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Fisheries Investigations on the Kongakut River, Arctic National Wildlife Refuge, Alaska, 1985

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Key Words
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Fisheries investigations on the Kongakut River, Artic National Wildlife Refuge, Alaska, 1985.

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Abstract:

Fishery investigations were undertaken on the Kongakut River of the Arctic National Wildlife Refuge (ANWR) in Alaska during June and July 1985. Arctic char (Salvelinus alpinus) and Arctic grayling (Thymallus arcticus) were the only fish species found. Spawning age grayling and young-of-the-year grayling fry appeared to be distributed throughout the study area. Juvenile char ages 0+ through 4+ and ripening adults were abundant in middle and lower reaches of the watershed. Adult non-spawning char apparently had left the system for the summer, entering Beaufort Sea lagoons to feed. The Kongakut River possesses good water quality typical of undeveloped non-glacial arctic streams. Twenty-two macroinvertebrate taxa were collected in surber samples: Chironomidae, Nemouridae, and Oligochaeta were the most abundant. Both diversity and density of invertebrates were low, probably due to the location of most of the sampling sites in mountain streams.

INTRODUCTION

For years, recreational users of the Arctic National Wildlife Refuge (ANWR) have been turning in glowing reports about the fishing along the Kongakut River. Long before the arrival of backpackers, river-rafters and pilots, the Kongakut River was well-known to the Inupiaq Eskimos for its fishing holes and for the access it provided to the mountains for hunting and trapping. On the coast, a portion of the Kongakut River delta just south of Siku Island was considered an important whitefish (Coregonus sp.) fishing area (Jacobson and Wentworth 1982). Commercial whalers of the last century and early 1900's found the river useful as a main travel route to their winter sheep hunting grounds (Jacobson and Wentworth 1982).

Despite all of the favorable mention the Kongakut has received, little scientific information regarding its fisheries has been reported. In light of increasing recreational use of the area, this void prompted a reconnaissance of the fishery resources of the Kongakut River drainage.

The goals of this study were to describe the habitat and aspects of the life histories of Arctic char (Salvelinus alpinus) and Arctic grayling (Thymallus arcticus) within the Kongakut River system. The objectives were:

1) to identify spawning and rearing areas and mid-summer distribution of char and grayling;
2) to describe age and growth charcteristics;
3) to delineate physical and chemical characteristics of the river and selected tributaries;
4) to determine species composition of benthic invertebrates.

STUDY AREA

The Kongakut River is in the eastern part of the ANWR on the north slope of the Brooks Range (Fig. 1). It originates at about 1,460 m in the Davidson Mountains at the Continental Divide and flows east, then north, to the Beaufort Sea, a distance of approximately 177 km. On 1:250,000 USGS quadrangle maps the river is a fifth order stream (Strahler 1957) at the mouth with a drainage area of 4,002 square km. Investigations of the river took place from sampling site 1, about 11 km from the headwaters, to sampling site 10 at Baseline Creek, about 45 km from the mouth of the Kongakut at the Beaufort Sea.

According to Wahrhaftig's (1965) classification of Alaska, the river runs through three different physiographic zones: the Arctic Mountain province, the Arctic Foothills province and the Arctic Coastal Plain. Most of the Kongakut drainage is in the Arctic Mountain province. In the headwaters, weather-resistant metasedimentary rock predominates. To the north is a narrow east-west belt of the Lisburne Formation consisting of Mississippian limestone and dolomites (Hobbie 1962). Springs and aufeis formations are often associated with the Lisburne Limestone group (Craig and McCart 1974) and are prevalent along the Kongakut River. The southern margins of the Arctic Foothills province were glaciated during the Pleistocene and glacial debris covers portions near the mountains (Detterman 1974). Permafrost may extend to depths as great as 275 m (Wiggins and Thomas 1962) and has a significant

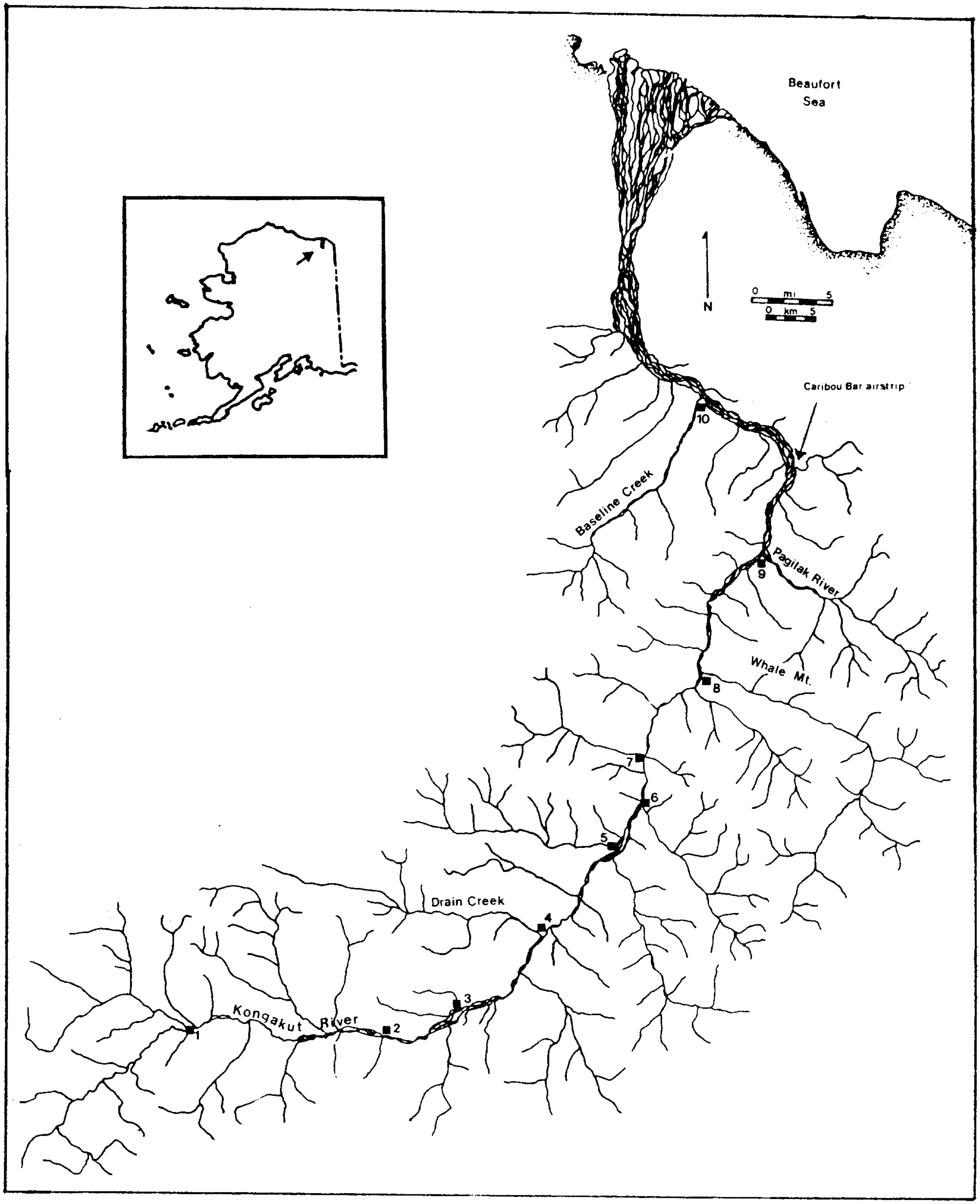

Fig. 1. The Kongakut River drainage with locations of sampling sites 1-10. Inset shows drainage location in Alaska.

effect on soils. The soils of the Arctic Coastal Plain province tend to lack well-defined soil horizons, to be slightly acidic and to be low in nutrients. Dark colored mineral soils (mollisols), which are neutral to slightly alkaline, predominate in the Arctic Foothills province (Wiggins and Thomas 1962). Only the upper few inches of the tundra mat thaws during summer and though it is highly absorbent, once saturated, run-off is total and additional rain flows immediately to streams. This sudden change in water volume in conjunction with an abundance of unconsolidated sand and gravel produces braiding (Detterman 1974) which is extensive in the Kongakut River.

MATERIALS AND METHODS

Access to the uppermost sampling site (see Fig. 1) was provided by helicopter. A 4-person crew conducted the study, moving downstream via inflatable rubber rafts. Camp sites were selected in advance based on inferences made from USGS 1:63,360 maps of the area.

Stream length, stream orders and drainage areas were measured from USGS 1:250,000 maps. Stream orders were determined using the method of Strahler (1957). Aufeis locations and approximate thicknesses were recorded to indicate possible Arctic char spawning areas.

Stream flow (discharge or runoff) was measured using a Marsh-McBirney velocity meter and a standard wading rod. Velocities were measured at approximately 0.6 of total depth (ft) and braided-channel flows were combined to obtain total flow. Total flow was calculated using the formula:

$$Q = \sum_{i=1}^{n} \sum_{i=1}^{k} W \times D \times V$$

where n = number of channels
k = number of cells
W = width of cell (ft)
D = mean depth (ft) of cell
V = mean velocity (ft/sec) of cell
(modified from Simon 1981)

Other stream characteristics measured were water temperature, conductivity, pH, total alkalinity, and total hardness. A Hach Mini-pH meter, model 17200, and a Hach Mini-Conductivity meter, model 17250, were used for the analysis. Both were temperature-adjustable thus values given for pH and conductivity are for those temperatures listed in Table 1. Total alkalinity and total hardness were measured in mg/l as $CaCO_3$ using Hach prepared chemicals and a Hach hand-held digital titrator. All measurements were taken at least twice; mean values are reported in Table 1.

Five replicate aquatic macroinvertebrate samples were collected in riffles at each site with a 1000-micron mesh surber sampler to depths of 10 to 15 cm. One kick sample was taken at each site. All samples were preserved in approximately 10% formalin in Whirl-Pak bags. Organisms were identified to family level whenever expertise allowed. Representative chironomid larvae were mounted in CMCP-10 media and identified when possible to sub-family. The following identification keys were used: Pennak 1978, Bryce and Hobart 1972, Oliver et al. 1978, and Merritt and Cummins 1984. Percent frequency of occurrence and percent composition are based on total number of individuals from all samples (Table 2). The mean, standard deviation, standard error and sampling precision were calculated for density of organisms at each sampling station (Table 3).

Minnow traps were baited with commercially prepared roe. Experimental monofilament gillnets consisted of four 305 cm panels with 2.5, 3.8, 4.1, and 5.4-cm bar meshes.

Fork length was recorded to the nearest mm for all fish. In addition, all mortalities were weighed wet to the nearest divisions of 0-250 g, 0-500 g, 0-2000 g, and 0-5000 g Pesola spring scales. Scales and otoliths (sagittae) were removed from Arctic grayling for ageing. Otoliths and digestive tracts were removed from Arctic char for ageing and food habits studies. Digestive tracts were preserved in approximately 5% formalin in Whirl-Pak bags in the field, then later dissected and the food items transferred to vials of isopropyl alcohol. Scales and otoliths were stored cleaned and dried in envelopes.

Otoliths were cleared in Photo-Flo 200 and ground on one side on fine 400 grit sand paper to enhance the clarity of age marks. They were viewed against a dark background with a dissecting microscope. The hyaline rings were counted starting with the first hyaline zone outside the dark centrum. Two independent ageings were made on each otolith. A third ageing was done in those cases of discrepancies between the first two determinations.

Fish caught with angling gear were measured to the nearest millimeter (fork length) and marked with numbered Floy FD-67 anchor tags.

A coefficient of condition (K) was calculated for char and grayling using the following formula:

$$K = \frac{(\text{Weight in g}) \times 10^5}{(\text{Fork length in mm})^3}$$

RESULTS

Physical and chemical characteristics

Physical and chemical data are summarized in Table 1. Mean conductivity and mean alkalinilty were highest (mean total hardness was high) at site 2, a small spring. These same characteristics were lowest at sampling site 7, which was located on a small tributary flowing east out of the Romanzof Mountains. The pH ranged from 6.4. at the uppermost sampling site to 7.7, measured at sampling site 10 on Baseline Creek.

We were unable to obtain flow in the main channel Kongakut River below sampling site 4. Channels flowing beneath large aufeis fields were unmeasureable. Heavy rainfall limited flow measurements to smaller tributaries that could be waded.

Macroinvertebrates

Table 2 lists the 22 macroinvertebrate taxa that were identified in the surber

Table 1. Physical and chemical characteristics of water at sampling sites, Kongakut River, June and July 1985. Conductivity meter was temperature-adjustable therefore values given are for these temperatures specified.

Sampling site	Location	Date	Approx. elevation (m)	Water temp. (°C)	pH	Conductivity (umhos/cm)	Total alkalinity (mg/l as $CaCO_3$)	Total hardness (mg/l as $CaCO_3$)	Flow (cms)
1 river	Table Mt. D-4 T6S, R38E, Sec. 12	6/22	855	7.0	6.4-6.5	240	73	116	9.70
trib				5.8	6.8	225	91	81	0.26
2 river	Table Mt. D-3 T6S, R40E, Sec. 12	6/24	700	7.3	6.4-6.5	285	100	116	11.56
trib				10.4	6.6-7.0	395	168	130	-
3 river	Table Mt. D-4 T5S, R41E, Sec. 35	6/25	630	5.5	6.8-6.9	260	-	-	-
trib				7.3	6.6-7.0	333	104	158	0.29
4 river	Demarc. Pt. A-2 T5S, R42E, Sec. 3	6/26	560	-	-	-	-	-	8.45
Drain Ck				6.7	6.7-6.8	320	84	138	0.87
5 trib	Demarc. Pt. A-2 T4S, R42E, Sec. 10	6/28	510	5.0	6.9-7.0	345	106	166	0.10
6 trib	Demarc. Pt. A-2 T3S, R43E, Sec. 36	6/29	480	4.8	6.8-6.9	175	66	103	0.67
7 trib	Demarc. Pt. A-2 T3S, R42E, Sec. 12	6/30	440	5.0	7.0-7.1	55	17	28	3.18
8 river	Demarc. Pr. B-2 T2S, R43E, Sec. 15	7/01	380	5.3	7.3	155	-	-	-
trib				2.9	7.1-7.3	128	54	72	0.06
9 Pagilak River	Demarc. Pt. B-1 T1S, R44E, Sec. 8	7/01	300	6.6	7.0-7.1	220	68	96	11.41
10 Baseline Creek	Demarc. Pt. C-2 T2N, R42E, Sec.24	7/03	185	11.3	7.5-7.7	318	88	134	9.42

Table 2. Macroinvertebrate taxa collected in surber samples, Kongakut River and tributaries, June and July 1985.

Platyhelminthes	Plecoptera
Turbellaria	Nemouridae
Tricladia	Capniidae
Planaridae	Perlodidae
	Leuctridae
Annelida	Trichoptera
Oligochaeta	Diptera
	Chironomidae
Arthropoda	Orthocladiinae
Crustacea	Ceratopogonidae
Amphipoda	Simulidae
Gammaridae	Tipulidae
	Culicidae
Arachnoidea	Ephydridae
Hydracarina	Coleoptera
Insecta	Curculionidae
Ephemeroptera	Hydrophilidae
Baetidae	Hemiptera
Heptageniidae	Mesoveliidae
	Collembola

samples. Table 3 gives densities of macroinvertebrates (organisms/m^2) and the number of taxa identified for each sampling site. Densities ranged from 6.5 organisms/m^2 to 400 organisms/m^2 with the greatest density occurring at sampling site 2, a spring. The largest number of taxa was found at sampling site 3, which was on a small tributary of the Kongakut. Percent species composition and percent frequency of occurrence are listed in Table 4. Chironomid larvae dominated both frequency of occurrence (they were found in 92 percent of all samples) and percent composition (33 percent of the total number of invertebrates collected were Chironimid larvae). Orthocladiinae was the only sub-family identified in the sub-sample of chironomids. Although greater numbers of less abundant taxa were found in kick samples, the taxa obtained by this method were the same as those picked from surber samples.

Fish distribution and abundance

<u>Arctic char</u>

Juvenile Arctic char were distributed throughout the study area and were either captured or observed in both the main channel and tributary streams. All juvenile Arctic char were captured with baited minnow traps (Table 5). Although the greatest effort (87.0 hrs) was expended at sampling site 1, no fish were captured with minnow traps; however, juvenile or small resident Arctic char were observed at that site. CPUE for minnow traps ranged from 0 fish/trap-hr (sites 1,4,6) to 1.16 fish/trap-hr at Pagilak River, site 9 (Table 5). CPUE for minnow traps tended to increase down-stream despite high, turbid water conditions resulting from heavy rains during July. Juvenile and young-of-the-year (YOY) Arctic char were observed or captured in backwater areas, behind boulders in fast water, and along the edges of fast-flowing water in the main

Table 3. Density (organisms/m^2) and number of taxa of macroinvertebrates at sampling sites, Kongakut River and tributaries, June and July 1985.

Sampling Station	Sample Size	Mean # Organisms/m^2	Standard Deviation	Standard Error	% Precision	Number of Taxa
1 River	5	155	81.1	36.3	23.4	7
1a Trib	5	7	9.6	4.3	61.4	2
1b Trib	5	271	251.5	112.5	41.5	7
2 River	5	93	64.4	28.8	31.0	5
2 Trib	5	400	300.3	134.3	33.6	4
3 Trib	5	207	107.5	48.1	23.2	12
4 River	5	50	16.3	7.3	14.6	9
4 Drain Ck	5	56	32.6	14.6	26.1	8
5 Trib	5	24	24.5	11.0	45.8	2
6 Trib	5	58	22.3	10.0	17.2	7
7 Trib	5	88	35.2	15.7	17.8	8
8 Trib	5	41	23.2	10.4	25.4	4
9 Pagilak R	5	105	101.6	45.4	43.2	6
10 Baseline Ck	5	84	74.2	33.2	39.5	9

Table 4. Frequency of occurrence of major macroinvertebrate taxa and percent composition of surber samples, Kongakut River and tributaries, June and July 1985; A = adult; P = pupae; N = nymph; L = larvae.

Taxon		Percent frequency of occurrence	Percent composition
Planaridae		7.1	0.5
Oligochaeta		35.7	13.0
Gammaridae		50.0	8.4
Arachanoidea		7.1	0.1
Hydracarina		14.3	0.3
Insecta			
Ephemeroptera	N	(42.8)	(8.4)
Baetidae	N	7.1	0.1
Heptegeniidae	N	42.8	8.3
Plecoptera	A	(14.3)	(0.1)
	N	(35.7)	(23.0)
Nemouridae	N	42.8	20.0
Capniidae	A	7.1	0.4
	N	14.3	0.3
Perlodidae	N	14.3	0.4
Leuctridae	N	14.3	0.1
Trichoptera	L	7.1	0.1
Diptera	A	(78.6)	(2.8)
	P	(57.1)	(1.5)
	L	(100.0)	(35.0)
Chironomidae	A	28.6	0.5
	L	92.8	33.0
Ceratopogonidae	P	7.1	0.1
Simuliidae	L	14.3	0.7
Tipulidae	A	14.3	0.5
	P	14.3	0.3
	L	28.6	1.2
Culicidae	P	50.0	4.8
Ephydridae	L	21.4	0.3
Coleoptera	L	14.3	0.3
Collembola	A	7.1	0.1
Hemiptera	A	21.4	0.4

Table 5. Fish sampling summary by gear type, Kongakut River, June and July 1985. AC = Arctic char, GR = Arctic grayling, CPUE = catch-per-unit-effort. One juvenile Arctic char was captured with a dip net at station 5.

Sample Site	Minnow Traps		Gill Net		Angling	
	Effort (hrs)	CPUE (per trap)	Effort (hrs)	CPUE (per net)	Effort (hrs)	CPUE (per person)
1	87.0	0.00	11.25	0.00	2.5	0.00
2	25.5	0.08 AC	12.75	0.31 GR	not attempted	
3	60.0	0.08 AC	11.5	0.09 GR	1.75	0.57 AC 1.14 GR
4	48.0	0.00	not fished		4.35	3.45 AC 0.46 GR
5	not fished		not fished		not attempted	
6	54.0	0.00	not fished		1.25	1.60 AC 1.60 GR
7	52.0	0.31 AC	11.3	0.00	1.75	4.00 AC 1.71 GR
8	56.0	0.93 AC	not fished		not attempted	
9	48.5	1.16 AC	24.5	0.00	0.70	1.43 GR
10	42.75	0.75 AC	8.5	0.12 GR	not attempted	

channel and tributary streams. Glova and McCart (1974) reported young char in similar habitats in the Firth River.

Adult Arctic char were captured via angling at sampling sites 3-7 (Table 5). Although 11.25 and 12.75 gill-net hours and 2.5 and 1.75 angling-hours were expended at sampling sites 1 and 2 respectively, no Arctic char adults were captured nor were any observed. At least 2 Arctic char escaped from the gill net at site 3. Highest angling CPUE (4.0 adults/angler-hr) was at sampling site 7 (Table 5). Adult Arctic char were present below and in the channels running through the large aufeis field located at sampling site 3. Adults were observed in a pool in Drain Creek (site 4) near the confluence with the main channel. They were captured in deep pools, in deep, fast riffles, and at the confluence of tributary streams and the Kongakut River.

Eleven Arctic char were marked with Floy tags at sampling site 4 (the confluence of the Kongakut and Drain Creek) and four were marked at sampling site 7. Fork lengths ranged from 525 mm to 682 mm. Weights were not taken from fish that were released (Table 7).

Arctic grayling

YOY Arctic grayling were observed throughout the study area. The portion of the Kongakut River which flows through the Arctic coastal plain was not sampled. We observed grayling in slow-moving margins of stream channels and occassionally in isolated pools in both the main channel of the Kongakut River and tributary streams. No juvenile Arctic grayling were captured at any of the sampling sites.

Adult Arctic grayling were captured at most sampling sites. Adults were captured with gill nets and by angling. The highest gill net CPUE was at sampling site 2 with 0.31 adults caught per net per hour (Table 5). The habitat at sampling site 2 was a backwater area with a mud bottom. Arctic grayling adults were captured with angling gear at all sites except 1 and 5. Although 2.5 hours were spent angling at sampling site 1, no adult grayling were captured. One adult was observed in a pool in a tributary stream. Angling was not attempted at the small tributary stream at sampling site 5. Highest angling CPUE (1.74 adults/angler-hr) was at sampling site 7 (Table 5).

Seven Arctic grayling were marked with Floy tags. One was marked at site 1, two at site 4 one at site 6, two at site 7, and one at site 9. Fork lengths ranged from 303 mm to 380 mm (Table 7).

Age and growth

Arctic char

Thirty-nine of the 45 pairs of otoloiths collected from Arctic char were aged (Table 6). Six pairs of otoliths were unreadable; these were from juveniles and were malformed. Summer growth beyond the last annulus was observed in all otoliths examined.

Juvenile fish ranged from age 1 to age 4 (Table 6). Most juveniles were age 1 and 2 with mean fork lengths of 98 mm and 131 mm respectively. The modal length class for juvenile Arctic char was 100-149 mm (Fig. 2).

Ten adult Arctic char were aged from otoliths. Ages 7 through 10 were represented with age 8 fish predominating (Table 6). Age 8 fish had the longest mean fork length (603 mm), the heaviest mean weight (2,069 g) and the highest mean coefficient of condition (0.94). All of the adult Arctic char captured had maturing gonads and we judged that they would spawn in the fall. Seven of the 10 fish were females. Based on the description by Craig and McCart (1974), all adult fish were from an anadromous stock. The modal length class was 600-649 mm (Fig 2).

Arctic grayling

Nine pairs of Arctic grayling otoliths were aged. Summer growth beyond the last annulus was observed in all otoliths. Otolith-ages ranged from 5 through 8 with age 8 fish predominant (Table 5). Mean fork lengths ranged from 268 mm (age 5) to 313 mm (age 8) and mean wet weights ranged from 185 g to 281 g,

Table 6. Age-specific fork lengths (mm), wet weights (g), female:male ratios and coefficients of condition (K) for 39 Arctic char and 9 Arctic grayling, Kongakut River, June and July 1985.

Species	Age	Sample size	Mean fork length (mm)	Mean weight (g)	Range	K	Sex ratio F:M
Arctic char	1	13	98		86-114mm		
	2	12	131		118-141mm		
	3	3	141		111-160mm		
	4	1	150				
	7	2	514	1185	512-516mm 1120-1250g	0.87	2:0
	8	4	603	2069	574-620mm 1750-2600g	0.94	2:2
	9	3	553	1525	535-565mm 1175-1700g	0.89	3:0
	10	1	655	2600		0.93	0:1
Arctic grayling							
	5	1	268	185		0.96	1:0
	6	2	267	178	265-268mm 175-180g	0.93	--
	7	2	327	343	316-337mm 325-360g	0.98	0:2
	8	4	313	281	298-337mm 240-320g	0.92	3:1

Table 7. Capture locations, fork lengths, sex and tag numbers of Arctic char and Arctic grayling taken and released in the Kongakut River, June-July 1985.

Sampling site	Date	Fork length (mm)	Sex	Tag Number (yellow)
		Arctic char		
4	6-25-85	648	M	003751
		621	F	003752
		609	F	003753
		577	-	003754
		525	-	003755
	6-26-85	682	M	003756
		640	M	003757
		574	F	003758
		560	F	003759
	6-27-85	610	F	003761
		574	F	003763
7	6-29-85	644	-	003766
		608	F	003767
		688	-	003769
	6-30-85	535	F	003770
		Arctic grayling		
3	6-25-85	318	-	003800
4	6-25-85	303	-	003760
		312	-	003762
6	6-28-85	361	-	003764
7	6-29-85	307	-	003765
		335	-	003768
9	7-01-85	380	-	003771

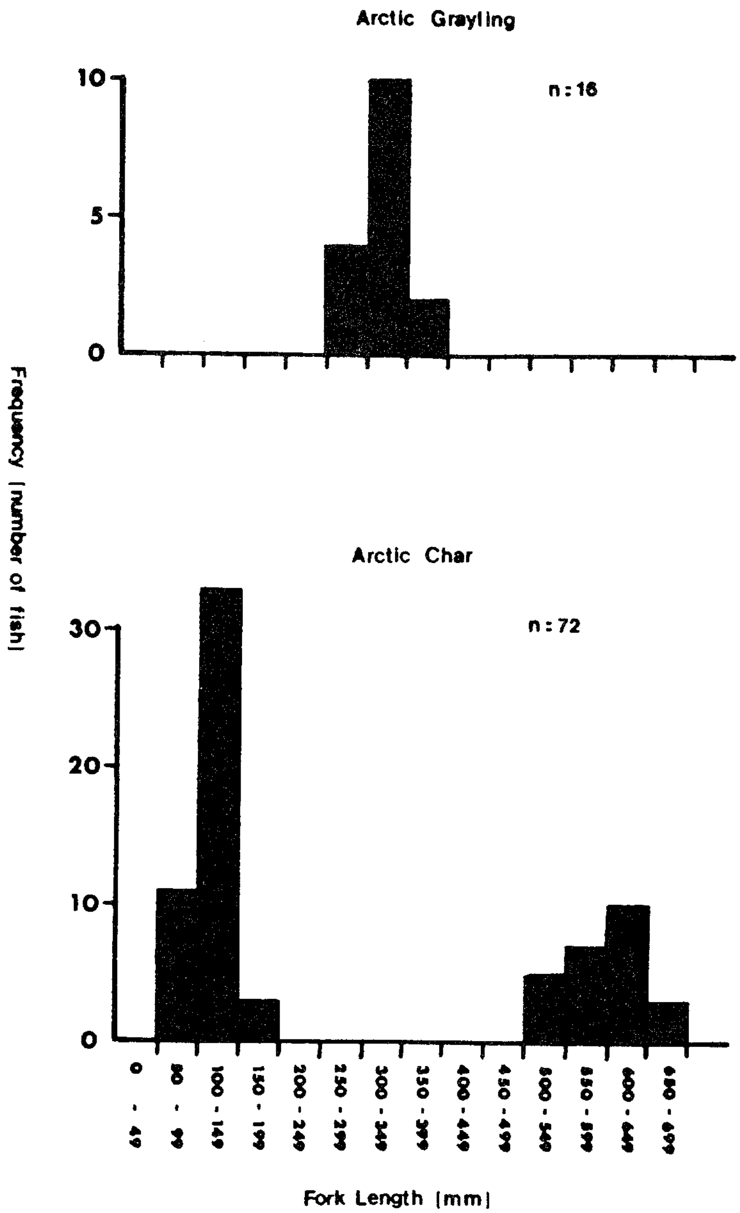

Figure 2. Length frequencies of Arctic char and Arctic grayling,taken from the Kongakut River, June and July 1985.

respectively (Table 5). Mean coefficient of condition was highest (0.98) for two 7-year-old male Arctic grayling (Table 5). Fork length range was also largest (346-337 mm) for age 7 fish. The modal length class was 300-349 mm (Fig. 2).

DISCUSSION

Weather is an important consideration when reviewing the information gathered in this study. An early break-up on the eastern North Slope was followed by a period of cold weather and little precipitation. By June, temperatures were quite warm but still little precipitation had fallen. For the first five days of the study (June 21-26) the Kongakut River water level was dropping. This situation explains the apparent loss of flow between sampling stations 2 and 4 (Table 1). After it began to rain (June 27) the water level rose every night. Stream flow on the average peaks in mid-June in the Arctic slope region (Feulner et al. 1971). The 1985 summer peak for the Kongakut was probably later, in early July while we were on the river. Instantaneous and average flows have been measured for many of the rivers and streams of the ANWR, but comparisons are not possible because measurements have been taken at different times of the year.

In general the selected chemical characteristics measured in the Kongakut River and tributaries were typical of undeveloped streams of the North Slope (Ward and Craig 1974, Smith and Glesne 1982, Glesne and Deschermeier 1984.) The high values for conductivity, alkalinity, and hardness collected at sampling site 2 were in accordance with values obtained for other springs in the ANWR (Ward and Craig 1974, Glesne and Deschermeier 1984). The apparent downstream decrease for these characteristics is most likely due to increased runoff in streams as a result of rain.

Both macroinvertebrate density and number of taxa were low for most sites. This was probably due to the location of most of the sampling sites on mountain streams. Glesne and Deschermeier (1984) summarized the classification systems of Craig and McCart (1974a) and Harper (1981) to produce the following definition of a "mountain stream": these streams exhibit low stream order and high gradient; flow regimes are highly variable; riparian vegetation is sparse; turbidity and suspended sediments are higher than in spring or tundra streams; and with the exception of deep pools, streams freeze to the bottom in winter. Great fluctuations in environmental conditions of mountain streams limit diversity.

Slack et al. (1979) found in the north-flowing Atigun River (in the Brooks Range) the distribution and diversity of benthic invertebrates were consistent with the hypothesis that aquatic biological communities are related to stream order. Craig and McCart (1974a) found a significant correlation between invertebrate densities and stream flow. Neither of these relationships were observed in this study. However, the finding of greatest macroinvertebrate density at a spring site is in agreement with the results of Glesne and Deschermeier (1984).

Species composition at sampling sites was similar to that of benthic communities in other Arctic streams (Craig and McCart 1974a). An attempt was made to identify Chironomid larvae to the sub-family level in order to establish which functional groups could be found at particular sites. Representative larvae were examined and all were identified as members of the sub-family Orthcladinae, which includes a wide variety of functional groups. Other studies have reported up to five sub-families of Chironomid larvae from Arctic streams (Oliver et al. 1978, Slack et al. 1979, Glesne and Deschermeier 1984). The absence of other sub-families in this survey may be due to different rates of larval development and emergence.

Fish distribution and abundance were difficult to determine in some areas downstream of sampling site 3 due to high turbid water, the result of heavy rain. The uppermost site on the Kongakut at which fish (both char and grayling) were taken was sampling site 2 (Fig. 1), approximately 100 km from the mouth. Furniss (1975) reported spawning anadromous char were abundant in August in both the main river and in tributaries between 65 and 120 km from the mouth. It appears that the upper limits of char distribution on the Kongakut River are the second-order tributaries which join the Kongakut about 120 km from the mouth.

The lowest sampling site on the river at which grayling and char were caught during this survey was sampling site 10 (Fig. 1). In the delta region downstream from this site, juvenile char have been collected during November from areas influenced by springs (Craig and McCart 1974b). Concentrations of fish have been observed in open water there in April. Char may share these areas with grayling during winter. Summer distribution of both species in the lower portion of the Kongakut remains unclear.

Spawning areas of anadromous Arctic char are associated with springs (Glova and McCart 1974, Johnson 1980, Smith and Glesne 1983, Daum et al. 1984). Spring water overflow during winter results in large ice formations called aufeis, which may be used as clues indicating nearby char habitat (Craig and McCart 1974a). On the Kongakut River, the distribution of Arctic char was associated with the distribution of aufeis (Fig. 5). Boulder-strewn gravels of the type typically used for spawning redds were evident near aufeis fields at site 3 and between sites 7 and 8. Spawning sites for grayling were not observed, but the abundance of YOY grayling throughout the drainage suggests many of the tributaries may be used as spawning areas. Juvenile grayling ages 1 - 4 were neither captured nor observed; therefore, it was not possible to determine rearing habitat for grayling this age.

Age-specific fork lengths for char and grayling from the Kongakut and other North Slope drainages are depicted in Figs. 3 and 4. The mean size of char aged 2 to 4 appears to be smaller than those taken from other streams. The mean size of older char (ages 7 to 10) from the Kongakut seems to be greater than that of the fish from the Hulahula and Firth Rivers. Small sample sizes prevent us from drawing general conclusions about growth rates in the Kongakut.

Residual char -- non-anadromous stream residents (usually males) -- were not collected in the samples. Char of this life history type have been taken from the Canning, Hulahula, and the Aichilik Rivers. Though they have not been reported they most likely exist in small numbers in the Kongakut as well.

Also absent from samples were char of ages 5 and 6. The sample size may have been too small to encompass all age groups. Another possible explanation for

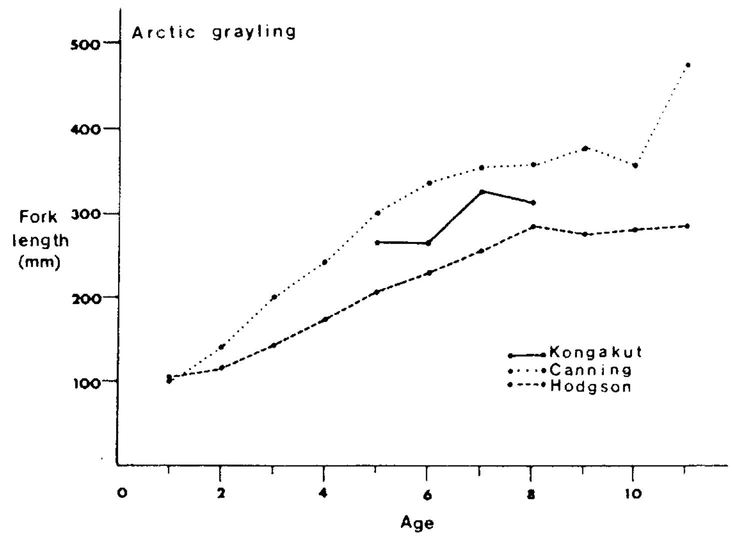

Fig. 3. Age-specific (based on otoliths) mean fork lengths of Arctic grayling from three river systems. Hodgson Creek data from Bain (1974); Canning River data from Smith and Glesne (1983); Kongakut River data, this study.

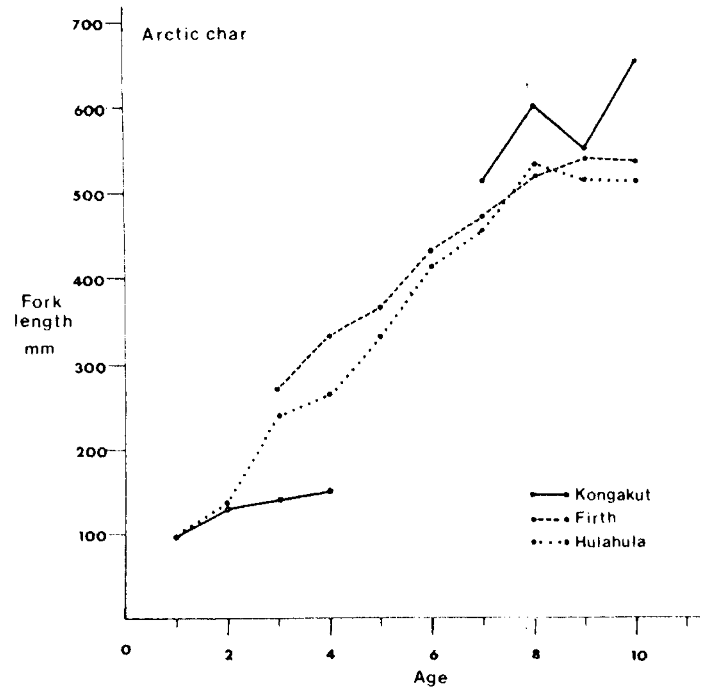

Fig. 4. Age-specific (based on otoliths) mean fork lengths of Arctic char from three river systems. Firth River data from Glova and McCart (1974); Hulahula River data from Smith and Glesne (1983); Kongakut River data, this study.

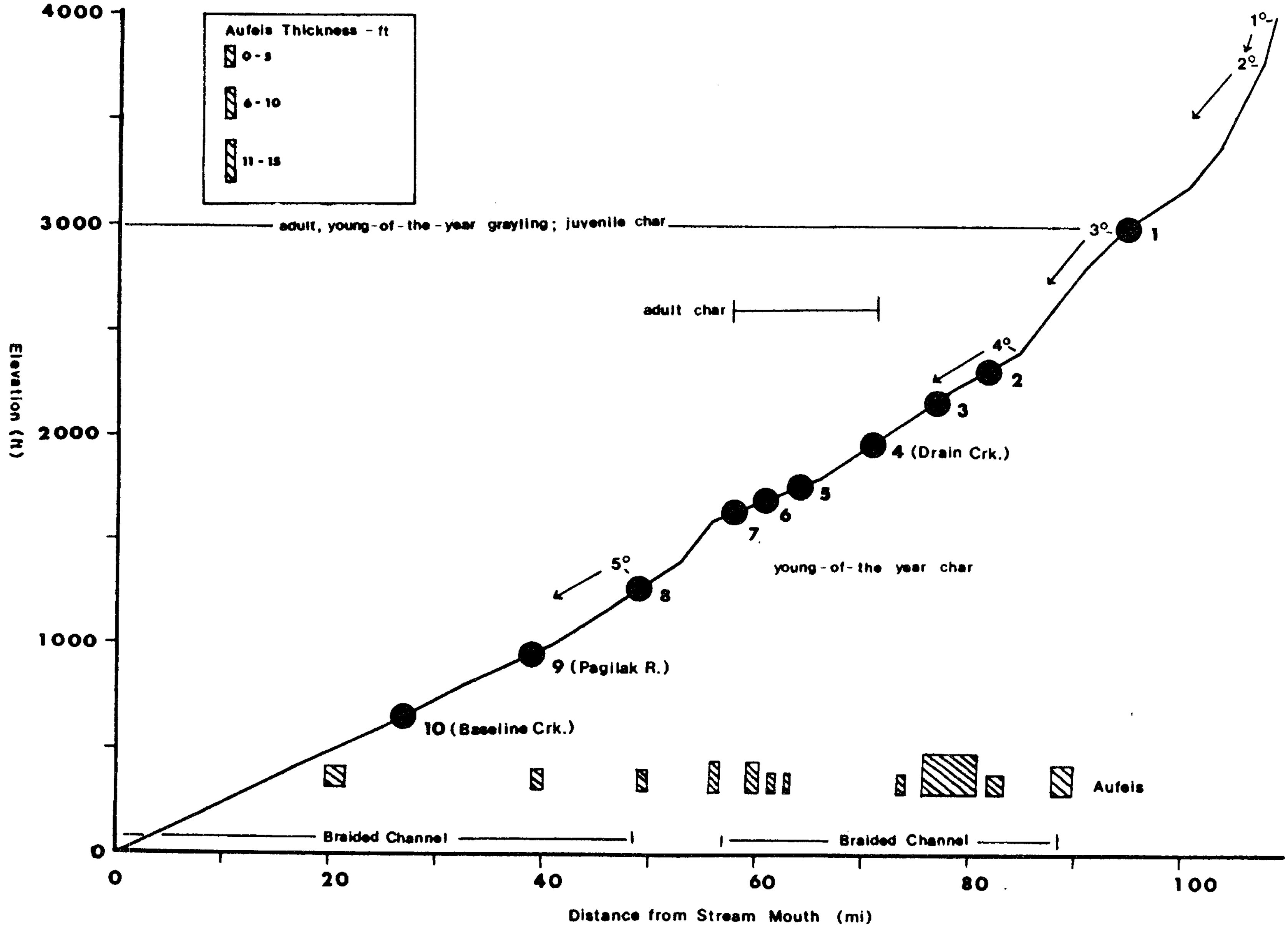

Figure 5. Arctic char and Arctic grayling distribution, extent of aufeis, stream order, and location of braided channels in relation to elevation and distance (miles) from the mouth of the Kongakut River.

the absence of 5 and 6 year olds is they had not begun their migration into freshwater. Older, mature adult char migrate upstream first; the size of the migrants decreases as the run continues. A third possibility is fish seven years and older (in spawning condition) did not leave the system that May, or if they did, spent a very short time at sea.

RECOMMENDATIONS

1. Specific spawning areas need to be identified. Annual surveys are recommended to establish baseline spawning populations prior to oil and gas development.

2. Identified spawning areas need to be ground-checked to document habitat characteristics (spring locations, flow, relative macroinvertebrate abundance, water chemistry, etc.), to obtain size and extent of spawning areas (via mapping), to obtain relaive abundance estimates of both adults and juveniles, to obtain spawning sex ratios, to obtain spawning and nonspawning population ratios, and to examine fish for tags from other studies.

3. A larger sample size needs to be collected to adequately describe growth, to assess mortality and to describe age distribution and sex ratios of char and grayling.

4. No juvenile Arctic grayling were captured during this study. A special attempt should be made to identify their distribution, relative abundance, and food habits.

7. Stream gaging stations and portable weather stations should be erected at the lowermost portion of each subdrainage and at spring origins to adequately describe flow regimes.

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