SPAWNING FISH SURVEYS IN COASTAL WATERSHEDS, 1968

by
Delbert G. Skeesick

Oregon Fish Commission
Coastal Rivers Investigations

August 1969

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SPAWNING FISH SURVEYS IN COASTAL WATERSHEDS, 1968

GENERAL INFORMATION

Spawning fish surveys on index areas of Oregon coastal rivers and tributaries are made annually by personnel of Coastal Rivers Investigation, Oregon Fish Commission. Annual peak counts of spawning salmon in the survey areas provide data for computing an index of the escapement into a coast-wide "fish-per-mile" figure for each species. Trends in abundance of spawning salmon are noted by comparing these data over a period of years. This report presents peak counts for 1968-69 and makes comparisons with similar data from previous years.

The earliest spawning fish surveys were established 22 years ago, and others were added as needed to form a coast-wide sampling program. Present annual survey distances are 28.5 miles for spring chinook, 37.7 miles for fall chinook, 9.9 miles for chum and 58.3 miles for coho. Additional surveys were conducted to observe spawning activity above partial barriers and fish ladders.

Index areas were often surveyed more than once to ensure that counts were made near the peak of the run. Variability in the timing of the spawning migrations between streams, volume and duration of flood flows and silt load frequently caused aborted surveys that had to be rescheduled and occasionally resulted in inadequate surveys on some standard index areas. Coastal Rivers personnel made 223 surveys encompassing 210 miles during the 1968-69 spawning season (Table 1). The surveys represent about 66% of the effort of the previous year. Surveys started on September 16, 1968, and continued through January 21, 1969.

Table 1. Number of spawning fish surveys and distances surveyed by Coastal Rivers staff during the 1968-69 spawning season

River system	Spring chinook		Fall chinook		Chum		Coho		Total	
	No.	Miles	No.	Miles	No.	Miles	No.	Miles	No.	Miles
Nehalem			6	5.0			2	1.0	8	6.0
Miami					9	5.1			9	5.1
Kilchis	1	2.0	2	2.0	5	2.7			8	6.7
Wilson	5	15.0	3	1.5	2	1/	5	6.5	15	23.0
Trask	2	5.0							2	5.0
Tillamook			3	5.1	2	0.9			5	6.0
Netarts Bay					2	0.8			2	0.8
Nestucca	2	3.0	7	5.5	5	3.0	17	12.3	31	23.8
Siletz	4	6.2	8	6.1					12	12.3
Yaquina			7	10.5			13	12.1	20	22.6
Beaver Creek							3	2.3	3	2.3
Alsea	15	23.2	8	13.2			16	14.0	39	50.4
Siuslaw			8	5.6					8	5.6
Tenmile							39	23.1	39	23.1
Coos							5	4.1	5	4.1
Coquille			8	6.5			9	6.3	17	12.8
Total	29	54.4	60	61.0	25	12.5	109	81.6	223	209.5

1/ Concurrent with fall chinook survey.

Since 1958, survey data have been exchanged with the Oregon Game Commission to avoid duplication of some surveys. The Game Commission provides data from 13 standard surveys established by the Fish Commission. These surveys are: 1.5 miles each for fall chinook and coho on the Nehalem River; 3.3 miles for coho on Tenmile Lakes tributaries; and 4.6 miles for coho on the Coquille River.

Survey personnel

Robert McQueen of the Astoria Laboratory conducted the surveys on the Nehalem River. Surveys between the Nehalem and Siuslaw rivers were conducted from the Newport Laboratory by Del Skeesick, Dennis Isaac, Richard Berry, Paul Brown and Don Gillham. Alan McGie and Edwin Cummings conducted surveys of the Siuslaw River and other stream systems south to Floras Lake from the Charleston Laboratory. Warren Knispel, Ron McDivitt and Ed Schwartz of the Oregon Game Commission provided data from their surveys.

Influence of weather on the 1968-69 spawning fish surveys

Weather had a dominating influence on spawning fish surveys in 1968. Abnormally heavy precipitation began in August and continued through January (Figure 1). In December and January heavy snowfalls blocked many access roads. From September 15, 1968, through January 15, 1969, measurable precipitation fell at Newport on 94 of the 123 days (76%). Conditions were equally as severe to the north and only slightly less severe to the south of Newport.

More surveys than normal were conducted for spring chinook because of uncertainty of attaining peak counts in the high flows. Fewer surveys than normal were conducted for fall chinook, chum and coho. All the

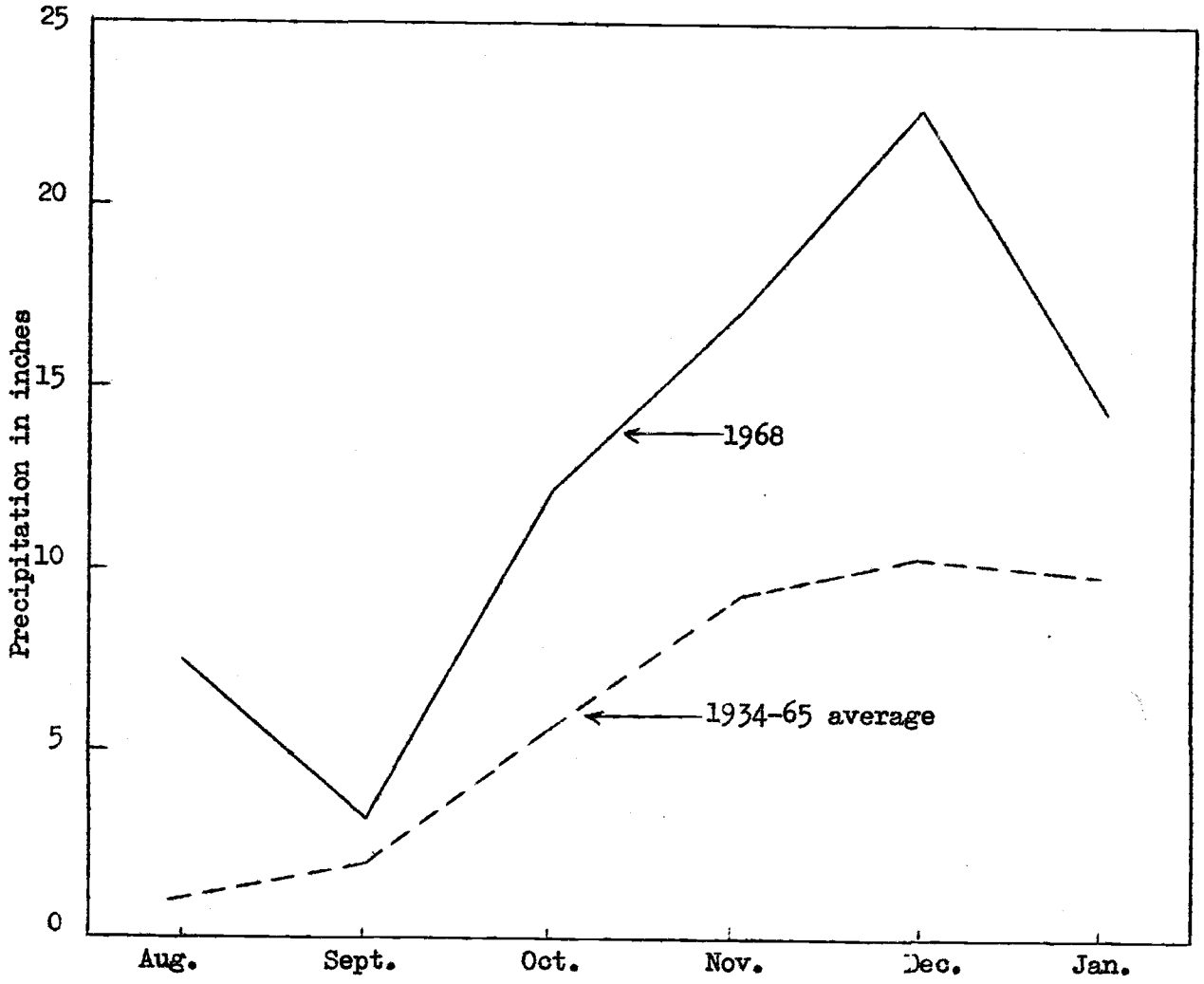

Figure 1. Comparison between 1968 monthly precipitation at Newport and long-term averages. (Data from U. S. Weather Bureau monthly climatological data summaries.)

completed surveys were conducted under abnormally high flows but the frequency of the surveys was reduced because of high flows, or access problems. Only 2 of the 12 Nehalem River coho surveys were completed, and these were after the peak spawning period.

Influence of human activities on 1968-69 spawning fish surveys

Activities of the Fish Commission, Game Commission and logging companies, have all affected the validity of the counts on some of our standard survey areas.

The fall chinook counts on the Siletz and Alsea rivers have been affected by the activities of the Fish Commission. Ladders and large returns of coho to the hatcheries have made it impossible to make satisfactory counts in three of the survey areas.

A ladder constructed at the upper end of the fall chinook survey area on Sunshine Creek of the Siletz River in 1963 has allowed fish, which normally would have spawned in the survey area, to spawn farther upstream. Since the installation of the ladder, the counts have averaged only 50% of the counts that were made in the 6 years previous. Since this survey area represents 30% of the index area for the Siletz River, the effect of the change is to cause a false decline in the trend for the whole river system of approximately 24%.

The recent increase in returns of coho to the Rock Creek Hatchery has resulted in large numbers of strays utilizing the chinook survey area on North Rock Creek for spawning. Abundance of coho in the survey area was first noted in 1965. Large masses of fish in each pool make it impossible to count all the live chinook present. The count of chinook carcasses is undoubtedly low because many are buried by the digging of the coho. The superimposition that is occurring in the survey area will undoubtedly be detrimental to

the chinook. Since this is a unique occurrence, the survey area is no longer indicative of the chinook abundance in the Siletz River.

Similar conditions have been occurring in the standard survey on Fall Creek on Alsea River. The tremendous number of coho which traverse the survey area during the chinook spawning period make it nearly impossible to obtain good counts. Considerable numbers of coho spawn below the hatchery causing superimposition on spring and fall chinook eggs already in the gravel. Again, this occurrence is unique in the Alsea system so the survey area counts are no longer indicative of the general conditions in the watershed.

The Oregon Game Commission study on Deer Creek has a strong influence on the coho counts made directly below their study area. Dead or dying fish are examined for completeness of spawning and are discarded below the weir. This disrupts the normal distribution of dead or moribund fish in our survey area on Deer Creek. On two adjacent streams, 33% of the peak count was dead fish while on Deer Creek, dead fish made up 88% of the peak count.

Log jams on Euchre and Little Euchre creeks on the Siletz River physically covered large portions of the fall chinook survey areas. Thus, the counting efficiency was reduced, and the counts do not reflect the actual number of fish present at the time the survey was made.

RESULTS

Spring chinook

The count of spring chinook in standard spawning fish surveys on four coastal watersheds was three fish per mile, equaling the count of the previous year. Counts of spring chinook have generally declined since 1958, and these were the next to the lowest counts recorded since spring chinook surveys were established in 1953 (Figure 2). The counts of adults

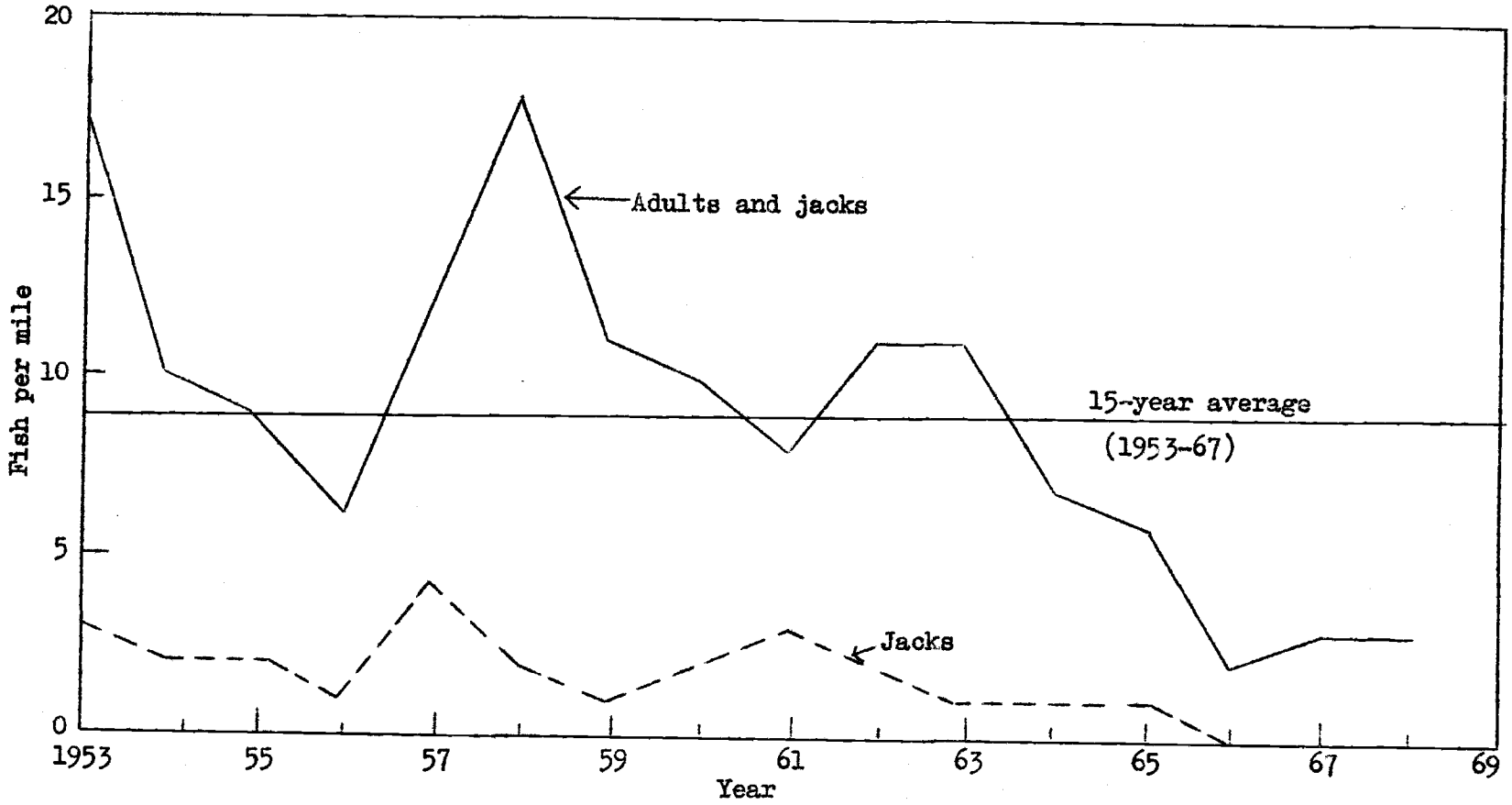

Figure 2. Average numbers of spring chinook per mile in standard survey areas of four coastal rivers, 1953-68

on individual watersheds ranged from 0 fish per mile on the Tillamook Bay tributaries to 7 fish per mile on the Siletz River surveys (Table 2). The jack count was 2 fish per mile on the Alsea River. No jacks were seen on the Nestucca or rivers tributary to Tillamook Bay. The average jack per mile count was zero.

Auxiliary counts on the Trask and Siletz rivers were 10 and 0 fish per mile, respectively. These counts were 29 and 0% of the respective averages.

Peak counts for each survey area are tabulated in the Appendix tables 1-4.

Fall chinook

The count of fall chinook in 6 coastal rivers was 24 fish per mile which was 10 fish per mile below the 16-year average (1952-67) (Table 3). The number of fish per mile between river systems ranged from 9 on the Alsea River to 67 on Tillamook Bay tributaries. All the rivers except the Tillamook Bay tributaries had fish-per-mile counts less than their long-term averages.

The trend counts show the expected rise in escapement level after cessation of commercial fishing in the rivers in 1956. In recent years, the counts varied less from year to year (Figure 3). The average fish per mile count this year was the lowest since 1956.

The counts in the auxiliary survey areas on the Siuslaw and Coquille rivers were equal to or above their averages but were low compared to the counts in recent years.

Peak counts for each survey area are tabulated in the Appendix tables 5-12.

Table 2. Summary of peak fish-per-mile counts of spring chinook in standard and auxiliary survey areas of coastal rivers since 1951 1/

	Standard					Auxiliary	
Year	Tillamook Bay tributaries	Nestucca	Siletz	Alsea	Weighted average fish per mile	Trask	Siletz
1951	--	108(5)	--	--	108(5)	27(3)	
1952	11(0)	39(5)	5(0)	--	13(1)	7(1)	
1953	7(1)	133(11)	11(2)	15(3)	18(3)	28(2)	
1954	12(2)	42(6)	4(0)	6(1)	10(2)	16(7)	
1955	8(2)	39(7)	4(1)	8(2)	9(2)	56(8)	
1956	6(1)	13(2)	4(0)	6(2)	6(1)	3(0)	
1957	16(6)	9(3)	14(4)	8(2)	12(4)	28(10)	13(4)
1958	29(3)	59(6)	2(1)	7(1)	16(2)	48(8)	9(2)
1959	7(1)	42(5)	1(0)	12(1)	11(1)	35(2)	8(1)
1960	10(2)	37(5)	4(0)	7(2)	10(2)	68(8)	8(0)
1961	11(6)	14(1)	1(0)	6(2)	8(3)	32(8)	1(1)
1962	13(1)	23(3)	2(0)	9(3)	11(2)	47(6)	1(1)
1963	16(1)	26(0)	14(8)	3(0)	11(1)	50(2)	15(4)
1964	7(1)	20(1)	15(1)	3(0)	7(1)	52(6)	12(0)
1965	3(1)	14(4)	12(4)	6(1)	6(1)	24(0)	1(0)
1966	3(1)	6(1)	0	2(0)	2(0)	8(2)	2(1)
1967	1(0)	27(3)	2(0)	3(0)	3(0)	18(2)	0
1968	0 0)	5(0)	7(1)	4(2)	3(0)	10(1)	0
1953-67 average	10(2)	34(4)	6(1)	7(1)	9(2)	34(5)	6(1)
Departure of 1968 from average	-10	-29	+1	-3	-6	-24	6
Miles surveyed	10.5	1.5	2.5	11.5		2.5	1.7

1/ Figures in parentheses indicate numbers of jacks included in the totals.

Table 3. Summary of peak fish-per-mile counts of fall chinook in standard and auxiliary survey areas of coastal rivers since 1950 1/

	Standard							Auxiliary	
Year	Nehalem	Tillamook Bay tributaries	Nestucca	Siletz	Yaquina	Alsea	Weighted average fish-per-mile	Siuslaw	Coquille
1950	15	—	24	—	23(3)	—	—		
1951	16(2)	—	16	—	33	—	—		
1952	41(5)	63(18)	194(10)	53(9)	61(16)	18	53(10)		
1953	24(6)	18(4)	10(2)	9(2)	14(1)	8(1)	13(2)		
1954	19(4)	12(4)	20(2)	13(1)	20(2)	10(3)	15(2)		
1955	26(12)	4(2)	35(5)	21(13)	29(9)	13(8)	20(9)		
1956	22(1)	9(4)	11(1)	15(4)	13(6)	—	14(4)	9	
1957	52(15)	66(22)	118(33)	34(5)	25(7)	18(4)	38(10)	11(4)	13(3)
1958	32(3)	60(11)	73(4)	62(7)	39(3)	—	49(5)	56(16)	17(3)
1959	37(3)	60(5)	55(0)	25(1)	23(2)	13(0)	28(2)	23(4)	13(1)
1960	60(30)	59(21)	131(34)	28(11)	15(6)	13(6)	35(13)	—	—
1961	62(5)	76(13)	100(16)	30(5)	23(2)	17(2)	38(5)	22(1)	—
1962	44(7)	64(9)	80(16)	55(11)	25(9)	12(4)	35(8)	17(7)	11(2)
1963	57(13)	88(8)	91(8)	40(6)	32(7)	21(4)	43(7)	25(1)	9(1)
1964	56(6)	67(11)	57(10)	55(14)	25(5)	18(5)	37(7)	119(18)	16(4)
1965	52(14)	54(12)	190(11)	26(4)	23(9)	22(4)	42(8)	29(6)	72(25)
1966	43(3)	86(17)	125(14)	30(2)	30(5)	27(5)	43(6)	73(9)	48(7)
1967	34(2)	110(14)	102(18)	23(3)	19(5)	16(4)	36(6)	61(14)	27(2)
1968	23(2)	67(12)	57(3)	15(2)	22(5)	9(3)	24(4)	40(15)	29(8)
1952-67 average	41(8)	56(11)	87(11)	32(6)	26(6)	16(4)	34(6)	40(7)	25(5)
Departure of 1968 from average	-18	+11	-30	-17	-4	-7	-10	0	+4
Miles surveyed	4.0	3.5	2.3	4.0	7.8	10.5		2.7	2.9

1/ Figures in parentheses indicate numbers of jacks included in the totals.

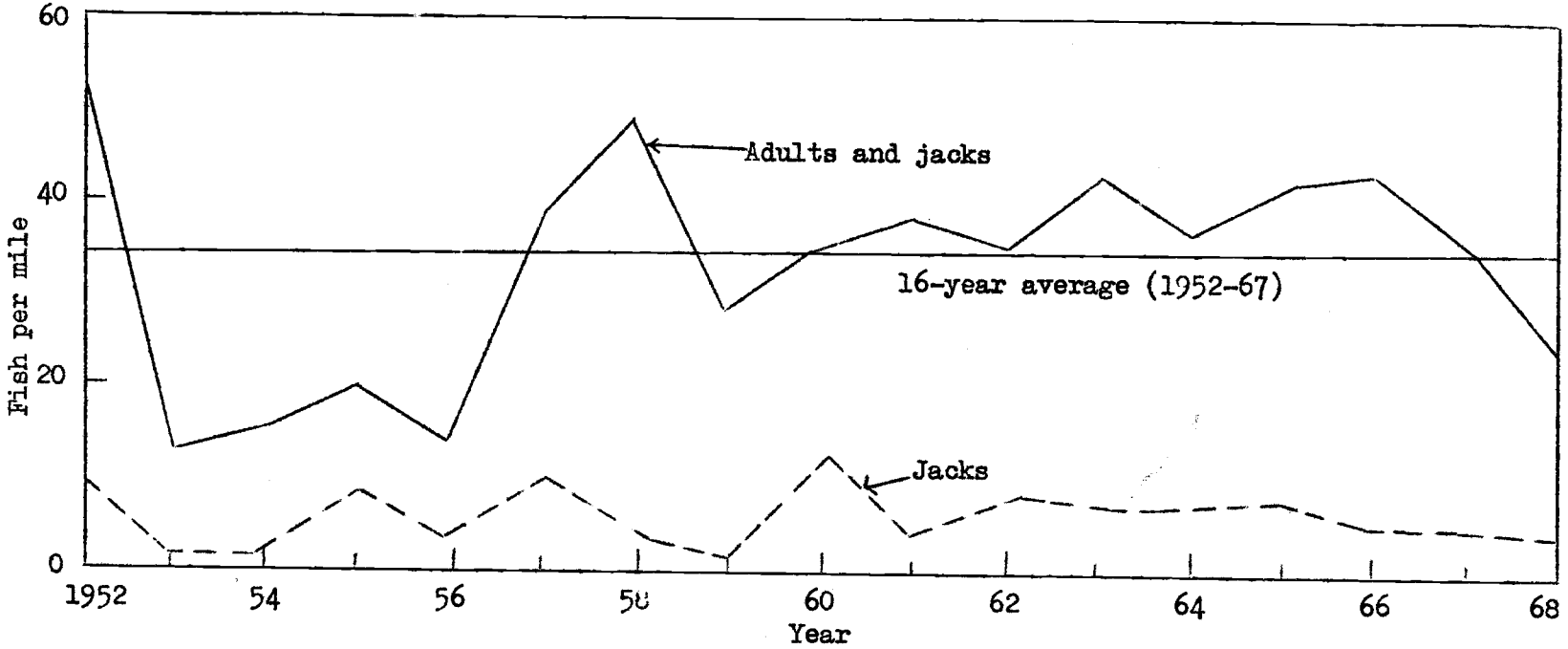

Figure 3. Average numbers of fall chinook per mile in standard survey areas of six coastal rivers, 1952-68

Coho salmon

The peak count of coho salmon in eight coastal drainages was 21 fish per mile, which was 11 fish per mile less than the 18-year average. Counts ranged from 13 fish per mile on Coquille River to 31 fish per mile on the Alsea River (Table 4). The Yaquina River was the only one which had a peak fish per mile count higher than its average. The counts on the other streams were from 2 to 32 fish less than the 1950-67 averages.

Impossible survey conditions on the Nehalem River made it necessary to estimate the peak fish-per-mile counts. A constant relationship between Nehalem River and the rest of the coast-wide counts was assumed. The Nehalem River total counts for 1966 and 1967 were divided by the sum of the peak counts from all the other 1966 and 1967 surveys and the resulting value was multiplied by the 1968 counts to arrive at an estimated peak count. The peak count was then divided by the number of miles which would have been surveyed to arrive at an estimate of the peak fish-per-mile count.

The peak fish-per-mile counts were the lowest since 1960 (Figure 4). The count of jack coho was two fish per mile which was the lowest since 1959. Nearly continuous high flows had a major affect on the counts. In a normal year, coho move during freshets and arrive on the spawning beds in surges. As the flows drop, the fish complete spawning and remain in the area after death. The best time to get a peak count is just after die-off begins. This year the high flows allowed a steady rather than pulsing migration upstream and tended to wash the spawned out fish downstream before they died so fewer fish were in the survey area at any given time and peak counts were reduced.

The peak counts of coho in the standard and auxiliary survey areas in tributaries of Tenmile Lake were 57 and 88 fish per mile, respectively (Table 5). These counts were only 21 and 33% of the average of the standard and auxiliary counts, respectively. These data can be used to estimate total escapement, based upon a population estimate study completed in 1955-56, (Morgan and Henry, 1959). The resulting estimates indicate a fairly static escapement level between 1960 and 1967 with a sharp decline in 1968 which equalled the record low of 1959 (Figure 5). The estimate of the jack population was next to the lowest observed.

Table 4. Summary of peak fish-per-mile counts of coho in standard survey areas of coastal rivers since 1950 1/

Year	River								Weighted average fish per mile
	Nehalem	Wilson	Nestucca	Yaquina	Alsea	Beaver Creek	Coos	Coquille	
1950	17	10	17(1)	9	13	15(3)	54(7)	41	21(--)
1951	43(2)	39(3)	73(1)	66(3)	67(4)	163(8)	118(24)	64(11)	67(6)
1952	51(3)	31(3)	67(1)	21(1)	36(3)	40(4)	104(13)	159(9)	69(5)
1953	21(1)	20(1)	20(0)	4(0)	11(1)	10(2)	31(7)	37(5)	20(2)
1954	8(1)	6(1)	23(2)	21(2)	27(1)	16(3)	29(12)	35(2)	21(2)
1955	14	15	21	12	27	23	35	26	20(--)
1956	34(1)	12(2)	13(1)	20(2)	45(5)	30(4)	81(28)	56(15)	37(6)
1957	45(1)	23(2)	20(3)	40(2)	38(2)	46(3)	24(3)	58(4)	41(2)
1958	7(1)	10(0)	10(1)	12(2)	9(0)	10(1)	8(2)	17(3)	11(1)
1959	21(1)	28(0)	14(0)	22(1)	26(2)	19(0)	22(2)	46(2)	27(1)
1960	16(4)	42(5)	11(3)	16(6)	21(6)	13(2)	19(12)	15(5)	18(5)
1961	34(2)	46(4)	21(2)	50(3)	50(8)	21(4)	75(40)	36(10)	41(7)
1962	23(3)	39(3)	13(1)	29(5)	24(3)	29(3)	55(19)	47(6)	31(5)
1963	18(1)	30(2)	26(4)	28(5)	36(5)	25(11)	26(7)	13(4)	24(4)
1964	32(2)	38(2)	42(6)	43(4)	53(7)	36(4)	37(5)	62(6)	45(5)
1965	27(2)	16(2)	34(7)	38(6)	34(6)	27(4)	16(2)	50(5)	34(4)
1966	18(2)	12(0)	31(4)	44(1)	45(6)	38(3)	19(3)	27(3)	30(3)
1967	16(1)	41(3)	25(3)	20(4)	29(4)	13(4)	24(5)	21(4)	23(4)
1968	13(1) 2/	21(2)	21(2)	30(3)	31(3)	29(2)	15(2)	13(2)	21(2)
1950-67 average	25(2)	25(2)	27(2)	27(3)	33(3)	32(3)	43(11)	45(5)	32(4)
Departure of 1968 from average	--	-4	-6	+3	-2	-3	-28	-32	-11
Miles surveyed	11.5	4.0	5.4	8.4	8.5	2.3	3.3	11.0	

1/ Figures in parentheses indicate numbers of jacks included in the totals.

2/ Estimated peak count--see text, page 12.

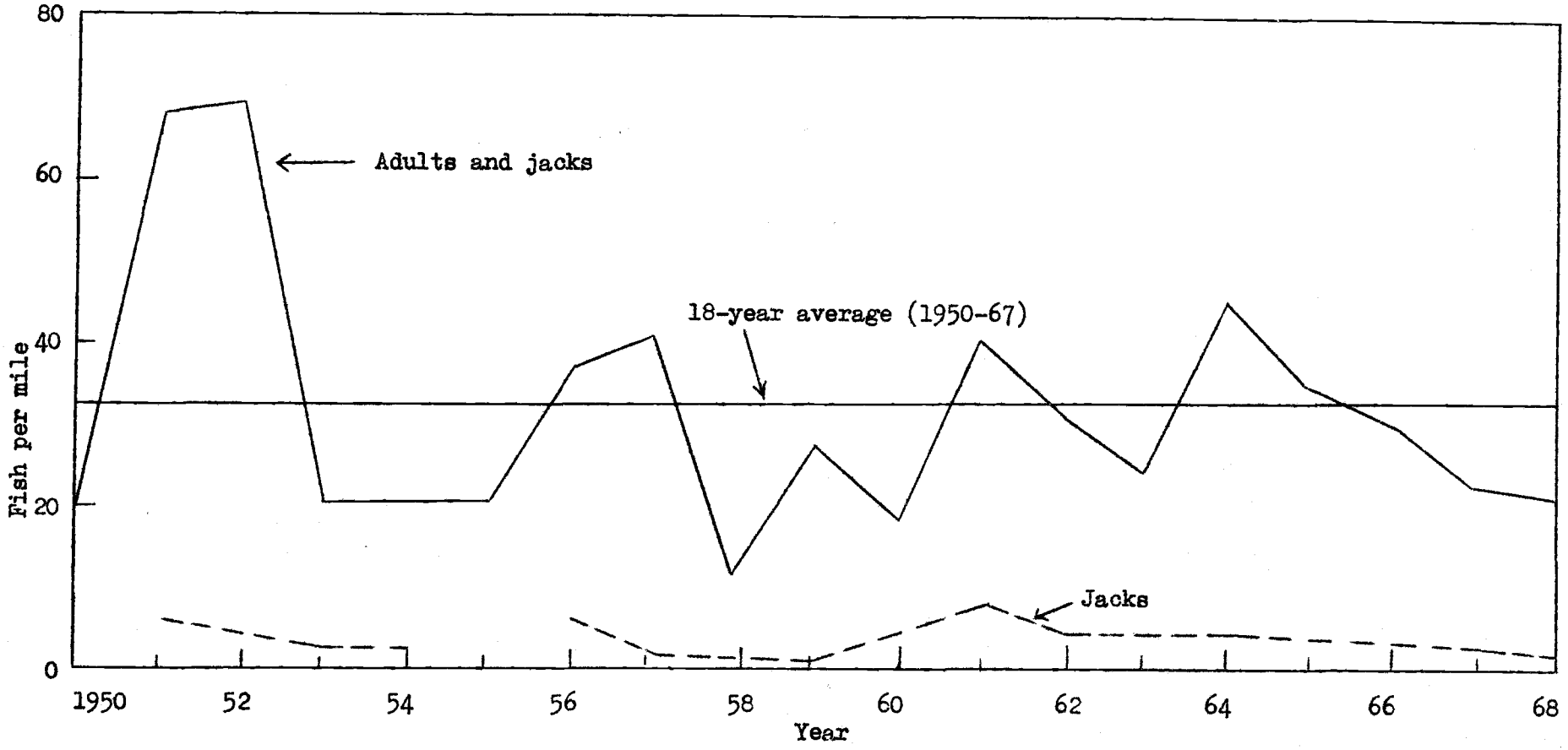

Figure 4. Average number of coho per mile in standard survey areas of eight coastal rivers, 1950-68

Table 5. Summary of peak fish-per-mile counts of coho in standard and auxiliary survey areas of coastal lakes tributaries since 1950 1/

Year	Standard	Auxiliary surveys		
	Tenmile Lakes	Tenmile Lakes	Devils Lake	Mercer and Sutton
1950	145(45)			
1951	435			
1952	493(99)			
1953	170(79)			
1954	260(111)			
1955	519(215)	526(171)		
1956	570(236)	504(244)		
1957	388(121)	406(138)	26(4)	
1958	170(95)	186(76)	43(36)	
1959	114(48)	88(21)	63(7)	47(14)
1960	168(118)	177(49)	17(11)	77(14)
1961	224(94)	229(92)	39(9)	56(19)
1962	219(96)	255(97)	84(20)	49(24)
1963	236(190)	238(144)	11(6)	34(13)
1964	268(143)	285(117)	30(7)	22(7)
1965	199(106)	164(56)	3(0)	9(2)
1966	180(75)	181(67)	19(0)	24(6)
1967	106(63)	197(100)	4(0)	15(6)
1968	57(30)	88(23)	—	—
1950-67 average	270(114)	264(106)	33(10)	40(12)
Departure from average	-213	-176		
Miles surveyed	0.8	17.1	0.7	2.5

1/ Figures in parentheses indicate numbers of jacks included in the totals.

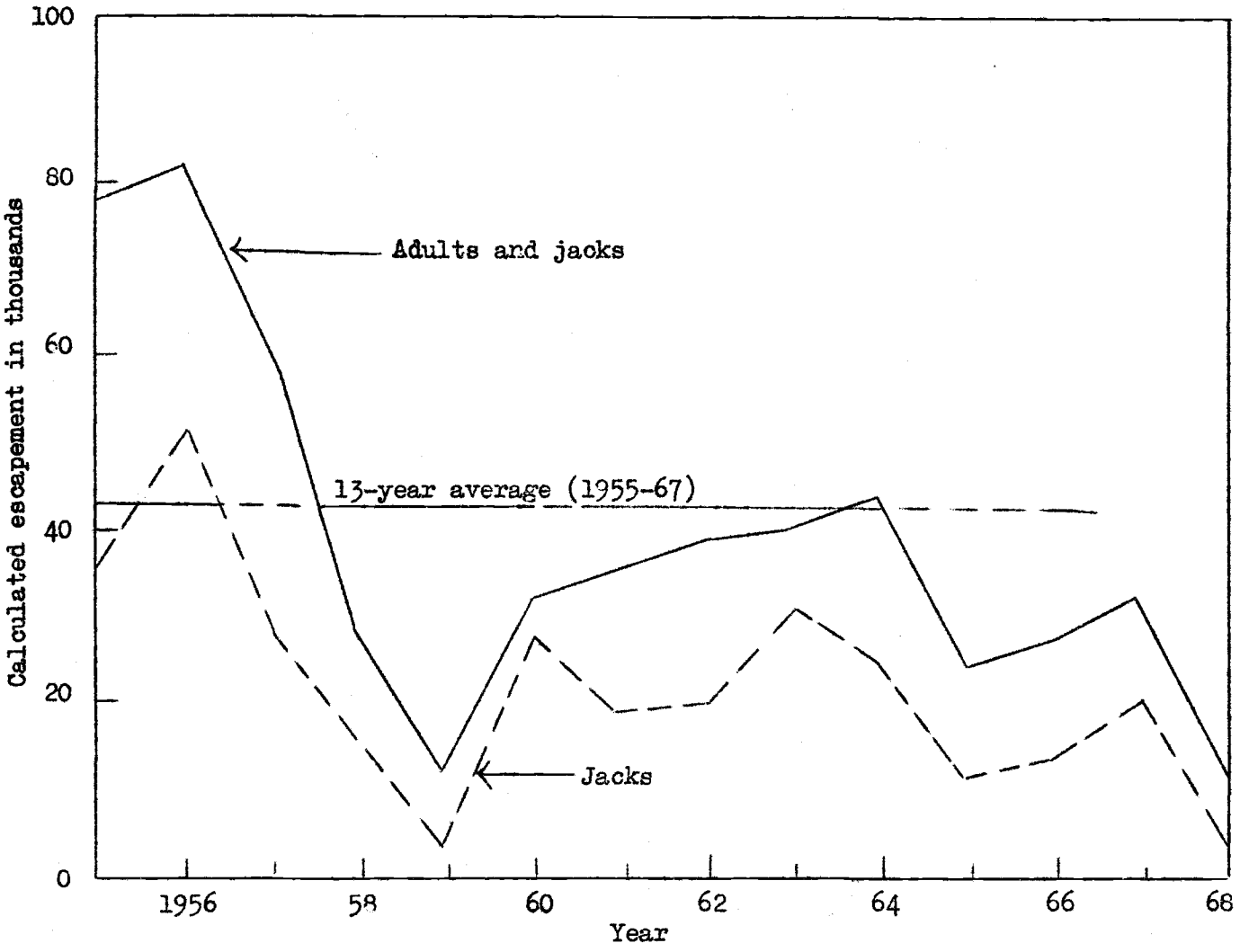

Figure 5. Calculated coho escapement into Termile Lakes, 1955-68

The estimated egg deposition in 1967 was 15.0 million eggs which was only 41% of the 1955-67 average (Table 6) and was the next to the lowest since the estimates were established in 1955.

Peak counts for each survey area are tabulated in the Appendix tables 13-24.

Chum salmon

The peak count of chum salmon in three drainage basins was 69 fish per mile (Table 7). This was 102 fish-per-mile less than the 15-year average but was intermediate between the counts of the 1964 and 1965 broods which produced it (Figure 6). All the standard survey counts were below their long-term averages. The extreme decline in the Whiskey Creek counts may have resulted from removal of a small log jam which allowed the fish to move above the survey area.

The auxiliary fish-per-mile count on Tillamook Bay tributaries was 127 fish which was 79 fish-per-mile lower than the 8-year average. The 1968 fish-per-mile count was intermediate between the brood years which produced it.

A strong downward trend on a 4-year cycle can be noted in the standard survey counts. This trend is reflected by the auxiliary fish-per-mile counts in 1963 and 1967. The low counts in 1968 follow the low counts of 1964 and 1960.

Peak counts for each survey area are tabulated in the Appendix tables 25-28.

Age, size and sex composition of 1968 chum run

As in previous years, attempts were made to sample dead chum salmon for age, length and sex, by collecting data from the first 50 dead fish

Table 6. Calculated escapement and egg deposition of ccho in Tenmile Lakes, 1955-68

Year	Calculated escapement				Potential egg deposition in millions 2/
	Adults	Per cent females	Jacks	Total	
1955	41,500	66.5 1/	36,000	77,500	82.8
1956	30,500	66.5 1/	51,500	82,000	60.9
1957	31,500	65.2	29,000	60,500	61.5
1958	12,500	62.9	16,000	28,500	23.7
1959	8,000	66.5 1/	4,500	12,500	15.9
1960	5,500	66.8	27,000	32,500	11.1
1961	16,000	66.2	19,500	35,500	31.8
1962	18,500	67.0	20,500	39,000	37.2
1963	11,000	71.6	30,500	41,000	38.7
1964	19,500	66.1	24,500	44,000	38.7
1965	12,500	71.3	12,000	24,500	26.7
1966	13,500	56.8	14,000	27,500	23.1
1967	11,500	60.9	21,000	32,500	21.6
1968	7,500	66.9	5,000	12,500	15.0
1955-67 average	17,846		23,538	41,346	36.4

1/ Estimated from the average female-to-male ratio of 1957-64.

2/ Based on fecundity of 3,000 eggs per female.

Table 7. Summary of peak fish-per-mile counts of chum in standard and auxiliary survey areas of coastal rivers since 1948

	Standard				Auxiliary
Year	Tillamook Bay tributaries	Nestucca	Whiskey Creek	Weighted average fish per mile	Tillamook Bay tributaries
1948	484				
1949	925				
1950	356	54			
1951	698	71			
1952	304	32			
1953	530	27	343	311	
1954	591	154	1,255	476	
1955	136	39	240	106	
1956	133	13	328	102	
1957	251	117	1,680	324	
1958	225	158	843	253	
1959	107	71	368	116	
1960	10	11	398	44	56
1961	20	51	875	108	80
1962	51	136	1,100	178	408
1963	66	146	552	141	288
1964	21	33	753	91	305
1965	27	29	353	57	107
1966	65	100	793	144	265
1967	26	58	913	117	140
1968	50	65	197	69	127
1953-67 average	151	76	720	171	206
Departure from average	-101	-11	-523	-102	-79
Miles surveyed	2.3	1.8	0.4		5.4

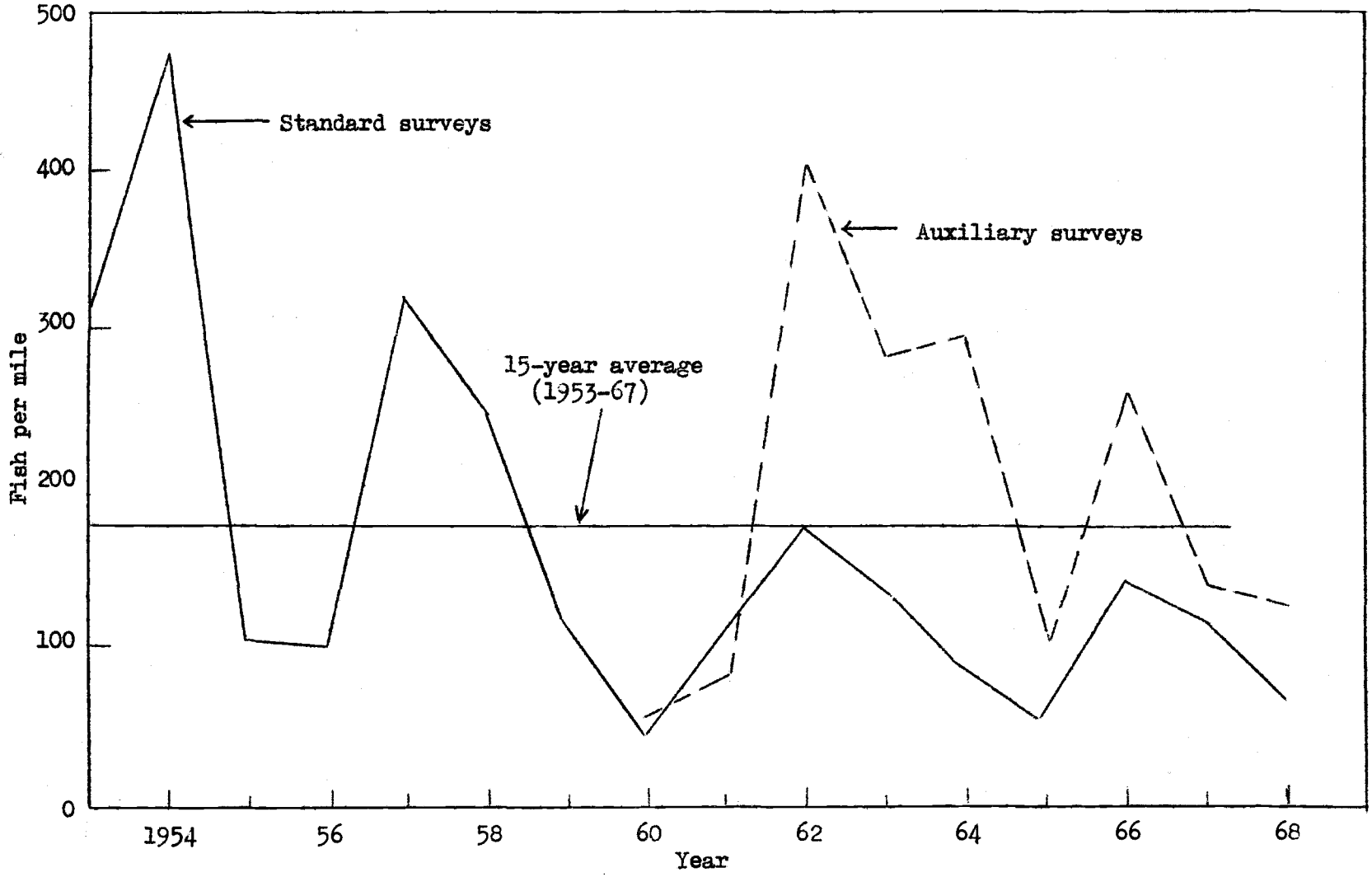

Figure 6. Average numbers of chum per mile in standard and auxiliary survey areas of three coastal drainages, 1953-68

encountered in each river system. Coal Creek of the Kilchis River was the only one in which the desired number was reached. A total of 112 fish was checked on Tillamook Bay tributaries, of which 99 could be assigned to age groups.

The length of fish by age and sex was within the limits found in previous inventories except that the average length of fourth-year females was slightly greater (Table 8). The size range was from 24 to 36 inches.

Third-year males were much less abundant than third-year females, but there were about equal numbers of each sex of fourth-year fish resulting in the most distorted sex ratio yet observed in this study. The overall sex ratio was weighted toward females.

The third-year fish dominated the run at about the same ratio as in 1961, 1962 and 1964 (Table 9, Figure 7).

SUMMARY

The surveys of spawning fish in coastal rivers in 1968 indicate that stocks of spring chinook and chum salmon remain at critically low levels. At present, they represent only 33 and 40% of their long-term averages, respectively.

Fall chinook indices of abundance were lowest since the low levels of 1953-56. Coho counts also declined but not as drastically.

RECOMMENDATIONS

Weather had such an overpowering effect upon the surveying conditions and counts this year that their veracity is questionable. For that reason I suggest that we discount their value this year, and delete them from the tables and the averages in succeeding years.

LITERATURE CITED

Morgan, A. R. and K. A. Henry, 1959. The 1955-56 silver salmon run into the Tenmile Lakes system. Fish Comm. Oreg. Res. Briefs, 7(1):57-77.

Table 8. Composition of Tillamook Bay chum by size, sex and age for years sampled, 1947-68

Age	Sex	1947	1949	1950	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
		Mean fork length (inches)												
3	Females	27.4	25.5	27.3	26.4	26.4	26.6	27.2	26.5	26.3	25.6	27.0	27.5	27.3
	Males	29.6	27.9	28.8	29.1	28.2	29.4	30.4	29.5	29.6	28.8	30.4	30.2	29.8
4	Females	28.8	27.9	28.6	28.4	27.5	29.0	29.0	28.6	29.0	28.3	28.0	28.8	29.2
	Males	31.4	30.3	30.5	31.5	30.9	30.1	32.5	32.3	32.6	30.8	30.7	31.9	31.8
5	Females	30.0	28.0	29.0	28.0	—	—	—	—	30.0	—	—	—	—
	Males	—	—	31.2	32.5	30.0	31.0	32.0	—	—	—	—	32.0	—
		Sex ratio (numbers)												
3	Females	16	3	135	79	34	53	85	24	57	26	24	23	45
	Males	5	12	232	71	26	48	81	30	50	38	19	22	22
4	Females	20	137	51	57	12	7	22	88	14	44	55	60	18
	Males	23	134	57	100	19	14	18	62	5	28	54	29	14
5	Females	1	1	1	1	0	0	0	0	1	0	0	0	0
	Males	0	0	5	2	1	1	1	0	0	0	0	2	0
Total		65	287	481	310	92	123	207	204	127	136	152	136	99
		Sex ratio (per cent)												
	Females	57	49	39	44	50	49	52	55	57	51	52	61	68
	Males	43	51	61	56	50	51	48	45	43	49	48	39	32

Table 9. Estimated age composition of Tillamook Bay chum

Year	Source of data	Per cent composition by age		
		3	4	5
1947	Gill net	32.3	66.2	1.5
1949	" "	4.6	95.4	0.3
1950	" "	77.5	21.1	1.5
1959	" "	51.2	48.0	0.8
1960	" "	68.2	30.8	1.0
1961	" "	83.4	16.0	0.6
1962	Spawning grounds	82.1	17.6	0.3
1963	" "	28.0	72.0	0.0
1964	" "	85.5	13.8	0.6
1965	" "	47.1	52.9	0.0
1966	" "	28.3	71.7	0.0
1967	" "	33.1	65.4	1.5
1968	" "	67.7	32.3	0.0

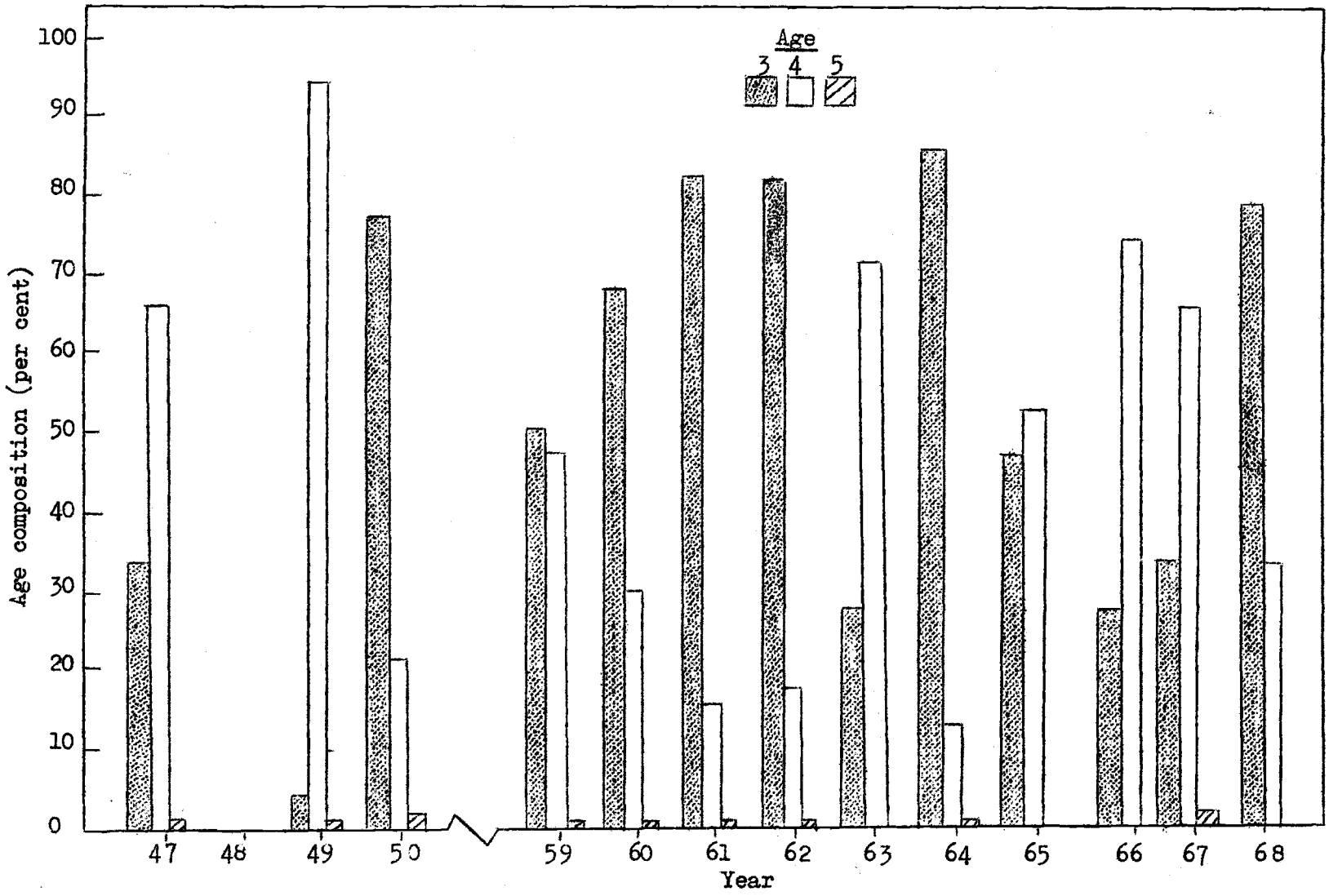

Figure 7. Age composition of Tillamook Bay chum salmon for years sampled, 1947-68