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Summer Distribution of Fishes in the Okpilak and Akutoktak Rivers, Arctic National Wildlife Refuge, Alaska, 1989

David W. Wiswar

Fishery Assistance Office, U.S. Fish and Wildlife Service
101 12th Avenue, Box 17, Room 222, Fairbanks, Alaska 99701

Abstract.—The summer distribution of arctic fishes was investigated in the Okpilak and Akutoktak rivers during three sampling periods in the summer of 1989. Four sites in each mainstem and 5-6 tributary sites were sampled in July; one mainstem and one tributary site were revisited in each river during early and late August. Arctic char *Salvelinus alpinus*, Arctic grayling *Thymallus arcticus*, and ninespine stickleback *Pungitius pungitius* were captured.

In the mainstem Okpilak River, juvenile Arctic char were captured from the mouth to about 50 km upstream in July and August and in the lower reaches of two tributaries. No adult or young-of-the-year Arctic char were captured. Adult Arctic grayling were captured at only one mainstem and one tributary site. Juvenile Arctic grayling were captured at all mainstem and two tributary sites. Juvenile and adult Arctic grayling ranged in fork length (FL) from 71 to 393 mm. Young-of-the-year Arctic grayling were absent from the mainstem in July, but were captured in a tributary of the lower Okpilak River. Young-of-the-year were captured in the mainstem Okpilak River near the tributary in August.

In the Akutoktak River, juvenile Arctic char were absent in July but were captured in August, 16 km upstream from the confluence of the Okpilak River. No adult or young-of-the-year Arctic char were caught. Juvenile and adult Arctic grayling were distributed in the mainstem Akutoktak River to about 40 km upstream in July, but were absent in late August. Juvenile and adult Arctic grayling ranged from 220 to 394 mm FL. Young-of-the-year Arctic grayling, first captured on July 6, were still present in the mainstem Akutoktak River in late August. Fish were not captured nor observed in any of the six tributaries of the Akutoktak River surveyed.

In both rivers, mean length increase of young-of-the-year Arctic grayling was greater between July and early August than between early and late August. There was no significant difference ($P > 0.5$) between the length-weight relationship of young-of-the-year between early and late August 1989. However, differences were significant ($P < 0.001$) between July and August, and between the Okpilak and Akutoktak rivers.

Juvenile Arctic char used both rivers for summer rearing. Arctic grayling utilized the mainstem Okpilak River primarily as a migration corridor to spawning and overwintering areas, and as rearing habitat for young-of-the-year fish. The mainstem Akutoktak River was utilized by Arctic grayling for spawning and provided rearing habitat for all life history stages.

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ARCTIC REFUGE INLAND FISHERIES, 1989

The U.S. Congress is considering whether to allow oil exploration and development activities to occur in the 1002 area of the Arctic National Wildlife Refuge. Activities that could affect fishery resources include construction and placement of roads and pipelines, oil spills, and water diversions. Baseline information on the range and distribution of fish in 1002 area rivers is limited. In order to be in a position to assess impacts from potential oil and gas activities, and recommend mitigation measures for such activities, fishery surveys of the Okpilak and Akutoktak rivers were conducted in the summer of 1989 to provide additional information on fish distribution.

The few fishery surveys that have been conducted on fish distribution in the Okpilak River have mostly occurred in July. Two adult Arctic grayling *Thymallus arcticus* were captured in the lower Okpilak River in early July 1983 (Daum et al. 1984). Young-of-the-year (age-0) Arctic grayling were observed near the mouth of a tributary stream in the lower Okpilak River but not in the mainstem (Lyons and Elliott 1987). With the exception of one radio-tagged adult (Wiswar et al. 1987), Arctic grayling have not been located in the mainstem Okpilak River above the confluence with the Akutoktak River (Ward and Craig 1974; Daum et al. 1984; Lyons and Elliott 1987). In addition to Arctic grayling, two juvenile Arctic char *Salvelinus alpinus* and two ninespine stickleback *Pungitius pungitius* were observed near the mouth of a tributary to the lower Okpilak River (Lyons and Elliott 1987).

In the Akutoktak River, adult Arctic grayling are distributed throughout the river in July (Daum et al. 1984). Juvenile Arctic grayling have been located 30 km upstream from the mouth but they are not uniformally distributed; most were captured in the lower river (Daum et al. 1984; Lyons and Elliott 1987). Arctic grayling young-of-the-year were observed in large numbers at upstream sites in mid-July 1987 (Lyons and Elliott 1987) and early August 1982 (Daum et al. 1984).

Temporal distribution of Arctic grayling in the Akutoktak River covers the period from early July to November; however, from mid-August to November, information is on relocation of radio-tagged adult Arctic grayling only. Adult Arctic grayling have been captured in the mainstem Akutoktak River from early July to mid-August (Daum et al. 1984; Lyons and Elliott 1987). Fall movements to possible overwintering areas were monitored for adult Arctic grayling from the Akutoktak River by radio telemetry in 1984 and 1985 (West and Wiswar 1985; Wiswar et al. 1987). Arctic grayling were relocated in the Akutoktak, Okpilak, and Hulahula rivers. Juvenile Arctic grayling have been captured in the Akutoktak River in July only (Daum et al. 1984), while young-of-the-year have been located in the mainstem in July and early August. Young-of-the-year Arctic grayling probably emerge from the gravel in Arctic coastal plain streams between late June and early July. Large numbers of young-of-the-year Arctic grayling emigrate from small tributary streams in late September (Craig and Poulin 1975; Elliott 1982). Overwintering locations of young-of-the-year Arctic grayling are unknown.

The objectives of this study were to:

1. Determine summer spatial and temporal distribution of arctic fishes by life history stage (young-of-the-year, juvenile, and adult) in the Okpilak and Akutoktak rivers,
2. Compare and contrast arctic fish distribution in the two streams (glacial versus tundra).

Study Area

The Okpilak and Akutoktak rivers are entirely within the boundary of the Arctic National Wildlife Refuge (Figure 1). The rivers flow north across the Arctic coastal plain. The Okpilak River is a glacial stream (Craig and McCart 1974) with a braided channel through most of its length. It originates in the Romanzof Mountains of the Brooks Range and flows into the Beaufort Sea where it shares a common delta with the Hulahula River. The Akutoktak River is a tundra stream that drains from the foothills of the Brooks Range and flows into the Okpilak River, approximately 30 km from the mouth. Okpilak Lake is located in the foothills of the Brooks Range and has a small stream connecting it with the Okpilak River.

The 1002 area of the Arctic National Wildlife Refuge lies within the Arctic coastal plain and is underlain by continuous permafrost. The climate is arctic marine and is characterized by long, cold winters and short, cool summers. Snowmelt in the foothills does not begin until late May and is usually rapid (10-14 days). Rivers run full during this period until late June or early July when flows subside. Rains may increase flows again in July and August (Clough et al. 1987; Lyons 1990). Thermograph recordings of water temperature from the lower Akutoktak River ranged from 2.4° to 14.9°C during the latter half of June, 7.3°-19.1°C in July, and 5.5°-14.8°C in mid-August (Lyons 1990). Maximum and minimum flows recorded were 47.67 m^3/sec on August 20 and 0.06 m^3/sec on July 3, 5-7, 1989 (Lyons 1990). Freeze-up on the coastal plain usually occurs in mid to late September (Clough et al. 1987). In 1989, river ice was forming on streams on September 20.

Methods

The mainstems and tributaries of the Okpilak and Akutoktak rivers were sampled in early July 1989 for fish distribution (Figure 1). Sites selected in the mainstem were at the confluence of the larger tributaries. Four mainstem sites in each river and sites in five tributaries of the Okpilak River and six tributaries of the Akutoktak River were sampled. In August, stations OM 3 and OT 4 on the Okpilak River and AM 3 and AT 6 on the Akutoktak River were resampled to determine temporal changes in fish distribution. Sites in August were selected because they are within the 1002 area and the July sampling indicated relatively abundant numbers of fish. Sampling dates were: July 2-14, August 4-8, and August 27-30, 1989.

Fish were collected with baited minnow traps, hook and line, dip nets, seines, backpack electrofisher, and gill nets. Visual observations of fish were recorded as well. Minnow traps (40.6 x 20.3 cm diameter, 0.6 cm bar mesh) were baited with processed salmon egg clusters and checked approximately every 24 h. Catch rates at each station were standardized to number of fish/h/trap. The number of traps per site ranged from two to 18. Traps were spaced at least 12 m apart. Seines were 9 x 1.2 m. Dip nets and seines were made from 0.16 cm ace mesh. Monofilament variable mesh gill nets consisted of four panels (3 m wide x 1.8 m deep) of 1.3, 2.5, 3.8, and 5.1 cm square mesh. In the mainstem Okpilak River, gill nets were checked approximately every 24 h. In the lake at station OT 1, Arctic grayling were observed from shore before nets were set. Nets were reset every one to two hours to minimize mortality.

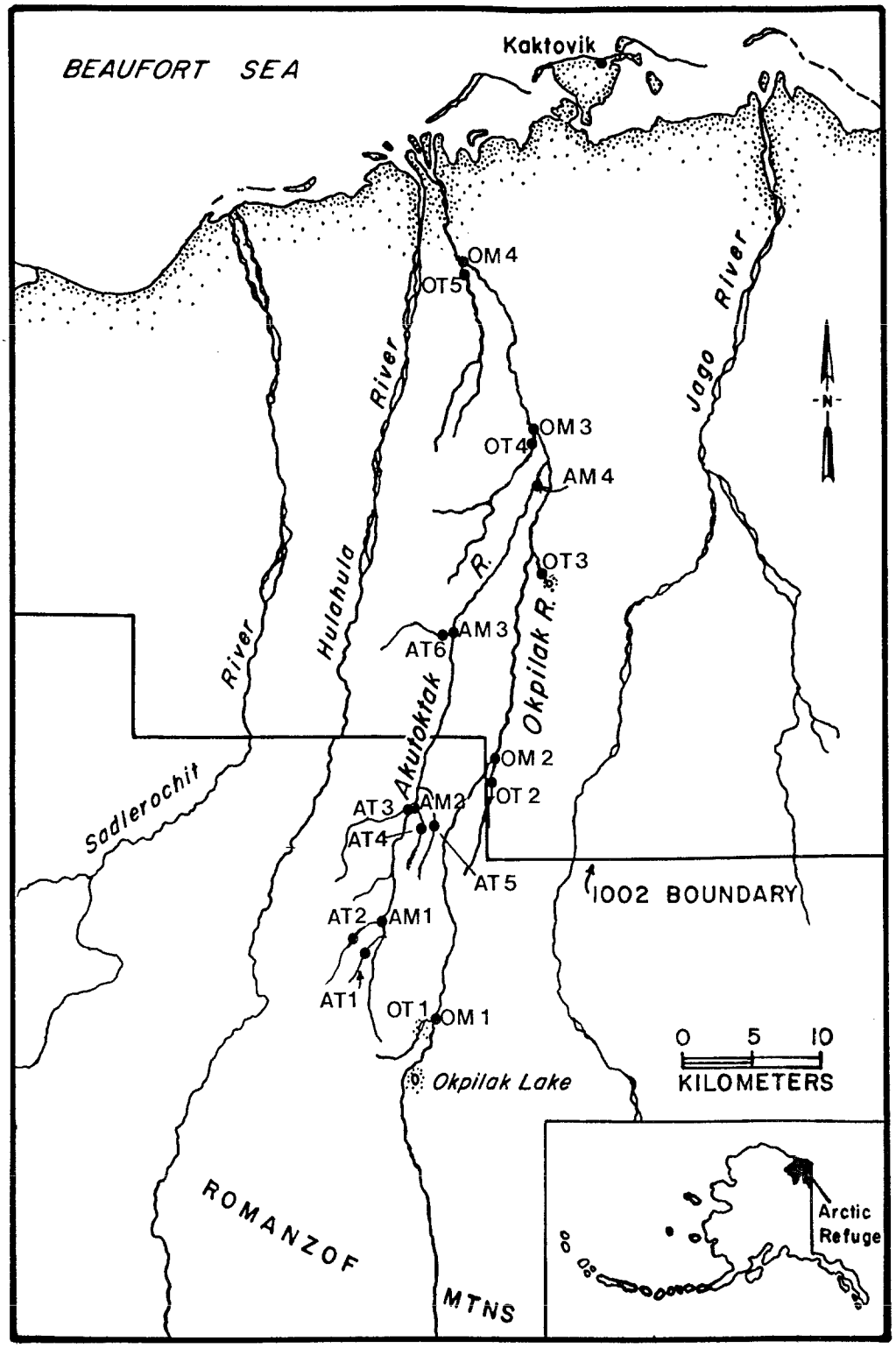

Figure 1.—Location of sampling sites in the mainstem and tributaries of the Okpilak and Akutoktak rivers, Alaska, summer 1989. AM = Akutoktak River mainstem site, AT = Akutoktak River tributary, OM = Okpilak River mainstem, OT = Okpilak River tributary.

Gill nets and minnow traps were used to determine relative abundance. Fish captured by seining, angling, and electrofishing were used to determine presence only since habitat variables (i.e., water velocity, depth, turbidity, conductivity, and stream substrate) reduce the capture efficiency of these gear types.

Juvenile and adult fish captured were counted and fork lengths (FL) measured to the nearest mm. Young-of-the-year Arctic grayling collected for length and weight analysis were preserved in 10% formalin and later transferred to Caro-Safe. Fish were blotted dry before being measured and weighed to the nearest 0.01 g. Regression of log-normal transformations of length and weight was used to describe the length-weight relationship (Ricker 1975) of young-of-the-year Arctic grayling. The slopes and intercepts of the regression lines from each sampling period on each river were tested for significant differences using a Z-test (Kleinbaum and Kupper 1978). Where there was no significant difference ($P > 0.05$) data were pooled.

Arctic char and Arctic grayling were categorized by life history stage (young-of-the-year, juvenile, and adult) based on length and age information from Yoshihara (1972), Craig and Poulin (1975), McCart (1980), Smith and Glesne (1983), Daum et al. (1984), West and Wiswar (1985), Corning (*in preparation-a*), and this study (Table 1).

Table 1.—Life history stage of Arctic char and Arctic grayling categorized by fork lengths.

Life history stage	Arctic char[a]	Arctic grayling[b]
Young-of-the-year	$\leq$ 70 mm	$\leq$ 73 mm[c]
Juvenile	71 - 300 mm	74 - 285 mm
Adult	> 300 mm	> 285 mm

[a] Yoshihara (1972), McCart 1980, Smith and Glesne (1983), Daum et al. 1984, and West and Wiswar (1985).

[b] Craig and Poulin 1975, Smith and Glesne 1983, Daum et al. 1984, Corning *in preparation-a*, and this study.

[c] In July, the maximum length of young-of-the-year Arctic grayling was 21 mm.

Results

Okpilak River

Juvenile Arctic char were distributed 50 km upstream in the mainstem Okpilak River (Table 2; Figure 2). In July, over 20 juveniles were captured (combined gear types) at each of the upper three sampling stations (OM 2-OM 4)(Table 3). Juveniles were captured in the lower reaches of two tributaries (OT 4 and OT 5). Juvenile Arctic char were also captured in the mainstem (OM 3) in early (N=27) and late August (N=56). Neither adult nor young-of-the-year were captured in the mainstem or any tributary streams. Arctic char captured in the Okpilak River ranged from 67-239 mm in length (Figure 3).

Table 2.—Summary of fish distribution by life history stage at sites sampled in the Okpilak and Akutoktak rivers, Alaska, July and August 1989. + = present, 0 = absent.

Station	Sampling period	Arctic char			Arctic grayling			Ninespine stickleback
		yoy[a]	juv[b]	ad[c]	yoy	juv	ad	
		Okpilak River mainstem						
OM 1	July 2-3	0	0	0	0	+	0	0
OM 2	July 5-7	0	+	0	0	+	0	0
OM 3	July 9-11	0	+	0	0	0	0	0
	August 4-5	0	+	0	+	+	0	+
	August 27-28	0	+	0	+	0	+	+
OM4	July 12-13	0	+	0	0	+	0	0
		Okpilak River tributaries						
OT 1	July 2-3	0	0	0	0	+	+	0
OT 2	July 5	0	0	0	0	0	0	0
OT 3	July 8	0	0	0	0	0	0	0
OT 4	July 9-11	0	0	0	+	0	0	+
	August 4-5	0	0	0	+	0	0	+
	August 27-28	0	+	0	0	0	0	+
OT 5	July 12-13	0	+	0	0	+	0	+
		Akutoktak River mainstem						
AM 1	July 3-4	0	0	0	0	0	+	0
AM 2	July 5-6	0	0	0	+	+	+	0
AM 3	July 8-10	0	0	0	+	+	+	0
	August 6-8	0	+	0	+	+	+	0
	August 29-30	0	+	0	+	0	0	0
AM 4	July 12-13	0	0	0	+	+	+	0
		Akutoktak River tributaries						
AT 1	July 2	0	0	0	0	0	0	0
AT 2	July 2	0	0	0	0	0	0	0
AT 3	July 5-7	0	0	0	0	0	0	0
AT 4	July 6	0	0	0	0	0	0	0
AT 5	July 6	0	0	0	0	0	0	0
AT 6	July 8-9	0	0	0	0	0	0	0
	August 6-7	0	0	0	0	0	0	0
	August 29-30	0	0	0	0	0	0	0

[a] yoy = young-of-the-year.
[b] juv = juvenile.
[c] ad = adult.

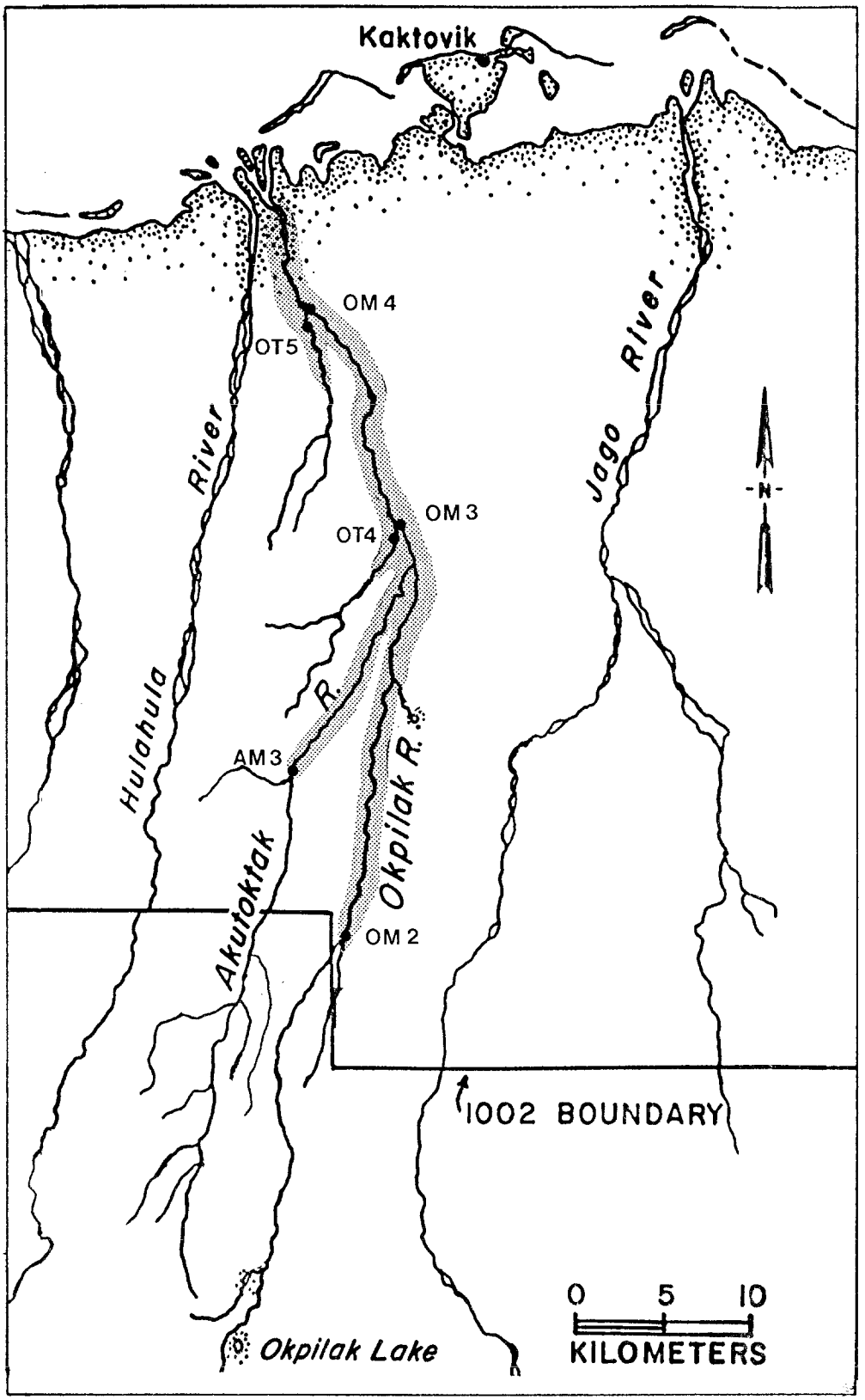

Figure 2.—Distribution of juvenile Arctic char (shaded area) in the Okpilak and Akutoktak rivers, Alaska, summer 1989. AM = Akutoktak River mainstem site, OM = Okpilak River mainstem, OT = Okpilak River tributary.

Table 3.—Capture information and length data for fish captured in the Okpilak River, Alaska, July and August 1989. AC = Arctic char, GR = Arctic grayling, NSB = ninespine stickleback, + = present, yoy = young-of-the-year.

Station	Date	Capture data						Fish length (mm)		
		Gear type	Sets (N)	Effort (h)	Species	N	CPUE (fish/h)	N	Mean (SE)	Range
Okpilak River mainstem										
OM 1	Jul 2-3	Gill net	1	24.0		0				
		Minnow traps	4	85.7		0				
		Seine	4		GR	1		1	149	
OM 2	Jul 5-7	Gill net	2			0				
		Minnow traps	11	288.6	AC	20	0.07	20	133.4 (2.6)	115-156
		Seine	11		AC	5		4	125.3 (5.4)	114-135
		Seine	11		GR	1		1	89	
OM 3	Jul 9-11	Gill net	1	23.5	AC	1	0.04	1	153	
		Minnow traps	6	287.9	AC	26	0.09	26	124.4 (3.3)	87-150
		Seine	1			0				
	Aug 4-5	Gill net	1	23.0		0				
		Minnow traps	10	235.0	AC	12	0.05	8	108.9 (6.5)	72-133
		Minnow traps	10	235.0	NSB	1	<0.01	1	45	
		Hook and line		7.6	AC	1		1	135	
		Electrofisher		1.1	GR	52		52	46.7 (1.4)	32-95
		Electrofisher		1.1	AC	14		14	122.2 (3.9)	99-139
		Electrofisher		1.1	NSB	5		5	45.4 (1.3)	42-49
	Aug 27-28	Gill net	1	25.0	GR	1	0.04	1	287	
		Minnow traps	10	242.5	AC	45	0.19	41	113.0 (4.7)	72-168
		Minnow traps	10	242.5	GR	4	0.02	4	61.5 (4.1)	55-73
		Hook and line		8.0		0				
		Electrofisher		1.7	GR	41		41	56.4 (0.9)	44-72
		Electrofisher		1.7	AC	11		11	108.9 (15.5)	67-239
		Electrofisher		1.7	NSB	16		14	49.8 (3.4)	35-72
OM 4	Jul 12-13	Gill net	1	23.9	GR	1	0.04	1	131	
		Minnow traps	6	143.1	AC	20	0.14	20	107.8 (4.6)	82-143
		Minnow traps	6	143.1	GR	1	<0.01	1	79	
		Seine	7		AC	1		1	78	

Table 3.--continued.

Station	Date	Capture data: Gear type	Sets (N)	Effort (h)	Species	N	CPUE (fish/h)	Fish length (mm): N	Mean (SE)	Range
Okpilak River tributaries										
OT 1[a]	Jul 2-3	Gill net[b]	2	5.1	GR	11	2.16	9	239.4 (8.4)	212-282
		Minnow traps[b]	2	46.8		0				
		Minnow traps	4	83.0		0				
		Hook and line[b]			GR	1		1	247	
		Hook and line			GR	1		1	340	
		Seine	3		GR	5		5	103.8 (16.4)	71-159
		Dip net			GR	7		7	267.3 (30.7)	194-393
		Visual			GR	>40				
OT 2	Jul 5	Visual				0				
OT 3	Jul 8	Seine	3			0				
OT 4	Jul 9-11	Minnow traps	6	258.7	NSB	3		3	62.3 (2.5)	58-71
		Seine	3		GR	55		47	15.9 (0.2)	13-19
		Dip net			GR	13		8	17.1 (0.7)	15-20
	Aug 4-5	Minnow traps	2	48.0		0				
		Visual			GR	+				yoy
		Visual			NSB	+				
	Aug 27-28	Minnow traps	2	54.0	AC	10	0.19	10	99.6 (9.0)	70-148
		Minnow traps	2	54.0	NSB	2	0.04	1	49	
OT 5	Jul 12-13	Gill net	1	28.3		0				
		Minnow traps	6	173.5	AC	2	0.01	1	132	
		Minnow traps	6	173.5	NSB	1	<0.01	1	63	
		Seine	6		GR	1		1	82	

[a] Includes lake and tributary at this site.
[b] Lake.

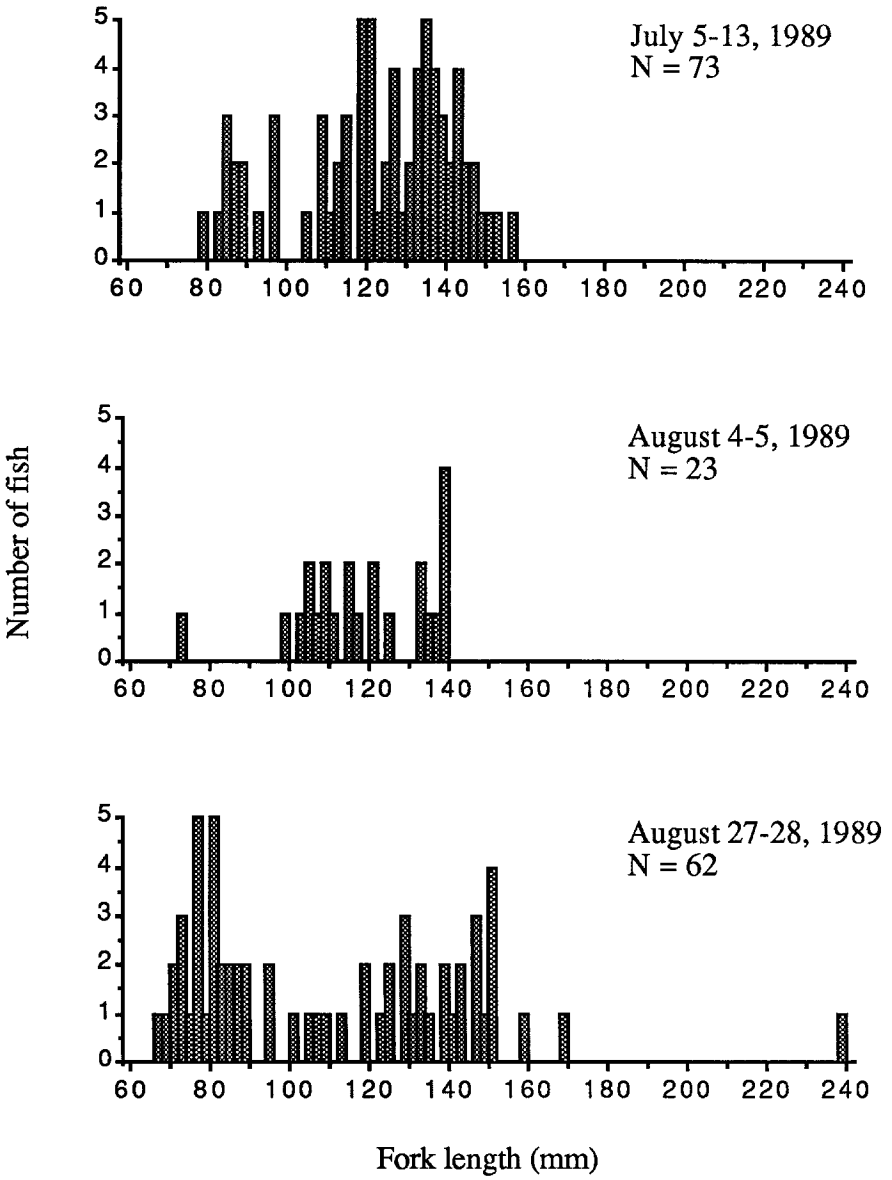

Figure 3.—Length-frequency distribution of juvenile Arctic char captured in the Okpilak River and its tributaries, Alaska, July and August 1989.

Twenty-five juvenile and adult Arctic grayling were captured in the lake and feeder stream at OT 1 in July and over 40 were observed at this location (Table 3; Figures 4-5). Additionally, a few juveniles (three or less) were captured at all mainstem stations in the Okpilak River, as well at OT 5 (Figure 5). One adult Arctic grayling was captured in the mainstem Okpilak River in late August. Juvenile and adult Arctic grayling ranged from 71 to 393 mm FL (N=31).

Young-of-the-year Arctic grayling were not captured in the mainstem Okpilak River during July sampling; however, they were captured at OM 3 in August (Table 2). Young-of-the-year were present in the lower reach of tributary OT 4 in July and early August, but not in other tributaries surveyed in July (Figure 6). Young-of-the-year from OT 4 and OM 3 ranged in length from 13 to 73 mm (Table 4; Figure 7). Mean length in July was 16.1 mm at OT 4 (Table 4). At OM 3 in early August, Arctic grayling averaged 44.9 mm FL and 56.8 mm FL in late August (Table 4; Figure 7). Mean length increased 1.07 mm/d between July 9 and August 5, and 0.52 mm/d from August 5 to August 28 (Figure 8).

There was no significant difference ($P > 0.5$) in the length-weight relationship of young-of-the-year Arctic grayling captured in the Okpilak River in early and late August. However, when comparing July and August (Figure 9) the difference was significant ($P < 0.001$).

Akutoktak River

No Arctic char were found in the Akutoktak River in early July (Table 2). In August, juvenile Arctic char were distributed at least 16 km upstream from the confluence of the Okpilak River (Figure 2). This site is about 50 km upstream from Hulahula-Okpilak delta. Fifty juvenile Arctic char were captured in August at AM 3, ranging from 74 to 164 mm FL. Juveniles less than 105 mm were not captured until late August (Table 5; Figure 10).

All three life history stages of Arctic grayling were found in the mainstem Akutoktak River, but no fish were found in its tributaries. In July and early August, 15 juvenile and 142 adult Arctic grayling were captured at AM 1-AM 4. Adults were captured at all, and juveniles at most, mainstem stations in early July (Table 2; Figures 4-5). Juveniles and adults occupied the head of most pools. Arctic grayling captured in July and early August ranged from 220 to 394 mm (Figure 11). Juveniles less than 220 mm were not captured in the Akutoktak River. Juveniles and adults were not captured in late August.

Young-of-the-year Arctic grayling were captured on July 6 at AM 2 and had recently emerged from the gravel. These fish were in the late protolarval and early mesolarval phases of development (Sturm 1988). After July 6, young-of-the-year were observed at all downstream locations sampled in the mainstem (Table 2; Figure 6) and were generally found near the tail end of pools along the stream margin. Fork lengths ranged from 11 to 70 mm (Figure 12) and averaged 17.4 mm FL in early July and 60.4 mm FL in late August (Table 4). Mean length increased 1.00 mm/d between July 9 and August 7, and 0.61 mm/d between August 7 and August 30 (Figure 13).

There was no significant difference ($P > 0.5$) beteeen the length-weight relationship of young-of-the-year Arctic grayling collected in Akutoktak River in early and late August 1989. However,

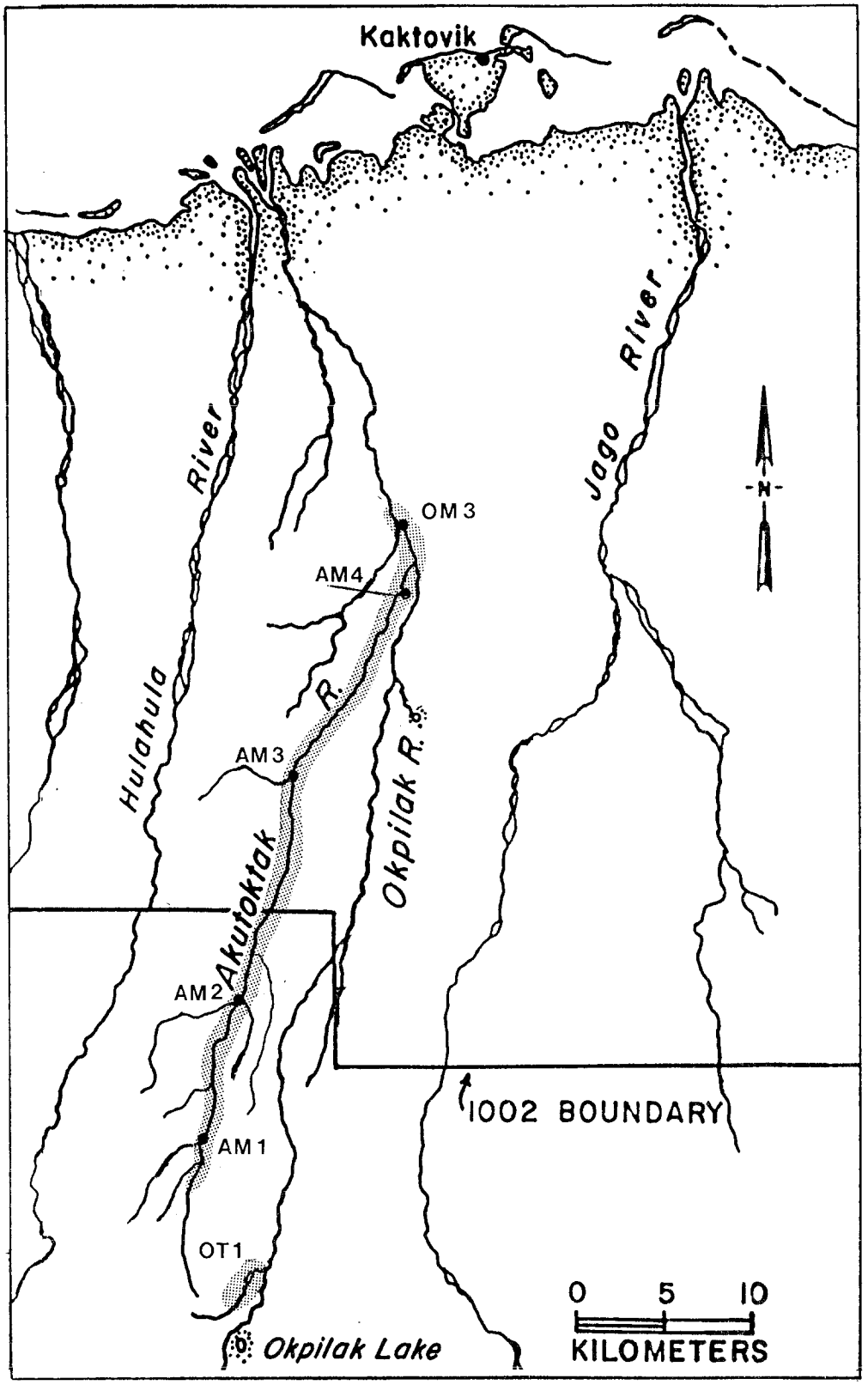

Figure 4.—Distribution of adult Arctic grayling (shaded area) in the Okpilak and Akutoktak rivers, Alaska, summer 1989. AM = Akutoktak River mainstem site, OM = Okpilak River mainstem, OT = Okpilak River tributary.

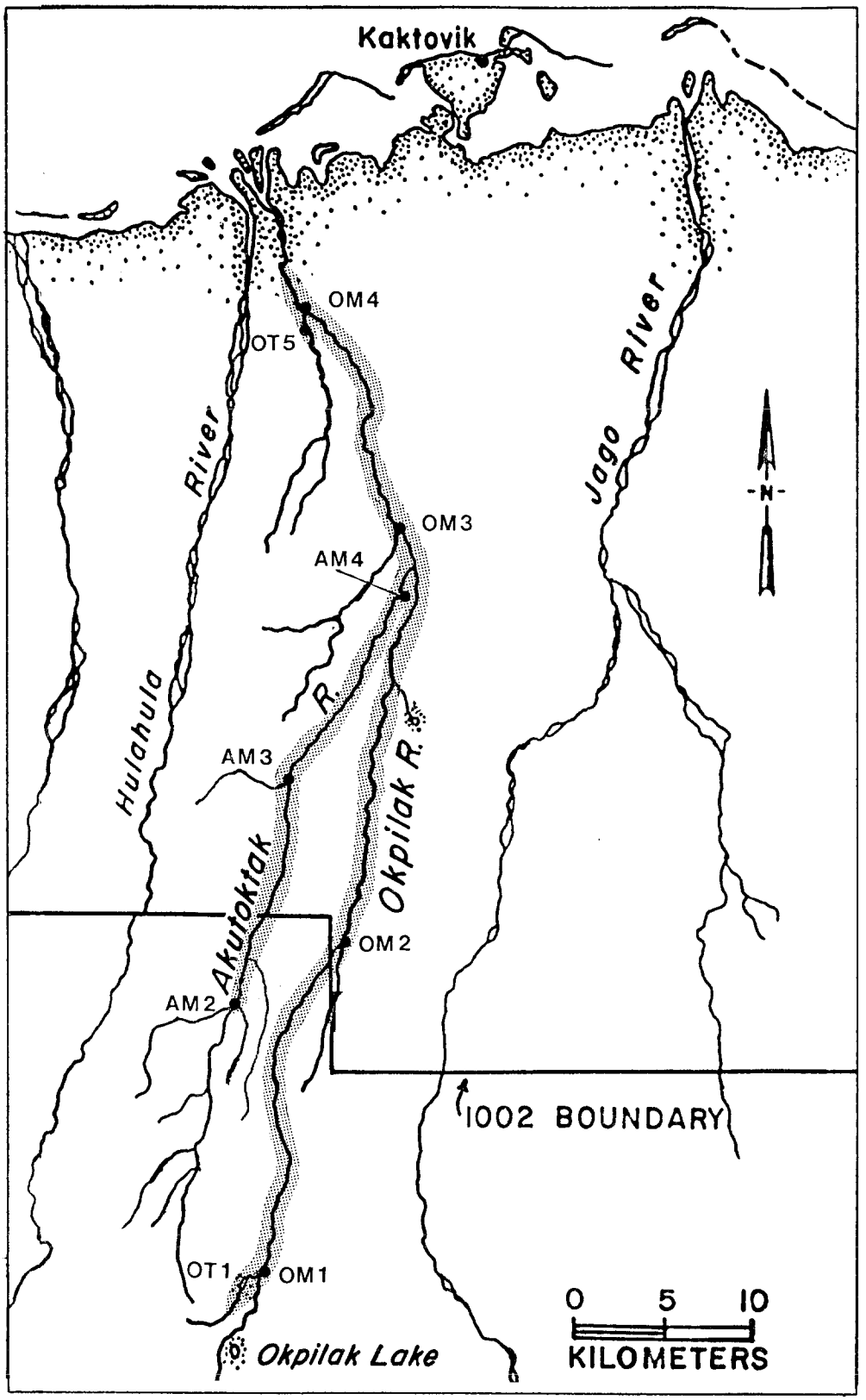

Figure 5.—Distribution of juvenile Arctic grayling (shaded area) in the Okpilak and Akutoktak rivers, Alaska, summer 1989. AM = Akutoktak River mainstem site, OM = Okpilak River mainstem, OT = Okpilak River tributary.

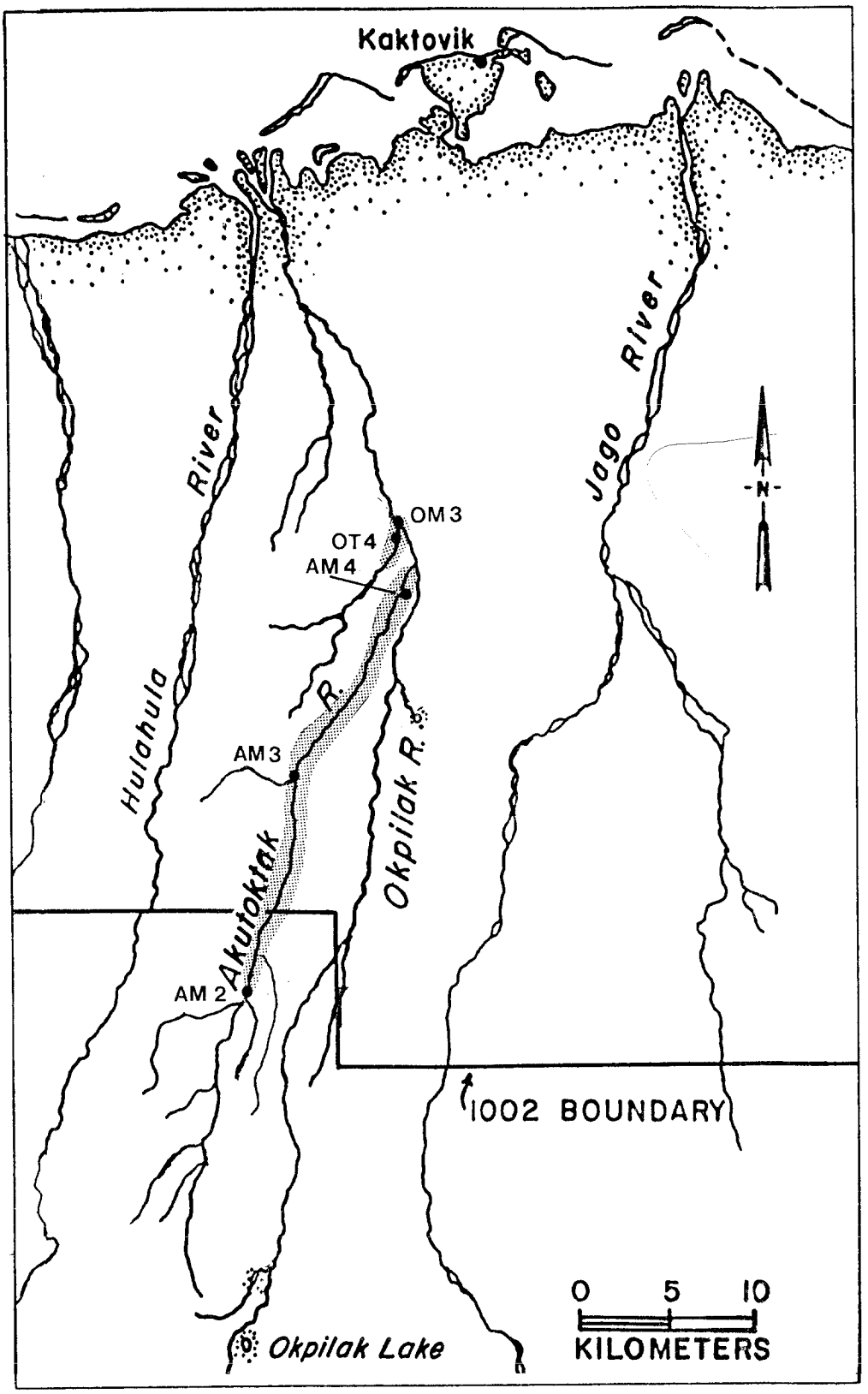

Figure 6.—Distribution of young-of-the-year Arctic grayling (shaded area) in the Okpilak and Akutoktak rivers, Alaska, summer 1989. AM = Akutoktak River mainstem site, OM = Okpilak River mainstem, OT = Okpilak River tributary.

Table 4.—Mean fork lengths and weights for young-of-the-year Arctic grayling from the Okpilak and Akutoktak rivers, Alaska, July and August 1989.

		Fish measurements					
		Fork length (mm)			Weight (g)		
Station	Date	N	Mean (SE)	Range	N	Mean (SE)	Range
			Okpilak River				
OT 4	Jul 9	55	16.1 (0.2)	13-20	55	0.02 (0.001)	0.01-0.04
OM 3	Aug 5	50	44.9 (0.6)	33-56	43	0.88 (0.04)	0.33-1.44
	Aug 28	45	56.8 (0.9)	44-73	41	1.66 (0.08)	0.89-3.55
			Akutoktak River				
AM 2&3[a]	Jul 6&9	44	17.4 (0.3)	11-21	44	0.02 (0.001)	0.01-0.04
AM 3	Aug 7	41	46.3 (0.9)	36-56	40	0.96 (0.05)	0.39-1.65
	Aug 30	19	60.4 (1.4)	50-70	18	2.32 (0.19)	1.20-3.79

[a] Station and date labeled respectively, data pooled, no significant difference in length and weight ($P > 0.8$).

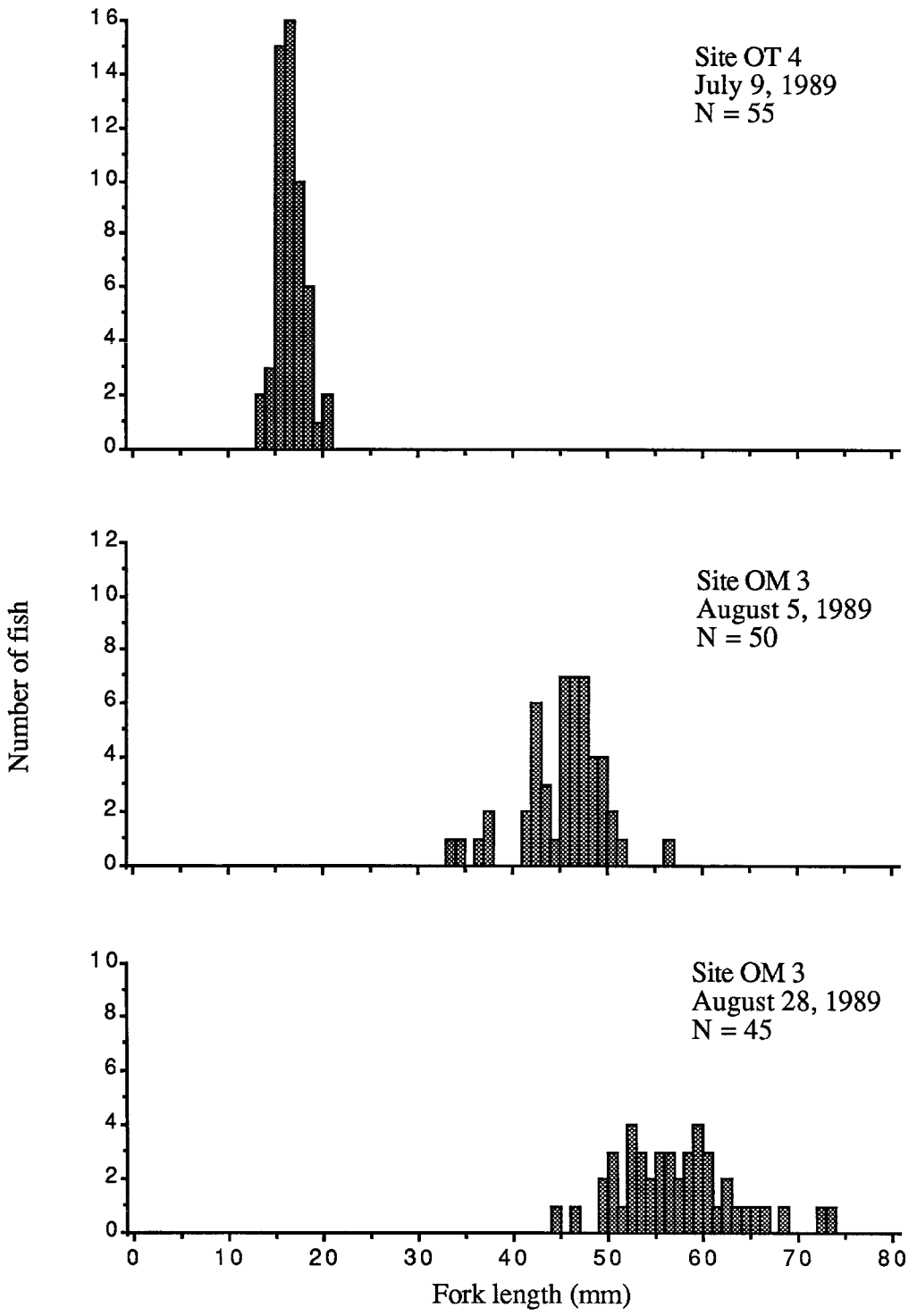

Figure 7.—Length-frequency distribution of young-of-the-year Arctic grayling captured at site OT 4 and the mainstem Okpilak River (OM 3), Alaska, July - August 1989.

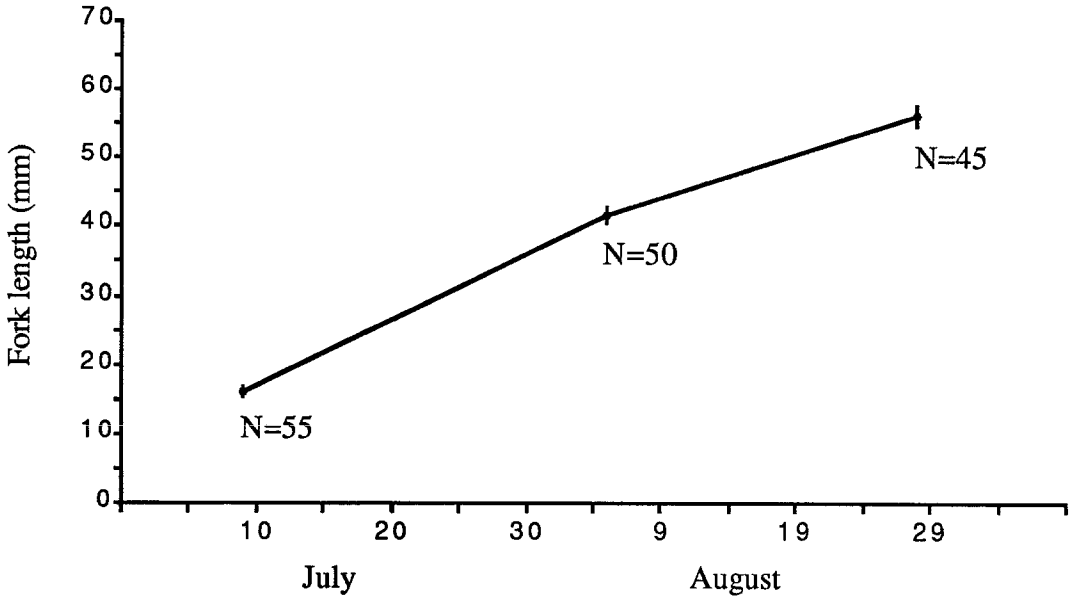

Figure 8.—Mean length of young-of-the-year Arctic grayling captured in tributary OT 4 and mainstem Okpilak River, Alaska, July - August 1989. Vertical lines indicate 95% confidence interval of the mean.

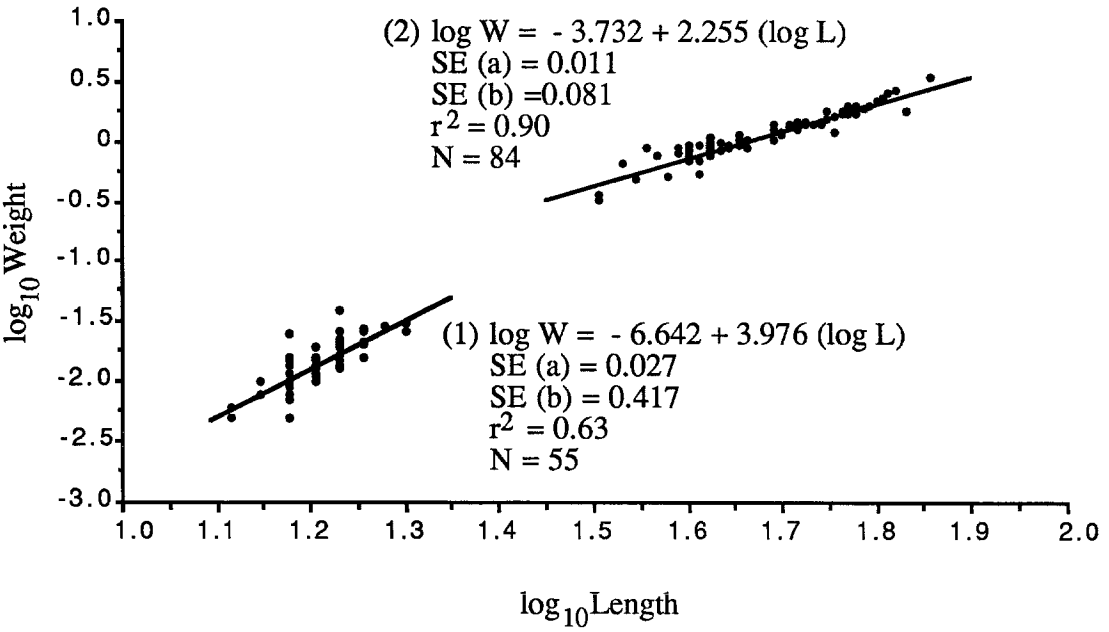

Figure 9.—Length-weight relationship of young-of-the-year Arctic grayling captured in tributary OT 4 and the mainstem Okpilak River, Alaska, July - August 1989. Equation (1) includes fish captured in July, and (2) August.

Table 5.—Capture information and length data for fish captured in the Akutoktak River, Alaska, July and August 1989. AC = Arctic char, GR = Arctic grayling, NSB = ninespine stickleback, + = present, yoy = young-of-the-year.

		Capture data						Fish length (mm)		
Station	Date	Gear type	Sets (N)	Effort (h)	Species	N	CPUE (fish/h)	N	Mean (SE)	Range
Akutoktak River mainstem										
AM 1	Jul 3-4	Minnow traps	11	278.8		0				
		Hook and line		5.3	GR	4		4	332.0 (8.2)	318-349
AM 2	Jul 5-6	Minnow traps	9	231.8		0				
		Dip net			GR	9		9	17.2 (0.5)	16-20
		Hook and line		5.3	GR	37		37	320.4 (5.6)	255-389
AM 3	Jul 8-10	Minnow traps	6	151.5		0				
		Dip net			GR	35		35	17.4 (0.4)	11-21
		Hook and line		8.3	GR	48		48	338.0 (4.3)	271-394
	Aug 6-8	Minnow traps	18	373.8	AC	19	0.05	17	120.4 (3.2)	106-147
		Minnow traps	18	373.8	GR	1		1	56	
		Hook and line		23.3	GR	25		21	314.1 (8.4)	220-372
		Electrofisher		0.4	GR	41		40	44.7 (0.7)	36-54
	Aug 29-30	Minnow traps	17	357.0	AC	27	0.08	25	113.6 (4.3)	77-142
		Minnow traps	17	357.0	GR	1	<0.01	1	65	
		Hook and line		11.0		0				
		Electrofisher		1.4	GR	18		18	60.2 (1.5)	50-70
		Electrofisher		1.4	AC	4		4	105.5 (20.3)	74-164
AM 4	Jul 12-13	Minnow traps	6	151.0		0				
		Hook and line		8.1	GR	47		47	333.4 (4.3)	266-378
		Visual			GR	+				yoy
Akutoktak River tributaries										
AT 1	Jul 2	Visual				0				
AT 2	Jul 2	Visual				0				
AT 3	Jul 5-7	Minnow traps	3	165.8		0				
AT 4	Jul 6	Visual				0				
AT 5	Jul 6	Visual				0				
AT 6	Jul 8-9	Minnow traps	6	160.5		0				
	Aug 6-7	Minnow traps	2	44.5		0				
	Aug 29-30	Minnow traps	2	48.5		0				

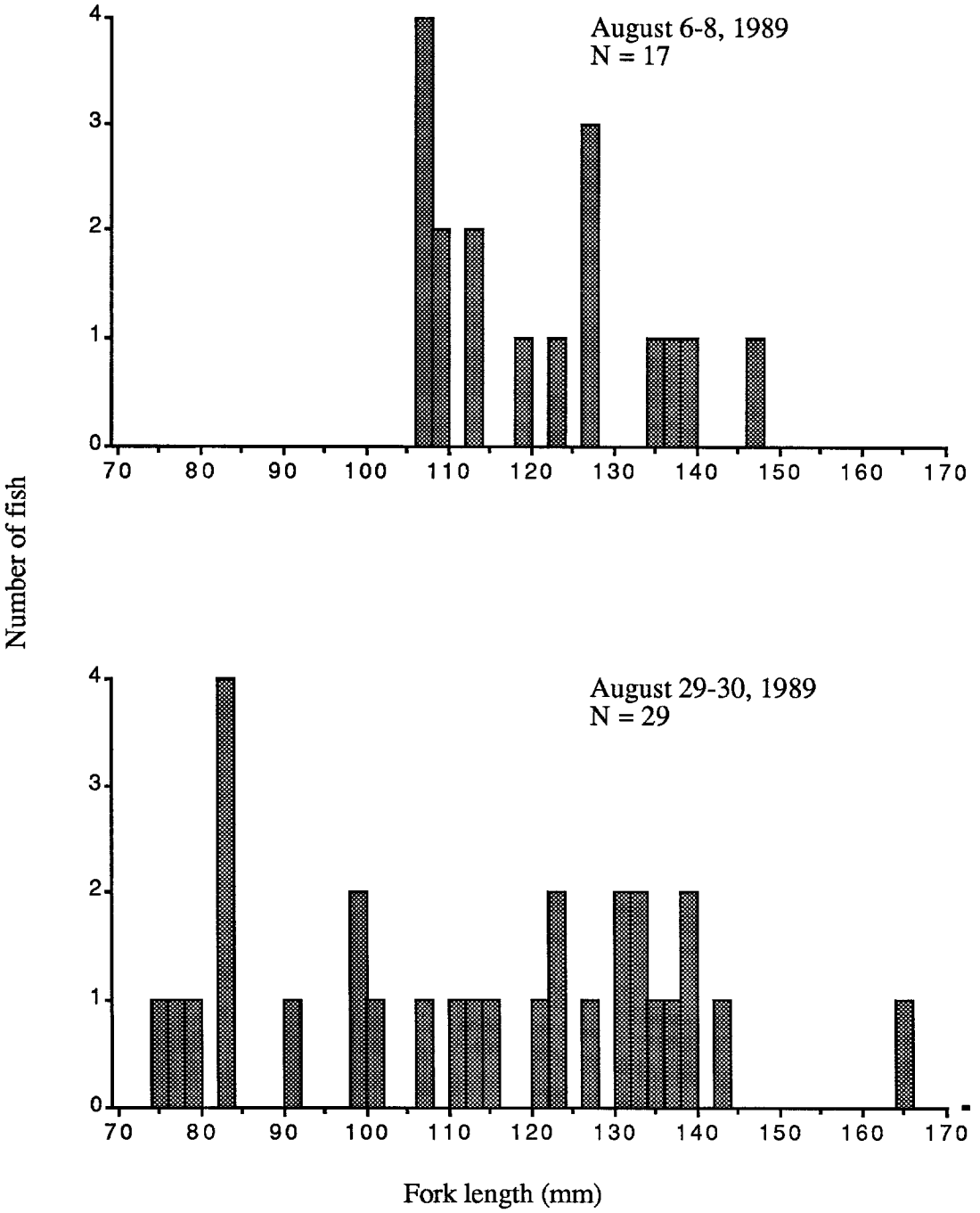

Figure 10.—Length-frequency distribution of juvenile Arctic char captured in the mainstem Akutoktak River, Alaska, August 1989.

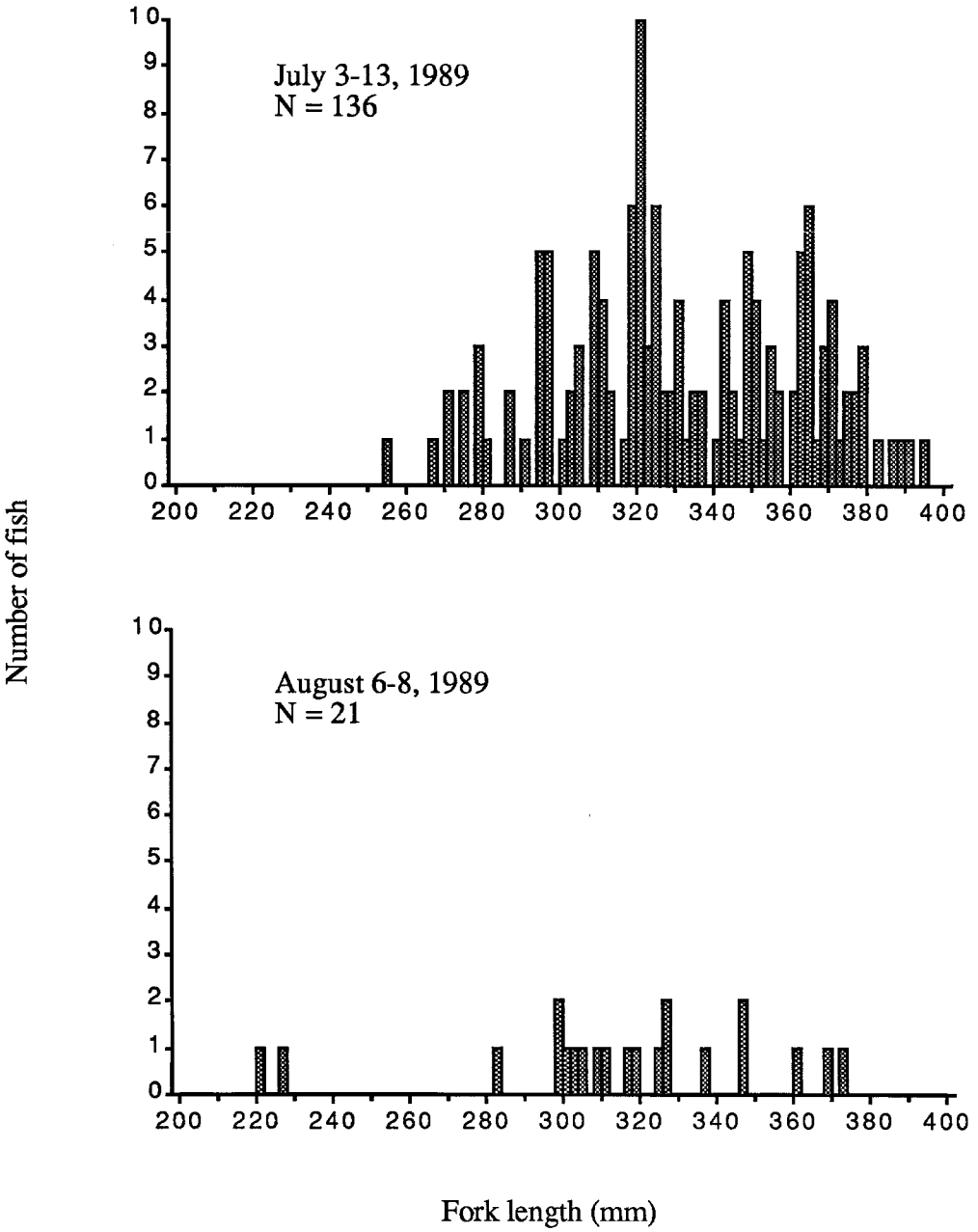

Figure 11.—Length-frequency distribution of juvenile and adult Arctic grayling captured in the mainstem Akutoktak River, Alaska, July and August 1989.

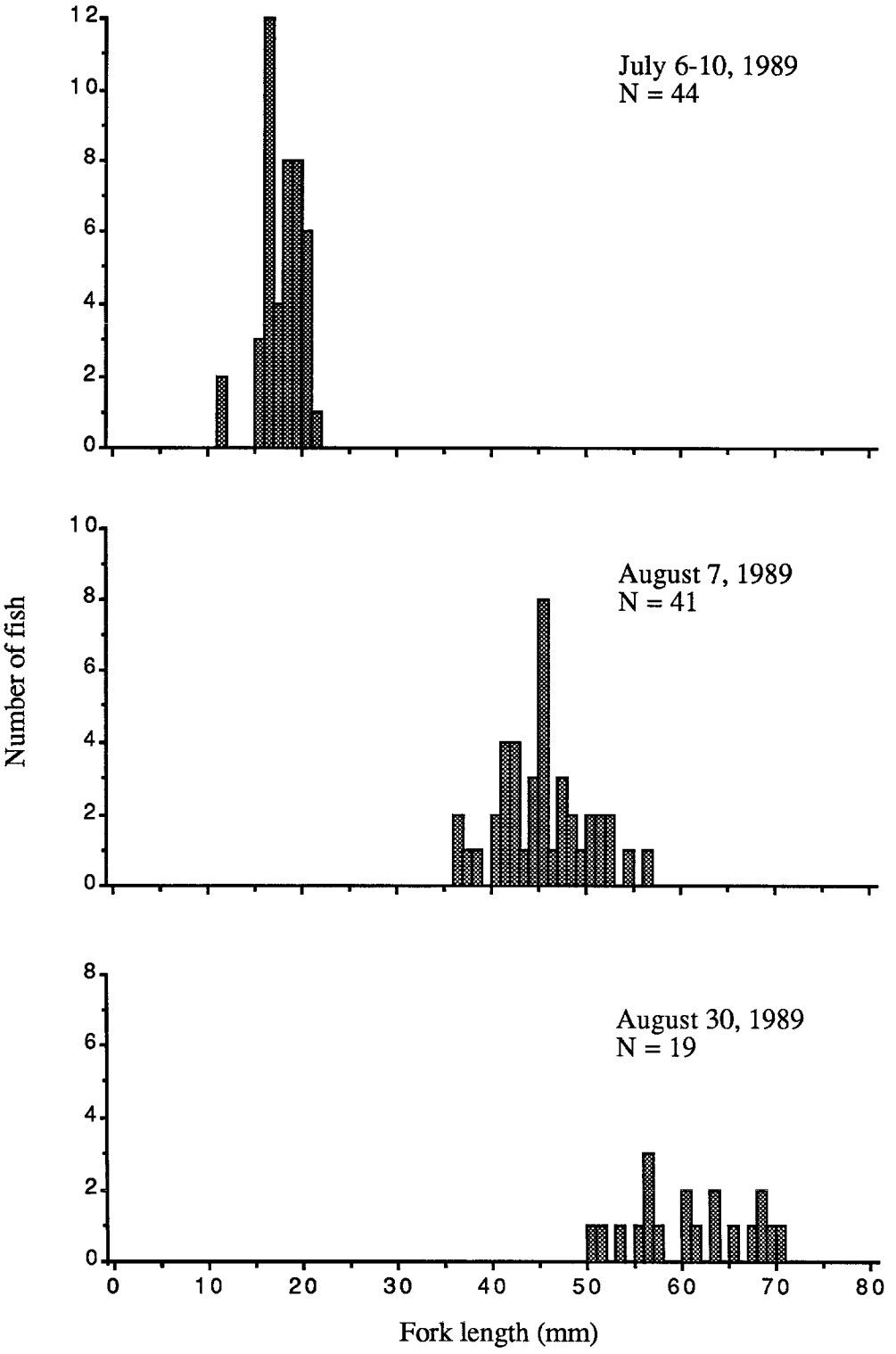

Figure12.—Length-frequency distribution of young-of-the-year Arctic grayling captured in the mainstem Akutoktak River, Alaska, July - August 1989.

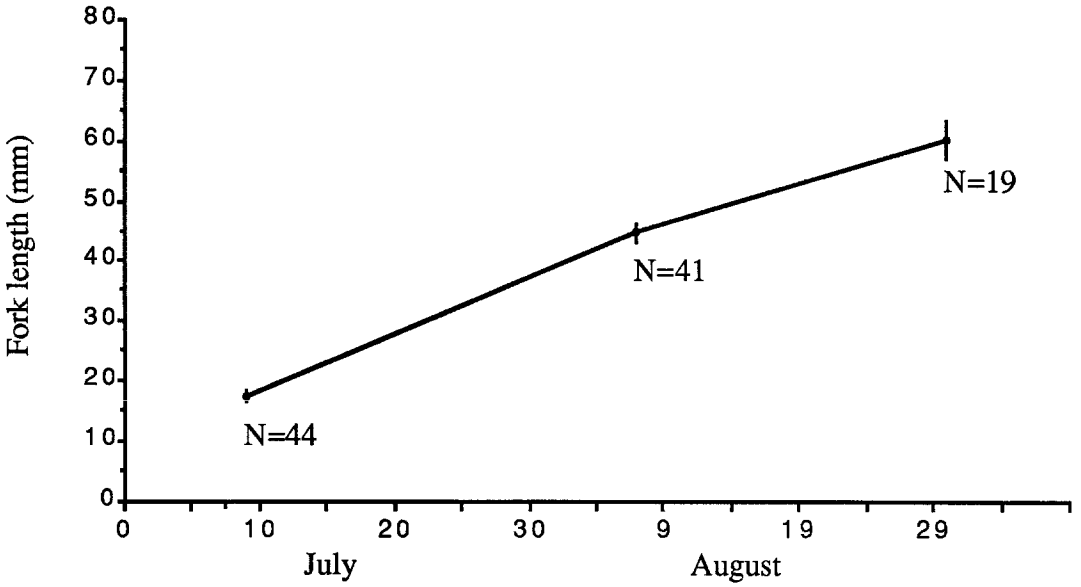

Figure 13.—Mean length of young-of-the-year Arctic grayling captured in the mainstem Akutoktak River, Alaska, July - August 1989. Vertical lines indicate 95% confidence interval of the mean.

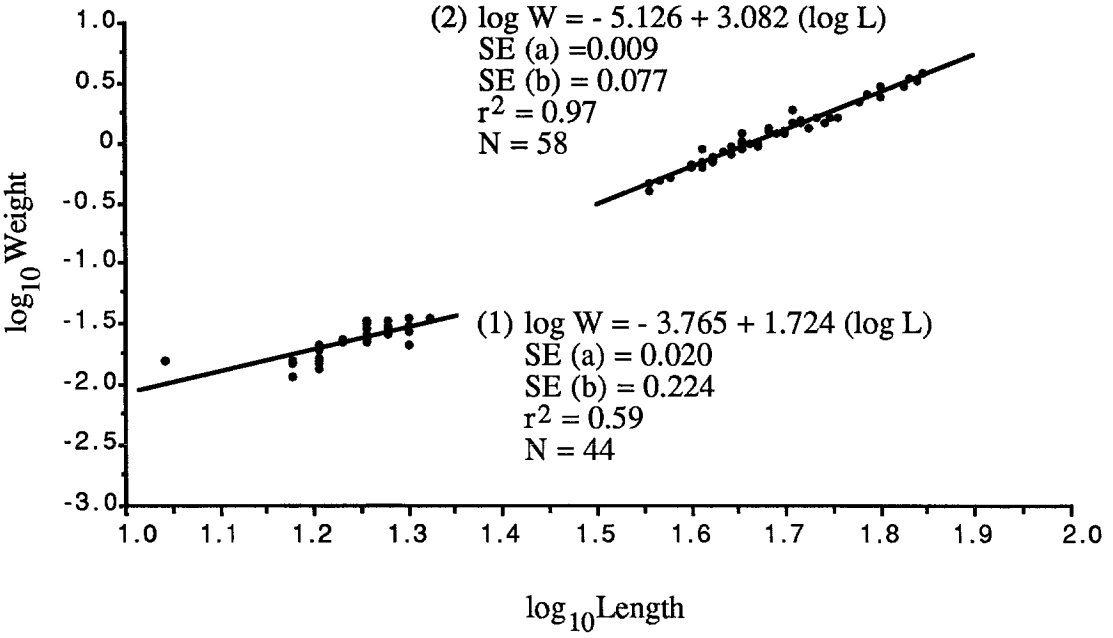

Figure 14.—Length-weight relationship of young-of-the-year Arctic grayling captured in the mainstem Akutoktak River, Alaska, July - August 1989. Equation (1) includes fish captured in July, and (2) August.

differences were significant ($P < 0.001$) between July and August (Figure 14), and between the Okpilak and Akutoktak rivers (Figures 9 and 14).

Discussion

Fish distribution and spatial and temporal comparisons

Arctic char.— Distribution of Arctic char in the Okpilak and Akutoktak rivers in 1989 was more extensive than previously documented. Juveniles were captured in 50 km of the mainstem Okpilak River (156 captured), at least 16 km of the Akutoktak River (50), and the lower reaches of two tributaries of the Okpilak River, OT 4 (10) and OT 5 (2). Prior to this study, only two juvenile Arctic char had been located in the Okpilak River and none in the Akutoktak River (Ward and Craig 1974; Daum et al. 1984; Lyons and Elliott 1987). The absence of adult and young-of-the-year suggest that these juveniles may be from another river system. Since the Okpilak and Hulahula rivers share a common delta, it is possible these fish migrated from the Hulahula River.

Juvenile Arctic char have been located substantial distances upstream in non-natal streams on the Arctic coastal plain. Juvenile Arctic char have been captured 50 and 35 km upstream in the Jago and Katakturuk rivers (Corning *in preparation-b*), as well as the lower reaches of Weir Creek (Craig and Poulin 1975) and the Tamayariak River (Corning *in preparation-a*).

The Okpilak and Akutoktak rivers are utilized by juvenile Arctic char for rearing. Although they were present in both rivers in August, juveniles were not located in the Akutoktak River in early to mid-July. Their appearance in the Akutoktak River may coincide with lower flows and a reduction of available habitat in the Okpilak River.

Arctic grayling.— All life history stages of Arctic grayling were found in the Okpilak and Akutoktak rivers; however, temporal distribution between these rivers differ. The Okpilak River is used primarily as a migration corridor to spawning and feeding areas in early June (McCart et al. 1972; Craig and Poulin 1975; Elliott 1982) and overwintering areas in August (West and Wiswar 1985, Wiswar et al. 1987). Only one adult and five juvenile Arctic grayling were captured in the mainstem. Low catch rates in the mainstem were similar to results of past investigations (Craig and Poulin 1975; Daum et al. 1984). In a classification scheme for rivers in the Tanana River drainage, Tack (1980) concluded that highly silted, rapid runoff rivers are used by Arctic grayling primarily as migration corridors during summer. Since Arctic grayling are sight feeders, the mainstem and side channels provide poor rearing habitat due to high turbidity. However, in the Okpilak River in August, river flow had subsided and young-of-the-year were found in small shallow pools and backwaters behind gravel bars. Water in these areas was relatively clear as suspended sediments settled out with the decrease in water velocity.

The Akutoktak River is utilized by Arctic grayling for summer feeding, seasonal migrations, and spawning. Arctic grayling were distributed over almost the entire river's length in July, at least 16 km upstream in early August, but absent in late August. The range distribution in July 1989 was

similar to that reported by Daum et al. (1984) in 1983, although then, most juveniles were located in the lower river.

Distribution of juvenile Arctic grayling in the Arctic Refuge has not been adequately described. Catch rates of juveniles have been disproportionately low to that of adults or length classes have been missing (Smith and Glesne 1983; Daum et al. 1984; Corning *in preparation-a*). In the Okpilak River, all juveniles were less than 150 mm FL; whereas, in the Akutoktak River all juveniles were greater than 220 mm FL. In Weir Creek, Craig and Poulin (1975) reported large numbers of juveniles migrating upstream shortly after breakup and a large proportion then moving back out of the stream during the second and third weeks of July. It is possible similar behavior by juveniles occurred in the Akutoktak River and sampling occurred after emigration.

In small tundra streams on the Arctic coastal plain, Craig and Poulin (1975) and Elliott (1982) found that Arctic grayling migrate from the stream shortly after spawning. Similarly, in the Okpilak River drainage, adult Arctic grayling were not located at OT 4 in early July, although the presence of young-of-the-year indicates this stream was used for spawning. More intensive sampling efforts in other tributary streams may reveal a wider distribution.

In this study, young-of-the-year Arctic grayling were first observed July 6. In streams on the Arctic coastal plain, spawning occurs in early to mid-June (McCart et al. 1972; Craig and Poulin 1975; Elliott 1982) and fry emerge 11 days to three weeks later (Morrow 1980). In headwater streams of the Sagavanirktok and Atigun rivers (Elliott 1982), young-of-the-year were first observed on June 26 and June 29 (McCart et al. 1972) and July 15 in the Tamayariak River (Corning *in preparation-a*).

Young-of-the-year were still present in the rivers in late August 1989. They probably remain in the Akutoktak River until mid or late September. Downstream migrations in other arctic tundra streams peaked during this period (Craig and Poulin 1975; Elliott 1982). Overwintering locations of young-of-the-year are unknown.

Biological Characteristics

Arctic char.— Most of the growth in young-of-the-year Arctic char occurs between mid-June and mid-August (McCart 1980). Growth slows in late August and September. At the end of their first year of growth, Arctic char in anadromous populations generally do not exceed 74 mm. Juvenile Arctic char captured in the Okpilak and Akutoktak rivers were in the length range that corresponds to one to four year old fish (Yoshihara 1972; McCart 1980; Smith and Glesne (1983); Daum et al. 1984; West and Wiswar 1985). In July and early August, two and three year old fish were most abundant, while in late August, one year old Arctic char predominated.

Arctic grayling.— Young-of-the-year Arctic grayling from the upper Atigun River in late June (Elliott 1982) ranged in length from 13 to 17 mm, which is similar to those from early July in this study. In rivers on the Arctic coastal plain, mean fork lengths in mid-August ranged from 28.4 to 43.0 mm in the Sagavanirktok and Atigun rivers in 1971 (McCart et al. 1972), and 30.1 to 45.8 mm in tributaries of the Tamayariak River in 1988 (Corning *in preparation-a*). By late August 1988, in the Tamayariak River, the mean fork length was 53.8 mm. Generally, young-of-the-year from

the Okpilak and Akutoktak rivers were slightly larger in August (Table 4) when compared to fish from the studies cited above.

Differences in the length-weight relationship of young-of-the-year Arctic grayling captured in July and August are probably due to changes in developmental phases. In July, these fish were in the late protolarval to late mesolarval phases; whereas, in August, fish were in the metalarval phase (Sturm 1988). As young-of-the-year obtain their true body form, the correlation between length and weight increases. Differences in the length-weight relationship between the Okpilak and Akutoktak rivers (Figures 9 and 14) may be due to time of spawning, time of hatching, availability of food, water temperature, and flow regime of each drainage.

Arctic grayling from the Akutoktak River in 1989 were similar in length to those captured in 1983 (Daum et al. 1984). While length frequencies also compare similarly to Arctic grayling captured in the Hulahula and Sadlerochit rivers and Itkilyariak Creek (Smith and Glesne 1983; Daum et al. 1984), larger adult Arctic grayling have been captured in the Tamayariak River (Smith and Glesne 1983; Corning *in preparation-a).* River drainages on the Arctic coastal plain may contain different stocks of Arctic grayling with specific length and growth characteristics. Alternatively, habitat variables in the Tamayariak River, including overwintering in the Canning River (West and Wiswar 1985; Wiswar et al. 1987), may be more favorable for growth.

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