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YUKON SALMON ESCAPEMENT
REPORT #24

ANVIK AND ANDREAFSKY RIVER SALMON STUDIES, 1984

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INTRODUCTION

The Anvik and Andreafsky Rivers are the two largest producers of summer chum salmon (Oncorhynchus keta) in the Yukon River drainage (Figure 1). Buklis (1982) estimated that the Anvik River alone accounts for 35% of the total production. Other known major spawning populations occur in the Rodo, Nulato, Gisasa, Hogatza, Melozitna, Tozitna, Chena, and Salcha Rivers (Figure 1). Summer chum salmon spawn in smaller numbers in a few other tributaries of the Yukon River as well. King salmon (O. tshawytscha) and pink salmon (O. gorbuscha) are found in both the Anvik and Andreafsky Rivers in lesser numbers, while coho salmon (O.kisutch) are known to occur in small numbers in the fall, but their escapements are not monitored.

Summer chum salmon escapements to the major spawning areas in the Yukon River drainage have been estimated by aerial survey from fixed wing aircraft for many years. Although subject to error due to weather and water conditions, and subjectivity on the part of the observer, aerial surveys are the most feasible method for monitoring escapements in a watershed as large and remote as that of the Yukon River. The Anvik and Andreafsky Rivers have been more intensively studied due to their large summer chum salmon production. Salmon were visually enumerated from counting towers on the Anvik River from 1972 through 1978, and counted by side-scanning sonar since 1979, while side-scanning sonar has been used on the East Fork Andreafsky River since 1981. This report presents the results of these studies for the 1984 field season.

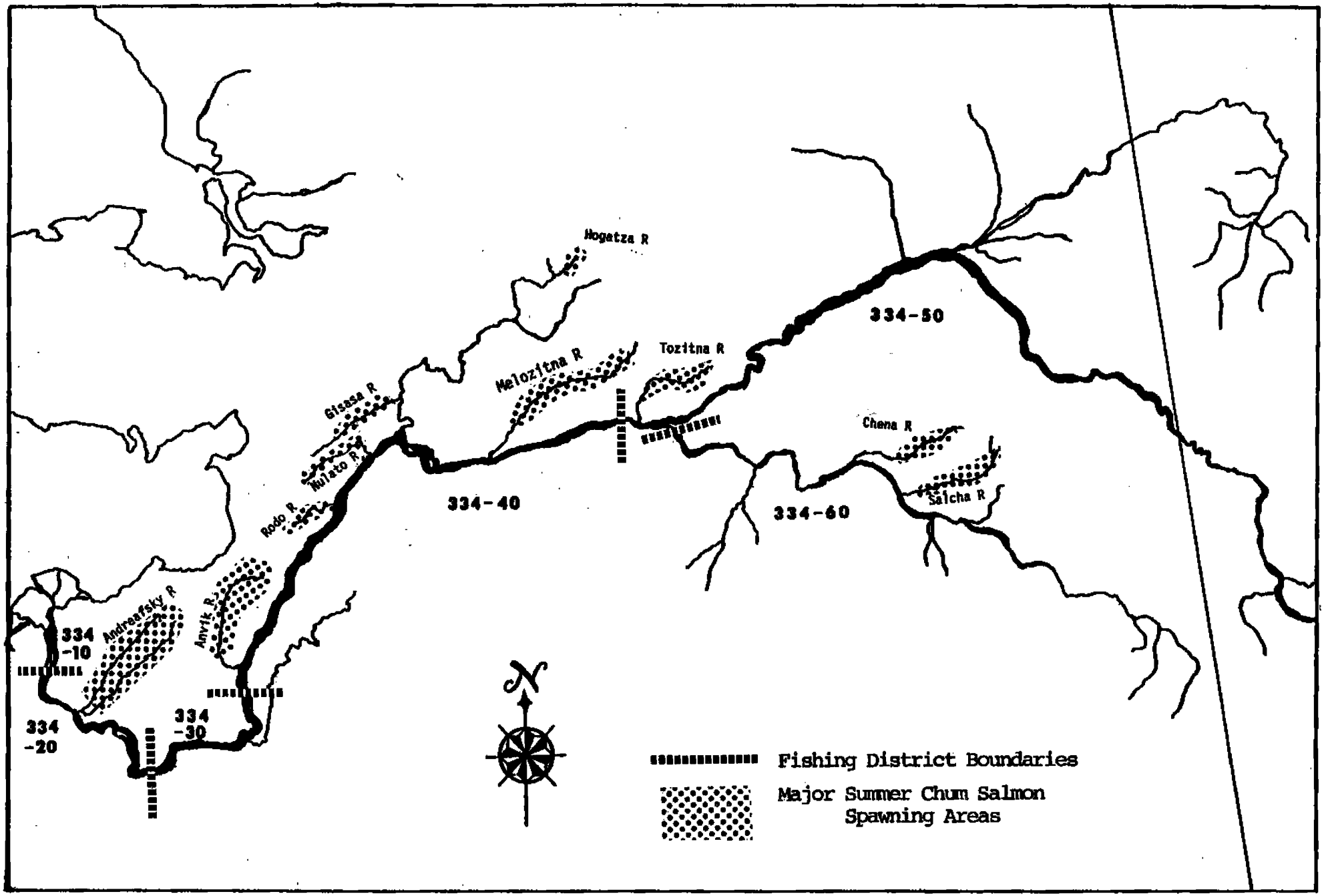

Figure 1. Map of the Yukon River, showing fishing districts and major summer chum salmon spawning areas.

ANVIK RIVER SALMON STUDY

The Anvik River (Figure 2) originates at an elevation of 1,300 feet and flows in a southerly direction 120 miles to its mouth at mile 318 of the Yukon River. It is a narrow run-off stream with a substrate of gravel and cobble, except in the upper reaches where bedrock is exposed. The Yellow River is a major tributary of the Anvik and is stained with tannic acid runoff. Downstream of the Yellow River confluence the Anvik River changes from a moderate gradient system confined to a flood plain of 0.75 to 1.5 miles wide to a low gradient system meandering through a much broader flood plain. Water clarity is reduced downstream of the Yellow River confluence. Numerous oxbows, old channel cutoffs and sloughs are found throughout the lower river.

Salmon escapement was enumerated from counting towers located above the Yellow River confluence between 1972 and 1978. A site 5-1/2 miles above the Yellow River was used from 1972 through 1975, and a site at Robinhood Creek, 2-1/2 miles above the Yellow River, was used from 1976 through 1978. Aerial surveys were flown each year (except 1974) in fixed-wing aircraft to estimate salmon abundance below the tower site. High and turbid water often affects the accuracy of visual salmon enumeration from counting towers and aircraft.

The Electrodynamics Division of the Bendix Corporation developed a side-scanning sonar counter during the 1970's capable of detecting and counting salmon migrating along the banks of tributary streams. The side-scan sonar counter is designed to transmit a sonic beam along a 60 foot aluminum pipe, or substrate. Echoes from fish passing through the beam are reflected to the transducer. The system electronics interpret the strength and number of the echoes, and tally salmon counts. The counter was tested at the Robinhood Creek tower site from 1976 through 1978, and proved to be both feasible and accurate. Salmon escapement was enumerated by sonar beginning in 1979, replacing and proving superior to the tower counting method. One sonar counter was installed on each bank of the Anvik River at mile 48, near Theodore Creek, each year. Distribution of aerial survey salmon counts from 1972 through 1978 indicated that virtually all of the summer chum salmon are found upstream of this site.

Methods and Materials

Two 1978 model sonar counters were operational on 22 June, 1984. The 40 foot east bank substrate was placed along a cut bank, with the top of the transducer housing 6 inches underwater and 6 feet from shore. The 60 foot west bank substrate was placed along a gradually sloping gravel bar, 100 feet downriver from the east bank counter. The top of the transducer housing was 1 foot underwater and 20 feet from shore. Weirs prevented salmon passage inshore of the transducer on each bank.

Sonar counts were totaled electronically in twelve sectors for each substrate and printed hourly. Sector counts missing as a result of debris or printer malfunction were estimated by averaging the counts in the same sector for the hour before and after the questionable sector count. Counts were hand totaled daily for each substrate, summed, and multiplied by the factor 1.10 (Buklis 1981) to account for midstream escapement not covered by the sonar counters.

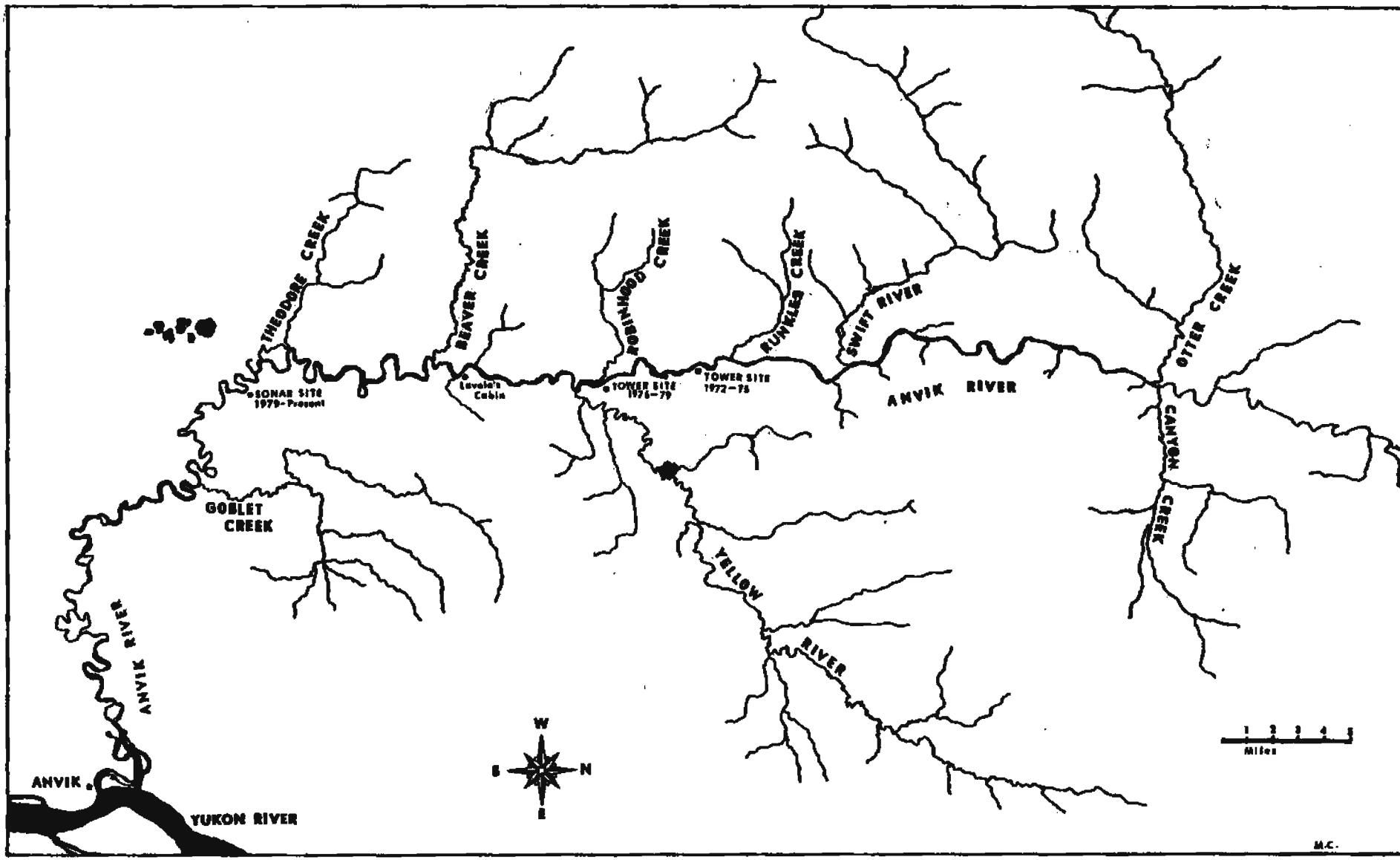

Figure 2. Map of the Anvik River.

These same methods and type of sonar counters have been used since 1979, except in 1982, when 16-sector 1981 model sonar counters were operated. Buklis (1983) outlines the difference between the 12-sector and 16-sector models in some detail. Since chum salmon greatly outnumber kings, and the counters do not distinguish between chums and kings, all sonar counts were attributed to chum salmon. A separate escapement estimate for king salmon was obtained by aerial survey. Pink salmon generally do not register sonar counts due to their small size and faster swimming speeds.

Each sonar counter was calibrated three times daily by observing fish passage with an oscilloscope for a 15 minute period. Salmon passing through the sonar beam produce a distinct oscilloscope trace. Sonar and oscilloscope counts for each calibration period are related in the following formula:

$$Q = \frac{SS}{SC}$$

Where: SS = Side scan counts
SC = Oscilloscope counts

If the difference between the counts was greater than 15% ($0.85 \leq Q \leq 1.15$) then the existing fish velocity setting was multiplied by Q to obtain the correct new setting. The system was then recalibrated for 5 minutes at the new setting. A record was kept of all adjustments to the sonar equipment. Mean date of passage was calculated using the daily sonar counts, following the method presented by Mundy (1982). Whenever water and light conditions allowed, fish passage over the substrates was visually enumerated from 10 foot counting towers. Polaroid sunglasses were worn to reduce water surface glare. Visual counts are reported as the net upstream passage, or the number of fish passing upstream across the substrate minus the number drifting back downstream across the substrate.

Water depth profile at the sonar site was measured at 20 foot intervals across the width of the river by probing with a pole marked in 1 inch increments. Water velocities were estimated by floating a stick 30 feet downriver three times, and averaging the time required as measured on a stopwatch to the nearest second. Climatological data was collected at noon each day at the campsite. A fence stake marked in 1 cm increments was set in the river. Changes in water depth are presented as negative or positive from the initial reading of 0 cm. Water temperature was measured in °C near shore, at a depth of about 1 foot. Air temperature is the average of the daily maximum and minimum in °C. Subjective notes were kept by the crew describing wind speed and direction, cloud cover, and precipitation.

A beach seine (100 feet long, 66 meshes deep, 2-1/2 inch stretch measure mesh) was set near the sonar site each day to capture chum and king salmon for age, sex, and size measurements. Captured fish were identified by species. King and chum salmon were placed in a holding pen, identified by sex, measured from mid-eye to fork of tail in millimeters, and one scale was taken for age determination. Scales were removed from an area posterior to the base of the dorsal fin and above the lateral line on the left side of the fish. The

adipose fin was clipped on each fish before release to prevent resampling. All king salmon captured were sampled, while some of the larger chum salmon catches were subsampled. In addition, king salmon carcasses were sampled during late July and early August from beaches between the sonar site and Robinhood Creek. Three scales were taken from each carcass. Scale samples were later pressed on acetate cards and the resulting impressions viewed on a microfiche reader for age determination.

Results and Discussion

Two sonar counters were operated from 22 June through 27 July. The river was approximately 190 feet wide at the sonar site and less than 4 feet deep on 11 July (Figure 3). Surface water velocity was 2.0 ft/sec over sector 6 of the west bank substrate and 2.4 ft/sec over sector 6 of the east bank substrate.

The season escapement estimate was 891,028 summer chum salmon (Table 1). Difficulties by the crew in aiming the east bank sonar beam resulted in inaccurate count data during the period 22 through 30 June. East bank counts for this period were estimated based on the magnitude of west bank counts and the relationship between east and west bank counts during the remainder of the season (Table 1). Buklis (1982) expanded the season escapement estimates for 1972 through 1978, making it possible to more directly compare visual count estimates from those years with the more recent sonar count estimates. The 1984 escapement was well above the 12 year average (1972-1983) of 521,393 summer chum salmon, and was exceeded only by the escapements in 1975 and 1981 of 900,967 and 1,479,582 summer chum salmon, respectively (Figure 4).

A total of 23.4 hours of sonar calibration was conducted over a 33 day period at the west bank site, and sonar accuracy (sonar count/oscilloscope count) averaged 1.01 (Table 2). Water turbidity and weather conditions (wind, rain, overcast) made it difficult to obtain a visual check on sonar accuracy. For most calibration periods visual counts could only be made over the first few inshore sonar sectors. Although visual counts could not be used to adjust the sonar electronics, they did provide a measure of salmon species composition. It should be stated that offshore species composition may have differed from that observed over the inshore 20 to 30 feet of the sonar substrate. A net upstream total of 5,561 chum salmon, 7 king salmon, and 932 pink salmon were visually counted at the west bank site during all calibration periods combined (Table 2). Sonar accuracy averaged 0.90 for 19.2 hours of oscilloscope calibration at the east bank site over a period of 27 days (Table 3). A net upstream total of 6,653 chum salmon, 16 king salmon, and 1,712 pink salmon was visually counted during these calibration periods (Table 3). Pink salmon returns to the Yukon River are strong in even numbered years, and this is apparent in the species composition of visual counts at the Anvik River sonar site for 1983 and 1984. Visual counts (east and west bank combined) were 99% chum salmon, 0.4% pink salmon, and 0.6% king salmon in 1983 (Buklis 1984), while they were 82% chum salmon, 17.8% pink salmon, and 0.2% king salmon in 1984. Pink salmon generally did not register sonar counts due to their smaller size and faster swimming speeds. Although they had a poorer target strength than chum and king salmon, a small percentage of the pink salmon probably were counted by the sonar electronics.

Peak daily counts of 80,563 and 71,000 summer chum salmon occurred on 9 and 12

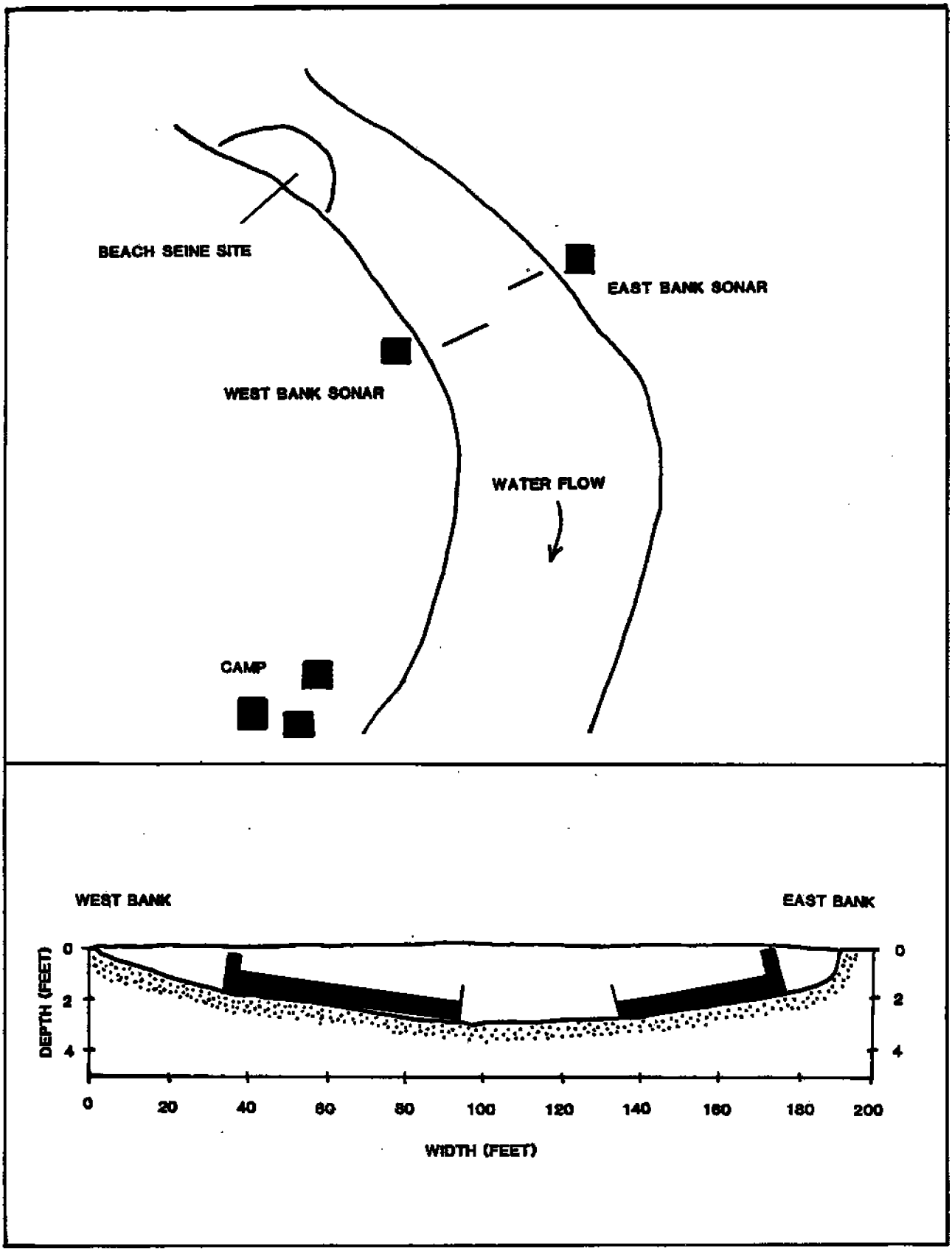

Figure 3. Map of the Anvik River sonar site, and river depth profile as measured on 11 July, 1984.

Table 1. Anvik River chum salmon sonar counts by date, 1984.

Date	West Bank	East Bank	Expanded Count 1/ Daily	Expanded Count 1/ Cumulative	% of Season Total Daily	% of Season Total Cumulative
6/22	190	(76) 2/	293	293	-	-
6/23	199	(80)	307	600	-	0.1
6/24	262	(105)	404	1,004	-	0.1
6/25	7,486	(2,994)	11,528	12,532	1.3	1.4
6/26	10,870	(4,348)	16,740	29,272	1.9	3.3
6/27	15,470	(6,188)	23,824	53,096	2.7	6.0
6/28	10,945	(4,378)	16,855	69,951	1.9	7.9
6/29	17,179	(6,872)	26,456	96,407	3.0	10.8
6/30	16,725	(6,690)	25,756	122,163	2.9	13.7
7/01	14,919	1,579	18,148	140,311	2.0	15.7
7/02	17,429	2,193	21,584	161,895	2.4	18.2
7/03	19,966	2,280	24,471	186,366	2.7	20.9
7/04	21,695	3,870	28,122	214,488	3.2	24.1
7/05	18,308	3,064	23,509	237,997	2.6	26.7
7/06	23,476	13,537	40,714	278,711	4.6	31.3
7/07	30,407	10,596	45,103	323,814	5.1	36.3
7/08	25,651	22,707	53,194	377,008	6.0	42.3
7/09	42,968	30,271	80,563	457,571	9.0	51.4
7/10	37,817	15,260	58,385	515,956	6.6	57.9
7/11	29,786	25,533	60,851	576,807	6.8	64.7
7/12	26,882	37,663	71,000	647,807	8.0	72.7
7/13	39,332	18,887	64,041	711,848	7.2	79.9
7/14	20,649	15,893	40,196	752,044	4.5	84.4
7/15	11,442	10,886	24,561	776,605	2.8	87.2
7/16	6,948	9,423	18,008	794,613	2.0	89.2
7/17	6,873	5,257	13,343	807,956	1.5	90.7
7/18	9,780	2,050	13,013	820,969	1.5	92.1
7/19	13,498	1,363	16,347	837,316	1.8	94.0
7/20	15,503	536	17,643	854,959	2.0	96.0
7/21	9,914	691	11,666	866,625	1.3	97.3
7/22	3,226	1,805	5,534	872,159	0.6	97.9
7/23	3,553	3,294	7,532	879,691	0.8	98.7
7/24	2,152	1,567	4,091	883,782	0.5	99.2
7/25	1,634	480	2,325	886,107	0.3	99.4
7/26	2,287	296	2,841	888,948	0.3	99.8
7/27	1,737	154	2,080	891,028	0.2	100.0

1/ Actual count expanded to account for escapement in middle portion of river by multiplying sum of east and west bank counts by 1.10. Expansion factor based on visual observation of fish passage in 1978.

2/ Daily counts in parentheses for east bank from 6/22 through 6/30 are estimated based on west bank counts due to inaccurate operation of sonar equipment at the east bank site during this period. The east bank averaged 28.7% of total daily sonar counts from 7/1 through 7/27. Therefore, west bank counts were multiplied by 0.40 to obtain estimated east bank counts.

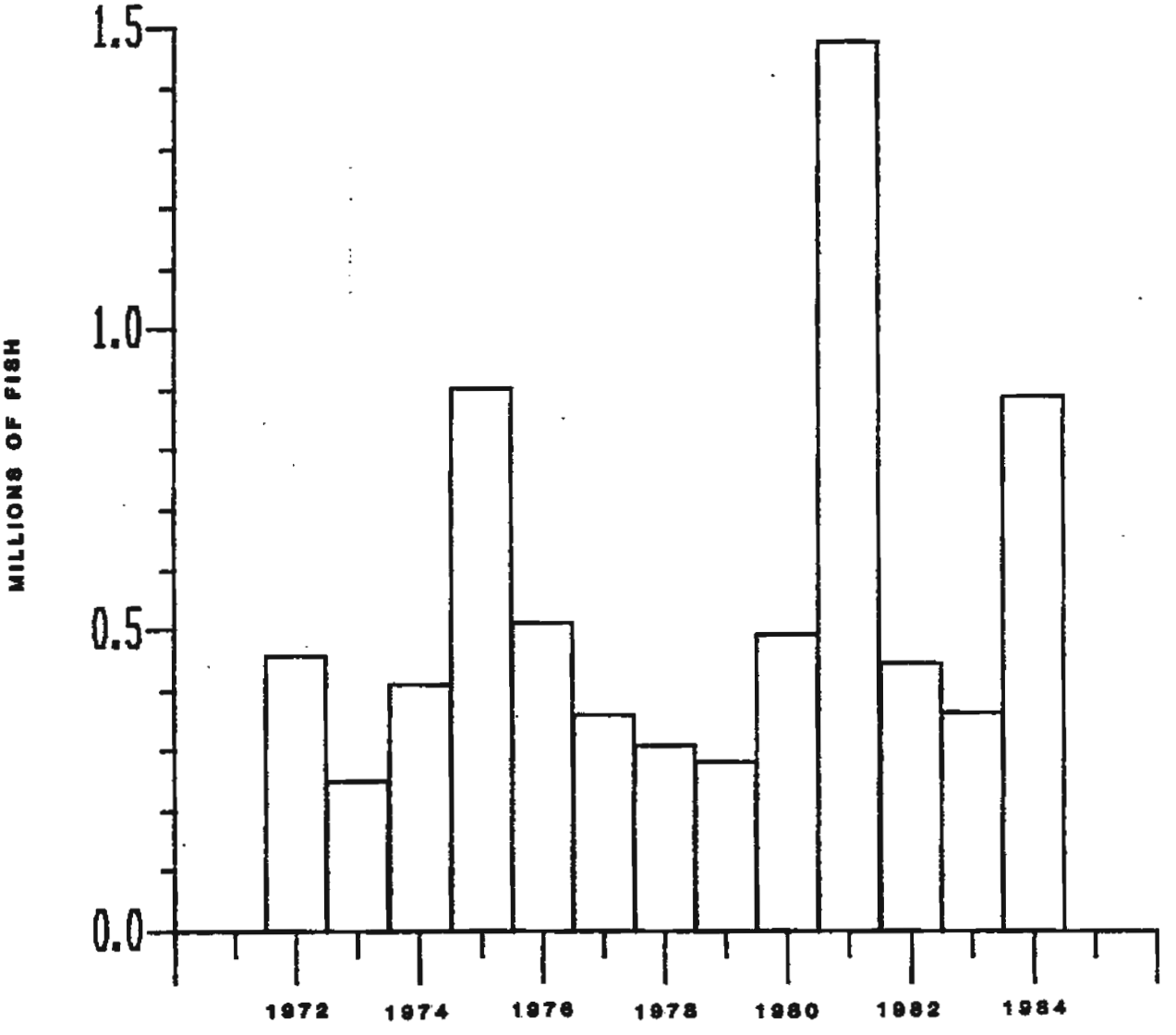

Figure 4. Anvik River summer chum salmon escapement, 1972-1984.

Table 2. Oscilloscope and visual calibration of salmon sonar counts at the Anvik River west bank site, 1984. 1/

Date	Hours Counted	Sonar Count	Scope Count	Sonar/ Scope	Visual Count 2/								
					Chum Salmon			King Salmon			Pink Salmon		
					Up	Down	Net	Up	Down	Net	Up	Down	Net
6/25	0.50	487	541	0.90	152	0	152	0	0	0	0	0	0
6/26	1.08	573	738	0.78	339	0	339	0	0	0	0	0	0
6/27	0.50	108	121	0.89	155	0	155	0	0	0	0	0	0
6/28	0.75	360	370	0.97	118	0	118	1	0	1	0	0	0
6/29	0.75	651	667	0.98	167	0	167	0	0	0	0	0	0
6/30	0.75	438	395	1.11	104	0	104	0	0	0	0	0	0
7/01	0.75	719	731	0.98	550	0	550	0	0	0	0	0	0
7/02	0.75	511	799	0.64	425	0	425	0	0	0	0	0	0
7/03	0.75	794	919	0.86	163	3	160	1	0	1	0	0	0
7/04	0.50	352	363	0.97	-	-	-	-	-	-	-	-	-
7/05	0.75	554	536	1.03	121	0	121	0	0	0	0	0	0
7/06	0.67	749	713	1.05	139	0	139	0	0	0	3	0	3
7/07	0.75	896	948	0.95	432	1	431	0	0	0	7	0	7
7/08	1.33	1,206	1,063	1.13	292	2	290	0	0	0	11	0	11
7/09	0.92	1,452	1,301	1.12	405	9	396	0	0	0	32	0	32
7/10	0.75	1,296	1,155	1.12	346	6	340	0	0	0	47	0	47
7/11	0.58	545	458	1.19	233	2	231	2	2	0	35	0	35
7/12	0.42	275	253	1.09	59	2	57	0	0	0	2	0	2
7/13	1.08	658	550	1.20	294	5	289	0	0	0	43	0	43
7/14	0.58	502	396	1.27	345	10	335	2	0	2	56	0	56
7/15	0.75	392	430	0.91	180	13	167	1	0	1	37	0	37
7/16	0.50	148	128	1.16	30	0	30	0	0	0	0	0	0
7/17	0.75	263	257	1.02	99	2	97	0	0	0	55	0	55
7/18	0.75	269	260	1.03	125	4	121	1	0	1	192	0	192
7/19	0.75	465	466	1.00	91	8	83	1	0	1	123	0	123
7/20	0.75	243	221	1.10	83	5	78	0	0	0	82	1	81
7/21	0.75	192	186	1.03	58	9	49	0	0	0	65	3	62
7/22	0.75	144	127	1.13	80	4	76	0	0	0	61	1	60
7/23	0.50	75	64	1.17	32	7	25	0	0	0	34	0	34
7/24	0.50	49	45	1.09	26	5	21	0	0	0	28	2	26
7/25	0.50	21	17	1.24	12	4	8	0	0	0	13	1	12
7/26	0.75	19	17	1.12	11	6	5	0	0	0	7	1	6
7/27	0.50	6	6	1.00	7	5	2	0	0	0	8	0	8
Totals	23.41	15,412	15,241	1.01	5,673	112	5,561	9	2	7	941	9	932

1/ Sonar electronics were adjusted to optimize counting of chum and king salmon only.

2/ Visual salmon counts are listed as upstream or downstream passage over the sonar substrate, with "net" being the difference between the two. Due to poor visibility (water turbidity, wind, overcast, rain) visual counts were often obtainable only for the first few sectors, or not at all, and therefore cannot be used to assess sonar accuracy.

Table 3. Oscillscope and visual calibration of salmon sonar counts at the Anvik River east bank site, 1984. 1/

Date	Hours Counted	Sonar Count	Scope Count	Sonar/ Scope	Visual Count 2/ Chum Salmon Up	Chum Salmon Down	Chum Salmon Net	King Salmon Up	King Salmon Down	King Salmon Net	Pink Salmon Up	Pink Salmon Down	Pink Salmon Net
7/01	1.00	93	310	0.30	446	0	446	0	0	0	0	0	0
7/02	0.75	365	836	0.44	1,036	0	1,036	0	0	0	0	0	0
7/03	0.92	412	1,074	0.38	707	0	707	0	0	0	0	0	0
7/04	0.50	45	100	0.45	-	-	-	-	-	-	-	-	-
7/05	0.67	69	98	0.70	64	0	64	0	0	0	0	0	0
7/06	0.83	528	461	1.15	149	0	149	0	0	0	0	0	0
7/07	0.83	360	347	1.04	215	0	215	0	0	0	1	0	1
7/08	0.83	615	587	1.05	343	1	342	0	0	0	6	0	6
7/09	0.75	653	683	0.96	553	5	548	2	0	2	21	0	21
7/10	0.67	293	289	1.01	240	1	239	1	0	1	59	1	58
7/11	0.33	232	213	1.09	218	0	218	0	0	0	45	0	45
7/12	0.75	1,057	908	1.16	513	0	513	0	0	0	91	0	91
7/13	0.75	959	948	1.01	659	4	655	6	0	6	140	0	140
7/14	0.75	1,338	1,216	1.10	656	10	646	3	0	3	400	0	400
7/15	0.83	929	864	1.08	515	6	509	0	0	0	358	0	358
7/16	0.50	514	502	1.02	135	2	133	0	0	0	5	0	5
7/17	0.75	101	110	0.92	74	5	69	3	0	3	242	0	242
7/18	0.75	147	135	1.09	66	2	64	1	0	1	146	0	146
7/19	0.75	32	30	1.07	26	5	21	0	0	0	66	0	66
7/20	0.50	27	28	0.96	14	1	13	0	0	0	38	0	38
7/21	0.75	49	44	1.11	26	7	19	0	0	0	36	3	33
7/22	0.75	55	50	1.10	27	5	22	0	0	0	18	1	17
7/23	0.50	24	22	1.09	5	1	4	0	0	0	3	0	3
7/24	0.50	29	29	1.00	16	9	7	0	0	0	24	1	23
7/25	1.08	25	19	1.32	15	10	5	0	0	0	13	5	8
7/26	0.75	31	27	1.15	17	5	12	0	0	0	8	1	7
7/27	0.50	0	1	-	1	4	-3	0	0	0	4	0	4
Totals	19.24	8,982	9,931	0.90	6,736	83	6,653	16	0	16	1,724	12	1,712

1/ Sonar electronics were adjusted to optimize counting of chum and king salmon only.
2/ Visual salmon counts are listed as upstream or downstream passage over the sonar substrate, with "net" being the difference between the two. Due to poor visibility (water turbidity, wind, rain, overcast) visual counts were often obtainable only for the first few sectors, or not at all, and therefore cannot be used to assess sonar accuracy.

July, respectively. These peaks represented 9.0% and 8.0% of the total season escapement count (Figure 5). Mean date of passage occurred on 9 July, with a standard deviation of 6.50 days. Run timing and the pattern of the 1984 escapement is similar to that of the historical data base, excluding 1981. Historical run timing data and inseason sonar counts were used to generate inseason forecasts of final 1984 escapement. Percent of season total escapement was averaged by date for the four previous years (1979, 1980, 1982, 1983). Inseason sonar counts were then expanded based on the average percent passage by that date for the historical data base. Estimates of 1,060,580 and 791,376 summer chum salmon were generated on 26 June and 1 July, respectively, using this method. These estimates are 119% and 89%, respectively, of the final season escapement estimate of 891,028 summer chum salmon. This approach should become more precise as the data base is extended.

Buklis (1982) postulated a 20 day lag time for summer chum salmon migration between the lower Yukon River fishery at Emmonak (District Y-1) and the Anvik River sonar site. If correct, this would mean that 50% of the Anvik River stock had passed through the Emmonak area by 19 June in 1984. The large mesh (8-1/2 inch) gillnet season in Y-1 ended by emergency order on 29 June, indicating that once again the majority of the Anvik River stock had passed through the intensive lower Yukon River fishery before mandatory changeover to chum salmon gear. This subject is addressed further in the conclusion section of this report.

Distribution of the combined east and west bank sonar counts by hour does not indicate a distinct diel pattern (Figure 6). Counts ranged from a low of 3.5% of total daily passage during 0900-1000 and 1000-1100 hours, to a high of 4.9% during 1800-1900 hours. Sixty-six percent of the sonar counts occurred on the west bank, 34% on the east bank. Distribution of sonar counts was higher in the inner and outer sectors for each substrate, and low in the middle sectors (Figure 6). Sector 1 of the west bank accounted for 19% of all sonar counts for both substrates combined.

An aerial survey of the Anvik River was flown on 17 July under cloudy conditions and 641 king salmon were counted. This was a very minimal estimate due to poor survey conditions. Chum and pink salmon were not enumerated. The king salmon estimate is similar to that obtained under poor survey conditions in 1983, and indicates that the escapement was about average in magnitude.

An unusually dry spring resulted in extremely low water conditions throughout the 1984 field season. Water level is usually high in early June, declines through the summer, and rises in late July or early August due to rain. The water level in 1984 was lower in mid-June than is usually seen at any time during the summer. River water depth further declined from the initial zero reading on 16 June to a low of -19 cm on 19 July (Figure 7). Heavy rainfall in late July resulted in a season high reading of +53 cm on 4 August. Water temperature ranged from a low of 10°C on 9 July to a high of 15°C on 23 June. Air temperature (daily max/min average) ranged from a low of 8°C on 7 July to a high of 21°C on 26 June.

Fifty-nine beach seine sets were made from 25 June through 27 July, and a total of 737 salmon was captured (Appendix Table 1). Species composition was

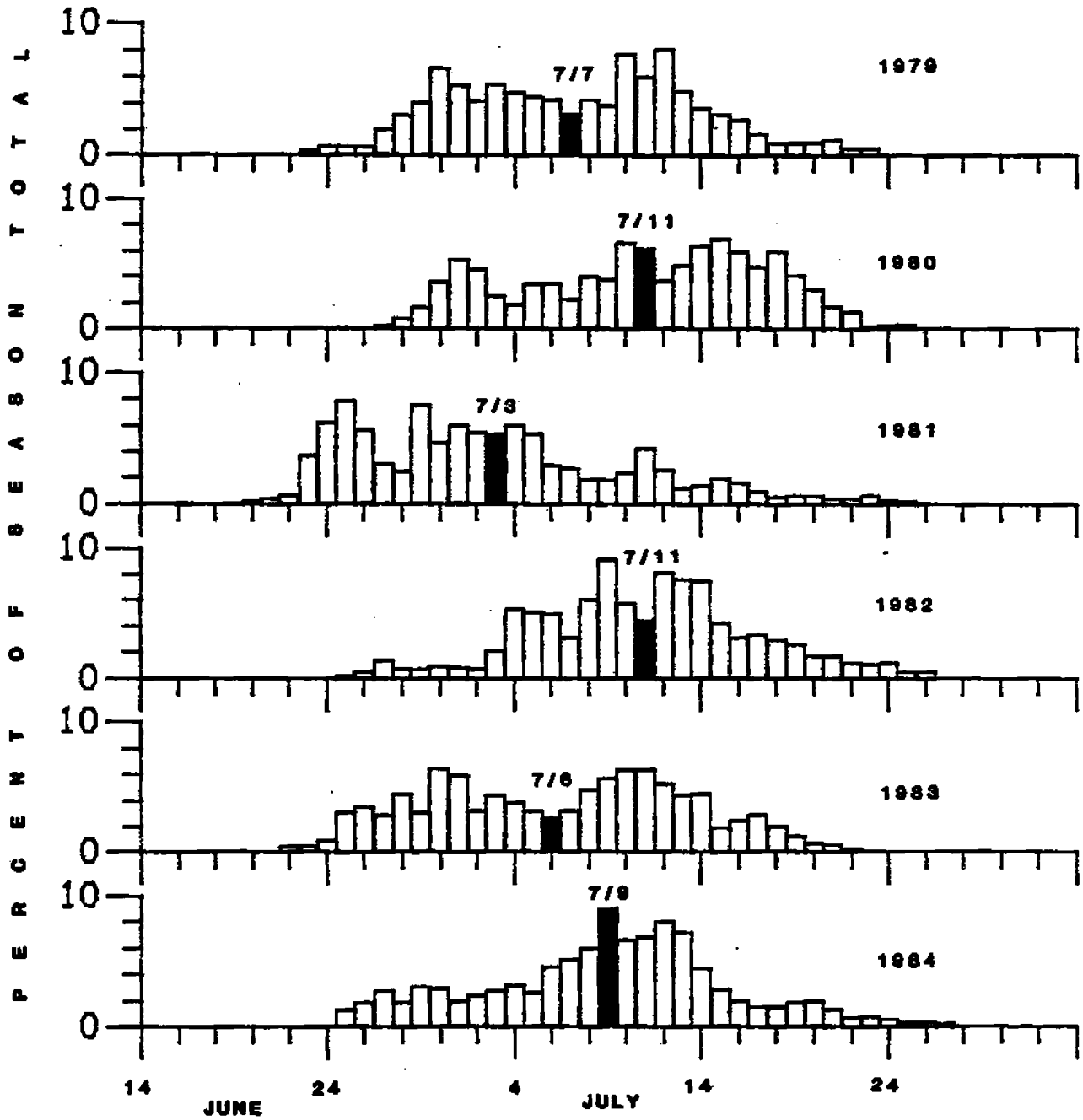

Figure 5. Daily summer chum salmon escapement past the Anvik River sonar site, 1979-1984. (Mean date of run passage is indicated by shaded bar.)

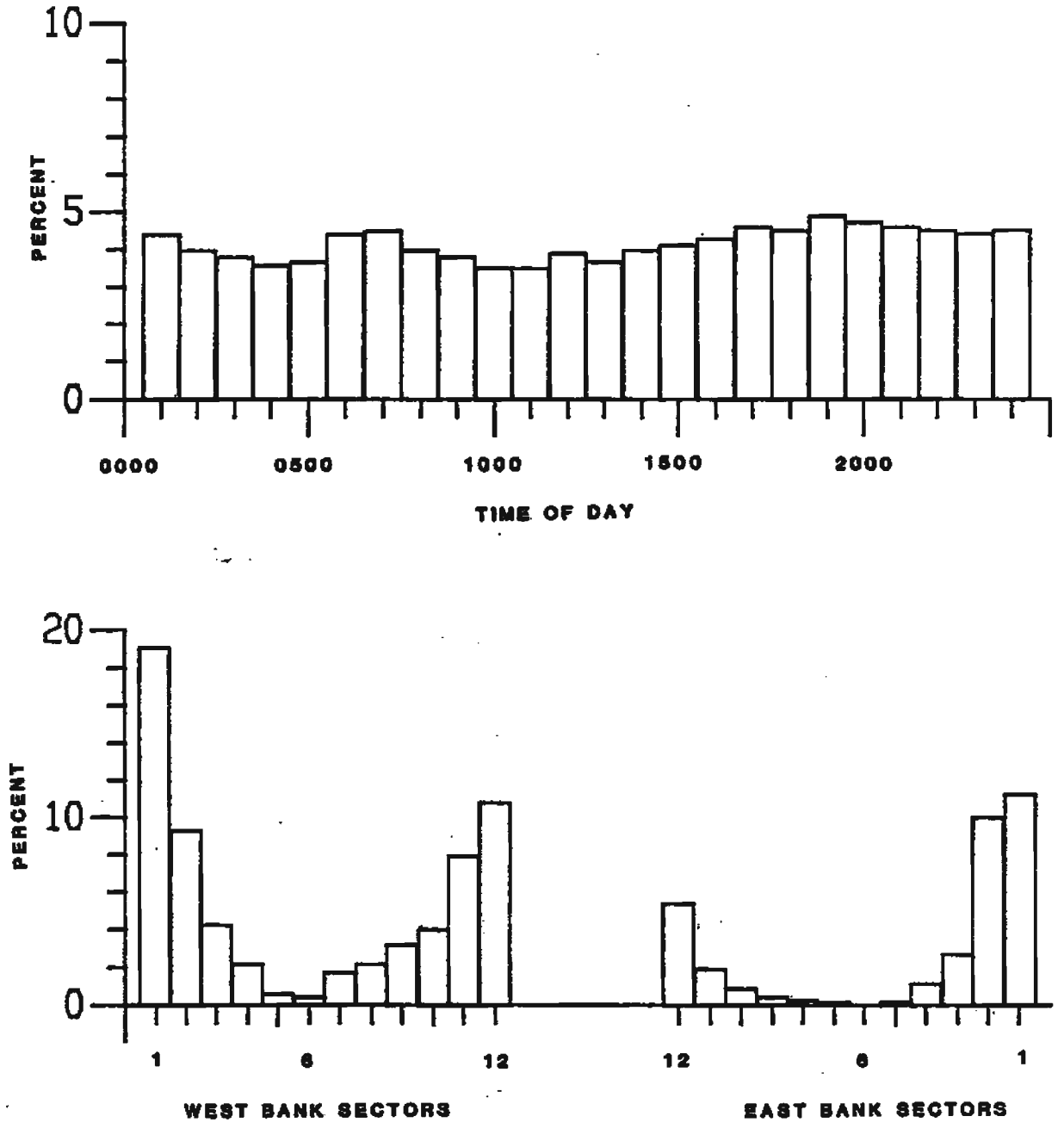

Figure 6. Summer chum salmon escapement past the Anvik River sonar site by hour (above), and by sonar sector (below), in 1984.

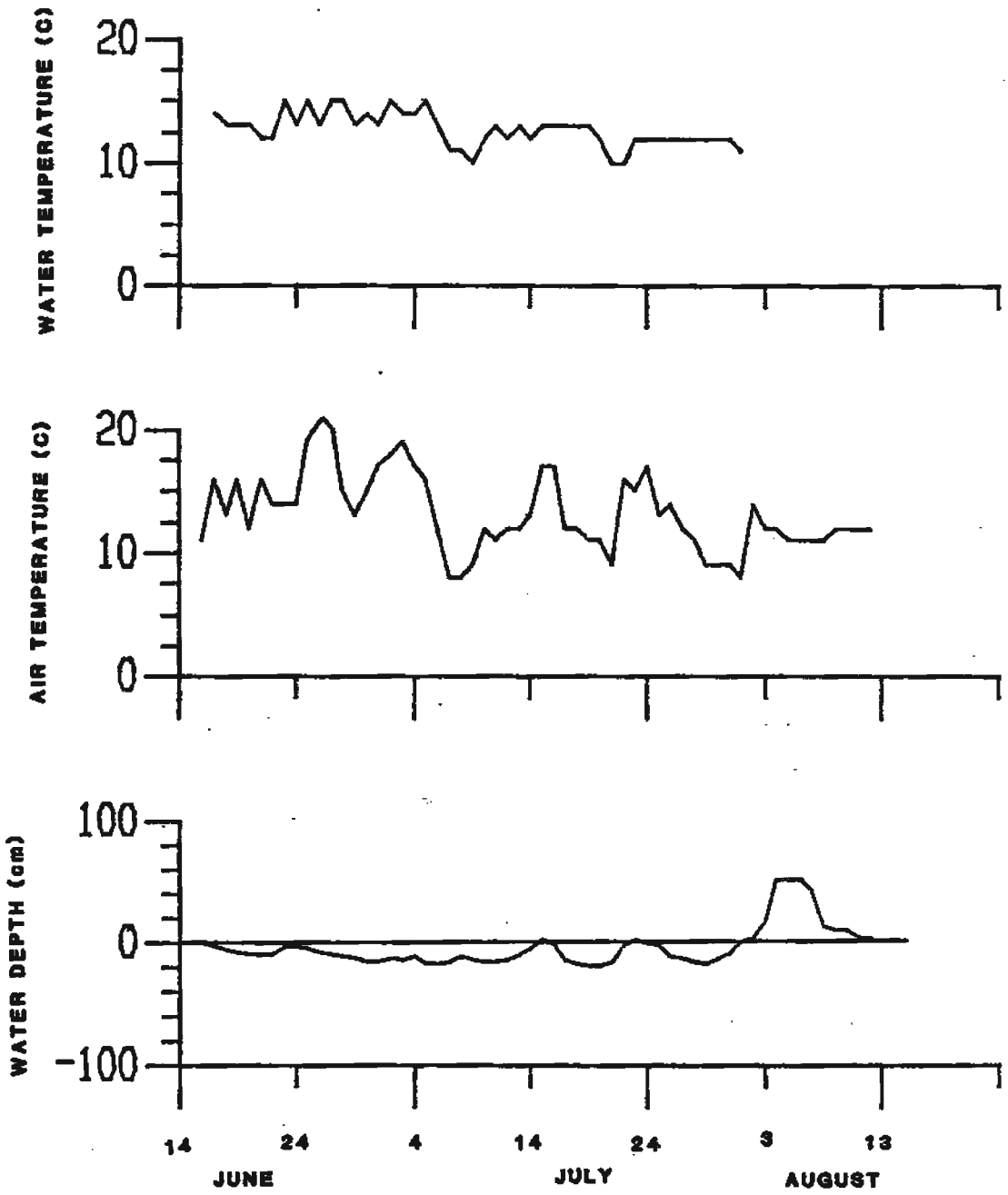

Figure 7. Water temperature, air temperature (max/min average), and water depth measured at noon daily at the Anvik River sonar site, 1984.

456 (62%) chum salmon (61% female), 1 (0.1%) king salmon (a male), and 280 (38%) pink salmon (56% female).

Of the 454 chum salmon sampled for age-sex-size data, 353 (78%) later proved to have ageable scales. Age composition was 87% age 4, 11% age 5, 2% age 3, and 0% age 6 (Appendix Table 2). Females accounted for 61% of the sample, and average lengths ranged from a low of 555 mm for age 3 females to a high of 610 mm for age 5 males. Females were not as well represented in the District 1 commercial gillnet fishery as they were in the Anvik River escapement, accounting for less than 50% of the catch samples for most fishing periods (Buklis and Wilcock, In prep). This is due to the size selective nature of the gillnet fishery and the larger size of male chums. Age composition of the commercial catch varied according to mesh size and progression of the run, but a strong age 4 component was apparent, similar to the escapement sample. Age 4 usually accounts for the majority of the summer chum salmon escapement to the Anvik River. Age 5 was the strongest age class in 1972, 1976, and 1981, but in all other years since 1972 age 4 has been predominant (Figure 8). The strong showing of age 3 fish in 1982 and age 4 fish in 1983 did not carry over into a strong age 5 component in 1984, as had been anticipated. The age 4 return in 1984 was the product of the 1980 parent year escapement, which was only average in magnitude. The 1985 escapement is expected to be predominantly age 4, due to the record parent year escapement in 1981.

Only 1 king salmon was captured by beach seine, but an additional 328 carcasses were sampled by boat survey of the river between the sonar camp and Robinhood Creek, a distance of 40 miles. Of the 329 king salmon sampled for age-sex-size data, 276 (84%) later proved to have ageable scales. Age composition was 50% age 5, 36% age 6, 12% age 4, and 2% age 7 (Appendix Table 3). Females accounted for 41% of the sample, and average lengths ranged from a low of 542 mm for age 4 females to 878 mm for age 7 females. Ages 5 and 6 account for the majority of the king salmon in the Anvik River escapement each year (Figure 9). The strong return of age 5 in 1984 is similar to that of the 1980 escapement, and sex composition is similar to that of most previous years. The commercial gillnet fishery selects for larger fish, with ages 6 and 7, and females, making up a greater share of the District 1 commercial catch than was found for the Anvik River escapement (Buklis and Wilcock, In Prep).

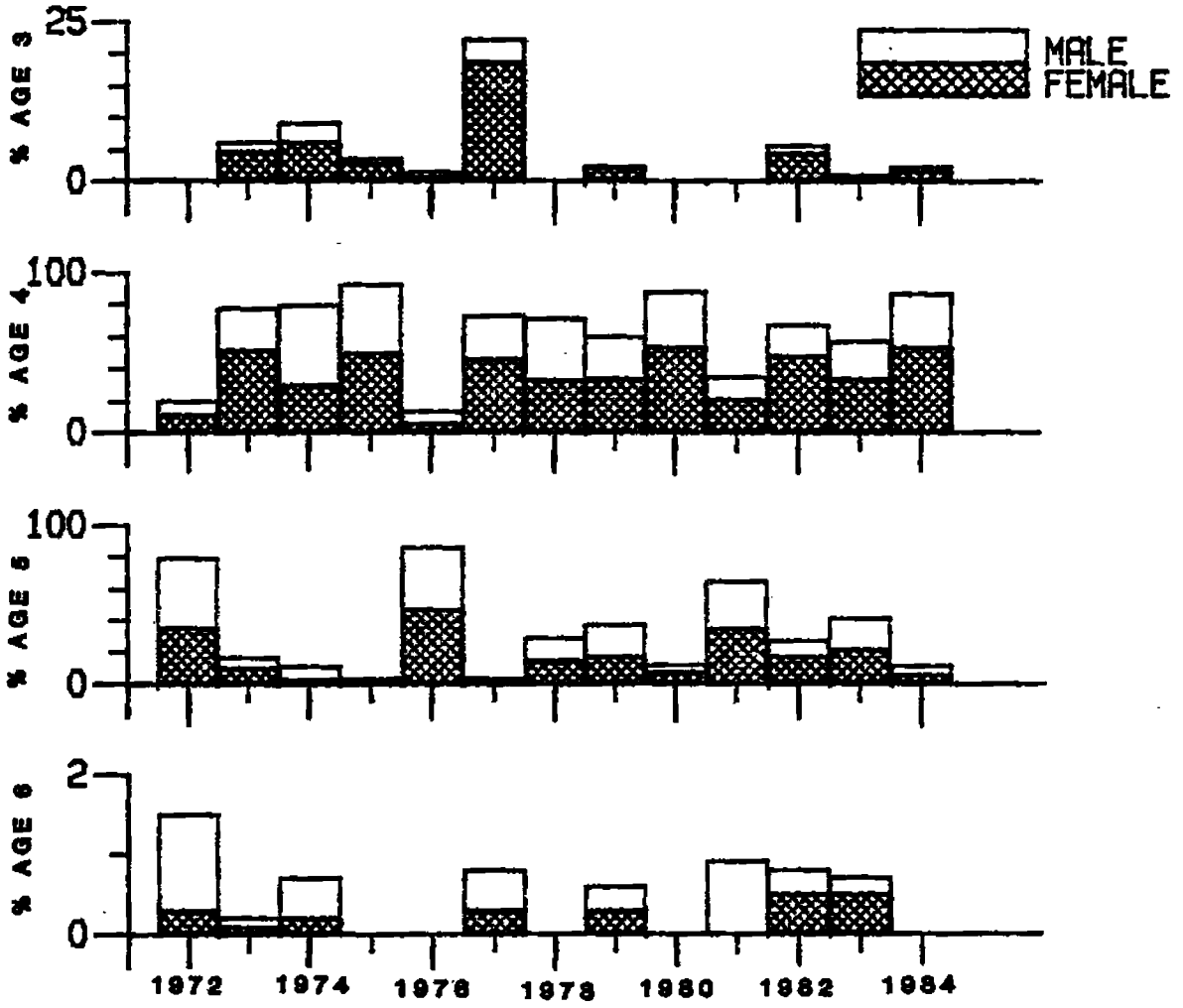

Figure 8. Age and sex composition of Anvik River summer chum salmon, 1972-1984.

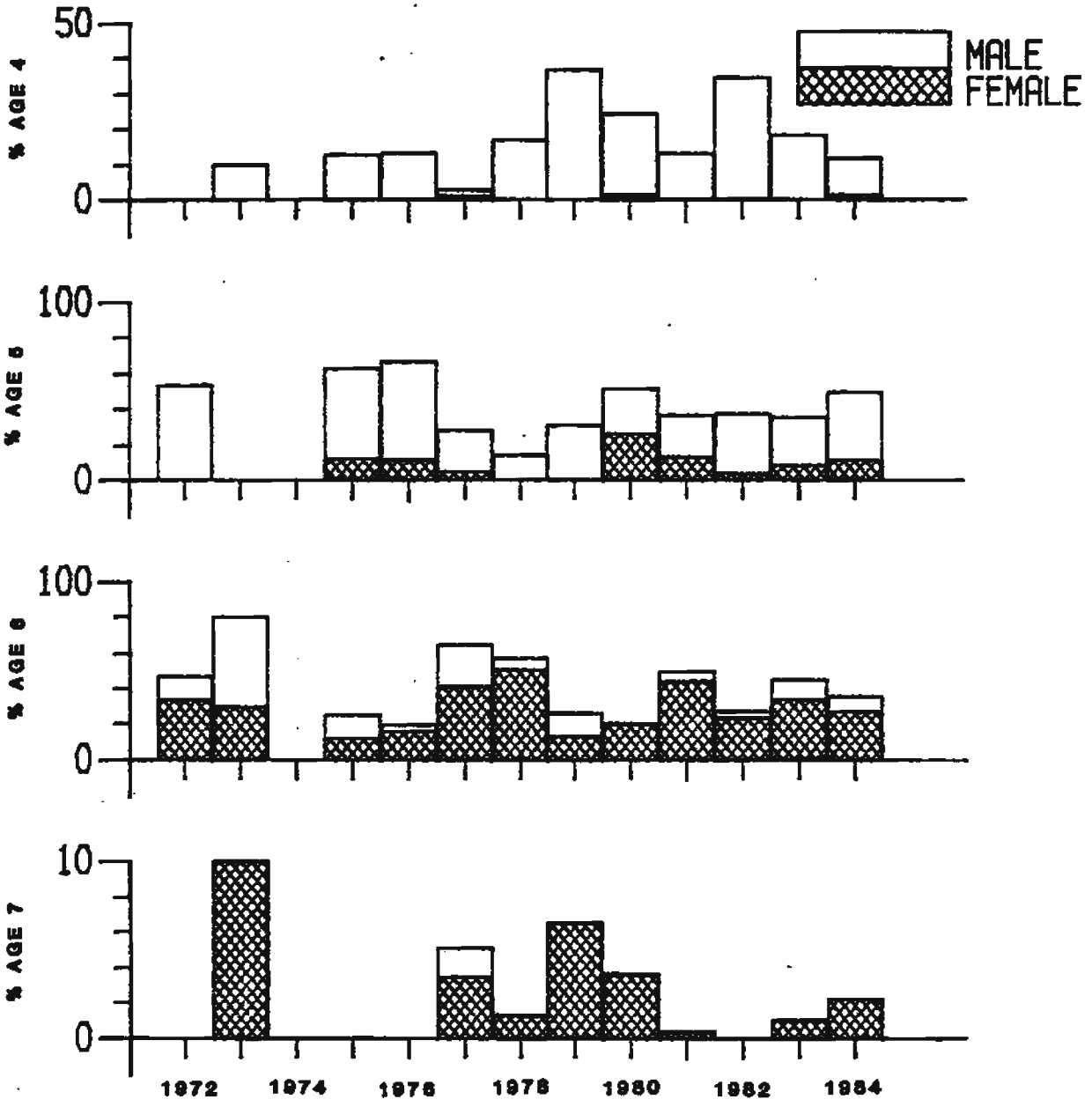

Figure 9. Age and sex composition of Anvik River king salmon, 1972-1984. (No samples were collected in 1974.)

ANDREAFSKY RIVER SALMON STUDY

The Andreafsky River (Figure 10) includes two main branches, the East and West Forks, and is located 100 miles upstream from the mouth of the Yukon River. It ranks second to the Anvik River in summer chum salmon production, second to the Salcha River in king salmon production, and supports the largest pink salmon run in the Yukon River drainage. Salmon escapements were estimated annually in both forks by aerial survey from fixed-wing aircraft prior to 1981. In that year a side-scan sonar counter was installed in the East Fork for the first time. Water clarity is generally good, but high water, rain, wind and cloud cover have resulted in poor aerial surveys in some years. Furthermore, even when weather and water conditions are good, aerial surveys provide only an index of salmon escapement, as opposed to the total enumeration possible with side-scanning sonar.

Below the confluence of the East and West Forks, the Andreafsky River is wide and slow moving, not suitable for side-scan sonar operation. The East Fork was chosen for the initial feasibility study in 1981 because it supports a greater average summer chum salmon escapement than the West Fork, based on previous aerial survey data. There is also less recreational use of the East Fork by the residents of St. Marys, a village of 500 people located near the confluence of the Andreafsky and Yukon Rivers.

Methods and Materials

The same sonar site used since 1981, located at mile 20 of the East Fork Andreafsky River, was used in 1984. One 60 foot sonar substrate was deployed in the middle of the channel between the west bank of the river and a small island (Figure 11). Weirs prevented salmon passage around either end of the substrate. The channel on the oppostie side of the island was not navigable to salmon due to shallow water and numerous gravel bars. A 1981 model sonar counter was used, which divides the counting range into 16 sectors, unlike the 1978 models used on the Anvik River which have 12 sectors. Other differences between the two models are described in detail by Buklis (1983). No expansion factors for the daily sonar counts were necessary since the entire river passable to salmon was either weired or covered by the sonar counter.

One 10 foot counting tower was built in shallow water near each end of the substrate for visual calibrations. Visual and oscilloscope calibrations were conducted in the same manner as described for the Anvik River. A beach seine site was located about 1/4 mile below the sonar site. The seine was set across the channel from a small gravel island to the east bank of the river. Methods and materials for age-sex-size sampling, measuring river velocity, depth profile, and climatological data were similar to those described for the Anvik River study.

Results and Discussion

The sonar counter was operational beginning on 22 June. The river was approximately 135 feet wide between the west bank and island at the sonar site, and ranged to a maximum depth of 3.25 feet as measured on 18 July (Figure 11). Surface water velocity was 2 ft/sec over the target end and midpoint of the substrate, but only 1.2 ft/sec at the transducer end, which

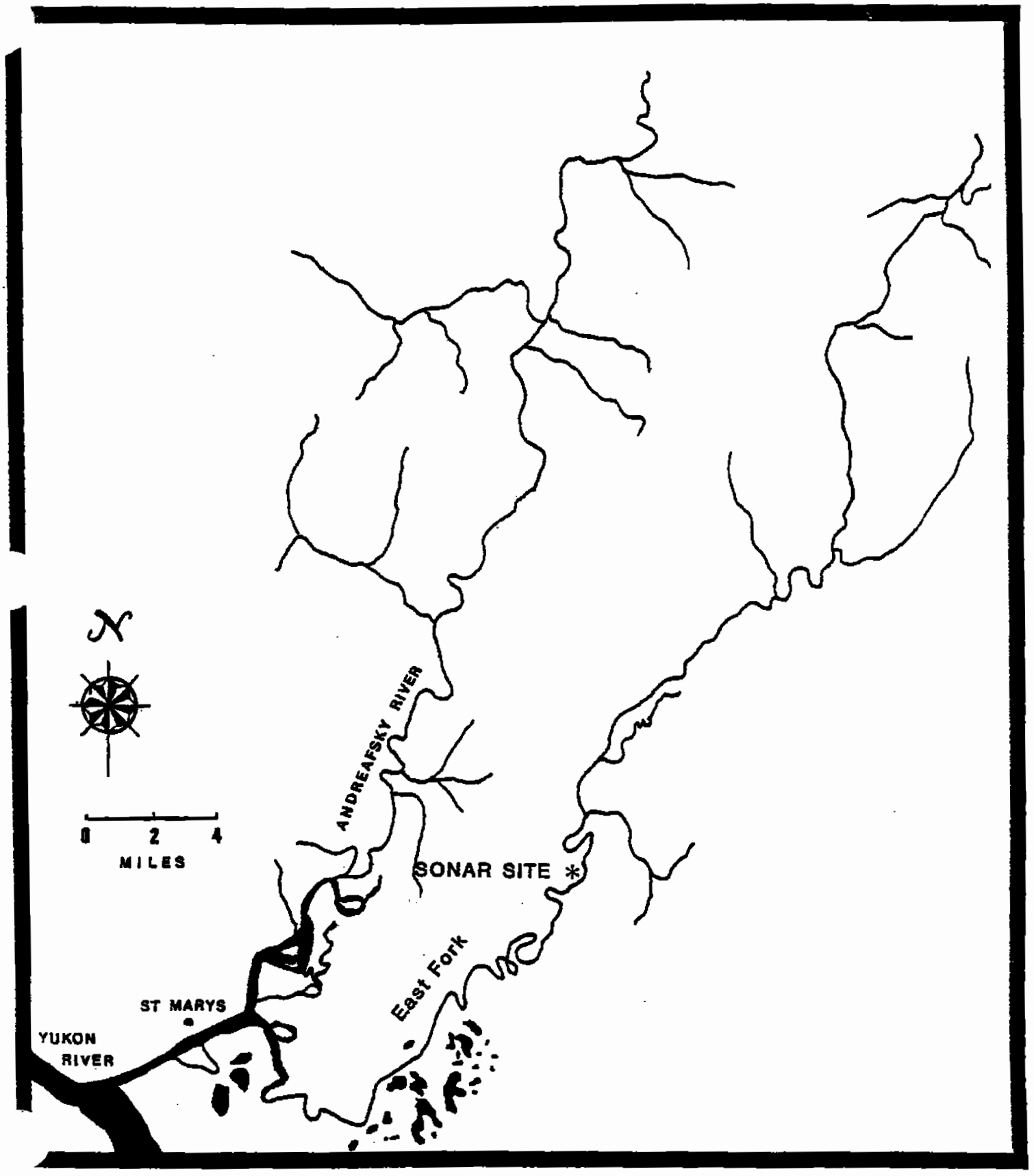

Figure 10. Map of the Andreafsky River.

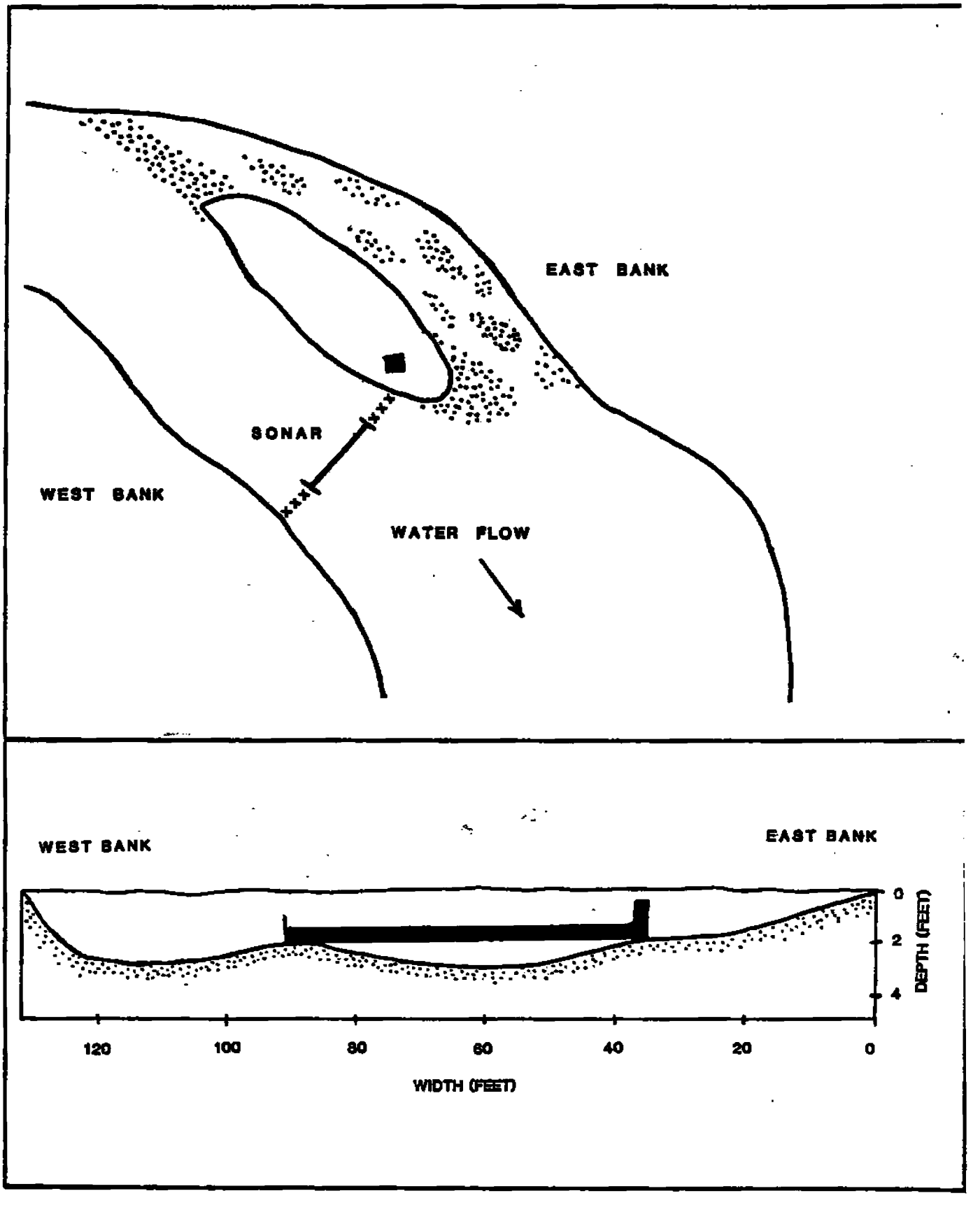

Figure 11. Map of the East Fork Andreafsky River sonar site, and river depth profile as measured on 18 July, 1984.

was located off the gradually sloping shore of the island.

Pink salmon abundance increased sharply beginning on 8 July, while chum and king salmon abundance declined steadily beginning on 10 July, based on visual observations (Figure 12). As a result, accurate enumeration of chum and king salmon by sonar became increasingly difficult, and was discontinued on 13 July. Since water clarity was sufficient to allow accurate visual enumeration of salmon passage, daily salmon escapement estimates during the period 14 through 25 July were based on expanded visual tower counts. Counting was conducted for 15 minutes every hour on the half hour, from 0630 through 2330 each day. Counts were multiplied by 4 to generate hourly estimates. The 18-hour total was expanded to a daily estimate based on the average contribution of this time block (0600-2400) to total daily escapement during the 24 June - 12 July period of sonar counting. The 18-hour time block accounted for 79% of total daily sonar counts. Therefore, 18-hour visual estimates were multiplied by 1.266 to generate daily estimates of salmon passage.

A total of 67,205 chum and king salmon was counted by sonar between 22 June and 13 July (Table 4). The sonar electronics were adjusted in order to minimize the frequency of pink salmon registering counts. Sonar accuracy averaged 1.02 as assessed by 16.3 hours of oscilloscope calibration over a 22 day period (Table 5). During these calibration periods a total of 918 (48%) chum salmon, 27 (1.4%) king salmon, and 949 (50%) pink salmon were visually enumerated. Water clarity was generally very good, but visual counts were not conducted during all calibration periods. Visual counts do, however, provide an estimate of species composition. The 945 salmon counted, excluding pinks, were 97.1% chum and 2.9% king. These proportions are very similar to those found for the 1983 visual count data. Applying these proportions to the season sonar count of 67,205 yields escapement estimates of 65,283 chum salmon and 1,922 king salmon.

Expanded tower counts from 14 through 25 July totalled an additional 4,842 chum, 551 king, and 166,039 pink salmon (Table 6). Resulting season escapement estimates (sonar and tower combined) are 70,125 chum salmon and 2,473 king salmon. The pink salmon estimate of 166,039 is only for the period 14-25 July, since an accurate estimate cannot be generated from the limited visual count data obtained during the period of sonar operation. The relative distribution of pink salmon visual counts (Figure 12) indicates that between one-third and one-half of the pink salmon escapement occurred before tower counting was initiated. Therefore, total season escapement was probably about 250,000 pink salmon. Buklis (1983) suggested that the 1982 pink salmon escapement to the East Fork Andreafsky River may have approached 1 million fish based on very limited visual count data. It now appears that that estimate was too high. Passage rates were similar between the two years, and the 1982 pink salmon escapement may have actually been more on the order of 200,000 to 300,000 fish.

Success of the tower counting method in estimating salmon escapement by species indicates that this method may be perferable to sonar enumeration in the East Fork Andreafsky River in the future, especially in even-numbered years when pink salmon are very abundant. The sonar equipment should be

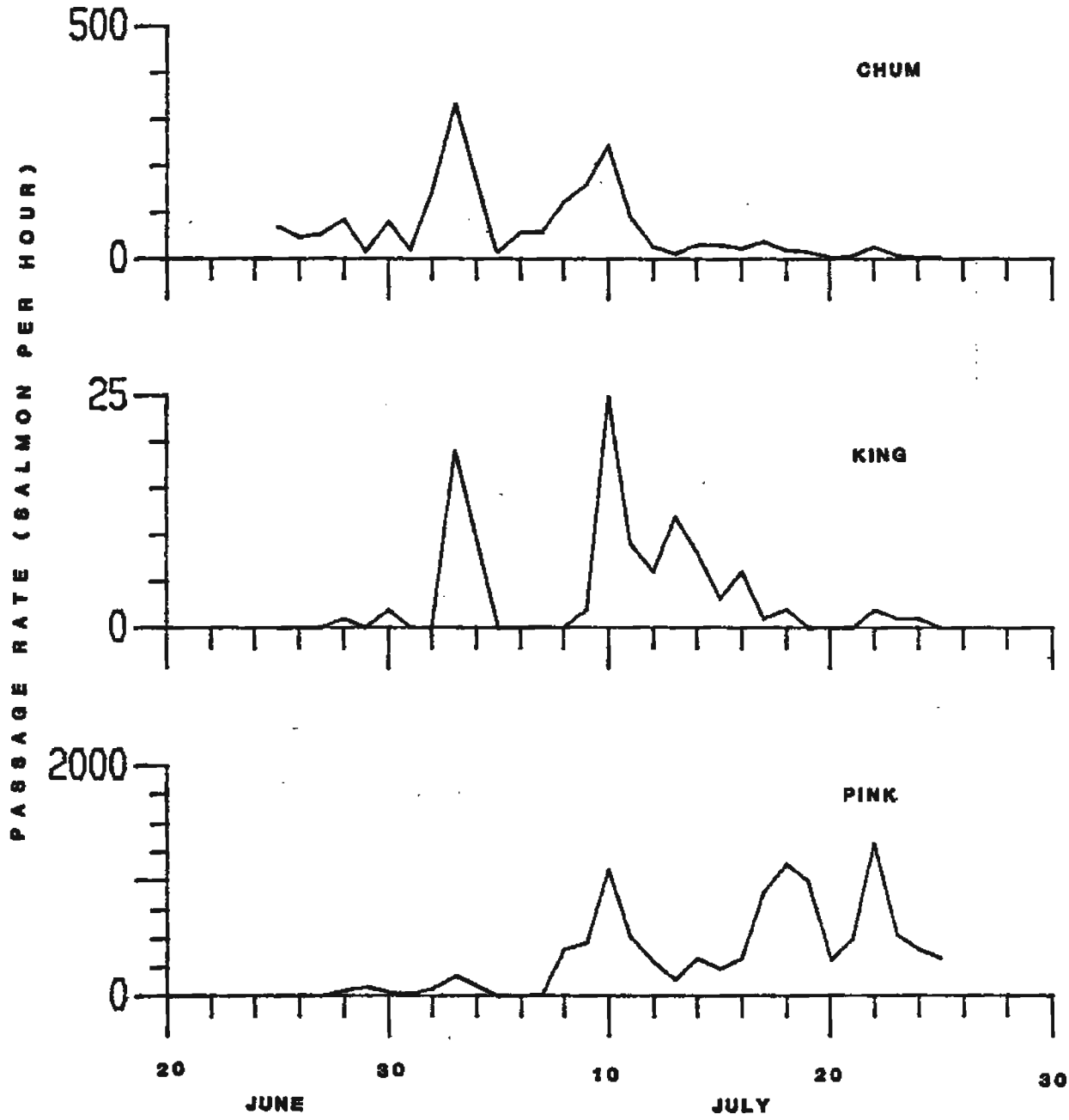

Figure 12. Hourly passage rate of chum, king, and pink salmon at the East Fork Andreafsky River sonar site based on visual counts, 1984.

Table 4. East Fork Andreafsky River chum and king salmon sonar counts by date, 1984.

Date	Sonar Count		% of Season Total	
	Daily	Cumulative	Daily	Cumulative
6/22	100	100	0.1	0.1
6/23	63	163	0.1	0.2
6/24	637	800	0.9	1.1
6/25	1,395	2,195	1.9	3.0
6/26	2,108	4,303	2.9	5.9
6/27	2,170	6,473	3.0	8.9
6/28	2,484	8,957	3.4	12.3
6/29	2,678	11,635	3.7	16.0
6/30	1,774	13,409	2.4	18.5
7/01	2,418	15,827	3.3	21.8
7/02	2,687	18,514	3.7	25.5
7/03	2,699	21,213	3.7	29.2
7/04	2,240	23,453	3.1	32.3
7/05	1,518	24,971	2.1	34.4
7/06	3,403	28,374	4.7	39.1
7/07	5,507	33,881	7.6	46.7
7/08	8,893	42,774	12.2	58.9
7/09	7,232	50,006	10.0	68.9
7/10	7,970	57,976	11.0	79.9
7/11	5,078	63,054	7.0	86.9
7/12	2,453	65,507	3.4	90.2
7/13	1,698	67,205	2.3	92.6
7/14	(901) 1/	68,106	1.2	93.8
7/15	(750)	68,856	1.0	94.8
7/16	(628)	69,484	0.9	95.7
7/17	(886)	70,370	1.2	96.9
7/18	(476)	70,846	0.7	97.6
7/19	(395)	71,241	0.5	98.1
7/20	(122)	71,363	0.2	98.3
7/21	(177)	71,540	0.2	98.5
7/22	(674)	72,214	0.9	99.5
7/23	(207)	72,421	0.3	99.8
7/24	(106)	72,527	0.1	99.9
7/25	(71)	72,598	0.1	100.0

1/ Daily counts in parentheses for period 7/14 through 7/25 are expanded visual counts of chum and king salmon combined, instead of sonar counts. Large numbers of pink salmon made it impossible to obtain accurate chum and king salmon sonar counts during this period. Visual counts were conducted for 15 minutes out of each hour, 18 hours per day, and expanded as outlined in Table 6.

Table 5. Oscilloscope and visual calibration of salmon sonar counts at the East Fork Andreafsky River sonar site, 1984. 1/

Date	Hours Counted	Sonar Count	Scope Count	Sonar/ Scope	Visual Count 2/								
					Chum Salmon			King Salmon			Pink Salmon		
					Up	Down	Net	Up	Down	Net	Up	Down	Net
6/22	0.75	0	0	-	0	0	0	0	0	0	0	0	0
6/23	0.75	1	0	-	0	0	0	0	0	0	0	0	0
6/24	1.00	6	12	0.50	0	0	0	0	0	0	0	0	0
6/25	1.08	61	108	0.56	75	0	75	0	0	0	0	0	0
6/26	1.00	127	160	0.79	30	0	30	0	0	0	0	0	0
6/27	1.05	66	79	0.84	31	0	31	0	0	0	0	0	0
6/28	1.00	108	98	1.10	85	0	85	1	0	1	46	0	46
6/29	0.92	13	20	0.65	7	2	5	0	0	0	26	0	26
6/30	1.00	70	61	1.15	80	0	80	2	0	2	34	0	34
7/01	0.75	15	17	0.88	18	2	16	0	0	0	11	0	11
7/02	1.00	144	115	1.25	149	2	147	0	0	0	55	1	54
7/03	0.67	167	185	0.90	226	1	225	13	0	13	116	1	115
7/04	0.92	78	90	0.87	-	-	-	-	-	-	-	-	-
7/05	0.50	14	12	1.17	8	0	8	0	0	0	2	0	2
7/06	0.67	87	78	1.12	38	0	38	0	0	0	4	0	4
7/07	0.48	92	93	0.99	32	4	28	0	0	0	9	0	9
7/08	0.47	101	98	1.03	44	0	44	0	0	0	111	0	111
7/09	0.50	101	75	1.35	41	0	41	1	0	1	88	4	84
7/10	0.50	122	43	2.84	22	0	22	0	0	0	104	1	103
7/11	0.30	69	57	1.21	29	0	29	0	0	0	149	0	149
7/12	0.23	9	15	0.60	6	0	6	1	0	1	92	0	92
7/13	0.75	29	37	0.78	8	0	8	9	0	9	109	0	109
Totals	16.29	1,480	1,453	1.02	929	11	918	27	0	27	956	7	949

1/ Sonar electronics were adjusted to optimize counting of chum and king salmon only.

2/ Visual salmon counts are listed as upstream or downstream passage over the sonar substrate, with "net" being the differnece between the two. Visibility was generally good for obtaining counts. However, for some calibration periods no visual counts were made.

Table 6. East Fork Andreafsky River salmon tower counts by date, 1984.

	Actual Count 1/									Expanded Count 2/		
	Chum Salmon			King Salmon			Pink Salmon					
Date	Up	Down	Net	Up	Down	Net	Up	Down	Net	Chum	King	Pink
7/14	148	7	141	37	0	37	1,437	4	1,433	714	187	7,257
7/15	136	1	135	13	0	13	1,067	1	1,066	684	66	5,398
7/16	101	2	99	26	1	25	1,426	1	1,425	501	127	7,216
7/17	172	1	171	4	0	4	4,045	0	4,045	866	20	20,484
7/18	88	1	87	7	0	7	5,137	0	5,137	441	35	26,014
7/19	79	1	78	0	0	0	4,459	2	4,457	395	0	22,570
7/20	24	0	24	0	0	0	1,381	13	1,368	122	0	6,928
7/21	34	0	34	1	0	1	2,245	15	2,230	172	5	11,293
7/22	122	0	122	11	0	11	5,990	14	5,976	618	56	30,262
7/23	35	0	35	6	0	6	2,376	12	2,364	177	30	11,971
7/24	18	0	18	3	0	3	1,823	13	1,810	91	15	9,166
7/25	12	0	12	2	0	2	1,508	31	1,477	61	10	7,480
Total	969	13	956	110	1	109	32,894	106	32,788	4,842	551	166,039

1/ Counts were conducted for 15 minutes each hour on the half hour, beginning at 0630 and ending at 2330 each day. Downstream counts do not include carcasses or moribund fish.

2/ Actual 15 minute counts were multiplied by 4 to estimate hourly salmon passage for each of the 18 hours during which tower counting was conducted. Passage for the 6 hours (0000-0600) during which tower counting was not conducted was estimated based on the hourly distribution of sonar counts during the period 6/24 through 7/12. The 0000-0600 time block averaged 21% of daily sonar counts. Therefore, the sum of the 18 hourly tower counts each day was multiplied by 1.266 to estimate total daily salmon passage.

available as a backup in the event that high and/or turbid water conditions prohibit visual enumeration.

The 1984 East Fork Andreafsky River escapement of 70,125 summer chum salmon was only 60% of the previous 12 year average escapement (1972 - 1983) of 116,799 fish, but similar in magnitude to escapements in 1974 and 1979 (Figure 13). It should be remembered that escapements were estimated by aerial survey from 1972 through 1980, and by sonar only since 1981. It may not be appropriate to directly compare estimates from the two methods. The 1984 escapement was only 48% of the average sonar escapement estimate (1981 - 1983) of 146,424 summer chum salmon. This was the first time in the four years that both sonar projects have been operational that summer chum salmon escapement to the East Fork Andreafsky River was substantially below average while it was well above average for the Anvik River. This may have been due not only to differential productivity and natural survival between the two stocks, but may also be an effect of run timing and removal by the commercial fishery. This is addressed further in the conclusion section of this report.

Peak daily escapement counts of 8,893 and 7,970 summer chum salmon occurred on 8 and 10 July, respectively. These daily peaks represent 12.2% and 11.0% of the total season escapement estimate (Figure 14). Mean date of passage was on 6 July, with a standard deviation of 5.8 days. The run timing pattern in 1984 was similar to that of 1983. Excluding the 1982 pattern, the three year data base will be used in 1985 to generate an in-season forecast of total season escapement similar to the method being used for the Anvik River.

Distribution of sonar counts by hour (Figure 15) indicates that salmon passage was greatest at 1800 - 1900 hours (6.5% of daily total) and lowest at 0600 - 0700 hours (2.1%). The sonar substrate was deployed such that the transducer end was on the eastern side of the channel, along the gradually sloping shore of the island, while the target end was on the western cutbank side of the channel. Distribution of counts by sonar sector indicates that most of the salmon passage occurred over the outer half of the substrate (Figure 15). Over 50% of all sonar counts for the season were registered in sectors 10 through 13.

An aerial survey of the East and West Fork of the Andreafsky River was conducted on 13 July. A total of 238,565 chum salmon, 1,993 king salmon, and 727,577 pink salmon was estimated on the West Fork under good conditions. Overcast and rain later in the day resulted in poor survey conditions on the East Fork, where a total of 95,200 chum salmon, 1,573 king salmon, and 190,150 pink salmon was estimated. The disparity between escapement estimates for the two forks for each of the three species may be partly explained by the poorer survey conditions on the East Fork. But escapements were clearly stronger for the West Fork. Large numbers of pink salmon reduced the ability to accurately estimate chum and king salmon abundance. The East Fork aerial survey estimate of chum salmon above the sonar site (93,700) was 1.4 times greater than the sonar count through that date (65,283). It is suspected that some pink salmon were included in the chum salmon aerial survey estimate.

River water depth was low and stable from the initial zero reading on 17 June through the entire escapement enumeration period (Figure 16). Water level

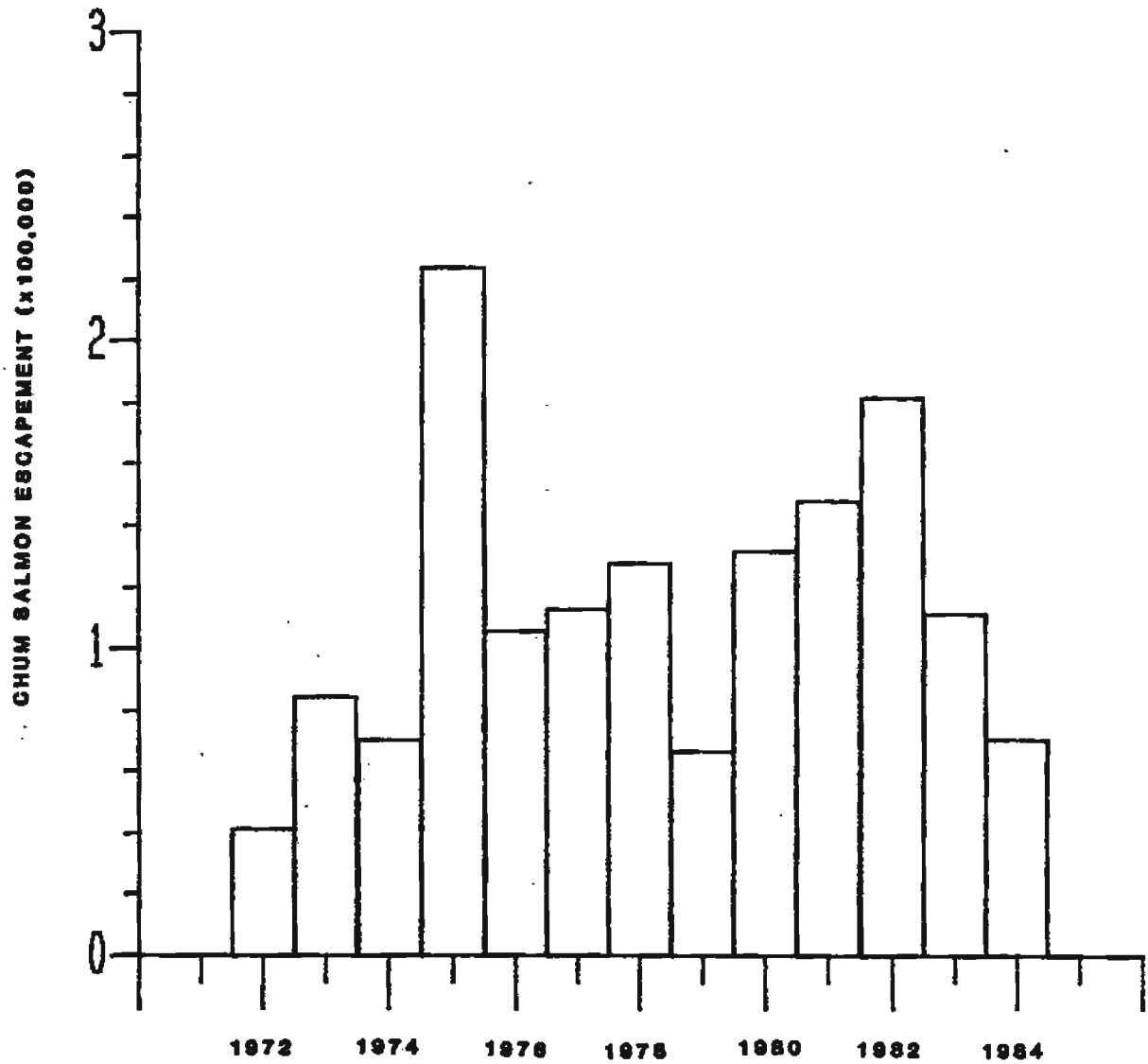

Figure 13. East Fork Andreafsky River summer chum salmon escapement, 1972-1984. (Aerial survey estimates, 1972-1980, and sonar estimates, 1981-1984.)

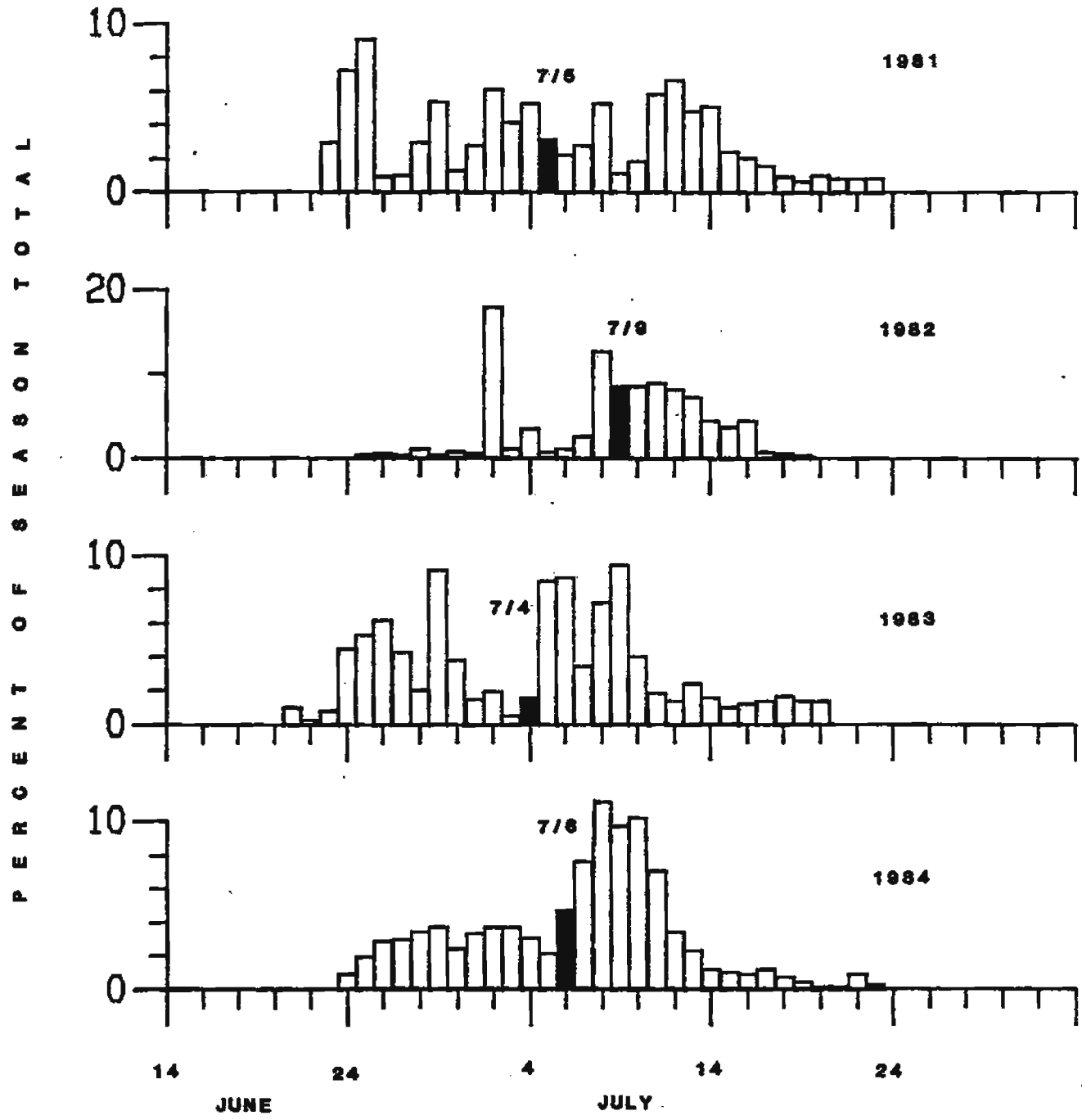

Figure 14. Daily summer chum salmon escapement past the East Fork Andreafsky River sonar site, 1981-1984. (Mean date of run passage is indicated by shaded bar.)

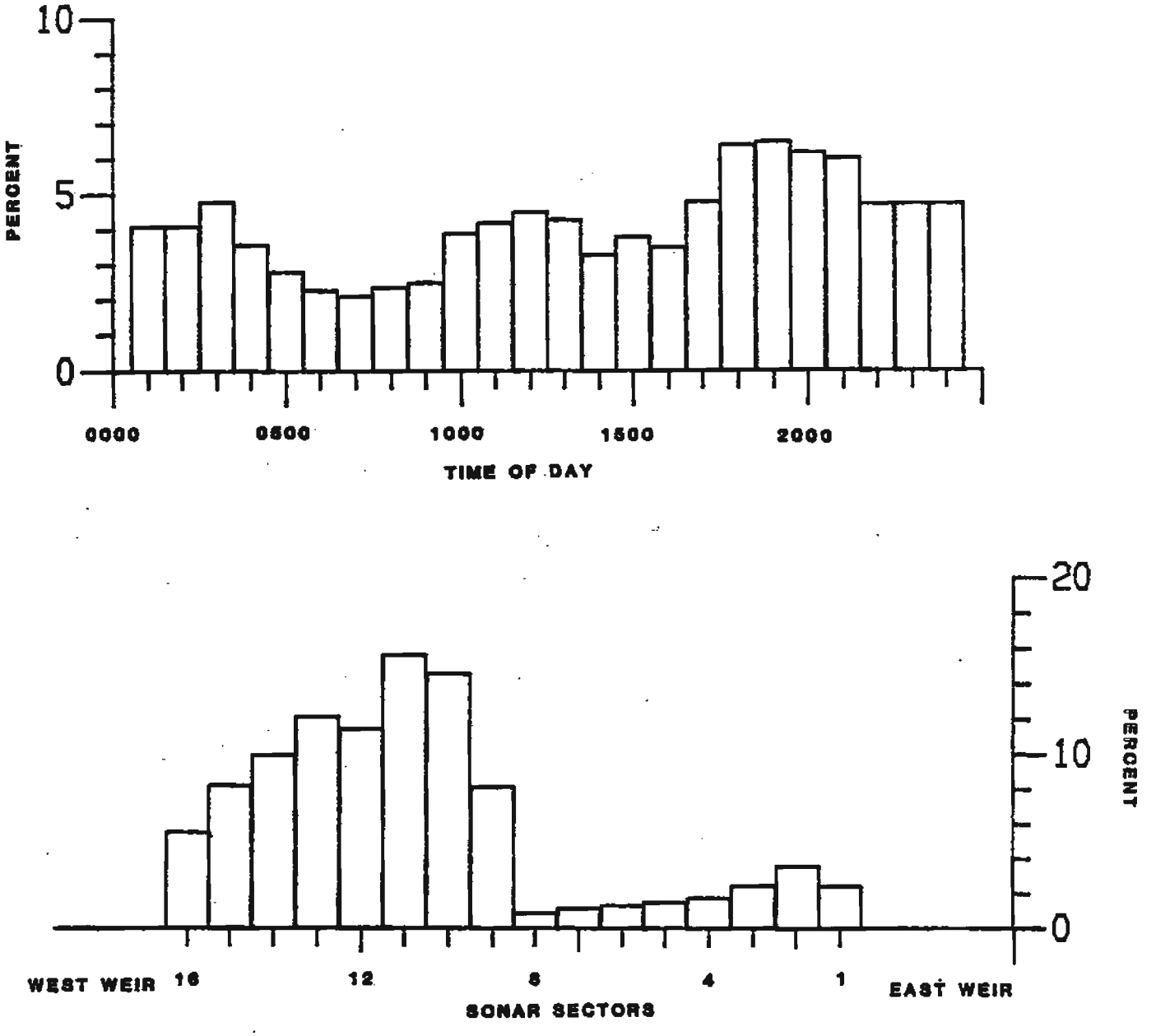

Figure 15. Summer chum salmon escapement past the East Fork Andreafsky River sonar site by hour (above), and by sonar sector (below), in 1984.

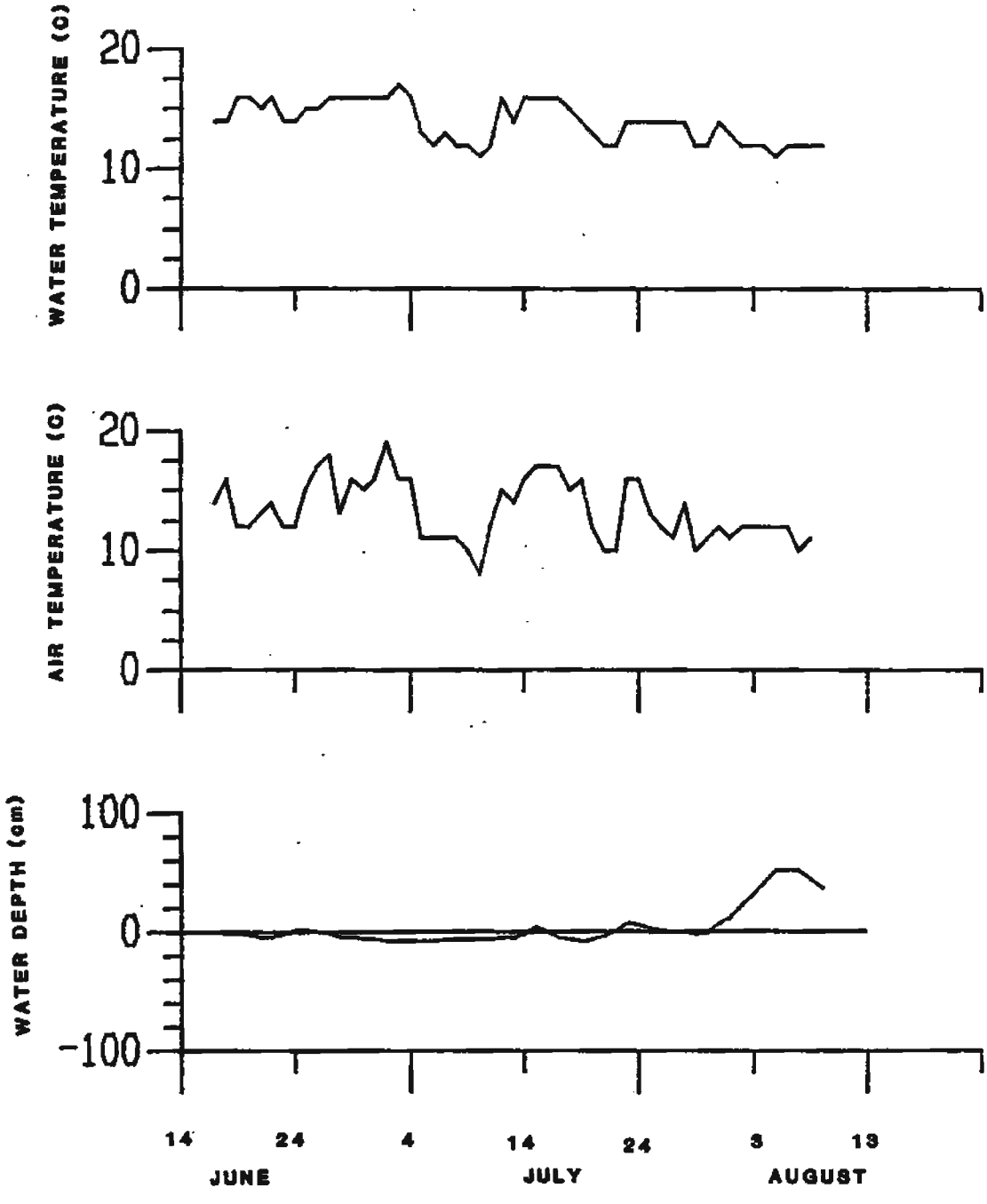

Figure 16. Water temperature, air temperature (max/min average), and water depth measured at noon daily at the East Fork Andreafsky River sonar site, 1984.

increased to a maximum of +52 cm on 5 August in response to heavy rain in late July and early August. Water temperature ranged from a low of 11°C on 10 July to a high of 17°C on 3 July. Air temperature (daily max/min average) ranged from a low of 8°C on 10 July to a high of 19°C on 2 July.

Three different beach seine sites were used in 1984. The initial site was the one used in 1983, located approximately 1/4 mile below the sonar site. The second and third sites, located within a quarter mile below the first site, were chosen due to low water and poor chum and king salmon catches at the initial site. Forty sets were made from 23 June through 25 July, and a total of 2,173 salmon was captured (Appendix Table 4). Species composition was 634 (29%) chum salmon (50% female), 76 (3.5%) king salmon (30% female), and 1,463 (67%) pink salmon (36% female).

A total of 510 chum salmon was sampled for age-sex-size data, 390 from beach seine catches and 120 carcass samples. Only 451 (88%) of the samples later proved to have ageable scales. Age composition of the pooled beach seine and carcass samples was 70% age 4, 24% age 5, 4% age 3, and 2% age 6 (Appendix Table 5). Females accounted for 51% of the total, and average length ranged from a low of 495 mm for age 3 females to 606 mm for age 5 males. Age and sex composition of the East Fork Andreafsky River escapement was almost identical to that of the District 1 commercial catch, but was composed of about 10% fewer age 4 and 10% more age 5 fish than the Anvik River escapement sample. For the four years in which escapement samples have been collected from the Andreafsky River, age 4 predominated in 1982 and 1984, while age 5 predominated in 1981 and 1983 (Figure 17). Age 3 made a stronger contribution to the escapement in 1984 than it had in any of the previous years.

A total of 491 king salmon was sampled for age-sex-size data, 76 from East Fork beach seine catches, 277 East Fork carcass samples, and 139 West Fork carcass samples. Only 422 (86%) of the samples later proved to have ageable scales. Age composition of the pooled beach seine and carcass samples was 50% age 5, 36% age 6, 13% age 4, 1.7% age 7, and 0.2% age 3 (Appendix Table 6). Females accounted for only 27% of the total, and average length ranged from a low of 385 mm for an age 3 male to a high of 923 mm for age 7 females. Age composition of the Andreafsky River sample was almost identical to that of the Anvik River sample. Age 5 was the predominant age class for the first time in the four years that samples have been collected from the Andreafsky River (Figure 18). The low female contribution in 1984 (27%) is comparable to the poor contribution of females in 1983 (29%) and 1982 (15%), and may result in poor production from these brood years.

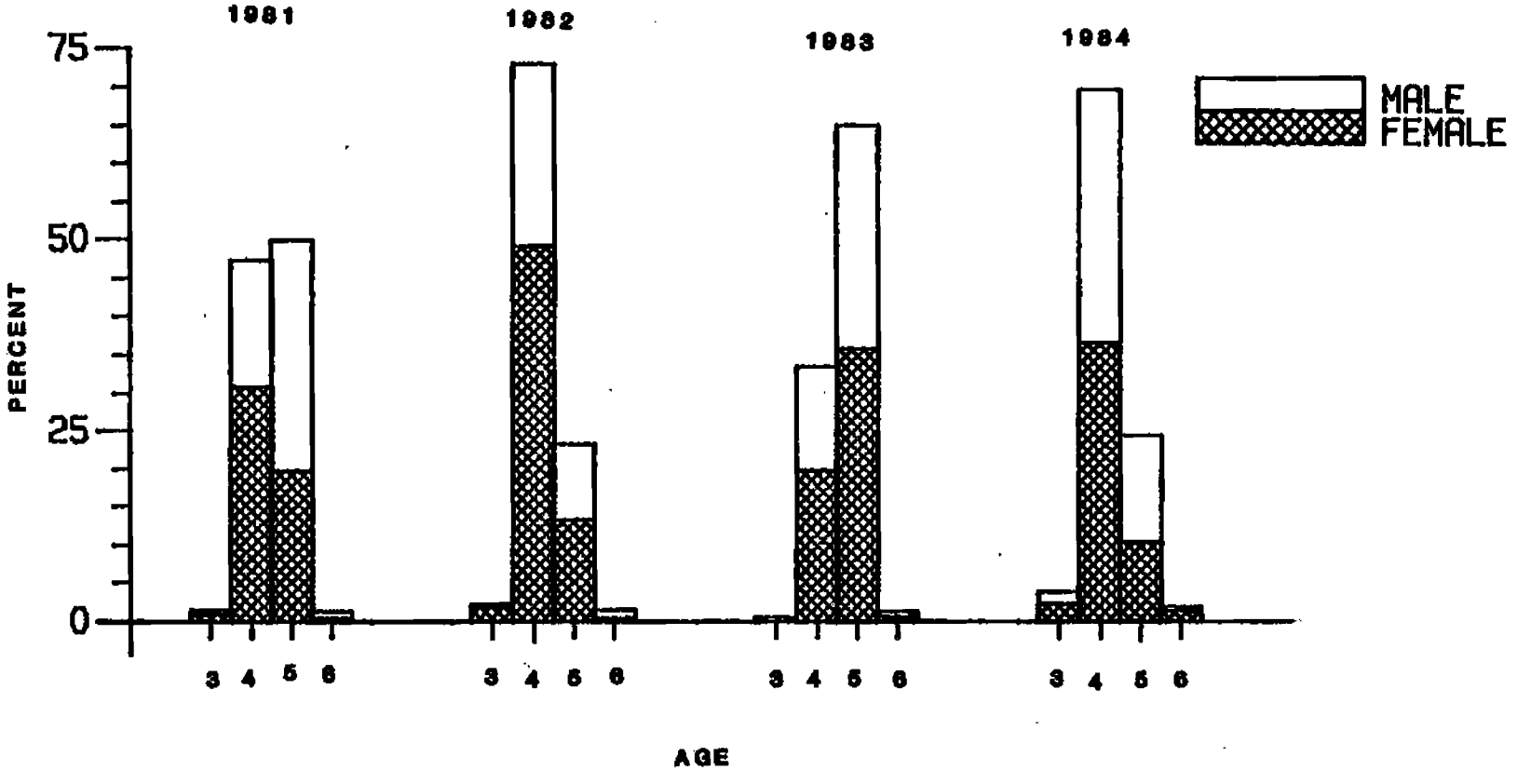

Figure 17. Age and sex composition of East Fork Andreafsky River summer chum salmon, 1981-1984.

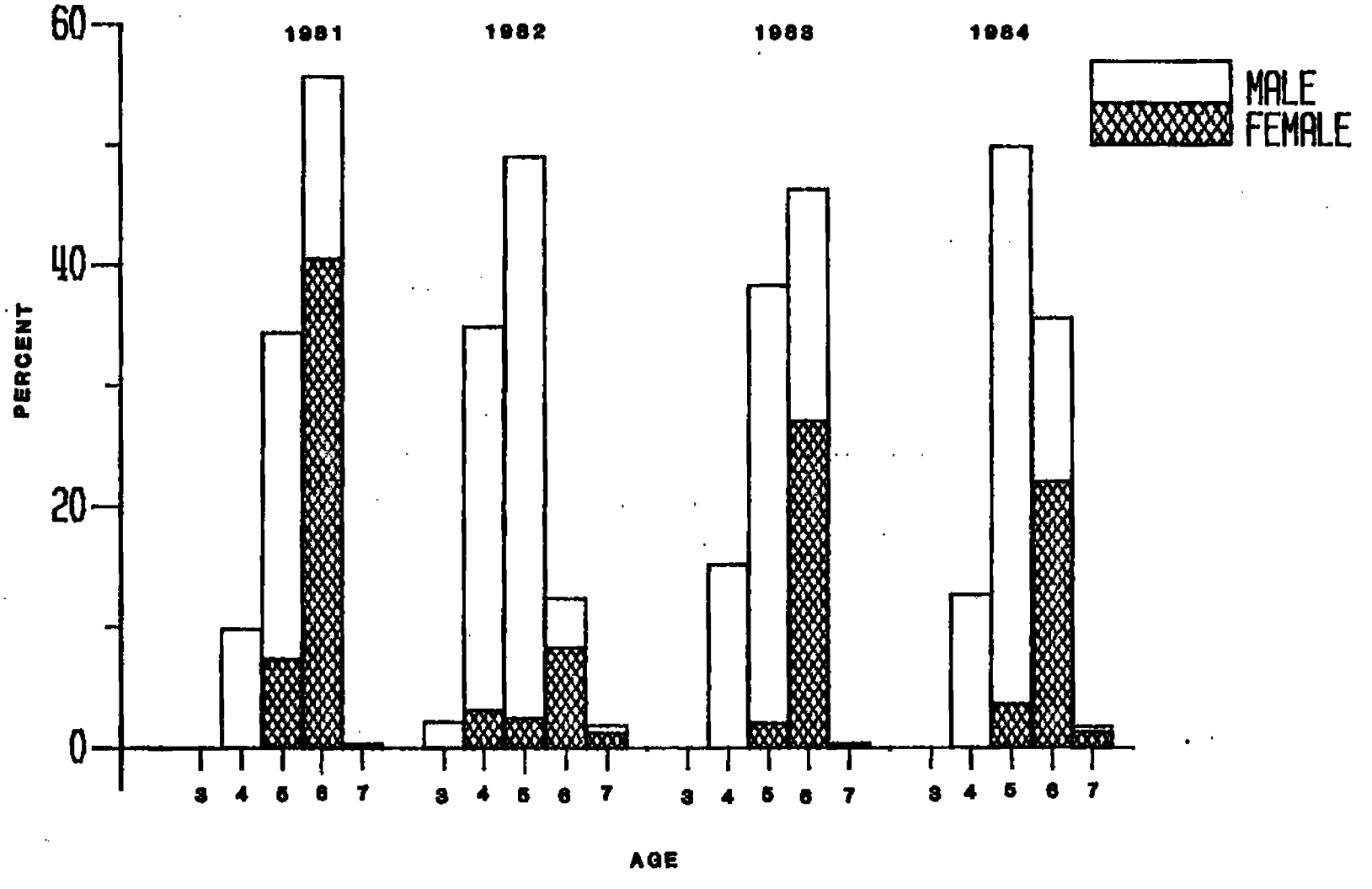

Figure 18. Age and sex composition of Andreafsky River king salmon, 1981-1984.

CONCLUSION

Escapement to the Anvik River in 1984 was 1.8 times greater than the escapement objective of 487,000 summer chum salmon (Buklis 1982). While a sonar escapement objective has not been established for the East Fork Andreafsky River, the 1984 escapement was the lowest documented in the four years that sonar enumeration has been conducted.

Total Yukon River harvest (commercial and subsistence combined) has ranged from 875,231 to 1,404,290 summer chum salmon, averaging 1,112,628 fish for the four year period, 1981-1984 (Table 7). Consistent escapement data for this period are available only from the Anvik and East Fork Andreafsky River sonar projects. Escapments to other important summer chum salmon spawning areas have been monitored by aerial survey only on an infrequent basis. An index of total return, for the purpose of this discussion, is defined as the sum of harvest and escapement to the Anvik and East Fork Andreafsky Rivers. This is a minimum estimate since several important spawning populations are not included. The resulting exploitation rates (harvest/return) are therefore maximum estimates.

The 1984 return index of 1,966,877 summer chum salmon was 1.3 times greater than the 1983 index, and 1.2 times greater than the 1982 index. However, escapement to the Anvik River in 1984 was 2.5 times greater than in 1983, and 2 times greater than in 1982. It appears that while total return of Yukon River summer chum salmon was stronger in 1984 than in either of the two previous years, escapement to the Anvik River was disproportionately greater.

Identifying a stock of salmon capable of supporting greater harvest does not solve the practical problem of directing fishing effort on that stock while protecting other, less abundant, species and stocks. For reasons of flesh quality and processing capability, the commercial fishery is concentrated in the lower Yukon River, where salmon stocks are mixed. With no tagging or stock identification data available, timing of individual stocks through the lower river fishery is not known. Even if we could define stock-specific harvest strategies, there is no assurance that these fish would actually be harvested. For example, market conditions in 1984 were such that prices offered for summer chum salmon were low, and processors were not encouraging deliveries in some fishing periods. Finally, the lower Yukon River fishery is directed at king salmon with large mesh gillnets until late June or early July, when changeover to small mesh chum salmon gear is required by regulation. Late king salmon run timing in 1984 resulted in a late changeover to chum salmon gear, which did not occur until 2 July in District 1.

Run timing of Yukon River summer chum salmon was documented at four locations in 1984 (Figure 19): test fishing with set gillnets in the delta area (Yukon River mile 20), sonar enumeration at the East Fork Andreafsky River (Yukon river mile 125), sonar enumeration at the Anvik River (Yukon River mile 365), and test fishing with a fishwheel on the Yukon River near Kaltag (Yukon River mile 420). Fishwheel catches at Kaltag provide an index of run timing for stocks bound for spawning areas upstream from the Anvik River. Mean date of passage, peak dates, and timing pattern was similar for the East Fork

Table 7. Harvest, escapement index, total return index, and exploitation rate of Yukon River summer chum salmon, 1981-1984.

	Harvest 1/			Escapement Index 2/			Total Return	Exploit.
Year	Commercial	Subsistence	Total	Anvik	EF Andreafsky	Total	Index 3/	Rate 4/
1981	1,196,006	208,284	1,404,290	1,479,582	147,312	1,626,894	3,031,184	46%
1982	614,262	260,969	875,231	444,581	181,352	625,933	1,501,164	58%
1983	924,878	240,386	1,165,264	362,912	110,608	473,520	1,638,784	71%
1984	755,724	250,000	1,005,724	891,028	70,125	961,153	1,966,877	51%
Average	872,718	239,910	1,112,628	794,526	127,349	921,875	2,034,503	55%

1/ Harvest is for the entire Yukon River drainage, and includes roe sales. Figures are preliminary for 1984.
2/ Sonar estimates of escapement to the Anvik and East Fork Andreafsky Rivers. This is only an index of Yukon River summer chum salmon escapement since several other important spawning streams are only surveyed on an infrequent basis, and are not included here.
3/ Sum of harvest and escapement index.
4/ Harvest divided by the return index. This is not a true exploitation rate since not all escapement populations are included in the index of return.

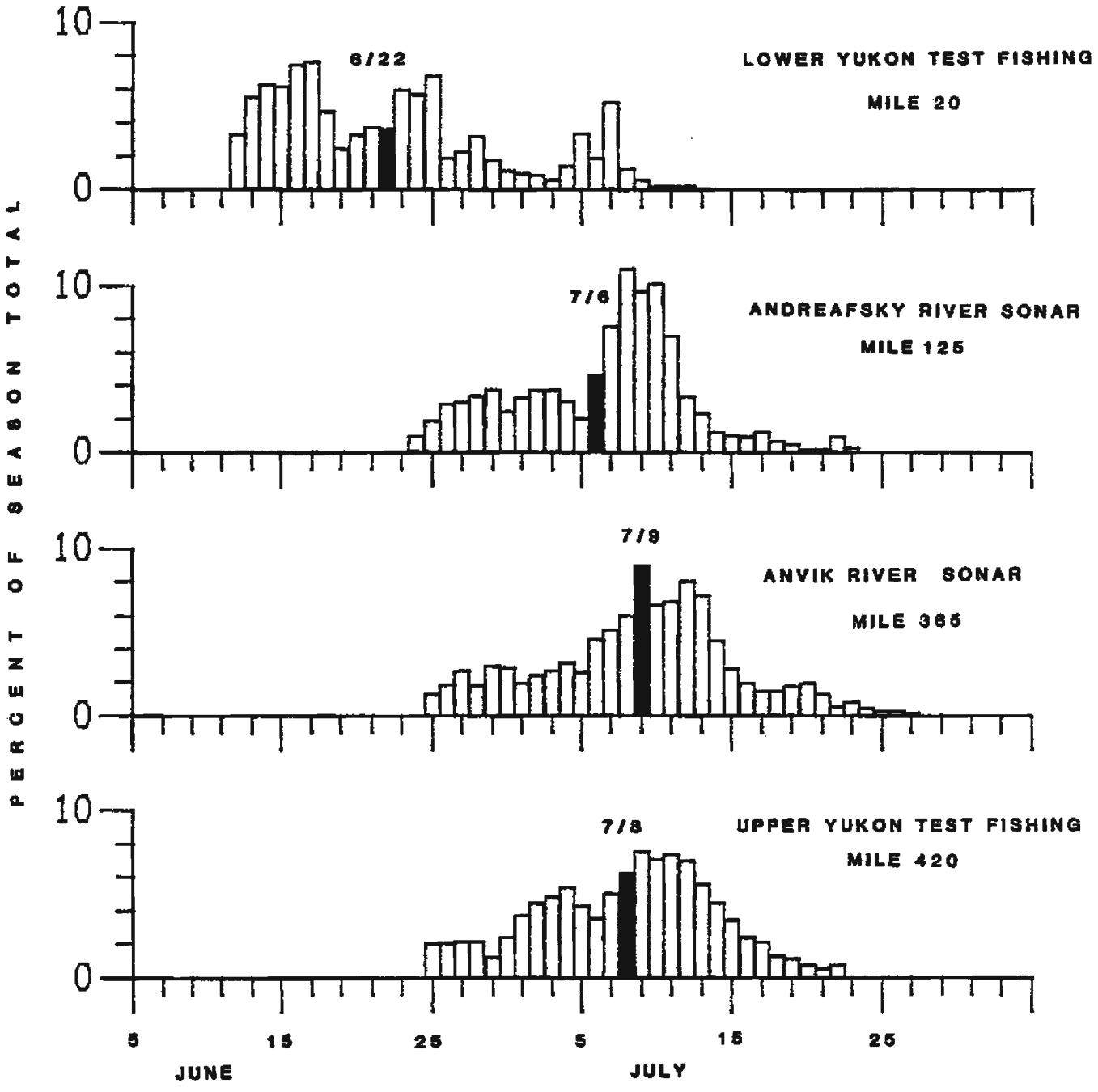

Figure 19. Run timing of Yukon River summer chum salmon in 1984 as indicated by catches or sonar counts at four sites. (Mean date of run passage is indicated by shaded bar. Mileages listed are approximate river miles from the South Mouth of the Yukon River.)

Andreasfsky River escapement, Anvik River escapement, and Kaltag test fishing catch in 1984. Mean and peak dates of passage at the mouth of the Yukon River occurred about 15 and 20 days earlier, respectively.

Since Yukon River summer chum salmon passage occurs at about the same time at three sites (East Fork Andreafsky River, Anvik River, Kaltag) covering a range of 300 river miles, one of two theories may explain run timing through the District 1 fishery:

1) Stocks enter the Yukon River in relatively discreet groups, with those bound for the furthest upriver spawning grounds entering first, followed by progressively lower river stocks, or

2) Stocks enter in a mixed group, with differential swimming speeds and milling behaviors accounting for the arrival of fish to the three sites at the same time.

If the former theory is correct, the Andreafsky River stock may pass through the lower river districts after the Anvik River stock, and sustain a greater exploitation rate due to the changeover to chum salmon gear later in the run. If the latter is correct, differential harvest of Anvik and Andreafsky River stocks may be due to different migration paths, milling behavior, and availability to capture gear. The Andreafsky River stock may move through the fishery more slowly and mill in areas where it is vulnerable to capture by gillnet gear, whereas Anvik River fish may be more directed in their movement upriver. It is not known at this time which theory more accurately describes the run timing of summer chum salmon stocks through the lower Yukon River fishery.

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Appendix Table 1. Anvik River salmon beach seine catch by species, sex, and date, 1984. 1/

Date	No. of Sets	Chum Salmon			King Salmon			Pink Salmon		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
6/25	1	0	0	0	0	0	0	0	0	0
6/26	1	0	0	0	0	0	0	0	0	0
6/27	0	-	-	-	-	-	-	-	-	-
6/28	2	11	7	18	0	0	0	0	0	0
6/29	2	25	23	48	0	0	0	0	0	0
6/30	2	14	15	29	0	0	0	0	0	0
7/01	1	16	15	31	0	0	0	0	0	0
7/02	3	20	22	42	0	0	0	0	0	0
7/03	0	-	-	-	-	-	-	-	-	-
7/04	0	-	-	-	-	-	-	-	-	-
7/05	0	-	-	-	-	-	-	-	-	-
7/06	1	5	7	12	0	0	0	0	1	1
7/07	1	0	0	0	0	0	0	1	1	2
7/08	1	5	12	17	0	0	0	1	1	2
7/09	1	6	18	24	0	0	0	1	1	2
7/10	3	14	22	36	0	0	0	3	5	8
7/11	3	16	30	46	0	0	0	5	5	10
7/12	0	-	-	-	-	-	-	-	-	-
7/13	0	-	-	-	-	-	-	-	-	-
7/14	2	12	21	33	0	0	0	9	10	19
7/15	5	14	23	37	0	0	0	21	20	41
7/16	0	-	-	-	-	-	-	-	-	-
7/17	7	10	29	39	0	0	0	23	38	61
7/18	3	3	6	9	1	0	1	17	34	51
7/19	5	1	11	12	0	0	0	24	24	48
7/20	2	0	5	5	0	0	0	5	4	9
7/21	4	3	8	11	0	0	0	10	6	16
7/22	4	1	0	1	0	0	0	0	2	2
7/23	0	-	-	-	-	-	-	-	-	-
7/24	0	-	-	-	-	-	-	-	-	-
7/25	0	-	-	-	-	-	-	-	-	-
7/26	3	2	2	4	0	0	0	3	4	7
7/27	2	0	2	2	0	0	0	0	1	1
Total	59	178	278	456	1	0	1	123	157	280

1/ All beach seining was conducted at a site on the west bank approximately 300 meters upstream from the sonar site.