Kobuk River Test Fishing Project, 1994

By

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INTRODUCTION

The Kobuk River originates on the south side of the Brooks Range in the Arrigetch Mountains inside the Gates of the Arctic National Park. The river flows roughly 500 river miles west where it terminates at Kobuk Lake. The lower 2/3 of the river is stained by tannin from primarily the Pah River, an upper river tributary. Five villages are located on the Kobuk River and all depend on Kobuk River chum salmon for subsistence use. Residents of Kotzebue also depend on Kobuk River chum salmon as a subsistence resource. The Kobuk River is also thought to support up to 50% of the commercial catch of chum salmon in the Kotzebue District.

This was the second consecutive year a drift gill net test fishing project operated in the lower Kobuk River. A test fishing project on the Noatak River was initiated in 1975 and continued through 1978, then operated again from 1987 to 1991. A Kobuk River test fishing project was considered in the mid-1980's but because of the importance of the Noatak River chum salmon stocks to the commercial fishery and it's close proximity, the test fishery was instituted on the Noatak River instead (Knuefer, 1990; Blaney and Lingnau, 1992; Lingnau, 1992). The Noatak River now has an operational sonar project monitoring the chum salmon migration in that river. The only previous salmon project in the Kobuk River drainage was a counting tower site on the Squirrel River, which was too distant to provide timely information for fisheries management. Because of the Kobuk River's tannic stain, test fishing is less susceptible to net avoidance by salmon often associated with clear water systems. This was a problem with the Noatak River test fishing project during years with low and clear water. This report represents the result of the second year of the Kobuk River drift test fishing project.

Management of the Kotzebue District commercial salmon fishery, particularly during the month of July, is dependent primarily on comparing commercial fishing period and cumulative season catch statistics to those of prior years. The drift test fishing project was initiated because of the need for an inseason index of run timing and abundance for Kobuk River chum salmon stocks, which largely support the first half of the commercial season in the Kotzebue District. While test fishing is a relatively low cost approach, it is also inherently susceptible to interannual variability in fish catchability. That typically requires that the data be interpreted in a somewhat qualitative way as an abundance index if calibration is not possible between years.

The objectives of the test fishing project for 1994 were:

1. To evaluate the feasibility of indexing chum salmon abundance in the Kobuk River using systematic drift gill net catches.

2. Describe the migratory timing for chum salmon in the lower Kobuk River.

3. Sample for age, sex and size.

In addition, a long term goal of the project, once sufficient historical data are available for

comparison, is to assess, in a qualitative way, the impact of the Kotzebue District commercial salmon fishery on chum salmon abundance in the lower Kobuk River for fisheries management purposes.

METHODS

Site Description

The site is approximately 70 river miles from the Kobuk Lake boundary markers of the commercial salmon fishing district (Figure 1). This is the furthest downstream site where the river runs through a single channel. The test fishing site was selected because of it's desirable stream characteristics. The site consists of a 1-1/2 mile river section located approximately 3 miles downstream from Kiana. The width of the river was approximately 250 meters and was divided into two sites (Figure 2). Site N is the north side of the river (right bank), which is the cut bank side of the river with the swiftest current. Site S is located on the south side of the river (left bank). Site S is located downstream from a major sandbar and has a gradual gradient. It is also the site with the slowest current.

A bottom profile near the test fish site reveals a near uniform bottom with a depth of 5-6 meters except on the right bank (Figure 3). This deeper portion of the river is about 9 meters and is on the side with the faster current. In the figure, the left and right banks near shore show a sharp drop. However, if this profile was drawn to scale, the gradient would not be near as steep.

Test Fishing

Fishing was scheduled to sample salmon passage during three different segments of the day at each of the two sites; morning (0800), mid-day (1500), and late evening (2200). Drifts were conducted by a two person crew, six days per week.

All test fishing drifts were made from a 20 foot open outboard motorboat for approximately 20 minutes with a 50 fathom gill net. If catch rates were high, fishing time was reduced, in order to control mortality. The net was composed of 5-7/8 in (14.9 cm) stretched mesh multifilament webbing, 45 meshes deep, and hung at a ratio of 2:1. Age-sex-length data were collected from chum salmon. Mortalities were given to nonprofit organizations or individuals for subsistence purposes.

Standardized Catches

Actual catches were converted to catch per unit of effort (CPUE) by considering fishing time

and the length of net used. Each CPUE index was the number of fish which would have been caught if 100 fathoms of net had been fished for 60 minutes. The index (I) was calculated as follows:

$$I = \frac{6,000\,(c)}{(l)\,(t)}$$

Where: c = number of chum salmon caught
l = length of net in fathoms
t = mean fishing time in minutes

Mean fishing time (t) was defined as the amount of time the entire net was fishing plus half the time it took to deploy and retrieve the net. Mean daily drift CPUE indices were calculated using the sum of the total time fished and total fish caught for each day. The mean daily indices were summed to produce a total seasonal CPUE indices for the period of data collection. Cumulative proportions of seasonal total test fish CPUE indices were also calculated.

Catch rate for each time period and site was determined by using the fishing time and number of fish caught for those specific time periods and sites. Seasonal abundance by site and time period were indexed by summing CPUE indices for each of the daily sites and time periods. Temporal distribution was depicted as a percent calculated by dividing each time period total by the total CPUE indices. Spacial distribution was described by dividing each sites CPUE seasonal total by the total of both sites CPUE indices. Temporal and spatial distribution was described as a percent since the number of drifts made at each site and the amount of each time period was fished varied.

RESULTS

Drifting began on July 13 and continued through August 29. CPUE indices were calculated for each drift and site (Table 1). There were 1,092 chum salmon caught in a total of 248 drifts (124 drift time periods) producing 3,414.6 chum salmon drift period CPUE index points (Table 2). Peak catch occurred on August 6 with a catch of 97 salmon. The daily CPUE was 102.56 and comprised 8.4% of the seasonal CPUE index. However, the peak daily CPUE of 108.98 occurred on August 4 and was 8.9% of the seasonal CPUE index. A total of 31.7, 39.8 and 28.5 percent of the seasonal CPUE indices was caught at 0800, 1500, and 2200 hours. A total of 8.4 and 91.6 percent of the total seasonal CPUE indices was caught at sites N and S. As in 1993, the time of day with the most movement was during mid-afternoon as shown with 39.8% of the seasonal CPUE. Not unusual was the higher proportion of the seasonal CPUE (91.6) being caught from the portion of the river with the slower current at Site S. A higher than normal river level may have also affected the migration pattern. The mean secchi for 1993 was

2.1 meter, 0.8 meter more than the secchi reading of 1.4 meter for 1994. However, the bulk of the run in 1994 occurred during the time when the water was the clearest.

Scales were analyzed from 624 chum salmon caught in test nets. The age composition was 3.0% Age-0.2, 58.0% Age-0.3, 36.6% Age-0.4 and 2.4% Age-0.5 (Table 3). The age composition of the 1994 Kotzebue commercial and Noatak River test fish catch is shown for comparison. Length by age comparison indicates that the Kotzebue commercial and commercial test samples were similar in size to the Kobuk River drift test fish catch. However, chums caught in test nets at the Noatak River sonar site were smaller by age class, with the exception of age-6 salmon, than both the Kotzebue commercial and commercial test and Kobuk River drift test fishing catch samples. These discrepancies are probably caused by the type of gear used. Most fishermen in the Kotzebue commercial fishery use 5-7/8 in or 6 in mesh gear. The test fishery at Noatak Sonar use a range of mesh sizes (2-3/4 in, 4 in, 5 in and 6 in).

Of the 1,092 chum salmon caught in the Kobuk River test fishery, none were released. All were either transported to elders or given to local residents using daily CB announcements notifying people about the availability of salmon.

The basic test fishing operation was set up the same as it had been in prior years on the Noatak River, except for that fishing times were changed from 1200, 1700 and 2200 to 0800, 1500 and 2200 to sample more evenly throughout the day. Drift sites were reduced from 3 to 2 because of the narrower river channel. The test fishing gear was intended to match the same gear being used in the commercial fishery. A total of 6 days of test fishing was missed due to regular days off. Only 3 drifts on 2 separate days were missed due to equipment failure. Climatological data is presented in Table 4 and Figure 7. Seasonal test fishing data for 1993-1994 is presented in Tables 5 through 7 and in Figures 4 through 6. Figure 4 shows test fishing CPUE by day for 1993 and 1994. Figure 5 and 6 compares cumulative CPUE and cumulative proportions of CPUE indices.

The test fishing CPUE indices generated (number of salmon caught) is influenced considerably by commercial fishing activity in Kotzebue Sound, as well as the number of drifts conducted and their timing compared to commercial periods. In addition, local salmon migration patterns can be greatly influenced by weather conditions. For these reasons, no interpolations were made for missing data points since accuracy of these estimates may not be reliable.

CONCLUSIONS

The Kobuk River test fishing project was successful in it's second year of operation. This year was dominated by higher than normal water levels and water clarity less than normal. The tannic staining of the river eliminates salmon net avoidance and provides for a more comparable catch rate whether the river is low and clear or high and turbid. During periods of clear water,

the tannic stain provides enough concealment of gillnets that fish were caught throughout the run. Comparisons of Kobuk River test fish CPUE, commercial catch and Noatak River sonar counts during 1993 indicated there was some correlation. These indices will be studied in 1994 also. Shortened and more frequent commercial fishing periods in the latter portion of the 1994 season may make this difficult. If correlations exist, the data could be used to estimate run timing of Kobuk and Noatak River chum salmon stocks.

The commercial catch from Period 6 on July 28-29 was substantially higher than average and may have been the cause of decreased test fish catches between August 2-3. If this in fact is true, migration timing from the commercial fishery to the test fish site is around 5-6 days. Subsequent fluctuations in test fish catches were probably more related to high water, as overall commercial fishing time was reduced but periods were scheduled more frequently. Comparing to 1993, the 1994 chum salmon migration past the test fish site was later and more compressed.

Bering Sea Fishermen's Association funded the test fish project from August 14 to August 30, an additional 2-1/2 weeks. This allowed the project to collect data for the entire run. Typically this project is funded for 5 weeks. In retrospect, a project 6 weeks in duration should be able to monitor the entire run into the Kobuk River. Ideally the project should begin around July 12 and end about August 20.

No aerial surveys were conducted during 1994. Nearly continuous rain kept river levels elevated and water clarity poor. Therefore, no correlations between test fish indices and aerial surveys were possible. Age composition and tributary escapement sampling support test fish results that the 1994 escapements were quite strong.

Local subsistence fishermen were interviewed throughout the season by the test fish crew. Catch rates from the test fishery seemed to track with subsistence catches. In the past there was only limited inseason run timing and abundance information provided by subsistence fishermen from the Kobuk River. This information was usually not available in a timely manner. With a test fish crew in Kiana, travel to subsistence fish camps to compare test fishing catch rates with subsistence catch rates is now feasible.

Logistically, test fishing on the Kobuk River near Kiana at the sites used in 1993 and 1994 appears feasible. The data obtained to date indicate that chum salmon run timing and an index of abundance may be obtained from this project. This information should improve in usefulness with additional years of data. It should be kept in mind, however, that interannual comparisons of abundance need to be made in a qualitative way due to the inherent interannual variability of fish catchability in a drift gill net test fishery, absent any means of calibrating these data.

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Table 1. Kobuk River drift test fish chum salmon CPUE by day, drift, and site, 1994. [a]

Date	CPUE by Drift [b]			CPUE by Site [c]		Daily CPUE	Cumm. CPUE
	#1	#2	#3	N	S		
13-Jul	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14-Jul	0.00	5.27	2.61	1.80	3.53	2.68	2.68
15-Jul	4.95	2.61	0.00	1.64	3.61	2.58	5.26
16-Jul	5.11	10.43	18.88	1.76	20.72	11.35	16.61
17-Jul [d]							16.61
18-Jul	2.64	0.00	18.46	0.00	14.12	7.16	23.77
19-Jul	23.74	10.32	2.76	0.00	24.53	12.40	36.17
20-Jul	2.86	8.09	0.00	1.80	5.54	3.65	39.82
21-Jul	10.79	11.03	0.00	0.00	14.12	7.30	47.12
22-Jul	5.45	2.58	2.70	0.00	7.16	3.56	50.68
23-Jul	24.83	13.48	11.16	3.69	29.09	16.49	67.17
24-Jul [d]							67.17
25-Jul	24.27	13.48	5.39	3.64	24.89	14.38	81.55
26-Jul	32.73	63.67	44.65	0.00	91.27	47.65	129.20
27-Jul	21.33	59.35	[e]	2.73	75.79	40.66	169.86
28-Jul	[e]	[e]	57.83	16.36	104.62	57.83	227.69
29-Jul	34.29	52.50	19.31	18.46	53.33	33.62	261.31
30-Jul	83.08	38.52	81.95	5.54	129.64	69.21	330.52
31-Jul [d]							330.52
01-Aug	51.43	124.68	67.20	16.62	174.78	82.16	412.68
02-Aug	27.00	74.56	92.80	3.58	131.61	65.12	477.80
03-Aug	62.34	93.91	51.69	7.80	142.70	71.79	549.59
04-Aug	124.93	120.00	82.39	35.56	199.09	108.98	658.57
05-Aug	78.86	14.12	78.32	7.62	121.12	59.74	718.31
06-Aug	116.13	93.33	92.90	41.65	172.08	102.56	820.87
07-Aug [d]							820.87
08-Aug	77.65	64.76	49.66	3.93	137.50	62.75	883.62
09-Aug	85.16	125.71	74.81	4.21	193.76	96.86	980.48
10-Aug	9.47	54.86	86.04	4.62	90.95	45.83	1,026.31
11-Aug	105.76	50.70	9.41	0.00	117.27	57.02	1,083.33
12-Aug	17.91	183.16	0.00	3.69	145.88	90.54	1,173.87
13-Aug	23.53	10.00	3.43	2.58	22.11	11.36	1,185.23
14-Aug [d]							1,185.23
15-Aug	6.96	8.09	0.00	1.80	9.50	5.13	1,190.36
16-Aug	3.33	33.80	11.25	9.92	25.12	16.23	1,206.59
17-Aug	0.00	0.00	0.00	0.00	0.00	0.00	1,206.59
18-Aug	0.00	0.00	0.00	0.00	0.00	0.00	1,206.59
19-Aug	8.28	0.00	3.00	6.32	2.07	3.12	1,209.71
20-Aug	0.00	0.00	0.00	0.00	0.00	0.00	1,209.71
21-Aug [d]							1,209.71
22-Aug	0.00	0.00	0.00	0.00	0.00	0.00	1,209.71
23-Aug	0.00	0.00	0.00	0.00	0.00	0.00	1,209.71
24-Aug	0.00	0.00	0.00	0.00	0.00	0.00	1,209.71
25-Aug	0.00	2.73	0.00	0.00	1.78	0.91	1,210.62
26-Aug	2.76	13.79	0.00	0.00	11.08	5.56	1,216.18
27-Aug	2.76	0.00	2.82	1.86	1.86	1.86	1,218.04
28-Aug	2.82	0.00	0.00	1.88	0.00	0.93	1,218.97
29-Aug	0.00	0.00	0.00	0.00	0.00	0.00	1,218.97
30-Aug	0.00			0.00	0.00	0.00	1,218.97

[a] Catch per unit effort is calculated in catch/100fm/hour
[b] Drift 1 begins at 0800, Drift 2 at 1500, Drift 3 at 2200.
[c] Site N is the North Bank (right bank), Site S is the South Bank (left bank).
[d] Regular Day Off
[e] Data unavailable due to poor weather conditions or mechanical failure.

Table 2. Kobuk River drift test fish chum salmon CPUE indices, mean CPUE and percent by drift (time of day) and site (location), 1994.

Drift Period	Season CPUE Indicies	No. of Period Drifts	Season Mean CPUE	Percent	Station	Season CPUE Indicies	No. of Site Drifts	Season Mean CPUE	Percent
1 0800 hrs.	1,083.2	42	25.8	31.7	N North Bank	211.1	43	4.9	8.4
2 1500 hrs.	1,359.5	41	33.2	39.8	S South Bank	2,302.2	43	53.5	91.6
3 2200 hrs.	971.9	41	23.7	28.5					
Total	3,414.6	124	27.5	100.0		2,513.3	86	29.2	100.0

Table 3. Comparison of chum salmon age and sex composition and mean length in the Kotzebue District commercial catch and commercial test nets compared to the Kobuk River and Noatak River drift test fish catch, 1994.

		Brood Year and (Age Group)				
		1991 (0.2)	1990 (0.3)	1989 (0.4)	1988 (0.5)	Total
Stratum Dates: 7/11–8/30 Sampling Dates: 7/12–8/30 Sample Size: 3,744		Kotzebue Commercial Catch and Commercial Test Net				
Female	Percent of Sample	0.9	28.8	13.8	1.3	44.8
	Number in Catch	34	1,079	516	48	1,677
	Mean Length (mm) [a]	565.7	583.2	599.9	600.6	
	Standard Error (Length)	3.4	0.9	1.1	3.7	
Male	Percent of Sample	2.4	34.2	17.1	1.6	55.2
	Number in Catch	88	1,279	639	61	2,067
	Mean Length (mm) [a]	566.7	600.8	620.8	628.6	
	Standard Error (Length)	2.9	0.9	1.2	5.2	
Total	Percent of Sample	3.3	63.0	30.8	2.9	100.0
	Number in Catch	122	2,358	1,155	109	3,744
	Standard Error	11	30	28	10	
Stratum Dates: 7/13–8/29 Sampling Dates: 7/13–8/29 Sample Size: 624		Kobuk River Drift Test Fish				
Female	Percent of Sample	1.6	20.7	13.8	1.0	37.0
	Number in Catch	10	129	86	6	231
	Mean Length (mm) [a]	558.5	586.6	601.2	599.2	
	Standard Error (Length)	5.6	2.5	2.4	7.5	
Male	Percent of Sample	1.4	37.3	22.8	1.4	63.0
	Number in Catch	9	233	142	9	393
	Mean Length (mm) [a]	561.1	602.7	621.6	623.7	
	Standard Error (Length)	7	2.0	2.7	7.5	
Total	Percent of Sample	3.0	58.0	36.6	2.4	100.0
	Number in Catch	19	362	228	15	624
	Standard Error	4	12	12	4	
Stratum Dates: 7/22–9/10 Sampling Dates: 7/22–9/10 Sample Size: 1,160		Noatak River Drift Test Fish				
Female	Percent of Sample	1.7	35.8	14.0	0.9	52.4
	Number in Catch	20	415	162	10	608
	Mean Length (mm) [a]	524.5	558.0	573.5	578.7	
	Standard Error (Length)	6.1	1.4	2.4	7.6	
Male	Percent of Sample	1.4	32.7	12.8	0.8	47.6
	Number in Catch	16	379	148	9	552
	Mean Length (mm) [a]	542.7	580.2	603.8	642.8	
	Standard Error (Length)	7.3	2.5	2.8	12.9	
Total	Percent of Sample	3.1	68.5	26.8	1.6	100.0
	Number in Catch	36	794	311	19	1,160
	Standard Error	6	16	15	4	

[a] Length was from mid–eye to fork–of–tail.

Table 4. Kobuk River climatological data, 1994.

Date	Time	Secchi (meters)	Water Temp(C)	Wind mph	Wind direction	Cloud Cover
13-Jul	1230			10	NE	2
14-Jul	1115			calm		1
15-Jul	930			calm		1
16-Jul	800	1.25	14.0	calm		1
17-Jul						
18-Jul	830	1.70	15.0	calm		1
19-Jul	900	2.12	15.0	15	NW	3
20-Jul	830	1.70	15.0	15	NW	3
21-Jul	800	3.10	14.0	calm		2
22-Jul	900	2.10	13.0	5	SW	4
23-Jul	900	2.30	13.0	10	SW	4
24-Jul						
25-Jul	930	0.87	12.0	calm		2
26-Jul	1000	1.25	12.0	calm		1
27-Jul	900	1.50	13.0	calm		1
28-Jul						
29-Jul	800	2.22	15.0	calm		3
30-Jul	900	2.37	5.0	calm		3
31-Jul						
01-Aug	800	2.37	15.5	calm		3
02-Aug	830	2.00	15.0	10	SW	3
03-Aug	900	2.25	13.0	calm		2
04-Aug	830	1.23	13.0	calm		3
05-Aug	1100	2.10	13.0	calm		1
06-Aug	800	2.10	14.0	calm		2
07-Aug						
08-Aug	900	2.00	14.0	5	West	3
09-Aug	1000	2.37	12.0	5	East	3
10-Aug	930	2.00	13.5	15	SW	3
11-Aug	900	2.00	13.0	20	SW	4
12-Aug	900	2.50	12.0	10	South	4
13-Aug	900	1.50	10.0	calm		3
14-Aug						
15-Aug	830	0.75	10.0	calm		3
16-Aug	900	0.70	10.0	calm		4
17-Aug	900	0.25	10.0	15	South	3
18-Aug	900	0.20	9.5	5	West	3
19-Aug	900	0.20	9.0	10	South	3
20-Aug	900	0.10	9.0	calm		3
21-Aug						
22-Aug	830	0.50	8.5	calm	East	1
23-Aug	830	0.30	8.0	calm	NE	3
24-Aug	830	0.50	9.0	calm	NE	3
25-Aug	900	0.75	8.0	calm	NE	3
26-Aug	900	0.62	8.0	calm	South	4
27-Aug	900	0.62	7.0	5	North	1
28-Aug	900	0.50	6.0	5	NE	1
29-Aug	830	0.05	5.0	calm	East	1
30-Aug	900	0.40	5.5	5	East	2

[a] Wind speed unavailable.

Cloud Cover:
0 – No observation
1 – Clear sky; cloud cover less then 1/10th of the sky
2 – Cloud cover not more than 1/2 of the sky
3 – Cloud cover more than 1/2 of the sky
4 – Sky is completely overcast
5 – Fog or thick haze (smoke, dust, etc.)

Precipitation:
0 – No observation
1 – Intermittent rain
2 – Continuous rain
3 – Snow
4 – Snow and rain mix
5 – Hail
6 – Thunderstorm
7 – No precipitation

Table 5. Kobuk River drift test fish chum salmon diurnal and spacial distribution expressed as mean CPUE by drift period and by site, 1993–94. [a]

Year	Mean CPUE by Drift Period [b]			Yearly Mean CPUE	Percent Mean CPUE by Drift Period [b]			Mean CPUE by Site		Yearly Mean CPUE	Percent Mean CPUE by Site	
	1	2	3		1	2	3	N	S		N	S
1993	13.0	21.3	15.9	16.8	25.4	43.4	31.1	10.0	24.9	17.4	28.7	71.3
1994	25.8	33.2	23.7	27.5	31.	39.8	28.5	4.9	53.5	29.2	8.4	91.6

[a] Drift 1 begins at 0800, Drift 2 at 1500, Drift 3 at 2200.
[b] Site N is along the North Bank (right bank), Site S is South Bank (left bank).

Table 6. Kobuk River drift test fish CPUE and cumulative CPUE by drift, 1993–94.

	1993			1994		
Date	Drift	Daily	Cum.	Drift	Daily	Cum.
12–Jul	1	15.5	15.5			
	2	2.5	18.0			
	3	16.0	34.0			
13–Jul	1	5.4	39.4	1	0.00	0.00
	2	15.5	54.9	2	0.00	0.00
	3	25.4	80.3	3	0.00	0.00
14–Jul	1	13.2	93.5	1	0.00	0.00
	2	0.0	93.5	2	5.27	5.27
	3	46.1	139.5	3	2.61	7.88
15–Jul	1	20.6	160.1	1	4.95	12.83
	2	33.9	194.0	2	2.61	15.44
	3	46.5	240.5	3	0.00	15.44
16–Jul	1	2.7	243.2	1	5.11	20.55
	2	32.5	275.7	2	10.43	30.98
	3	2.7	278.5	3	18.88	49.86
17–Jul	1	23.5	302.0	1 [a]		49.86
	2	28.7	330.7	2		49.86
	3	0.0	330.7	3		49.86
18–Jul [a]	1		330.7	1	2.64	52.50
	2		330.7	2	0.00	52.50
	3		330.7	3	18.46	70.96
19–Jul	1	5.5	336.1	1	23.74	94.70
	2	2.7	338.8	2	10.32	105.02
	3	23.5	362.3	3	2.76	107.78
20–Jul	1	2.8	365.1	1	2.86	110.64
	2	5.4	370.5	2	8.09	118.73
	3	0.0	370.5	3	0.00	118.73
21–Jul	1	2.8	373.2	1	10.79	129.52
	2	5.5	378.7	2	11.03	140.55
	3	1.9	380.6	3	0.00	140.55
22–Jul	1	2.8	383.4	1	5.45	146.00
	2	0.0	383.4	2	2.58	148.58
	3	13.2	396.6	3	2.70	151.28
23–Jul	1	2.7	399.3	1	24.83	176.11
	2	26.1	425.4	2	13.48	189.59
	3	51.6	477.0	3	11.16	200.75
24–Jul	1	8.2	485.2	1 [a]		200.75
	2	8.1	493.3	2		200.75
	3	10.9	504.2	3		200.75
25–Jul [a]	1		504.2	1	24.27	225.02
	2		504.2	2	13.48	238.50
	3		504.2	3	5.39	243.89
26–Jul	1	10.9	515.1	1	32.73	276.62
	2	8.1	523.2	2	63.67	340.29
	3	26.4	549.6	3	44.65	384.94
27–Jul	1	15.5	565.1	1	21.33	406.27
	2	8.1	573.1	2	59.35	465.62
	3	0.0	573.1	3 [b]		465.62

(continued)

Table 6. (Page 2 of 3)

	1993			1994		
Date	Drift	Daily	Cum.	Drift	Daily	Cum.
28-Jul	1	11.2	584.3	1 [b]		465.6
	2	16.2	600.5	2 [b]		465.6
	3	21.6	622.1	3	57.8	523.5
29-Jul	1	2.7	624.8	1	34.3	557.7
	2	0.0	624.8	2	52.5	610.2
	3	0.0	624.8	3	19.3	629.6
30-Jul	1	0.0	624.8	1	83.1	712.6
	2	0.0	624.8	2	38.5	751.2
	3	2.8	627.5	3	82.0	833.1
31-Jul	1	16.2	643.7	1 [a]		833.1
	2	16.2	659.9	2		833.1
	3	5.4	665.3	3		833.1
01-Aug [a]	1		665.3	1	51.4	884.5
	2		665.3	2	124.7	1,009.2
	3		665.3	3	67.2	1,076.4
02-Aug	1 [b]		665.3	1	27.0	1,103.4
	2	0.0	665.3	2	74.6	1,178.0
	3	13.3	678.6	3	92.8	1,270.8
03-Aug	1	42.2	720.8	1	62.3	1,333.1
	2	71.5	792.3	2	93.9	1,427.0
	3 [b]		792.3	3	51.7	1,478.7
04-Aug	1	16.7	809.1	1	124.9	1,603.6
	2	60.0	869.1	2	120.0	1,723.6
	3	51.3	920.3	3	82.4	1,806.0
05-Aug	1	40.9	961.2	1	78.9	1,884.9
	2	191.6	1,152.8	2	14.1	1,899.0
	3	2.7	1,155.5	3	78.3	1,977.3
06-Aug	1	12.8	1,168.3	1	116.1	2,093.5
	2	13.8	1,182.1	2	93.3	2,186.8
	3	29.3	1,211.4	3	92.9	2,279.7
07-Aug	1	47.5	1,258.9	1 [a]		2,279.7
	2	2.8	1,261.6	2		2,279.7
	3	8.4	1,270.0	3		2,279.7
08-Aug [a]	1		1,270.0	1	77.7	2,357.3
	2		1,270.0	2	64.8	2,422.1
	3		1,270.0	3	49.7	2,471.8
09-Aug	1	5.5	1,275.5	1	85.2	2,556.9
	2	0.0	1,275.5	2	125.7	2,682.6
	3	0.0	1,275.5	3	74.8	2,757.4
10-Aug	1	0.0	1,275.5	1	9.5	2,766.9
	2	8.1	1,283.6	2	54.9	2,821.8
	3	29.3	1,312.9	3	86.0	2,907.8
11-Aug	1	11.3	1,324.2	1	105.8	3,013.6
	2	40.4	1,364.7	2	50.7	3,064.3
	3	0.0	1,364.7	3	9.4	3,073.7
12-Aug	1	11.3	1,375.9	1	17.9	3,091.6
	2	0.0	1,375.9	2	183.2	3,274.7
	3	0.0	1,375.9	3	0.0	3,274.7

(continued)

Table 6. (Page 3 of 3)

	1993			1994		
Date	Drift	Daily	Cum.	Drift	Daily	Cum.
13-Aug				1	23.5	3,298.3
				2	10.0	3,308.3
				3	3.4	3,311.7
14-Aug				1 [a]		3,311.7
				2		3,311.7
				3		3,311.7
15-Aug				1	7.0	3,318.7
				2	8.1	3,326.8
				3	0.0	3,326.8
16-Aug				1	3.3	3,330.1
				2	33.8	3,363.9
				3	11.3	3,375.1
17-Aug				1	0.0	3,375.1
				2	0.0	3,375.1
				3	0.0	3,375.1
18-Aug				1	0.0	3,375.1
				2	0.0	3,375.1
				3	0.0	3,375.1
19-Aug				1	8.3	3,383.4
				2	0.0	3,383.4
				3	3.0	3,386.4
20-Aug				1	0.0	3,386.4
				2	0.0	3,386.4
				3	0.0	3,386.4
21-Aug				1 [a]		3,386.4
				2		3,386.4
				3		3,386.4
22-Aug				1	0.0	3,386.4
				2	0.0	3,386.4
				3	0.0	3,386.4
23-Aug				1	0.0	3,386.4
				2	0.0	3,386.4
				3	0.0	3,386.4
24-Aug				1	0.0	3,386.4
				2	0.0	3,386.4
				3	0.0	3,386.4
25-Aug				1	0.0	3,386.4
				2	2.7	3,389.2
				3	0.0	3,389.2
26-Aug				1	2.8	3,391.9
				2	13.8	3,405.7
				3	0.0	3,405.7
27-Aug				1	2.8	3,408.5
				2	0.0	3,408.5
				3	2.8	3,411.3
28-Aug				1	2.8	3,414.1
				2	0.0	3,414.1
				3	0.0	3,414.1
29-Aug				1	0.0	3,414.1
				2	0.0	3,414.1
				3	0.0	3,414.1
30-Aug				1	0.0	3,414.1
				2		3,414.1
				3		

Table 7. Kobuk River drift test fish mean daily and cumulative CPUE, daily and CPUE proportions, 1993–94. [a,b]

	Catch Per Unit Effort				Proportions			
	1993		1994		1993		1994	
Date	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
10–Jul								
11–Jul								
12–Jul	11.18	11.18			0.023	0.023		
13–Jul	14.22	25.40	0.00	0.00	0.029	0.051	0.000	0.000
14–Jul	20.57	45.97	2.68	2.68	0.042	0.093	0.002	0.002
15–Jul	35.08	81.05	2.58	5.26	0.071	0.164	0.002	0.004
16–Jul	13.19	94.24	11.35	16.61	0.027	0.191	0.009	0.014
17–Jul	17.27	111.51	[a]	16.61	0.035	0.226	[a]	0.014
18–Jul	[a]	111.51	7.16	23.77	[a]	0.226	0.006	0.020
19–Jul	10.71	122.22	12.40	36.17	0.022	0.247	0.010	0.030
20–Jul	2.76	124.98 +	3.65	39.82	0.006	0.253	0.003	0.033
21–Jul	3.20	128.18	7.30	47.12	0.006	0.259	0.006	0.039
22–Jul	5.52	133.70	3.56	50.68	0.011	0.271	0.003	0.042
23–Jul	27.15	160.85	16.49	67.17	0.055	0.325	0.014	0.055
24–Jul	9.06	169.91	[a]	67.17	0.018	0.344	[a]	0.055
25–Jul	[a]	169.91	14.38	81.55	[a]	0.344	0.012	0.067
26–Jul	15.22	185.13	47.65	129.20	0.031	0.375	0.039	0.106
27–Jul	8.06	193.19	40.66	169.86	0.016	0.391	0.033	0.139
28–Jul	16.36	209.55	57.83	227.69	0.033	0.424	0.047	0.187
29–Jul	0.93	210.48	33.62	261.31	0.002	0.426	0.028	0.214
30–Jul	0.92	211.40	69.21	330.52 +	0.002	0.428	0.057	0.271
31–Jul	12.58	223.98	[a]	330.52	0.025	0.453	[a]	0.271
01–Aug	[a]	223.98	82.16	412.68	[a]	0.453	0.067	0.339
02–Aug	6.74	230.72	65.12	477.80	0.014	0.467	0.053	0.392
03–Aug	54.49	285.21 *	71.79	549.59	0.110	0.577	0.059	0.451
04–Aug	44.23	329.44	108.98	658.57 *	0.090	0.667	0.089	0.540
05–Aug	89.30	418.74 +	59.74	718.31	0.181	0.847	0.049	0.589
06–Aug	18.60	437.34	102.56	820.87	0.038	0.885	0.084	0.673
07–Aug	20.52	457.86	[a]	820.87	0.042	0.927	[a]	0.673
08–Aug	[a]	457.86	62.75	883.62	[a]	0.927	0.051	0.725
09–Aug	1.84	459.70	96.86	980.48 +	0.004	0.930	0.079	0.804
10–Aug	12.63	472.33	45.83	1,026.31	0.026	0.956	0.038	0.842
11–Aug	18.11	490.44	57.02	1,083.33	0.037	0.992	0.047	0.889
12–Aug	3.74	494.18	90.54	1,173.87	0.008	1.000	0.074	0.963
13–Aug			11.36	1,185.23			0.009	0.972
14–Aug			[a]	1,185.23			[a]	0.972
15–Aug			5.13	1,190.36			0.004	0.977
16–Aug			16.23	1,206.59			0.013	0.990
17–Aug			0.00	1,206.59			0.000	0.990
18–Aug			0.00	1,206.59			0.000	0.990
19–Aug			3.12	1,209.71			0.003	0.992
20–Aug			0.00	1,209.71			0.000	0.992
21–Aug			[a]	1,209.71			[a]	0.992
22–Aug			0.00	1,209.71			0.000	0.992
23–Aug			0.00	1,209.71			0.000	0.992
24–Aug			0.00	1,209.71			0.000	0.992
25–Aug			0.91	1,210.62			0.001	0.993
26–Aug			5.56	1,216.18			0.005	0.998
27–Aug			1.86	1,218.04			0.002	0.999
28–Aug			0.93	1,218.97			0.001	1.000
29–Aug			0.00	1,218.97			0.000	1.000
30–Aug			0.00	1,218.97			0.000	1.000

[a] Regular days off.
[b] Quartiles (25% and 75%) are indicated by "+" and the 50% point is indicated by a "*".

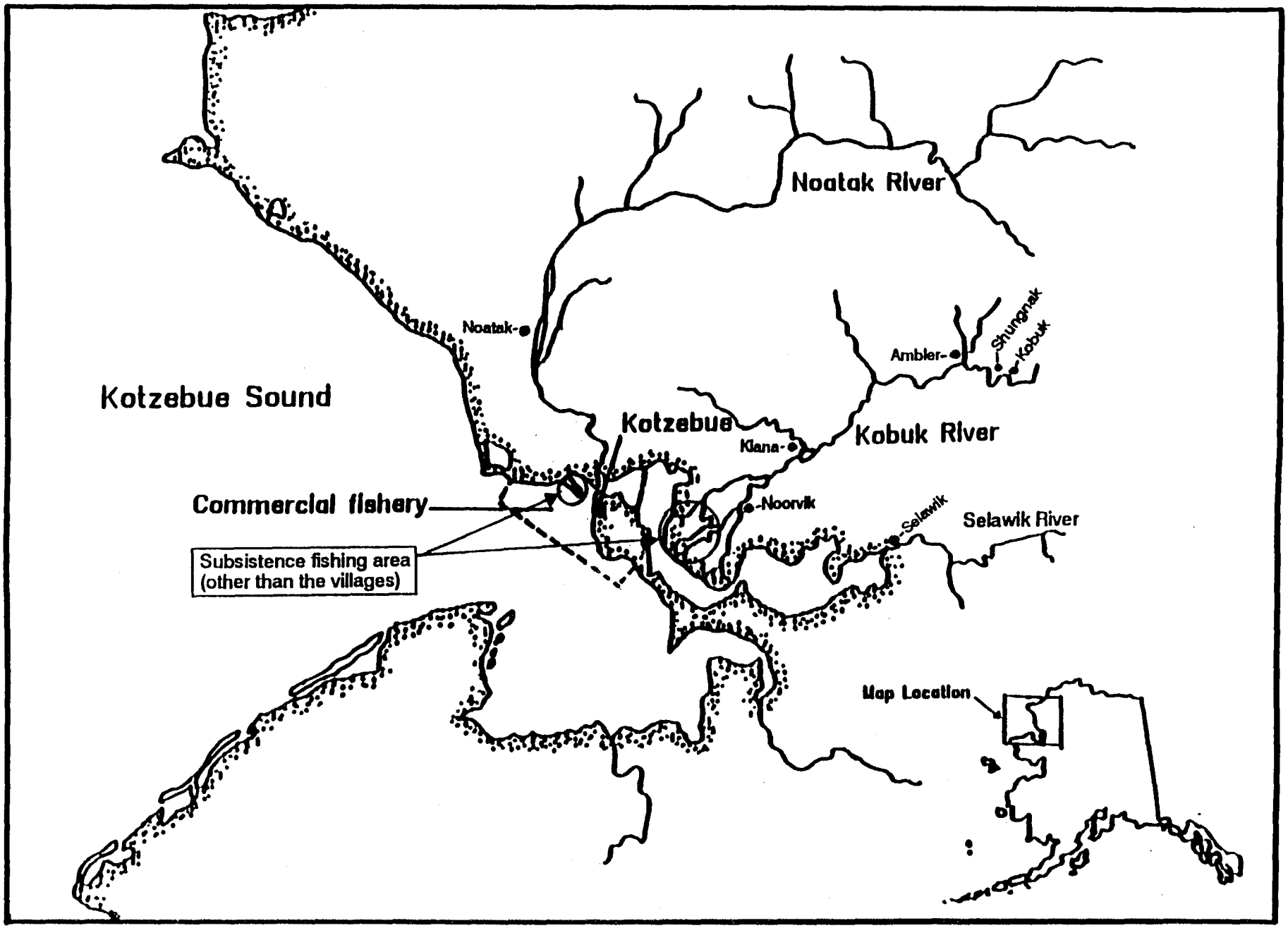

Figure 1. Kotzebue Sound commercial fishing district, villages and subsistence fishing areas.

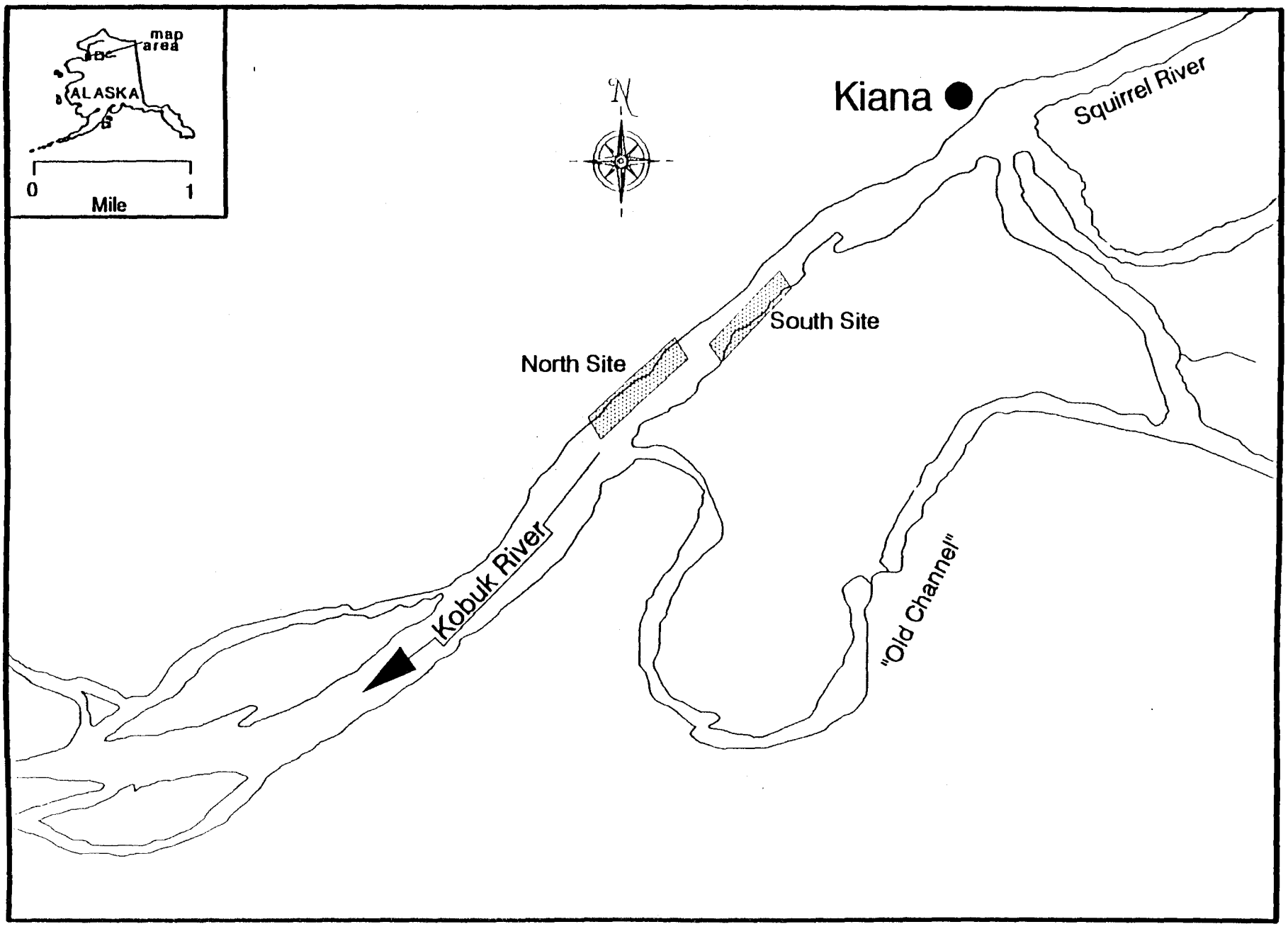

Figure 2. Lower Kobuk River test fish sites.

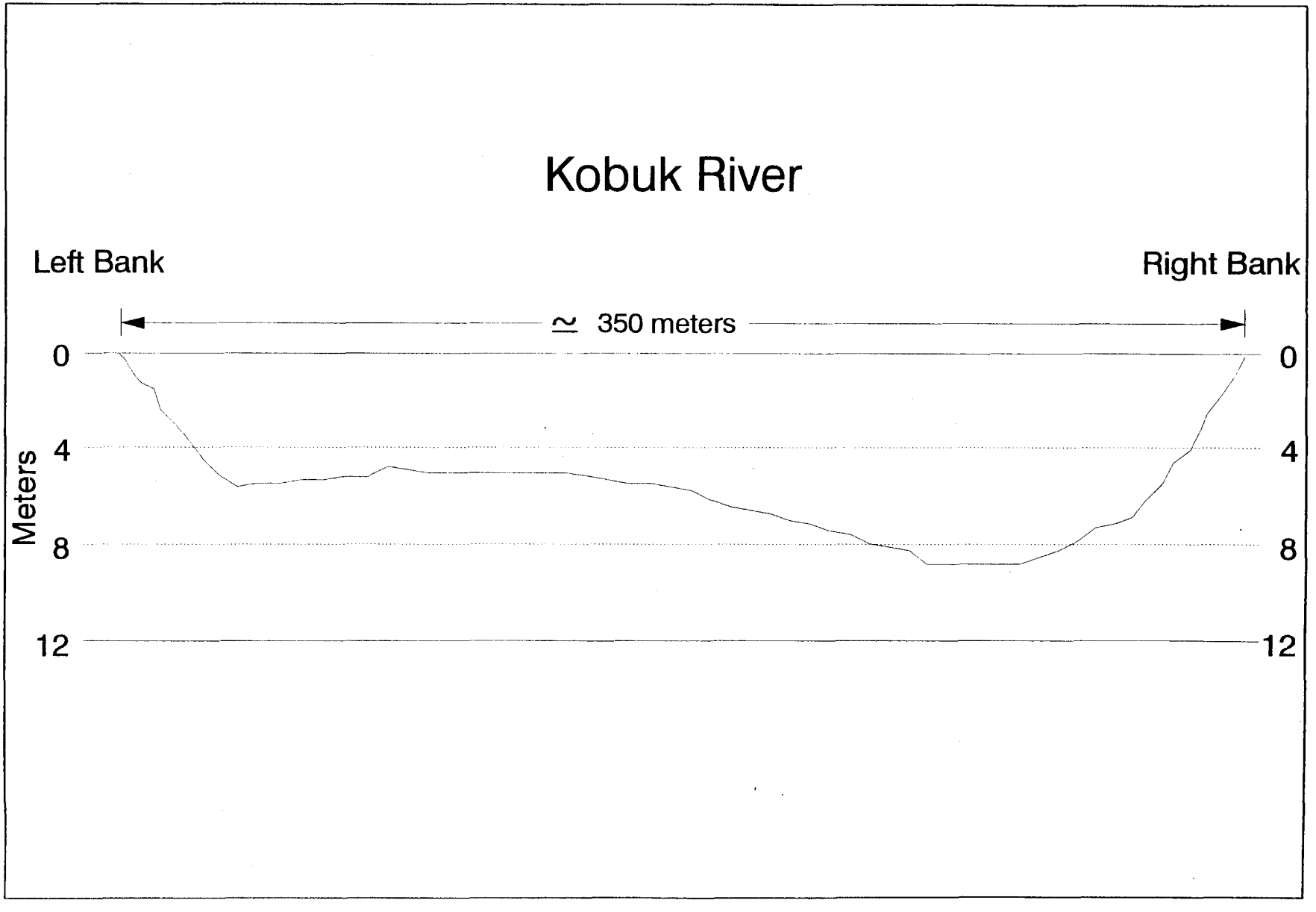

Figure 3. Kobuk River bottom profile near the test fish site, 1994.

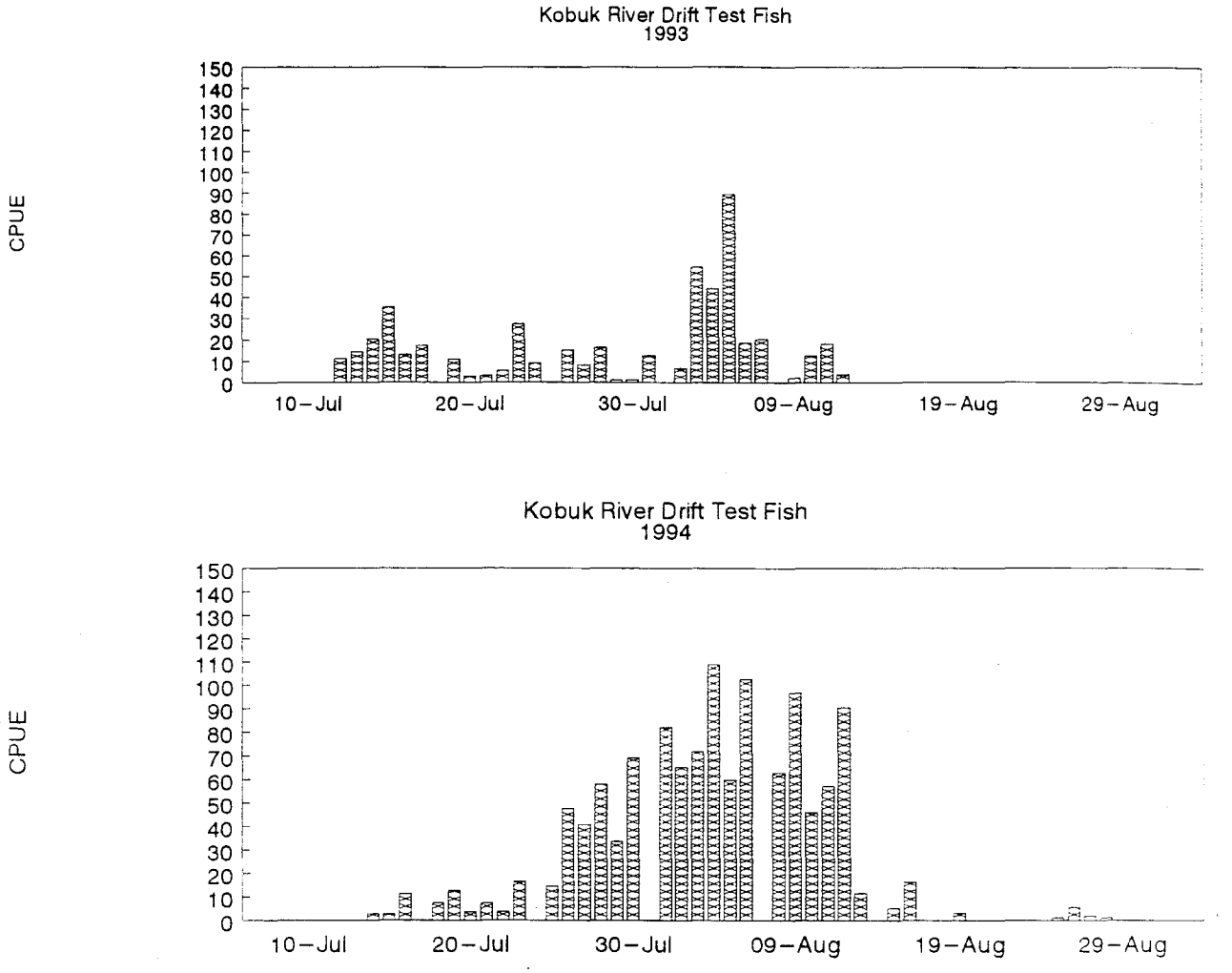

Figure 4. Kobuk River drift test fish daily CPUE, 1993-94.

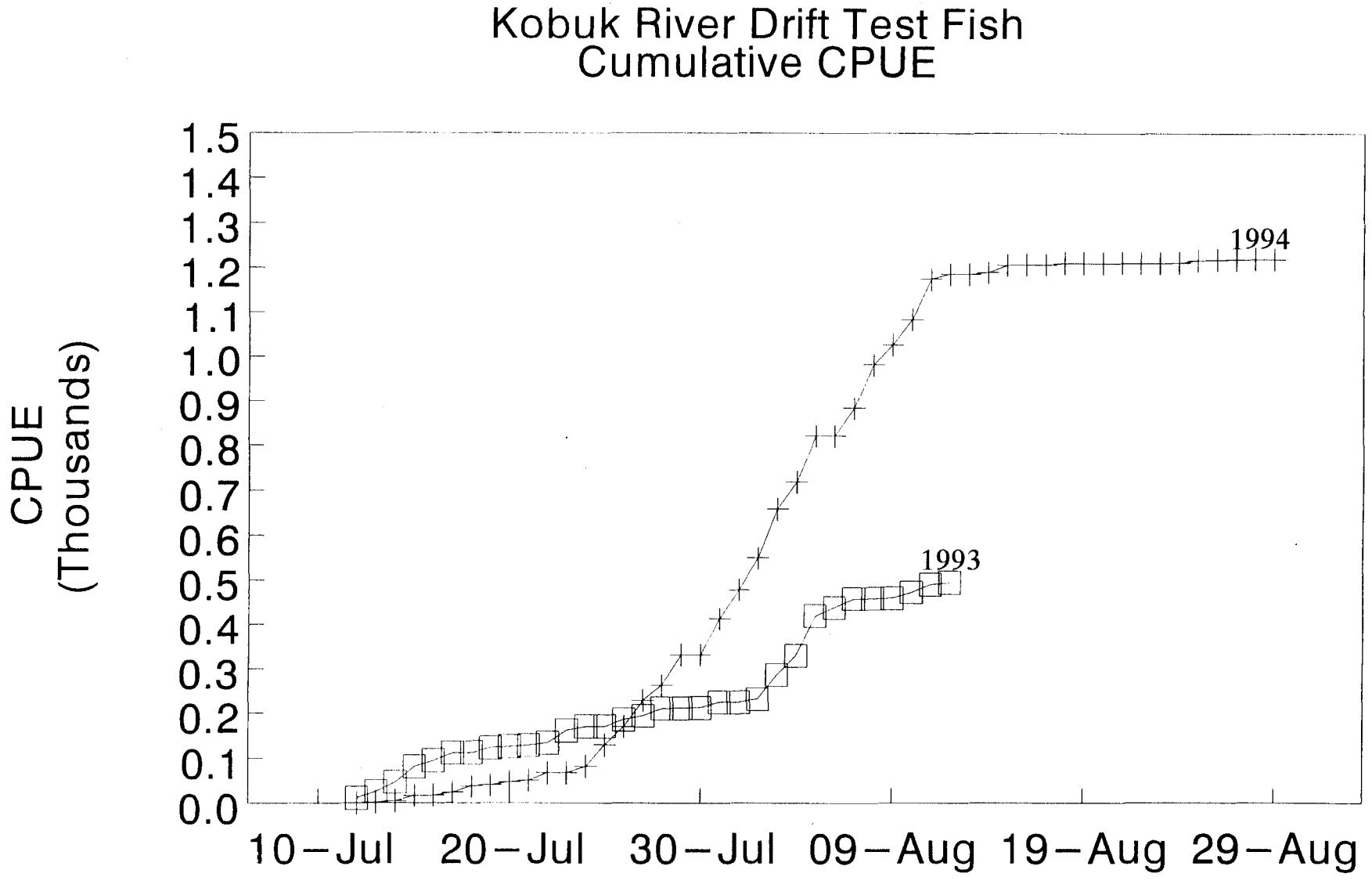

Figure 5. Kobuk River drift test fish cumulative CPUE, 1993–94.

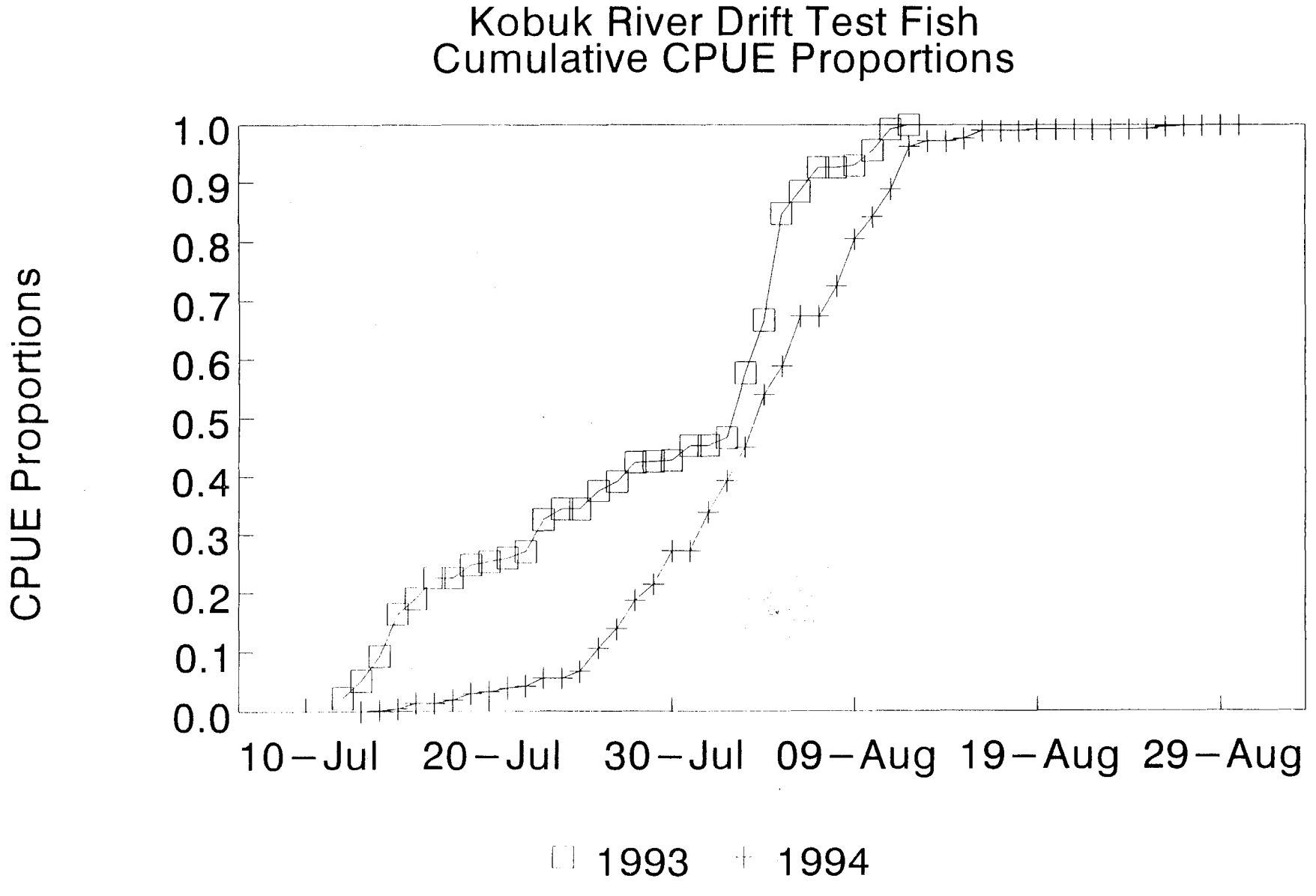

Figure 6. Kobuk River drift test fish cumulative CPUE proportions, 1993–94.

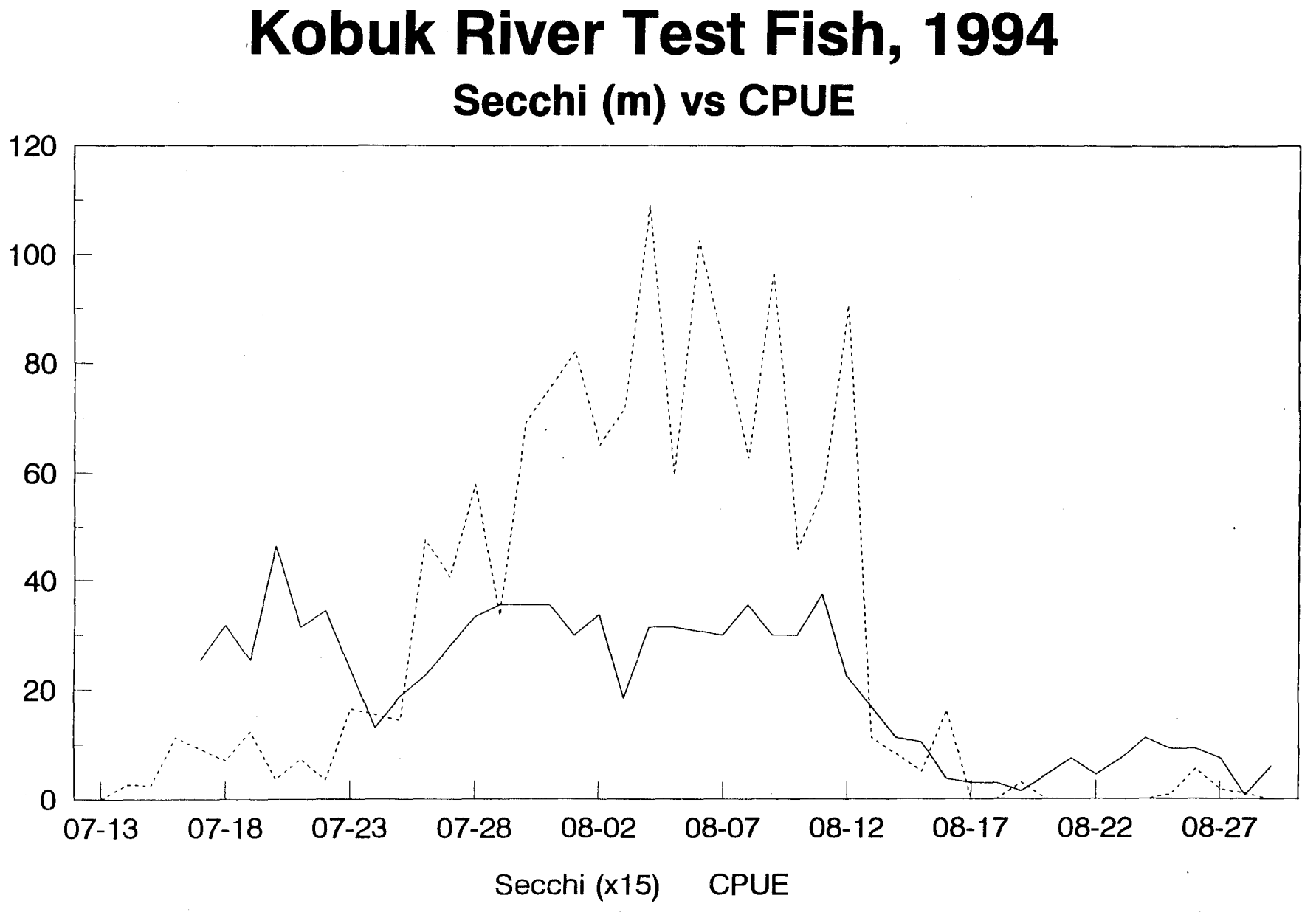

Figure 7. Kobuk River test fish daily secchi readings in meters compared to the daily CPUE, 1994.