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YUKON SALMON ESCAPEMENT
REPORT #18

ENUMERATION OF SUMMER CHUM AND KING SALMON BY SIDE-SCANNING SONAR IN THE MELOZITNA RIVER IN 1982

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ABSTRACT

An escapement estimate of 22,710 summer chum salmon was made in the Melozitna River using side-scanning sonar from June 26 through July 23, 1982. The summer chum salmon run peaked on July 14, approximately 10 days later than in 1981. Fifty-eight percent of the counts were made by the east-bank counter and 42% by the west-bank counter. River surface water temperatures and velocities were monitored daily. Attempts to collect salmon age, sex, and size data were unsuccessful due to extremely low river water conditions.

MELOZITNA RIVER SONAR

Introduction

King and summer chum salmon are the most important commercial species in the lower Yukon River, while fall chum salmon are most important in the upper river, above the Koyukuk River. Whereas king salmon spawning occurs throughout the Yukon River drainage, most summer chum salmon spawn in tributaries to the Yukon River below the confluence of the Koyukuk River, as well as within the Koyukuk River drainage. A lesser percentage spawns in several tributaries of the Yukon River between Galena and Tanana. A few streams in the Tanana River drainage are also utilized. By comparison, most fall chum salmon spawn in the upper Yukon River drainage, particularly the Porcupine and Tanana River systems.

Management of king and summer chum salmon is made difficult due to lack of in-season escapement information; salmon cannot be visually enumerated until runs have reached clear-water tributaries, some of which are hundreds of miles above the fishery. To provide more timely in-season escapement data in the lower and middle Yukon River tributaries, two rivers were selected for side-scanning sonar feasibility studies in 1981—the Andreafsky and Melozitna rivers. The Andreafsky River is the second most important in the Yukon River drainage for summer chum salmon production, while the Melozitna River is believed to be a substantial contributor to summer chum salmon stocks in the middle Yukon River area. Based upon 1981 feasibility study results, both rivers were monitored with side-scanning sonar in 1982 to document salmon spawning escapements.

The Melozitna River heads northwest of the Ray Mountains and flows southwest in excess of 135 miles through the Kokrines Hills to its confluence with the Yukon River near the village of Ruby. A unique feature of the river is that the upper river is characterized by a low gradient and slow-moving water. Only within the lower 10 to 15 miles does the river increase in water velocity, after flowing through a large canyon. Although total salmon escapement estimates are lacking, it is known that substantial numbers of summer chum salmon utilize three or four clear-water tributaries to this river. Spawning in the mainstem river is suspected, but the extent is unknown. Few king salmon are believed to utilize the Melozitna River.

This report presents results of the 1982 Melozitna River side-scanning sonar studies.

Objectives

Overall objectives of the 1982 Melozitna River studies were to determine timing and magnitude of the salmon spawning escapement and to collect age-sex-size information. The following specific objectives were identified in order to meet overall project objectives:

1. Install two side-scan sonar counters (one on either side of the river) and partial adult salmon weirs to enumerate adult salmon escapement;

2. Test fish with gillnets to examine species composition and age-sex-size characteristics of adult salmon escapement; and

3. Monitor selected climatological and hydrological parameters at the sonar site.

Methods

Adult salmon escapement to the Melozitna River in 1982 was enumerated with two sonar counting units. Two models of the Side Scan Sonar Counter were used: a 1977 and a 1981 model. Both models were developed by the Hydrodynamics Division of Bendix Corporation. Two 60-ft-long aluminum substrates were deployed from opposite banks of the Melozitna River approximately 4 miles upstream from its confluence with the Yukon River (Figure 1). The west-bank substrate was deployed on June 24 and the east-bank substrate on June 25. Both substrates were positioned so that the top of the inshore transducer housing lay approximately 8-10 inches below the water surface, while the offshore target ends of both were approximately 5 ft below the surface. The west-bank sonar counter became functional at 1100 hours and the east-bank counter at 1600 hours on June 26.

Surface water velocities were measured daily with a digital flow meter over the substrates at four locations: over each transducer housing and over each target. A depth profile of the river was made at the sonar counting site on two occasions. The first profile was made on June 28 after sonar installation and weir construction were complete, and a second one on July 13, 2 days after the lowest recorded river water level.

Weirs were constructed to shore from the inshore end of both substrates to prevent salmon passage. Only 60 ft of the mid-river remained unsampled by June 26, following sonar installation and weir construction. Weirs were constructed of metal "T" stakes and 2-inch by 4-inch cattle fencing. Sections to the weirs were added or removed and the substrates moved as necessary to compensate for fluctuations in river water level.

Some differences exist between the 1977 model sonar counter (east-bank counter) and the 1981 model (west-bank counter). The major difference is that the 1977 model electronically tabulates hourly salmon counts into 12 sectors, with each sector representing approximately 5 ft of the counting range. The 1981 counter tabulates hourly counts into 16 sectors, with each sector representing approximately 3.75 ft of the counting range. Further, the 1981 counter has a feature designed to distinguish king salmon from other salmon species. Both counters printed out hourly

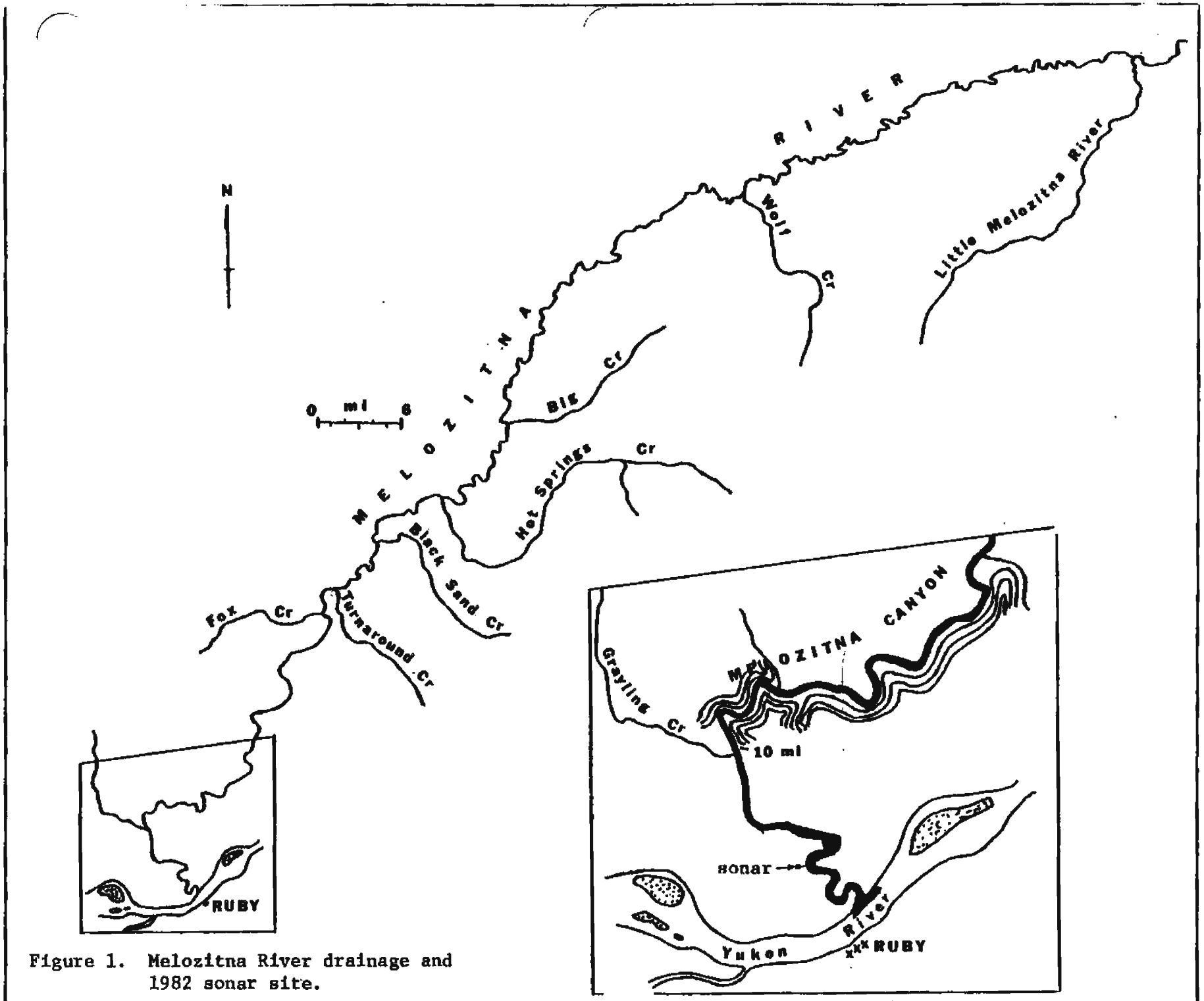

Figure 1. Melozitna River drainage and 1982 sonar site.

counts by sector. Counts were hand tabulated by sector for each 24-hour period from 0100-2400 hours for each sonar counter.

Adult salmon swimming speed may vary within a given day or throughout the duration of the salmon run. These variations may be a function of changes in water velocity or level, light penetration into the water (i.e., darkness versus daylight), or possibly upstream salmon migration densities. Consequently, the pulse repetition rate of each sonar counter was checked daily and adjusted as necessary to prevent overcounting or undercounting of salmon.

Salmon passing through the insonified water column produce a distinct pattern on an oscilloscope screen which can be distinguished from patterns caused by debris or smaller fish species. Consequently, oscilloscope calibration data were collected daily from each sonar counter and used to adjust the pulse repetition rate of each counter and sonar counts as necessary.

Initially, each sonar counter was calibrated daily for a minimum of four 20- to 30-minute periods within the following hourly blocks:

0830-0930 hours
1600-1700 hours
2000-2100 hours
2230-2330 hours

Once the daily salmon migration pattern was identified, 30-minute calibration periods were scheduled for each counter to insure adequate (increased) coverage was made during hours of peak migration. Less calibration effort was placed on periods of the day or night when salmon passage rates were the lowest. Whenever a difference of 16% or more occurred between oscilloscope counts and sonar counts, the pulse repetition rate was adjusted, provided that fish were passing at a rate of 100/hour or more during that particular calibration period. After any adjustment to the pulse repetition rate, an additional 10- to 15-minute calibration was made. No adjustment was made to the pulse repetition rate, regardless of the percent agreement, if salmon passage rates were less than 100/hour during any calibration period. If fish passage rates for any given day never exceeded 100/hour, the pulse repetition rate was only changed at 2400 hours of that day, but only if the average deviation for all calibration periods for that day differed by 16% or more.

Oscilloscope data were also used to adjust daily sonar counts. Adjustments to sonar counts were made in a similar fashion as adjustments to the pulse repetition rate (i.e., based upon the 100 fish/hour passage rate), except that count adjustments were always made only once each day (when necessary) after the 2400-hour tape printout. This permitted having all calibration data for the 2400-hour period available to help make proper count adjustments. However, more than one adjustment to the day's count was made when necessary, based upon calibration results and fish passage rates.

Procedures for adjusting sonar pulse repetition rates and daily sonar counts applied to each sonar unit; i.e., averaging or combining calibration data between the east-bank and west-bank counters was not done.

A single 5-7/8"-mesh gillnet, 50 ft long by 10 ft deep, was fished in the vicinity of the sonar site to capture adult salmon for age-sex-size sampling. Four drifts per day (two on either side of the river) were made below the sonar site. Resulting catches were examined to estimate the proportion of sonar counts generated by different fish species.

All king salmon and no more than 30 chum salmon were sampled daily for age-sex-size. Each fish was sexed by external examination, measured from mid-eye to fork-of-tail to the nearest 5 mm, scale sampled for subsequent age analysis, and the adipose fin clipped to prevent resampling. Duration of each gillnet drift, resulting catch, and age-sex-size data were recorded. Salmon carcasses were to be sampled in a similar manner once they began to appear in the area as the season progressed.

A river water-level gauge (meter stick) was installed at the sonar site on June 24. Daily changes in water level and surface water temperature were monitored at noon. Other daily observations included recording the occurrence of precipitation and percent cloud cover.

Results and Discussion

Timing: Sonar counting operations on the Melozitna River began on June 26 in 1982, 7 days earlier than in 1981. Although the same counting site was selected for the 1982 studies, two sonar counters were used as opposed to only a single unit in 1981. Only 52 salmon were counted from about noon through 2400 hours of the first day of sonar operations. Very few salmon were observed in the lower river from June 21 (arrival of field crew) until sonar counting began.

Department test-net catch data from the mouth of the Yukon River indicated that the 1982 summer chum salmon and king salmon runs were about 10 to 14 days later than occurred in 1981. Further, fishwheel catches of summer chum salmon at a test site near Kaltag were highest during the last week of June in 1981, and in 1982 peak catches occurred from about July 5-11.

Peak sonar counts in the Melozitna River occurred on July 14, when 11.6% of the total 1982 sonar-estimated escapement was made (Figure 2). This peak was at least 10 days later than the peak of the 1981 Melozitna River salmon run, which occurred on or just prior to July 4 (Barton 1982a).

Timing of salmon past the east and west bank counters was similar (Figure 3), and, as in 1981, no distinct timing differences in fish

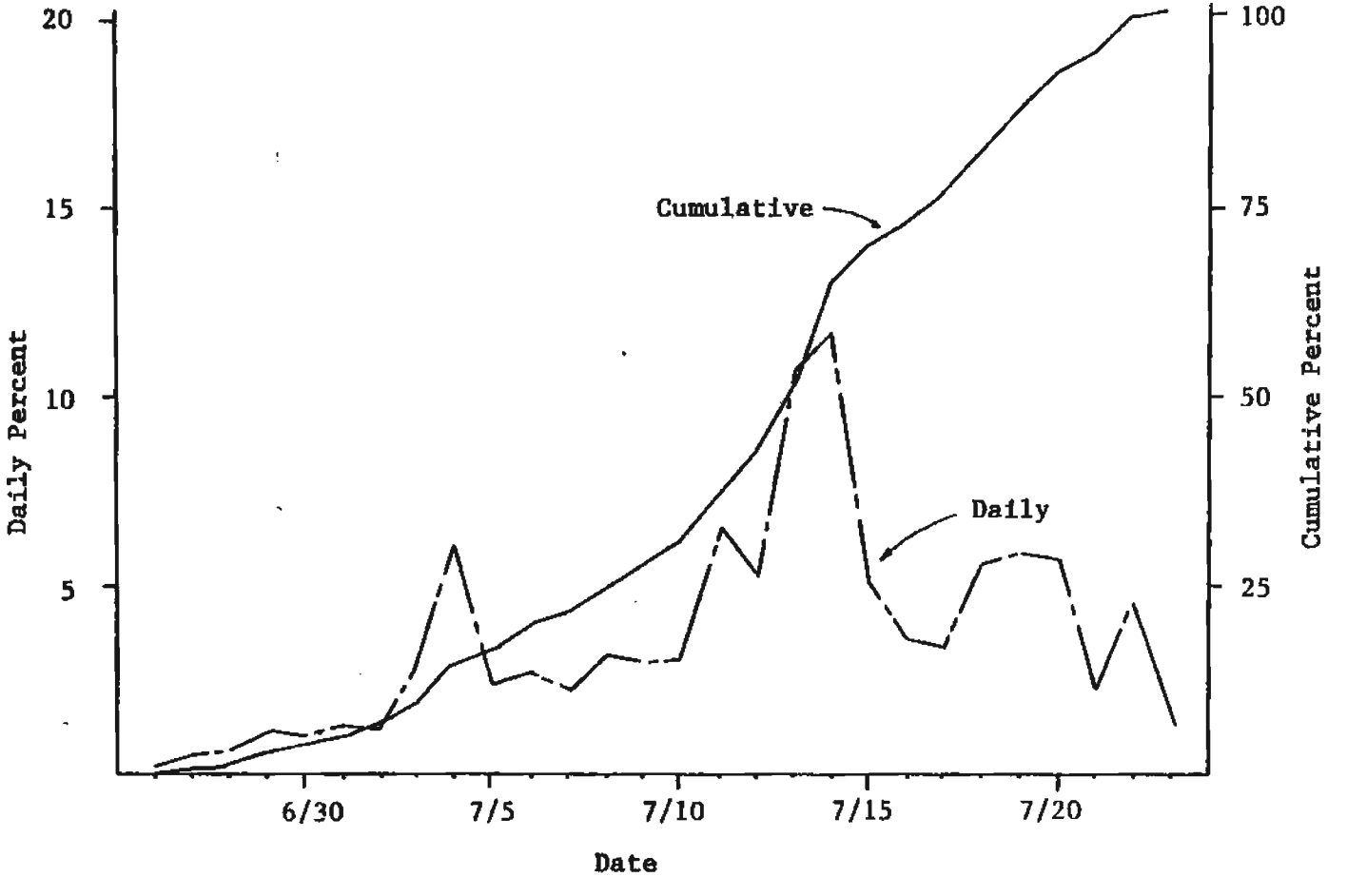

Figure 2. Relative timing of Melozitna River summer chum salmon escapement, June 26 through July 23, 1982.

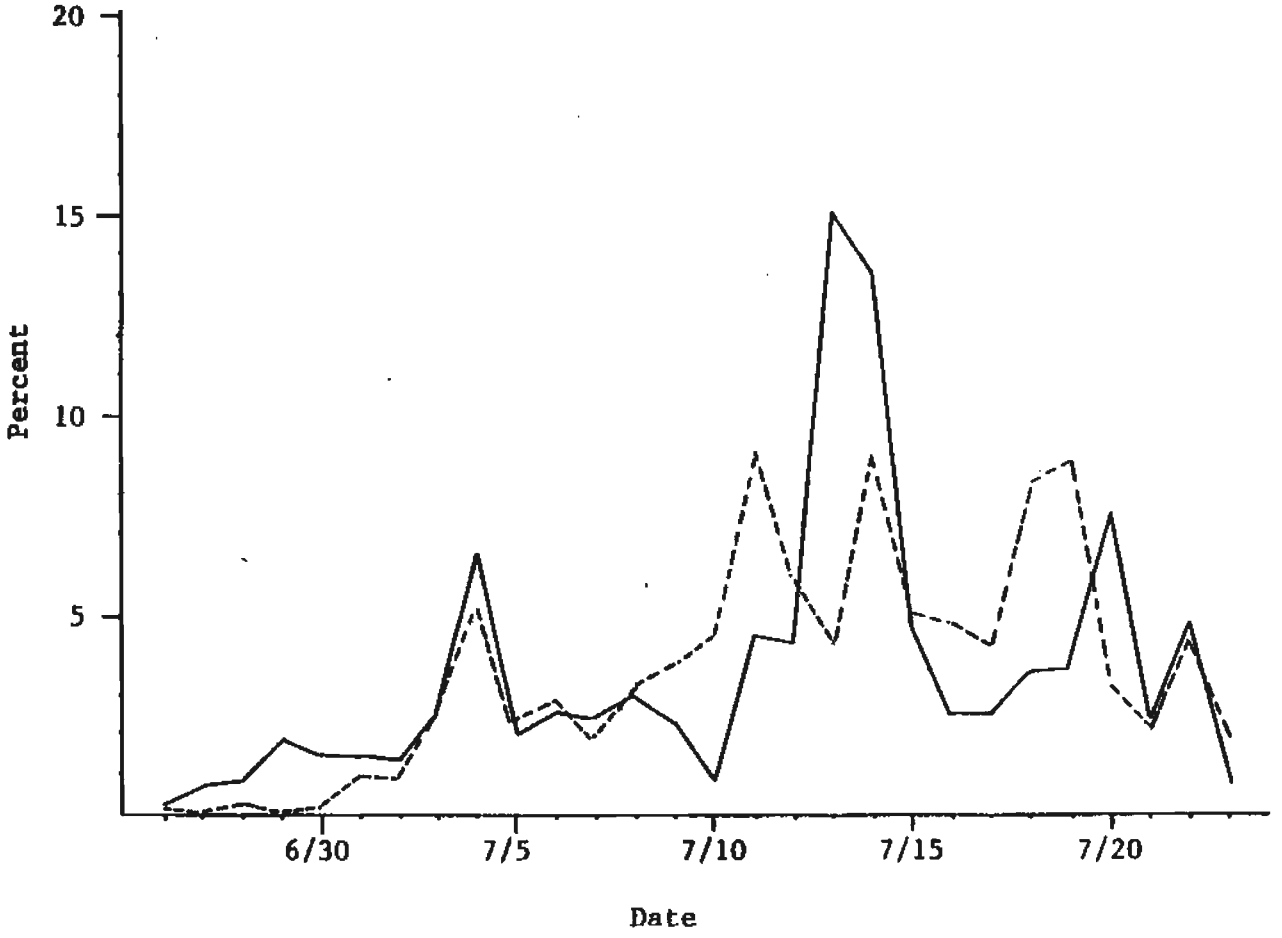

Figure 3. Relative timing of Melozitna River summer chum salmon escapement past east bank sonar counter (solid line) and west bank counter (broken line), June 26 through July 23, 1982.

movement upriver with respect to day or night were observed with either sonar counter.

A few salmon were still passing the sonar site upon terminating operations on July 23. However, only 1.2% (234) of the total sonar-estimated escapement was counted on that date.

Surface water temperature at the sonar site was 60.8°F on July 13 and 14, the period of peak salmon migration. Temperatures ranged from 53.6°F on July 23 to 64.6°F on July 10, with an average of 59.7°F for the duration of the project (Figure 4). The average 1982 temperature was 4.8°F warmer than in 1981. Warmest water temperatures accompanied lowest river water levels, averaging 63°F for the lowest water period of July 7-12.

Aerial escapement surveys have been flown since 1975 of several clear-water index streams of the Melozitna River. Surveys are generally conducted within the last 2 weeks of July. During this period, estimates of salmon spawning within the mainstem river are hindered due to dark-stained and turbid water. Consequently, only a general statement on spawn timing can be made which, at best, applies only to chum salmon in those clear-water streams where aerial surveys have been successful. Little can be said in reference to king salmon spawn timing due to the low numbers of individuals that have been observed in the Melozitna River drainage.

Observations since 1975 indicate that chum salmon spawn in the aerial index streams during the latter part of July. However, in 1981 some spawning occurred in early July, as revealed from the first appearance of spawned-out chum salmon carcasses on July 10 on the gravel bar at the sonar site (Barton 1982a). Only a single aerial survey was flown in 1982 due to persisting inclement weather in late July and August. The survey was flown on August 5 under fair conditions and included only Melozi Hot Springs Creek. A total of 9 king and 464 chum salmon were counted. Spawning was judged to have been at peak.

Distribution: The Melozitna River was estimated to be 235 ft wide at the sonar counting site when the first depth profile was made on June 28 (Figure 5). Approximately 60 ft of the middle of the river was left unsampled after sonar installation and weir construction had been completed. This represents approximately 75% sampling coverage of the river width. Sampling coverage increased with falling water levels as each sonar substrate was moved farther out and additional sections to the weirs were added as needed. By July 13, only 25 ft remained between the offshore ends of each sonar substrate. A second depth profile was made on that date, and the river was estimated to be 205 ft wide, with an approximate 88% sampling coverage.

River water level steadily increased from July 13 until the project terminated, but neither sonar substrate had to be moved. Consequently,

Figure 4. Daily changes in water level (solid line) and surface water temperature (broken line) at the Melozitna River sonar site, June 24 through July 24, 1982.

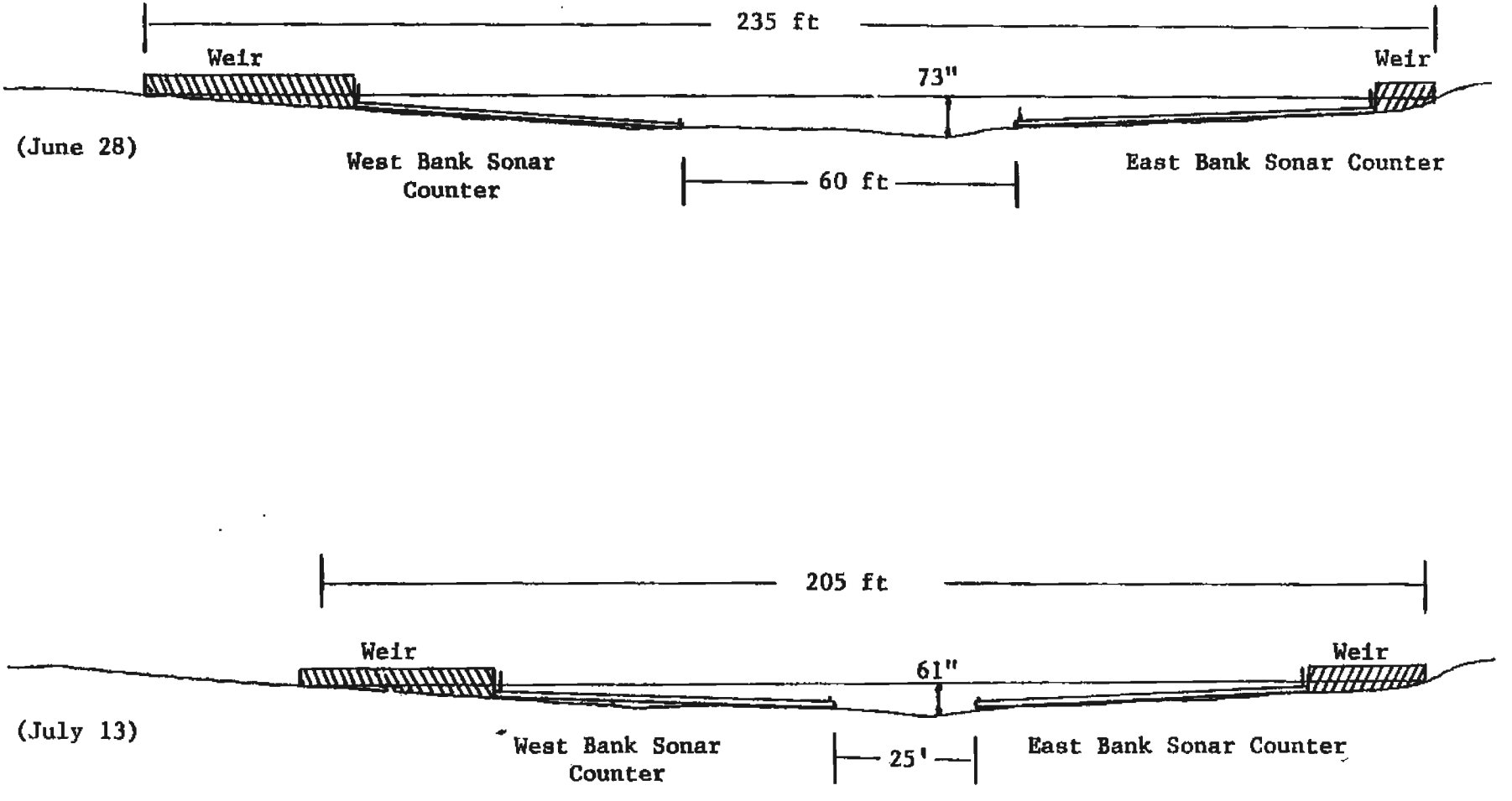

Figure 5. Sampling coverage of the Melozitna River with side scanning sonar as estimated on June 28 (above) and July 13 (below), 1982.

the fraction of the river sampled continued to increase as the water rose, with only 25 ft of the middle of the river remaining unsampled.

Distribution of salmon passing over each sonar substrate differed (Figures 6 and 7). Seventy-three percent of the west bank counts occurred over the inshore half of the substrate; 43% occurred within the first 3.75 ft alone. Although only 27% of the west-bank counts occurred over the outer half of the sonar substrate, 5% were in the last 3.75 ft of the counting range, suggesting some salmon may have passed upstream undetected, beyond the counting range.

East-bank count results revealed 61% of the salmon passed over the outer half of the substrate, with 7% in the last 5 ft of the counting range, again suggesting some salmon may have passed upstream undetected by the east bank counter. Fifty-eight percent of the total Melozitna River sonar counts were on the east bank, and 42% were on the west bank. It is estimated that at least 3,000 additional salmon migrated upstream between the two sonar substrates (Figure 7). Upstream migrant salmon distribution as shown in this figure indicates most salmon migrated upstream in the main river channel, where water velocities were greatest. The large number shown passing along the west bank over substrate sector one resulted from those fish leading around the weir. At times in excess of 40 ft of weir existed on the inshore end of the west bank substrate.

Surface water velocities were measured daily at noon at four locations across the sonar site: over each substrate transducer housing and each substrate target (Figure 8). Average surface water velocities for the duration of the project measured at these four locations were as follows:

East Substrate Transducer	3.00 ft/sec
East Substrate Target	5.48 ft/sec
West Substrate Transducer	2.64 ft/sec
West Substrate Target	4.75 ft/sec

Knowledge of king salmon spawning distribution within the Melozitna River drainage is primarily confined to observations made on six clear-water index streams (Figure 1). Aerial surveys of these streams have been flown as weather permits each year since 1975. From 1975 through 1980, king salmon have only been observed in two of the index streams, Blacksand Creek and Melozi Hot Springs Creek, while chum salmon occur in all six streams. A few observations have revealed both species occupying the mainstem Melozitna River between Fox Creek and Melozi Hot Springs Creek. Whether these fish were spawning in this area or migrating to tributary streams is not known.

Based on aerial survey observations since 1975, Melozi Hot Springs Creek is the most important for both king and chum salmon spawning, followed by Blacksand Creek. Fox, Turnaround, and Wolf creeks are the next in importance for chum salmon spawning. The fewest number of chum salmon has been observed in Big Creek. Extent and importance of king and chum salmon spawning in the mainstem Melozitna River are unknown.

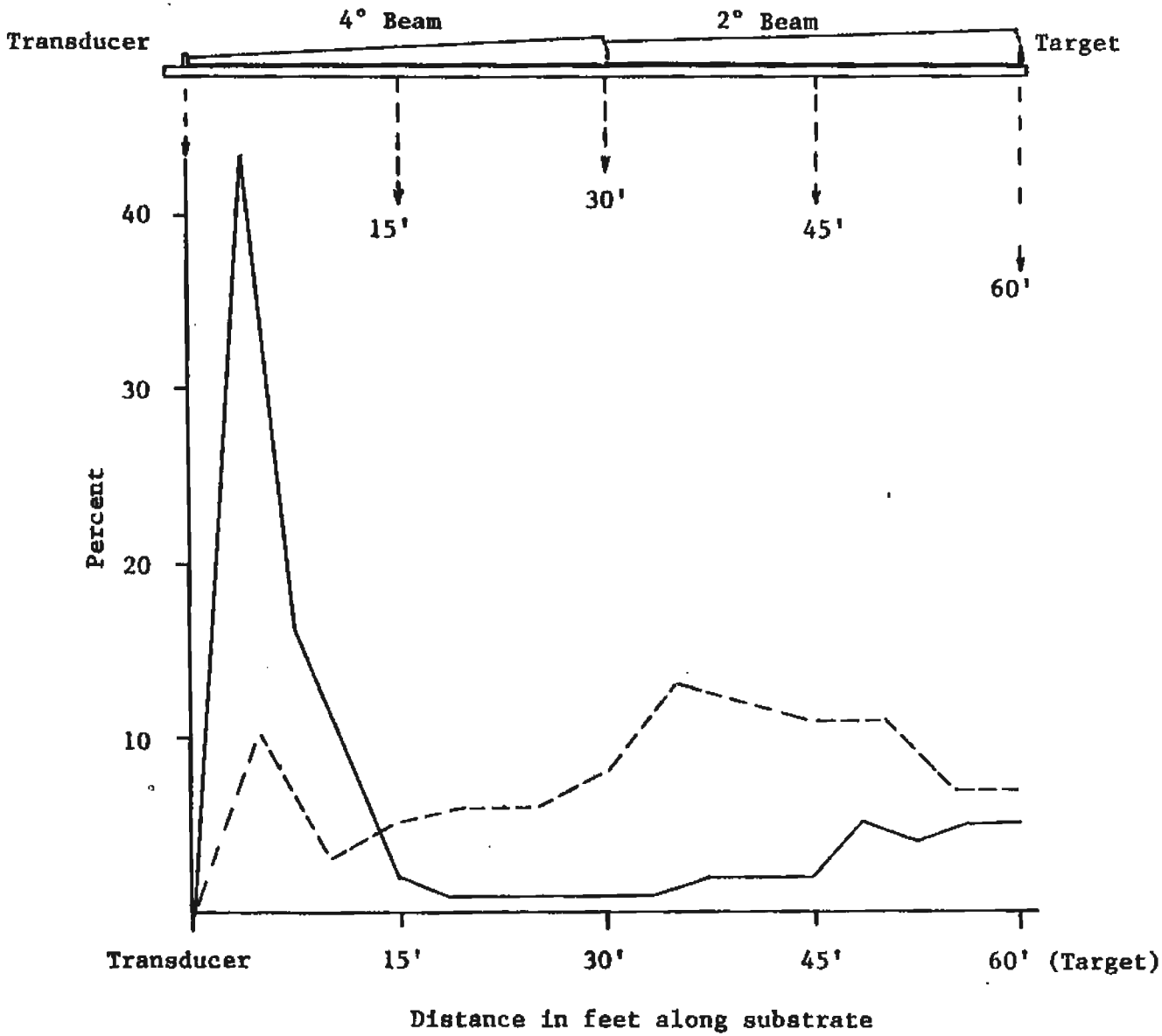

Figure 6. Distribution of salmon counts over east bank sonar substrate (broken line) and west bank sonar substrate (solid line) in the Melozitna River June 26 through July 23, 1982.

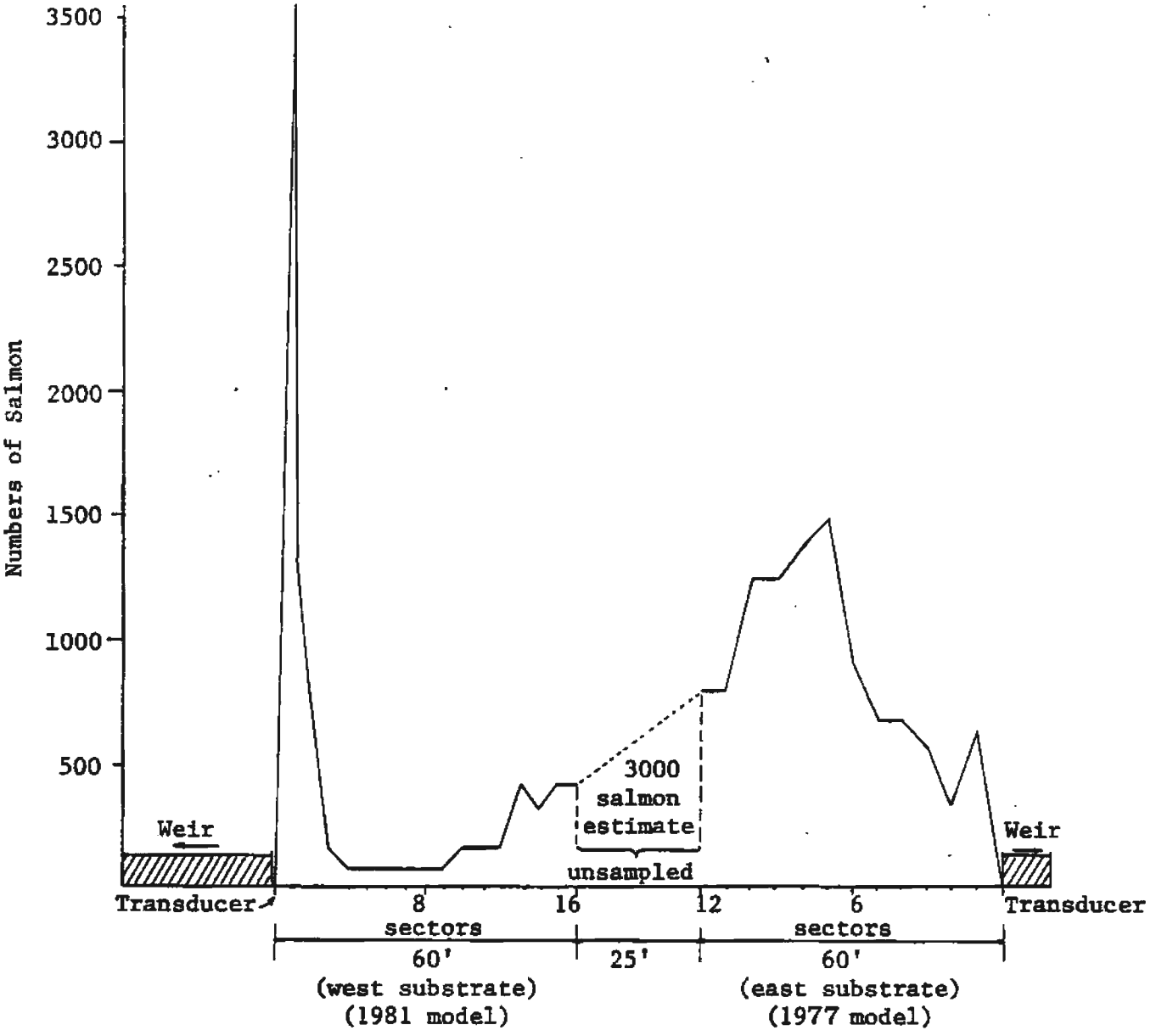

Figure 7. Estimated number of salmon in the Melozitna River passing the sonar site undetected based upon salmon distribution over each sonar substrate from June 26 through July 23, 1982.

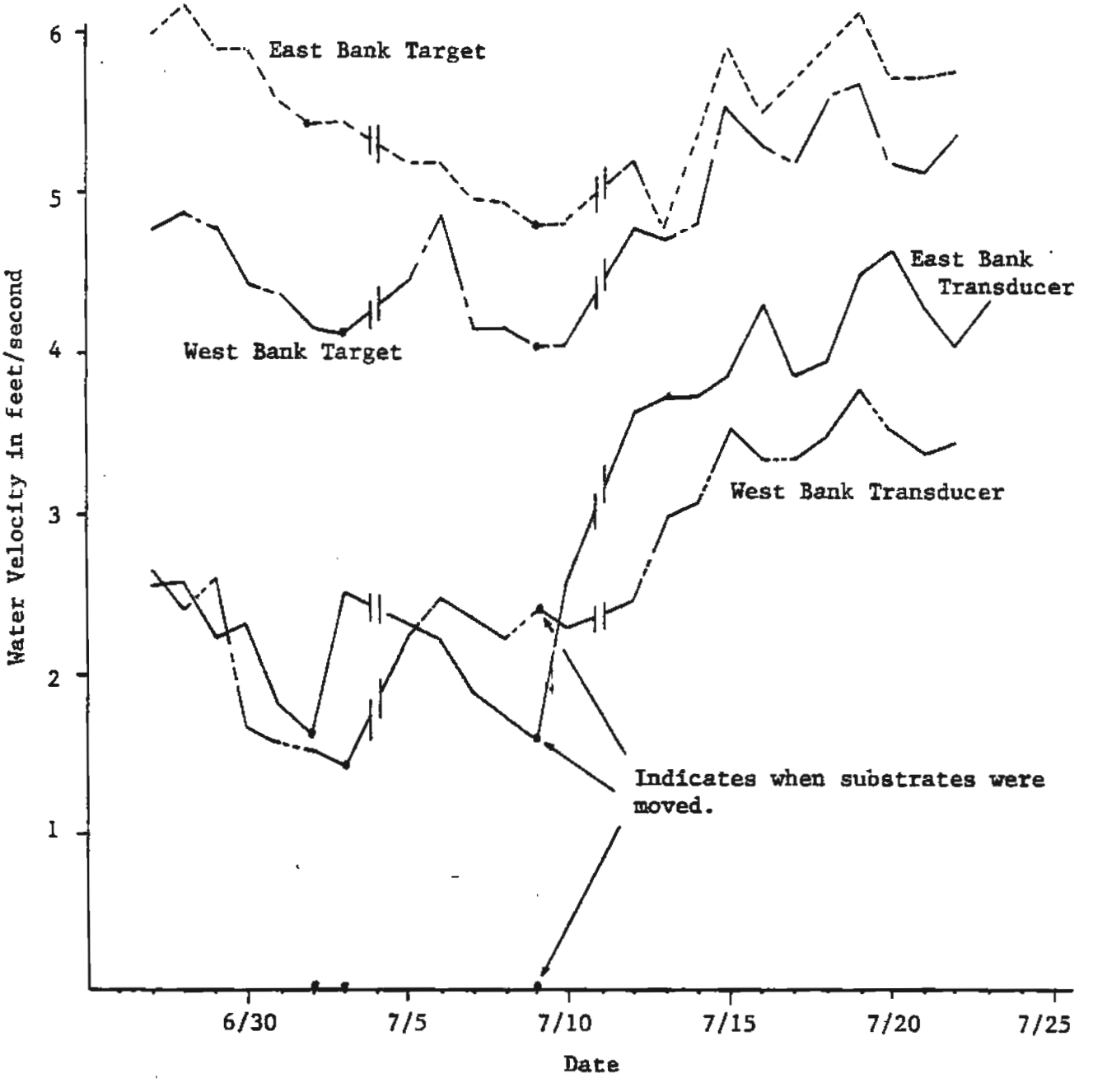

Figure 8. Daily changes in surface water velocity over the east and west bank sonar substrates in the Melozitna River from June 26 through July 23, 1982.

It is interesting to note that personnel from the Bureau of Land Management reported the presence of numerous chum salmon carcasses in the Little Melozitna River in September 1980 and 1981 (J. Webb, personal communication). Webb also reported chum salmon carcasses present in early September 1982, but in markedly reduced numbers. It is not known if those chum salmon are a later spawning population (fall chums) or late spawning summer chums. The Department has never surveyed the Melozitna River drainage in the fall months.

Abundance: The total sonar salmon count from June 26 through July 23, 1982 was 19,710 (Table 1). Results showed 58% of the sonar counts were made on the east bank, while 42% were made on the west bank. At least an additional 3,000 salmon are estimated to have passed between the sonar substrates undetected, based upon an analysis of salmon distribution over each sonar substrate (Figure 7). The final estimated Melozitna River salmon escapement in 1982 is 22,710.

The above estimate includes adjusted counts from July 5 through July 23, based upon daily oscillocsope calibration results. Sonar counts tallied prior to July 5 were considered valid (apart from debris counts, which were excluded) since salmon passage rates past the sonar site were too low to allow for meaningful calibration results. A total of 70 calibration periods (30 on the east bank and 40 on the west bank), averaging 29 minutes each, occurred over a 14-day period from July 5 through July 22. This represents in excess of 33 hours of oscilloscope calibration.

East-bank calibration results ranged from a 20% sonar undercount to a 40% sonar overcount. West-bank results ranged from a 33% undercount to a 23% overcount.

The large-fish discriminator on the west-bank sonar counter only identified 30 fish (0.36%) as king salmon. Applying this percentage to the total salmon escapement estimate (22,710) would result in a species composition of 82 king salmon and 22,628 summer chum salmon. However, the same 1981 sonar counter used on the west bank during these field studies was deployed in the Sheenjek River in September 1981 and 1982 to monitor fall chum salmon escapements to that river. Although there are no king salmon which utilize the Sheenjek River during the September migration of fall chum salmon, 0.37% and 0.35% of the 1981 and 1982 sonar counts, respectively, were identified with this counter as being king salmon (Barton 1982b). Consequently, the final 1982 Melozitna River sonar estimate (22,710) should be considered summer chum salmon, with a very small and unknown percentage being king salmon. Only nine king salmon were observed in Melozi Hot Springs Creek on the August 5 aerial survey.

Test gillnet catches in the Melozitna River in 1982 were extremely small for the duration of the project due to very low river water conditions. Consequently, results cannot be used to examine salmon

Table 1. Meloxitna River daily and cumulative sonar counts from June 26 through July 23, 1982.

	East Bank Counter		West Bank Counter		Daily Total		Cumulative Total	
Date	Sonar Count	%	Sonar Count	%	Counts	%	Counts	%
6/26	38	0.3	14	0.2	52	0.3	52	0.3
6/27	79	0.7	11	0.1	90	0.5	142	0.8
6/28	95	0.8	21	0.3	116	0.6	258	1.4
6/29	212	1.9	9	0.1	221	1.1	479	2.5
6/30	172	1.5	19	0.2	191	1.0	670	3.5
7/1	177	1.5	74	0.9	251	1.3	921	4.8
7/2	153	1.3	74	0.9	227	1.2	1148	6.0
7/3	288	2.5	221	2.7	509	2.6	1657	8.6
7/4	743	6.5	429	5.2	1172	5.9	2829	14.5
7/5	229	2.0	209	2.5	438	2.2	3267	16.7
7/6	285	2.5	230	2.8	515	2.6	3782	19.3
7/7	263	2.3	176	2.1	439	2.2	4221	21.5
7/8	332	2.9	272	3.3	604	3.1	4825	24.6
7/9	258	2.3	306	3.7	564	2.9	5389	27.5
7/10	216[a]	1.9	373[b]	4.5	589	3.0	5978	30.5
7/11	500[c]	4.4	757	9.1	1257	6.4	7235	36.9
7/12	482	4.2	486	5.9	968	4.9	8203	41.8
7/13	1715	15.0	359	4.3	2074	10.5	10277	52.3
7/14	1539	13.5	745	9.0	2284	11.6	12561	63.9
7/15	541	4.7	420	5.1	961	4.9	13522	68.8
7/16	283	2.5	401	4.8	684	3.5	14206	72.3
7/17	290	2.5	345	4.2	635	3.2	14841	75.5
7/18	403	3.5	669	8.1	1072	5.4	15913	80.9
7/19	415	3.6	718	8.7	1133	5.7	17046	86.6
7/20	840	7.4	271	3.3	1111	5.6	18157	92.2
7/21	257	2.3	177	2.1	434	2.2	18591	94.4
7/22	533	4.7	352	4.2	885	4.5	19476	98.9
7/23	83	0.7	151	1.8	234	1.2	19710	100.0
Total	11421	99.9	8289	100.1	19710	100.1	—	—

[a] Daily oscilloscope results revealed an average of 9 salmon per hour passage rate (216 total). Could not use sonar counts due to low-water false-counting from 1900-2400 hours.

[b] Includes only 0100-2000 hour counts. Low water level resulted in false counts from 2100-2400 hours.

[c] Low river water level resulted in unreliable sonar and oscilloscope data. Estimate 500 salmon, based on subjective evaluation of printout tape.

timing, distribution, or species composition. However, that relatively few king salmon utilize the Melozitna River drainage is illustrated by aerial survey results since 1975 (Table 2). The largest number of king salmon observed (136) was in 1975. This number represented only 1.1% of the total number of salmon observed on that survey.

Salmon escapement in 1981 was counted with a single sonar unit deployed from the east bank. An estimate of 19,707 salmon was made (Barton 1982a). Test-netting results in that year, together with an examination of upstream migrant distribution across the east bank substrate, revealed a substantial number of salmon passed beyond the sonar counting range. In 1982, it was estimated that 50.3% (11,421) of the total escapement (22,710) passed upriver over the east bank counter. Assuming a similar distribution in 1981 would result in an escapement estimate of 39,178 salmon from July 3 through July 26 for that year. This could still be considered a conservative estimate since the 1981 sonar project occurred subsequent to the peak of upstream salmon migration in that year (Barton 1982a). In any event, it is reasonable to assume that the 1982 Melozitna River summer chum salmon escapement was at least 42% lower than the 1981 escapement.

Age-Sex-Size Composition: Only 26 chum salmon (17 males, 9 females) were captured in 30 drift gillnet sets made from July 1 through July 22. Total soak time amounted to only 14.5 hours. Extremely low water levels persisting throughout July prevented more sampling with the 10-ft deep gillnet. Underwater snags and rocks in the shallow water required constant mending of the net. Only 15 of the samples were ageable, and age 5_1 predominated, followed by age 4_1.

Unlike 1981, when chum salmon carcasses appeared on the gravel bar near the sonar site, providing additional AWL samples, no carcasses appeared in the area in 1982.

Summary

1. An escapement estimate of 22,710 summer chum salmon was made in the Melozitna River from June 26 through July 23, 1982. These counts include an estimated 3,000 salmon which migrated upstream between the sonar substrates. It is likely that a very small percentage of the counts were king salmon.

2. The Melozitna River salmon run peaked on July 14, at least 10 days later than in 1981.

3. The 1982 summer chum salmon escapement was at least 42% lower than the 1981 escapement to the Melozitna River.

4. The west bank sonar unit accounted for 42% of the total sonar count, while the east bank unit accounted for 58%.

Table 2. Comparative king and summer chum salmon escapement estimates based on aerial surveys of selected index streams in the Melozitna River drainage, 1975-1982.[a]

	1975		1976		1977		1978		1979		1980		1982	
	Kings	Chums	Kings	Chums	Kings	Chums	Kings	Chums	Kings	Chums	Kings	Chums	Kings	Chums
Mainstem Melozitna R.	31	2068	1	200										
Blacksand Cr.		2971	3	450	2	75	1	1054		625(23)				
Fox Creek		1835				41		309		57(16)		73(17)		
Turnaround Cr.		863		40				196		268(16)				
Melozi Hot Springs Cr.	105	4196	9	1768	13	1014	8	4012	9	1469(16)	11	6345(29)	9[b]	464[b]
Wolf Creek										160(16)				
Big Creek										4(20)				
Totals	136	11,933 (29)	13	2458 (25)	15	1130 (20)	9	5571 (13)	9	2583 (16,20,23)	11	6418 (17,29)	9	464

[a] Numbers in parentheses show dates in July that observations were made. No surveys were flown in 1981 due to bad weather.

[b] Survey flown August 5.

5. No distinct timing differences of fish movement upriver with respect to day or night were observed with either sonar counter.

6. River surface water temperature at the sonar site ranged from 53.6°F to 64.6°F, with an average of 59.7°F for the duration of the project. The average was 8.4°F warmer than the 1981 average temperature.

7. Low river water level conditions greatly hindered gillnet test fishing, resulting in a catch of only 26 chum salmon (17 males, 9 females). Age 5_1 fish predominated the small sample.

8. Only a single aerial escapement survey of Melozi Hot Springs Creek could be flown in 1982, due to inclement weather. Only 9 king salmon and 464 chum salmon were counted.

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