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TAZIMINA RIVER SOCKEYE SALMON STUDIES

Evaluation of Spawning Ground Survey Data

by

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1.0 ABSTRACT

Available data on the relative magnitude of the sockeye salmon escapement to Tazimina River have been summarized. No counts or estimates of absolute escapement have been made. Some early evidence is almost anecdotal while recent stream survey data can be used as relative but quantitative abundance indexes with unknown but presumably wide confidence limits judging from experience elsewhere. The relative number of salmon observed in the canyon-falls area of Tazimina River over the period 1967-1981 have also been summarized.

Escapements to Tazimina River were low in the 1950's as were the total Bristol Bay salmon runs, which had declined in relation to earlier decades from excessive commercial harvest and unfavorable environmental conditions. Superimposed on this was an intensive subsistence fishery on Tazimina River stocks, especially during years of small runs. A strong resurgence of the Bristol Bay sockeye salmon runs commenced during the last salmon cycle and is also reflected in recent escapements to the Tazimina River where the trend follows an exponential curve.

TAZIMINA RIVER SOCKEYE SALMON STUDIES

2.0 INTRODUCTION

The Tazimina River is one of the major producers of sockeye salmon in the Newhalen River-Lake Clark component of the Kvichak River system in Bristol Bay in southwestern Alaska (Figure 1). Records of observavations on the spawning grounds of sockeye salmon in the Tazimina River system date back to 1920. Over the period 1920-1938 management agents and wardens of the Bureau of Commercial Fisheries (BCF) conducted ground, and to a much lesser extent, aerial surveys of the Tazimina River. The inconsistency of the coverage and timing of the surveys during this period do not generally permit a quantitative comparison of numbers, except in some years when index counts of spawners were made. From 1939-1957, except during the war years, 1942 and 1943, BCF personnel conducted systematic aerial surveys of a select group of index areas within the Kvichak system which also included the Tazimina River. Since 1955 the relative abundance of spawners in the Tazimina River has been routinely assessed by personnel of the Fisheries Research Institute (FRI).

This report was assembled under a contract with Dames & Moore ($3,500). All FRI original field observations 1947-1981 were financed by grants from the Bristol Bay salmon industry, the Bureau of Commercial Fisheries, and the Alaska Department of Fish and Game.

3.0 THE STUDY AREA

3.1 Physical Description

The Tazimina River is a tributary of the Newhalen River, and empties into Six-Mile Lake across from the village of Nondalton (Figure 1). Its total length is 54.0 mi, however, a falls 9.5 mi from the mouth presents a total block to salmon. The total accessible spawning area has been set at 792,308 yd^2 (163.7 a), from measurement of total river length and estimated average width below the falls. By visual inspection of gravel suitability for spawning, 22%, or 174,240 yd^2 (36.0 a), was classified as potential spawning area (Demory, Orrell and Heinle 1964). The river usually runs clear and seldom floods during the period of sockeye salmon spawning (exceptions 1959 and 1980) and is one of the few spawning areas in the Newhalen River-Lake Clark system where salmon can be consistently assessed by visual means.

3.2 Sockeye Salmon Runs

The time of occupancy of adult sockeye salmon in most years is from mid-July to mid-September, however, during some years of large runs, live salmon have been observed into mid-October. The period of spawning occurs from 15 August to 10 September in most years, but can be appreciably extended in years of large runs. Distribution extends to the falls in years of large abundance, however, most spawning occurs below river mile 7 where several heavily braided areas containing numerous side channels are utilized in most years.

4.0 MATERIALS AND METHODS

4.1 Materials

All existing BCF and FRI spawning ground records for the Kvichak River system were thoroughly reviewed for information on Tazimina River. The BCF data covering the period 1920-1957 were acquired from semi-monthly and Annual Management Reports, Reports of the Commissioner of Fisheries to the Secretary of Commerce (Alaska Fishery and Fur Seal Industry Reports), and considerable unpublished information acquired in 1975 from the archives of the National Marine Fisheries Service (NMFS) Lab in Auke Bay, Alaska.

4.2 Survey Methods

Since 1955 FRI has conducted systematic aerial, and to a much lesser extent ground, boat and scuba, surveys of many of the more than 100 spawning areas utilized by sockeye salmon in the Kvichak system. The common procedure has been to conduct aerial surveys on calm, clear days, between 1000 h and 1500 h whenever practicable. Optimal airspeed and altitude have ranged between 70 to 100 mph and 300 to 500 ft, respectively. Observers wearing polaroid glasses have made counts of live and dead salmon, usually in units of 100 and 1000.

It is recognized that estimates of salmon abundance at any one time do not correctly estimate the total number of spawners returning to the spawning gravels of an individual spawning area, as spawners are not a stationary population and new entrants arrive to take the place of those that die after spawning. Therefore, in practice it has been attempted to cover all major spawning areas at least once and sometimes two or three times during the season to assure observations during the peak of spawning, here defined as the time of the maximum abundance of spawners.

It is also recognized that counts of every fish in a stream, pond, or beach spawning area cannot be made by an observer flying overhead at 70 to 100 miles an hour. Spawning populations often number up to several hundred thousand in years of large runs and may be distributed over only a few miles of river or beach with spawner densities of several to a square meter. Thus, the objective has been to obtain an index of relative abundance, during or near the peak of spawning when the maximum observed abundance of spawners are present. In practice this maximum observed abundance has been used as an index to the number of spawners and is used for year to year comparisons. This index represents at best a measure of peak abundance, or some unknown portion of the true population returning to a spawning area.

4.3 Data Analysis

All quantitative data for Tazimina River were grouped into four periods of information, but with some overlap.

4.3.1 Period 1920-1938. BCF personnel conducted ground, boat, and to a much lesser extent, aerial surveys of a number of important Kvichak spawning areas during most years over the period 1920-1938. The consistency of the coverage, timing of the surveys, together with the overlap of personnel during this period, generally only permit a qualitative comparison of abundance. Assessments of overall abundance to the Kvichak system were usually presented as descriptions of completeness of utilization of available spawning grounds. However, during some years, for a number of important spawning areas, oftentimes including Tazimina River, index counts of spawners were obtained.

4.3.2 Period 1939-1957. From 1939-1957, excluding 1942 and 1943, BCF personnel established a program that systematically surveyed a group of index areas and this data was then used to obtain an estimate of Kvichak

escapement (Eicher 1952[1]). Ground and boat surveys were less extensive during this period with aerial surveys becoming the major method of assessment.

4.3.3 Period 1947-1954. From 1947-1954, FRI, financed by the salmon processors of Bristol Bay, made occasional spawning ground surveys of some of the major spawning groups. Generally the coverage and timing of these surveys was not as conducive towards obtaining estimates of peak spawner abundance as were the BCF surveys conducted during these same years.

4.3.4 Period 1955-1981. Beginning in 1955, FRI established a much expanded stream survey program with increased funding from BCF. Since 1955 FRI has systematically conducted spawning ground surveys in the Kvichak system. The number of stream, pond, and mainland and island beach spawning areas routinely indexed has increased considerably in relation to earlier survey periods. Aerial surveys have continued to be the major method of assessment.

4.3.5 Use of Data. In this report all the presented peak index values for the Tazimina River prior to 1955, except 1949, are from BCF records. Data presented for 1949 and 1955-1981 are from FRI stream survey records.

4.3.6 Criteria Used in Selecting Peak Index Values. During many years the Tazimina River was surveyed more than once during the season. For these years the following criteria were used in selecting the peak index values presented in this report.

1) The experience and consistency of the observer. It is statistically better to use only one observer over a number of years.
2) The quality of the survey; light, wind, and other visibility criteria were considered.

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[1]Eicher, G. J. 1952. Bristol Bay stream survey indices, 1939-1951. U. S. Fish. Wildl. Serv., unpublished manuscript. 9 pp.

3) The extent and coverage of the survey.

4) The timing of the survey was carefully considered. If the survey was too early some fish may not have arrived and a large portion of fish present may have been schooled both in the stream and off the mouth. Accuracy decreases rapidly when fish are densely schooled and some portion of fish schooled off or in the vicinity of the mouth may have been destined to spawn in other areas. Surveys made past the peak of spawning tend to err on the low side. Counts of morbibund and dead fish tend to be much less reliable than counts of the same population live and distributed evenly over the spawning gravels. Salmon carcasses in streams tend to become concentrated and silted down in deep pools, eddies, and along and under banks.

During those years when only one spawning ground survey was made, even though it was not always made during the peak of spawning, unless the timing and survey conditions were too inadequate for reasonable comparison to other years, the index values were used. In this work the index values recorded for the years 1959, 1972, and 1973 were not used in the calculation of range and mean values because of poor visibility and late timing.

4.3.7 Direction. The data analysis was directed towards determining the past relative contribution of Tazimina River to the total salmon escapement to the Newhalen River-Lake Clark system, and the Kvichak system as a whole. No attempt is made to incorporate catch data from the Bristol Bay commercial fishery which on the average takes 40 to 50% of the Kvichak run. In practice, this does not change the relative importance of the Tazimina River salmon resource, but it certainly underestimates its absolute production. In addition, the portion of salmon in the canyon-falls

area (RM 8.5-9.5) of Tazimina River was determined from magnetic tape recordings of descriptive accounts of estimated numbers made during aerial surveys conducted over the period 1967-1981.

5.0 RESULTS AND DISCUSSION

5.1 Relative Importance of Tazimina Sockeye Salmon Runs

All available information concerning Tazimina River peak spawning ground indexes is presented in Table 1. Since no absolute escapement values have been made for Tazimina River its importance can only be assessed in relative terms. The relative importance of Tazimina River salmon production was examined in a number of ways.

5.1.1 Tazimina River Peak Spawning Ground Index as Percent of Total Kvichak Escapement Count

The relationship of the Tazimina River peak spawning ground index to the total Kvichak escapement shows it represents 0 to 4.49% and .80%, range and mean, respectively (Table 1, Figures 2 and 3a), during the years 1955-1981, the only period for which there exists absolute estimates of the Kvichak escapement. It should be cautioned that in this particular case we are comparing an index of escapement, which only represents the abundance of spawners at one time, and not the total number of spawners, to an absolute estimate of escapement obtained from a systematic count over time, with no adjustment being made to expand the index to represent the true Tazimina River escapement.

5.1.2 Tazimina River Peak Spawning Ground Index as Percent of Total Spawning Ground Index

Comparison of the Tazimina River index to the total index of spawners accounted for in Kvichak system spawning ground surveys shows it contributing 0 to 17.65% and 4.22%, range and mean, respectively (Table 1, Figures 4 and 3b), during the years 1955-1981. The total index of spawners accounted for represents the total peak spawning ground counts of salmon from all stream, pond, and mainland and island beach spawning areas surveyed.

5.1.3 Tazimina River Peak Spawning Ground Index as Percent of Total Index of Stream Spawning Areas

The Tazimina River index as a percent of the total index of stream spawning areas shows it contributing 0 to 24.93% and 6.16%, range and mean, respectively (Table 1, Figures 5 and 3c), during the period 1955-1981. The total index of stream spawning areas represents the total of peak spawning ground counts of salmon for all stream spawning areas surveyed. This comparison within the same spawning area type is made because indexes between different spawning area types are not directly comparable due to differences in visibility and other conditions.

5.1.4 Tazimina River Peak Spawning Ground Index as Percent of Four Major Rivers Routinely Indexed

Considering the Tazimina River index as a percent of the total index of four major rivers routinely surveyed (Copper, Iliamna, Gibraltar and Tazimina) shows it contributing 0 to 43.7% and 13.38%, range and mean, respectively. This comparison is made to utilize available quantitative information prior to 1955 to further investigate the relative importance and trends through time.

5.1.5 Tazimina River Index as Percent of Newhalen River-Lake Clark System Escapement Counted Above the Newhalen River Proper

The Tazimina River peak spawning ground index as a percent of the total escapement to areas above the Newhalen River in the Newhalen River-Lake Clark system can only be reasonably estimated for the 3 years 1979-1981, when the escapement up the Newhalen River was systematically counted from intermittent visual counts. These 3 years of data show the Tazimina River index representing 7.05 to 13.03% and 9.57%, range and mean, respectively, of the escapement to spawning areas above the Newhalen River, here defined as above the outlet of Six-Mile Lake. Salmon catches of the Nondalton subsistence fishery were subtracted from the Newhalen River escapement

estimates before this comparison was made. Once more it is cautioned that we are comparing an index of escapement (Taximina River spawning ground index) to an estimate of escapement obtained from a systematic count over time with no adjustment being made to expand the index to represent the true Taziminia River escapement.

5.1.6 Differences from Values Presented in Earlier Publications

The only significant difference in Taximina River peak spawner indexes presented here from earlier publications is the value for 1940. In Demory et al., (1964) the only survey recorded for 1940 reports 500,000 salmon on the 26 July. The details of this survey (Lucas 1940[2]) were looked at closely. The statement is made that "there appeared to be over 500,000 reds in the river and just off the mouth. Very few of these fish had begun spawning as yet." Tazimina River was flown again on 21 August and the index of spawners numbered 14,250. Eicher (loc. cit.) uses the 21 August index of 14,250 as the peak index in his report. Examination of the Naknek-Kvichak catch data and stream survey index data for other Iliamna Lake and Lake Clark spawning areas surveyed in 1940 gives no indication of a run size large enough to obtain an index of 500,000 for the Tazimina River. The 26 July survey was flown almost 1 month prior to the normal time of peak spawning in the Tazimina River. Experience tells us that the 26 July survey was too early to assess the relative number of spawners returning to the Tazimina River. Many of the salmon seen in this survey were probably densely schooled near the mouth and others concentrated in adjacent side sloughs along the shore of Six-Mile Lake. For there to be such a difference in the two indexes, considerable numbers must have been destined to spawn in other areas of the Lake Clark system. Similar situations have been observed in FRI surveys over the years.

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[2]Lucus, F. R. 1940. Kvichak watershed escapement. Pages 21-22 in Bristol Bay District Annual Rpt. in 1940.

5.2 Trends in Tazimina River Sockeye Salmon Production

Examination of Tazimina River peak spawning ground indexes, relative percent contribution relationships, and Kvichak River escapement counts (Table 1, Figures 2-7) shows a recent increasing trend of higher contributions of Tazimina River sockeye salmon to the total Kvichak escapements. Explanation of the recent buildup of the Newhalen River-Lake Clark system, which includes Tazimina River, is documented in internal FRI reports which will soon be published and will not be discussed further here. We do know from historical records that back in the 1920's and 1930's there were a number of years of very strong runs to the Newhalen River-Lake Clark system. Unfortunately no quantitative data presented as index counts for Tazimina River, or other important Kvichak spawning areas, were obtained during these years. However, reliable qualitative descriptions exist and leave little doubt that several runs in the 1930's equaled, and most likely far exceeded, any of the large runs that have since occurred in this system, with the possible exception of the large run of 1979. This suggests that the Tazimina River may have not achieved its full potential since most of the quantitative historic studies of this system have occurred during a period when the entire Kvichak system was in, or recovering from, a depressed state. The full potential of Tazimina River is not known since no measurements of total escapement have been made. Index counts range from 0 to 500,000. Spawners do not represent a stationary population as new entrants arrive to take the place of those that die after spawning. The degree to which subsequent spawners utilize spawning gravels occupied earlier in the spawning season has not been studied.

5.3 Portion of Salmon in the Canyon-Falls Area

The results of the evaluation of the portion of salmon that have been observed in the canyon-falls area of the Tazimina River is summarized in Table 2. The percent of the peak spawning ground index observed in the canyon-falls area ranged from 0 to 5.24% over the period studied, 1967-1981. Generally the portion of salmon observed in the canyon-falls area was proportional to the size of the return. This area is highly unsuitable habitat for successful spawning because of bedrocks and high water velocity. Loose eggs were observed in one eddy in the canyon during an aerial survey in 1974.

5.4 Limitations of Data

There are a number of limitations to the data presented here which affect their usefulness and must be considered when interpretations are made.

5.4.1 Impact of Subsistence Fishery on Tazimina River Salmon Runs

Considerable limitations concerning the results presented here are imposed by the impacts of personal use, or subsistence fisheries, on Tazimina River sockeye salmon stocks. The cumulative total subsistence catch of sockeye salmon in the Kvichak River system as a percent of the cumulative total Kvichak escapement, for the years of complete records, 1955 and 1963-1981, represents 1.21%, while the annual subsistence catch as a percent of the Kvichak escapement ranges from .29% to 32.53% (Table 3). Tazimina River stocks, like all other Kvichak stocks, are first impacted by the low level subsistence fishery at the outlet of Iliamna Lake (Igiugig), just upriver from where the Kvichak escapement is systematically counted (Figure 1). Next, Tazimina River salmon returns are moderately impacted by the village of Newhalen personal use fishery as they pass up the Newhalen River.

However, by far the greatest impact on Tazimina River salmon returns comes from the Nondalton subsistence salmon fishery which is centered in Six-Mile Lake directly adjacent to the Tazimina River.

The Nondalton personal use fishery has accounted for nearly 40% of the cumulative total recorded subsistence catch for the Kvichak system from 1955-1981, and its annual catch as a percent of the total Kvichak subsistence catch ranges from 15.60% to 64.78% (Table 3). Annually this fishery catches some unknown portion of the salmon returning to Tazimina River and other spawning areas of the Newhalen River-Lake Clark system. Recorded catches of sockeye salmon over the period 1955-1981 range from 8,000 to 49,000, and average nearly 28,000 (Table 3). There is a recent declining trend of catches due to reduced effort, however, this has been partially compensated for by a concurrent increase in the sport catch of salmon, predominately as they migrate up the Newhalen River enroute to Tazimina River and other spawning areas.

It is not possible to reasonably estimate the portion of the annual salmon run to Tazimina River that has been taken by the Nondalton fishery since salmon destined for other spawning areas of Lake Clark have also been vulnerable to this fishery as they passed through Six-Mile Lake. However, it is known that salmon returns to the Tazimina River in years of low and moderate abundance have been significantly impacted (Figures 2 and 7). In this report no attempt was made to adjust for the effects of the subsistence fishery except in section 5.1.5. Therefore, the information presented here on the past relative importance of the Tazimina River sockeye salmon resource errs on the conservative side, and should be treated, or accepted, with caution.

5.4.2 Other Limitations

1) As may be expected, the accuracy of aerial surveys is inversely proportional to the density of populations and the variance in an observer's estimate is proportionate to the size of the estimate. Experiments conducted elsewhere have indicated that an observer will detect differences in population size of plus or minus 50% (Bevan 1961).

2) Estimates made at any one time do not correctly estimate the total number of spawners as the population is not stationary and some fish remain unobserved in deep pools, under overhanging brush or trees, or below the limits of visibility in turbid or glacier-fed rivers or lakes. Observations will give at best an index, or a relative fraction, of the true number of spawners. Assuming that the length of life of individuals on the spawning beds is relatively constant from year to year we can use the maximum observed abundance as an index to the number of spawners.

3) Timing is critical as the objective is to obtain indexes at the peak of abundance, or peak of spawning. Accuracy decreases rapidly when fish are densely schooled or when many are dead and discolored and oftentimes silt covered or washed under and along stream banks.

4) Varying weather and visibility conditions, different observers, pilot ability and other problems common to all aerial surveys contribute to the extraneous variance.

5) Visibility differs between areas and area types, which greatly influences the indexes obtained. The prime example of this is the Newhalen River-Lake Clark system where glacial flour restricts visibility in many areas, especially along Lake Clark beaches and in the Newhalen River (not so much recently but during many

years prior to the 1970's).

6) Typically our aerial survey counts have accounted for less than 20% (range 8-33%) of the total Kvichak escapement in any one year (Poe 1981[3]). No attempt has been made to expand survey counts to account for the entire escapement. For these reasons the numbers presented in our stream surveys must be considered as indexes of escapements only and not as actual escapements.

7) The effectiveness of our surveys increased through the years as we became more familiar with the spawning areas and the timing of peak spawning in different areas, but the extent of this is difficult to assess and it does not effect a comparison of indexes between areas over a series of years.

5.5 Other Sources of Possible Information

5.5.1 BCF Photographic Surveys of Tazimina River

From 1947-1955 photographic surveys of sockeye salmon spawners were conducted in Bristol Bay river systems by BCF personnel (Kelez 1947 and Eicher 1953). Photographically, index areas within index areas were used. The Tazimina River was one area that was routinely photographed. The area photographed is the first straight stretch above the mouth (RM 1.5-2.0). An unsuccessful search was made for these records at the NMFS Auke Bay Lab in 1975. It is not known if these records still exist. Mr. George Eicher was contacted. The last time he saw these records was in 1956 in Seattle.

[3]Poe, P. H. 1981. Kvichak Sockeye Salmon Studies - 1981 Kvichak spawning ground surveys. Univ. Washington, Fish. Res. Inst. Unpublished Preliminary Report, 15 December 1981, 14pp.

5.5.2 1979 Photographs of High Density Spawning in Tazimina River

A unique series of high quality photographs were taken by Mr. Tom Kline, a graduate student working on the FRI project on 24 August. The Tazimina River peak spawning ground index for 1979 is the highest on record (503,750). Analysis of these photographs could provide valuable information on optimum utilization, distribution, and high density spawning.

6.0 SUMMARY

Historic BCF and FRI spawning ground surveys were evaluated to determine the past relative contribution of Tazimina River to total counted salmon escapement to the Newhalen River-Lake Clark system and the Kvichak system as a whole. Catch data from the Bristol Bay commercial fishery, which on the average takes 40 to 50% of the Kvichak run, was not incorporated in the analysis. Although this does not change the relative importance of the Tazimina River salmon resource, it certainly underestimates its absolute production. The relative portion of salmon that were observed in the canyon-falls area of Tazimina River over the years 1967-1981 was also evaluated.

The peak spawning ground indexes of Tazimina River sockeye salmon have represented 0 to 4.49% of the total Kvichak River system counted escapement, 0 to 17.65% of the total index of sockeye salmon accounted for on the spawning grounds, and 0 to 24.93% of the total index of stream spawning areas of the Kvichak system. Peak spawning ground indexes of the Tazimina River the last 3 years have represented 7.05 to 13.03% of the total estimated escapement to areas above the Newhalen River. A recent trend of higher contributions of Tazimina River salmon to the total Kvichak escapements is indicated. The percent of the peak spawning ground index observed in the canyon-falls area of Tazimina River ranged from 0 to 5.24%.

Considerable limitations are imposed on all of the relative quantitative abundance indexes presented because of extraneous unknowns concerning the relationship of indexes to true escapement values and the impacts of the subsistence salmon fishery. While recorded Kvichak escapements have varied 2 orders of magnitude Tazimina River indexes have varied 5 orders of magnitude. Part of this difference is attributable to the high vulnerability of Tazimina River salmon to the subsistence fishery in years

of low level Kvichak escapement. Thus the information presented here on the relative importance of the Tazimina River sockeye salmon resource probably errs on the conservative side.

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Eicher, G. J., Jr. 1953. Aerial methods of assessing red salmon populations in western Alaska. J. Wildl. Mangmt. 17(4): 521-527.

Kelez, G. B. 1947. Measurement of spawning populations by means of aerial photography. Pac. Fishm., 45:46-51.

Table 1. Tazimina River. (1) Peak spawning ground index (PSGI), (2) PSGI as PCNT total Kvichak escapement, (3) PSGI as PCNT total accounted for in stream surveys, (4) PSGI as PCNT total of stream spawners accounted for in stream surveys, (5) PSGI as PCNT of 4 major river systems indexed routinely over time, (6) PSGI as PCNT of Lake Clark escapement. Sockeye salmon, Kvichak River system, Bristol Bay, Alaska.

YEAR	(1)	(2)	(3)	(4)	(5)	(6)
1920	50	*	*	*	*	*
1924	40000	*	*	*	10.92	*
1940	14250	*	*	*	*	*
1941	7650	*	*	*	17.83	*
1944	6600	*	*	*	39.29	*
1945	7500	*	*	*	19.11	*
1946	8500	*	*	*	15.37	*
1947	36700	*	*	*	25.74	*
1948	24700	*	*	*	23.96	*
1949	12000	*	*	*	**	*
1950	7500	*	*	*	11.19	*
1951	4000	*	*	*	2.50	*
1952	17000	*	*	*	5.15	*
1953	17000	*	*	*	20.48	*
1954	3400	*	*	*	9.94	*
1955	85	.03	.26	.30	.58	*
1956	32300	.34	2.43	3.21	6.18	*
1957	10000	.35	2.83	3.83	6.92	*
1958	600	.11	.61	.90	2.54	*
1959	150**	**	**	**	**	*
1960	55000	.38	1.93	4.12	10.05	*
1961	30000	.81	4.58	7.65	10.32	*
1962	4000	.15	1.40	1.81	2.93	*
1963	0	.00	.00	.00	.00	*
1964	150	.02	.16	.21	.50	*
1965	49100	.20	1.34	3.92	6.64	*
1966	4880	.13	.79	1.16	2.04	*
1967	1560	.05	.29	.43	.56	*
1968	250	.01	.07	.12	.20	*
1969	22610	.27	3.32	5.57	12.29	*
1970	85450	.61	3.25	6.53	12.76	*
1971	12925	.54	2.96	4.10	7.42	*
1972	20**	**	**	**	**	*
1973	12**	**	**	**	**	*
1974	104470	2.36	11.66	17.79	41.69	*
1975	149950	1.14	5.66	9.25	18.53	*
1976	16390	.83	***	***	13.84	*
1977	7205	.54	***	***	7.24	*
1978	146900	3.54	16.72	21.69	43.70	*
1979	503750	4.49	17.65	24.93	43.33	7.05
1980	128500	.57	6.52	7.95	14.40	8.62
1981	28215	1.67	8.40	10.05	15.46	13.03
RANGE	0 TO 503750	0 TO 4.49	0 TO 17.65	0 TO 24.93	0 TO 43.70	7.05 TO 13.03
ARITH MEAN	41054 N=39	.80 N=24	4.22 N=22	6.16 N=22	13.38 N=36	9.57 N=3

* INSUFFICIENT DATA FOR COMPARISON.

** SURVEY CONDITIONS OR TIMING INADEQUATE. DATA NOT USED TO MAKE COMPARISONS OR IN CALCULATIONS OF MEAN VALUES.

*** DATA TAKEN BUT PRESENTLY NOT SUMMARIZED IN THIS FORM.

SOURCE 1920-1954 (EXCEPT 1949) BCF RECORDS AND REPORTS.

1955-1981 + 1949 FRI STREAM SURVEY DATA.

Table 2. Percent of Tazimina River peak spawning ground index of sockeye salmon documented in the Canyon-Falls area (river miles 8.5-9.5) during the period 1967-1981.

Year	Date	Index Canyon-Falls	Total index	Percent in Canyon-Falls
1967	14 Aug	*	1,560	*
1968	12 Sep	*	250	*
1969	5 Sep	***	22,610[1/]	***
1970	25 Aug	2,500	85,450	2.93
1971	2 Sep	**	12,925	**
1972	27 Sep	****	****	****
1973	28 Sep	****	****	****
1974	5 Sep	5,470	104,470	5.24
1975	10 Aug	1,400	149,950	0.93
1976	23 Aug	245	16,200	1.49
1977	1 Sep	0	7,205	0
1978	23 Aug	***	146,900	***
1979	6 Sep	13,500	503,750	2.68
1980	6 Sep	2,600	128,500	2.02
1981	6 Sep	220	28,215	0.78
Range		0-13,500	250-503,750	0-5.24
MEAN	Arithmetic	3,242	92,922	2.01
	Geometric	660	27,344	1.75
		n = 8	n = 13	n = 8

* No coverage of upper river as survey terminated after running out of fish in lower reaches.

** Coverage mouth to falls but no breakdown by sections.

*** Fish distributed from mouth to falls but no breakdown by sections.

**** Survey too late to be representative.

Source: Dictabelt and cassette tape records of stream surveys conducted by P. H. Poe, 1967-1981.

[1/] Peak spawning ground index count is from 11 Aug. survey when fish extended to 1 mile below falls; fish distribution extended to falls on 5 Sep.

Table 3. Kvichak River system sockeye salmon subsistence information (1) Kvichak escapement, (2) Kvichak system total subsistence catch, (3) Total Kvichak subsistence catch as percent of total Kvichak escapement, (4) Nondalton subsistence catch, and (5) Nondalton subsistence catch as percent of total Kvichak subsistence catch, 1955 and 1963-1981.

Year ****	(1) ********	(2) ******	(3) *****	(4) *****	(5) *****
1955	250,546	81,510	32.53	27,360	33.57
1963	338,760	56,600	16.71	25,000	44.17
1964	957,120	79,000	8.25	35,000	44.30
1965	24,325,926	69,500	.29	35,500	51.08
1966	3,775,184	70,700	1.87	45,800	64.78
1967	3,216,208	63,600	1.98	29,600	46.54
1968	2,557,440	68,600	2.68	33,700	49.13
1969	8,394,204	74,200	.88	44,000	59.30
1970	13,935,306	105,651	.76	42,880	40.59
1971	2,387,392	61,709	2.58	22,089	35.80
1972	1,010,000	50,156	4.97	24,057	47.96
1973	226,554	39,127	17.27	8,545	21.84
1974	4,433,480	98,015	2.21	29,509	30.11
1975	13,140,450	115,516	.88	48,704	42.16
1976	1,965,282	75,936	3.86	20,490	26.98
1977	1,341,144	71,940	5.36	27,175	37.77
1978	4,149,288	83,859	2.02	17,289	20.62
1979	11,218,434	65,520	.58	14,749	22.51
1980	22,505,268	72,556	.32	11,316	15.60
1981	1,754,358	75,554	4.31	15,153	20.06
Total	121,882,344	1,479,249		557,916	
Mean	6,094,117	73,962	1.21*	27,896	37.72*
Range	226,554 to 24,325,926	39,127 to 115,516	.29 to 32.53	8,545 to 48,704	15.60 to 64.78

* Represents percent of cumulative totals.

Data Source 1955 and 1963-1964 FRI records
1965-1981 Alaska Department of Fish and Game (Dick Russell)

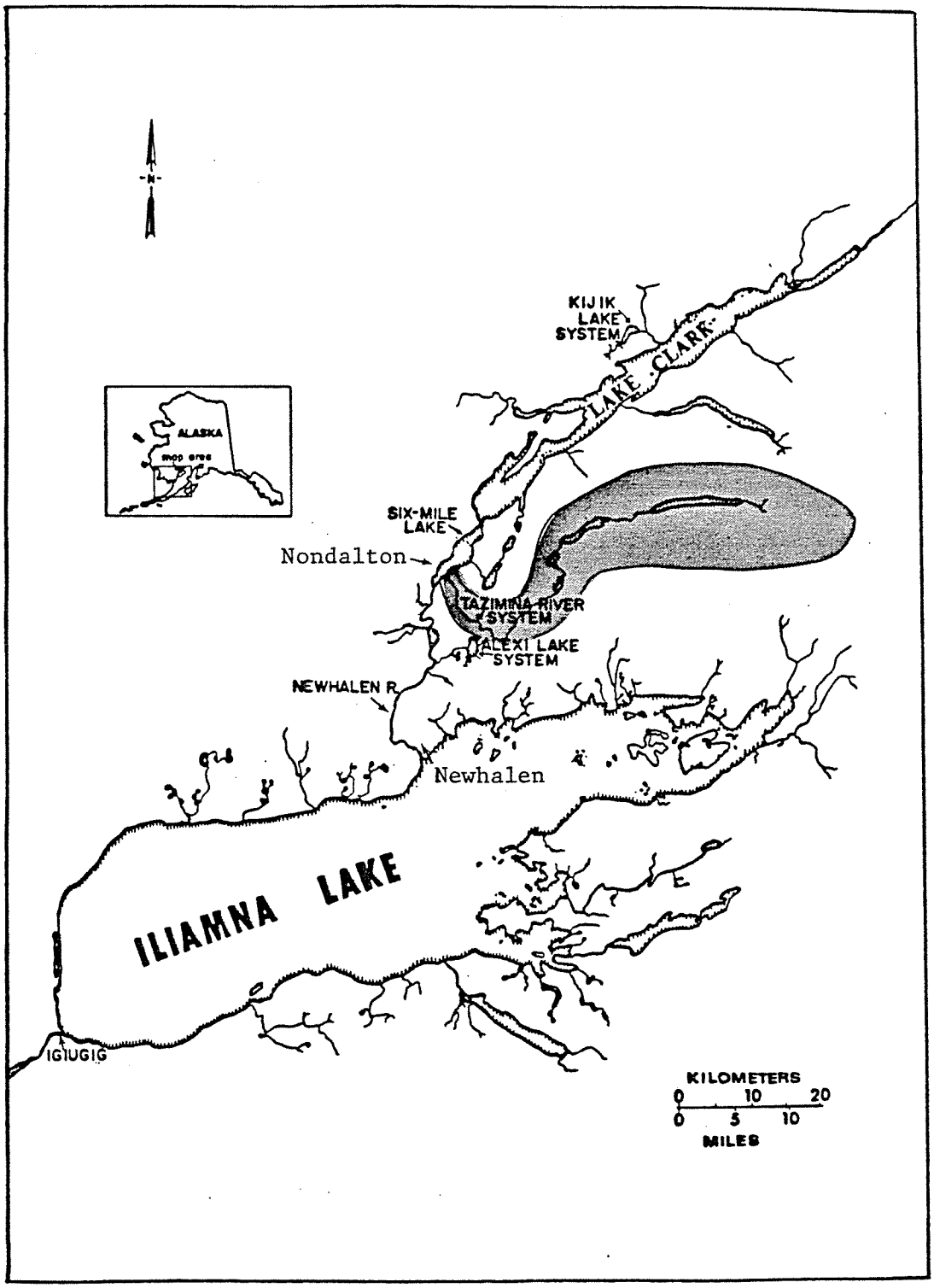


Fig. 1. Location of the Tazimina River system (shaded area) in the Newhalen River-Lake Clark system of the Kvichak River system.

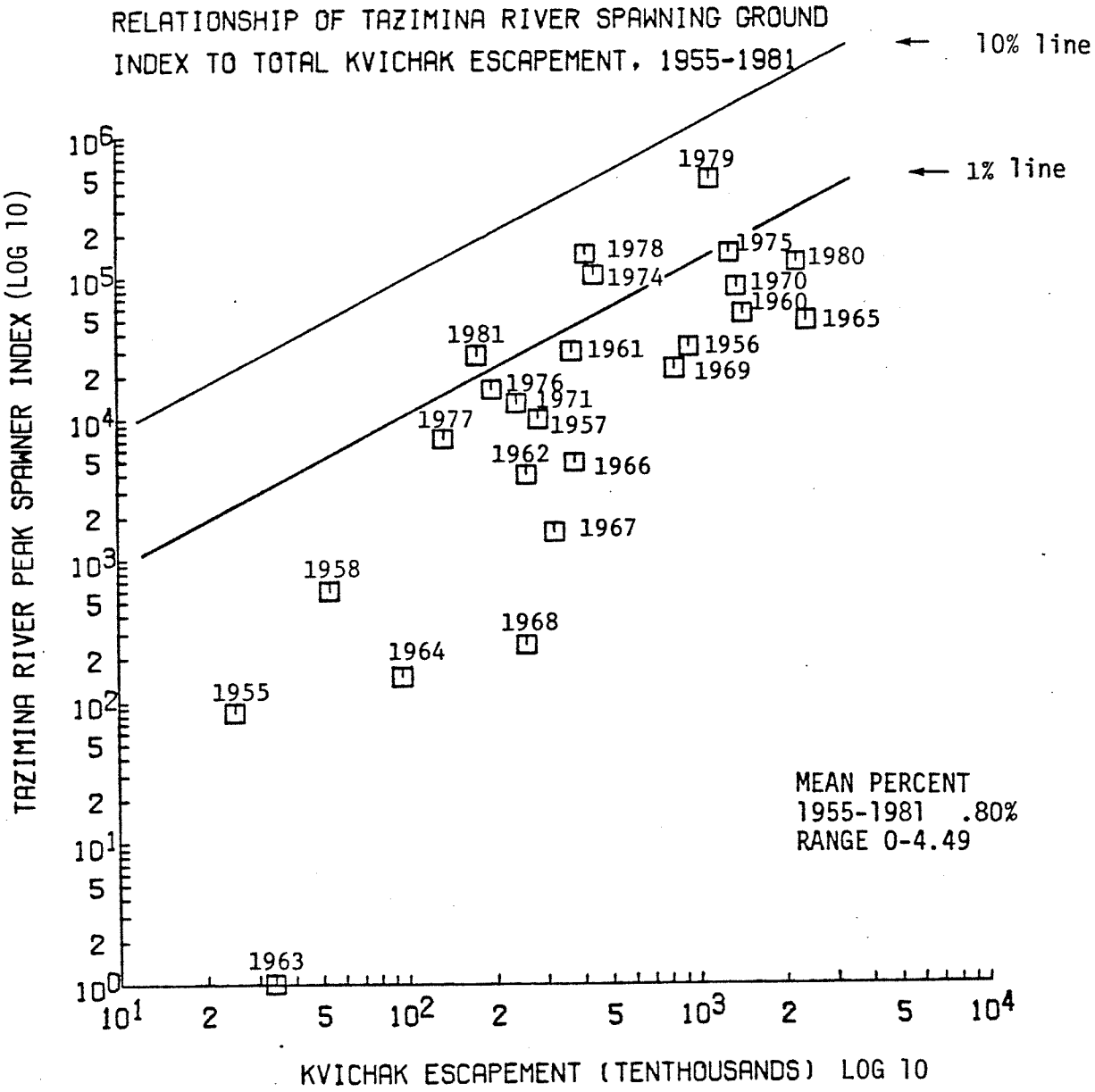
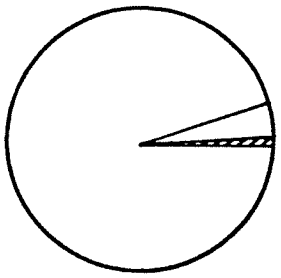
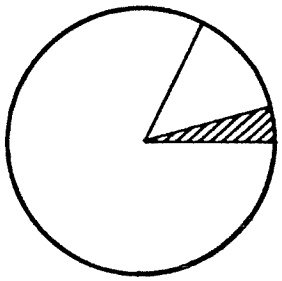


Fig. 2. Tazimina River peak spawning ground index as a percentage of total Kvichak River system escapement.



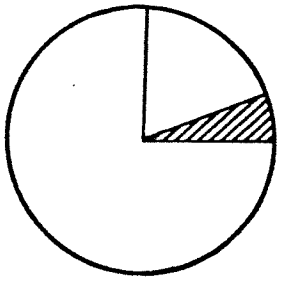
RANGE 0 - 4.49%
MEAN .80%

Fig. 3a. Tazimina River peak spawning ground indexes as a percentage of total Kvichak River system escapements, 1955-1981.



RANGE 0 - 17.65%
MEAN 4.22%

Fig. 3b. Tazimina River peak spawning ground indexes as a percentage of total index accounted for in Kvichak stream surveys, 1955-1981.



RANGE 0 - 24.93%
MEAN 6.16%

Fig. 3c. Tazimina River peak spawning ground indexes as a percentage of total index of Kvichak system stream spawning areas, 1955-1981.

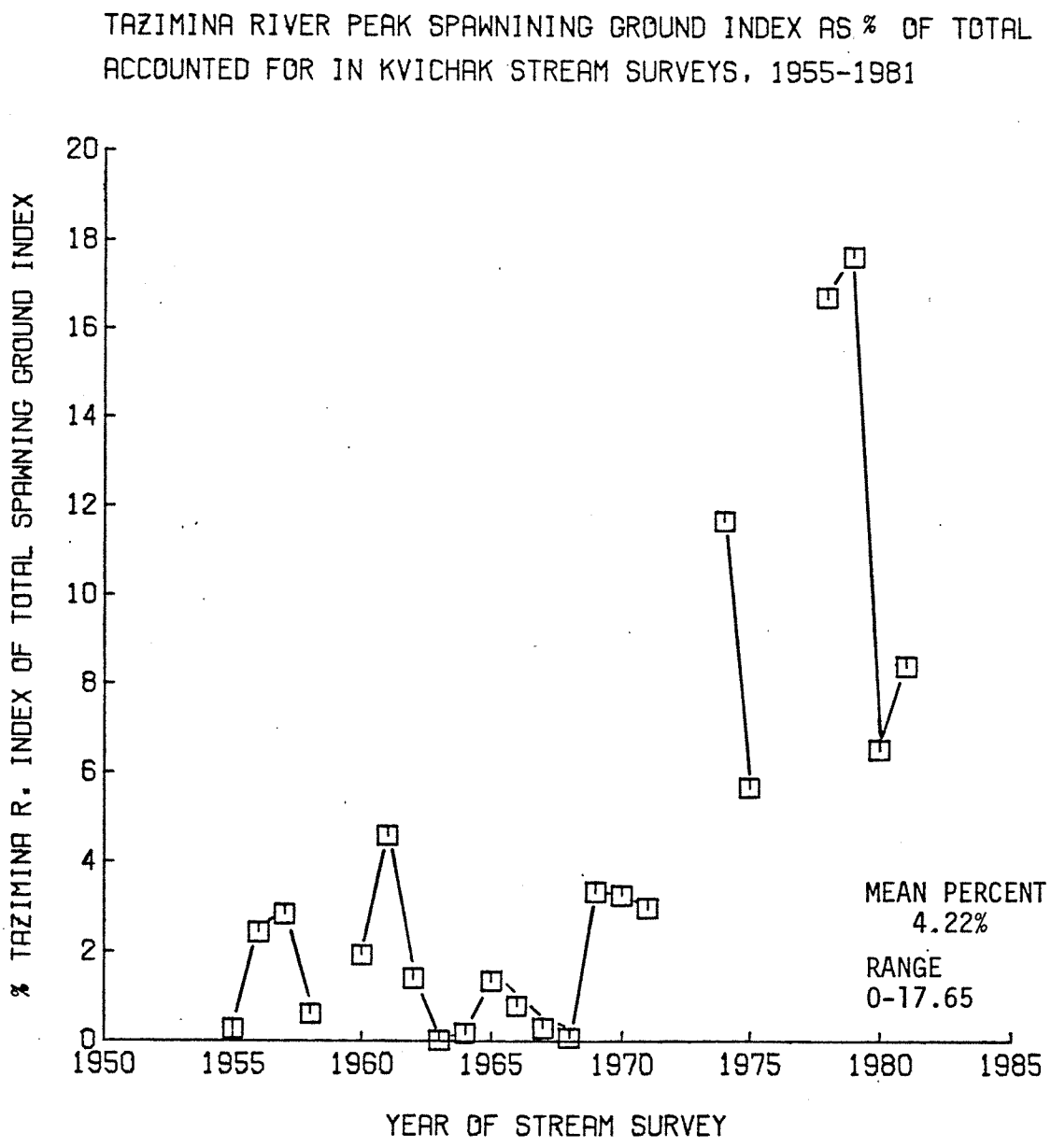


Fig. 4. Tazimina River peak spawning ground indexes as a percentage of total index accounted for in Kvichak system stream surveys, 1955-1981.

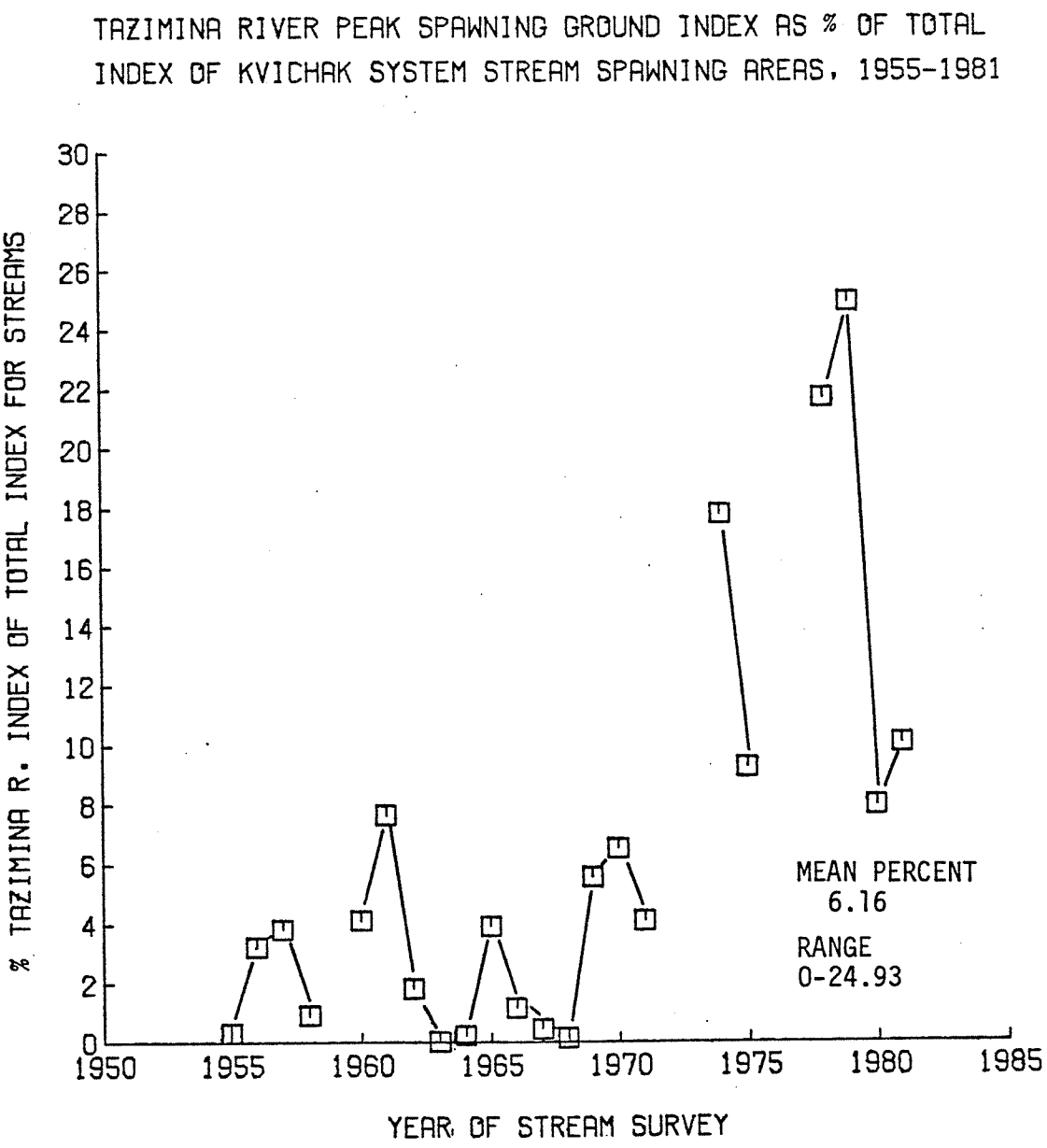


Fig. 5. Tazimina River peak spawning ground indexes as a percentage of total index of Kvichak system stream spawning areas, 1955-1981.

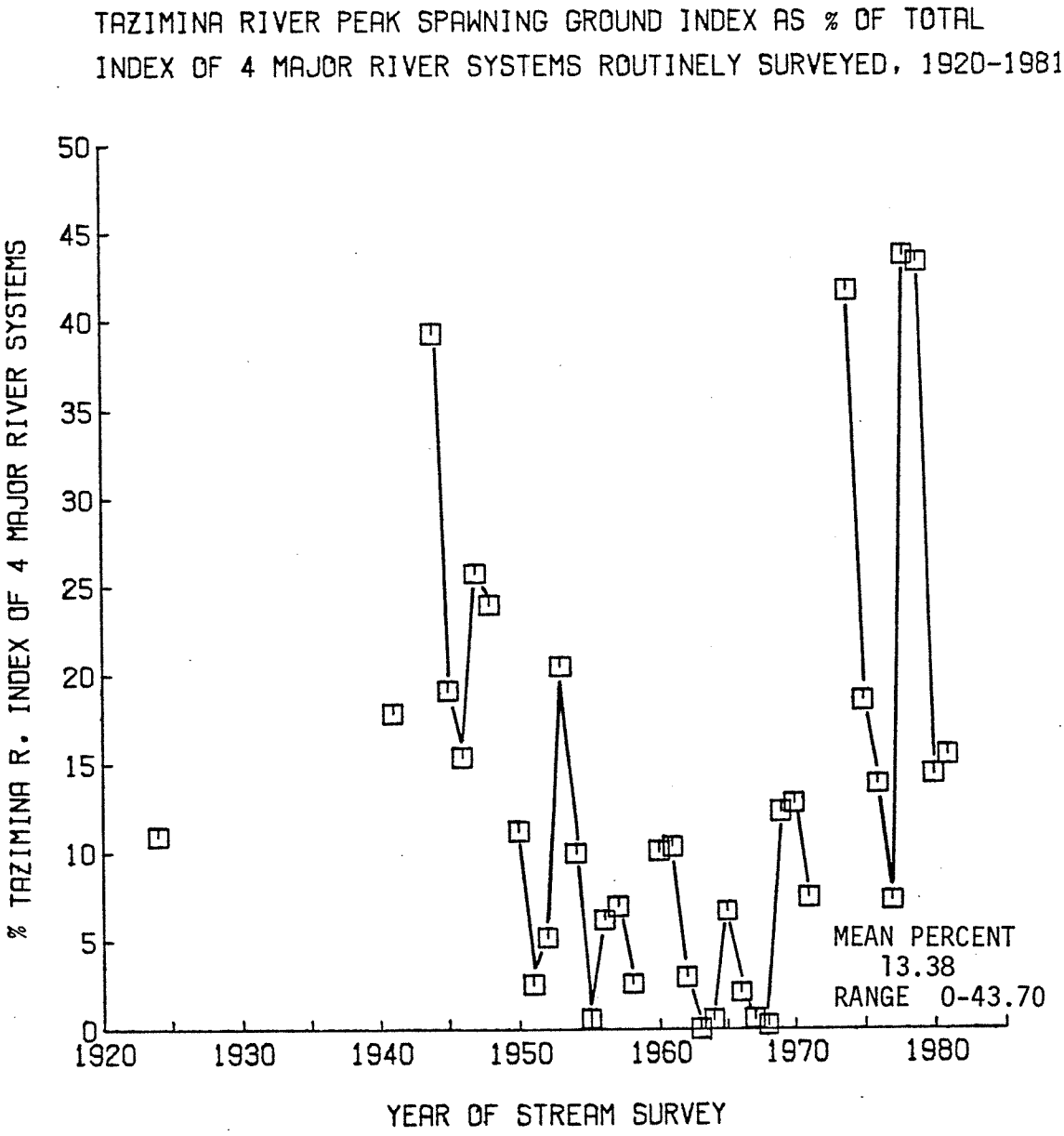
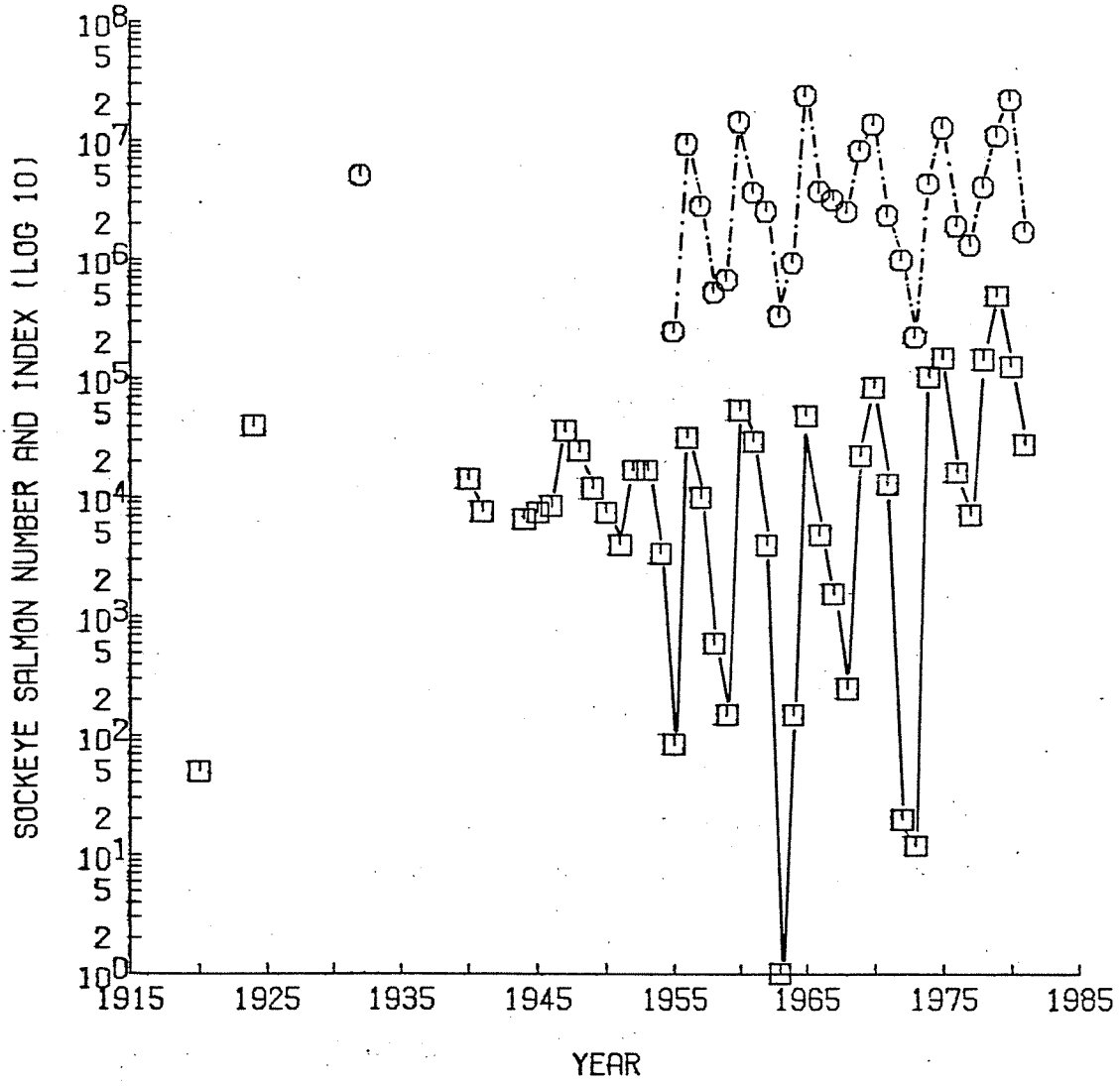


Fig. 6. Tazimina River peak spawning ground indexes as a percentage of total index of 4 major river systems routinely surveyed, 1920-1981 (Copper, Gibraltar, Iliamna and Tazimina River systems).

KVICHAK RIVER SYSTEM TOTAL ESCAPEMENT AND TAZIMINA RIVER PEAK SPAWNING GROUND INDEX INFORMATION DURING THE PERIOD 1920-1981



⊡	YEAR VERSUS TAZRINDEX	RANGE	0 - 503,750
⊙	YEAR VERSUS KVISESCAPE	RANGE	226,554 - 24,325,926

Fig. 7. Kvichak River total escapements and Tazimina River peak spawning ground index information during the period 1920-1981.