Fairbanks Fishery Resouces Progress Report Number FY86-3

NOTES ON THE AGE, GROWTH, DISTRIBUTION AND SUMMER FEEDING HABITS OF ARCTIC FLOUNDER IN BEAUFORT LAGOON, ARCTIC NATIONAL WILDLIFE REFUGE, ALASKA, 1985

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Key words: Arctic flounder, distribution, summer feeding habits, Beaufort Lagoon, Arctic National Wildlife Refuge

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May 2, 1986

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Notes on the age, growth, distribution and summer feeding habits of Arctic flounder in Beaufort Lagoon, Arctic National Wildlife Refuge, Alaska, 1985.

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Abstract: Arctic flounder (Liopsetta glacialis) was the second most abundant species captured in Beaufort Lagoon in July and August 1985, and comprised 10% of the total number of fish captured in the lagoon. They ranged in length from 55-298 mm with the length interval 126-150 mm predominating. These fish were primarily 3 and 4 years old. Arctic flounder were most numerous at the nearshore mainland sampling station. Numbers of Arctic flounder captured were generally low and constant throughout July and August. A marked increase in catch began in mid-August. The major prey item during the summer was the amphipod Gammarus setosus. Isopods and polychaetes were also preyed upon.

INTRODUCTION

In concurrence with Section 1002(c) of the Alaska Natural Interest Lands Conservation Act (ANILCA) to provide baseline information on the fish and wildlife on the Arctic coastal plain, Arctic flounder (Liopsetta glacialis) were collected to determine their age and growth, distribution within the lagoon, and feeding habits. Arctic flounder are an abundant marine species inhabitating Beaufort Lagoon during summer months. They remain in the nearshore coastal waters during winter (Morrow 1980). Because of their abundance and tendency to remain nearshore, Arctic flounder may prove to be a good indicator species for future monitoring in the area facing development. Concurrent with this report, baseline histopathological and contaminant studies on this species is included in Fairbanks Fishery Resources Progress Report Number FY86-4 (West 1986).

STUDY AREA

Beaufort Lagoon (69°52'N, 142°15'W) is located approximately 60 km southwest of Barter Island (Fig. 1). The lagoon borders the Arctic coastal plain and is separated from the Beaufort Sea by a long, narrow barrier island. The Aichilik and Egaksrak Rivers are major rivers flowing into the lagoon. Traditional names for smaller embayments within Beaufort Lagoon are Nuvagapak Lagoon on the west of the Aichilik River delta, and Egaksrak Lagoon on the east side. All sampling was confined to Nuvagapak Lagoon.

The nearshore waters are influenced by a northwesterly longshore current and wind patterns associated with storms (Truett 1981). The entrances to Beaufort Lagoon are near Angun Point and the Aichilik River delta. Beaufort Lagoon is described as a limited exchange lagoon (Hachmeister and Vinelli 1984) where the flow of nearshore waters is restricted from entering the lagoon by the barrier islands.

Most of Beaufort Lagoon is covered with fast ice during the winter months. The open water season usually runs from late June until September or October. In June, snow melt runoff enters the lagoon from the rivers and accelerates breakup in the lagoon. Waters inside the lagoon tend to be warmer and less saline than offshore waters during the summmer months due to the freshwater intrusions being retained within the lagoon by the barrier islands.

The width of Beaufort Lagoon varies from 0.3 km (0.2 mi.) to approximately 2.0 km (1.2 mi.). Water depths are up to 3.7 m (12 ft.) deep over an organic-mud substrate. The shoreline of the barrier island is comprised of sand and small-size gravel.

METHODS

Fish sampling was conducted at Beaufort Lagoon, Alaska, at three stations and included three habitat types (Fig. 2): nearshore mainland (Station 2); mid-lagoon (Station 3); and inside barrier island (Station 4). Two fish sampling methods were used: 1) dual trap, directional fyke nets with 61 m (200 ft.) leads and 15.25 m (50 ft.) wings extended perpendicularly from shore (Stations 2 and 4), and 2) 38.1 m (125 ft.) monofilament experimental gill net

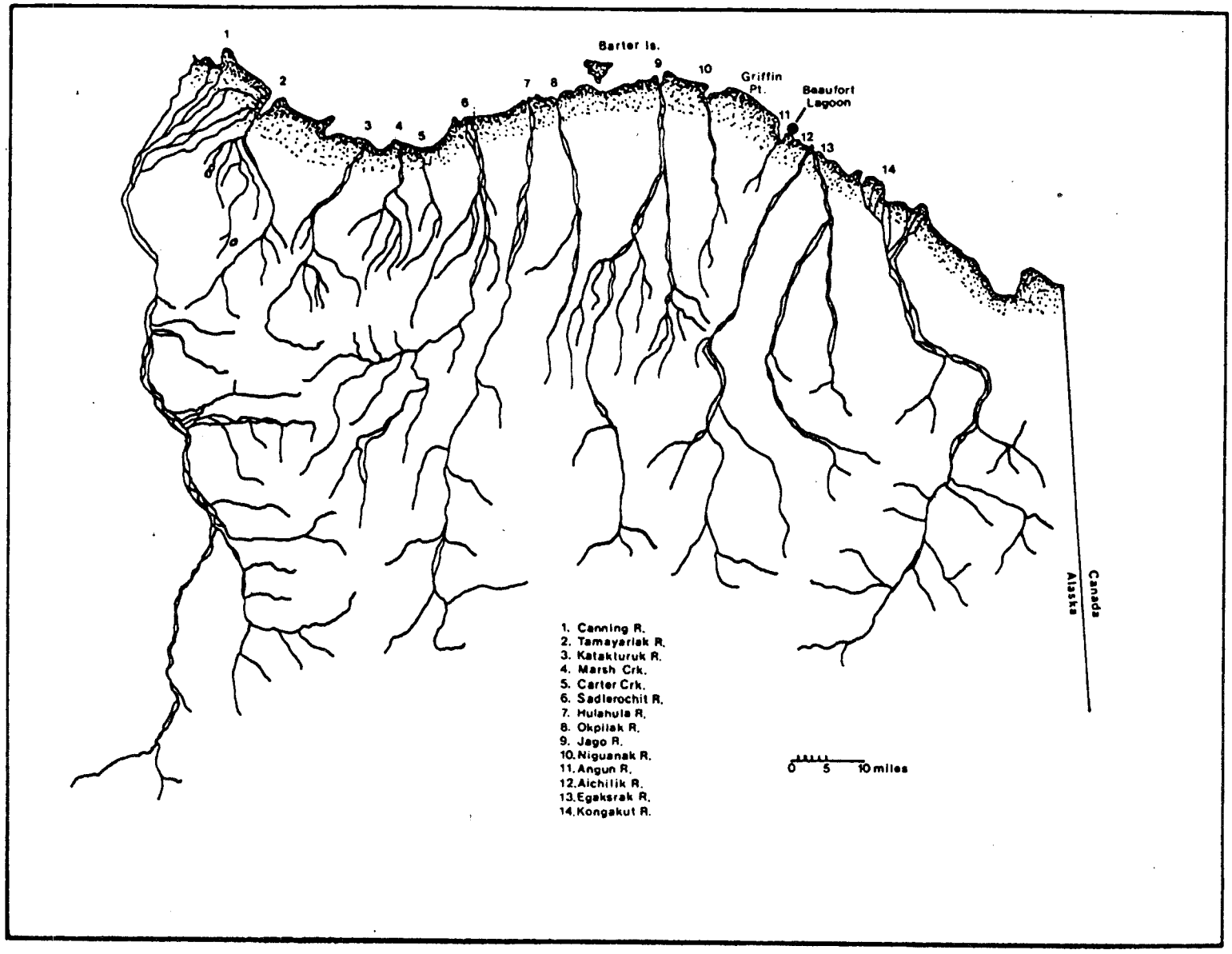

Figure 1. Major rivers on the north slope in the Arctic National Wildlife Refuge, Alaska.

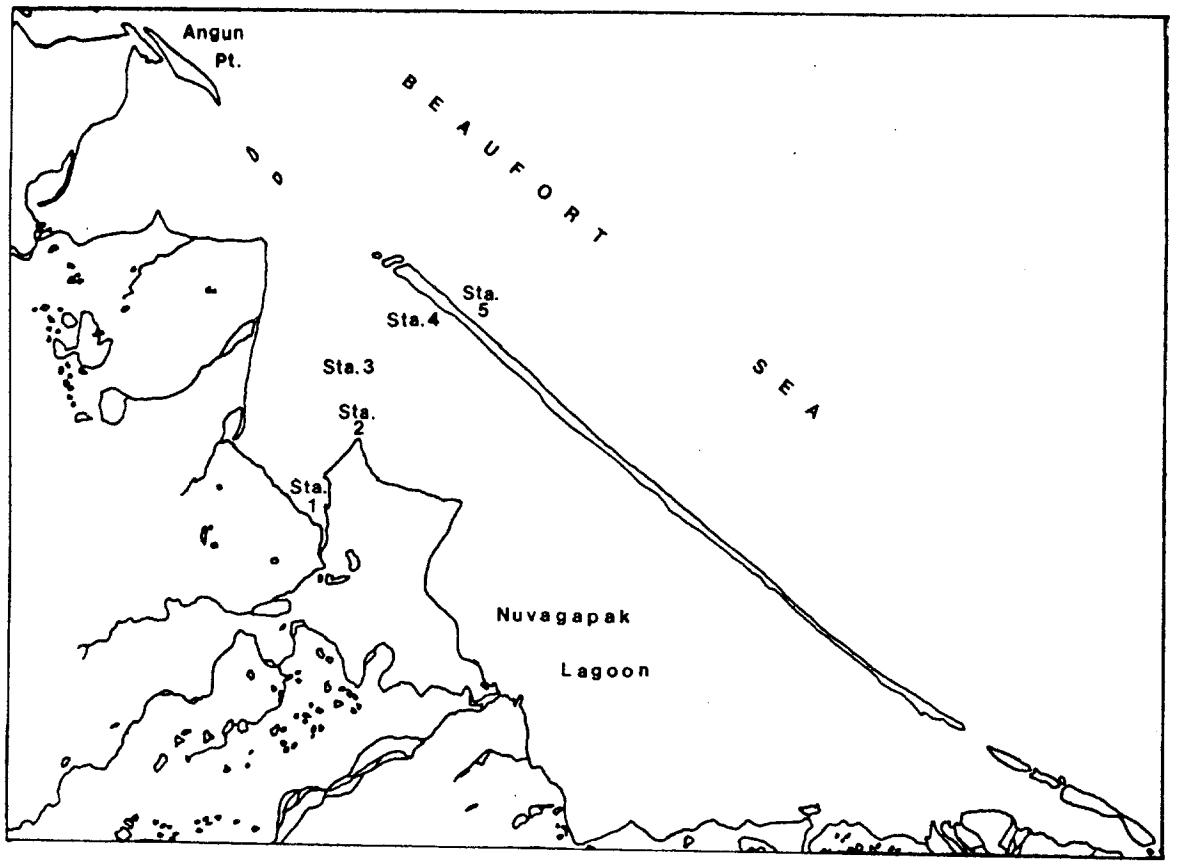

Figure 2. Sampling stations, Beaufort Lagoon, Alaska, 1985. Stations 2 and 4 were fyke net stations operated July 7 to August 9; station 3 was an experimental gillnet site fished July 22 - 29, 1985.

with 5 panels of 12.7, 25.4, 38.1, 50.8, and 63.5 mm (0.5, 1.0, 1.5, 2.0, and 2.5 inch) bar mesh. The two fyke net stations were operated from July 7 to August 9, 1985 and the gill net station from July 22-29, 1985. Fork lengths of fish were measured to the nearest millimeter (mm). Weights of fish were determined by using a Pesola spring scale with a range of 0 to 250 g or an Ohaus balance accurate to 0.1 g.

Ages were determined from otoliths. Otoliths were cleaned in Kodak Photo-Flo 200 and read under a Bausch and Lomb dissecting scope, 3-7x.

Fish esophagi and stomachs were excised and preserved in formalin or iso-propanol and contents were later removed and stored in iso-propanol. Prey items were separated by taxa. The prey items were analyzed by using a modification (West and Wiswar 1985) of the Index of Relative Importance (IRI) developed by Pinkas et al. (1971).

IRI = % Frequency of Occurence (% Number + % Volume).

RESULTS AND DISCUSSION

Arctic flounder comprised 10% of the total number of fish captured in Beaufort Lagoon during July and August 1985. Arctic char (Salvelinus alpinus) and fourhorn sculpin (Myoxocephalus quadricornis) were the most numerous species comprising 43% and 37%, respectively, of the total catch (Wiswar and West 1986). Arctic flounder were second only to fourhorn sculpin (Myoxocephalus quadricornis) as the most abundant marine species caught.

Length frequencies

Arctic flounder captured in Beaufort Lagoon by fyke net ranged in length from 55 mm to 298 mm. The fish from the 101-125 mm and 126-150 mm length intervals were the most frequent in Beaufort Lagoon (Fig. 3). These lengths correspond to the 3 and 4 year age class flounder (Table 1). Griffiths (1983) reported Arctic flounder between 80 and 120 mm to dominate the catch in Angun and Beaufort Lagoons in a short survey conducted between July 25 and August 5, 1982. In a survey along the western Beaufort Sea coast from Point Barrow to Harrison Bay Schmidt et al. (1983) found over 80% of the Arctic flounder catch was under 200 mm. Arctic flounder captured in Simpson Lagoon (Craig and Haldorson 1981) were larger, with the predominant length group represented by fish greater than 180 mm.

Age and growth

The age-specific length, weight and sex ratio for Arctic flounder collected from Beaufort Lagoon is presented in Table 1. In 1985 age classes 3 and 4 were dominant in the fyke net catch. The oldest flounder, a female, was age 9 and measured 298 mm. Weights ranged from 11.5 g for age 4 fish to 346.7 g for age 9 fish. No females were found under age 5. Female flounder dominated (79%) age classess 6-9 years.

In Beaufort Lagoon in 1984 (West and Wiswar 1985) the age classes 3 and 4 were also dominant in the fyke net catch. Bendock (1979) reported age 10 to predominate between Harrison Bay and Flaxman Island in 1975 and 1976 during the open water season. Andriyashev (1954) reported different age classes

Table 1. Age specific length, weight, and sex ratio for Arctic flounder, Beaufort Lagoon, Alaska, July-August 1985 (n=38).

Age	n	Total length(mm) mean	range	S.D.	Weight (g) mean	range	S.D.	n	Sex Ratio Female:Male
4	6	135.3	94-174	29.3	31.9	11.5-65	20.5	0[a]	-
5	18	163.5	125-195	17.0	55.8	19.2-96.1	19.9	15[b]	1:2.7
6	10	202	185-216	10.6	112.0	69.2-161	27.6	10	4:1
7	2	220.5	220-221	0.7	155.0	150-160	7.1	2	1:1
8	0								
9	2	276.5	255-298	30.4	287.4	228-346.7	83.6	2	1:0

a Sex was not determined.
b Sex was not determined for 3 of the fish aged.

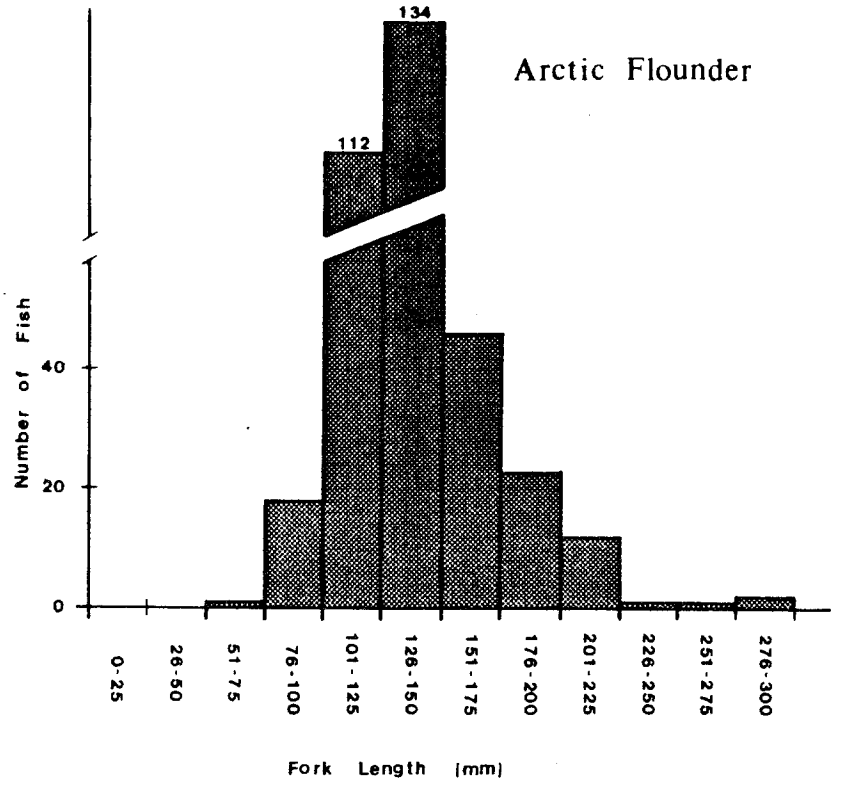

Figure 3. Length frequencies of 350 Arctic flounder captured with fyke nets, Beaufort Lagoon, Alaska, July and August 1985.

predominating in different regions and different times of the year off the Siberian coast. The predominant age class(es) reported from different areas may also be dependent on gear type. Arctic flounder have been reported up to age 19 in Nunaluk Lagoon Y.T. (Griffiths et al. 1975); however, other studies have shown the maximum age to range from 9 to 12 years along the Siberian coast (Andriyashev 1954), Kaktovik Lagoon, Alaska, (Griffiths et al. 1977), and between the Canning and Colville Rivers (Bendock 1979).

Few studies have reported age-specific length of Arctic flounder. In Nunaluk Lagoon, Yukon Territory (Griffiths et al. 1975) age classes 4 and 5 flounder had larger mean lengths than those from Beaufort Lagoon, but age class 6 and above were smaller (Fig. 4). This same comparison also holds for Arctic flounder from Kolgueu Island, U.S.S.R. (Andriyeshev 1954).

Distribution within the lagoon

Arctic flounder were most numerous at the nearshore mainland station (Sta. 2) during this study where 87% of the total number were caught. Arctic flounder moving in a westerly direction accounted for 56% of the total catch; almost twice that of those moving east (31%). At the barrier island station (Sta. 4) the difference in the percent of the catch between flounder moving east and

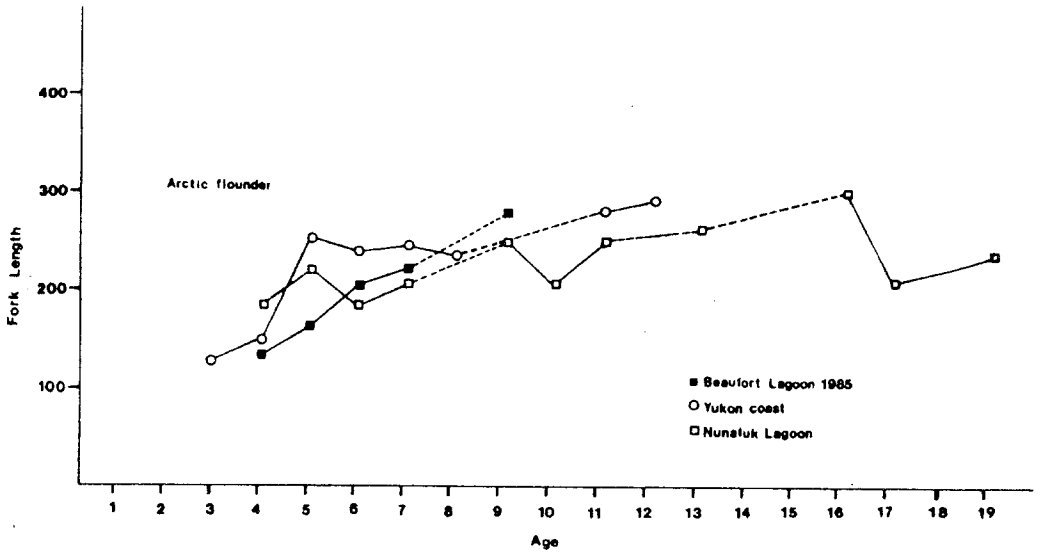

Figure 4. Comparison of age-specific length of Arctic flounder captured in Beaufort Lagoon, Alaska, 1985 with other Beaufort Sea coastal areas; Yukon coast (Kendal et al. 1975), Nunaluk Lagoon, Y.T. (Griffiths et al. 1975). Line hashed to indicate missing age groups in sample.

west was slight and total numbers were low. In 1984 the Station 2 fyke net also received a major portion of the catch, 63% (West and Wiswar 1985). No Arctic flounder were captured at the mid-lagoon gill net station (Sta. 3), probably more due to gear type than sampling location.

The catch-per-unit-effort (CPUE) (Table 2) of Arctic flounder caught per trap/hour moving westerly at the nearshore mainland showed the greatest variation ranging from 0.11 - 2.11 . The highest CPUE occured during the period of August 8-9, the last period sampled. Generally the CPUE at this station was below 0.30 fish/trap-hr. The CPUE at the west trap at this station was less variable and ranged from 0.05 - 0.35 fish/trap-hr. No discernible peak periods of abundance were observed except for the marked increase on August 8-9 at the nearshore mainland station.

Table 2. Catch-per-unit-effort of Arctic flounder in fyke nets, Beaufort Lagoon, Alaska, July and August 1985.

Nearshore Mainland (Station 2)			Lagoon Side of Barrier Island (Station 4)		
Dates	West trap*	East trap*	Dates	West trap*	East trap*
7/8-10	0.21	0.27	7/8-10	0.09	0.02
11-13	0.21	0.14	11/13	0.03	0.01
14-16	0.35	0.19	14-16	0.11	0.01
17-19	0.05	0.29	17-19	0.03	0.03
20-22	0.19	0.29	20-22	0.00	0.01
23-26	0.23	0.43	23-26	0.06	0.03
7/28 - 8/81	0.23	0.27	7/30 - 8/1	0.03	0.02
8/2-4	0.21	0.34	8/2-4	0.10	0.07
5-7	0.13	0.11	5-7	0.04	0.04
8-9	0.34	2.11	8-9	0.08	0.19

* West trap caught fish moving east; east trap caught fish moving west.

Feeding habits

Thirty-nine Arctic flounder collected from Beaufort Lagoon in 1985 were examined to determine summer feeding habits. Fifteen of the stomachs examined were empty. The amphipod Gammarus setosus was the most important prey item followed by isopods and polycheates (Fig. 5). The amphipod comprised the largest percent of prey items and was found in over 50% of the stomachs containing prey items. Isopods and mysids appeared in about one-third of the stomachs (Table 3).

The food habits of Arctic flounder in Beaufort Lagoon are similar to those reported from other areas along the Beaufort Sea coast (Bendock 1979, Griffiths et al. 1975, Craig and Haldorson 1981). In Simpson Lagoon, Arctic flounder fed heavily on the amphipod Onisimus sp. which was reported to be the most abundant food source in the lagoon (Griffiths and Dillinger 1980). In Beaufort Lagoon, the amphipod Gammarus setosus appears very abundant based on stomach analysis of other fish species (West and Wiswar 1985). Arctic flounder showed less variation in their diets than the other species examined from Beaufort Lagoon (West and Wiswar 1985).

The fyke net traps were checked approximately every 24 hours. The long retention time probably accounted for the high number of empty stomachs (38%). The retention time may also bias the results by overemphasizing the importance of G. setosus in the diet. The size of G. setosus lends them capable of passing through the mesh of the trap as well as the mouth of the trap, while other organisms such as polychaetes and isopods may not do so as readily. Feeding while in the traps cannot be discounted as any small organisms in the trap could be prey items.

Table 3. Prey items of Arctic flounder, Beaufort Lagoon, Alaska, July and August 1985.

Prey item	% N	% V	% FO	IRI
Amphipoda				
Gammarus setosus	73	44	54	6318
other	3	9	17	204
Isopoda	13	15	38	1064
Polychaeta	10	8	13	234
Mysidacea	1	5	8	48
Unidentified material	-	19	21	398

Total number of prey items = 301
Number of stomachs with contents = 24
%N = aggregate percent number of prey
%V = percent mean volume
%FO= percent frequency of occurence
IRI= Index of Relative Importance

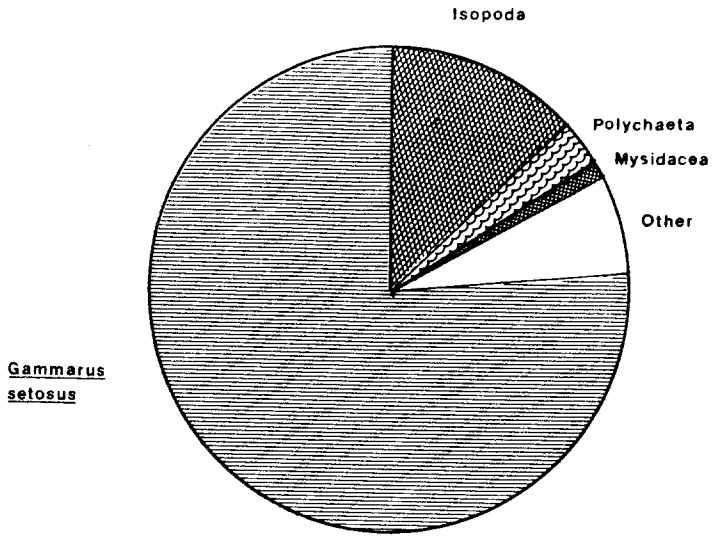

Figure 5. Comparison of IRI values of major prey items of Arctic flounder, Beaufort Lagoon, Alaska, July and August 1985.

ACKNOWLEDGEMENTS

The author wishes to thank the following people for assisting in data collection: Robin L. West, Tonya M. Stevens, C. Ann Swartz, Michael Phillips and Patricia Rost. Thanks also to Susan Mang and David Daum for manuscript preparation and Reed Glesne for manuscript review and editing.

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