by three timing categories in Prince William Sound using 1961 as a base.

Timing of Run	Brood Year	Escapement	Percent Reduction From 1961	Calculated Return	Percent Reduction From 1961
EARLY	1961	293,000		376,000	
Ending 7/15	1963	105,000	64.2	64,000	83.0
	Average	199,000		220,000	
	1965	31,000	89.4	(34,000)	90.6
				↗ 1967 Return	
MIDDLE	1961	553,000		1,228,000	
Ending 7/25	1963	334,000	39.6	859,000	30.0
	Average	444,000		1,044,000	
	1965	173,000	81.9	(406,000)	66.9
				↗ 1967 Return	
LATE	1961	1,110,000		4,996,000	
After 7/25	1963	785,000	28.2	2,477,000	50.4
	Average	948,000		3,737,000	
	1965	701,000	36.8	(2,763,000)	44.7
				↗ 1967 Return	
				Sum 3,203,000	
TOTALS	1961	1,956,000		6,600,000	
	1963	1,224,000		3,400,000	
	Average	1,590,000		5,000,000	
	1965	905,000		2,800,000	

NOTE: Computation of return by timing categories. Early catch to July 15th plus escapement on July 21st, Middle catch to July 25th plus escapement on August 7th, Late catch after July 25th plus escapement on September 1st. Evidently there are differences in rates of return between segments since the sum of categories does not equal estimates derived from the total. Difference between total estimates in Table 2 and 3 are caused by slight differences in using peak estimates.

Table 3. Comparison of pink salmon escapements and returns in three areas of Prince William Sound using 1961 as a base.

Brood Year	Area	Calculated Escapement	Percent Reduction from 1961	Calculated Return	Percent Reduction from 1961
1961	Eastern	1,208,000		3,630,000	
1963		795,000	34.2	1,972,000	45.7
	Average	1,001,000		2,801,000	
1965		514,000	57.5	(1,438,000)	60.4
				↗	
				1967 Return	
1961	Western	707,000		2,112,000	
1963		510,000	27.9	1,258,000	40.4
	Average	609,000		1,685,000	
1965		385,000	45.5	(1,065,000)	50.4
				↗	
				1967 Return	
1961	Southern	289,000		858,000	
1963		69,000	76.1	170,000	80.2
	Average	179,000		514,000	
1965		77,000	73.4	(221,000)	74.2
				↗	
				1967 Return	
				Sum 2,700,000	
1961	Totals	2,204,000		6,600,000	
1963		1,374,000	37.7	3,400,000	49.5
Average		1,789,000		5,000,000	
1965		976,000	55.7	2,700,000	59.1

NOTE: If survival similar to 1961 - total 1967 forecast 2.9 million.

If survival similar to 1963 - total 1967 forecast 2.4 million.

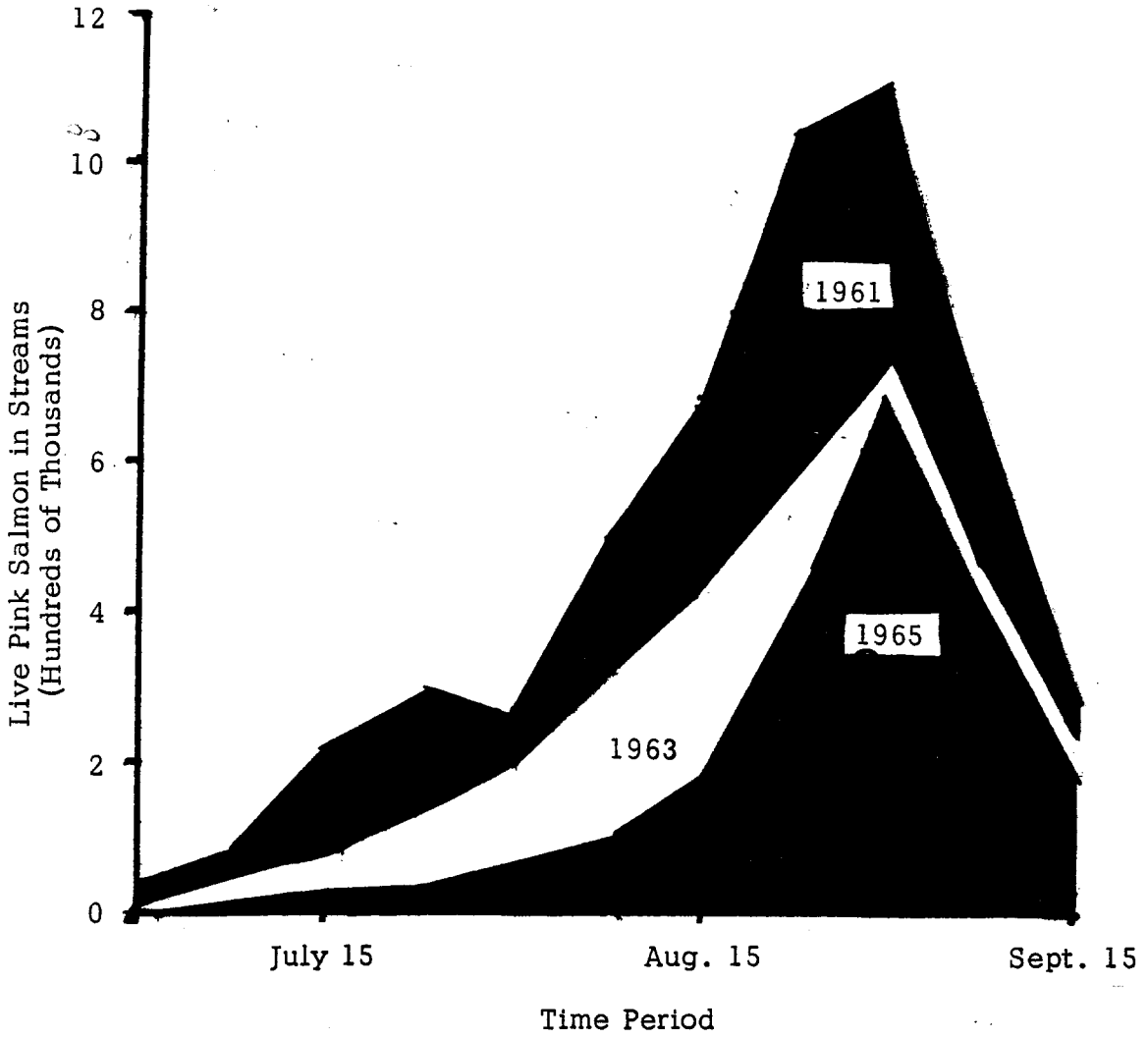

Figure 1. Timing and magnitude of Prince William Sound pink salmon escapements for brood years 1961, 1963, and 1965.

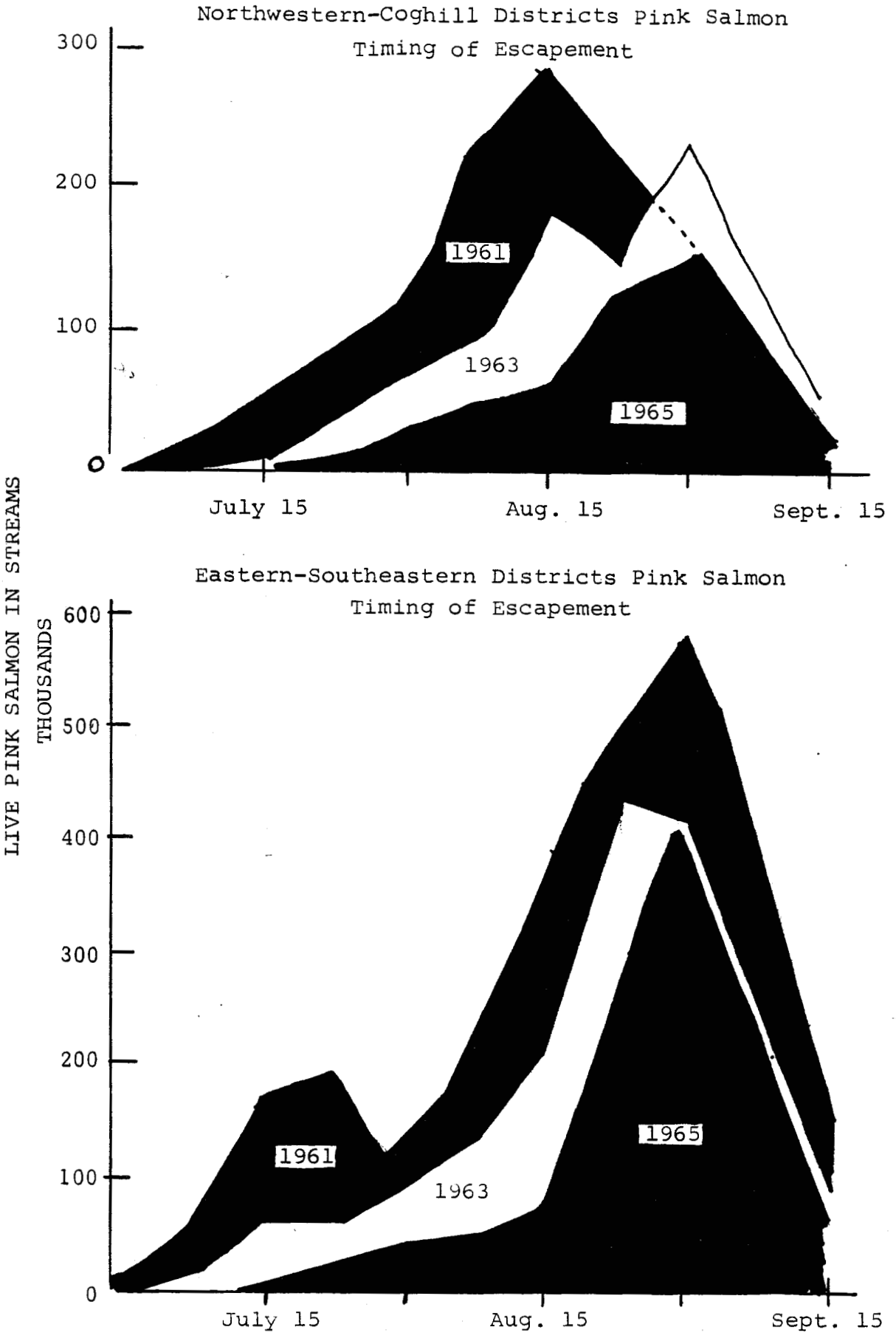

Figure 2. Pink Salmon Escapements 1961-1965 of Principal Odd Year Production Areas.

of Irish Cove.

1967 FORECAST USING ESCAPEMENT LEVELS

If the timing and production of escapements are indicative of the timing and production of the returning run as was the case in 1963 and 1965, the run in 1967 should be later than either 1963 or 1965. In Table 2 are listed the escapements by time period and the returning runs since 1961. Freshwater survival varies considerably and it is possible to receive a good return from a mediocre escapement level but this usually occurs when conditions are ideal. The winter of 1965-1966 was relatively severe. Temperature records kept at Mile 13 (FAA station) indicated the mean temperature from November to the following March (when eggs were developing) was slightly colder than the severe temperatures recorded during the winter of 1955-1956. The latter apparently caused extremely depressed pink runs throughout Alaska in 1957.

If we assume the rate of return from the pink salmon escapement in 1965 is in proportion to the average of escapement and return of 1961 and 1963 brood years the estimates for 1967 by timing category become:

To July 15th	34,000
To July 25th	406,000
After July 25th	2,763,000
Total	3,200,000

By converting these data to percentages we find that 86 percent of our return in 1967 should come after July 25th.

If our assumptions are valid, this skewed return is a reflection of the reduced escapement levels of those streams that produce fish in the early- and middle-run categories with the skewed timing pattern being most apparent in the Northwestern and Coghill districts. With the exception of Coghill River, runs destined for that area should be of the late run category (example Shrode Creek).

Table 3 lists escapements since 1961 by major areas in Prince William Sound (Figure 3). The Eastern area contains the Eastern and Southeastern districts. The Western area is comprised of the Northern, Northwestern, Coghill, Eshamy and Southwestern districts. Montague district becomes the Southern area. Districts have been categorized in this manner for ease of discussion and because it appears that on the odd-year cycle a majority of fish caught in these areas belong there. Undoubtedly, exceptions will occur particularly in the Montague and Southwestern districts[1/].

1/ See Appendix for detailed escapement data - Tables A, B.

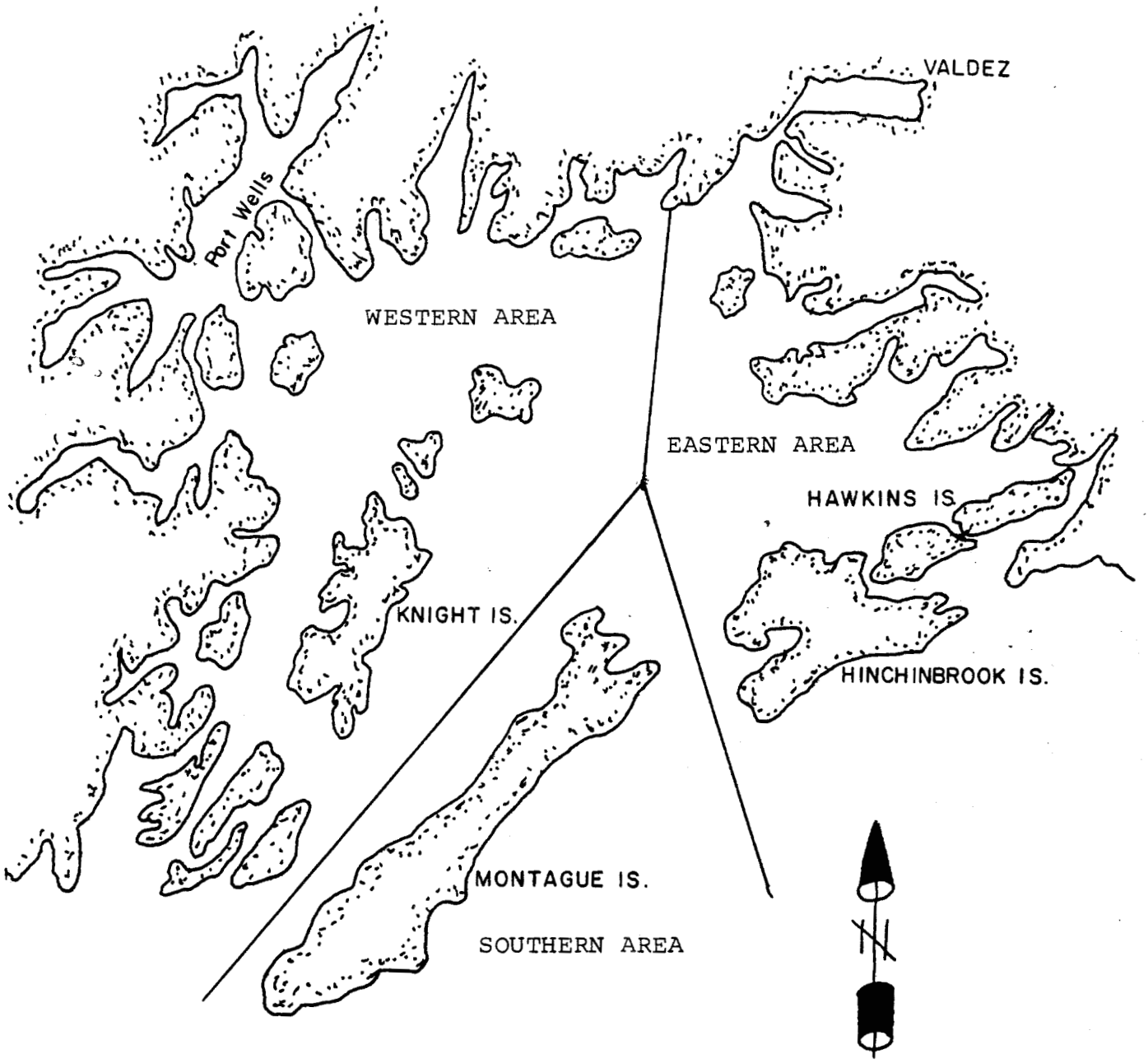

Figure 3. Three areas of Prince William Sound.

A significant reduction of escapements since 1961 occurred in the Western area which in 1965 was 45.5% below 1961. Detailed examination of data from this area indicates, however, that Southwestern district escapements increased over 1963 and were principally of late nature. Shrode Creek received 30% of the late run escapement in the entire Western area.

Southern (Montague) runs are in trouble as a result of the tremendous land upheavals and attendant compensating (erosion) changes of the base levels of the producing streams. At least 50% of the poor escapement in 1965 (77,000) spawned in new, poor quality, rapidly eroding riffles. An estimate of the returning run to Montague in 1967 derived from escapements therefore would undoubtedly be an over-estimate.

Eastern area escapements (Eastern and Southeastern districts) exhibited a decline from either 1961 or 1963. There is a possibility because of poor surveying conditions in late August of 1965, that we underestimated the late run escapement in the Southeastern district. These data then might yield an underestimate of the returning run.

Total run to these three areas were derived by multiplying the total return by the percent contribution of the parent escapement to the total escapement. Area estimates derived in this manner assume that the ratio of escapement to return is constant for the three areas. By proportioning the 1965 escapement to the average of escapement and return for 1961 and 1963 brood years it appears that; the Eastern area should account for 53% of the return, the Western area 39% and Montague about 8%. In numbers of fish a mean estimate of return (without knowledge of freshwater survival) would be:

Eastern Area	1,438,000
Western Area	1,065,000
Montague	221,000
TOTAL	2,724,000

Summation of the escapement data by both timing and area indicates that the late run apparently will contribute a higher percentage to the total run than either 1963 or 1965 percentages and that will be mainly in the Eastern area. If Shrode Creek, which accounted for a high percentage of the late run escapement in the Western area, experienced poor survival conditions then the late run in the Northwestern district of the Western area would be somewhat lower.

It should be emphasized that escapement data can only provide a general pattern of return and since only two years of data, 1961 and 1963 were used we cannot put a confidence interval on these estimates. The

alevin sampling program should provide insight pertaining to the severity of the freshwater mortality following spawning during the summer of 1965.

1967 PINK SALMON FORECAST BASED ON ALEVIN INDICES

The linear relationship between mean weighted pink salmon alevins per square meter and the returning run that was the basis for the 1966 forecast is illustrated in Figure 4. The contributing data is listed in Table C of the Appendix. It is readily apparent that the 1966 return based on samples collected in the pre-earthquake spawning area did not conform to previous data. If this is a function of the spawning distribution change then a new set of data will be necessary unless we compensate for this change by interjecting the fry densities obtained in the new spawning area. If this was done the forecast in 1966 would have been in the neighborhood of 4.9 million. Calculations ($r^2 = .924$) from this linear regression, $Y = .6303 + .0234\ (137.0)$ indicate the 1967 pink salmon run should be between 2.0 and 5.6 million (90% confidence interval) with the average expected return in the neighborhood of 3.8 million.

As mentioned in the Introduction there was a distinct possibility that sampling was not comparable because of the difficulty in obtaining upstream samples particularly in the uplifted zone. The possibility also existed that sampling different streams each year might be causing a high percentage of the error in the forecasts.

It would be extremely valuable then to examine alevin abundance data using a standard list of streams and comparable sampling areas within these streams. For the purpose of this analysis if the upstream area of a particular stream on the even-year cycle or odd-year cycle was sampled one year but not two years later then upstream data was omitted for that stream. An exception to this rule was data collected the spring of 1961 when upstream samples were not collected in two districts. However, upstream abundance that year was extremely high and it is assumed the abundance was similar in all districts. This assumption probably would cause a slightly lower index of abundance than the actual index of abundance. Data previous to 1961 was not utilized as very few streams were sampled in those years that have been sampled since 1961.

The standard stream lists for the odd- and even-year cycles are somewhat different and this may lead eventually to slightly different relationships. The odd-and even-year cycles have varied in production levels the past few years and is caused in part by occurrences in the Northern district. This district is relatively unimportant on the odd-year cycle. Weighting of intertidal and upstream mean densities by the percent spawners utilizing these zones on the odd- and even-year cycles apparently compensates for dissimilar spawning distributions. Even-year cycle pinks more heavily utilize intertidal zones than odd-year pinks.

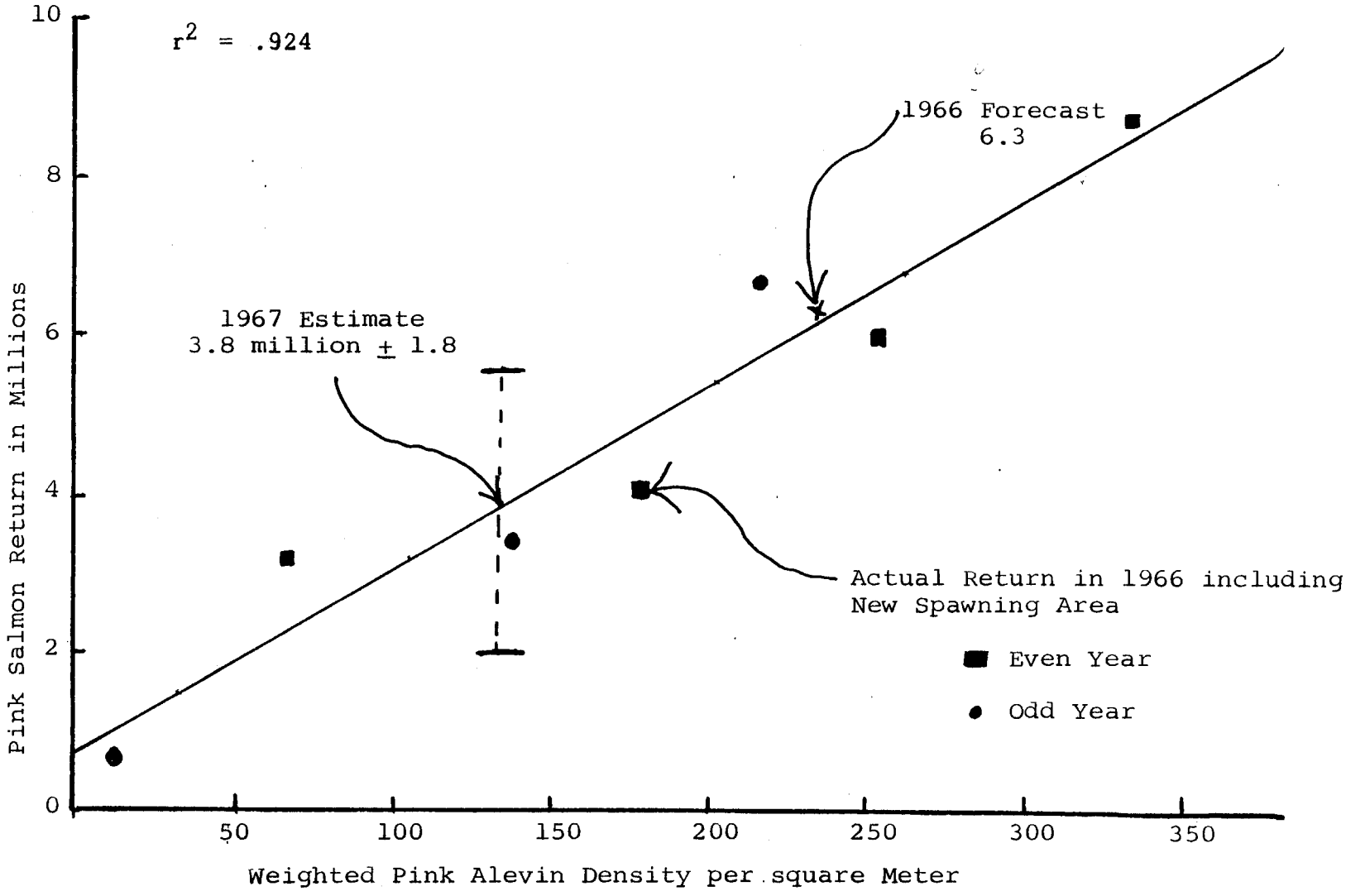

Figure 4. Relationship between weighted Pink Alevin Density and Return - For all Streams

A comparison of percent deviations between the forecast and return by various groupings of the data, should point out which grouping yields the lowest percent deviation between forecast and return. Since we are combining odd- and even-year cycles the differences between the two cycles and in the standard stream lists would be incorporated in the various groupings.

Table 4 shows a comparison of the maximum percent deviations between mean forecasts in "hind" sight and the returns based on different groupings of data. The maximum percent deviation in items one and two (all stream sampling pooled and weighted) were 62.5% and 52.5% respectively, and both occurred in 1966. However in items three and four (standard streams pooled and weighted) the maximum percent deviation would have occurred in 1964 and 1965 (23.3 and 11.8) and not in 1966. If the data in Table 4 does reflect the most accurate bases for forecast (we need more years of data) then the 1967 forecast should be based on item four or the weighted (intertidal plus upstream) alevin index derived from a standard list of streams (Table D, Appendix).

The formula for calculating the 1967 return based on a linear regression (Figure 5) derived from the standard stream list and weighted alevin indices ($X_1 = \frac{X_I}{N_I}(a) + \frac{X_F}{N_F}(b)$ (Table 4), is $Y_{67} = .0265\ (X_{66}) - .705$ or .0265 (152.3) - .705 or 3.3 million ± 0.8 million, (90% Confidence Interval). The linear correlation coefficient (r,) in this instance is .933. It is to be expected that this correlation coefficient will decrease as more data is obtained.

If we use weighted alevin indices since 1961 from pre-earthquake intertidal and upstream zones coupled with new spawning area data (1966's run) from all streams sampled, then the linear correlation coefficient is .952 and the formula for 1967's forecast becomes $Y_{67} = .0271\ (137.0) - .330$ or 3.5 million ± 2.1 million (90% Confidence Interval).

If we assume everything presented in the alevin index section thus far is erroneous and a new relationship has to be established between alevins per square meter and return in Prince William Sound we then find the forecast for 1967 based on all streams and zones sampled is equal to $\frac{178.5}{137.0} = \frac{4.0}{X} = 3.1$ million with no confidence interval. Table 5 is a comparative summary of the forecasts from six treatments of the alevin indices, besides the 3.1 million estimate. It is apparent from the data in Table 5 that unless the ocean and estuarine survival is greater than experienced in the past, 5.6 million would be the largest return that we could expect. The data indicates, however, the likelihood of this occurring is rather remote. The most likely return should be between 2.5 and 4.1 million, or a rather poor run.

Table 4. Comparison of percent deviation between forecast and return of four methods of data treatment.

All Streams Pooled	All Stream Weighted	Standard Streams Pooled	Standard Streams Weighted
$\bar{X} = \frac{X}{N}$	$\bar{X}_1 = \frac{X_I}{N_I}$ (a) + $\frac{X_F}{N_F}$ (b)	$\bar{X} = \frac{X}{N}$	$\bar{X}_1 = \frac{X_I}{N_I}$ (a) + $\frac{X_F}{N_F}$ (b)
Maximum Percent Deviation			
62.5%	52.5%	23.3%	11.8%
Range			
+ 27.3 to - 62.5	+ 20 to - 52.5	+ 15.2 to - 23.3	-11.8 to - .1

X = Alevins excavated.

X_I = Alevins excavated, intertidal zone.

X_F = Alevins excavated freshwater zone.

$\bar{X}_1$ = Weighted alevin density.

N = Number of square feet excavated.

N_I = Number of square feet excavated, intertidal zone.

N_F = Number of square feet excavated, freshwater zone.

a = Percent spawners utilizing intertidal zone.

b = Percent spawners utilizing freshwater zone.

NOTE: Densities are converted to fry per square meter.

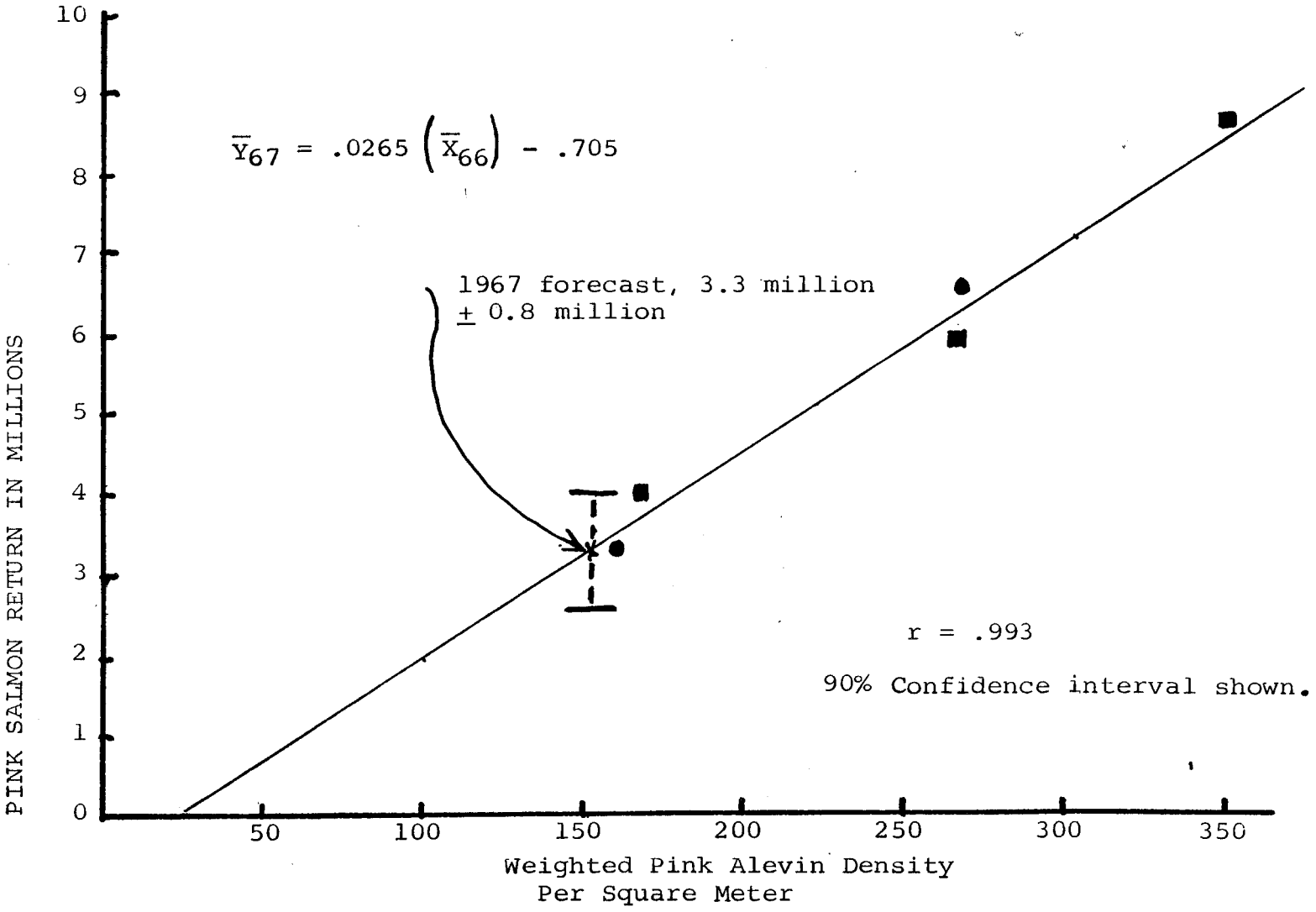

Figure 5. Relationship between weighted mean pink alevin densities and returning run - standard streams.

TABLE 5. Summary of 1967 Pink Salmon Forecasts Based on Various Treatments of the Alevin Index Ranked by Probable Accuracy.

Method and Number of Years of Data	Mean Alevin Density Per Square Meter X	Regression	1967 Mean Estimate in Millions	Range 95% Confidence	Range 90% Confidence	Degrees Freedom
Standard List 5-W	152.3	Y = - .705 + .0265(x)	3.3	2.2 - 4.4	2.5 - 4.1	3
All Streams 7-WN	137.0	Y = .631 + .0234(x)	3.8	1.5 - 6.1	2.0 - 5.6	5
All Streams 5-WN	137.0	Y = - .330 + .0271(x)	3.5	.6 - 6.4	1.4 - 5.6	3
23 Standard Streams $\frac{1965}{1967}$ 1-WN	140.2		3.2			
30 Standard Streams $\frac{1966}{1967}$ 1-WN	134.1		2.9			
16 Standard Streams $\frac{63+65}{1967}$ 2-W	169.0		3.5			

KEY: W - Mean density in the pre-earthquake intertidal and upstream weighted by percent spawners that utilized those zones.

WN - Includes weighting by pre-earthquake intertidal and upstream plus the new zone.

DISTRICT AND TIMING FORECASTS BASED ON THE ALEVIN INDEX

In this section alevin abundance data from the standard lists of streams for the odd-year returns of 1963-1965, will be used. In the timing forecasts, however, rather than weighting mean densities by the percent of spawners using intertidal and upstream zones, (this escapement distribution data is not complete) the mean density by timing category was simply derived by dividing the total number of fry excavated by the total number of samples for each timing category. This assumes spawning distributions were similar each odd-year cycle. Table 6 shows, if our mean forecast of 3.3 million is accurate, the approximate strength of the three segments. It appears from these data that the early and middle runs may be weaker than 1961 or 1963. If the run falls into the 3.3 to 4.1 million category the early and middle segments still would not support much of catch over escapement needs. Of course, these mean estimates of 99,000 early, 620,000 middle, and 2,580,000 late are based on the assumptions the timing of run will be similar to 1961 and 1963. If the early-run arrived in the Sound a week early then all segments of the run would probably be early by that amount of time.

If the run develops in the lower range of the forecast, 2.5 to 3.3 million, then these estimates would be high. Aerial surveys in early and mid-July will provide data on the strength of the developing early and middle runs.

Table 7 shows a comparison between mean weighted alevin densities and the returns since 1963 for the three area classifications in Prince William Sound. Alevin densities yielding the 1967 Eastern area forecast are slightly larger than the densities in 1965, but the difference (174 and 176 per square meter) is not significant. These data indicate when corrected to the regression, an average estimate of about 2,051,000 pinks for 1967 in the Eastern area. By far the biggest reduction in numbers of returning pinks on an area basis should occur in the Southern area (Montague district) and the 1967 run should be around 169,000. The Western area densities were found to be lower than the densities that yielded 2,112,000 pinks in 1963, and 1,258,000 in 1965. Therefore an average return to be expected in the Western area corrected to the regression is around 1,080,000 pinks. It should be remembered that if the return is in the 2.5 to 3.3 million bracket these estimates will be high. Conversely, if the return is in the upper range of the forecast 3.3 to 4.1 then these estimates would be low.

There is a distinct possibility that the Southern area forecast (Montague) is an overestimate, because of the tremendous changes that are occurring there.

Table 6. Comparison of pooled alevin densities and return by timing category, 1961, 1963, 1965 brood years.

Year of Return	Pink alevin density per square meter	Calculated Return	Estimate 1965	Estimate 1967	Corrected to mean estimate of regression
EARLY to July 15					
1963	238	376,000			
1965	172	64,000	272,000		
Average	205				
1967	114			122,000	99,000
				3%	
MIDDLE July 15 to July 25					
1963	331	1,228,000			
1965	218	859,000	809,000		
Average	275	1,044,000			
1967	197			748,000	620,000
				19%	
LATE After July 25					
1963	207	4,996,000			
1965	141	2,477,000	3,403,000		
Average	174	3,737,000			
1967	145			3,114,000	2,580,000
				78%	
TOTALS					
1963		6,600,000			
1965		3,400,000	4,484,000	3,984,000	3,300,000

Table 7. Comparison by area of mean pink alevin densities and return for the odd-year cycle since 1963.

Area and Year of Return	Percent Potential	Pink Alevin Density Per Square Meter	Calculated Return	Estimate 1965	Estimate 1967	Corrected to Regression
EASTERN						
1963	58	300	3,630,000			
1965	53	174	1,972,000	2,105,000		
Average		237	2,801,000	(55.25%)		
1967		176			2,080,000 (62.16%)	2,051,000
WESTERN						
1963	37	295	2,112,000			
1965	39	178	1,258,000	1,274,000		
Average		237	1,685,000	(33.44%)		
1967		154			1,095,000 (32.73%)	1,080,000
SOUTHERN						
1963	5	207	858,000			
1965	8	104	170,000	431,000		
Average		156	514,000	(11.31%)		
1967		52			171,000 (5.11%)	169,000
TOTALS				3,810,000	3,346,000	3,300,000

COMPARISON OF DISTRICT AND TIMING FORECASTS USING ALEVIN ABUNDANCE AND ESCAPEMENT

Figure 6 illustrates what the average run should be in 1967 compared to 1961 or 1963 by time period and area, derived from mean standard stream list alevin abundance and mean escapement estimates.

Mean alevin abundance indicates a stronger Eastern area run in 1967 than the mean escapement estimate, (2,080,000 versus 1,438,000). There is close agreement between alevin and escapement forecast basis for the Western and Southern areas. Both mean area estimates are quite low (1,095,000 and 1,065,000) compared to the good run of 1963 (2,112,000).

There appears also to be close agreement in the forecasts for the early run derived from escapement and alevin abundance (99,000 - 34,000) (both are poor). Escapement data indicates a lower middle-run return (406,000) than alevin abundance (620,000). Mean alevin abundance indicates a slightly lower mean late run than escapement but difference is not significant.

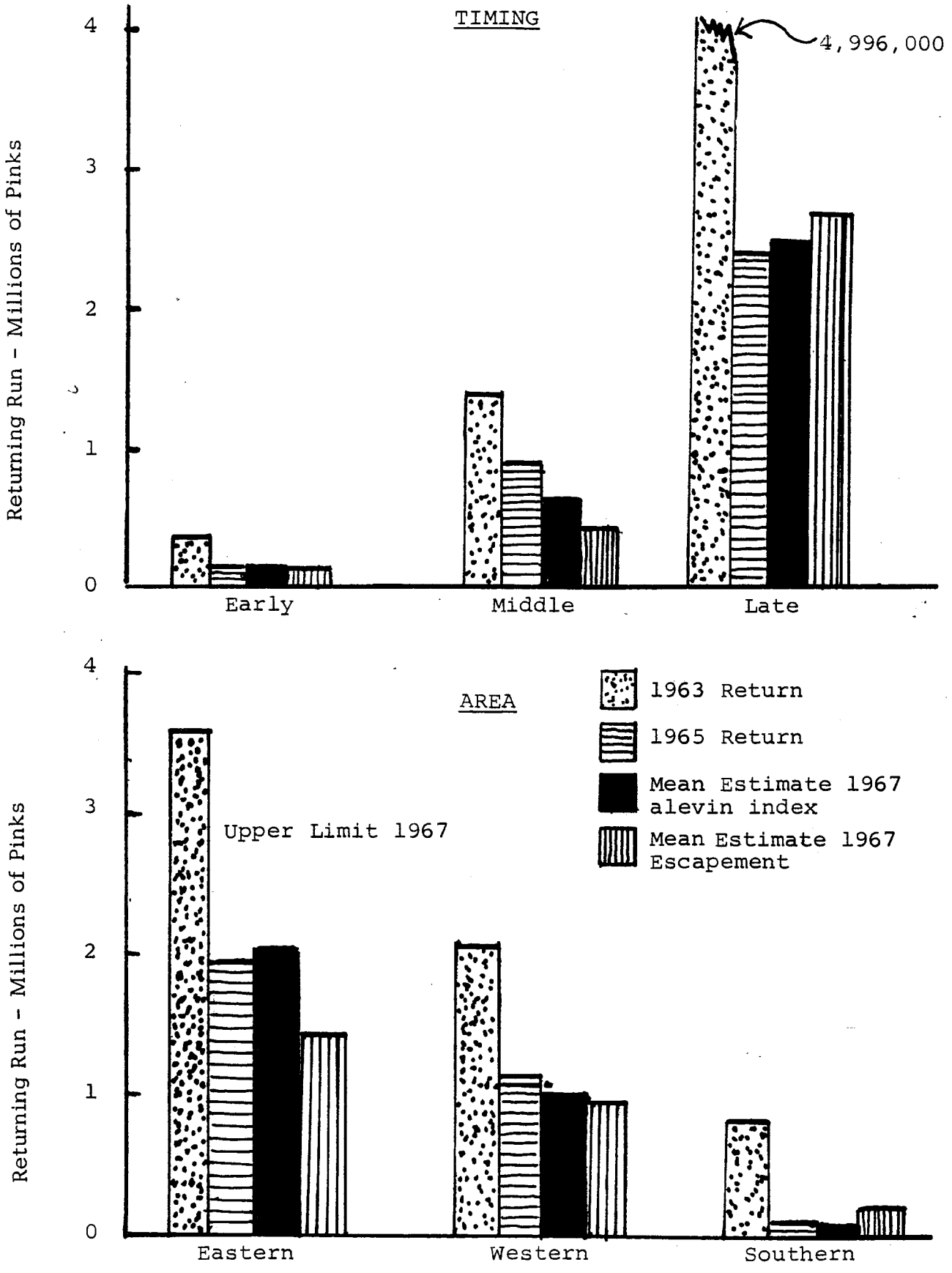

Figure 6. Average expected return in 1967 compared to 1963 and 1965 by using weighted alevin index and escapement.

SUMMARY OF PINK FORECAST

1. The estimated total Prince William Sound 1965 pink salmon escapement was 976,000 or 55.7 percent below the 1961 escapement (2,204,000) that produced 6.6 million pinks in 1963.

2. The 1965 estimated early-run escapement was 31,000 or a reduction of 89.4 percent below 1961 (293,000).

3. Middle-run escapement was 173,000 or 81.9 percent below 1961.

4. Late-run escapement was 701,000 or 36.8 percent below 1961 (1,110,000).

5. Eastern area (Eastern and Southeastern districts) escapements were 57.5 percent below 1961 (514,000-1,208,000).

6. Western area (Northern, Northwestern, Coghill, Southwestern-Eshamy districts) escapements were 45.5 percent below 1961 (385,000-707,000). Thirty percent of the late-run escapement in this area was in one system.

7. Southern area (Montague district) escapements were 73.4 percent below 1961 (77,000-289,000). At least 50 percent of spawn from this escapement was probably lost because of erosion of new spawning area.

8. Based on escapement estimates since 1961 that do not take into account freshwater survival differences from brood year 1961 and 1963 or the affects of the earthquake, the mean estimate for the run in 1967 is about 2,700,000 pinks.

9. Based on escapement estimates by timing category the mean forecasts by timing categories are*:

Early to July 15	34,000
Middle July 15 to July 25	406,000
Late after July 25th	2,763,000

* Totals will vary since differing rates of returns are being proportioned and then summed.

10. Mean area forecasts based on escapements and proportioned returns since 1961 indicate:

Eastern	1,438,000
Western	1,065,000
Southern	221,000

11. Apparently the high error in the 1966 pink forecast based on the alevin index was caused by an index that did not reflect the spawning distribution changes in the uplifted zone.

12. Analysis of pink alevin data indicates that the most accurate forecasts will probably be based upon data collected from the same streams annually and similar sampling levels by zone. Weighting zonal alevin mean densities by the percent spawners utilizing the intertidal and upstream zones appears to be necessary.

13. Based upon weighted mean alevin densities obtained from the same streams annually and by the percent spawners utilizing the pre-earthquake intertidal and upstream zone, the forecast for the 1967 pink salmon run (90% Confidence Interval) is between 2.5 and 4.1 million with an average expected return of 3.3 million.

14. Based upon six other treatments of the alevin indices mean estimates are 3.8, 3.5, 3.5, 3.2, 3.1 and 2.9 million. All treatments indicate relatively small run in 1967.

15. The 2.9 million estimate is based upon mean densities obtained from the pre-earthquake, intertidal, and upstream zones plus the new spawning area and weighted by the percent spawners using these zones. Thirty streams were sampled in a like manner the spring of 1965 (1966's run) and the spring of 1966 (1967's run).

16. A breakdown of the 3.3 million forecast by timing category and area indicate the following average expected returns:

Early run	99,000
Middle run	620,000
Late run	2,580,000
Eastern area	2,080,000
Western area	1,080,000
Southern area	169,000

CONCLUSIONS - PINK SALMON FORECAST

Escapement and alevin indices indicate the 1967 pink salmon run will probably be below 5.6 million with an average estimate of return of 3.3 million, but can go as low as 2.0 million.

The late run (after July 25th) in the Western and Eastern areas will be the strongest feature of the run in 1967. The Eastern area (Eastern and and Southeastern districts) will probably make up approximately 62 percent of the total run in 1967 and be slightly stronger than 1965 but well below 1963's run.

The early and middle runs with the exception of Coghill River and several streams in the Eastern district should produce lower numbers of pinks than either 1963 or 1965.

CHUM SALMON FORECAST SYNOPSIS

Based upon chum alevin indices available since 1961 and an average percent return of four-year-old chums, the 1966 chum forecast called for 580,000 chums. Actual return in 1966 was approximately 653,000 (429,000 catch, 224,000 escapement) or an error of 12.6 percent in the forecast.

Escapements that will contribute four-and three-year-old chums 1/ to the run in 1967 were quite large (371,000 in 1963, and 443,000 in 1964) as shown by Table 8. The Eastern, Northern, Northwestern and Coghill districts are the major chum producing districts.

Approximately 20 percent of the intertidal spawning area in the Northwestern-Coghill districts was lost because of land subsidence. Three-year-old chums returning in 1967 will be the first return from this disrupted environment.

Alevin densities (Table 9) indicate that the four-year-old chum run in 1967 should approximate 339,000 or very much like the 1965 four-year-old run of 336,000 2/. Chums returning as four-year-olds in 1967 were in the gravel during the earthquake and tsunamies and mortality from that catastrophe undoubtedly helped contribute to a low alevin index. (1967 estimated returns by age classification are shown in Table 9 in parenthesis).

However, the fact that the 1964 brood year spawning yielded an exceptionally high index of 75 alevin/m^2 (sampling in spring of 1965) provides some optimism regarding the 1967 return of 3-year chum salmon. The question is will chums originating from this apparently successful brood year of 1964 return in good numbers as 3's in 1967? Perhaps fair numbers will not return as 3's in 1967 but return instead in 1968 as a very strong four-year run.

One estimate derived from the data in Table 9 is based on the assumption that we will receive a fair run of 3's in 1967. This estimate is approximately 603,000.

The other estimate is based on the method that accurately forecast 1966 chum salmon run. That estimate, 443,000 assumes the four-year-old year run will be similar percentage-wise to 1965 and 1966. Methods for obtaining the two estimates are shown below Table 9 symbolically.

1/ See Appendix Tables E-G for detailed chum escapements.
2/ Age analysis of 1964, 1965, and 1966 chum runs are shown in Appendix Table H.

Table 8. Chum salmon escapements, by management district, 1956-1964.

Management District	1956	1957	1958	1959	1960	1961	1962	1963	1964
Eastern	100,200	161,500	42,400	35,100	92,000	118,000	238,700	148,100	176,840
Northern	46,000	33,200	12,300	4,000	24,700	50,400	67,700	68,400	64,750
Northwestern & Coghill	64,500	46,200	10,500	107,100	40,500	70,900	96,000	114,200	136,590
Southwestern	4,900	5,300	4,400	1,300	4,800	4,800	10,600	5,300	3,560
Montague	4,900	8,700	7,000	3,500	16,800	34,400	34,200	15,100	31,650
Southeastern	17,100	13,500	9,200	6,700	23,000	59,900	39,700	20,000	29,160
Prince William Sound Total	237,600	269,400	85,800	157,700	201,900	338,400	486,900	371,100	442,550

Source: F.R.I., University of Washington, 1957-1958; U.S.F.W.S. 1956-1959; A.D.F.&G., 1960-1964.

Table 9. Chum salmon alevin densities and return for 3, 4, and 5-year olds.

Brood Year	Alevin Density Per Square Meter	Return by age[1] groups 3	4	5	Total
1960	64.8	540,000	644,000	32,000	1,215,000
1961	31.7	152,000	332,000	56,000	540,000
1962	38.1	29,000	513,000	(35,000)[2]	
1963	30.6	84,000	(342,000)[2]		
1964	75.0	(226,000)[2]			

1/ Age estimates based on scale analysis from stream samples only (see Appendix).
Four-year-old percentages: 1964-69.5, 1965-84.4, 1966-78.5

2/ 1967 forecast (Total 603,000)

FORECAST METHODS (Number of fish in thousands).

Method I - Ratio of return, by age class, to alevin index.

Let

X_i = Alevin index corresponding to age i chum salmon returning in 1967.

G_i = Geometric mean ratio of age i chum salmon return to corresponding alevin index point.

R_i = 1967 return of age i chum salmon.

Then

$R_3 = G_3 X_3 = (3.02)(75.0) = 226$

$R_4 = G_4 X_4 = (11.19)(30.6) = 342$

$R_5 = G_5 X_5 = (0.93)(38.1) = 35$

Total = 603

Method II - Expanded estimate of 4-year return to total by using average age composition.

From Method I, the estimated 1967 return of 4-year chums is 342,000. Four-year chums have averaged 77.2% of the total return for the years 1964-66. Thus, a return of 342,000 4-year chums in 1967 would indicate an approximate total return of 443,000.

Assuming that the alevin index, from this standard list of chum streams, represents a relatively accurate index of earthquake mortality the spring of 1964, and the spawning area lost in the Northwestern-Coghill districts, then there is reason to believe that there is better than a 50/50 chance of a fairly substantial run of three-year-old chums returning in 1967.

If this in fact does occur then chums should begin appearing in fair numbers in mid-July and particularly in the Northern Northwestern - Coghill and Eastern districts. Aerial surveys should confirm or reject this hypothesis.

In summary, escapement levels of the parent years 1963 and 1964 were good. The alevin index however indicates the possibility of a poor four-year-old chum run in 1967, but this may be offset by a fairly strong three-year-old return. (Five-year-olds have been relatively unimportant in Prince William Sound).

Though the chum forecast was accurate in 1966, without firm knowledge of whether chum salmon in Prince William Sound intermittently hold over in the ocean and return as 4's instead of 3's or visa versa, it is possible that forecasting of chum salmon runs accurately, will be as difficult as round-hauling "diving dogs".

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APPENDIX TABLES

Appendix Table A. PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

Stream No. 5/	Stream or Bay	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
	EASTERN DISTRICT						WEEK ENDING							
2	Hartney Creek									1200				3760
11	Humpy Creek			150	208	894		100						1200
21	Rogue Creek			50	73	7	2	330			1340		165	1770
35	Koppen Creek		2500		1700	2578	1182	2300			26500		3920	43720
36	Sheep Creek		0	0	80	100		760		8000	7830		2270	11396
41	Pass Creek			0	0	0		0	6300					14920
46	Comfort Creek			0	0	0		300	1740					3676
48	Beartrap River			0				500	5760					12940
51	Olsen Creek		100	50	165			300		9800		4500		13346
52	Control Creek		0	200	520			200	2400	5710	9300		1135	10066
54	Carlson Creek		0	0	210			0		1670				1632
56	St. Matthew Creek		0	50	340			0	1880	4090				4204
65	Coho Creek		0					0	0	2700				2520
76	Irish Creek		1500			480		1200		40540				43168
80	Whalen Creek		0		0			50		3870				3048
83	Keta Creek				0			0		20				772
87	Sunny River			0				0		100				1060
89	Fish Creek		0	0	400	325		400		6290				7046
99	Lagoon Creek		0			50		700		4100				4680
106	Gladhough Creek					35				2000				1718
115	Millard Creek		0	0		100		500		4300				4680
116	Duck River		0	0		200				5600				7160
117	Indian Creek		200	1000		2690	3000	4000		10330				14680
121	Levshakoff Creek			0		526		300		320				1578
123	Gregorioff Creek					360		200		2000				2284
129	Vlasoff Creek			0		930		0		2000				2972
133	Sawmill Creek		0			1340				40				1208
143	Siwash Creek			100						80				212
152	Twin Falls Creek		0					0		300				280
153	Steller Creek		0	0		2820		1500		2500				5568

Appendix Table A1 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

EASTERN DISTRICT		WEEK ENDING											
Stream No. 5/	Stream or Bay	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
	Other Streams 2/		0	25	78	870	29	1897	1640	7145	2855	0	15	30625
DISTRICT TOTALS 3/ (106 Streams)		700	5800	7175	13084	23305	21113	29257	106600	19085	151345	68690	18305	257853

1/ Ground counts underlined.

2/ From records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table A2 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

Stream No. 5/	Stream or Bay	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
	NORTHERN DISTRICT							WEEK ENDING						
224	Backyard Creek					0		500		2500				3140
229	Cedar Creek		0			0		1700		2500				4160
234	Wells River		300			7500		10000		4800				17800
241	Cannery Creek		0			0		2500		2300				5000
258	Jonah Creek					0		3500		4100				7960
264	Siwash Creek					0	0	0		300				340
279	Canyon Creek					0				2600				3600
	Other Streams 2/		50	200	0	100	150	570		14100				17820
	DISTRICT TOTAL 3/ (50 Streams)	0	350	800	1350	7600	14200	22170	29290	33580	25810	11200	3200	59820

1/ Ground Counts underlined

2/ From Records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table A3 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

Stream No. 5/	COGHILL DISTRICT Stream or Bay	WEEK ENDING 7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
322	Coghill River		2000	5000	16000	20400		21400		26200				62000
	Other Streams 2/							51		450				820
DISTRICT TOTALS 3/		0	2000		16000		20000		23500		20500		0	
(14 Streams)		0		5000		20400		41451		26950		1250		62820

1/ Ground counts underlined.

2/ From records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table A4 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

Stream No. 5/	NORTHWESTERN DISTRICT Stream or Bay	WEEK ENDING 7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
421	Mill Creek		0		0	0		1700		1400	4440			5976
428	Pirate Creek		0		0			500			100			620
430	Meacham Creek		0		0	0		440		3200	2620			3912
432	Swanson Creek		0		0	200		5100		11000	11340			18256
435	Logging Camp Creek		0		100			1100						7800
450	Tebenkof Creek		0			0				100				160
454	Halferty Creek		0			0		2000		3100				5040
455	Paulson Creek		0			300		1600		2200				3640
471	Wickett Creek							1000			490			1456
476	Shrode Creek		0		0	300		16600		70000	65140			95616
480	Mink Creek		0		0	300		5010		12300				16044
484	East Finger Creek							410		200				584
485	West Finger Creek							670		1800				2188
	Other Streams 2/		0	0				3760		10450	713			26488
DISTRICT TOTALS 3/ (45 Streams)		0	0	0	100	1700	22590	40336	74030	131550	114663	58405	16460	187775

1/ Ground counts underlined.

2/ From records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table A5 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

ESHAMY DISTRICT		WEEK ENDING											
Stream No. 5/	Stream or Bay	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
510	Eshamy Lagoon									2500				3040
510	Eshamy River					0		449		1500				1860
	Other Streams 2/									1500				4440
DISTRICT TOTALS 3/			0		0		800		5600		5000		0	
(6 Streams)		0		0		0		2749		7500		1700		9340

1/ Ground counts underlined.

2/ From records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table A6 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

Stream No. 5/	SOUTHWESTERN DISTRICT Stream or Bay	WEEK ENDING 7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
603	Ewan Creek		0			0				4000				7612
608	Jackpot River		0		0			1800		20000				32000
628	Chenega Creek					0				450				660
630	Bainbridge Creek				0	0		1000		3500				4080
	Other Streams 45 2/		0			200		2180		13870				21028
DISTRICT TOTAL 3/			0		0		10450		302050		37300		5150	
(49 Streams)		0		0		200		21180		41820		15300		65380

1/ Ground counts underlined.

2/ From records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table A7 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

Stream No. 5/	MONTAGUE DISTRICT Stream or Bay	WEEK ENDING 7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
703	Clam Beach Creek							0		1600				1720
707	MacLeod Creek							50		2500				2860
736	W. Shore, Montague Is.					0		0		0				
739	Swamp Creek					0		200						1120
741	Chalmers River					0		50		1100				2540
745	Wild Creek					0		0		1100	1730			1932
746	Schuman Creek					0		3		1800				2881
747	Cabin Creek					0				2200				3920
749	Shad Creek					0		827		2900	7000			7891
752	Stockdale Creek					0				3400				6680
759	Rocky Creek					0				2800				4440
770	Udall Creek					0				400	1310			1284
775	Pautzke Creek					0				1100	2640			2656
	Other Streams 2/					0		500		27400	2170			37118
DISTRICT TOTALS 3/ (50 Streams)		0	0	0	0	0	0	4530	24450	51300	62600	35725	13900	77042

1/ Ground counts underlined.

2/ From records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table A8 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

SOUTHEASTERN DISTRICT		WEEK ENDING											
Stream No. 5/	Stream or Bay	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
806	Dog Salmon Creek					0		1700	3500	3100				5040
810	Garden Creek					0		270	700	2000				1882
812	Constantine Creek				100	100		350	6500	19000				20500
817	Deer Creek					100		1600		3500				5120
818	Juania Creek					1000		7060		6300				13584
821	Brown Bear Creek				150	2000		4000	3500	6500				11060
823	Johnstone Creek								100					160
827	Captain Creek								1500	2100				2980
828	Cook Creek					0			5000	12300				13800
829	King Creek					0			300	1200				1280
831	Double Creek					0			3000	10500				12400
834	Hardy Creek					0			6500	22400				25560
835	Scott Creek					0			7500	30000				35000
836	Dan's Creek					0								
837	Dan's Bay					0		1000	2000					6600
839	Dan's Bay					0			200	3700				3240
844	Makarka Creek					0	0		800	5100				4960
847	Hawkins Creek					0	0		5000	5600				8640
849	Rollin Creek					0	0		0	3640				3856
850	Canoe Creek					0	5		4346	5000				7740
851	Zillesenoff Creek					0			500	1970				2188
856	Cedar Bay					0	0		50					128
857	Cedar Bay					0	8		800					1610
861	Bernard Creek					0	52		4750					12600
862	Clamdigger Creek					0								
863	Orca Creek					0	0		50					60

Appendix Table A9 (cont.) PRINCE WILLIAM SOUND PINK SALMON, 1965
(Live Counts in Streams) 1/ 4/

SOUTHEASTERN DISTRICT		WEEK ENDING											
Stream No. 5/	Stream or Bay	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
867	Trail Creek													
	Other Streams 2/				450	1000	37	1035	14590	47560		500	100	55983
DISTRICT TOTALS 3/			0		700		11237		82586		173740		29375	
(49 Streams)		0		0		4200		31637		213760		92580		255926

1/ Ground counts underlined.

2/ From records maintained on small streams which usually have a total of less than 2000 pinks.

3/ Contains interpreted data where surveys lacking on certain weeks.

4/ Stream life calculated from stream life factor of 2.5 weeks.

5/ Stream numbering system revised in 1962.

Appendix Table B. RECAPITULATION OF WEEKLY PINK SALMON COUNTS BY DISTRICT, 1965
(Live Counts in Streams) 1/

No. of Streams	DISTRICT	7/3	7/10	7/17	7/24	7/31	8/7	8/14	8/21	8/28	9/4	9/11	9/18	Calculated Season Total
106	Eastern	700	5800	7175	13084	23305	21113	29257	106600	19085	151345	68690	18305	257850
50	Northern		350	800	1350	7600	14200	22170	29290	33580	25810	11200	3200	59820
14	Coghill		2000	5000	16000	20400	20000	21451	23500	26950	20500	1250	0	62820
45	Northwestern				100	1700	22590	40336	74030	133550	114663	58405	16460	187780
6	Eshamy						800	2749	5600	7500	5000	1700	0	9340
49	Southwestern				700	4200	11237	31637	82586	213760	173740	92580	29375	255930
50	Montague							4530	24450	51300	62600	35725	13900	77040
49	Southeastern					200	10450	21180	32050	41820	37300	15300	5150	65380
369	P. W. S.		8150		31234		100390		378106		590958		86390	
	TOTAL	700		12975		57405		173310		701545		284850		975960

1/ Totals rounded to nearest 10 salmon.

Appendix Table B1 (cont.) RECAPITULATION OF WEEKLY PINK SALMON COUNTS IN 1963 BY DISTRICT
(Live Counts in Streams) 1/

No. of Streams	DISTRICT	WEEK ENDING 6/23	6/30	7/7	7/14	7/21	7/28	8/4	8/11	8/18	8/25	9/1	9/8	9/15	9/22	Cal. Season Total
97	Eastern	0	10	11430	60820	77550	50650	46000	44770	50430	204650	182290	129670	67120	19790	378050
44	Northern	0	0	500	1600	4760	15950	17350	20520	29650	33800	34800	22550	9420	3520	77770
9	Coghill	0	0	0	0	10000	20000	35000	35000	34300	38600	41250	20650	770	150	59540
49	Northwestern	0	0	0	400	7270	34400	81450	144450	149250	150900	185145	114880	53105	19860	294690
9	Eshamy	0	0	0	0	0	0	1000	2400	4000	5650	5400	5560	3780	1900	11980
39	Southwestern	-	0	100	250	1550	2600	2330	3700	7970	15480	24400	18040	11420	6550	37790
56	Montague	-	0	400	1450	2950	4650	15060	15700	12700	51770	31730	19000	10670	5700	68710
50	Southeastern	-	0	0	0	1400	12100	61200	145000	168250	284700	230900	106260	39940	10450	417180
353	Prince William Sound Total	0	0	12430	64520	105480	140350	295390	411540	456550	785550	735915	436610	196225	67920	1344710

1/ The counts were derived from 1086 aerial surveys and 185 ground surveys. Total surveys 1,271

Appendix Table B 2 (cont.) RECAPITULATION OF WEEKLY PINK SALMON COUNTS IN 1961 BY DISTRICT

Number of Streams	DISTRICT	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	Cal. 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	36400	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	Prince William Sound Total	8500	62940	210560	293710	277690	431130	678080	820400	1093700	1101760	676900	280830	65610	2203800

Appendix Table C. RESULTS OF PINK SALMON ALEVIN SAMPLING ALL STREAMS, 1957-1966

Brood Year	Percent Spawners By Zone		New Spawning Area	Alevin Density By Zone		New Spawning Area	Weighted Alevin Index	Returning Run In Millions
	Intertidal	Freshwater		Intertidal	Freshwater			
1957 1/	43	57	-	11.8	(14.1) 4/	-	13.1	.6
1958	76	24	-	64.9	(77.4)	-	67.9	3.2
1960	77	23	-	331.4*	339.8	-	334.4	8.7
1961 2/	35	65	-	158.0*	247.9	-	216.4	6.6
1962	70	30	-	246.4	269.0	-	253.2	6.0
1963	46	54	-	114.5	157.7	-	137.8	3.4
1964 3/	49	26	25	248.8	216.9	50.5	178.8	4.0
1965	33	54	13	105.9	182.2	28.3	137.0	

1/ Square yard samples.

2/ 3 square foot samples.

3/ 2 square foot samples.

4/ No upstream samples taken in 1957 and 1958, estimated from observed ratios of 1960-1963 alevin populations. Source Kirkwood (1962).

* Samples eliminated 4-6 foot tide stratum-1960-1961. Adjustment estimated for years 1958 and 1959.

Appendix Table D. RESULTS OF SAMPLING STANDARD PINK SALMON STREAM LIST
1961 - 1966

Brood Year and number samples	Percent Spawners By Zone		Alevin Density by Zone Per Square Meter		Weighted Alevin Density	Return In Millions
	Intertidal	Freshwater	Intertidal	Freshwater		
1960-342 1/	77	23	315.3	474.0	351.8	8.7
1961-675 2/	35	65	180.4	317.2	269.3	6.6
1962-736	70	30	257.2	286.7	266.1	6.0
1963-802	46	54	118.5	194.9	159.7	3.4
1964-886 3/	65	35	187.1	135.9	169.1	4.0
1965-774	37	63	110.0	177.2	152.3	

1/ Square-yard samples.

2/ Three-square-foot samples.

3/ Two-square-foot samples.

Appendix Table E. RECAPITULATION OF WEEKLY CHUM SALMON COUNTS BY DISTRICT
(Live Counts in Streams) 1/

No. of Streams	DISTRICT		WEEK ENDING 6/21	6/28	7/5	7/12	7/19	7/26	8/2	8/9	8/16	8/23	8/30	9/6	9/13	9/20	Cal. Season Total2/
50	Eastern	500	2900	6200	13490	50260	63395	49120	52320	57110	48050	40525	30040	19200	8930	176840
23	Northern		2200	3520	7570	17275	28275	23290	20820	17150	13620	11290	9390	5140	2320	64750
29	N. Western-Coghill		800	4580	16830	34020	64150	53605	43250	38105	28515	25650	19370	10220	2370	136590
10	S. Western-Eshamy				70	210	450	580	1020	1470	1370	1210	1350	820	360	3560
8	Montague					450	910	5220	9745	16825	12600	12700	12820	5390	2440	31650
14	S. Eastern				350	880	4880	6410	6700	7600	8880	12600	10800	8550	5250	29160
134	P. W. S. TOTAL	500	5900	14300	38310	103095	162060	138225	133855	138260	113035	103975	83770	49320	21670	442550

1/ The counts were derived from 1,250 aerial surveys and 76 ground surveys.

2/ Cumulative weekly counts, divided by stream life factor of 2.5 weeks

Appendix Table F. 1963 RECAPITULATION OF WEEKLY CHUM SALMON COUNTS BY DISTRICT
(Live Counts in Streams) 1/

No. of Streams	DISTRICT	WEEK ENDING 6/23	6/30	7/7	7/14	7/21	7/28	8/4	8/11	8/18	8/25	9/1	9/8	9/15	9/22	Cal. Season Total2/
56	Eastern	2300	7250	16120	30390	66720	42330	34920	26810	43670	42030	25715	15692	9590	6555	148060
31	Northern Coghill	200	4420	14450	15140	16240	20925	25870	31200	10220	13610	9305	5380	2790	1220	68390
51	N. Western Eshamy	590	1400	10590	9930	34100	50550	52420	55140	24090	16720	7636	4360	1430	440	114240
17	S. Western	-	0	500	1050	1600	3220	2240	650	1850	1350	690	96	60	20	5320
19	Montague	-	0	50	100	300	500	0	7760	7150	9950	6350	3100	1700	720	15070
20	S. Eastern	300	500	4000	4000	3000	3900	3840	4500	5350	9000	6500	3070	1460	620	20020
194	Prince William Sound TOTAL	3390	13570	45710	60610	212960	121405	119290	126060	92330	92660	56196	31698	17030	9575	371100

1/ The counts were derived from 1,086 aerial surveys and 185 ground surveys. Total surveys 1,271.

2/ Cumulative weekly counts divided by stream life factor of 2.5 weeks.

Appendix Table G. 1962 RECAPITULATION OF WEEKLY CHUM SALMON COUNTS BY DISTRICT
(Live Counts in Streams) 1/

No. of Streams	DISTRICT	6/30	7/7	7/14	7/21	7/28	8/4	8/11	8/18	8/25	9/1	9/8	9/15	9/22	Calculated Season Total 2/
44	Eastern	3500	21210	34850	44250	59160	54090	52080	48610	51690	60120	64220	64150	38720	238680
19	Northern	150	5050	10500	15150	21500	18900	18870	21220	21050	22900	12210	1670	0	67670
35	N. Western and Coghill	0	1400	6450	22800	42860	46720	43310	37760	21200	11250	4550	700	100	96018
12	S. Western and Eshamy	100	350	1550	2820	3100	4810	4220	3680	3090	1850	750	200	0	10610
7	Montague	0	0	0	500	2000	5690	8750	12800	16950	19600	19700	10450	4390	34190
15	S. Eastern	200	500	3000	4300	7600	14850	13050	12960	10100	10100	10200	10340	2040	39690
132	Prince William Sound TOTAL	3950	28510	56350	89820	136220	145060	141280	137030	124080	125820	111630	87510	45250	486858

1/ The total counts were derived from 877 aerial surveys and 226 ground surveys. Total surveys 1,103.

2/ Cumulative weekly counts, divided by stream life factor of 2.5 weeks.

Appendix Table H. CHUM SALMON AGE ANALYSIS BY COMPARABLE TIME PERIODS IN THE FISHERY, 1964 - 1966.

Date		No. of Chums sampled by age group				Percent each age group			
		3	4	5	Total	3	4	5	Total
7/22-7/28	1964	188	372	25	585	32.14	63.59	4.27	100
	1965	19	427	14	460	4.13	92.83	3.04	100
	1966	18	169	10	197	9.13	85.79	5.08	100
7/28-8/2	1964	345	476	9	830	41.57	57.35	1.08	100
	1965	4	84	5	93	4.30	90.32	5.38	100
	1966	24	289	6	319	7.53	90.59	1.88	100

Appendix Table I. CHUM AGE ANALYSIS IN STREAMS, 1964 - 1966

	No. of chums sampled age				Percent each age			
		3	4	5	Total	3	4	5	Total
Years	1964	103	436	87	627	16.45	69.65	13.90	100
	1965	31	355	34	420	7.38	84.52	8.10	100
	1966	145	881	97	1123	12.81	78.45	8.64	100