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FORECAST OF 1968 PINK AND CHUM SALMON RUNS IN PRINCE WILLIAM SOUND

By:

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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 and chum salmon runs. Therefore, only the results of 1966-67 field work will be presented to finalize the 1968 pink and chum salmon forecasts. 1/

The 1967 pink salmon run was expected to be between 2.5 and 4.1 million fish. The actual return in 1967 was 3.8 million (1.2 million escapement and 2.6 million catch) or well within the limits of the forecast based upon a standard stream list and 90 percent confidence interval. The percent deviation from the mean estimate (3.3 million) and the actual return was 15.2 percent which for management purposes is acceptable.

For the past few years we have been attempting to breakdown the total pink run forecast into forecasts by time period and specific district or district groups. Table 1 lists the mean pink salmon forecasts by timing and areas in Prince William Sound and the actual returns in 1967. See Figure 1 for location of areas and districts.

All timing estimates were low, but not uniform, since the early run forecast was slightly more than one-half of the run that actually returned. This was preliminary due to the Coghill River receiving an above average run

1/ Preliminary analyses are publicized as soon as sampling program is completed each spring.

Table 1. Mean Pink Salmon Forecasts and Actual Returns by Timing in the Fishery and Specific Areas in 1967.

Time Period	To July 15	July 15 - 25	After July 25
Forecast	99,000	620,000	2,580,000
Return	233,000	727,000	2,844,000
Difference	+134,000	+107,000	+264,000

Area*	Eastern	Western	Southern
Forecast	2,051,000	1,080,000	169,000
Return	2,047,000	1,767,000	26,000
Difference	-4,000	+687,000	-143,000

* Eastern Area - Comprised of Eastern, Southeastern Districts.

Western Area - Comprised of Northern, Northwestern, Coghill, Southwestern and Eshamy Districts.

Southern Area - Montague District

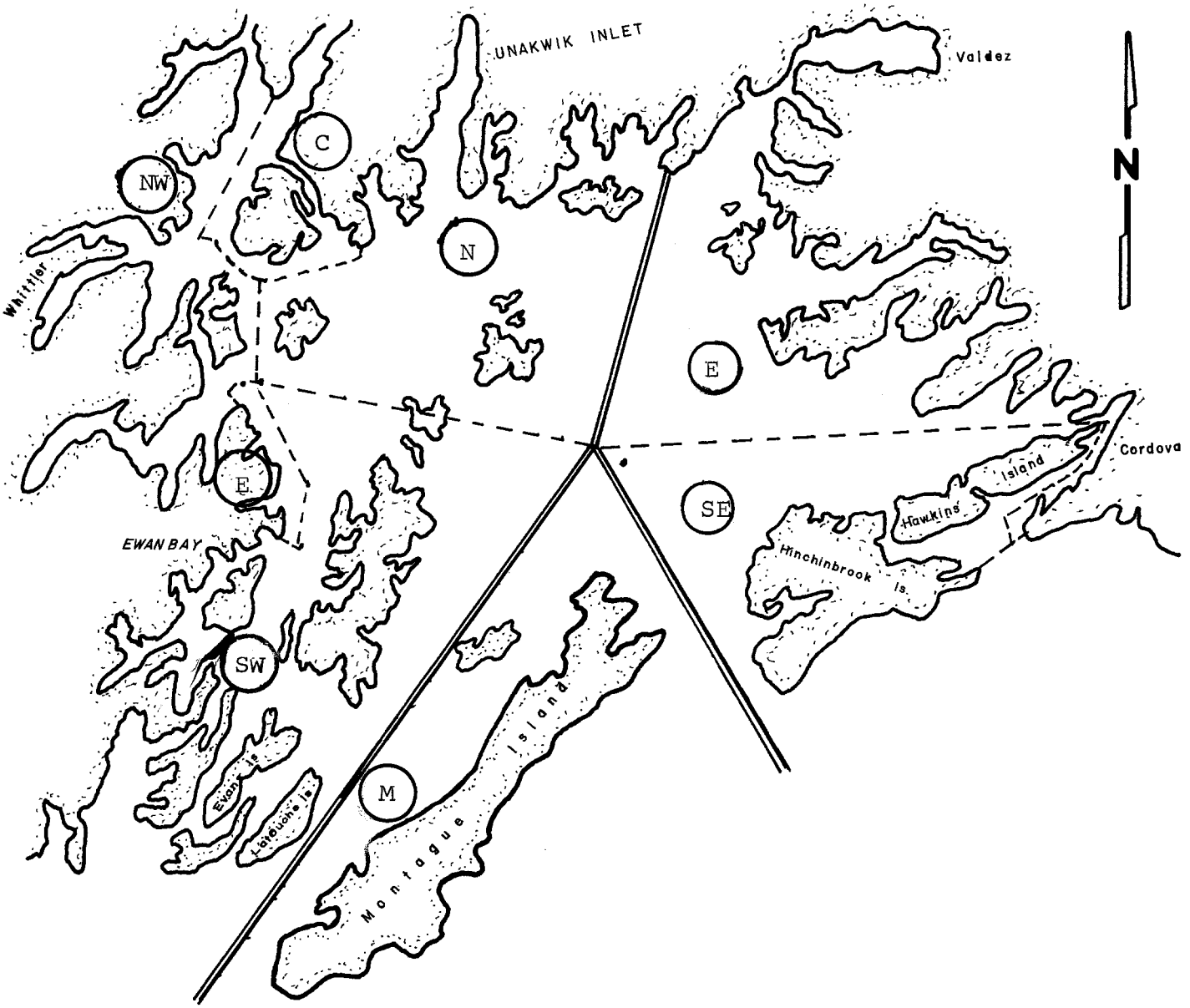


FIGURE 1: Major Stocks and Districts in Prince William Sound.

in 1967. We had anticipated Coghill producing a good run and the season was allowed to remain open in that district following the red salmon drift gill net fishery.

The differences in the mean area forecasts and return were greatest in the Western and Southern (Montague) areas. We underestimated the Western area run by 687,000 and this underestimate was caused primarily by two of our largest pink salmon producers receiving above average runs. These were Coghill River and Shrode Creek (a fish passage facility was constructed in Shrode Creek in 1962). There is a possibility that we may be able to remove this chance for error in the future by adjustment of our sampling program.

The Southern area (Montague District) estimate was 143,000 above the actual return (26,000). Montague Island was closed to commercial fishing in 1967 since an extremely poor run was expected. The poor run of pinks on Montague Island was a direct result of streams reacting to the base level change caused by the Alaska earthquake of March, 1964.

In general, with the exception of Montague Island, it appears that uplift and subsidence of land associated with the earthquake, has not affected the odd-year cycle of pinks as seriously as the even-year cycle of pinks. The most probable reason for odd-year pink runs not suffering as much as even-year pinks is because odd-year pink spawners more heavily utilize upstream spawning areas than even-year pinks. These upstream spawning areas thus far have not been subjected to massive erosion. Furthermore, odd-year spawners have not exhibited a marked tendency to shift downstream into the new, poor quality, intertidal spawning areas of uplifted streams (Montague Island is an exception) as even-year cycle pinks have done.

UNUSUAL FACTORS AFFECTING THE 1968 PINK SALMON RUN

Uplift and Subsidence

The pink salmon run in 1968 will be the second even-year return to reflect the deleterious effects of the Good Friday earthquake of March 27, 1964. These effects were triggered by the uplift and subsidence of land associated with the earthquake.

Of 223 producing pink salmon streams in Prince William Sound, 138 were uplifted from 1 to 31.5 feet, 43 subsided 1 to 6 feet, and 42 remained at essentially the same sea level (see Figure 2 for areas effected). For the

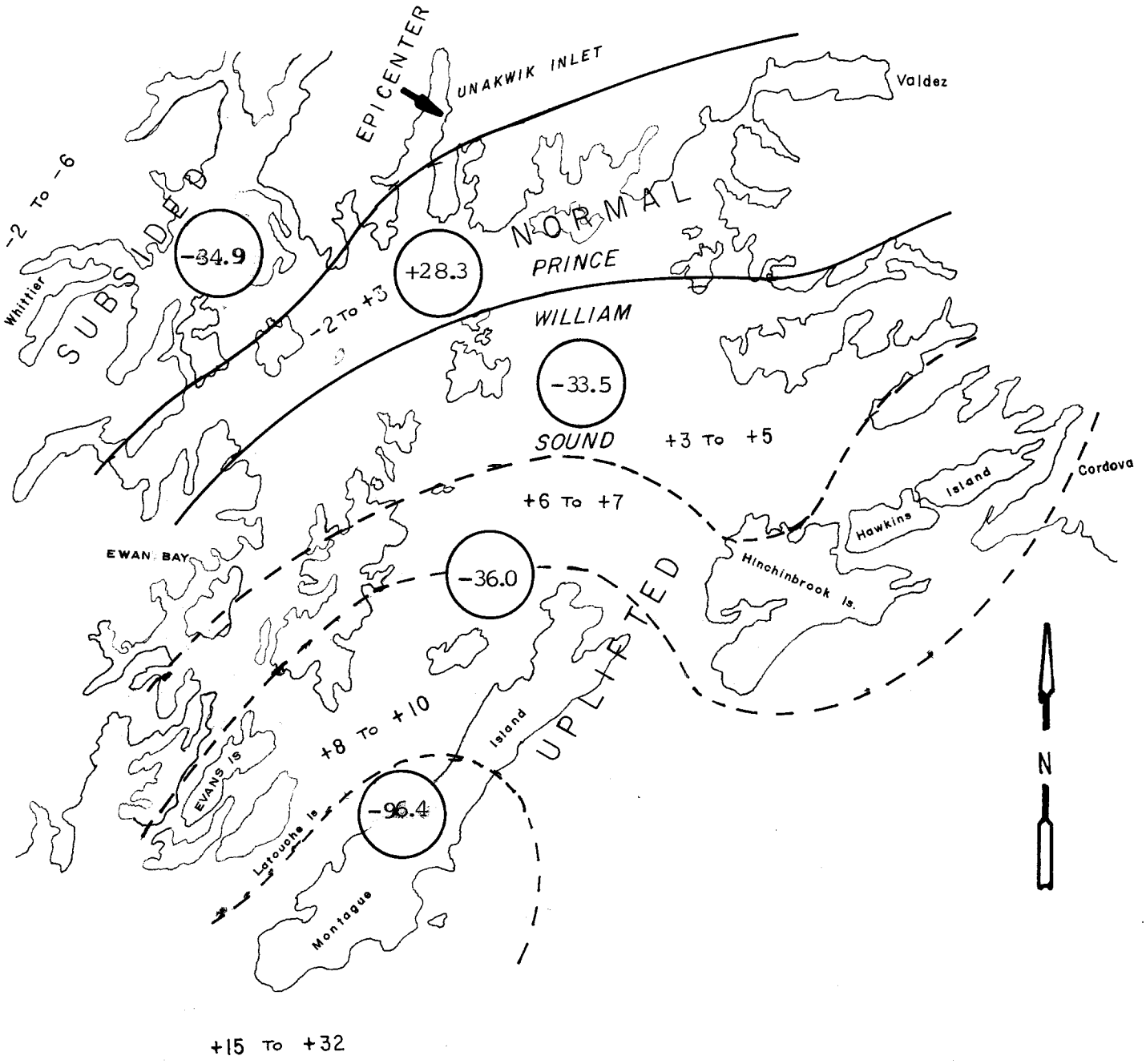


Figure 2: Per cent reductions of escapements by tectonic sub-category in 1966 compared to the average of 1960, 1962, and 1964.

most part, damaged in the uplifted streams differs from that in the subsided streams.

The most serious aspect of uplift that affected even-year pink salmon production was a highly significant downstream shift of spawners, that increased as uplift increased, into newly created intertidal and freshwater spawning riffles (Roys, 1967). This was followed by high mortality of eggs and alevins caused by excessive horizontal and vertical movement of spawning beds. Movement of spawning gravels was a natural reaction of stream flows to a lowering of the base level. Initially, (fall of 1964 to spring of 1965) excessive erosion was observed in newly created spawning areas but by the spring of 1966 signs of unusual gravel movements were also detected in the pre-earthquake spawning beds. The most severe erosion took place generally in those streams that experienced the greatest uplift (particularly Montague Island), but by the spring of 1967 severe spawning bed movements were detected in less uplifted streams (particularly Hawkins and Hinchinbrook Islands).

The immediate effect of subsidence (mainly the Northwestern part of Prince William Sound) was to decrease the amount of spawning area available. This occurred because former productive spawning beds are not now utilized by spawners (an upstream shift of spawners was noted in the subsided zone). In addition to a permanent loss of spawning area, much of the new intertidal spawning area is of a poorer productive capacity than the pre-earthquake intertidal spawning area. This is because a higher percentage of the new intertidal stream area is comprised of non-productive pools, log jams, etc. Figure 2 shows the tectonic deformations in Prince William Sound and are categorized into the following major zones: (1) Normal, -2 to +3 feet, (2) uplift, 3 to 15+ feet, and (3) subsided, -2 to -6 feet.

Comparison of Pre- and Post-Earthquake Escapements and Alevin Densities by Tectonic Zones

It would be of interest to examine pink salmon escapement estimates obtained from streams in Prince William Sound prior to and following the earthquake by tectonic category. An examination of escapement data in this manner might provide an insight into what areas production potential has been seriously curtailed. For example, if the escapement in 1966 in the 6-10 foot uplift category was considerably below the average since 1960 but normal zone escapement in 1966 was similar to the average, then we might be uncovering a clue to how serious the production potential curtailment has been. Furthermore, if this percent reduction in escapement in 1966 was lower in the minimal uplifted areas

and greatest in maximum uplifted areas then the chances of these data being indicative of the earthquake effects are quite good. In this context it is to be remembered that erosion and spawner displacement initially was most serious in the maximum uplifted areas in 1964 and the escapement distributions in 1966 reflect the first return following these unusual events.

The data in Table 2 indicates that escapement in 1966 in the normal category was 28.3 percent above the average of 1960-1964, but as uplift increased the percentage decline in escapements increased. (33.5% in 3-5 foot category, 36.0% in 6-10 foot, and 96.4% in 15 foot + category). A decline also was evident in the subsided zone (34.9%).

If the escapement reductions in Table 2 actually reflect the affects of the earthquake, alevin densities following spawning in 1964 and 1966 should reflect reductions similarly. Unfortunately because of the low number of streams sampled prior to 1965 we cannot compare specific categories in the uplifted zone but we can pool the uplifted data and then compare the uplifted, normal and subsided categories (Table 3).

These data indicate that the alevin densities in the normal category have fluctuated but following the earthquake they have remained relatively high (218 alevins per square meter for the 1968 return). This is in contrast to the uplifted and subsided categories where alevin densities have declined considerably (101 and 147 for the 1968 return respectively).

Briefly then, in the normal category prior to and following the earthquake, escapements and subsequent alevin densities have remained relatively high. However, in the various uplifted categories escapements have declined commensurate with the amount of uplift. Subsequent even-year alevin densities are low in the uplifted category compared to pre-earthquake abundance and exhibit a possible trend of continuing declines. Subsided category escapements are lower than pre-earthquake levels as are alevin densities but the decline in the alevin indexes appears to be leveling off. These trends are probably correlated with the type of damage sustained. An immediate reduction of alevin densities occurred in the subsided category because of a permanent loss of intertidal spawning area (area lost is included in samples) and poorer quality new intertidal spawning area. In the uplifted categories, a trend of decreasing alevin densities occurs because of streams still reacting to the base level change. The major question is what can we expect for a run in 1968 since these unusual events have occurred or are continuing to occur?

Table 2. Percent Increase or Decrease from Average Pink Salmon Escapement for Years 1960 to 1964 Compared to 1966 by Tectonic Category.

Category	Average 1960 to 1964	1964	1966	Percent change in 1966 from: Average	1964
NORMAL					
-2 to +3 feet	367,000	399,000	471,000	+28.3	+18.0
UPLIFT					
3 to 5 feet	281,000	267,000	187,000	33.5	-30.0
6 to 10 feet	458,000	484,000	293,000	36.0	-39.5
15+ feet	110,000	67,000	4,000	-96.4	-94.0
Total Uplift	849,000	818,000	484,000	-43.0	-40.8
SUBSIDED					
-2 to -6 feet	473,000	532,000	315,000	34.9	-40.9

NOTE: Comparison of 1964 and 1966 are also shown, as stream surveyors changed in 1964 and the development of the fishery was very similar in 1964 and 1966, however the same trends are evident.

Detailed escapement estimates for brood year 1966 are listed in the Appendix.

Table 3. Alevin Densities by Tectonic Category Prior to and Following the Earthquake by Year of Adult Return.

	Pink Alevins Per Square Meter			
	Pre-Earthquake		Post-Earthquake	
Tectonic Category	1962	1964	1966	1968
Normal -2 to +3 feet	237	207	228	218
Subsided -2 to -6 feet	319	342	167	147
Uplift +3 to 31.5 feet	336	267	171	101

1968 PINK SALMON FORECAST BASED ON THE ALEVIN INDEX

In this section the total run forecast, that hopefully takes into account all the deleterious effects of the earthquake, will be presented followed by area and timing forecasts. Also, an analysis will be presented of results obtained from the expanded alevin sampling program that has been conducted since the earthquake. With data from this expanded program in hand it is possible to suggest where specific strengths and weaknesses in the run may develop in 1968 and point out specific areas that are suffering severely from the after effects of the earthquake.

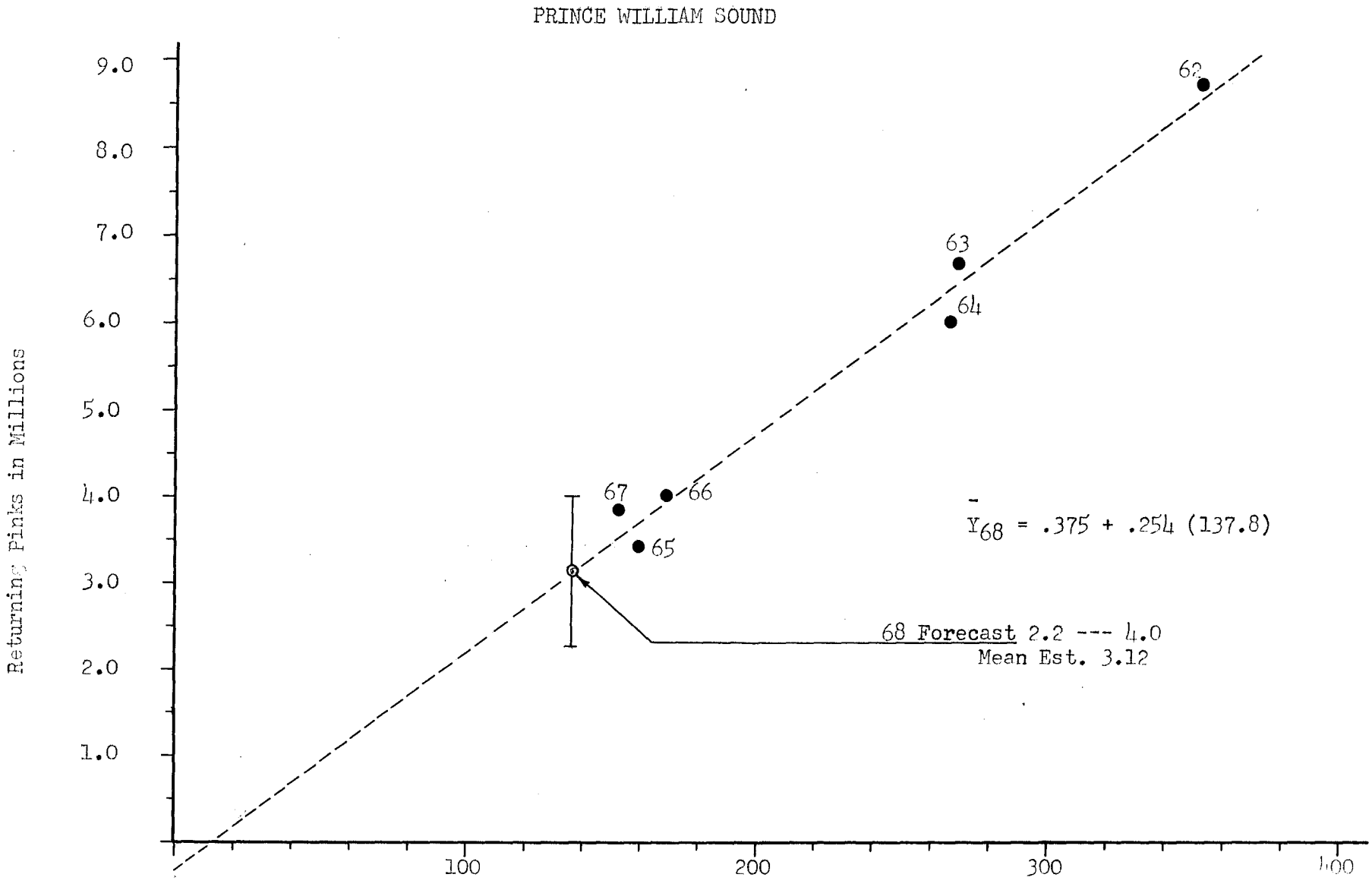
Total Pink Run for 1968

The linear relationship (basis for past forecasts) between mean weighted pink salmon alevins per square meter and the returning run, obtained from a standard list of streams is illustrated in Figure 3. The contributing data is listed in Table 4.

Calculations derived from the regression $\overline{Y}_{68} = -.375 + 0.254\ (137.8)$ indicate that the 1968 pink salmon run should be between 2.2 and 4.0 million at the 90 percent confidence interval with an average expected return of 3.1 million. (This estimate includes catch plus escapement). In other words, we have one out of 10 chances of the run being below 2.2 million or above 4.0 million. Furthermore, we have only one chance in twenty of the run being less than 2.0 million or larger than 4.2 million. This means that a small harvest is possible. The major concern is when and where a small harvest could be conducted.

Timing of the Run

Our knowledge of the timing of runs in Prince William Sound is still in the early stages of development. It is not yet clear whether the earthquake has triggered timing pattern changes. There is a possibility that the run in 1968 may exhibit a tendency to be earlier in certain areas of the Sound than observed since 1960. This "earliness" may show up in the areas of major uplift (Montague, Hawkins, Hinchinbrook Islands). We suspect that freshwater seeking spawners in the Sound tend to arrive earlier than intertidal spawners and with new freshwater alevin densities higher in the uplifted streams than new intertidal densities this earliness may occur. This would mean that pinks would begin showing up off uplifted stream mouths perhaps a week earlier than in the past (around the 20th of



(Figure 3) Pink Salmon Alevins per Square Meter

Table 4. Results of Sampling Standard Pink Salmon Stream List 1961 - 1967.

Brood Year	Percent Spawners By Zone		Alevin Density by Zone Per Square Meter		Weighted Alevin Density	Return in Millions
	Intertidal	Freshwater	Intertidal	Freshwater		
1960	77	23	315.3	474.0	351.8	8.7
1961	35	65	180.4	317.2	269.3	6.6
1962	70	30	257.2	286.7	266.1	6.0
1963	46	54	118.5	194.9	159.7	3.4
1964	65	35	187.1	135.9	169.1	4.0
1965	37	63	110.0	177.2	152.3	3.8
1966	65	35	102.5	203.5	137.8	(3.1)

July). This earliness would not necessarily indicate a strong run as the later (intertidal) segment in the uplifted streams will be weak. There is no indication that runs may be earlier in the subsided or normal stream categories or in other words a shift to a predominance of freshwater spawners.

Table 5 is a comparison of alevin densities and estimated returning runs by timing category. These data indicate the middle and late run segments have suffered the greatest reductions (53.7 and 51.2 percent respectively) compared to the average since 1960. Comparison of alevin densities obtained since 1960 indicate mean estimates by timing category as follows (catch and escapement):

Early to July 15th	202,000
Middle to July 30th	992,000
Late after July 30th	1,907,000
Total	3,101,000

It is to be remembered that these are mean estimates and if the run shows up in the lower range of the forecast (2.2 to 3.1 million) then these estimates will probably be high. The reverse is also true if the run returns in the upper range of the forecast (3.1 to 4.0 million) these estimates will probably be low.

Early run streams that may exhibit some strength are Wells River (Northern District), Stellar Creek (Valdez Arm) and the two major systems in Pigot Bay. Middle run streams that may produce well are Jonah Creek (Unakwik), Millard Creek (Galena Bay) and Control Creek (Olsen Bay). Late-run streams that may have good runs are Duck River and Indian Creek (Galena Bay), Vlasoff (Jack Bay), St. Mathews (St. Mathews Bay), Cedar Creek (Cedar Bay), Falls Creek (Latouche Island) and Totemoff Creek (Chenega Island).

Forecast by Areas

It is desirable from a managerial as well as industrial standpoint to have foreknowledge of where we can expect harvestable levels of pinks. From this point of view a breakdown of the total run forecast into major stocks is in order (Table 6). This analysis indicates the largest reductions from the average of runs since 1962 will occur in the Western and Southern areas (54.9 and 92.9 percent respectively). See Figure 1 for areas. In terms of total run to a particular area in 1968, our mean estimates become: Eastern 1,516,000, Western 1,652,000, Southern 31,000.

These major areas however, encompass a variety of dissimilar earthquake effects. For example, the Western area has been subjected to maximum subsidence

Table 5. Comparison of Pooled Pink Salmon Alevin Densities and Return by Timing Category 1960, 1962, 1964, and 1966 Brood Years.

Year of Return	Pink Alevin Density Per Square Meter	Return	Percent of Total	Converted to Regression	Percent Reduction from Average
Early to July 15					
1962	414	444,000	5.0		
1964	339	202,000	3.3		
1966	143	145,000	3.6		
Average	299	264,000			
1968	208	(183,000)	6.5	(202,000)	-23.5
Middle to July 30					
1962	253	2,298,000	26.1		
1964	259	2,464,000	39.7		
1966	223	1,670,000	41.8		
Average	245	2,144,000			
1968	103	(902,000)	32.0	(992,000)	-53.7
Late after July 31					
1962	409	6,058,000	68.8		
1964	257	3,535,000	57.0		
1966	160	2,127,000	53.2		
Average	275	3,907,000			
1968	122	(1,733,000)	61.5	(1,907,000)	-51.2
Total		(2,818,000)		(3,101,000)	

Table 6. Comparison of pooled pink salmon alevin densities and return by major stocks, 1960, 1962, 1964 and 1966 brood years.

Area	District	Year of return	Alevin Density per sq. meter	Return	Percent of total	Percent reduction from average
Eastern	Eastern	1962	325	2,791,000	32.1	
	Southeastern	1964	261	2,030,000	33.6	
		1966	210	1,625,000	40.4	
		Average	265	2,149,000	35.4	
		1968	187	(1,516,000)	47.4	29.5
Western	Northern, Northwestern	1962	365	4,936,000	56.8	
	Coghill, Southwestern,	1964	304	3,715,000	61.6	
	Eshamy	1966	161	2,332,000	58.0	
		Average	277	3,661,000	58.8	
		1968	125	(1,652,000)	51.6	54.9
Southern	Montague	1962	302	958,000	11.1	
		1964	190	289,000	4.8	
		1966	95	63,000	1.6	
		Average	196	437,000	5.8	
		1968	14	(31,000)	1.0	92.9
Prince William Sound Total				(3,199,000)		

of 6 feet (primarily Northwestern-Coghill Districts) to varying amount of uplift of 3-10 feet (Southwestern and Eshamy Districts). It also has experienced areas of little tectonic deformation (mainly Northern District). Knowing this, there may be sub-areas (tectonic categories) within these major areas that are going to experience major reductions from past production levels but at the same time sub-areas that were not affected by the earthquake may produce quite well. It follows, therefore, that a comparison of the alevin densities and subsequent returns by tectonic sub-category in 1966 with alevin densities and estimated returns in 1968 may yield the answer to the question - "what areas have suffered most from the effects of the earthquake?" Only these two years of alevin density data by specific tectonic category may be compared because prior to brood year 1964 (return of 1966) a significant number of samples were not collected in each tectonic sub-category.

Forecast by Tectonic Sub-Category

A problem is encountered if we try to project run strengths and weakness in 1968 by tectonic sub-category. The problem is that fish destined for the normal area may be caught in the 3-5 foot uplifted area or the opposite may hold true. However, for this analysis let us assume that fishing mortality is relatively constant for all tectonic sub-categories and that fishing mortality in 1968 would be similar to 1966 (unless regulations changed this). To support this assumption let us first examine alevin densities and the subsequent escapements by major tectonic area from two years where the development of the fishery appeared to be similar, (return years of 1964-66) (Table 7). In those two years the seine fishery commenced around the 20th of July and for the most part closed approximately the same time. Montague Island and the Northern Districts were closed a week earlier in 1966 than 1964 because of escapement needs. If the fishing mortality between these two years was relatively constant then the ratio of alevin densities for these two years should be very similar to the ratio of the resultant escapements. The data in Table 7 demonstrates this as there are relatively small differences between ratios in the major tectonic categories. These differences are as follows: Normal +.08, subsided +.10, and uplift -.05. Therefore, in our 1966 forecast, if we had planned on similar fishing mortality we could have projected fairly accurately what the escapements were likely to be from a comparison of alevin densities. Escapement projections by major tectonic areas for 1966's run are also listed in Table 7. You will note the percent deviations between projected escapements and actual escapements was quite small (-7.6 to +12.1 percent). Continuing with this type of analysis, we see that in 1968, if fishing mortality timing and distribution of effort was similar to 1964 or 1966, that the projected escapements for 1965 would, when compared to the actual escapement for 1966, experience a decline in the subsided

Table 7. Comparison of projected pink salmon escapements and actual escapements based on alevins per square meter for tectonic zones.

Year of return	Alevin Density	Ratio 64/66	Projected escapement	Actual escapement	Ratio 64/66	% Deviation
Normal						
1964	207		-	399,000		-
1966	228	1.10	439,000	471,000	1.18	+7.2
1968	218		435,000			
Subsidence						
1964	342			532,000		
1966	167	.49	260,000	315,000	.59	+12.1
1968	147		278,000			
Uplift						
1964	267			818,000		
1966	171	.64	524,000	484,000	.59	-7.6
1968	101		300,000			

and uplifted categories but remain quite good in the normal category. The greatest decline in 1968 apparently would occur in the uplifted category or an escapement of 300,000 which is 63 percent below 1964 and 38 percent below 1966.

Previously in this discussion we assumed that if fishing mortality was similar in 1968 to 1966 certain areas might receive poor runs and that this would probably be related to effects of the earthquake. To substantiate this hypothesis, we then pointed out that it was possible by major tectonic category to project escapements in 1966 from 1964 by using alevin indices which indicated fishing mortality was relatively constant in all categories. Since this was possible then an analysis of this type of sub-tectonic area where extensive alevin data is available (1966 vs. 1968) should point out (1) where the runs are likely to be weak and, (2) what the escapements are likely to be unless corrective measures are implemented. The estimated escapements and assumed total return in 1966 and estimates for 1968 by tectonic sub-category are listed in Table 8. These data indicate that the poorest runs per unit area[1/] in 1968 compared to 1966 will occur in those areas experiencing the greatest uplift (mainly where uplift was greater than 6 feet) (Figure 4).

Table 8. Pink salmon escapement and assumed total return in 1968 by tectonic sub-category if fishing mortality was similar to 1966.

Category	No. Streams sampled	Alevin Density per sq. meter		Escapement		Assumed return	
		1966	1968	1966	1968	1966	1968
Normal	9	338	302	471,000	421,000	1,484,000	1,326,00
Subsidence	5	172	148	315,000	271,000	992,000	854,00
Uplift							
3 to 5 feet	7	296	190	187,000	120,000	588,000	377,00
6 to 10 feet	10	200	108	293,000	158,000	924,000	499,00
15+ feet	1	0	0	4,000	4,000	12,000	12,00
TOTALS	32			1,270,000	974,000	4,000,000	3,068,00

1/ The 6-10 foot uplifted category contains approximately twice as many streams as the 3-5 foot category.

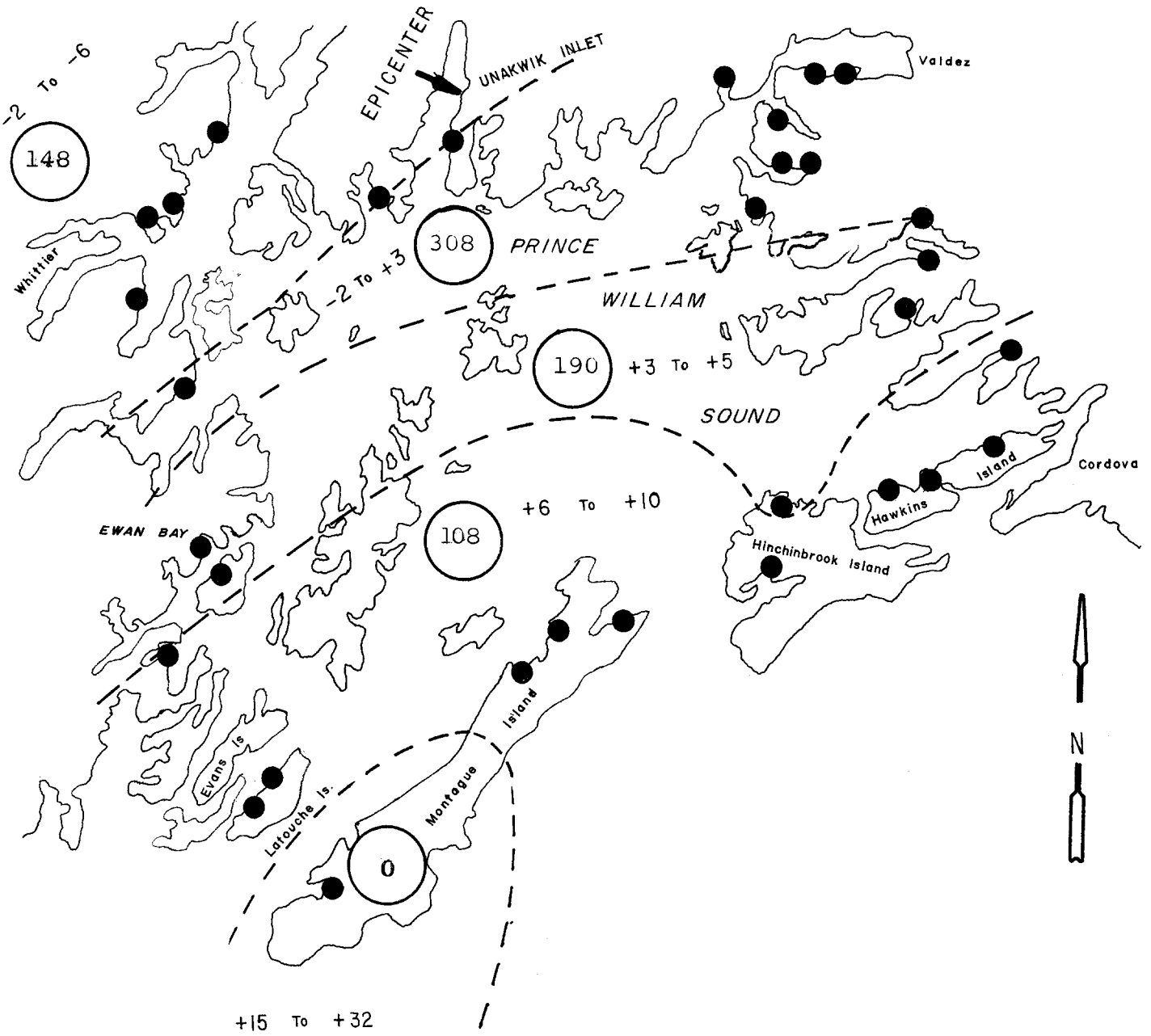


Figure 4. Alevin densities by tectonic sub-category yielding 1968's return. (Black dots are streams sampled for brood years 1964-1966 (1966 and 1968 return).

If these prognostications are substantially correct then how much of a harvest could the various stocks withstand above escapement goals? Escapement goals for 1968 in the normal zone are unchanged, are somewhat lower in the subsided category (loss of spawning area), but substantially larger in the uplifted categories. Escapement goals in the uplifted category must be larger because (1) new spawning area is available (though poor quality), (2) spawners are using both old and new spawning areas.

Mean estimated returns and escapement goals by category for 1968 are listed in Table 9. From these data it is obvious that if fishing mortality and areas fished were the same in 1968 as 1966 then certain tectonic categories would not receive the desired escapement goals. These tectonic categories are those areas that were uplifted at least 6 feet (Figure 4) and namely Montague, Latouche, Hawkins, Hinchinbrook Island and that part of the Eastern District east of Port Gravina. Estimates for the 3 to 5 foot uplift category, (Dangerous Passage, Port Gravina, Port Fidalgo), indicate a small harvest of stocks destined for those areas could be realized. The most intensive harvest, (relative to the amount of gear), could be permitted on those stocks destined for the normal category, (Valdez Arm), and that portion of the subsided category lying east of Esther Island, (Northern District).

Table 9. Mean estimated harvest by specific tectonic category for Prince William Sound pink salmon in 1968.

Category	Mean Estimate of Total Run	Escapement Goals Pre-earthquake	Escapement Goals 1968	Percent Inc. or Decrease	Mean Estimated Harvest 1968
Normal -2 to +3 feet	1,326,000	314,000	314,000	0	1,012,000
Subsided -2 to -6 feet	854,000	419,000	235,000	-20%	519,000
Uplift 3 to 5 feet	377,000	210,000	252,000	+20%	125,000
6 to 10 feet	499,000	379,000	606,000	+60%	None
15+ feet	12,000	78,000	140,000	+80%	None
TOTALS		1,400,000	1,647,000		1,656,000

Note: Escapement goals calculated for the uplifted segments assume that the old intertidal spawning area in the uplifted category that become freshwater following the earthquake will develop an even-year freshwater run.

SUMMARY OF PINK SALMON FORECAST

1. The pink salmon run in 1968 will be the second even-year return to reflect the effects on production of uplift and subsidence of the land associated with the Good Friday earthquake of March 27, 1964.

2. Streams in Prince William Sound have been categorized into major tectonic areas: normal, subsided and uplifted. This classification is based upon amount of deformation observed.

3. Pink escapement in the normal category streams (-2 to +3 feet uplift) in 1966 (return of 1968) was 28.3 percent above the even-year average from 1960 to 1964, and 18 percent above the 1964 escapement. The normal zone prior to the earthquake produced approximately 21.3 percent of the total Prince William Sound pink run.

4. Pink salmon escapement in subsided streams (-2 to -6 feet and upstream shift of spawners) in 1966 was 34.9 percent below the even-year average of 1960 to 1964 and 40.9 percent below 1964. A significant amount of spawning area has been lost to production because the new tide levels have "drowned out" former high production intertidal areas. The subsided zone prior to the earthquake produced approximately 27.8 percent of the total Prince William Sound pink run.

5. Pink salmon escapement in uplifted streams (+3 to 31.5 feet and downstream shift of spawners) in 1966 was 43.0 percent below the even-year average of 1960 to 1964 and 40.8 percent below 1964. Percentage reductions in escapement increased as uplift increased. Escapement in 1966 in streams that were uplifted over 15 feet was 96.4 percent below the average. Prior to the earthquake the uplifted zone produced about 50.9 percent of the total Prince William Sound pink salmon run. The reaction of streams to base level changes is probably the major mortality factor.

6. Thus far there is a linear relationship between mean indexed pink alevin abundance and the subsequent returning run.

7. Mean pink alevin densities per square meter by zone yielding 1968's run are as follows: normal 218, subsided 147, uplifted 101. Following the earthquake, alevin densities have remained relatively high in the normal zone, but declined in the uplifted and subsided zones.

8. Based upon weighted mean alevin densities obtained from sampling the

same streams annually and weighted by the percent spawners utilizing pre-earthquake intertidal and upstream zones, the forecast for the 1968 pink salmon run is for a total run of between 2.2 and 4.0 million (90% confidence interval) with an average expected return of 3.1 million. This estimate includes catch plus escapement.

9. Mean estimated timing forecasts based on pooled alevin densities corrected to the regression indicate (catch + escapement):

To July 15	202,000
To July 30	992,000
After July 30	1,907,000

These mean estimates represent reductions from the even-year average of 1962-1966 of 23.5 percent early, 53.7 percent middle, and 51.2 percent late. The early run should be slightly stronger than 1966 whereas the middle and late runs will be considerably weaker than the 1966 run.

10. Mean estimated area forecasts based on pooled alevin indices and catch plus escapement data compiled from the individual areas indicate the following run size in 1968:

Eastern Area	1,516,000
Western Area	1,652,000
Southern Area	31,000

These mean estimates represent reductions from the average of 1962 - 1966 of 29.5 percent in the Eastern Area, 54.9 percent in the Western Area, and 92.9 percent in the Southern Area.

11. Based on an analysis of data collected from the expanded alevin sampling program following the earthquake (brood year 1964 and 1966) and assumed returns by tectonic sub-category in 1966 mean estimates of run size for 1968 by sub-tectonic category were:

Normal		1,326,000
Subsidence		854,000
Uplift	3-5 feet	377,000
	6-10 feet	499,000
	15+ feet	12,000

12. If fishing mortality in 1968 was similar to 1966 then escapement goals would probably not be realized in areas where uplift was greater than 6 feet

and be difficult to achieve in those areas uplifted 3 to 5 feet.

CONCLUSION PINK SALMON FORECAST

The alevin index indicates the 1968 total pink salmon run will probably be below 4.0 million but above 2.2 million with an average estimate of return of 3.1 million. This estimate indicates a poor to very poor run.

Early run pinks destined for Valdez Arm and Wells River should be slightly more abundant than 1966 but less abundant than in 1962 or 1964. Middle run pinks should be less abundant than 1962, 1964 or 1966. Late run pinks will experience a major reduction from 1962, 1964, 1966 in the uplifted parts of Prince William Sound and in particular, Hawkins, Hinchinbrook and Montague Islands and that portion of the Eastern District east of Sheep Point. The strongest part of the late run should occur in the Northern District and that part of the Eastern District lying west of Gravina Point. However, if an intense fishery develops in the Southwestern District on pinks destined for the Northern District and Valdez Arm, poor fishing may result in these two areas.

If the run develops as predicted then a total closure might have to be implemented soon after August 1 to achieve stated escapement goals.

CHUM SALMON FORECAST SYNOPSIS

Methods

One of the major problems encountered in reliably forecasting chum salmon runs is the variable age composition of the run from year to year. Four-year-old chum salmon usually make up approximately 75 percent of the total Prince William Sound chum salmon runs. However, in some years where a large chum salmon run has developed an exceptionally strong return of 3-year-olds has been detected. Our problem is that we do not know what causes chums to return as 3's instead of 4's or vice versa.

The past chum salmon forecast for 1967 therefore was divided into two methods which were: (1) a ratio of return by age class (3's, 4's and 5's) to alevin index and (2) expanded estimate of the 4-year-old return from alevin index into a total run estimate by using average 4-year-old age composition.

Method one indicated a return of 603,000 with an age composition of 37 percent 3's, 57 percent 4's and 6 percent 5's.

Method two indicated a return of 443,000 with an age composition of 77.2 percent 4's and the remainder 3's and 5's (Table 10).

Table 10. Chum salmon alevin densities and returns for 3, 4, and 5-year olds.

Brood Year	Alevin Density Per Square Meter	Return by Age Groups 3	4	5	Total
1960	70.9	540,000	644,000	32,000	1,216,000
1961	25.5	152,000	332,000	56,000	540,000
1962	51.3	29,000	513,000	61,000	603,000
1963	26.9	84,000	372,000		
1964	76.8	22,000	(683,000)*		
1965	39.8				

* 1968 forecast of four-year-olds.

The actual return in 1967 was 459,000 in which 81 percent of this number were 4-year-olds. In other words Method two was quite accurate.

Alevin Index Forecast

A linear relationship between the chum alevin index obtained from a standard list of streams and the returning four-year-old run is starting to develop (Figure 5). If this is a true relationship (several more years of data are needed for confirmation) then the 1968 four-year-old chum run should be approximately 683,000 or between 584,000 and 783,000 (90% confidence interval). The strength of the four-year-old chum run in 1968, however, will be affected by tectonic land form changes. Without a return of four-year-olds that have been affected by erosion, spawning bed loss, etc., we cannot be absolutely certain that the alevin index for the four-year-old run in 1968 is representative of the earthquake effects. However, high densities of chum alevins were noted particularly in the normal streams of Prince William Sound.

Expansion of the four-year-old estimate (78.4% of return in 1968) into the total return yields an estimate of $\frac{78.4}{683,000} \times \frac{100}{X}$ or a run of approximately 871,000. This estimate is very similar to the good chum run of 1964.

Ratio of Four-Year-Old to Three-Year-Old Chums

An interesting aspect of the chum age analysis is that if we rank three-year-old returns starting with the largest runs and descending to the smallest and then ratio them to the 4's (same brood year) we find that as the three-year-old run decreases in magnitude the ratio of subsequent 4's to the previous years 3's increases (Table 11, Figure 6). For example, when a large run of 3's developed as in 1963 (brood year 1960) of 540,000, the following year (1964) 644,000 four-year-olds were detected. The ratio of 4's to 3's becomes $\frac{644}{540} = 1.19$. However, when a three-year-old run was small as in 1965 (brood year 1962) or 29,000 the subsequent ratio of 4's to 3's becomes $\frac{513}{29} = 17.69$. In 1967 (brood year 1964) we detected 22,000 3's. Therefore, by using the inverse proportion $\frac{29}{22} \times \frac{X}{513}$ we find the estimate of 4's in 1968 is 676,000 or very close to the mean estimate derived from the alevin sampling of 683,000.

None of these data however shed light on whether a substantial run of 3's

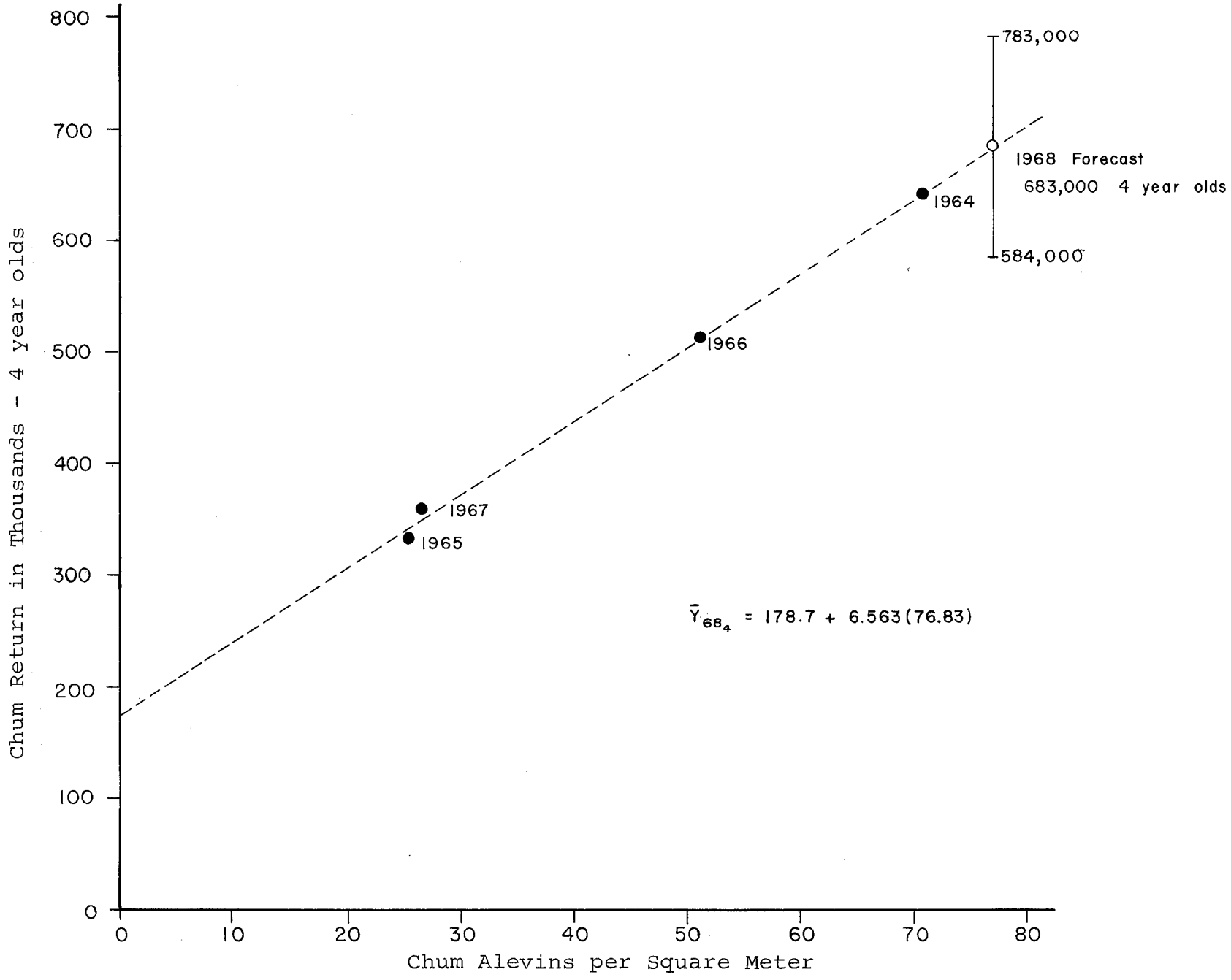


Figure 5. Relationship of Chum Alevins per Square Meter and the 4 Year Old Return

Table 11. Ranked order of three-year-old chums and subsequent four-year-old return.

Brood Year	3-year-olds	4-year-olds	Ratio 4/3
1960	540,000	644,000	1.19
1959	323,000	639,000	1.98
1961	152,000	332,000	2.18
1957	137,000	357,000	2.61
1958	132,000	877,000	6.64
1963	84,000	372,000	4.43
1953	83,000	704,000	8.48
1954	66,000	595,000	9.02
1962	29,000	513,000	17.69
1964	22,000	(676,000)*	(30.73)

* 1968 forecast of four-year-olds.

Note: Years where a fishery was not operating have been omitted.

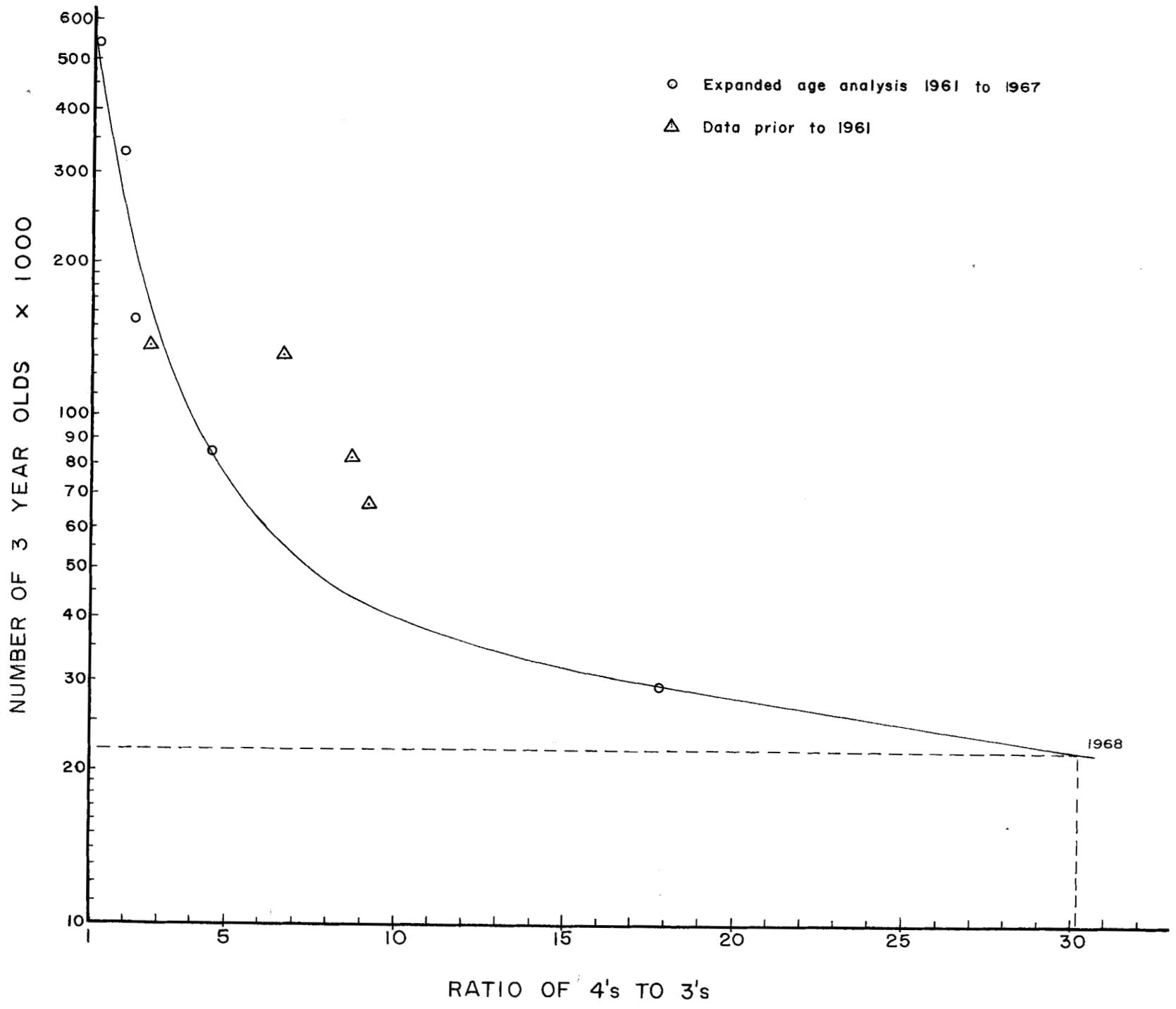


Figure 6. Relationship of 3 Year Old Chum Salmon to the Ratio of 4 to 3 Year Olds from Same Brood Year. Curve fitted by eye.

will develop in 1968. Past chum data suggests that on years of a fairly strong four-year-old return (600,000 or better) a substantial number of 3's also show up.

Detailed chum salmon escapements for brood year 1964 are listed in the appendix.

Conclusions Chum Forecast

The alevin index indicates the 1968 four-year chum salmon run should be between 584,000 and 783,000 with an average expected return of 4's of 683,000. Expansion of the mean estimate of 4's to all age classes indicates a run of approximately 871,000.

Chum alevin densities were exceptionally high in Valdez Arm but very poor on Montague Island and fair to poor in the Northwestern-Coghill Districts.

Until the run materializes in 1968 we will not know the extent of the damage to chum salmon production brought about by the earthquake. However, if the alevin index is a true reflection of this damage then we should see chum runs materializing in good strength in the northern parts of the Sound by the 15th of July.

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LITERATURE CITED

NOERENBERG, WALLACE H.

1964. Forecast research on 1964 Alaskan pink salmon fisheries: Prince William Sound. Alaska Department of Fish and Game Informational Leaflet No. 36, Juneau, Alaska. 51 p.

1963. Salmon forecast studies on 1963 runs in Prince William Sound. Alaska Department of Fish and Game, Informational Leaflet No. 21, Cordova, Alaska. 17 p., 6 figs.

1961. Observations on spawning and subsequent survival of fry of the 1960 salmon runs in Prince William Sound, Alaska. Alaska Department of Fish and Game, Memorandum No. 5, Cordova, Alaska. 22 p., 6 figs.

ROYS, ROBERT S., ALLEN S. DAVIS and W.H. NOERENBERG

1965. Forecast research on 1965 Central Alaska pink salmon fisheries. Alaska Department of Fish and Game, Informational Leaflet No. 65, Juneau, Alaska. 54 p.

ROYS, ROBERT S.

1966. Forecast of 1966 pink and chum salmon runs in Prince William Sound. Alaska Department of Fish and Game, Informational Leaflet No. 80, Juneau, Alaska. 48 p.

1967. Forecast of 1967 pink and chum salmon runs in Prince William Sound, Alaska Department of Fish and Game, Informational Leaflet No. 104, Juneau, Alaska. 49 p.

1967. Synopsis of observations of the effect of tectonic deformation on pink salmon runs in Prince William Sound, Alaska. Report being edited by Alaska Earthquake Committee, National Academy of Science. On file in Cordova. 68 p.

APPENDIX

TABLE A 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	EASTERN DISTRICT Stream or Bay	WEEK ENDING 7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
26	Simpson River, Simpson Bay	0	0	0	0	300				1950			2420
35	Koppen Creek, Sheep Bay	200	2000	8400	24930	9000	1300	3490	6000	5800			25770
36	Sheep River, Sheep Bay	0	5	400	2500	3500	4000	1600	4000	13500			13800
48	Beartrap River, Port Gravina	0	0	2500	9700	4100		8000		5010			18940
50	Gravina River, Port Gravina	0	0	0	0								5420
51	Olsen Creek, Port Gravina	100	1000		6000	3800	1800		6915	6393			15400
52	Control Creek, Port Gravina	0	0	900	5260	4000	1200	2690		2540			8880
56	St. Mathews Creek, Port Gravina	0	0	0	500	500		2100	6000	7900			9280
76	Irish Creek, Port Fidalgo	0	1500	1500	1270	700	440		4000	2820			6530
80	Whalen Creek, Port Fidalgo	0	0	0	620	700		1400		2610			4210
83	Keta Creek, Port Fidalgo	0	0	0	40	80	0	0		5500			8650
87	Sunny River, Port Fidalgo	0	0	0		0	0	0		4770			7110
89	Fish Creek, Port Fidalgo	0	1000	600	1700	7000	620	1120		11200			15700
94	Fish Bay, Port Fidalgo	0	0	0	0	3000	2000	5250		2400			6860
99	Lagoon Creek, Port Fidalgo	300	200	1000	13300	16000	12350	10500		14300			36460
114	Turner Creek, Galena Bay	0	0	0	0		200	260		2600			2585
115	Millard Creek, Galena Bay	0	0	5000	40000	21000	12690	21900		47000			54650 4/
116	Duck River, Galena Bay	0	0	0	2000	3000	6100	12000		100000			91240
117	Indian Creek, Galena Bay	0	200	4670	4300	18000	3410	5000		15020			29040
120	Donaldson Creek, Johnson Cove	0	0		500	900	500	1020		1380			2440
121	Levshakoff Creek, Jack Bay	0	200	2100	1800	1200	690	2060		3630			7230
123	Gregorieff Creek, Jack Bay	0	100	460	500	1200	710	810		2690			3950
127	Naomoff River, Jack Bay	0	00				2300	5200		28720			32330
129	Vlasoff Creek, Jack Bay	0	0		1200		1900	4320		11550			14190
131	Port Valdez	0	0	0	4000		3000			950			6940
133	Sawmill Creek, Port Valdez	0	200		1700		1680			970			4700
152	Twin Falls Creek, Sawmill Bay	0	0							2780			2930
153	Stellar Creek, Sawmill Bay	0	500	4500	11000		7330			16300			38250
Other Streams (76) 2/ 3/		0	0	80	1850	2700	1409	5500	5057	5899			13540
District Total 3/		600		38910		135980		118145		329037	48530		489445
(104 Streams)			6905		136635		79979		231427		180285		

1/ Ground counts underlined. 2/ From records maintained on small streams which had a total of less than 2000 pinks in 1966. 3/ Contains interpreted data where surveys lacking on certain weeks. 4/ Stream life factor 4.0 weeks, these calculated from stream life factor of 2.5 weeks. 5/ Stream numbering revised in 1962.

TABLE B 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	NORTHERN DISTRICT Stream or Bay	WEEK ENDING 7/2	7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
214	Long Creek													
	E. Long Bay		0	0		0	300			3000				3560
216	Vanishing Creek													
	W. Long Bay		0	0		0	2300			8000				11920
217	Long Bay		0	0		0				3000				4160
224	Backyard Creek													
	Fairmount Passage		0	0		0				2000				2560
229	Cedar Creek													
	Cedar Bay		0	0	50	150	1000	1600		4000		28070		29630
234	Wells River													
	Wells Bay		300	12000	12000	11380		26000		38000		17100		77910
241	Cannery Creek													
	Unakwik Inlet		0	0	0	300	2000	4000	6000	3500		6600		7350 4/
257	Jonah Bay													
	Unakwik Inlet		0	0	0	300	2100			3000				5120
258	Jonah Bay													
	Unakwik Inlet		0	0	0	15700	54000	48000		31000				51680 4/
264	Siwash River													
	Unakwik Inlet		0	0	0	1200	1600	5500	10500	19000		12350		28260
265	Unakwik Creek													
	Unakwik Inlet		0	0	0	500	100		3330			380		5360
279	Canyon Creek													
	Eaglek Bay	0	0	0	0	1000	1000	3000		300				3160
282	Eaglek River Delta													
	Eaglek Bay	0	0	0	0	100	1200	3400		12000		3000		14000
284	Eaglek River Delta													
	Eaglek Bay	0	0	0	0	100				100		2400		2320
Other Streams (30) 2/ 3/		0	0	0	0	200	1100	300	100	3750		1770		8720
District Total		0	300	12000	12050	30930	82300	104800	121830	137550	109750	81370	34950	255710

1/ Ground counts underlined; others are aerial counts.
2/ From records maintained on small streams which had a total of less than 2000 pinks each in 1966.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Stream life factor 4.0 weeks, these calculated from stream life 2.5 weeks.
5/ Stream numbering revised in 1962.

TABLE C 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	III COGHILL DISTRICT Stream or Bay	WEEK ENDING 7/2	7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
322	Coghill River													
	College Fiord	0	0	250	1200									6260
(Other Streams) (5) 2/ 3/		0	0	0	0	950	400	1900		1800		170		4250
District Totals 3/		0		250		3450		6900		2700		170		
(12 Streams)			0		1200		7400		2900		1300			10510

1/ Ground counts underlined; other are aerial counts.
2/ From records maintained on small streams which had a total of less than 2000 pinks each in 1966.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Stream life factor 4.0 weeks, these calculated from stream life of 2.5 weeks.
5/ Stream numbering revised in 1962.

TABLE D. 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	IV NORTHWESTERN DISTRICT Stream or Bay	WEEK ENDING 7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
421	Mill Creek												
	Bettles Bay	0	7500		7000	4100	5000		18000		2900		29200
422	Bettles River												
	Bettles Bay	0	0	0	200				2000		1000		2800
424	Hummer Bay	0	0		1300		400		7000		420		6450
425	Hummer Bay	0	800		500	1300	1500		8000		270		9050
428	Pirate Creek												
	Port Wells	0	0	0	500	0	2500		400		15		2650
430	Meacham Creek												
	Pigot Bay	0	3300		5250	4200	4000		4000		940		12760
432	Swanson Creek												
	Pigot Bay	0	5000		20000	32000	21000		15000		12100		57840
435	Logging Camp Creek												
	Passage Canal	0	106	700	2400	1100			3000		390		4920
450	Tebenkoff Creek												
	Blackstone Bay	0	0	500		700							3000
451	Blackstone Creek												
	Blackstone Bay	0	0	700		900							4000
454	Halferty Creek												
	Cochrane Bay	0	0	900		2000			8000		910		11120
455	Paulson Creek												
	Cochrane Bay	0	200	360	2310	1300			3500		110		5090
458	Parks Creek												
	Cochrane Bay	0	0	1750		2000			8000		3300		12420
469	Wickett Creek												
	Cochrane Bay	0	28	50	2000						190		2850
476	Shrode Creek												
	Culross Passage	0	0	100	3000	2300			4000		4060		6240 4/
480	Mink Creek												
	Port Nellie Juan	0	420	800	700				7000		310		7690
485	West Finger Creek												
	Kings Bay	0	0	200	600	2000					670		3230
Other Streams (22) 2/ 3/		0	425	1000	3240	2454		1000	820	1310	4		9120
District Totals 3/ (39 Streams)		0	17779	25660	57540	62454	55970	73550	96820	59300	29049	7300	190430

TABLE D - CONTINUED

1/ Ground counts underlined; others are aerial counts.
2/ From records maintained on small streams which had a total of less than 2000 pinks each in 1966.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Stream life factor 4.0 weeks, these calculated from stream life 2.5 weeks.
5/ Stream numbering revised in 1962.

TABLE E. 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	V. ESHAMY DISTRICT Stream or Bay	WEEK ENDING 7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
510	Eleshansky Creek												
	Eshamy Lagoon	0	0	700									6220
511	Eshamy River	0	0	22									5070
Other Streams (None) 2/ 3/													
District Totals 3/ (6 Streams)		0	0	722	1800	4400	7200	6000	5000	2500	500	100	11290

1/ Ground counts underlined; others are aerial counts.
2/ From records maintained on small streams which had a total of less than 2000 pinks each in 1966.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Stream life factor 4.0 weeks, these calculated from stream life of 2.5 weeks.
5/ Stream numbering revised in 1962.

TABLE F. 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	VI. SOUTHWESTERN DISTRICT Stream or Bay	WEEK ENDING 7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
603	Ewan Creek, Ewan Bay	0	0	0	700	1500			6000				6960
604	Erb Creek, Ewan Bay	0	700	900	700	100			3000		110		4280
608	Jackpot River, Jackpot Bay	0	0	0	1300	15000			26000				27820 4/
610	Jackpot Bay, West Arm	0	0	0	1000	1500			5000				6800
613	Jackson Creek, Jackpot Bay	0	0	0		1200			2300		550		3640
621	Totemoff Creek, Dangerous Passage	0	0		400	300			6000		23		6330
630	Bainbridge Creek, W. Whale Bay	0	0	0	1400	300			1200				2020
633	Pablo Creek, E. Whale Bay	0		4000	1800	300			1200				4380
636	Whale Creek, E. Whale Bay	0		2500	1100	400			700				2680
666	O'Brien Creek, Crab Bay	0	0	0	100	2900			9000		210		10880
670	Montgomery Creek, Latouche Island	0	0	0	0	600			1800				2440
673	Falls Creek, Latouche Island	0	0	0	300	1100			6700		120		6690
674	Falls Creek, Latouche Island	0	0	0	0	700			1700				2180
677	Hayden Creek, Latouche Island	0	0	0	0	100			5000		140		5300
Other Streams (13) 2/ 3/		0	0	600	1250	1430			3670		700		7760
District Total 3/		0		8100		27650		62110		46325		1300	
(48 Streams)			3200		10100		44500		80870		7993		99160

1/ Ground counts underlined; others are aerial counts.
2/ From records maintained on small streams which had a total of less than 2000 pinks each in 1966.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Stream life factor 4.0 weeks, these calculated from stream life of 2.5 weeks.
5/ Stream numbers revised in 1962.

TABLE G 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	VII. MONTAGUE DISTRICT Stream or Bay	WEEK ENDING 7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
740	Kelez Creek, S. of Port Chalmers	0	0	0	0	2100	4000		1500		870		5130
741	Chalmers River, Port Chalmers	0	0	0	0	100	6000		500		100		4030
747	Cabin Creek, Port Chalmers	0	0	0	0	100			3900		400		3720
748	Gilmore Creek, N. of Port Chalmers	0	0	0	0	100	1000		3000		150		3330
749	Shad Creek, N. of Port Chalmers	0	0	0	0	600	2000		4000		200		4760
752	Stockdale Creek, Stockdale Harbor	0	0	0	0	0	1500		2000				2240
753	Outer Stockdale Harbor	0	0	0	0	700	3000		300				2280
775	Pautzke Creek, Zaikoff Bay	0	0	0	0	10			2000		1600		3180
Other Streams (19) 2/ 3/		0	0	0	0	1320	2500		9475	2300	1400		13278
District Totals 3/ (47 Streams)		0	0	0	0	5030	23970	27390	26675	15340	5490	1215	41948

1/ Ground counts underlined; others are aerial counts.
2/ From records maintained on small streams which had a total of less than 2000 pinks each in 1966.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Stream life factor 4.0 weeks, these calculated from stream life 2.5 weeks.
5/ Stream numbering revised in 1962.

TABLE H 1966 PRINCE WILLIAM SOUND PINK SALMON
(Live Counts in Streams) 1/

Stream No. 5/	VIII. SOUTHEASTERN DISTRICT Stream or Bay	WEEK ENDING 7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
810	Garden Creek, Port Etches	0	0	0	0	40	700		8000				8340
812	Nucher Creek, Port Etches	0		200	300	3000	7000		31000				30960
815	Constantine Creek												
	Constantine Harbor	0		500	1800	3000	3800		29000				30420
817	Deer Creek, Deer Cove	0				1600			2000				3640
818	Juania Creek, Juania Bay	0							8000				10800
821	Brown Bear Creek, Shelter Bay	0			10	1200			3000				4480
827	Captain Creek, Anderson Bay	0				3000	7000		3100				7720
828	Cook Creek, Anderson Bay	0			120	1600	2200		2500				4090
829	King Creek, Double Bay	0				900			2950				3980
831	Double Creek, Double Bay	0				700	1300	1800					3840
833	Bates Creek, Hawkins Cutoff	0	0	50		200			3600				3640
834	Hardy Creek, Hawkins Cutoff	0	0	0		1900			6000				7840
835	Scott Creek, Hawkins Cutoff	0	0	0		100			12000				14720
836	Dan's Creek, Hawkins Cutoff	0	0	0		2600			4000				6560
844	Makarka Creek, Hawkins Island	0	0	0					4600				6880
847	Hawkins Creek, Hawkins Island	0	0	0	170	3500			9450	100			12000
849	Rollins Creek, Canoe Passage	0	0	0	0				2200				2320
850	Canoe Creek, Canoe Passage	0	0	200	20	300			1900				2370
855	West of Cedar Bay	0	0	0	0	2000							5800
856	West Lagoon, Cedar Bay	0	0	0	0	1000			4560				6540
858	North Lagoon, Cedar Bay	0	0	0	0	400			4000				4680
861	Bernard Creek, Windy Bay	0	0	0	1570	1700			12560				14850
Other Streams (9) 2/ 3/		0	0	0	0	700	1125		2381		12		4560
District Total 3/		0		950		32340		115950		90860		5350	
(55 Streams)			300		4290		66225		165051		21542		201030

1/ Ground counts underlined; others are aerial counts.
2/ From records maintained on small streams which had a total of less than 2000 pinks each in 1966.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Stream life factor 4.0 weeks, these calculated from stream life of 2.5 weeks.
5/ Stream numbers revised in 1962.

TABLE I 1966 RECAPITULATION OF WEEKLY PINK SALMON COUNTS BY DISTRICT
(Live Counts in Streams) 1/

No. of Streams	District	WEEK ENDING 7/2	7/9	7/16	7/23	7/30	8/6	8/13	8/20	8/27	9/3	9/10	9/17	Calculated Season Total
52	Eastern		600	6905	38910	136635	135988	79979	118145	231427	329037	180285	48530	489445
25	Northern	300	300	12000	12050	30930	82300	104800	121830	137550	109750	81370	34950	255710
36	Northwestern-Coghill		0	18029	26860	60990	69854	62870	76450	99520	60600	29219	7300	200940
29	Southwestern-Eshamy		0	3200	8822	11900	32050	51700	68110	85870	48825	8493	1400	110450
27	Montague		0	0	0	0	5030	23970	27390	26675	15340	5490	1215	41948
31	Southeastern		0	300	950	4290	32340	66225	115950	165051	90860	21542	5350	201030
200	Prince William Sound Total	300	900	40434	87592	244745	357554	389544	527875	746093	654412	326399	98745	1299523

1/ The counts were derived from 407 Aerial surveys and 191 ground surveys. Total surveys 598.

TABLE J Recapitulation of Weekly Pink Salmon Counts in 1964, by District
(Live Counts in Streams) 1/

No. of Streams	District	WEEK ENDING 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	Calculated Season Total
99	Eastern	0	1550	4150	14150	44600	116370	108460	100250	152840	225075	208730	190710	72390	485460
53	Northern	0	0	0	1000	5800	84160	126600	154670	141200	205230	243990	95230	32105	348990
15	Coghill	0	0	500	1500	3130	3700	4700	8100	13485	7235	1900	820	480	18220
46	Northwestern	400	2950	15400	32050	35600	69770	119660	116240	127900	147930	154540	60730	23560	338450
5	Eshamy	0	0	900	1850	3600	5800	9500	8454	5900	4600	2975	1130	540	18100
55	Southwestern	0	0	3400	6560	14730	20220	27740	42570	59020	84270	101425	53315	22570	154700
58	Montague	0	0	0	600	7680	13620	21695	38090	40350	53650	62480	48200	18395	121920
52	Southeastern	0	0	0	2000	7550	7450	72850	123180	150175	191950	161650	132440	53670	358850
383	Prince William Sound Total	400	4500	24350	59710	122690	321090	489205	591550	689470	918940	935915	500275	222510	1844690

1/ The counts were derived from 1250 aerial surveys and 76 ground surveys.

TABLE K PRINCE WILLIAM SOUND CHUM SALMON, 1964
(Live Counts in streams) 1/

EASTERN DISTRICT Stream No. 5/	Stream or Bay	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	Calculated Season Total 4/
35	Koppen Creek Sheep Bay				1200	18000	9500	4000		230						14790
36	Sheep River Sheep Bay				0	400	1300	1000		7350				450		11080
48	Beartrap River Port Gravina				1000	6800	6500				1000	600				10340
50	Gravina River Port Gravina				0	0	350	500		3000	2100					4580
51	Olsen Creek Port Gravina				2700	4800	8000	7700			1200					14100
52	Control Creek Port Gravina				200	900	5200	500			200					3210
80	Whalen Creek Port Fidalgo					600	1100	1100								2360
87	Sunny Bay Port Fidalgo				0	0	0	50				8200		1700		9740
89	Fish Creek Port Fidalgo				200	1100	4000	700								3330
116	Duck River Galena Bay				0	400	4600		9500	15000		5000		200		21500
117	Indian Creek Galena Bay				5000	8800	9000		2500	2000				150		16180
123	Gregorieff Creek Jack Bay				300	300	1700									3790
127	Naomoff River Jack Bay				0	0			9600	10000			11000			29720
129	Vlasoff Creek Jack Bay				0	1700	200	100	2500	4500			2000	1000		7620
131	Waterfall Creek Port Valdez					0	2200		400							2060
133	Sawmill Creek Port Valdez					2000	600		500							2030
152	Twin Falls Creek Sawmill Bay					0	500			100				2730		3170
153	Stellar Creek Sawmill Bay				1000	2000	3000	2000	2000							5440
Other Streams (23) 2/ 3/			50	200	590	2460	2995	3420	4070	3450	3825	3605	2460	1600	500	11700

TABLE K - CONTINUED

EASTERN DISTRICT		WEEK ENDING													Calculated
Stream No. 2/	Stream or Bay	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	Season Total 4/
DISTRICT TOTAL			2900		13490		63395		52320		48050		30040		8930	
(50 Streams) 3/		500		6200		50260		49120		57110		40525		19200		176840

1/ Ground counts underlined; others are aerial estimates.
2/ From records maintained on small streams which had a total of less than 2,000.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Estimates calculated from stream life factor 2.5.
5/ Stream numbering system revised in 1962.

TABLE L PRINCE WILLIAM SOUND CHUM SALMON, 1964
(Live counts in streams) 1/

NORTHERN DISTRICT Stream No. 5/	Stream or Bay	WEEK ENDING 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	Calculated Season Total 4/
214	Long Creek														
	E. Long Bay						1000	3300	6700			5000	2000		12560
216	Vanishing Creek														
	W. Long Bay							1000	2100						2280
234	Wells River														
	Wells Bay			6500	15000	24000	16000	9400	1500						31700
264	Siwash River														
	Unakwik Inlet					1200	2700	4000	2100						5940
276	Black Bear Creek														
	Eaglek Bay					1500			800			3000			6640
279	Canyon Creek														
	Eaglek Bay					200			1500						2210
Other Streams (10) 2/ 3/			20	110	305	625	990	1120	2450	1420	890	390	190	20	3420
DISTRICT TOTAL			3520		17275		23290		17150		11290		5140		64750
(23 Streams) 3/		2200		7570		28275		20820		13620		9390		2320	

1/ Ground counts underlined; others are aerial estimates.

2/ From records maintained on small streams which had a total of less than 2,000.

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

4/ Estimates calculated from stream life factor 2.5.

5/ Stream numbering system revised in 1962.

TABLE M PRINCE WILLIAM SOUND CHUM SALMON, 1964
(Live counts in streams) 1/

NORTHWESTERN & COGHILL DISTRICTS		WEEK ENDING													Calculated
Stream No. 5/	Stream or Bay	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	Season Total 4/
322	Coghill River														
	College Fiord				16000	19000		8600	13000						37640
419	Bettles Bay					6500									8120
421	Mills Creek														
	Bettles Bay				0			6000	4000						10400
424	Hummer Bay				0	0		2500	300			500			2480
425	Hummer Creek														
	Hummer Bay				0	2200		1500	2000			7000			11880
430	Meacham Creek														
	Pigot Bay				4000	12000		3500	500			1500			14680
432	Swanson Creek														
	Pigot Bay				2500	8000		5500	5000			1000			15240
450	Tebenkof Creek														
	Blackstone Bay								1800						2160
454	Halferty Creek														
	Cochrane Bay					1200		1500	1000			800			3600
458	Parks Creek														
	Cochrane Bay								1600						2190
476	Shrode Creek														
	Culross Passage					1000			0			2000			3500
479	Culross Creek														
	Culross Passage					1500		150				1000			3100
484	E. Finger Creek														
	Kings Bay					2000		1500							3860
495	Chimevisky Lagoon														
	McClure Bay					3000					3000				9760
Other Streams (16) 2/ 3/			280	1500	3170	3250	3005	2300	2405	1715	1050	820	320	120	7980
DISTRICT TOTALS		800		16830		64150		43250		28515		19370		2370	
(29 Streams) 3/			4580		34020		53605		38105		25650		10220		136590

1/ Ground counts underlined; others are aerial estimates.
2/ From records maintained on small streams which had a total of less than 2,000.
3/ Contains interpreted data where surveys lacking on certain weeks.
4/ Estimates calculated from stream life factor 2.5.
5/ Stream numbering system revised in 1962.

TABLE N PRINCE WILLIAM SOUND CHUM SALMON, 1964
(Live counts in streams) 1/

SOUTHWESTERN & ESHAMY DISTRICTS — Stream No. 5/ Stream or Bay	WEEK ENDING 7/12	7/19	7/26	8/2	8/9	8/16	8/23	8/30	9/6	9/13	9/20	Calculated Season Total 4/
Other Streams (10) 2/ 3/	70	210	450	580	1,020	1,470	1,370	1,210	1,350	820	360	3,560
DISTRICT TOTALS (10 Streams) 3/	70	210	450	580	1,020	1,470	1,370	1,210	1,350	820	360	3,560

1/ Ground counts underlined; others are aerial estimates.

2/ From records maintained on small streams which had a total of less than 2,000.

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

4/ Estimates calculated from stream life factor 2.5.

5/ Stream numbering system revised in 1962.

TABLE O PRINCE WILLIAM SOUND CHUM SALMON, 1964
(Live counts in streams) 1/

MONTAGUE DISTRICT		WEEK ENDING										Calculated
Stream No. 5/	Stream or Bay	7/19	7/26	8/2	8/9	8/16	8/23	8/30	9/6	9/13	9/20	Season Total 4/
741	Chalmers River, Port Chalmers		100		4700	12000			11000			22940
775	Pautzke Creek, Zaikoff Bay				4000				520			4370
Other Streams (6) 2/ 3/		300	610	720	1045	2825	1600	1400	1300	690	340	4340
DISTRICT TOTAL (8 Streams) 3/		450	910	5,220	9,745	16,825	12,600	12,700	12,820	5,390	2,440	31,650

1/ Ground counts underlined; others are aerial estimates.

2/ From records maintained on small streams which had a total of less than 2,000.

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

4/ Estimates calculated from stream life factor 2.5.

5/ Stream numbering system revised in 1962.

TABLE P PRINCE WILLIAM SOUND CHUM SALMON, 1964
(Live counts in streams) 1/

SOUTHEASTERN DISTRICT Stream No. 5/	Stream or Bay	WEEK ENDING 7/12	7/19	7/26	8/2	8/9	8/16	8/23	8/30	9/6	9/13	9/20	Calculated Season Total 4/
812	Nuchek Creek Port Etches			0	800				1000				2280
815	Constantine Creek Constantine Harbor		100	3000	4000				2000		5000		11260
821	Brown Bear Creek Shelter Bay				450				2000				3520
828	Cook Creek Anderson Bay				100		1000		2000				2590
831	Double Creek Double Bay					300			2000		100		2130
839	Dan's Bay Hawkins Cutoff					350			2500				3940
Other Streams (3) 2/ 3/		250	620	1550	900	850	800	880	1100	700	650	300	3440
DISTRICT TOTAL (14 Streams) 3/		350	880	4,880	6,410	6,700	7,600	8,880	12,600	10,800	8,550	5,250	29,160

1/ Ground counts underlined; others are aerial estimates.

2/ From records maintained on small streams which had a total of less than 2,000.

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

4/ Estimates calculated from stream life factor 2.5.

5/ Stream numbering system revised in 1962.

TABLE Q Recapitulation of Weekly Chum Salmon Counts by District, 1964
(Live Counts in Stream) 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	Calculated Season Total
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	Northwestern-Coghill		800	4580	16830	34020	64150	53605	43250	38105	28515	25650	19370	10220	2370	136590
10	Southwestern-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	Southeastern				350	880	4880	6410	6700	7600	8880	12600	10800	8550	5250	29160
134	Prince William Sound Total	500	5900	14300	38310	103095	162060	138225	133855	138260	113035	103975	83770	49320	21670	442,550

1/ The counts were derived from 1250 aerial surveys and 76 ground surveys.