FISHERIES RESEARCH BOARD OF CANADA

MONTREAL

"CALANUS" Series

Foreword

In 1947 the Fisheries Research Board of Canada initiated the Eastern Arctic Investigations. These were seasonal investigations with headquarters at McGill University, Montreal, under Prof. M. J. Dunbar of the Department of Zoology. The following year the 50-foot wooden diesel ketch "Calanus" was built and sailed to Chimo, Quebec.[1] There began in 1949 a series of exploratory marine biological investigations with the vessel, covering a large area of the eastern Canadian arctic.[2]

In 1956 the Arctic Unit of the Fisheries Research Board was established on a full-time basis. This incorporated the Eastern Arctic Investigations and includes Board programs across the Canadian arctic in marine and freshwater fisheries, biological oceanography and marine mammals, as well as east coast programs in marine mammals.

The "Calanus" Series consists of collected reprints of publications resulting directly from the vessel's program. In the early years all investigations were centred on the vessel. Now a second vessel of the Unit operates in the western arctic, and marine sampling is carried out as well from various government survey ships and ice-breakers. For this reason the collection of a special "Calanus" Series will not be continued. Results of the Unit's work will continue to appear in Board publications, or in the Board's "Studies" Series, collected reprints of work by Board staff published in outside journals.

The 24 papers of the "Calanus" Series therefore represent work of the Board's arctic investigations in 1947 and 1948, and programs connected with the vessel from 1949 to 1959. It is hoped that these will, for a long time, form a useful reference on eastern arctic marine biology.

H. D. Fisher,
Scientist in Charge

Montreal, Canada, 1963.

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[1]Dunbar, M. J. 1949. "Calanus". New arctic research vessel. Arctic *2*(1): 56-57.

[2]Dunbar, M. J. 1956. The "Calanus" expeditions in the Canadian arctic, 1947 to 1955. Arctic *9*(3): 178-190.

LIST OF SERIES PAPERS

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1 Dunbar, M. J. and E. H. Grainger.
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2 Dunbar, M. J. and H. H. Hildebrand.
Contribution to the Study of the Fishes of Ungava Bay.

3 Grainger, E. H.
On the Age, Growth, Migration, Reproductive Potential and Feeding Habits of the Arctic Char (*Salvelinus alpinus*) of Frobisher Bay, Baffin Island.

4 Grainger, E. H.
Station List of the *Calanus* Expeditions, 1951-52, together with Frobisher Bay Stations, 1948, 1950 and 1951, and Resolution Island Stations, 1950.

5 Grainger, E. H.
Polychaetous Annelids of Ungava Bay, Hudson Strait, Frobisher Bay and Cumberland Sound.

6 Dunbar, M. J.
The Amphipod Crustacea of Ungava Bay, Canadian Eastern Arctic.

7 Bousfield, E. L.
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8 Fontaine, Marion.
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9 Grainger, E. H.
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15 Dunbar, M. J.
Physical Oceanographic Results of the "Calanus" Expeditions in Ungava Bay, Frobisher Bay, Cumberland Sound, Hudson Strait and Northern Hudson Bay, 1949-1955.

16 Lubinsky, I.
Studies on *Mytilus edulis* L. of the "Calanus" Expeditions to Hudson Bay and Ungava Bay.

17 Bursa, Adam S.
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18 Bursa, Adam.
Phytoplankton of the *Calanus* Expeditions in Hudson Bay, 1953 and 1954.

19 Grainger, E. H. and J. G. Hunter.
Station List of the 1955-58 Field Investigations of the Arctic Unit of the Fisheries Research Board of Canada.

20 Grainger, E. H.
The Annual Oceanographic Cycle at Igloolik in the Canadian Arctic. 1. The Zooplankton and Physical and Chemical Observations.

21 Grainger, E. H.
The Copepods *Calanus glacialis* Jaschnov and *Calanus finmarchicus* (Gunnerus) in Canadian Arctic-Subarctic Waters.

22 Grainger, E. H.
Zooplankton of Foxe Basin in the Canadian Arctic.

23 Squires, H. J.
Decapod Crustacea of the *Calanus* Expeditions in Frobisher Bay, Baffin Island, 1951.

24 Dunbar, M. J.
The Life Cycle of *Sagitta elegans* in Arctic and Subarctic Seas, and the Modifying Effects of Hydrographic Differences in the Environment.

Station List of the "Calanus" Expeditions, 1947-50

By M. J. Dunbar and E. H. Grainger
McGill University, Montreal

(*Received for publication April 10, 1951*)

"CALANUS" SERIES, NO. 1

ABSTRACT

A list is given of 167 stations where biological or oceanographic observations or collections were made, in Ungava Bay and adjacent waters.

INTRODUCTION

The Fisheries Research Board Eastern Arctic Investigations have been continued in Ungava Bay and adjacent waters for four seasons, 1947-50, and the mass of material collected is in process of being worked out. The field of operations is being shifted to Baffin Island in 1951. Following the modern practice of expedition series of this sort, the station list for the four seasons is published separately here, together with the necessary maps, so that reference to stations can be made in the forthcoming papers of the "Calanus" series without the tedious and expensive process of repeating lists and maps in each separate publication. Dates at which stations were occupied are not included; many stations were occupied more than once, and all relevant information in the matter of dates will appear in the publication of results.

The "Calanus" herself was built in 1948, and was used in the field during the seasons of 1949 and 1950. Smaller, locally owned boats were chartered in 1947 and 1948. The name "Calanus", however, is here applied to all individual expeditions made under the Eastern Arctic Investigations, for convenience and ease of reference.

J. Fish. Res. Bd. Can., 9(2) 1952.
Printed in Canada.

LIST OF STATIONS

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
	1947				
1	7 miles north of Koksoak River mouth	58°39′	68°15′	18-31	plankton hauling, hydrographic
1A	False River	58°24.5′	67°58′	—	littoral collecting
2	Koksoak River	58°27′	68°12′	11	plankton hauling, hand-line fishing
3	18 miles north of Koksoak River mouth	58°50′	68°13′	28	plankton hauling, benthos (dredging), hydrographic
4	between Leaf Bay and Koksoak River	58°45′	68°21′	shallow	hand-line fishing
5	south of Station 4	58°39′	68°20′	shallow-0	littoral collecting, hand-line fishing
6	Kassigiaksiovik River mouth, Leaf Bay	58°52′	68°58′	5-0	plankton hauling, littoral collecting, seine fishing
7 & 54	Leaf Bay	58°55′	68°53′	10	plankton hauling, benthos (dredging), hydrographic
8	Leaf Bay	58°52′	68°54′	—	littoral collecting
9	Leaf Bay	59°02′	68°43′	24	plankton hauling
10	Leaf Bay	58°53′	69°03′	4-5	hand-line fishing
11	6 miles northeast of Gyrfalcon Islands	59°11′	68°47′	46	benthos (dredging), hand-line fishing, hydrographic
12	northeast of Hopes Advance Bay	59°30′	69°10′	4-5	littoral collecting, hand-line fishing
13	near Station 12	59°30′	69°00′	46-55	plankton hauling, long-line fishing
14	10 miles east by south from Payne Bay	59°55′	69°21′	53	sounding
15	Payne Bay	59°58′	69°43′	18	sounding
16	Payne Bay	60°01′	70°01′	5-0	littoral collecting, hand-line fishing
17	southeast of Tuvalik, Payne Bay	60°01′	69°25′	62	long-line fishing
18	east of Tuvalik	60°02′	69°03′	84	plankton hauling, hydrographic

LIST OF STATIONS—*Continued*

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
19	Payne Bay	60°03′	69°40′	shallow	hand-line fishing, long-line fishing
20	4 miles west of Station 14	59°53′	69°29′	less than 64	benthos (dredging)
21	5 miles west of Station 14	59°54′	69°31′	64	benthos (dredging)
22	Inuksulik (1), 10 miles north of Gyrfalcon Islands	59°18′	68°57′	9-11	plankton hauling, hand-line fishing
23	north of Leaf Bay	59°05′	69°04′	—	littoral collecting
24	near Station 23	59°06′	69°00′	7	sounding
25	3 miles north-east of Gyr-falcon Islands	59°08′	68°48′	35	benthos (dredging), hydrographic
26	Leaf Bay	58°56.5′	69°02′	29	sounding
27	Leaf Bay	58°55.5′	69°01′	47	benthos (dredging)
28	Leaf Bay	58°54.5′	68°59′	27	benthos (dredging), hand-line fishing
29	between Leaf Bay and Kok-soak River	58°47′	68°21′	—	sealing
30	10 miles north of Koksoak River mouth	58°42.5′	68°10′	36	benthos (dredging)
31 & 65	Inukshuktuyuk, in Koksoak River	58°31.5′	68°12′	shallow-0	plankton hauling, littoral collecting
32	18 miles north by east of mouth of George River	59°04′	65°57′	7-9	hand-line fishing
33	Keglo Bay	59°13′	65°45′	shallow 18-27 27	plankton hauling, benthos (dredging), hand-line fishing, long-line fishing, hydrographic
34	24 miles north of George River mouth	59°16′	66°17′	47	hand-line fishing, hydrographic
35	Keglo Bay	59°10′	65°44′	5	sounding
36	Keglo Bay	59°12′	65°41′	7-13	hand-line fishing
37	Keglo Bay	59°05.5′	65°45′	3-4	plankton hauling

LIST OF STATIONS—*Continued*

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
38	Keglo Bay	59°03′	65°47′	shallow	plankton hauling
39	George River	58°33.5′	65°57.5′	—	gill-net fishing
40	Keglo Bay	59°02′	65°48′	shallow-0	plankton hauling, littoral collecting
41	29 miles west of Adlorilik	59°34′	66°24′	240	plankton hauling, hydrographic
42 & 73	4 miles north of Adlorilik	59°34.5′	65°27′	7-9	hand-line fishing
43	Port Burwell, inner harbour	60°24.8′	64°49.9′	shallow	plankton hauling, hand-line fishing
44	Forbes Sound	60°23.5′	64°50.5′	80	plankton hauling, long-line fishing, hand-line fishing, hydrographic
45	Port Burwell, outer harbour	60°24.5′	64°50.5′	27-37	benthos (dredging), long-line fishing, hand-line fishing
46	Forbes Sound	60°23.5′	64°52.5′	92-110	long-line fishing
47	Forbes Sound	60°22.8′	64°52′	110	long-line fishing
48	12 miles south by west of Port Burwell	60°14′	64°58′	14-18	hand-line fishing
49	Adlorilik	59°29′	65°26′	—	littoral collecting
50	9 miles southwest of Beacon Island, mouth of George River	58°45′	66°37′	—	
51 & 235	Pitulaksitik, between Whale River and George River	58°29.5′	66°55′	shallow-0	plankton hauling, littoral collecting
52	8 miles north of False River mouth	58°37′	67°51′	16-17	benthos (dredging)
1948					
53	5 miles north of Inukshuktuyuk Point, mouth of Koksoak River	58°38′	68°13′	9	plankton hauling, benthos (dredging)
54 & 7	Leaf Bay	58°55′	68°53′	—	plankton hauling
55	10 miles east of Gyrfalcon Islands	59°08′	68°34′	85	long-line fishing, hydrographic

LIST OF STATIONS—*Continued*

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
56	23 miles northeast of Whale River mouth	58°37′	67°06′	18 (at least)	plankton hauling, benthos (dredging), hydrographic
57	10 miles north by west of Keglo Bay	59°21′	66°00′	96 shallow	plankton hauling, hydrographic, hand-line fishing
58	20 miles south by west of Port Burwell	60°05′	65°06′	20	benthos (dredging)
59	Forbes Sound	60°24′	64°51′	15 54	benthos (dredging), hand-line fishing, hydrographic
60	Young Inlet southeast of Port Burwell	60°19.8′	64°40.5′	28 (at least) 36 (at least)	plankton hauling, long-line fishing, hydrographic
61	west of Munro Harbour	60°24′	64°55′	45 64	long-line fishing, hydrographic
62	between Bush and Killinek Islands	60°29′	64°44′	29	plankton hauling, hand-line fishing, hydrographic
63	Forbes Sound	60°22.5′	64°48.5′	—	plankton hauling
64	False River	58°27.5′	67°56′	—	littoral collecting
65 & 31	Koksoak River	58°31.5′	68°12′	—	littoral collecting
66	Burwell, outer harbour	60°24.4′	64°50′	—	littoral collecting
67	inner harbour, Burwell	60°24.8′	64°49.6′	—	littoral collecting
68 & 120	tidal lake, southeast of Port Burwell	60°24.5′	64°49′	—	littoral collecting
69	south of Young Inlet	60°20.5′	64°44.5′	—	littoral collecting
70	Port Burwell, inner harbour	60°25.1′	64°50.2′	—	littoral collecting
71	McLelan Strait	60°22′	64°44′	36	long-line fishing
72	mouth of George River	58°50′	66°21′	18	hand-line fishing
73 & 42	4 miles north of Adlorilik	59°34.5′	65°27′	15	hand-line fishing
74	Forbes Sound	60°24′	64°50′	14-18	hand-line fishing
75	Young Inlet (various points)			5-30	hand-line fishing

LIST OF STATIONS—*Continued*

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
76	mouth of Young Inlet	60°21.5′	64°46.5′	18	hand-line fishing
77	Forbes Sound	60°22.5′	64°48.8′	18-27	hand-line fishing
78	west end of McLelan Strait	60°22.3′	64°46.7′	46	hand-line fishing
79	between Bush and Killinek Islands	60°28.5′	64°43.2′	18	hand-line fishing
80	Port Harvey, northern Killinek Island	60°28.5′	64°41.4′	22	hand-line fishing
81	southern Lenz Strait, north of Killinek Island	60°29.1′	64°49′	5	hand-line fishing
82	Amittoq Inlet, 1 mile northwest of Port Burwell	60°25.9′	64°51.5′	27	hand-line fishing
83	1 mile north of Amittoq Inlet	60°26.8′	64°52.1′	18	hand-line fishing
84	south by west of Munro Harbour	60°24.4′	64°52.8′	18-21	hand-line fishing
85	west of Munro Harbour	60°24.4′	64°56′	100	long-line fishing
86	12 miles south by west from Port Burwell	60°13′	64°58′	9	hand-line fishing
87	5 miles south by west of Station 86	60°08′	65°03′	9	hand-line fishing
88	3 miles south by west of Station 87	60°05.5′	65°05′	27	hand-line fishing
89	25 miles north of Adlorilik	59°57′	65°14′	18	hand-line fishing
90	1 mile north of Adlorilik	59°31′	65°25′	9-30	hand-line fishing
91	8 miles west by south of Adlorilik	59°27′	65°40′	5-36	hand-line fishing
92	between George and Whale Rivers	58°32′	66°56′	11	hand-line fishing

LIST OF STATIONS—*Continued*

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
1949					
101	2 miles southeast of Beacon Island, mouth of George River	58°52′	66°23′	18	plankton hauling
102	Forbes Sound	60°23.5′	64°52′	90-130	benthos (trawling), benthos (dredging)
103	2 miles west of Jackson Island, west of Port Burwell	60°24′	64°58′	145-275 (depth varied) 290	plankton hauling, benthos (dredging), benthos (trawling), long-line fishing, hydrographic
104	west of Jackson Island	60°26′	65°10′	255	plankton hauling
105	Port Burwell, outer harbour	60°24.2′	64°51′	15-28	hand-line fishing, hydrographic
106	3 miles west of Cape William Smith	60°21′	64°58′	100-110	plankton hauling, benthos (dredging)
107	Forbes Sound	60°22′	64°47′	55-73	benthos (dredging), long-line fishing
107A	Mission Cove, Port Burwell	60°25.2′	64°50.8′	—	littoral collecting
107B	inlet south of Mission Cove	60°25.05′	64°50.9′	—	littoral collecting
108	Hydrographic section from Port Burwell to Akpatok Island	60°22′	65°42′	360	hydrographic
109		60°23′	66°25′	110	hydrographic
110		60°24′	66°52′	115	hydrographic
111		60°24′ (position uncertain)	67°35′	57-63	hydrographic
112 & 205	Imilik	60°46′	69°27′	—	littoral collecting
113	Hydrographic section from Payne Bay to Akpatok Island	60°05′	69°17′	60-75	hydrographic
114		60°08′	68°50′	145	hydrographic
115		60°10′	68°26′	225	hydrographic
116	Hydrographic section from Akpatok to the Koksoak River	59°50′	68°30′	145	hydrographic
117		59°25′	68°45′	100	hydrographic
118		59°04′	68°12′	32	hydrographic
119	Forbes Sound	60°23.8′	64°52.2′	127	long-line fishing
120 & 68	tidal lake, southeast of Port Burwell	60°24.5′	64°49′	—	shark

LIST OF STATIONS—*Continued*

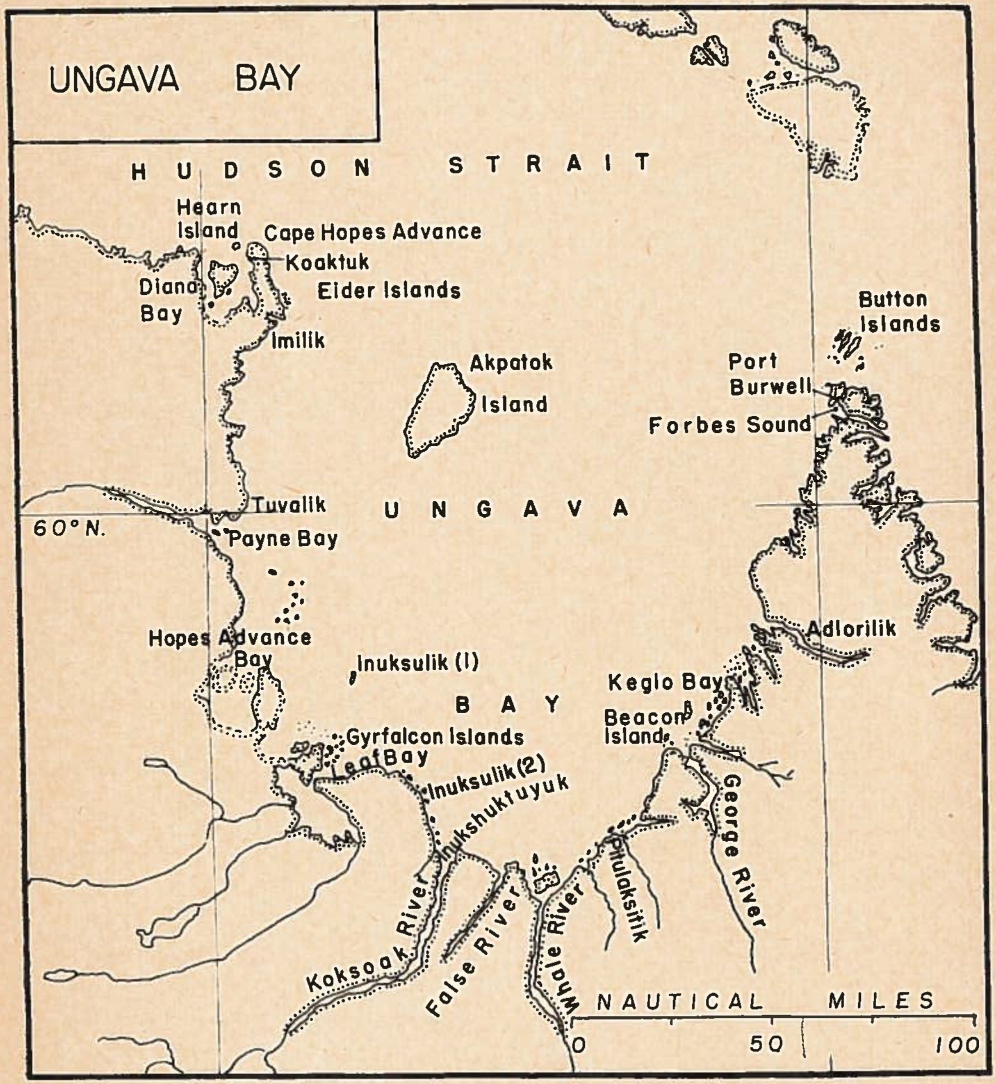
Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
121	Forbes Sound	60°22.2′	64°47.3′	28-55	hand-line fishing
122	Fox Harbour	60°25.7′	64°52.2′	28-55	hand-line fishing
123	Calanus Harbour, Button Islands	60°39.5′	64°41.8′	— 15 7	littoral collecting, plankton hauling, hand-line fishing, hydrographic
123A	mouth of Koksoak River	58°31.5′	68°10′	shallow	plankton hauling
124	north by west of Inuksulik (1)	59°25′	69°00′	—	plankton hauling
125	Payne Bay	60°00′	70°04′	18	plankton hauling
125A	Payne Bay	60°03′	69°37′	12	plankton hauling, hand-line fishing
126	Hydrographic section from Payne Bay to Akpatok Island	60°04′	69°26′	70-91	benthos (dredging), benthos (trawling), hydrographic
127		60°07′	69°07′	106	hydrographic
128		60°12.5′ 60°14′	68°27′ 68°26′	185 185	hydrographic plankton hauling
129	10 miles north of Koksoak River mouth	58°43.3′	68°17′	—	plankton hauling
1950					
201A	Adlorilik	59°29′	65°18.5′	0-12	littoral collecting, hydrographic
201B	Adlorilik	59°22′	64°58′	0-18	littoral collecting, hand-line fishing, hydrographic
201C	Adlorilik	59°29.5′	65°20.5′	80-100	plankton hauling, benthos (dredging), hydrographic
202	10-mile radius from 25 miles NNW of George River mouth			—	sealing
203	5 miles northeast of Inuksulik (2)	58°50′	68°18′	30	plankton hauling, benthos (dredging)
204	Inuksulik (2)	58°47′	68°23′	—	littoral collecting
205 & 112	Imilik	60°46′	69°27′	0-18	littoral collecting, hydrographic

LIST OF STATIONS—*Continued*

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
206	5 miles east of Imilik	60°45′	69°17′	55-90	plankton hauling, benthos (dredging)
207	Eider Islands	60°53′	69°19′	27-91	long-line fishing
208	400 yards north of Cape Hopes Advance	61°05.3′	69°34′	80-90	plankton hauling, benthos (dredging), long-line fishing
208A	3 miles north of Cape Hopes Advance	61°08′	69°33′	195	hydrographic
208B	Cape Hopes Advance	61°05′	69°33′	—	littoral collecting
209	5 miles north of Cape Hopes Advance	61°10′	69°33′	183	plankton hauling
210	Diana Bay, east of Hearn Island	61°04.5′	69°39′	90-110	long-line fishing, benthos (dredging)
211	Diana Bay, 1 mile west of Koaktuk	61°02.5′	69°41.5′		plankton hauling
212	Diana Bay, Koaktuk	61° 02′	69°38′	shallow-0	plankton hauling, benthos collecting, littoral collecting, hand-line fishing
213	Diana Bay, 1 mile south, west of Hearn Island	61°03.5′	69°44′	90	long-line fishing
214	Diana Bay, ½ mile north-east of Station 213	61°03.8′	69°43.5′	90	long-line fishing
215	Diana Bay, south	60°49.5′	69°52′	—	littoral collecting
216	Diana Bay, south	60°49.5′	69°56′	18-20	benthos (dredging)
217	Wakeham Bay	61°41′	71°56′	18-0	littoral collecting, plankton hauling, benthos collecting, hand-line fishing
218	Hydrographic section from Wakeham Bay to Lake Harbour	61°51′	71°46′	137	hydrographic
219		62°02′	71°25′	at least 400	hydrographic
220		62°14′	71°05′	about 300	hydrographic
221		62°12′	69°38′	274	hydrographic

LIST OF STATIONS—*Continued*

Station	Map location	North Latitude	West Longitude	Depth (metres)	Type of station (work done)
222	south of Lake Harbour	62°45′	69°41′	80-90	plankton hauling, benthos (dredging)
223	near Station 222	62°43′	69°37′	20-75	plankton hauling
224	Port Burwell, outer harbour	60°24.2′	64°50.5′	18-60	hand-line fishing, long-line fishing
224A	Mission Cove, Port Burwell	60°25.1′	64°50.8′	—	littoral collecting
225	Button Islands, north of Mac-Coll Island	60°40.5′	64°39.7′	22	benthos collecting, hand-line fishing
226	Button Islands, east of Mac-Coll Island	60°38′	64°38.9′	90-100	plankton hauling, benthos (dredging)
227	Button Islands, south of Minto Anchorage	60°35.9′	64°43.5′	0-20	littoral collecting, hydrographic
228	southwest of Beacon Island, mouth of George River	58°52′	66°28′	14	plankton hauling
229	Adlorilik	59°29′	65°17.5′	13-0	plankton hauling, littoral collecting
230	Adlorilik	59°30′	65°17.5′	—	plankton hauling, hand-line fishing
231	Adlorilik	59°28.5′	65°15′	63-90	plankton hauling, benthos (dredging)
232	Adlorilik	59°23′	65°01′	10	plankton hauling, long-line fishing
233	Adlorilik	59°30.5′	65°21.5′	shallow	hand-line fishing
234	10 miles west of Adlorilik	59°31′	65°45′	82-90	plankton hauling hydrographic
235 & 51	Pitulaksitik, between Whale River and George River	58°29.5′	66°55′	—	littoral collecting
236	off mouth of Koksoak River	——	——	—	sealing


UNGAVA BAY
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Cape Hopes Advance
Koaktuk
Diana Bay
Eider Islands
Imilik
Akpatok Island
Button Islands
Port Burwell
Forbes Sound
Tuvalik
60° N.
UNGAVA
Payne Bay
Hopes Advance Bay
Inuksulik (1)
BAY
Adlorilik
Keglo Bay
Beacon Island
Gyrfalcon Islands
Leaf Bay
Inuksulik (2)
Inukshuktuyuk
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Pitulaksitik
Whale River
False River
Koksoak River
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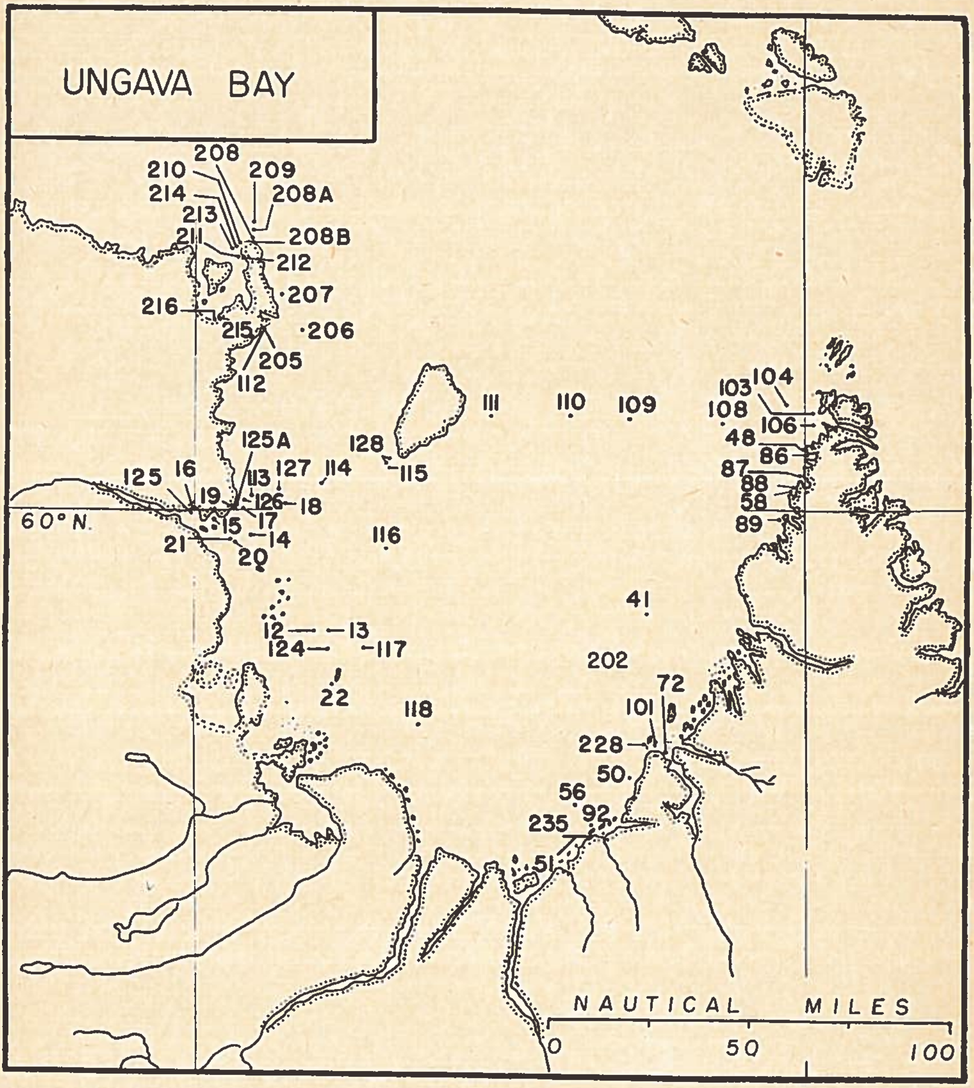
FIGURE 1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22
118
101
228
50.
56
92
235
51
NAUTICAL MILES
0
50
100

Figure 2

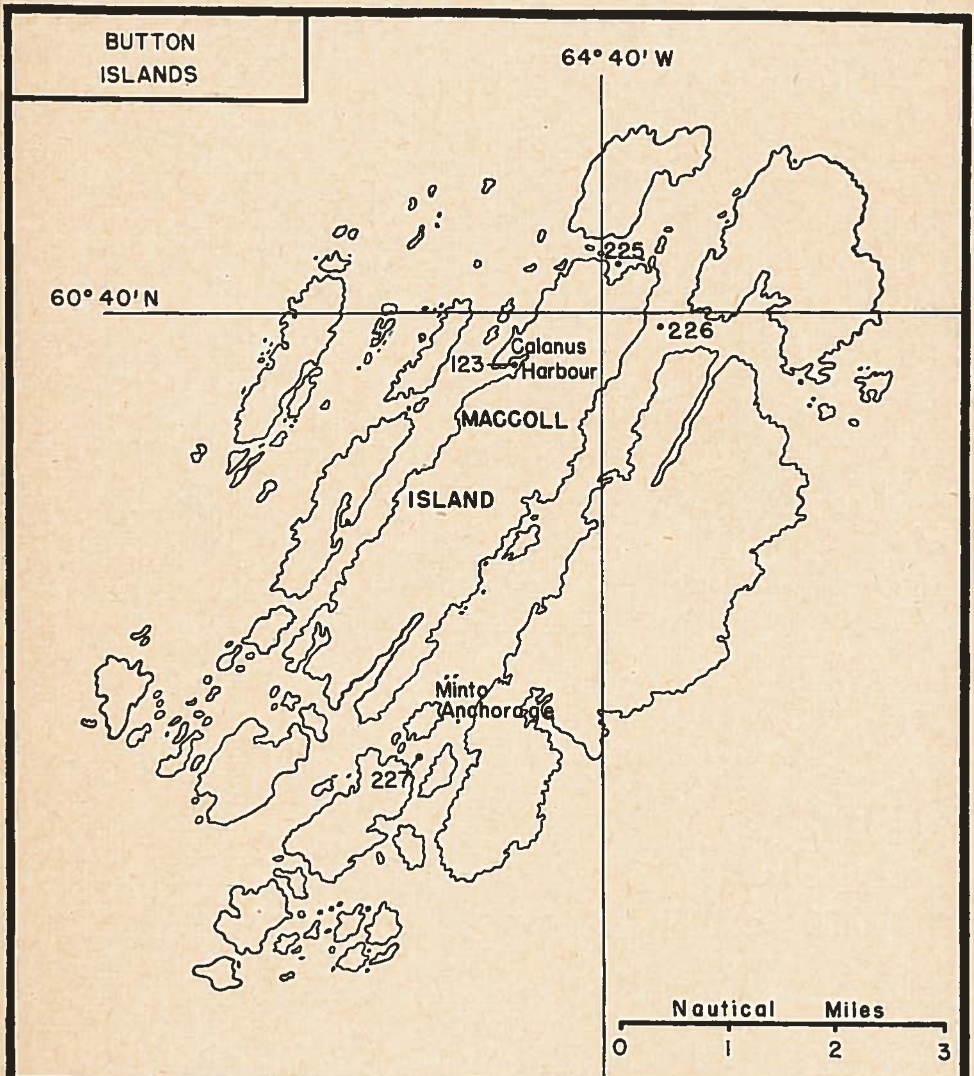
BUTTON
ISLANDS
64° 40' W
60° 40' N
225
226
Calanus
Harbour
123
MACCOLL
ISLAND
Minto
Anchorage
227
Nautical Miles
0
1
2
3

FIGURE 3

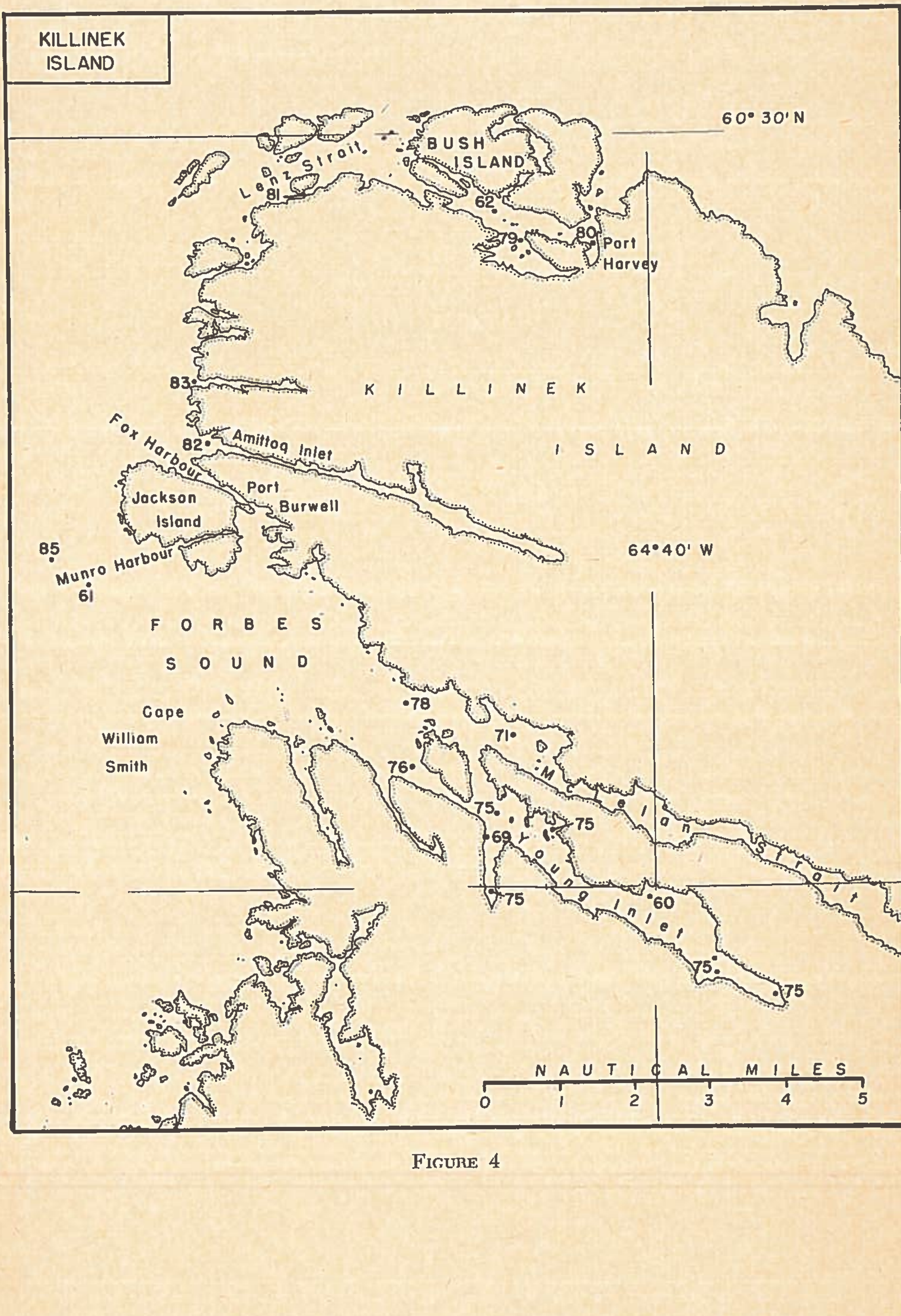
KILLINEK ISLAND
60° 30' N
BUSH ISLAND
Lenz Strait
81
62
79
80
Port Harvey
83
KILLINEK
ISLAND
Fox Harbour
82
Amittoq Inlet
Port Burwell
Jackson Island
85
Munro Harbour
61
64°40' W
FORBES
SOUND
Cape William Smith
78
71
76
Mc Lelan Strait
75
69
75
Young Inlet
75
60
75
75
NAUTICAL MILES
0 1 2 3 4 5

FIGURE 4

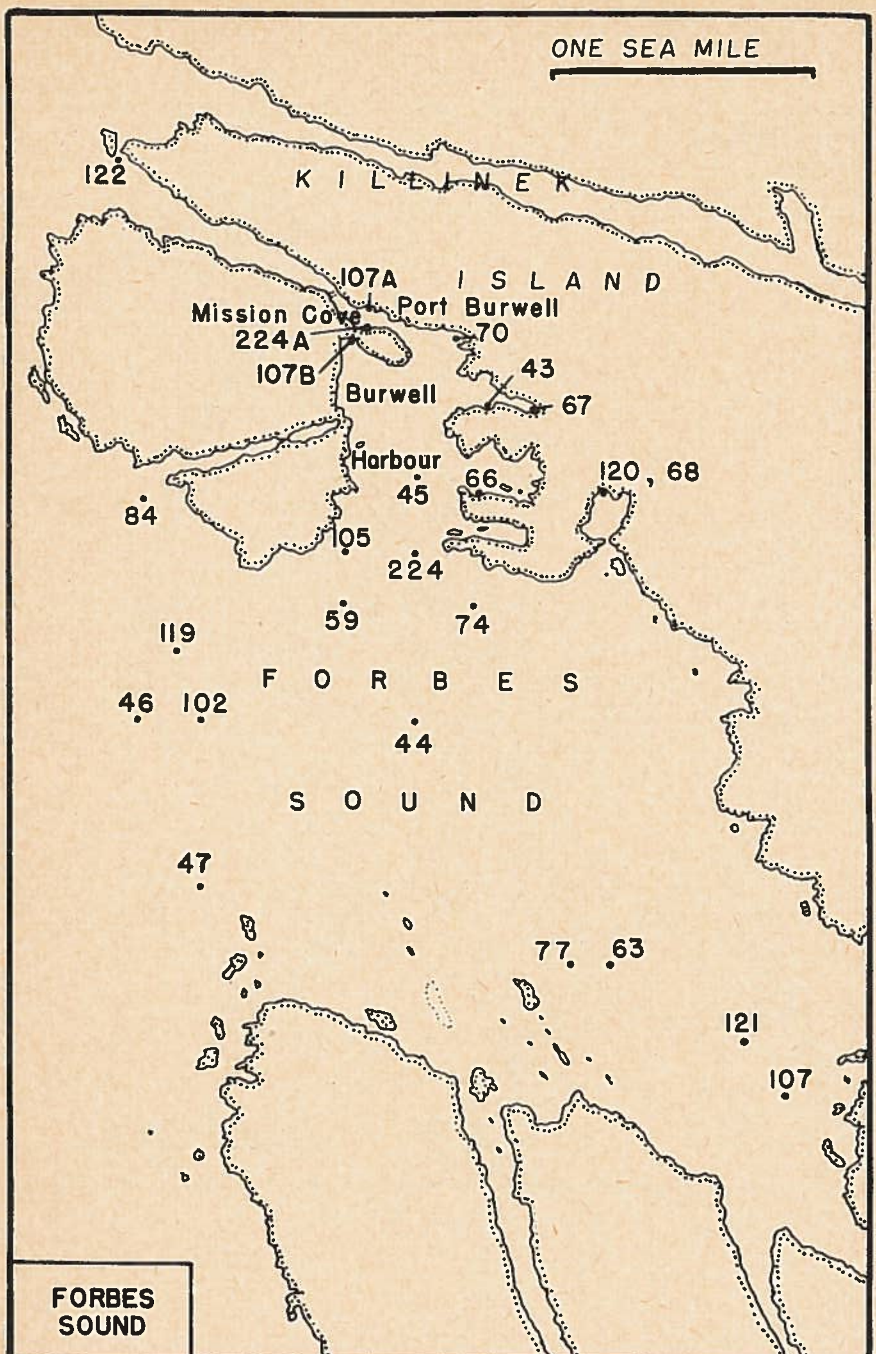
ONE SEA MILE
122
K I L L I N E K
I S L A N D
107A
Port Burwell
Mission Cove
224A
70
107B
43
Burwell
67
Harbour
120, 68
66
45
84
105
224
59
74
119
F O R B E S
46
102
44
S O U N D
47
77
63
121
107
FORBES
SOUND

Figure 5

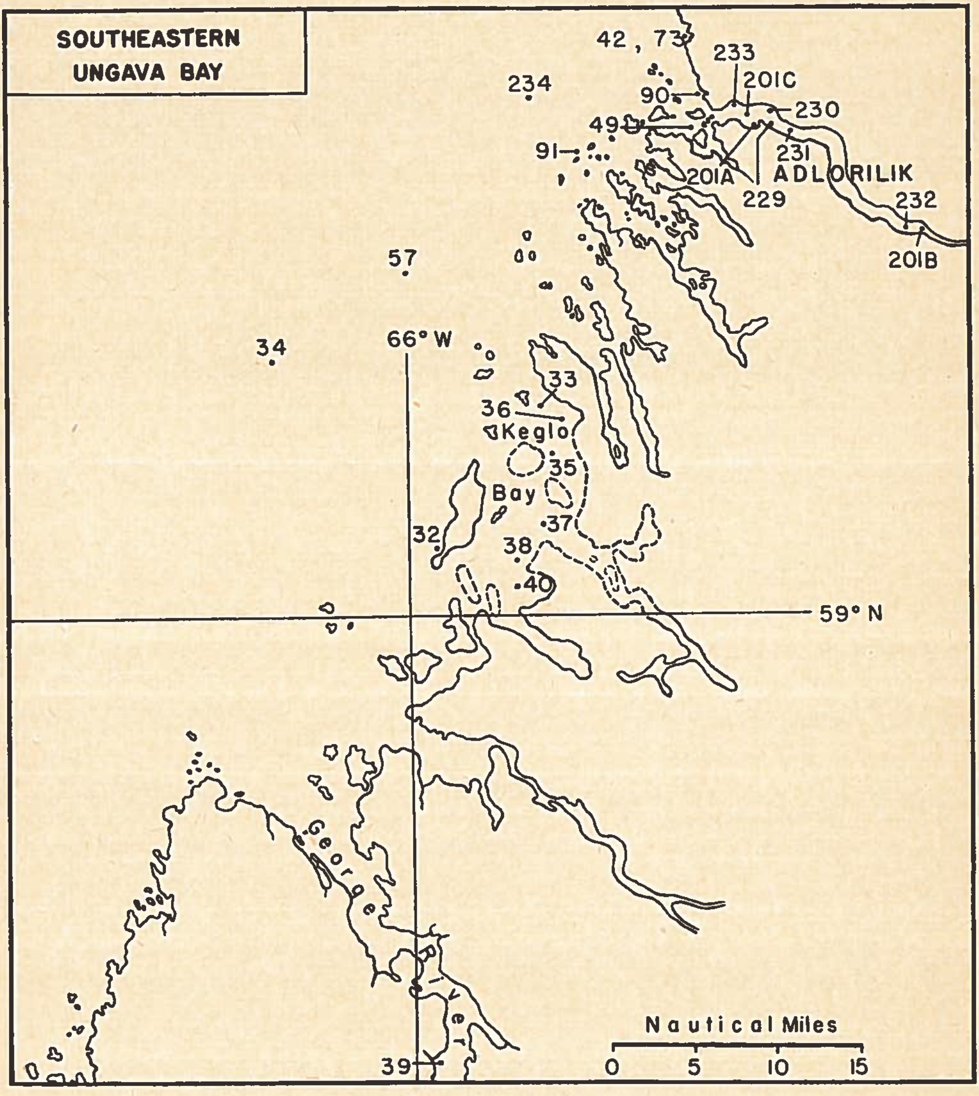
SOUTHEASTERN
UNGAVA BAY
42, 73
233
234
201C
90
230
49
231
91
201A
ADLORILIK
229
232
201B
57
34
66° W
33
36
Keglo
35
Bay
37
32
38
40
59° N
George
River
Nautical Miles
0
5
10
15
39

FIGURE 6

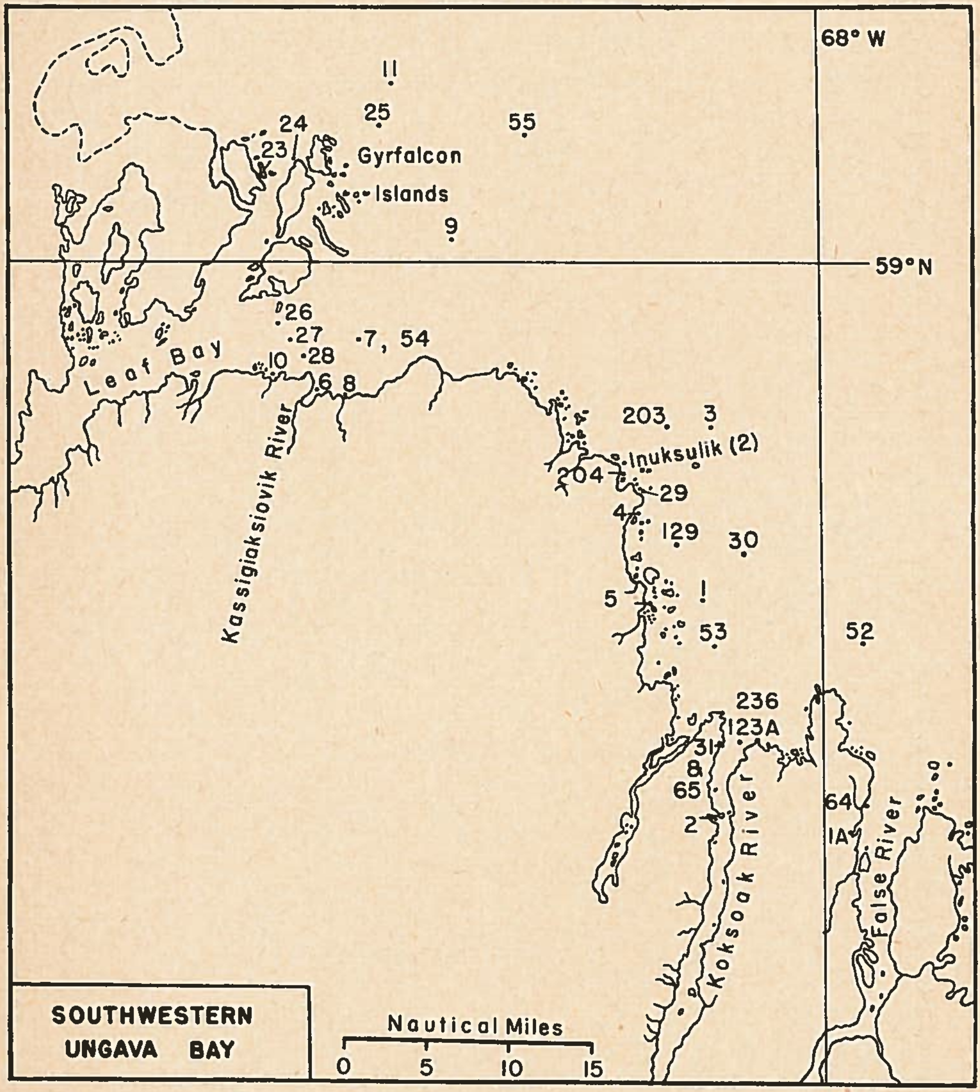
68° W
59° N
11
25
55
24
23
Gyrfalcon
Islands
9
26
27
·7, 54
10
28
6
8
Leaf Bay
Kassigiaksiovik River
203
3
Inuksulik (2)
204
29
4
129
30
5
1
53
52
236
123A
31
8
65
2
64
1A
Koksoak River
False River
SOUTHWESTERN
UNGAVA BAY
Nautical Miles
0
5
10
15

Figure 7

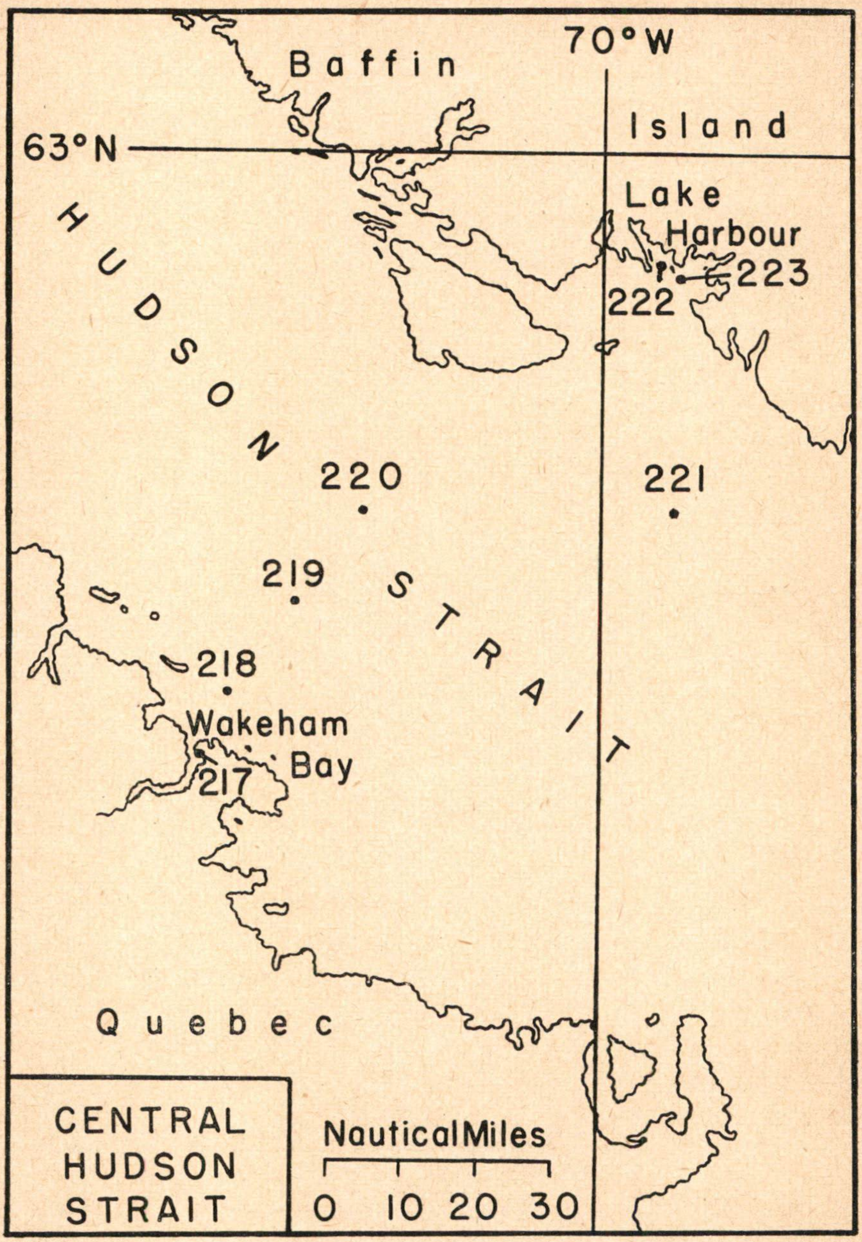
70° W
Baffin
Island
63° N
Lake
Harbour
223
222
HUDSON
STRAIT
220
221
219
218
Wakeham
Bay
217
Quebec
CENTRAL
HUDSON
STRAIT
Nautical Miles
0 10 20 30

FIGURE 8

Contribution to the Study of the Fishes of Ungava Bay

By M. J. Dunbar and H. H. Hildebrand
McGill University, Montreal

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"CALANUS" SERIES NO. 2

ABSTRACT

The aquatic environment of the Ungava Bay area and watershed is described. Forty-four species of fishes are recorded, belonging to twenty-one families. Twenty-nine are marine forms, two are anadromous, and thirteen are predominantly or entirely freshwater forms. Seventeen are new records for Ungava Bay, and a few are new for the whole of the Canadian Eastern Arctic. The marine piscine fauna is shown to be in the main subarctic, containing such arctic-subarctic forms as *Salvelinus alpinus, Reinhardtius hippoglossoides, Gymnocanthus tricuspis, Icelus bicornis, Aspidophoroides olriki, Lumpenus fabricii,* etc., and subarctic-boreal species such as *Salmo salar, Gadus callarias, Sebastes marinus, Liparis atlanticus* and *Mallotus villosus.* More strictly arctic species in the fauna are *Boreogadus saida, Triglops nybelini* and *Oncocottus quadricornis;* there are two Atlantic boreal species recorded, *Paralepis rissoi kröyeri* and *Lampanyctus crocodilus,* and the remainder are fishes of wide north-south range, found in all three zones (arctic, subarctic, boreal), such as *Somniosus microcephalus, Myctophum glaciale, Ammodytes dubius, Triglops pingeli, Eumicrotremus spinosus, Liparis tunicatus, Lumpenus maculatus, Lycodes reticulatus.*

INTRODUCTION

In 1947, the Fisheries Research Board launched the eastern arctic marine investigations, based on two general terms of reference: (1) the investigation of the physical and biological oceanography of the eastern arctic region of Canada, and (2) the discovery and study of any marine resources which could be developed in the interests of the native population. The programme of research was placed under the direction of the senior author, and field work started in Ungava Bay.

The 1947 reconnaissance was carried out with the help of such boats as were available at Fort Chimo, a small 30-foot motor boat and a 40-foot Peterhead boat, native-owned. Both sides of Ungava Bay were studied by the present authors, from Payne Bay around to Port Burwell. The area covered was necessarily restricted by the inadequacy of the craft used, but nevertheless the season's work demonstrated the most fruitful lines of research for the future.

Hildebrand made a short visit to the Fort Chimo area again in March 1948, for a three weeks' study of the winter fishing in certain lakes, and of the species involved. In the summer of 1948, Hildebrand and P. A. Orkin, again in a Peterhead boat, studied sealing conditions in the western part of Ungava Bay,

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and spent the latter part of the summer in the vicinity of Port Burwell, collecting more material for the study of the Atlantic cod. During this season the new research vessel "Calanus", a 50-foot diesel ketch, was built in Nova Scotia, and was sailed up to Fort Chimo in August and September, to be beached for the winter.

The "Calanus" made possible much more extensive work than was attempted in the first two seasons. There were no geographic limitations on the waters studied, the ship being capable of working both at sea and in shallow inshore waters, and the equipment included trawls, and larger dredges than could be handled from the smaller craft. During this season the senior author was in charge of the field operations, assisted by E. H. Grainger. The station list for all this work has been published separately in this series (Dunbar and Grainger, 1952), and for all references in this present paper to stations and geographic locations, the reader is directed to that general station list.

The difficulties resulting from the inadequacy of the boats used in 1947 and 1948 need not be enlarged upon here. The available maps of Ungava Bay are very incomplete and often inaccurate, and there are not many soundings. Other limitations were placed upon the work by the short season at our disposal and by the very erratic climate of the area.

The first discovery of Ungava Bay by Europeans is in some doubt. Presumably information from Portuguese fishermen must have been responsible for a bay which appears on Mercator's map of 1569 and which is supposed to represent Ungava Bay. The first certain record of exploration in the vicinity of Ungava Bay is that of John Davis, (in 1587), who named Cape Chidley. The exact location of the Cape Chidley of John Davis is in dispute, but is now credited to several small islands off the eastern coast of Killinek Island.

Weymouth visited Ungava Bay in 1602, and Henry Hudson, having read Weymouth's journals, entered Hudson Strait in 1610. Ungava Bay was not mentioned for a number of years after Hudson, but undoubtedly many of the exploring parties which entered Hudson Bay passed Ungava Bay, and at times probably sailed into it. French fur traders penetrated far into the region, and a map published by Delisle in 1703 used the name "Baie du Sud" for Ungava Bay.

In 1811 two Moravian missionaries, Kohlmeister and Kmoch, sailed from Labrador into Ungava Bay, taking the treacherous route through McLelan Strait (Ikerasak). Many of the features of the eastern and southern portions of the bay were mapped and named by them. They ascended the Koksoak River at least as far as Fort Chimo, where they were well received by the natives. On their return to England, they described the region in enthusiastic terms, for it seemed to them very pleasant compared to the barren coast of northern Labrador.

No notice appears to have been taken of this report except by the Hudson's Bay Company, which took steps to open trading negotiations at Chimo. There is considerable confusion in the published dates of the first establishment of the first Ungava Bay trading post. According to Elton (1942), who had access to the company's files, a preliminary survey was made in 1828 by Dr. Mendry (or Hendry), who approached Fort Chimo overland from Richmond Gulf in Hudson

Bay. The post was established by Nichol Finlayson in 1830, but owing to difficulties in supplying it (the marine route still being largely unexplored), it was abandoned in 1843. In 1866 it was reopened, and supplied by the new vessel "Labrador". Of special interest to the present subject is the development of a commercial salmon fishery by the Hudson's Bay Company, starting in 1881 (see below). Other trading posts were later opened at Port Burwell, George River, Payne Bay and Leaf River. The Leaf River and Port Burwell posts have since been closed.

Collection of natural historical material, including fish, did not begin in Ungava Bay until the arrival of L. M. Turner in 1882. Lucien McShan Turner was sent to Fort Chimo by the United States Army Signal Service at the instigation of S. F. Baird of the Smithsonian Institution. Turner's instructions were to reside in the region, keeping weather data, making ethnological investigations and collections of animals and plants; in carrying out this programme he spent over two years, from August 6, 1882 to September 4, 1884, in and around Fort Chimo. The collections and material he brought home were very considerable, but only his ethnological work, and an abbreviated list of the birds recorded, have been published. His manuscript material, including some fifty pages on fishes, is deposited in the United States National Museum, and for the opportunity of studying this, and also for permission to publish all or part of it, the present authors are indebted to that institution. In the material presented here, Turner is quoted at some length on several of the species discussed.

The Canadian Government expeditions to Hudson Strait and Hudson Bay, in 1884, 1885 and 1886, under A. R. Gordon, visited Killinek Island and established an observation station at Burwell. Between 1892 and 1895, A. P. Low of the Geological Survey made explorations in the Ungava Peninsula, and in 1897 he explored the south coast of Hudson Strait from King George Sound and including Ungava Bay as far east as George River. There was little exploratory work from that date until quite recent years. Several small collections have been made by individuals on Government Patrol parties; in 1927 Frits Johansen visited Port Burwell as naturalist on board the "Larch", and Dunbar made marine collections during short visits at the same station (Burwell) in 1939 and 1940.

The total Eskimo population of the Ungava Bay district is small, probably somewhat under a thousand. In 1940, census figures showed 257 at Chimo, 357 at Payne Bay, and 203 at George River and Burwell, giving a total of 817 for that year. This population is normally scattered along the shores in hunting and fishing groups, and the census locations refer simply to the trading posts at which they obtain their supplies. The Indians at Fort Mackenzie, inland from Chimo, numbered about 180 in 1940. The Eskimo population appears to have been increasing steadily for many years.

The fishing activity of the native population is not great, and is restricted almost entirely to the Atlantic salmon and the arctic char. The problem of the development of a marine fishery in Ungava Bay, by and for Eskimos, will be dealt with in a separate paper in this series.

LITERATURE

There is no publication dealing with the fishes of Ungava Bay alone. The earliest ichthyological reference to the area is probably that of McLean (1849), who lists trout, whitefish, suckers and salmon as comprising the fish fauna of the region. Davis (1854) adds the northern pike to this list. Robert Bell and A. P. Low, of the Geological Survey of Canada, have a number of references to fish in the reports of their investigations in the Ungava region. L. M. Turner mentions a few of the fish in his report on the ethnology of the region and in several short papers. His main work on the fish has never been published, as already mentioned above, and some of this manuscript material is used in the present paper. Kendall (1909) in working on his paper on the fishes of Labrador, became acquainted with Turner's collection in the U. S. National Museum, but Turner's manuscript with details of locality, abundance, etc., appears to have eluded his search. Kendall published the list of fishes in Turner's collection with the statement that Turner collected in the vicinity of Fort Chimo. One of the present authors (H.H.) finally unearthed the manuscript notes, and its use has allowed the correction of certain errors in the published distribution of some of the fishes.

Since Kendall's list in 1909, a few species of fish collected at Port Burwell by Johansen in 1927 have been recorded by Vladykov in his publication on the fishes of the Hudson Bay region (Vladykov, 1933). Legendre and Rousseau (1949) have recorded certain salmonids, suckers, sticklebacks and the northern pike from rivers flowing into Ungava Bay (George and Payne Rivers). Perhaps the most interesting record in this latter paper is that of a cyprinid, *Couesius plumbeus*, from a stream close to Indian House Lake.

AQUATIC ENVIRONMENT

The watershed of Ungava Bay is vast and partially unexplored. Our knowledge of the fishes of the interior is limited to the writings of A. P. Low, who travelled in the area during the years from 1892 to 1895. Low used only common names for the fishes observed, such as salmon, whitefish, trout and suckers, and the difficult portages made the collection of fishes impossible. Dr. Jacques Rousseau made two voyages in recent years, down the George River in 1947 and along the Payne River in 1948, and was able to preserve small fish collections. L. M. Turner has some information of the fresh waters near Fort Chimo, and the present authors made collections of fresh-water fishes where possible during an essentially salt-water investigation.

Except for the limestone island of Akpatok, the terrain and watershed belong to the Canadian Shield, of a general low-lying topography to the south and west, with the mountains of northern Labrador to the east. Five major rivers drain into the bay; the Koksoak, George, Leaf, Whale and Payne Rivers, in that order of magnitude; and several lesser streams, the most important of which are the Mukalik, Tuktuk, Tunulik and Korok Rivers. The combined freshwater contribution of these rivers is enormous, and must play a decisive part in lowering the salinity of the waters of the bay, at least in the upper layers.

The tree-line takes a somewhat unsteady course across this watershed. In the northern extremities of their distribution, the trees (dominated by tamarack and black spruce) are found only in the river valleys and in other depressions in the terrain. From the present inconclusive studies there appears to be a relation between the northern limit of trees and the distribution of fresh-water fishes, and there is also the suggestion that the limiting factor in several cases may be food supply rather than the direct temperature effect.

Frozen conditions on the lakes in the Fort Chimo area are prolonged. Frost may occur in any month of the year, and the freezing of the lakes takes place in late October or November. The ice cover was found to vary between 42 and 54 inches on the lakes visited by Hildebrand early in April 1948, and the variation appeared to be correlated inversely with snow cover. The ice on the lakes begins to melt in May, and the outlets open shortly after; but the ice does not disappear completely until the beginning of July. In 1948, several days of high wind broke up the ice on Lake Mendry near Fort Chimo earlier than usual, and the lake was free of ice by the 25th of June.

The duration of the snow cover varies considerably from year to year. Many of the hills and steeper slopes are bare of snow by the middle of May, but the snow persists in protected places well into July, sometimes throughout the summer. The snow falls again first in September. No glaciers form anywhere in the Ungava Bay drainage.

Hildebrand's work in March and April (March 21 to April 13) 1948 covered three lakes close to Fort Chimo. Lake Mendry (also called locally Whitefish Lake), Lac Berthet (Goudies Lake), and Lake Stewart, which is unnamed on Canadian charts. The proximity of these lakes to the settlement of Fort Chimo was apparently responsible for the reduction of the fish populations recorded. Details of methods used on this survey, and of the fish themselves, are given below.

The physical oceanography of Ungava Bay, shown by the present series of field studies, will be published in a separate paper. The salinities and corrected temperatures from the 1949 work are not available at the time of writing, but the 1947 results are sufficient to show the general nature of the water. Thus at station 41 (see station list, Dunbar and Grainger, 1952), on August 17, 1947, the following readings were obtained:

Depth (m.)	T°C.	S ‰	Oxygen (cc/1.)
0	2.30	32.01	8.15
10	2.33	32.00	8.05
25	2.00	32.00	7.95
50	0.54	32.27	7.17
100	–0.79	32.50	7.26
150	–0.95	32.77	6.95
200	–1.92	32.75	7.12

The very low temperature at 200 metres is remarkable and is comparable to the figures obtained in Hudson Bay in 1930 by Hachey (1931). Such low temperatures were not recorded in 1948 or 1949.

Temperatures were somewhat lower in the upper layers in the early part of the season, as is to be expected, and the salinities also were lower in June and July, showing strong coastal influence and the effects of melting ice. It is clear that the water of Ungava Bay is strongly affected by both these factors, and that temperatures are always low. The highest temperature recorded was in 1949, at station 114 on August 24, where the surface temperature was 5.80°C. In the matter of temperature, the waters of Ungava Bay lie between the strictly arctic conditions recorded from the Baffin Island coasts and the strongly sub-arctic waters of west Greenland, where the Atlantic influence is strong. It is doubtful whether any great Atlantic intrusion can be shown from the physical data alone, but the fact that the temperatures are not low enough to signify unmixed polar water, and the presence within the bay of the Atlantic cod (*Gadus callarias*), and the Atlantic salmon (*Salmo salar*), together form good evidence for Atlantic influence.

The western and southern portions of Ungava Bay are shallow, in general less than 100 metres in depth. In the eastern half of the bay depths of over 200 metres have been recorded, and in the extreme northeast, off Burwell, the water approaches 400 metres depth. Just outside the bay, west of the Button Islands, there is a sudden drop over a small area to 800 metres. The general pattern of the bathymetry is given by Dunbar (1951); more detailed information is in preparation. The bottom is muddy and rocky, and almost everywhere very uneven.

METHODS OF COLLECTING

The fishes described here were taken by dredge, tow net, hand line, a few by long-line trawl and otter-trawl, and some by hand in the intertidal zone. Details of long-lining and otter-trawling will be published separately; neither method was found to be satisfactory in Ungava Bay. A 150-foot seine net was used for a short time in 1947, in Leaf Bay, but neither the fish population nor the terrain was found to be suitable for that technique. In the fresh-water work in the winter of 1947-48, Hildebrand used gill nets in the lakes near Fort Chimo, of four-, five- and six-inch mesh (stretched measure) and 8-feet depth. To thread these nets under the ice, a Lake Winnipeg "prairie jigger" was used, no doubt for the first time in that whole area. The native method is still the laborious procedure of digging holes in the ice every five to ten feet and pushing a pole from hole to hole to take the first line under the ice. The Lake Winnipeg method made a considerable impression on Hildebrand's Eskimo assistants and it is hoped that when suitable materials and facilities are made available to the natives, they will make their own jiggers. For a description of the method, see Sprules (1949).

The classification used here is taken from Jordan, Evermann and Clark's "Checklist of the Fish and Fishlike Vertebrates of North and Middle America" (1930) except where more recent revisions necessitate changes. The authors have followed especially A. S. Jensen, who has done so much excellent work on the fauna of Greenland waters. Eskimo names are given as well as the common

English names, where possible, using those applicable in the Ungava Bay dialect. An Eskimo name may well cover two or more separate species, sometimes because the Eskimos do not appear to recognize the differences, often because they are recognized as similar. The word "ogac" is used for all three species of cod found in the area, and there is apparently no recognition of specific difference. (This is in contrast to the Greenland habit, where three names are used.) On the other hand, "Miluiak" covers both species of sucker, but the Eskimos will tell you that there are two kinds to be found. The two sticklebacks are given the same name, and even such widely divergent forms as the arctic eelpouts and the fresh-water burbot are seen to have certain external features in common and are called "Shulupaoluk".

"Ekaluk" is used generically to mean any kind of fish, but is also used specifically to refer to the arctic char. There are often names for the different sexes and colorations of fishes, notably the char. No attempt was made to gather the large number of names applied to this species. "Ekralugak" and "Nutidilik" both seem to be used for the small, landlocked form, although the latter also has an age significance. As for the Atlantic salmon, the original native name appears to have been discarded. The Ungava Bay Eskimo now avers emphatically that the Eskimo name for *Salmo salar* is "salmon". The word "Kapisilik", or "Kavisilik", which in Greenland is used for the Atlantic salmon, is applied in Ungava Bay and on the Labrador to the whitefishes; it means in fact "the scaly one".

ACCOUNT OF THE SPECIES

Somniosus microcephalus (Bloch and Schneider). Greenland shark; ekalukjuak

Atlantic, arctic and subarctic, extending south to Scotland, the Skagerrak, and Cape Cod. Represented on the Pacific side by a closely related, but apparently distinct, form (Bigelow and Schroeder, 1948). Common in Davis Strait and Baffin Bay, and along the whole of the west Greenland coast. In the Canadian arctic, information on its abundance is lacking, but there are indications that it is very common in certain areas. In Ungava Bay, two specimens were recorded by Turner (1885), one at the mouth of the Koksoak River, the other a few miles up the river, both entangled in salmon nets. These two specimens were identified by T. H. Bean and entered in the U. S. National Museum catalogue. The next record is that of Vladykov (1933), on the basis of a specimen collected at Burwell in October 1927, the teeth of which were preserved.

During the present Fisheries Research Board field work, sharks were recorded only at Port Burwell, apart from the reports of local residents. On August 5, 1948, a Greenland shark measuring 10 ft. 1 inch (3.35 m.) was washed up in the inner harbour by a spring tide, in a dying condition. In 1949, four shark were seen by the "Calanus" party, and two of them were landed. A fifth individual, apparently of the same species, was caught by a commercial vessel anchored in Burwell outer harbour, while jigging for cod. Of the four seen by the "Calanus", one was shot by Eskimos at the surface in a small salt water lake, one was shot but lost in the Mission Cove anchorage, another was seen to break the surface in the outer harbour, and the fourth was caught on longline. The individual which entered Mission Cove was probably attracted by the blood and oil from some fifteen seals which the Eskimos were cutting up on the shore.

The Greenland shark is seen sporadically in various parts of the Ungava Bay coastal waters, but it is by nature a deep-water animal. These shark are occasionally killed off the mouth of Payne Bay, and they are known to be stranded sometimes at the mouths of the Koksoak, Korok, and George Rivers. At Burwell, they are reported by the natives as being very common during the time of the autumn migration of the harp seals (*Phoca groenlandica*) through McLelan Strait, when they are caught in seal nets and do considerable damage to the seal hunt. The same thing, in smaller numbers, is also reported from Wakeham Bay, on Hudson Strait, and shark have always been known to be fairly common at Diana Bay and Cape Hopes Advance.

The two shark landed at Burwell in 1949 measured 9 ft. 6 in. and 12 ft. 2 in. (3.12 and 4.00 m.). Both were males, but only the smaller individual had well-developed claspers. In the larger animal, the claspers were represented by small rudimentary nodules, and until the specimen was cut open and displayed normal testes and vasa deferentia, it was entered in the field note-book as a female. In reviewing the early literature of the Greenland shark, some corroboration for this abnormality was found. It is not mentioned by Bigelow and Schroeder (1948), nor by Jensen (1948), but Turner (1874) and Lütken (1880) found evidence for suggesting that the claspers in the Greenland shark were, or could be, very poorly developed. In a series of specimens examined by Jungersen (1899), on the other hand, (specimens of ventral fins detached from the body), a gradient of clasper development, in proportion to the size of the fin, was recorded, the largest extending some 5 cm. beyond the tip of the fin; and Jungersen concluded that "every idea of the Greenland Shark differing from other Sharks in only possessing rudimentary ventral appendages must be dropped". The present writers consider, however, that the matter must remain in abeyance and undecided at present, because both the 1949 specimens were outside the norm described by Jungersen. The smaller specimen had claspers extending considerably more than 5 cm. beyond the tip of the fin, yet the animal itself was only 9½ feet in length; and in the larger specimen the claspers were negligible. Unfortunately, exact measurements were not made; but there is certainly evidence for a considerable variation in the development of the claspers of the form known at present as *Somniosus microcephalus*. This is rendered the more possible by the fact that there is some reason to suppose, on the evidence of the type of egg found in this shark, that it is an oviparous form (Bigelow and Schroeder, 1948); it is not beyond the bounds of possibility that fertilization in this species may be external.

The food of the Greenland shark consists of fish and seal. In Ungava Bay, fish bones and the lenses of fishes' eyes were found in shark stomachs. One individual had eaten a flatfish not identifiable further. The only flatfish recorded by the present survey in Ungava Bay waters was the Greenland halibut, *Rein-*

hardtius hippoglossoides, in young stages only, and it is possible that the remains found in the shark stomach belong to that species. In one stomach the remains of a small seal were taken, including a piece of seal-meat of about five inches cube measure. In the same stomach were found numbers of large fish scales, varying in size up to 13 mm. on the greatest diameter, and considerably altered by enzymic or acid action. After consultation with Dr. Ernest Lachner of the U. S. National Museum, who thought the scales might possibly belong to *Macrourus berglax*, *Macrourus* scales were experimentally digested in pepsin and hydrochloric acid, and in hydrochloric acid alone. The digested scales so produced resembled very closely those found in the shark's stomach.

Although the Greenland shark is clearly active enough to catch and devour seals (Bigelow and Welsh, 1925), it cannot be described as a very fearsome animal, at least at the surface. It has been known by whalers to gouge out large pieces of the flesh of dead whales, as described by Scoresby (1820), but there seems little evidence for the statement by Jordan and Evermann (1896) that this fish is an enemy to whales, "biting out large masses of flesh from their bodies". Jensen (1925) comments on the surprising fact, a common experience in Greenland, that these sharks "can be hauled up from such a depth (abt. 250-400 m.) with a line no thicker than a piece of stout string, and killed from the Kyak with no other weapon but a knife".

Attached to the eye of the largest animal caught in the 1949 season was a large copepod ectoparasite, a female *Lernaeopoda elongata* (Grant), with the following measurements:

Overall length	60 mm. approx. (second maxillae, or "arms", much contracted)
Trunk plus cephalothorax	22 mm.
Egg strings	29 mm.

These parasites, which are always attached to the cornea, appear to be very common on the Greenland shark (Grant, 1827; Wilson, 1915).

Samples of shark livers were preserved in brine, and later analysed by Dr. F. A. Vandenheuvel of the Experimental Station at Halifax, with the following results:

Oil content	60 per cent approx.
Refractive index (20°C.)	1.47154
Iodine number	100
Vitamin A content	1805 I.U. per gram
Unsaponifiable material	8.6 per cent

In Greenland, the economic importance of *S. microcephalus* is considerable, but in the Canadian arctic no effort has hitherto been made to use this resource. The native shark fishery in Greenland began at the beginning of the last century, when the liver oil was purchased and sold; and in the present century the skins have also been marketed, and the meat, dried, used for dog-feed (Jensen, 1925). During recent decades the annual catch of shark by the Greenlanders has averaged about 50,000 animals (Jensen, 1948), in west Greenland. In Denmark Strait Norwegian fishermen carry on a commercial shark fishery whose production of liver oil is about half as great as that of the native Greenland fishery on the west coast (Greenland Administration, 1944), and in very recent years these vessels are reported to be operating in Baffin Bay.

The fresh meat of the Greenland shark contains a toxin which is injurious to both men and dogs. When dried and mixed with a little shark or seal oil, it provides good dog-feed which has been used in Greenland for generations, but has not been used among the Canadian Eskimos. For a discussion of this toxicity, see Jensen (1948).

Salmo salar Linnaeus. Atlantic salmon; salmon

A north Atlantic species, ascending all suitable rivers in northern Europe, Iceland, and northeastern North America, south to France and New England. The Atlantic salmon is rare in Greenland, being known only from certain restricted points along the southwest coast, such as Kapisigdlit in Godthaab Fjord, off Ikerasak in the Sukkertoppen district and in Amerdlok Fjord near Holsteinsborg. According to Jensen (1939) this species is increasing in abundance in Greenlandic waters, reflecting the increasing Atlantic influence of recent decades.

The Atlantic salmon has long been known to occur in Ungava Bay, but the records, up to the time of Turner, were open to doubt, because there were no museum specimens and because of the wide confusion resulting from the fact that the vernacular name "salmon" is commonly used in the north for the arctic char (*Salvelinus alpinus*). Kendall (1935) considered that the occurrence of Atlantic salmon in the rivers of Ungava Bay was very unlikely, since it was known to be very rare or absent on the Labrador coast north of Hopedale. The species was first reported, by common name, by McLean (1849). Other authors contributing to our knowledge of the Atlantic salmon in Ungava Bay are Bell (1885), Turner (1885, 1889) and Low (1896, 1898 and 1899). Museum specimens are in the U. S. National Museum (collected by Turner), in the Royal Ontario Museum of Zoology (Dymond, 1941) and in the collection of the University of Montreal (Legendre and Rousseau, 1949).

The Atlantic salmon ascends the larger rivers of the eastern half of Ungava Bay between (and including) the George and the Koksoak. According to native reports, it is occasionally taken as a stray in the Leaf River, farther west. It is not known from the Payne River, in spite of Low's (1899) report that it is. Low's information in this instance was not first-hand, and like the report of Wakeham (1898) that "salmon" are to be found in Hudson Strait and along the Baffin coast, it is no doubt based on the arctic char. Turner (1885) also reported the Atlantic salmon from rivers west of the Koksoak, on native information, and described the Leaf River as containing "an abundance of Salmon and Trout". Since this again is second-hand information it must be regarded with considerable doubt, although it is by no means impossible that the Atlantic salmon was more widespread in the rivers of Ungava Bay than it is at the present day. At present, the western limit of the normal distribution of *Salmo salar* in Ungava Bay is the Koksoak River.

The spawning areas of the Ungava Bay salmon are not definitely known (see Low, 1898), but all of them lie within the tree limits. The time of the beginning of the upstream migrations is very variable, between July 25 and the end of August in the Koksoak, according to contemporary observation and information. Turner (1885) recorded that the salmon arrived in the Koksoak River "seldom before the 24th of July and on several occasions as late as the 20th of August". The salmon run is thus very variable, both in timing and in numbers of fish. There is some evidence of two runs, or at least of two peak periods, the first run being composed of the larger fish. In 1947, the greatest run occurred in the first three weeks of August. In 1948 there was an almost complete failure of the salmon run in both the Koksoak and the George Rivers. There was an early run from July 25 to the end of the month, followed by a blank month in August. The reasons for this great variation are not known. Sometimes, as happened in 1948, there is a late run in September, never in large numbers.

Salmon stomachs examined at George River by the present writers were empty, in agreement with the general finding that the Atlantic salmon eats little or nothing while on the upstream migration. Turner (1885) states that specimens he examined contained species of fish, including *Boreogadus saida* and various sculpins. As these species are marine, Turner's specimens must have been taken in the estuary. Several salmon examined at George River were found to be heavily parasitized.

The Atlantic salmon is of some importance economically to the Eskimos of Ungava Bay; and the unreliability of the upstream run is therefore a source of considerable concern to them, for the salmon are used not only for immediate human consumption, but also for the all-important dog-feed in the winter, the fish being stored in drums and allowed to become tainted and finally frozen. The present annual catch on the Koksoak River (by Eskimos) probably varies between about 12 and 40 barrels (one barrel equals approximately 300 lbs. of fish). The native catch in 1947 was estimated at about 35 barrels, in 1948 less than 14 barrels. The George River catch was approximately the same in 1947 as on the Koksoak, but in 1948 less than five barrels were obtained. The fish are taken in gill nets.

Commercial fishing for the Atlantic salmon of Ungava Bay was undertaken by the Hudson's Bay Company from 1881 onwards; this is the only sustained commercial fishery which has existed in the eastern arctic waters. When Lucien Turner visited Chimo in 1882 the fishery was in full swing on the Koksoak River. Gill nets of six- and six-and-a-half-inch mesh were used, set at some ten fishing stations between Chimo and the sea. During the first four years of the fishery a small refrigerator ship, the "Diana", was used to take the salmon to England, the vessel being equipped with a dry air freezing plant and able to store about fifty tons of fish. Later it was found cheaper and more profitable to salt the salmon for transportation. According to Turner, the yield for the first four years (during most of which Turner was at Chimo) was as follows:

1881	40 tons approx.; average weight 19 lb.
1882	24 tons approx.; average weight 16 lb.
1883	38 tons approx.; average weight 14.5 lb.
1884	less than 40 tons; average weight 14.7 lb.

The output of the fishery varied not simply because the abundance of fish varied, but because the number of men working was not constant, nor the number of fishing stations operated. The fishery has never been large, and grew consistently smaller as the years went by. It will be noticed that in the first four years the average weight of the fish dropped considerably.

In 1884 a similar fishery was opened on the George river, and also on the Whale River. In 1896 Low wrote that the salmon catch averaged 100 tierces on the Koksoak, 50 tierces on the Whale River and 120 tierces on the George. (The tierces were probably of about 300 lb. each.) The take from the Koksoak was thus already down considerably since the beginning of operations. Four years later, Low (1899) reported that the salmon fishery had steadily declined and that in 1897 it had been almost a total failure. From the scattered records available for the later years, it is apparent that the output continued to decline, and the fishery was finally given up in the early 1930's.

Cristivomer namaycush (Walbaum). Grey trout, lake trout

In fresh water from northern New England to the Great Lakes; across Canada to British Columbia, and common north to the limit of trees at least; known also from the barren grounds south of Hudson Strait. The precise northern limit of distribution is not known. Anderson (1913) records this species as common in the larger lakes of northern Alaska and east to Coronation Gulf. Pfaff (1937) reports specimens from King William Island and Baker Lake. Manning (1942) records a separate specimen taken on Southampton Island, and suggests the possible occurrence of the lake trout on Baffin Island.

In the Ungava Bay region the lake trout is very common in the larger lakes and streams. Turner (1885) reported it from the Koksoak River, Whitefish Lake (Lake Mendry) and Goudie's Lake (Lac Berthet), all in the vicinity of Chimo. Hildebrand obtained this form by jigging through the ice on Lac Berthet during April 1948, in depths of about fifty feet. Two more specimens were taken in gill nets set under the ice in the outlet of Lake Stewart in eight feet of water. These two specimens are in the McGill University collection.

Mr. B. M. May, manager of the trading post at George River, informed the writers that lake trout were very common in the lakes of the George River area. This is further supported by the field notes of Dr. Jacques Rousseau, who traversed the length of the George River by canoe in 1947. His notes include lake trout taken on the George River at Rapide Raciot, Ruisseau Coomis, Indian House Lake, and near Hades Hill (Legendre and Rousseau, 1949).

The present writers were unable to determine the northern limits of the lake trout in the region east of Ungava Bay. One native Eskimo at Port Burwell stated emphatically that they do not occur on Killinek Island or near McLelan Strait. On the west side of Ungava Bay, Flaherty (1918) found the lake trout common in the Leaf River drainage. Rousseau obtained it in Payne Lake and from the outlet of that lake in 1948 (Legendre and Rousseau, 1949). No definite records are available for the country north of Payne Lake, but it is to be expected that this species occurs in all suitable lakes and streams to Hudson Strait.

The lake trout is the largest known fish occurring in the region (with the exception of the Greenland shark). There are reports of individuals up to 100 lb. in weight, which are not necessarily true. One Eskimo, Joby White from Chimo who is a little under five feet tall, told the writer that he had caught a lake trout that was taller than he, by jigging through the ice. The largest fish reported in the literature from the Ungava Bay region weighed only 45 lb. The largest taken by the (junior) writer was only 60 centimetres long; but the area fished was already considerably fished by the native population.

In the Ungava Bay drainage, *Cristivomer* is found usually in the deeper water of the larger lakes. It appears the most reluctant of the trouts and chars to enter salt water. Weed (1934), however, states that in the region of Nain, in Labrador, the lake trout is occasionally taken in the sea. Native reports in Ungava Bay indicate that an occasional one is taken in brackish water in the George and Koksoak Rivers, but we obtained no definite statement that the lake trout are ever taken in the salt water of Ungava Bay.

Many writers have remarked on the voracious carnivorous habits of this species. The food of the adult is almost entirely fish. In the Fort Chimo area ciscos, whitefish and suckers have been found to be common food. May (personal communication) reports that mice and shrews are quite often found in the stomach of the lake trout, and it is quite possible that during periods of abundance the small mammals play a significant part in the diet of the fish.

The lake trout has considerable economic importance to the native population. Comparatively few are caught by the Eskimos, but it forms a large and important part of the fish diet of the Naskapi Indians, who catch them both by hand line and in gill nets. Large specimens are apt to damage the nets, and some lakes in the Indian area are not fished with gill nets for this reason. As for the Eskimos, the greater part of the lake trout fishery is carried on in the fall, after the snow cover has provided a highway to the lakes. Some few are taken in gill nets set for whitefish, but the majority are caught by jigging with hand lines. The hand-line fishing is done through the ice both in the fall and in the spring in the Ungava Bay region, very little during the middle of winter. It is done chiefly by the women and boys, especially the former, very often by the old women only. Fish taken after spending all winter under the ice are in poor condition; Turner reported that they have a disagreeable taste in the spring of the year.

Salvelinus fontinalis (Mitchill). Brook trout, speckled trout; anuk

Eastern North America from the colder streams of New England (and in mountain streams as far south as Georgia), west to the tributaries of Lake Superior and north at least as far as the Severn River on the west side of Hudson Bay; on the eastern side of Hudson Bay, known at least as far as about 24 miles north of Great Whale River. In the Ungava bay drainage, known from the Payne River and the George River, and rivers in between.

This species was first reported in our area by Turner (manuscript, 1885), from George River and Fort Chimo. The first published record of this species from the tributaries of Ungava Bay, is that of Kendall (1909). During the 1947-49 field work, it was collected from the vicinity of the trading posts at Chimo and George River. Its northward limit was not established. It is known to be common from George River on the east to Leaf River on the west; in other words it is reported or recorded as common in all streams flowing for the most part through timbered country. From native reports, it is not found on Killinek Island, Burwell, nor was it collected there by the writers. Hantsch (1908) identified small salmonids at Burwell as S. *fontinalis,* but it is almost certain that the fish in question were S. *alpinus,* probably landlocked. The most northerly reliable record in the whole area is that of Legendre and Rousseau (1949), on a specimen obtained in Payne Lake.

Small specimens were obtained from Blueberry Creek, near Fort Chimo, and there is apparently a permanent population in that stream, which is not ascended at all by the arctic char. In the Koksoak River itself, and in the lakes of the Chimo region, speckled trout up to 10 lb. in weight are not uncommon, according to local information. On the George River, specimens were taken in Bobs Lake, in the small tributary streams, and throughout the outlet from Bobs Lake to the tidepools of the George. The outlet of Bobs Lake is a rocky, fast-flowing stream with one waterfall of about twenty-five feet. A minnow trap set immediately at the top of the falls captured small specimens of *fontinalis,* and it is probable that the population below the falls is augmented by individuals spawned in the lake. Specimens up to 22 cm. in length (total length) were taken at the foot of the falls, together with numerous arctic char (*alpinus*). The speckled trout apparently spawn in the lower portions of the outlet stream, while the char do not. Gonads observed during the latter part of August 1948 were nearly ripe; it is probable that spawning takes place in September or October.

In Bobs Lake small specimens of the speckled trout were very common in the shallows near shore; they were extremely shy and sought shelter under the stones which lined the shallow-water area. Three small individuals of 12, 12 and 14 cm. total length, with gonads approaching maturity were taken in a shallow tributary hardly two feet wide on August 29, 1948.

Some of the trout go to sea in the Ungava Bay area, although every stream visited in the southern part of the bay apparently had its permanent population as well. We have seen specimens taken at MacKay's Island, a region of definitely brackish water near the estuary of the Koksoak River. According to May (personal communication), the brook trout are taken in gill nets set for arctic char during the spawning run of the latter. There appears to be no definite separation between the runs of the two species, and the catch is usually a mixed one, with the arctic char in the great majority.

Very little is known of the food habits of this form on the northern edge of its range. The small trout in Blueberry Creek were feeding mainly on insects. Specimens approaching maturity in the lower part of the outlet from Bobs Lake (George River) were found to have empty stomachs. Larger fish feed mainly on other fish; shrews and other small mammals have occasionally been reported from their stomachs.

The economic importance of the speckled trout in the Ungava Bay drainage is not great, being largely displaced by the more desirable arctic char. Turner (1885) describes how brook trout were taken in some numbers after freeze-up when they congregate in the deep holes of the streams, where they can be easily hooked or speared. Similar accounts are given of the present day. The brook trout are also taken, as mentioned above, in gill nets used primarily for arctic char and for whitefish.

Salvelinus alpinus (Linnaeus). Arctic char; ekaluk

The alpinoid group of chars has been a source of puzzlement to taxonomists, owing to its great plasticity. They show great variation in colour and form, depending on locality, age, sex and sexual maturity. A large area of their distribution lies north of the region commonly visited, and there are many early descriptions which are incomplete and which come from localities in which no subsequent collecting has been done. In this present work, no intensive taxonomic study has been attempted, the writers preferring to wait until more material is available from a larger range, so that the limits of variation, if at all discernible, can be the better delineated. The confusion of the scientific terminology is not helped by the variety of vernacular names applied to this species, which has even led in the past to unwarranted extension of the published range of other salmonids, such as the Atlantic salmon. The arctic char is known commonly as "salmon", "arctic salmon", "Hearne salmon", "salmon trout" and "sea trout", all of which names should be abandoned. Eskimo names are also variable, depending on the maturity and sexual differences of the fish.

The arctic char is circumpolar in distribution, with its greatest abundance north of the tree-line. In arctic America it ranges very probably to the extreme northern limits of land. The northernmost record is from Floeberg Beach on the north coast of Ellesmere Island (Gunther, 1878).

In Ungava Bay and its drainage, the arctic char occurs in all suitable lakes and rivers. In the southern part of the region it is replaced in some of the smaller streams by the speckled trout. It occurs all along the coast in salt water at least during the spring months. There are many streams which contain populations apparently landlocked, which do not migrate to the sea, and which mature at a very small size. The writers measured specimens of the arctic char over a wide size-range, from these small landlocked individuals reaching maturity at lengths of 8 and 10 cm., up to sea-run fish of over 60 cm. The largest specimen measured was 69 cm. fork length. Spawning individuals in the outlet of Bobs Lake (George River) ranged from 25 to 50 cm. The native fishery obtains fish largely in the weight range of 2 to 8 lb. (1-4 kg.), but larger specimens are reported by the natives—over 20 lb. on occasion. Yessipov (1935) records an individual weighing 16 kilograms from Novaya Zemlya.

Observations on this fish during the present series of expeditions were limited owing to preoccupation with marine work. The char were studied briefly at two stations—at Burwell, and George river. One specimen was caught through the ice in March 1948 near Chimo (see below), a few were collected at Chimo itself, and two small landlocked specimens were collected by Father Steinmann, of Koaktuk (Koartuk) at Cape Hopes Advance, and very kindly shipped to the present authors for study.

Port Burwell is situated on Killinek Island, which is separated from the mainland of the Labrador by the turbulent McLelan Strait, or Ikerasak. It is a bleak and barren island cut by sharply defined valleys and hills and with a cold and foggy climate which does not encourage vegetation. Most of the exposed rock belongs to the Canadian Shield, and is mostly gneissic. The char were collected from two small lakes connected by an impermanent stream, lying about one-quarter of a mile north of Burwell itself. These lakes, measuring approximately 450 by 150 yards and 250 by 100 yards respectively, have extensive shallow shore-lines and are nowhere deep; the upper lake was found to be five feet deep in the centre, and the lower lake, though not measured, is reported by the Eskimos to be almost as shallow. The outlet from the lower lake is a small stream which enters the Burwell inner harbour over a fall of about eighty feet. One large glacier erratic of limestone was found in the drainage area, and limestone pebbles on the shore are not uncommon. The water in the lakes remains very cold throughout the year. The area draining into them usually has snowbanks on it until late in July.

Commercial minnow traps, set in narrow inlets among the sedge and sphagnum moss, were very successful in catching the char. One trap set in the connecting stream between the two lakes caught 33 small char which were approaching spawning condition. Although no direct observations on spawning were made, it is possible that there is an upstream movement in summer in these landlocked populations. At Burwell, spawning most probably occurs in the upper lake, for there are no permanent tributary streams suitable for spawning.

Specimens were taken between July 28 and August 16, 1948. They ranged in length (fork length) from 54 mm. to 170 mm.; nearly all of them were approaching sexual maturity and all of them retained their parr markings. The males showed a reddening of the ventral and anal fins, and a slight reddish wash to the belly. The smallest male measured 54 mm. and had advanced gonads. Females of lengths from 65 to 170 mm. contained ovaries in process of maturing. The largest female had indistinct parr markings, and the belly was a golden yellow in colour.

The following fecundity counts were made on three specimens taken at Burwell in August 1948. Lengths are fork lengths measured after the specimens had been preserved in formalin for one year. The size of the ova (formalin-hardened) was approximately 4 mm.

		Number of eggs in	
Date	Length (mm.)	right ovary	left ovary
August 7, 1948	88	12	5
" 7, 1948	95	15	9
" 16, 1948	82	14	7

Two small specimens of char were obtained from a stream beside the Mission at Koaktuk, Cape Hopes Advance, through the good offices of Father Steinmann. These are known to the Eskimos as "Ekralugak", and may or may not be landlocked. The suggestion that they are landlocked is supported by the fact that the ovaries (both specimens are females) are in process of development to maturity at a very small body-length. They measure 125 and 110 mm., fork length, the larger specimen with eggs up to 3 mm. diameter, the smaller one with eggs considerably smaller, about 1 mm. diameter. They were taken on July 25, 1949, so that the smaller egg-size is in keeping with the August condition already described for Burwell. The right ovary of the larger specimen contained 75 enlarged eggs (up to 3 mm.), and about 70 smaller cells, white and undeveloped. The left ovary was smaller, as in the Burwell specimens.

The char were also observed and collected in the outlet stream from Bobs lake, close to the George River trading post; the stream runs into the George River itself. Bobs Lake is not named on any chart of the region; the Eskimos call it Tessialuk, which is the name usually given to all lakes of this size. The lake drains over a fall about twenty-five feet high, which acts as an effective barrier to the migration of fish into the lake from below. We have specimens of brook trout, S. *fontinalis,* and sticklebacks, *Gasterosteus aculeatus,* from Bobs Lake, and the lake trout, *Cristivomer,* is known to live in it. No arctic char have ever been taken from the lake, but they are common during the summer run in the stream below the waterfall.

The char enter this stream, which is little over half a mile in length, during the latter part of July in most years. In 1949, they did not arrive until early in August, some time after August 2nd. In 1948 they were already plentiful when Hildebrand arrived at George River on July 25th, and the gonads were almost ripe. The char are found in the pools immediately below the falls, and also at times in the lower parts of the stream. Spawning, which presumably must take place, has not been witnessed either by the present writers or by the local residents. According to local information, the char leave the stream in the middle of September.

Thirty-five char from this stream were examined in 1948 for food and parasites. They ranged in total length from 35 to 50 cm., with an average about 45 cm. All the stomachs were empty, and parasites were not abundant. A few nematodes were taken from the region of the pyloric caeca. Parasitic copepods in the mouth and gill region are not uncommon. Turner (1885) records taking tapeworms from the intestines of char, the parasites being described by Leidy (1885).

Over the greater part, if not all, of the geographic range of the char, the upstream migration appears to take place in late July and during the month of August. No attempt is made here to summarize the information on this point, the whole question of the biology of the char being reserved for a separate publication. The following quotation from Turner's unpublished manuscript (1885) concerns the Ungava Bay char as such, and is therefore inserted here:

> At Ft. Chimo these fish begin to ascend the river (Koksoak) about the twenty-fifth of July, rarely earlier; and occasionally as much as twelve days later. At the beginning of the "run" but a few fish will appear and be greatly augmented in number in the course of three or four days. The "run" as it is called lasts from eight to fifteen days, decreasing as it increased with about four days in which the fish are plentiful.
>
> These trout ascend the rivers until they come to suitable spawning beds. I have seen them over a hundred and ten miles up the river. Beyond the falls they cannot ascend as here is

a perpendicular wall of over forty feet, over which rushes a tremendous torrent of water. They are known to ascend the Larch or North river, a tributary of the Koksoak, affluent at about 110 miles from the mouth of the latter river, to a great distance.

Of the winter biology of the char, very little is known. Very little information was gathered during the winter visit to Chimo in 1948. Only one specimen was obtained, hooked through the ice on a hand line in eight feet of water. It had been feeding on fish, which were too badly damaged for identification. Very few char are taken from the lakes in the vicinity of Fort Chimo during the winter, but a number are taken in the George River area, in gill nets. The natives say that their best catches are on brief moonlight nights. It is the local opinion that the char are largely inactive during the winter in fresh water, and it is also reported that they commonly have fungal growths on the skin. and that they are usually in very poor condition.

The sea-run fish live mainly on amphipods and on fish. In the Ungava Bay area the common amphipods *Gammarus locusta* and *Pseudalibrotus littoralis* probably form the bulk of the diet. Landlocked individuals are reported to feed on "Komuks" (insect larvae), sticklebacks, and smaller specimens of their own kind.

The economic importance of the char is considerable, to the Eskimos, wherever it occurs. During the upstream run, the numbers of fish present in the streams is impressive. Ross (1835) reported the taking of 3,378 fish, with a total weight of six tons, with a small net at the mouth of a single stream on Boothia Peninsula. From the little we know at the moment about the growth rate and powers of reproduction and recovery of the char, it is most probable that fishing on such a scale as this would very soon jeopardize the population of a stream. Even on the normal Eskimo scale of fishing, streams may become seriously depleted and require a rest for some years before the numbers are restored.

The char is the most important food fish of the Arctic Eskimo, except for populations living in the Mackenzie basin. who rely on whitefish, and the west Greenlanders who depend on Atlantic cod. In west Greenland, however, the char is an important secondary fish food in season. It has been shipped commercially from Greenland in small quantities since 1930, and commercial fishing for char was carried on in Frobisher Bay, Baffin Island, in 1947, 1948 and 1950. In Ungava Bay a few char were salted and shipped to England for a number of years. There seems to be little doubt that a commercial fishery concentrated in one locality can do serious damage to the char population. On the other hand, by spreading the effort over areas which are at present hardly fished at all, the char fishery might well be developed considerably as an Eskimo enterprise.

Leucichthys artedi (LeSueur). Cisco, tullibee, lake herring; kapisilik

Widespread in Canada, from the Great Lakes north at least to Great Bear Lake; ranging east to Coppermine River, Baker Lake and Fort Chimo. Pfaff (1937) identifies a coregonid fish from King William Island as *Argyrosomus tullibee,* which may belong to this species.

Three specimens of the cisco are known from Ungava Bay. Two were taken from a lake trout stomach in Lac Berthet by Turner (1885), and the other was caught in Stewart Lake by gill net set in eight feet of water near the outlet, in 1948 (Hildebrand). Stewart Lake, two miles west of Chimo, is unnamed on current charts. This latter specimen, now in the McGill University collections, measured 181 mm. total length (to the tip of the tail in a natural position). Scale readings gave an age of 6+ years, indicating a growth rate very considerably less than the rates recorded in this species for Hudson Bay (Dymond, 1933), where the average fork length at this age was 335.3 mm. The gill-raker count was 40 (upper arch 15, lower arch 25). The colour in life was dark blue above and silvery below.

Nothing is known of the biology of the cisco in the Chimo region. Neither the native nor the white population distinguish between the Coregonids found there. It does not appear to be at all abundant. The present writers found only one specimen out of over sixty Coregonids, and L. M. Turner, who probably saw several hundred individuals of this group, obtained only two specimens of *L. artedi.*

Coregonus clupeaformis (Mitchill). Whitefish, common whitefish; kapisilik

Extends over almost the whole of the mainland of Canada east of the Rockies, except the maritime provinces. Known from the Yukon, the mouth of the Mackenzie and the arctic mainland coast, Baker Lake, Chimo and Ungava generally; south to the Great Lakes. In Ungava Bay, judging from the collecting by the writers and observation of native catches, this is the most common coregonid. It is common in most of the streams and lakes within the tree-line, from Leaf River on the west to George River on the east. The northward extension was not determined. One Eskimo from Fort Chimo reported that north of the tree-line a few small individuals of "whitefish" (species not specified) were taken as far north as Hopes Advance Bay, on the west side of Ungava Bay, but that beyond that point they were unknown. No definite record was obtained of their occurrence in the Payne Bay area; the natives do not regularly fish in that region. One Eskimo report had it that whitefish used to be taken in small numbers in a lake near Cape Hopes Advance. Rousseau took no specimens of whitefish during his traverse of western Ungava along the Kogaluk and Payne Rivers (Legendre and Rousseau, 1949).

For the precise identification of the Ungava Bay specimens, the writers are indebted to Dr. Dymond and Dr. Scott, of the Royal Ontario Museum of Zoology. The material appears to be identical with that for the Great Lakes specimens. Gill-raker counts from nine specimens taken from Goudies Lake (Lac Berthet on the Canadian chart) during April 1948 are given here, the fish themselves being now in the McGill University collections:

Number of fish	Upper arch	Lower arch	Total
1	10	15	25
4	9	17	26
1	8	18	26
1	10	16	26
1	10	17	27
1	9	18	27

These specimens were adults of from 45 to 50 cm. total length, taken in gill nets of 3- to 5-inch mesh, over muddy bottoms in depths varying from 16 to 56 feet. The nets were laid near a conspicuous landmark from which the lake gets its native name Ninaoyuk ("like a nose"), and which is approximately 600 feet in height.

A large number of the whitefish stomachs examined during March-April 1948 were empty, which may well have resulted from a prolonged stay in the gill nets. Five stomachs were crammed with food consisting chiefly of chironomid larvae, fish eggs (*Catostomus?*), small gastropods and pelecypods. Chironomid larvae made up the major portion of the food. The fish were taken under an ice cover approximately four feet thick, and the fine condition of the fish themselves would indicate regular feeding during the winter, which is not surprising considering that there are only some three and one-half months in the year during which the lakes are free of ice. In the outlets from the lakes, open water exists from June to the end of December, but the months of total open water are July, August, September and part of October. The condition of the whitefish was much better than that of the lake trout, which apparently have greater difficulty in finding sufficient food during the winter months.

Scale readings were made to determine the ages of the fish examined. They involved considerable difficulty, largely on account of the slow growth, especially during the early years of life. The readings were made by Hildebrand, and both authors are indebted to Dr. Van Oosten of the U. S. Fish and Wildlife Series for advice in this matter. Lengths given here are total lengths (tail in natural position):

Length *cm.*	Age *yrs.*	Length *cm.*	Age *yrs.*	Length *cm.*	Age *yrs.*	Length *cm.*	Age *yrs.*
34	9	43	12	46	14	47	14
35	12	44	14	46	15	48	12
38	12	44	11	46	14	48	14
40	14	44	11	47	15	48	14
40	14	45	12	47	14	48	14
40	13	45	13	47	15	49	14
40	13	45	13	47	12	50	14
41	11	45	14	47	10	51	14
43	13	46	14	47	14		

The number of specimens (35) is too small to allow any general plotting of a growth curve, but it is large enough to show clearly that the growth rate is very slow. The population studied comes from an area where the natives fish regularly.

Whitefish are of only nominal importance to the Eskimos of the Ungava Bay region. Fishing is carried on chiefly during the fall, when the ice is thin, and a few are caught in the brackish estuaries in the summer during the anadromous run of the arctic char. It is clear that any development in lake fishing by the natives must take place in the winter, when the snow affords a highway to many of the lakes which are accessible in summer only by long and difficult portages.

The Nascopie Indians who trade at Fort Chimo do much more lake and stream fishing than do the Eskimos, and the whitefish occupy an important place in their diet.

An attempt was made in the 1870's by the Hudson's Bay Company to obtain enough whitefish to supply the post at Fort Chimo. Mr. Goudie of Northwest River, employed to make the experiment, established an experimental fishing station on the lake which now bears his name. No figures have been discovered to show the progress of this mission, and the memory of it is vague even amongst the oldest natives. It appears to have been abandoned before 1880; the slow growth rate of these fish in the northern parts of its range gives one possible explanation for the short life of the enterprise.

Whitefish are regularly caught in salt water in James Bay (Lower, 1915) and in other parts of the north. However, no substantiated occurrence of whitefish in the salt water of Ungava Bay was recorded, although they are regularly caught in char nets in brackish water. So far as could be ascertained, they are not caught in nets set for arctic char along the sea coast.

Prosopium cylindraceum (Pallas). Round whitefish; kapisilik

Ranges from the Yenesei River in Siberia across northern Alaska, Great Bear Lake, Baker Lake and Fort Chimo, south to the Great Lakes and Maine. In the Ungava Bay drainage this is apparently a rare fish. Turner (1885) obtained a single specimen by hand from the Koksoak River; this specimen is now in the U. S. National Museum. The only other specimen was obtained by Hildebrand from a native fisherman at McKay's Island, also in the Koksoak River. This second individual is in the McGill University collection. It measures 37.5 cm. total length; the gill-raker count is: upper arch 6, lower arch 11, total 17; the estimated age from the scales is 8+ years.

As the natives do not distinguish between the coregonids of the region, no information on the occurrence of the round whitefish could be gathered. They claim that the river "kapisilik" differ from the specimens caught in lakes, and it is possible that a greater percentage of round whitefish in the river catch is the basis for this.

It is to be noticed that all the coregonids in our present area, according to native reports and the experience of the writers, seem to have their effective limits of dispersal at or near the tree line. This suggests that further investigation on the causes of this limit, whether they are climatic or biotic, or both, would be of great general ecological interest.

Mallotus villosus (Müller). Caplin

A north Atlantic form. Sleggs (1933) gives the southern boundary of distribution as corresponding with the 45°F. isotherm, with stragglers to the Gulf of Maine and Oslo Fjord in Norway. Northward, caplin are known from the White Sea, Spitsbergen, Iceland and both east and west coasts of Greenland. The westward extension in the Canadian arctic is complicated by the fact that the central arctic caplin has not been determined since the Pacific form was separated as a valid species, *M. catervarius*. The genus is nearly circumpolar, and appears to be continuous across the North American arctic. Saemundsson (1949) refers this whole range to the one species, *villosus*. The great numbers in which this species appears at certain times of year are well known over the whole of its range.

In Ungava Bay the precise times and places of its appearance are not fully known. Turner (1885) describes its appearance in great abundance at the mouth of the Koksoak on August 8, 1884, when as many specimens as wanted could be dipped up by hand net. Turner's specimens are now in the U. S. National Museum, and were reported upon by Kendall (1909). Turner made the interesting comment that this was the first appearance of caplin in the southern portion of Ungava Bay. Taken together with another observation of Turner's, namely that the caplin were at that time going farther and farther north up the Labrador coast each year, it would appear that the 1880's were comparable in this respect to the present decades, in which the caplin, along with many other fishes, are extending their range northward (Jensen, 1939, etc.). It has already been pointed out by Dunbar (1946) that the decade of 1880 appears to have been somewhat warmer in west Greenland, at least so far as the marine climate is concerned, than the two decades following. Turner, writing in 1885, adds: "within Hudson Strait they [the caplin] had not been detected until several years ago when a few were seen in the neighbouring waters of George's River".

In contrast to Turner's catch in the Koksoak, only three specimens of *Mallotus* were obtained during the present field work in 1947, 1948 and 1949. These were young individuals, 5.5 cm. long, with the larval pigmentation, taken in plankton nets set from a stationary boat in the tidal current between the mainland and an island, at station 51, (Pitsulasitik, August 29, 1947). In three seasons some 750 cod stomachs (*Gadus callarias*) were examined at Port Burwell, but not a single specimen of *Mallotus* was found in them. On the Labrador coast, it is a common statement that the caplin precede the cod northward each year; the caplin, however, apparently has little or nothing to do with the movement of the cod into Ungava Bay. In point of fact, this appears to be true also of the cod in northern Labrador. Cape Harrigan is given by Thompson (1943) as the limit of the region in which the caplin figures in abundance in the food of the cod. Templeman (1948), on the other hand, publishes records of caplin being taken at cracks in the ice at Nain, during the winter.

Sleggs (1933), describing the habits of the caplin along the Newfoundland shores, states that the spawning swarm, or "rolling" of the caplin in the surf, occurs when temperatures are below 10.5°C., and generally between 8.5°C. and 10.5°C. (surface temperatures). Templeman's (1948) figures are lower, showing spawning swarming behaviour to occur between temperatures of 5.6° and 8.4°C. These temperatures are well above the maximum surface temperature during the present years anywhere in Ungava Bay. This again suggests that the waters of Ungava Bay were possibly warmer during the time of Turner's field work than they are at present. And yet Turner, in an undated manuscript narrative part of which is housed in the Smithsonian Institution, describes being ice-bound at the mouth of the George River at the beginning of August 1882. Serious ice at that time of the season in the present years is not known. It is clear that much valuable information on cycles in the marine climate would have been obtained by routine observations at sea during the history of the trading into Ungava Bay.

Catostomus commersoni LeSueur. Common white sucker; miluiak

Ranges from the Mackenzie River to the Patricia district of Ontario; from the Koksoak River in Ungava south to Georgia and the Gulf of Mexico. There are no records from north of the tree-line.

In the Ungava Bay region, this species is known definitely only from one lake, Lake Mendry near Chimo. Turner obtained a specimen here in 1883 (Kendall, 1909). Hildebrand took three specimens in a small stream connecting Lake Mendry with a smaller lake to the south, in a gill net set in eight feet of water. Rousseau (Legendre and Rousseau, 1949) collected this species from the George River, some distance upstream, in latitudes 55° and 57°. Our records indicate that it is much less common than the following species.

Catostomus catostomus (Forster). Sturgeon sucker; miluiak

Found from the Kotzebue drainage of Alaska east in northern Canada to the Keewatin district of the Hudson Bay drainage and farther to Leaf River and Chimo in northern Quebec, and the Labrador; south to Minnesota, the Great Lakes and northeastern New England.

This species was reported from three stations in the George River by Rousseau, and eleven specimens were obtained by Hildebrand from Lac Berthet (Goudies Lake) and Lake Stewart, where it was the only species of sucker found. They were caught in gill nets in water of from 8 to 26 feet in depth, and ranged in length from 35 to 40 cm.; one large individual measured 55 cm. When landed through the ice they survived for a considerable length of time, in contrast to the whitefish, which succumbed immediately. They were observed to be approaching maturity during early April 1948, and eggs found in whitefish stomachs suggested that possibly a few suckers had already spawned.

The northward limit of the distribution was not determined. Native reports indicate that in some lakes along the Leaf River it is extremely common. No authenticated report of its occurrence north of the tree-line was obtained. Rousseau (loc. cit.) did not take it in the Payne River area, nor did we find it on Killinek Island (Burwell).

Suckers are not valued by the Eskimos as food; they are used chiefly as dog-feed, and as such they can have some importance to the native economy. Most of the fish are caught in gill nets set under the ice in the fall. Large numbers are also caught in the spring, before break-up, especially on bright sunny days, according to one report. At this time the suckers are apparently moving to the spawning beds. To the Indians in the neighbouring bush country the suckers are of more direct significance, periods being recorded when they formed the bulk of the diet for several months.

Couesius plumbeus (Agassiz). Lake northern chub

This species was not found by the authors of this paper, but two specimens were obtained from the George River, far upstream, in a small tributary five miles west of Indian House Lake, by Rousseau (Legendre and Rousseau, 1949) in 1947. This was the first, and so far the only, record of a cyprinid north of the St. Lawrence drainage in this region.

Paralepis rissoi kröyeri Lütken

A north Atlantic species, of general distribution, usually in deep water, from about 30°N. latitude to the waters of Greenland. Jensen (1942) states that it is known from west Greenland on the basis of five specimens, two from Umanak Fjord, and three from the extreme southwestern tip of the island.

In Ungava Bay the species has not been recorded before. Six specimens were taken from cod stomachs (*Gadus callarias*) in Forbes Sound, Port Burwell, on August 21 and 23, 1947, one on August 7, 1948, and two on August 3, 1949, all from cod stomachs and all from the same locality. Vertebral counts were not possible on all the specimens, owing to damage by digestion. Two of the 1947 specimens had counts of 83 and 84, the 1948 specimen showed 83 vertebrae, and one of the 1949 specimens had 85. It is on the basis of these counts that the specimens have been referred to *P. rissoi kröyeri,* after Ege (1930).

Paralepis has not been recorded hitherto from the Canadian arctic. It is an Atlantic genus, and a migrant form, as is shown by the wide separation between the areas of adult and juvenile capture (Jensen, 1942). It probably enters northern waters by the Atlantic Drift route, arriving in west Greenland and Ungava Bay by way of the Irminger current. The effects of the cooling of the west Greenland current as it progresses northward are apparently well shown by *Paralepis,* according to Jensen (1942, p. 19), who writes: "So strongly does the water gradually become cooled that these fishes are paralyzed . . . becoming an easy victim to seals and fishes of prey, or they float dying or dead up to the surface of the water, and thereupon may drift ashore".

This is undoubtedly a rare fish in Ungava Bay, even at Burwell, whither it must be carried by Atlantic water from west Greenland. It was unknown to the resident Eskimos at Burwell. Such a distinctive fish, which we obtained up to 255 mm. in length, would almost certainly be remembered by the natives if they were washed ashore even rarely in the inhabited region of Killinek Island.

Lampanyctus crocodilus (Risso). Lantern fish

Bathypelagic in distribution in the Mediterranean and Atlantic; not previously recorded from Ungava Bay, or from any station in the Canadian arctic. Jensen (1926) reported this species as common south of the submarine ridge between Baffin Island and Greenland. Several damaged specimens from cod stomachs were taken at Burwell in August 1947, one specimen in 1948 and again a few in 1949. Like the foregoing species, *Lampanyctus crocodilus* is an Atlantic bathypelagic immigrant into Ungava Bay, although it is able to breed in much colder water than *Paralepis.* The Ungava Bay specimens are imperfect, and most of the photophores are absent. The 1947 specimens were referred to this species by the late Dr. S. F. Hildebrand on the basis of a comparison of body proportion and fin positions with other species of lanternfish known from the north Atlantic.

Lampanyctus is a deep-water form, but like many Atlantic deep-water forms, it is clearly found in shallower water at the northern limits of its range. All the Ungava Bay specimens came from cod stomachs, and all efforts to catch cod in water deeper than about 25 fathoms were unsuccessful. The following data were obtained from the present material: Total length 66 to 126 mm., gill rakers approximately 26, vertebrae 43 to 46, dorsal rays 18.

Myctophum glaciale (Reinhardt). Glacier lanternfish

Known from north Atlantic and arctic waters. Along the coast of Greenland, this is one of the most northerly of the bathypelagic fish in distribution, and it is found both north and south of the submarine ridge between eastern Baffin Island and west Greenland. It has not previously been recorded from Ungava Bay. Specimens were obtained from the stomachs of Atlantic cod at Burwell in both 1947 and 1948, and on August 13, 1948, one of the Eskimo crew collected a perfectly preserved specimen from the surface of the inner harbour of Burwell. Several of the specimens taken from cod stomachs were too small and damaged for certain identification, and have been referred to this species only tentatively.

The 1947 specimens were taken between August 19 and 25; a careful watch for this species was kept in examining cod stomachs at Burwell during the first part of August 1948, but none was obtained before August 11, when they were the most abundant vertebrate constituent in the stomach contents. It is possible that *Myctophum* does not arrive at Port Burwell until the seasonal warming effect reaches its maximum. In 1949, however, specimens of Myctophidae were obtained in cod stomachs on August 3, whose identification was uncertain.

The glacier lanternfish is well known to the Eskimos of Port Burwell, who call it "mikiapic kapisilik" (the very small fish with scales). One native stated that he had often seen them on the surface of the water in McLelan Strait, and that they are often dead or dying.

Esox lucius Linnaeus. Northern pike; kikiyuk

A holarctic northern form. In northern North America the northern pike ranges in suitable habitats to the northern limit of the mainland. Records exist from Point Barrow, Alaska, the delta region of the Mackenzie, and the drainages of Hudson Bay and Ungava Bay. In Ungava Bay it was first reported by common name by Davies (1854). Legendre and Rousseau (1949) recorded it on the basis of field notes from the George River at three stations. No specimens were taken by the present writers, but one damaged individual, caught by Eskimos and chewed by dogs, was referred to this species in 1947, with considerable doubt.

Eskimos report that an occasional specimen is taken in the Koksoak and the George River in the vicinity of the trading posts. Farther inland it is reported as common, and as being taken often by the Indians in the Fort Mackenzie region. Certain lakes in the Whale River drainage are stated to contain large numbers of the northern pike. There seems to be no evidence for the invasion of salt water, but it is occasionally taken in brackish water in the Koksoak. The Eskimos of Fort Chimo know this species as "kikiyuk" on account of its large teeth. It is known to do occasional damage to gill nets.

Boreogadus saida (Lepechin). Arctic cod, arctic pollack; ovak, ogac.

(The Ungava Eskimo use the same word for the polar cod, the Atlantic cod and the Greenland cod; in this the dialect differs from Greenlandic Eskimo, which has separate words for the three species.)

The polar cod is circumpolar in distribution, the southern limit depending apparently upon the degree of admixture of non-polar water. It is considerably less abundant along the margin of the subarctic area than in the pure polar water farther north. In Ungava Bay, the species was first collected by L. M. Turner (Kendall, 1909). Turner (manuscript, 1885) states that when his ship was beset among the ice floes in Ungava Bay, the polar cod was observed to be very common. Vladykov (1933) recorded this species from Port Burwell, taken in the stomachs of Atlantic cod.

Several damaged specimens of *Boreogadus* were taken from cod stomachs at Burwell by the present writers. One specimen was taken from the stomach of a bearded seal (*Erignathus*) about ten miles northeast of the Gyrfalcon Islands in July 1948. A small gadid observed by Hildebrand in the same month, swimming among the ice floes, probably belonged to this species. One pelagic young was taken in a plankton tow near Burwell in August 1947.

One native at Burwell reported that only "small cod" occurred there during the winter. It is known that most or all of the Atlantic cod (*Gadus callarias*) migrate away from Burwell in the late fall, but the "small cod" described here may be either the polar cod or the Greenland cod (*G. ogac*), or both.

The polar cod is a pelagic form, found from the surface to about one thousand metres. It is very commonly found in water containing abundant ice, and it has even been recorded from pools on the ice-floe surfaces. Very little is known of its spawning habits. Murdoch (1885) reports that pelagic fry are taken in the inshore water at Point Barrow in July, and considerable numbers of them, from 10 to 21 mm. in length, were recorded by Dunbar (1947a) in the coastal waters of Baffin Island in July, August and September.

Turner, in his 1885 manuscript, comments on the bright coloration of this little cod, describing specimens three inches in length and under, taken from among the ice floes of Ungava Bay during the first few days of August 1882: "I do not remember to have seen colors on fishes to be so brilliant as were shown on these. The palest olive green above; brilliant purple reflections of ever-changing hue on sides of silvery white, and pure silver white on the lower parts. These colors so constantly undergoing changes that the sides were scarcely half a second of time the same color".

The details of taxonomy of the polar cod are little known. Russian workers have recently recognized two genera with two species each, occurring in the circumpolar region. Our material from Ungava Bay is as yet too fragmentary to allow for comment on the taxonomy.

Gadus callarias Linnaeus. Atlantic cod; ovak, ogac (see note on Eskimo name under *Boreogadus saida*)

An Atlantic fish, found northward almost to the limit of the subarctic, and southward to New England and France. Recorded from Novaya Zemlya, Spitsbergen, Iceland and Greenland. In Greenland it is found at least as far north as Upernavik, in latitude 73°, in summer.

In Ungava Bay, the identity of the cod occurring at Port Burwell was definitely established for the first time by Vladykov (1933), as *callarias.* Many early travelers had reported codfish from Burwell, using the common name and collecting no specimens. They are present only during a few weeks in summer, from the beginning of August to the end of September or early October. The precise time at which they disappear from the vicinity is not known; there are as yet only Eskimo reports to go on, and since the natives do not at present make much use of the cod the reports are not necessarily reliable.

The local habits of the cod in the Burwell area were found to be such that their occurrence during the months of August and September is patchy. Shallow shelves off the shores of the islands gave the best fishing results, in depths between about six and sixteen fathoms, the cod being taken in smaller numbers down to thirty-five fathoms. Details of the fishing techniques used, and also of the biology of the Atlantic cod at Burwell, will be published separately in a later paper in this series.

Gadus ogac Richardson. Greenland cod, fjord cod; ogak, ovak (see note on Eskimo names, under *Boreogadus saida*)

Predominantly west Greenlandic in distribution, but found along the arctic coast of Canada to Bathurst Inlet; Hudson Strait, and south along the Labrador to the Gulf of St. Lawrence. In Ungava Bay, the Greenland cod was first reported by Kendall (1909) from the Turner collection. Vladykov (1933) reported it from Burwell. Turner (1885) described it as being "quite plentiful along the Labrador coast and as far within Hudson Strait as the mouth of George's river. At the latter place they are, however, quite rare, oftener seen dead than alive. They are occasionally found with their livers cut out by the seals, which catch them, and the bodies are thus cast on the ice or shore". The Greenland cod cannot be considered common in Ungava Bay, on the basis of the present field work, but it is possible that it occurs locally, in special habitats which have not yet been discovered. During four seasons of collecting (1947-50), by dredge, long line and hand line, on both sides of Ungava Bay from the Button Islands and Burwell around the inshore and offshore waters to Cape Hopes Advance, only one specimen of *Gadus ogac* was taken, at Burwell (Forbes Sound) on July 6, 1949, by hand line. One other specimen was sent to the senior author by Father Steinmann, collected on July 25, 1949, at Koaktuk in Diana Bay. It is not of any significant importance to the Eskimos.

Lota lota maculosa LeSueur. Burbot, loche; mari, shulukpaoluk

The burbot is circumpolar in distribution; *maculosa* is known from the eastern part of the Hudson Bay drainage to Labrador, south to Delaware, across the United States to the Columbia River system. The area of intergradation with *L. l. lepturus* of the Yukon system is not known. In Ungava Bay it was first reported by Kendall (1909), based on Turner's specimens from Fort Chimo. The present writers obtained no specimens of this species. It is known to the Eskimos of the Chimo region, but is never taken in large numbers. On the other hand, Turner in his 1885 manuscript says of the burbot that it is "quite common in the lakes of Ungava district; in fact more common than the number of specimens obtained would indicate". Turner took four individuals. They are caught by the Indians inland, rather than by the Eskimos. Turner mentions the Indian name "mari" for the burbot, and remarks that it is also used by the Eskimos. The name "Shulukpaoluk", an Eskimo word, is also used. It means "feathered like an arrow" and refers to the long dorsal and anal fins; being a descriptive name, it is also applied to other fishes with similar fin patterns, in particular the eelpouts.

Reinhardtius hippoglossoides (Walbaum). Greenland halibut, arctic flatfish; natarnak (this is the name applied by the Greenland Eskimos to the Atlantic halibut only (*Hippoglossus*); in Ungava Bay it seems to apply to any flatfish)

General distribution subarctic and arctic, known from northwest Greenland and Spitsbergen south to Norway and Newfoundland, rarer as far as Cape Cod. The Greenland halibut has not been reported previously from Ungava Bay. Between August 19 and 25, 1947, 29 small specimens from 3 to 5 inches (7.5 to 13 cm.) in length were taken from stomachs of the Atlantic cod at Burwell, and in the succeeding three seasons these small *Reinhardtius* were found to be one of the commonest fishes in the diet of the cod at that station, at least during the month of August. They were not taken elsewhere. Specimens of similar size were also taken occasionally in the dredge hauls, and once in an otter-trawl, at depths down to seventy fathoms, in Forbes Sound. Vertebral counts varied between 61 and 64, and anal rays from 72 to 75. These figures, together with the symmetry of the mouth and the vertical position of the left eye, are diagnostic for *Reinhardtius*.

No adult specimens of the Greenland halibut were taken. The long line fishing was not successful for any kind of fish; nor were the depths of water investigated (down to about two hundred metres) sufficient to reach the known vertical range of the adults. In Greenland they are caught in considerably greater depths. One pleuronectid, however, of larger size, was taken from the stomach of a Greenland shark at Port Burwell (see above). It was incomplete, lacking several tail vertebrae and part of the skull, and measured in this condition 36 cm. Fifty vertebrae were present, the number being incomplete, and the left orbit was vertical in position. On these characteristics alone, it is very probable that the specimen should be referred to *Reinhardtius hippoglossoides*.

Apart from this specimen, the largest obtained in Ungava Bay (all specimens came from the vicinity of Burwell) was 158 mm. in total length. Jensen (1935) states that the Greenland halibut is bilaterally symmetrical in West Greenland waters up to 54 to 57 mm., and is pelagic until a length of about 80 mm. is reached.

From the frequency with which the young *Reinhardtius* were taken from cod stomachs at Burwell, it is clear that it is a fairly abundant member of the shallow water benthos. Until the adults are found, however, it is not possible to determine its possible economic value to the native population. One Eskimo at Burwell reported having seen a flatfish washed ashore in the autumn of 1947 in Lenz Strait, off the northeast tip of Killinek Island.

No other species of flatfish has been recorded from Ungava Bay. Kendall (1909) assumed that specimens of pleuronectids collected by Lucien Turner and labelled "Labrador" came from Ungava Bay, since Turner did most of his collecting there. Turner's own manuscript, however, makes it clear that his specimens came from Rigolet, on the Labrador, and that "no species [of *Pleuronectes*] was obtained from Hudson Strait".

Gasterosteus aculeatus Linnaeus. Three-spined stickleback; kakilishek

A circumpolar form in fresh and coastal salt water south to north Africa, northern China, southern Japan, Lower California and Chesapeake Bay. The northern limits of distribution in arctic Canada are uncertain, but it has been taken in Baffin Island and Hudson Strait, and in James Bay. It is common in south Greenland. In Ungava Bay it is one of the most common fresh-water fish throughout the area. The present writers have specimens in the McGill University collection from the Koksoak River at Forth Chimo, from the George River and from the region of Cape Hopes Advance. It has also been observed to be very abundant in Payne Lake (Legendre and Rousseau, 1949). During the present field work, it was found in most streams and lakes visited. Many ponds with no apparent means of access for fish contained this species. In the Koksoak River *Gasterosteus* was taken in tidal pools; adults with nearly ripe gonads were taken on June 28, 1948, in such pools.

In Bobs Lake, close to the George River trading post, *Gasterosteus* was found in 1948 to be heavily infested with the cestode *Schistocephalus*, from one to six worms being taken in the body cavity of almost every fish examined. Identification to species was not made; the genus is known from fish-eating birds, such as gulls and mergansers.

Pungitius pungitius Linnaeus. Nine-spined stickleback; kakilishek

A very widespread species, in both fresh and salt water; not recorded from Greenland or Iceland; found south to Central Europe, Saskatchewan and the Great Lakes, and coastwise to New Jersey; recorded from Baffin Island and King William Island, and islands in Hudson Bay. It was first reported from Ungava Bay by Kendall (1909), and the present McGill University specimens are from Leaf Bay, the Koksoak River at Fort Chimo, False River and Tunulik River. Rousseau obtained this species at the outlet of Payne Lake (Legendre and Rousseau, 1949). The species was found to be very common in streams draining into Leaf Bay, in brackish water, and was also taken in fresh water in the Kasigiaksiovik River (Leaf Bay). It was common in tidal pools on the Koksoak River, but not so numerous as *Gasterosteus*. One specimen was taken in a stramin net set in the tidal current near Tunulik on August 29, 1947.

The variations in a given population of *Pungitius* have not been delineated; in this paper, *P. brachypoda* Bean, described from Cumberland Gulf is regarded as synonymous with *P. pungitius,* following Vladykov (1933) and Pfaff (1937). In 17 specimens from Ungava Bay the dorsal spines ranged from 9 to 11.

Ammodytes dubius Reinhardt. Lesser sand eel, sand launce

The genus *Ammodytes* has recently been studied by Jensen (1941), who has shown that the species *lancea, marinus* and *dubius* can be regarded as representing a cline, geographically ranging from northwest Europe to arctic waters, with increasing numbers of fin rays and vertebrae from south to north, following the well-known pattern in fishes. Saemundsson (1949) refers to this form in Iceland as "*Ammodytes lancea*-group". Jensen (1941) concludes his study as follows: "The general impression is, in my opinion, that the different conditions under which the species *Ammodytes lancea* lives, e.g. depth, temperature and salinity of the water, spawning time, contribute towards the formation of subspecies and races, which in this respect can be considered as ecologically conditioned".

The specimens from Ungava Bay all belong probably to *dubius*, the arctic form, although most of the specimens are immature planktonic larvae and cannot be determined with certainty; the fin rays in many of them are not completely developed. The majority (187 specimens) were taken in plankton nets at station 51 (Pitsulasitik), on August 29, 1947, in quite shallow water (five to six metres). The bottom was a muddy glacial sand. In 1949, a few very small specimens were obtained in plankton nets at stations 103 (off Burwell), 124 (near mouth of Koksoak River), and 129 (ten miles north of the Koksoak mouth). One fully developed specimen was obtained at station 101 (near Beacon Island). Measurements and counts on this specimen are as follows:

Length	59 mm.
Head	12 mm.
Head in length	4.9
Dorsal rays	63
Anal rays	31
Pectoral rays	14
Vertebrae	74

These figures agree with Jensen's counts for *A. dubius.*

This is the first record of this species from Ungava Bay. It was not taken from cod stomachs at all.

Sebastes marinus Linnaeus. Rosefish

A north Atlantic fish, known on the North American side from Umanak in west Greenland south to New York. It has not hitherto been recorded from Ungava Bay. Only two small specimens were taken during the present field work (1947-49), from cod stomachs at Port Burwell during August 1947.

Triglops pingeli Reinhardt

North Atlantic, north Pacific, and Arctic, in various subspecies. Specimens have been described from Hudson Bay by Vladykov (1933), and referred to the Pacific subspecies *beani.*

The present material consists of 26 specimens, taken as follows:

Ringed seal (*Phoca hispida*) stomach, off mouth of Koksoak river, July 7, 1948. Ten small specimens.

Cod stomachs, Port Burwell, August 1947 and 1948. Ten small specimens.

Dredge samples. Station 107 (Forbes Sound), 30-40 fathoms, July 7, 1949. One small specimen.

Station 126 (between Payne Bay and Akpatok Island), 36-50 fathoms, August 23, 1949. Three specimens.

Planktonic young, two specimens (24 and 28 mm., total length); station 101 (south of Beacon Island), June 26, 1949.

The largest specimen is only 95 mm. standard length. The material from the cod and seal stomachs is not identifiable to subspecies, and the planktonic young are too immature. The four dredged specimens (all of them males) have the following measurements and counts:

Standard length (mm.)	D	A	P	V	Depth of caudal peduncle into standard length %
67	XI, 24	25	19	I, 3	4.0
68	XI, 25	25	18	I, 3	4.1
61	X, 24	24	19	I, 3	4.4
95	XI, 25	25	19	I, 3	4.0

Following the recent revision of the species by Jensen (1944), these specimens are thus referred to the subspecies *T. p. pingeli,* known hitherto from east and west Greenland, and the coast of Baffin Island. Vladykov (1933) referred his Hudson Bay specimens to the Pacific subspecies *beani,* largely on the basis of the depth of the caudal peduncle, following Rendahl (1931). The typical *beani* has a caudal depth of 2.3 to 2.4 per cent of the body length; the Hudson Bay specimens examined by Vladykov were fairly close to this figure, with 2.6 to 2.9 per cent. Vladykov also reported other Pacific affinities in the Hudson Bay fauna.

Triglops nybelini Jensen

Jensen (1944) established this species from specimens from west and east Greenland water, and from Jan Mayen, differing from *Triglops pingeli* in the following characteristics: eyes larger; pectoral rays 20 to 22 (16 to 19 in *pingeli*); central ray in ventral fin longer than the others (innermost ray longest in *pingeli*); and the colour pattern, which lacks the saddle marking of *pingeli,* and is characterized by longitudinal dark bars along the lower sides, below the lateral line.

The Ungava material includes one specimen of a young *Triglops* which appears to belong to this species. Taken in a No. 00 silk plankton net towing at about thirty metres depth, the specimen measures 27 mm. standard length, 31 mm. total length. The snout-anus distance is 2.7 in the total length, and the fin-ray counts are: D, X-25; A, 26; P, 22. The central ray of the three soft ventral rays is the longest, and the eye is very large. In all these characters it agrees with the description of *T. nybelini* published by Jensen, and moreover it differs in all these respects not only from the descriptions of adult *T. pingeli,* but from the young planktonic individual of *pingeli* described and figured by Dunbar (1947a), taken in southern Baffin Island. The present specimen was taken at station 128, southwest of Akpatok Island, on August 24, 1949.

As in most cases of planktonic young fish, there are details of proportion and colour which differ from the adult condition. The lower jaw thrusts slightly forward of the tip of the upper jaw, and the adult coloration is not developed. The most striking colour characteristic is a dark line along the back, on either side of the base of the dorsal fins, extending from the front of the first dorsal to the caudal fin. The peritoneum is very dark (Figure 1).

Cottus cognatus gracilis Häckel. Common slimy muddler, bullhead

This species has been previously reported from Chimo by Kendall (1909), from Turner's specimens. The present writers found it to be very common on the Koksoak River and in tributaries, in brackish water particularly. It was very abundant in tide-pools, often found together with *Gasterosteus.*

Myoxocephalus scorpioides (Fabricius). Arctic sculpin; kanayuk

Common in shallow water in the North American arctic and subarctic, from the coasts of Greenland and Baffin Island south to the Gulf of St. Lawrence, and west along the arctic coast of Canada to Dolphin and Union Strait. In Ungava Bay it is one of the commonest sculpins in the shallow coastal water, being taken chiefly in the intertidal zone or immediately below it. It was taken by hand line, and occasionally in shallow-water dredge hauls, all round the shores of the bay, including Port Burwell, Keglo Bay, at the mouth of the Tunulik River, Leaf Bay, and Inukshuktuyuk.

Although over three thousand pelagic fry of cottids were examined from Ungava Bay, it was found impossible to separate the young of *M. scorpioides* from those of *M. scorpius.* The older specimens, however, are fairly simply separated. Vladykov (1933) gives five points of difference, one of which, the completeness of the lateral line in *scorpioides,* is not valid for our present specimens, since the lateral line is also complete in many of the *scorpius* individuals. On the basis of the present material, the following appear to be good *scorpioides* characteristics: (1) The head spines are developed into soft tentacles; (2) there are warty prominences on the head; (3) the ventrals are shorter than in *scorpius,* not reaching the anus; (4) the pectorals reach only just to the front of the anal fin; (5) pectoral rays number 15-16, not higher (17-18 in *scorpius*); (6) the caudal peduncle is longer than in *scorpius;* (7) the mouth is smaller and the maxilla shorter, the latter reaching to the middle of the eye; (8) the snout is considerably narrower and sharper than in *scorpius.* The presence or absence of a pore beyond the last gill slit appears to be a less reliable characteristic.

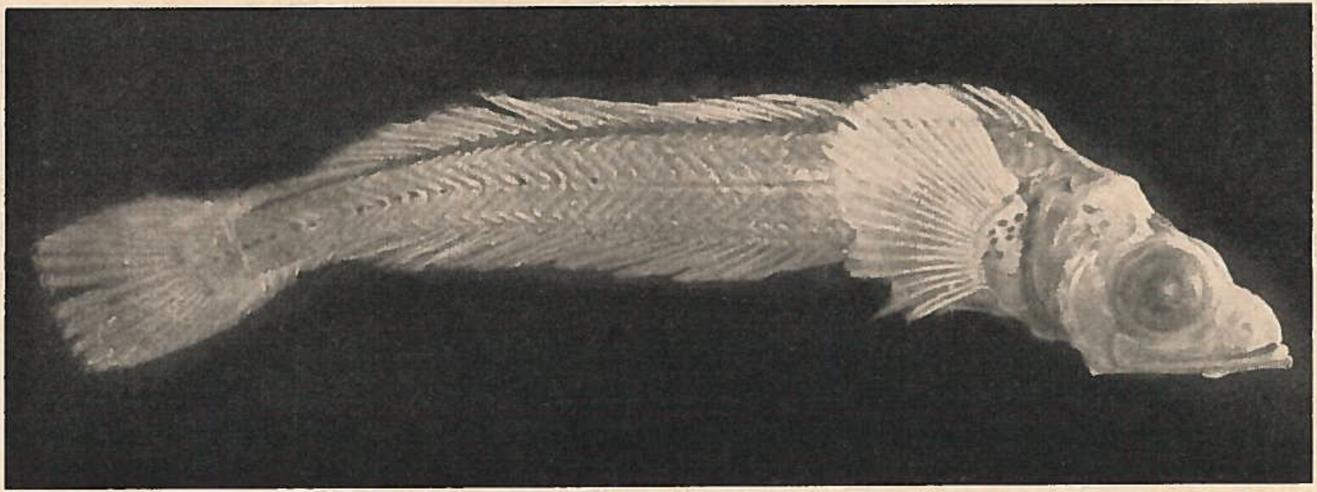

FIGURE 1. *Triglops nybelini* Jensen. Young planktonic larval specimen, 31 mm. total length. (Photograph by J. W. Pollock.)

The arctic sculpin, particularly in the young stages, favours intertidal regions where small streams enter the sea. This is true also of *M. scorpius*; in both species, this preference is lost in the adult. It was found to subsist largely upon the littoral amphipod *Gammarus locusta*. It does not reach the size of *scorpius*, and has no value to the Eskimos.

Myoxocephalus scorpius (Linnaeus); (Syn. *M. groenlandicus* (Cuvier and Valenciennes)). Daddy sculpin, common sculpin; kanayuk

This species has been recognized as *M. groenlandicus* principally by American authors. There appears, however, to be no set of characteristics which definitely distinguish the American from the European form. Pfaff (1937) has pointed out that the North American specimens tend to reach a larger size and to have a greater number of fin rays. The specimens taken by the present authors in Ungava Bay are very close to the range of fin rays of specimens from the North Sea given by Duncker (1927):

North Sea:	D. VII-XI, 14-17; A. 10-14; P. 16-17
Ungava Bay:	D. VIII-XI, 15-17; A. 13-15; P. 16-18
Hudson Bay, Hudson Strait:	D. IX-XII, 15-18; A. 12-15; P. 17-18 (Vladykov, 1933)

M. scorpius is known from the coast of arctic North America from Dolphin and Union Strait to Ungava, and from Baffin Island, Greenland, Iceland and Spitsbergen south to New York and the Bay of Biscay. Vladykov (1933) considers that *M. stelleri* of the Bering Sea should be reduced to a variety or subspecies of *M. scorpius*. In Ungava Bay this is the commonest fish in the inshore waters, recorded by hand line from Payne Bay, Leaf Bay, the estuary of the Koksoak, False River, George River, Keglo Bay, Adlorilik and Killinek Island. In addition, about two thousand planktonic young were taken in plankton nets from all parts of the bay. The shallow water within a few miles of the mouth of the Koksoak River was found to be especially rich in the planktonic young of several fishes, including *scorpius*. This species has been shown to dominate in subarctic rather than high-arctic waters; in the latter its place seems to be taken by the next species, *Oncocottus quadricornis* (Dunbar, 1947b).

In size, the daddy sculpin was taken up to 18 inches (46 cm.). The colour was extremely variable, from black to a pale olive green on the dorsal surface, and from white to blotched with yellow and orange ventrally. It is omnivorous in habit. The commonest food found in the stomachs was *Gammarus locusta*, but specimens taken in the deeper parts of the littoral were found to be feeding chiefly on crabs and prawns. Fish remains were not common; one specimen contained a large lumpenid blenny in its stomach, others occasionally contained the young of their own species. The specimens were heavily parasitized by nematode worms, and every individual examined contained several in the liver.

This species is not unimportant to the native population. Cooking pots in native shacks and boats were observed to contain the daddy sculpin many times during the summer season, and women and boys make a practice of jigging for them on the ebb tide, especially if other sources of food are in short supply. They may also serve as dog-feed, and indeed the dogs themselves sometimes catch them in tide-pools or at the water's edge.

Oncocottus quadricornis (Linnaeus); (Syn. *Myoxocephalus quadricornis*). Four-horned sculpin; kanayuk

In general a high-arctic form, known along the entire arctic coast of North America and Asia, and north to Spitsbergen, Jan Mayen, arctic (as opposed to subarctic) parts of Greenland and the Canadian Arctic Archipelago. It has been reported from Floeberg Beach, northern Ellesmere Island, the most northerly record of any marine fish in the North American sector. There is a relict form in the Baltic Sea and several freshwater relicts.

This species is here reported for the first time from Ungava Bay on the basis of four specimens obtained in 1947 and 1948. One specimen was taken in the dredge in Leaf Bay in 15 metres of water; two were caught by hand in a tidal lake near Port Burwell; and one was found dead on the tidal flats at Fort Chimo during the spring tides in September 1948. They were all small, ranging from 64 to 106 mm. total length, with the following fin ray count: D VIII, 14-15; A 14-16; P 14.

The scarcity of *Oncocottus* in Ungava Bay in comparison with *Myoxocephalus* is in agreement with the known general distribution of the two fishes, the former being the predominantly arctic form, the latter the predominantly subarctic; it also confirms the subarctic nature of the waters of Ungava Bay, which, although not easily amenable to demonstration by the study of physical oceanography, is inferred by the considerable number of Atlantic representatives in the fauna.

Gymnocanthus tricuspis (Reinhardt). Stag-horn sculpin

Known from arctic and subarctic seas south to Maine and Norway, common west to Hudson Bay. Common in Ungava Bay; it was first reported from there by Vladykov (1933) on the basis of two mature specimens collected at Burwell. The present material consists of five adults (taken in Keglo Bay (four specimens) and at the mouth of the Koksoak River (one specimen)), and a number of planktonic young taken at stations 18, 22, 37, 40, 124 and 129. A few damaged specimens were taken from cod stomachs at Burwell, and in addition there is a considerable number of larval specimens too small to be identified with certainty.

There has been considerable confusion in the taxonomy of this genus, and the authors are indebted to Dr. L. P. Schultz of the United States National Museum for permission to examine his manuscript on the problem. The junior author (Hildebrand) made a special study of a number of specimens of *G. tricuspis* from various parts of the north, and of its close relative *G. pistilliger*. Vladykov (1933) described a new subspecies of *G. tricuspis* (*G. t. hudsonius*) on the basis of two immature specimens from Nottingham Island and two mature specimens from Port Burwell, differing from the typical form (*T. tricuspis*) in the possession of longer ventral fins, longer anal papilla in the male, complete absence of bony granulations on the head, and slightly different coloration. Until a larger body of material is at hand from the eastern arctic waters, we prefer not to identify the present Ungava Bay specimens to either subspecies. With regard to the bony granulations on the head, Hildebrand made the following observations on *Gymnocanthus tricuspis* material in the U.S. National Museum:

	Granulation in:					
	Females			Males		
Locality	none	weak	heavy	none	weak	heavy
Battle Harbour, Labrador	1	3	1	0	0	0
Assizes Harbour, Labrador	0	0	0	0	0	1
Anatalak bay, Labrador	1	0	3	0	1	0
Red Bay, Labrador	0	0	0	0	0	2
Nachvak, Labrador	0	0	1	0	0	0
Ungava Bay	2	0	0	0	0	2
Holsteinsborg, Greenland	5	8	3	0	1	7
Egedesminde, Greenland	0	0	1	0	0	0
Totals:	9	11	9	0	2	12

Nine females and five males of *G. pistilliger,* and five females and three males of *G. galeatus,* all showed heavy granulations. All specimens, of all three species, were over 150 mm. in total length. It seems doubtful if the extent of granulation on the head can be considered a useful taxonomic character in *G. tricuspis,* on the present analysis.

The following is a synopsis of four adults taken in Ungava Bay:

Females: two specimens, 199 and 195 mm. total length.

D XI, 15-16; A 17-18; P 19. Head without bony granulations, ventrals reaching only to the vent, anal papilla very short; first dorsal yellowish with a few black bars on fin rays; abdomen white.

Males: two specimens, 193 and 195 mm. total length.

D XI, 15-16; A 17-18; P 18-19. Abundant bony plates on top of skull from the interorbital space to the insertion of the first dorsal; ventrals prolonged past the vent to at least the middle of the anal fin; pectoral fin roughened; anal papilla more than twice as long as in the females; dorsal fins high; spiny dorsal black, with two rows of light bars on fin rays; abdomen dusky.

Most of the pelagic young taken in plankton nets were small, below 20 mm. total length. Three, however, were slightly larger, and were sufficiently different, not only in size but in developing characteristics, from the specimens described by Dunbar (1947a), to make them of interest to the student of the juvenile taxonomy of the cottids. All three measured 25 mm. total length (22 mm. standard length), and showed the full fin-ray formula: D XI-XII, 15-16; A 17; P 19. The preopercular spine is slightly curved upward, and without the antler-like processes present in the adult, and there is the remnant of pigment spots along the mid-ventral line forward of the vent, characteristic of the young of this species. The nostrils are double, the anterior pair being produced in tubular fashion.

Gymnocanthus tricuspis was found to be commonest below about 30 metres, outside the shore zone inhabited by *M. scorpius.* The pelagic young were taken in the same hauls as other cottid planktonic larvae, usually in shallow water.

Icelus bicornis (Reinhardt)

The genus *Icelus* has recently been reviewed by Jensen (1949), whose work is followed here. *Icelus bicornis* was formerly given circumpolar range, but the Siberian and Bering Sea subspecies (*I. b. beringianus* Schmidt) has been shown to be identical with *I. spatula* Gilbert and Burke. The two species are separated in the males by the very different form of the urogenital papilla, and Jensen has found a characteristic on which to separate the females as well, namely the form of the lateral-line scales, which have well developed spines both dorsal and ventral to the lateral-line pore in *bicornis,* but only dorsal to the pore in *spatula.* The present known distribution of *Icelus bicornis* on this new definition is not circumpolar, but extends from the Canadian eastern arctic to Spitsbergen and the Barents and Kara Seas. At both ends of its range it mingles with *spatula.* Vladykov (1933) reported *bicornis* (old definition) from Hudson Bay; his specimens have not been examined by the present authors. All six of them were females.

Three specimens of this species were taken in the dredge in Ungava Bay, at station 126 (between Payne Bay and Akpatok Island) in 75 metres of water, in August 1949. One is a male, measuring 41 mm. standard length (50 mm. total length), and the other two are females measuring 88.5 and 61 mm. standard length (approximately 102 and 73 mm. respectively total length; the tails are damaged). The lateral-line scales are typical according to Jensen's (1949) figures and description.

Icelus spatula Gilbert and Burke

This species fills in the part of the circumpolar range in which *bicornis* is not found, according to present knowledge, from the Kara Sea eastward to the Bering Sea, and probably along the North American arctic coast to Hudson Strait and Davis Strait. The species is not so far known from the central Canadian arctic or from the north coast of Alaska, but there is small doubt that this is due to the small amount of collecting that has been done in those parts. As mentioned above, it is separated from *bicornis* by the markedly different shape of the urogenital papilla in the male, which is short with a narrow prolongation in *bicornis,* and long and expanded in *spatula;* and by the form of the lateral-line scales in both sexes.

Icelus spatula has been taken in west Greenland, but not in east Greenland, and once off Exeter sound in eastern Baffin island. It is known from the Bering Sea, the Kamchatka coast, and along the Siberian shelf west to the Kara Sea. In Ungava Bay, it was taken in the same dredge haul as produced the *I. bicornis* just described, at station 126 in August 1949. Four specimens were obtained, two males and two females, measuring 54.5, 58, 45 and 44 mm. standard length (64, 68, 55 and 53 mm. total length approximately). Although the lateral-line scales agreed in general with Jensen's description and figures, in lacking the two or more spines ventral to the pore, there was some variation in the precise form of this ventral lobe of the scale. There is a posterior projection immediately ventral to the pore which in two of the specimens approached the form of a true spine. Such a variation is in fact suggested by Jensen's figures, but is not mentioned in the text. If *bicornis* and *spatula* are in fact good species, they certainly appear to occupy the same habitat where they overlap, since both species were obtained in the same haul, and nowhere else.

Aspidophoroides olriki Lütken. Sea poacher

Known from Greenland waters, Hudson Bay and arctic seas generally; Murman coast, Kara Sea, Bering Sea; probably circumpolar. South to northern Norway and Newfoundland. In Ungava Bay, A. P. Low collected one specimen in 1897. The 1947-49 material consists of five pelagic young taken in plankton nets at station 1 (1947) and stations 101 and 103 (1949); and three adults taken in the dredge at station 33 (1947) and stations 102 and 106 (1949), at depths ranging from 27 to 130 metres.

Eumicrotremus spinosus (Müller). Spiny lumpfish

This widespread North Atlantic and arctic fish was taken only twice during the 1947-49 field work, once in the dredge in Keglo Bay (station 33) and once in a plankton net at station 103, off Forbes Sound. The dredged specimen measures 31 mm. and was taken in 25 metres of water; the planktonic specimen, 8 mm. total length, was caught between five and ten metres below the surface.

Family LIPARIDAE: The taxonomy of the liparids is still in a somewhat chaotic state, in spite of fairly recent publications which have individually illuminated the situation, but which taken together obscure it again owing to the disagreement shown. So far as the present material is concerned, the issue is one of the status of *Liparis liparis* (Linnaeus), *Liparis tunicatus* Reinhardt, and *Liparis major* (Gill). In the determination of the present material we have referred both to the review of the genus published by Burke (1930) and to Parr's (1932) discussion of the species *L. liparis* and *L. koefoedi;* but there are points of uncertainty not covered by either author. In many respects one solution of the problem would be to return to Ehrenbaum's (1905) very broad definition of *L. liparis,* which includes the present *liparis, tunicatus* and *atlanticus,* and might be made to include more still, with the acceptance of the proposition that *L. liparis* is a highly variable species.

Liparis atlanticus (Jordan and Evermann). Sea-snail; nipisak (these common names apply to all the liparids)

This species is known from rocky shores of eastern North America from Cape Cod to Quebec Labrador. The present Ungava Bay record is based on a single specimen taken in a tide-pool at station 51 (Pitsulasitik, between the George River and Whale River), with the following determining characteristics: total length 87 mm.; D 35, A 28, P 28; gill opening very small, above base of pectoral rays; dorsal fin notched, the first four rays prolonged and with the ends free; dorsal separate from caudal; anal attached to caudal.

This appears to be the first record of the species north of the Gulf of St. Lawrence, and it is to be expected that present researches along the Labrador coast will find it there.

Liparis tunicatus Reinhardt

Burke (1930) recognizes this species as distinct from the European *L. liparis*, although the writers are aware that the European authors, notably Jensen, do not consider the Greenland liparid *Cyclopterus liparis* of Fabricius (1780), upon which Reinhardt based the species *tunicatus*, as distinct from European *L. liparis*. Burke's (1930) specimens came from the collection of Lucien Turner, from Ungava Bay.

The present material consists of twelve specimens taken by dredge and in tide-pools, and a few in plankton nets which are large enough for certain identification. There are also several damaged specimens from cod stomachs at Burwell, and a large number (over 150) of small planktonic young which are not certainly identifiable, and which may include individuals of the next species (*L. koefoedi*). Apart from planktonic catches, which were made at a variety of stations, *L. tunicatus* was taken at Burwell, Keglo Bay, Tunulik, Leaf Bay, and off the mouth of Payne Bay (station 126). It is one of the commonest fishes in the bay, and appears to make a habit, in the post-larval and adult stages, of swimming up into the surface layers during the night. The planktonic young were very abundant, next in numbers to those of *Myoxocephalus scorpius*. The largest specimen taken measured 157 mm. total length; those taken in tide-pools were under 100 mm.

The synopsis of the identifiable specimens is as follows: D 42-43; A 33-36; P 36-38; pyloric caeca 30-35; gill opening small, extending opposite 3-6 pectoral rays. Colour typically brown, "the colour of glue", with numerous melanophores; one specimen taken over black mud at Port Burwell was nearly black in colour when captured, but changed to brown when kept alive in a jar of water on deck.

Two doubtful specimens are referred to this species pending confirmation or complete revision of the genus. One, taken in the dredge at station 126, measures 65 mm., and differs from the typical *tunicatus* pattern in the following characters: pectoral 40, eye 4.3 in head (as opposed to 5-6 in head for the typical *tunicatus*), gill slit smaller, overlapping only one pectoral ray. The size of the eye, and of the gill slit, resembles the condition found in the north-western form *herschelinus* Scofield. The colour pattern is not typical of either species, being varied with an irregular banding of darker brown upon the normal brown field. The colour pattern in *L. liparis* and *L. tunicatus*, however, is known to be variable. In other characteristics this specimen answers to *tunicatus* without difficulty: D 43, A 35, pale peritoneum, notched pectoral, unnotched dorsal, etc.

The other doubtful specimen was taken in a plankton net at station 101, at the surface, at midnight on June 26-27, 1949, and measures 132 mm. total length. It departs from the definition of *tunicatus* given by Burke (1930) in the number of dorsal rays, but it appears to be still farther away from other species of the genus. D 35, A 34, P 36; vertebrae 48, pyloric caeca about 40, peritoneum pale; gill slit extends down opposite four pectoral rays. The low number of dorsal rays will not fit into Burke's key; the only species it fits is the *Liparis liparis* of Ehrenbaum (1905), of which the definition allows for considerable variation in the number of fin rays.

Liparis koefoedi Parr, 1932; (syn. *Liparis major* (Gill) of Burke, 1930, partim)

An arctic species, circumpolar. Parr (1932) has shown that the *Liparis major* (Gill) of Burke (1930), is not the same as the *Cyclopterus liparis major* of Fabricius (1780), to which Burke referred it, which latter form should therefore retain the name *major; Liparis major* (Gill), along with various identifications of *Liparis fabricii,* has been given the new name *koefoedi.* (The original *L. fabricii* of Krøyer appears to have been in fact identical with *L. l. liparis.* The "*L. fabricii* Krøyer" of Dunbar (1947a), from Hebron and Lake Harbour, should therefore be corrected here. These young specimens are probably all *Liparis koefoedi,* but may include also some *L. tunicatus.*)

Liparis koefoedi can be distinguished from all other members of the genus by the very dark peritoneum, and by the high number of dorsal and anal rays. It is also distinguished from other liparids in the Ungava Bay region by the fact that the inner teeth in each jaw are large and simple, not trilobed.

The Ungava Bay material consists of a number of specimens varying in length from 40 to 91 mm., including one taken by dredge, station 106 (outside Forbes Sound) July 7, 1949, five taken in plankton nets in deep water (220-230 metres wire) at station 103, July 6 and 14, 1949, and about twenty specimens taken from cod stomachs at Port Burwell, 1948 and 1949. The fin-ray formula of the undamaged specimens was: D 46-48, A 38-41, P 33-35, which is in close agreement both with Burke's description of *Liparis major* (Gill) and Parr's account of *L. koefoedi* Parr.

Eumesogrammus praecisus (Krøyer)

Known from the coasts of Greenland, and from Hudson Bay and Port Burwell (Vladykov, 1933). Also from Bering Strait and the Sea of Okhotsk. Represented in the present collection by one specimen from a cod stomach at Burwell, taken on August 23, 1947, and four planktonic young taken close to the surface at station 129 (southwest Ungava Bay) on August 25, 1949. Ova in the adult (1947) specimen were almost ripe. Fin-ray numbers on the largest of the planktonic young (25 mm. total length) were: D 45, A 37, P 16. It is possible that not all the dorsal rays are developed.

Lumpenus maculatus (Fries)

Known from the North Atlantic region from west Greenland south to New England, and in Scandinavian waters; also from Spitsbergen, the Murman coast, Barents Sea, and from the Bering Sea, south to the Aleutian Islands. In the eastern arctic of Canada, one specimen was taken in Jones Sound by the "Godthaab" expedition of 1928. According to Jensen (1944) it is the commonest member of the genus in Greenland waters, but it appears to be less common in Ungava Bay, on present findings, than *L. fabricii.* In Ungava Bay it is known from Burwell only, two specimens having been taken from cod stomachs on August 2, 1948. It is easily identified in the field by the prolongation of the lower pectoral rays.

Lumpenus fabricii Reinhardt

A widespread species in arctic and sub-arctic waters, circumpolar. Vladykov (1933) has recorded it from Hudson Bay. In Ungava Bay it is probably one of the commoner members of the bottom fauna. Specimens were taken from cod stomachs on August 21 and 22, 1947, and on August 2, 1948; and 13 planktonic young were taken in 1947 at stations 1, 22, 37, 43, 51, 106 and 103, some of which are too small for certain identification; others, with fin rays fully developed, are readily recognizable. One specimen was taken from a ringed seal stomach on July 7, 1948, off the mouth of the Koksoak River.

Lycodes reticulatus Reinhardt. Eelpout; sulupavak

A North Atlantic species, from Greenland and Spitsbergen south to New England; recorded from Hudson Bay by Vladykov (1933). Taken twice in Ungava Bay during the 1947-49 field work, once on a long-line trawl in Forbes Sound, in 35 fathoms of water (station 46, August 24, 1947), and once from the stomach of a bearded seal (*E. barbatus*) off the Gyrfalcon Islands on July 16, 1948. Other lycodids were also obtained from cod stomachs, but could not be identified with certainty. The specimens belong to the typical *reticulatus* subspecies, not to the subspecies *L. r. hacheyi* set up by Vladykov (1933) based on two specimens from Hudson Bay.

Gymnelis viridis (Fabricius)

A circumpolar arctic species, common also in the subarctic, south in North America to Nova Scotia. Eight specimens were taken from cod stomachs at Burwell, in August 1947 and 1948, and two specimens from a bearded seal stomach, Gyrfalcon Islands, in July 1948.

CONCLUSION

There is no doubt that the number of species recorded here for Ungava Bay (44 in all, including one (*Couesius plumbeus*) which has been found only at some distance from the bay itself, although within the Ungava Bay watershed) will be considerably increased as the study of the area continues. The fact that it was necessary, owing to the nature of the bottom, to rely on dredges rather than trawls for the benthonic collecting, has probably resulted in certain species having been overlooked. It is probable, from a study of the hydrographic conditions, that the number of species ultimately recorded for the bay will lie somewhere between the known numbers for Hudson Bay and for west Greenland, the former environment being strictly arctic and the latter markedly subarctic. It might also be expected that the greater variety of species will be found in the vicinity of Port Burwell, where the subarctic influence is strongest; this pattern of distribution is indeed apparent from the present collection.

It is not considered that the field study of the fishes of Ungava Bay has yet reached the stage where it is feasible to discuss the material in zoogeographic terms; that is, to give significance to the fact that several species have so far been found only in certain parts of the bay and not elsewhere—always with the obvious exceptions of the Atlantic species (*Gadus callarias, Salmo salar*) which occur only in the eastern part of the bay. It is interesting, on the other hand, to consider the known fish fauna of the bay as a whole (1) to determine where in the arctic-Atlantic scale the fauna should be put, and (2) to examine its position in the Pacific-Atlantic scale. Not only is the present set of the water north of continental arctic Canada a west-east movement, but there are historical connections between the waters of the western (Pacific-influenced) arctic and those of Hudson Bay; a Pacific flavour in the fauna of the eastern arctic waters is therefore not unexpected.

Thirteen of the species recorded here are predominantly or entirely of fresh-water habit. The remaining 31 species are marine (including the anadromous arctic char), and can be divided into five geographical groups as follows, which show that the fauna of Ungava Bay is, on the whole, subarctic:

(1) Arctic species, found only in the fringes of the subarctic: *Boreogadus saida, Triglops nybelini, Oncocottus quadricornis.*

(2) Arctic-subarctic fishes, of wider tolerance than group (1): *Salvelinus alpinus* (predominantly arctic), *Gadus ogac* (predominantly subarctic), *Reinhardtius hippoglossoides, Myoxocephalus scropioides, Gymnocanthus tricuspis, Icelus bicornis, I. spatula, Aspidophoroides olriki, Liparis koefoedi, Eumesogrammus praecisus, Lumpenus fabricii, Gymnelis viridis.*

(3) Subarctic-boreal species: *Salmo salar, Mallotus villosus* (predominantly subarctic), *Gadus callarias* (predominantly subarctic), *Sebastes marinus, Myoxocephalus scorpius, Liparis atlanticus.*

(4) Atlantic (boreal) species: *Paralepis rissoi krøyeri, Lampanyctus crocodilus.*

(5) Species of wide north-south range, in all three marine zones (arctic, subarctic, boreal): *Somniosus microcephalus* (predominantly subarctic), *Myctophum glaciale, Ammodytes dubius, Triglops pingeli, Eumicrotremus spinosus, Liparis tunicatus, Lumpenus maculatus, Lycodes reticulatus.*

The fresh-water species of the Ungava Bay drainage are predominantly subarctic (Hudsonian) and more southerly (Canadian zone) species. The number of fresh-water fishes found north of the tree-line is extremely small, a fact which is no doubt related to the productivity of the soil and hence of the lakes in the two regions. Excluding the ubiquitous arctic *Salvelinus alpinus,* only *Cristivomer namaycush, Coregonus clupeiformis, Prosopium cylindraceum,* and the two sticklebacks, *Gasterosteus aculeatus* and *Pungitius pungitius,* are found to any extent north of the tree-line, and most of them only to a limited distance.

Vladykov (1933) recorded two Pacific species (*Gymnocanthus galeatus, Liparis cyclostigma*) and one subspecies (*Triglops pingeli beani*) from Hudson Bay, none of which had been noted from the eastern arctic before. The present collection from Ungava Bay does not include these forms, and the only possible Pacific affinities which the Ungava Bay fauna has so far been shown to have are in the possession of *Icelus spatula,* and perhaps *Eumesogrammus praecisus.*

Icelus spatula is the relative of *I. bicornis* which takes the latter's place from the Kara Sea eastwards to the Bering Sea, and possibly (not yet confirmed) in the central Canadian arctic as well. It is known in the eastern arctic area from Ungava Bay (present record) and from stations in west Greenland, but not from east Greenland. Ungava Bay and west Greenland may to this extent be said to possess the Pacific member of the genus; both regions are zones of contact and overlap between the two species. *Eumesogrammus praecisus* is known from west Greenland, Ungava Bay, Hudson Strait, and from the Sea of Okhotsk and the Bering Sea (Jensen, 1944).

Only five of the species recorded are known to be truly circumpolar in distribution. Others may later be found to be so. The five known forms are: *Gasterosteus aculeatus, Lota lota, Boreogadus saida, Esox lucius, Oncocottus quadricornis.*

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On the Age, Growth, Migration, Reproductive Potential and Feeding Habits of the Arctic Char (Salvelinus alpinus) of Frobisher Bay, Baffin Island

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"CALANUS" SERIES, NO. 3

ABSTRACT

The Arctic char (*Salvelinus alpinus* Linn.) was studied, in the summers of 1948, 1950 and 1951, about the mouth of the Sylvia Grinnell River, Frobisher Bay, Baffin Island.

Otoliths are shown to be reliable age indicators and are used for age determination. Because of deficiencies in the sampling of the fish a calculated growth curve has been constructed. The calculated growth rate is obtained by showing the relationship between otolith width and fish length and expressing it in the equation: log (fish length) $= -1.503 + 1.982$ log (otolith width). The relationship between otolith ring diameter and fish age is demonstrated, and from these two relationships the lengths of fish at earlier ages are calculated.

The char grow very slowly, and reach an age of more than 24 winters. They migrate to the sea in late June and return to fresh water from late July until September. The first movements to the sea probably occur during the fifth, sixth and seventh summers. Sexual maturity in the females is reached at a length of about 45 cm., and at an age of approximately 12 winters. Egg counts of maturing fish averaged 3,589. Only about 33 per cent of the females over 45 cm. were maturing. At least 30 food species were found in the stomachs.

Additional growth, fecundity and food studies were made on small samples from George River, Herschel Island and Adlorilik.

CONTENTS

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INTRODUCTION

THE GROWTH RATE of the Arctic char (*Salvelinus alpinus* Linn.) of Canadian waters has not previously been studied, nor has it been the subject of more than slight attention in any of the parts of its wide range. Data on the aging and rate of growth of the Arctic char are presented with the object of showing the general pattern of growth of this fish in Frobisher Bay, Baffin Island.

The material consists of 1,566 specimens of Arctic char from the Sylvia Grinnell River, Frobisher Bay, taken as follows:

Year	*No. of fish*	*Type of fishing gear*
1948	386	gill nets of 6½″, 6″ and 4″ mesh (stretched)
1950	320	gill nets of 6″, 5″, 4″ and 1″ mesh (stretched); minnow traps; hand nets
1951	860	gill nets of 5½″, 4″ and 2½″ mesh (stretched); minnow traps; hand nets; gaffs; jigs

In addition, small samples from George River, southeastern Ungava Bay, Herschel Island, N.W.T. and Bay of Two Rivers, Frobisher Bay, were taken with gill nets.

The Arctic char is an anadromous and landlocked salmonid found in cold waters of the northern hemisphere. It has been recorded from Greenland, Iceland, Svalbard (Spitsbergen), Novaya Zemlya, Bear Island, northern Norway, northern Siberia, Alaska and northern Canada, in which regions the anadromous form is found. In addition, the land-locked form is found in the far north, and also in areas to the south of the sea-run char, in lakes of Sweden, southern Norway, Finland, England, Ireland, Scotland, the Orkneys, the Shetlands, the Alps and the U.S.S.R. (Jensen, 1948).

A variety of names has been given to the Arctic char in different parts of its range, and in many cases the characters upon which different specific and subspecific names have been based are obscure. Dymond and Vladykov (1933) have included in the *Salvelinus alpinus* group the forms found in northern North America and Asia to which the following subspecific names have been given: *alpinus*, *malma*, *leucomaenis*, *erythrinus*, *kundscha*, *spectabilis*, *pluvius*, *imbrius*, *arcturus*, *naresi*, *alipes*, *stagnalis*, *aureolus*, *oquassa*, *marstoni* and *fontinalis* (the latter an Asiatic subspecies of *alpinus*, not to be confused with the American brook trout).

Because of the confused state of the taxonomy of these fish, the populations dealt with in this paper are considered as *Salvelinus alpinus*, with the possibility of subspecific classification, following the suggestion of Dymond (in Manning, 1942) who said, "There are undoubtedly local variations among Arctic Char as among other wide-ranging species, but they have not yet received sufficient study to enable us to know which of them are worthy of sub-specific names."

THE SYLVIA GRINNELL RIVER

Field work was carried out on the Arctic char in Frobisher Bay, southeastern Baffin Island, during the summers of 1948, 1950 and 1951. The work of 1950 was done by John Wright, while that of the other years was carried out by the author.

Fishing in 1948 and 1950 was conducted in association with a commercial fishing operation, with Wright and the author acting as scientific observers, based for the most part on board ship in Koojesse Inlet, while that of 1951 was done independently from a shore base by the author alone.

The Sylvia Grinnell is a southward-flowing river originating in the interior of Baffin Island and emptying near the northwestern extremity of Frobisher Bay, at about 63° 44′ north latitude, 68° 34′ west longitude. A lake, not seen by the author, but reported by residents of the area, apparently exists some 25 to 30 miles inland from the mouth of the river, and it is in this region that the char are said to spend the winter.

The lower portion of the Sylvia Grinnell and the bay adjacent to its mouth are shown in Figure 1. The river empties into an arm of the bay over four separate waterfalls, the height of which vary with tidal conditions from almost nothing to some 12 feet. This height does not equal the tidal variation of the upper part of Frobisher Bay, because of the nature of the estuary into which the river flows. At low tide the water level about the base of the falls remains higher than that of Frobisher Bay, water being added from the river and lost over shallow rapids which appear at several places between the falls and the bay. Thus from the time of the appearance of these rapids during the falling tide until the next rising tide has obliterated them, the water level about the falls remains fairly constant, and it affected by only the latter part of each rise in tide. At no time during the summer of 1951 did the salt water extend above the falls. North of the falls, in the lower five miles of the river, there are several sections of rapids and the water flow is fast throughout.

The river itself and the bay into which it flows are frozen over during a large part of the year. In 1951 the ice covering over the river had only recently broken on June 10, and the area below the falls and extending out over the bay to the limit of visibility was iced over completely. By June 25 the area about the mouth of the river had become relatively clear, apart from fast-ice remaining along the shore, and the flow of ice down the river had diminished sufficiently to permit the use of nets. The fishing region remained ice-free throughout the rest of the 1951 season. Ice was absent during all the 1948 fishing period, and except for a brief wind-driven return between August 19 and 23, the 1950 fishing was ice-free.

The tidal rise and fall are extensive in Frobisher Bay. The mean spring tides are about 32 feet above the normal low-tide mark (Canada, Dept. Mines and Tech. Surv., 1951) and serve to alter greatly the conditions about the mouth of the Sylvia Grinnell River. While at high spring tides the falls are almost obliterated, and nearby islands are reduced (Figure 1), at low spring tides the falls are thundering masses of water and the coastline below them is altered by the appearance of large expanses of dry land. Navigation up to the falls from the bay, even in the smallest craft, becomes impossible at low tide.

FISHING METHODS

Most of the fishing was done in the estuary adjacent to the mouth of the Sylvia Grinnell River. Additional fish were taken from nets set off islands in

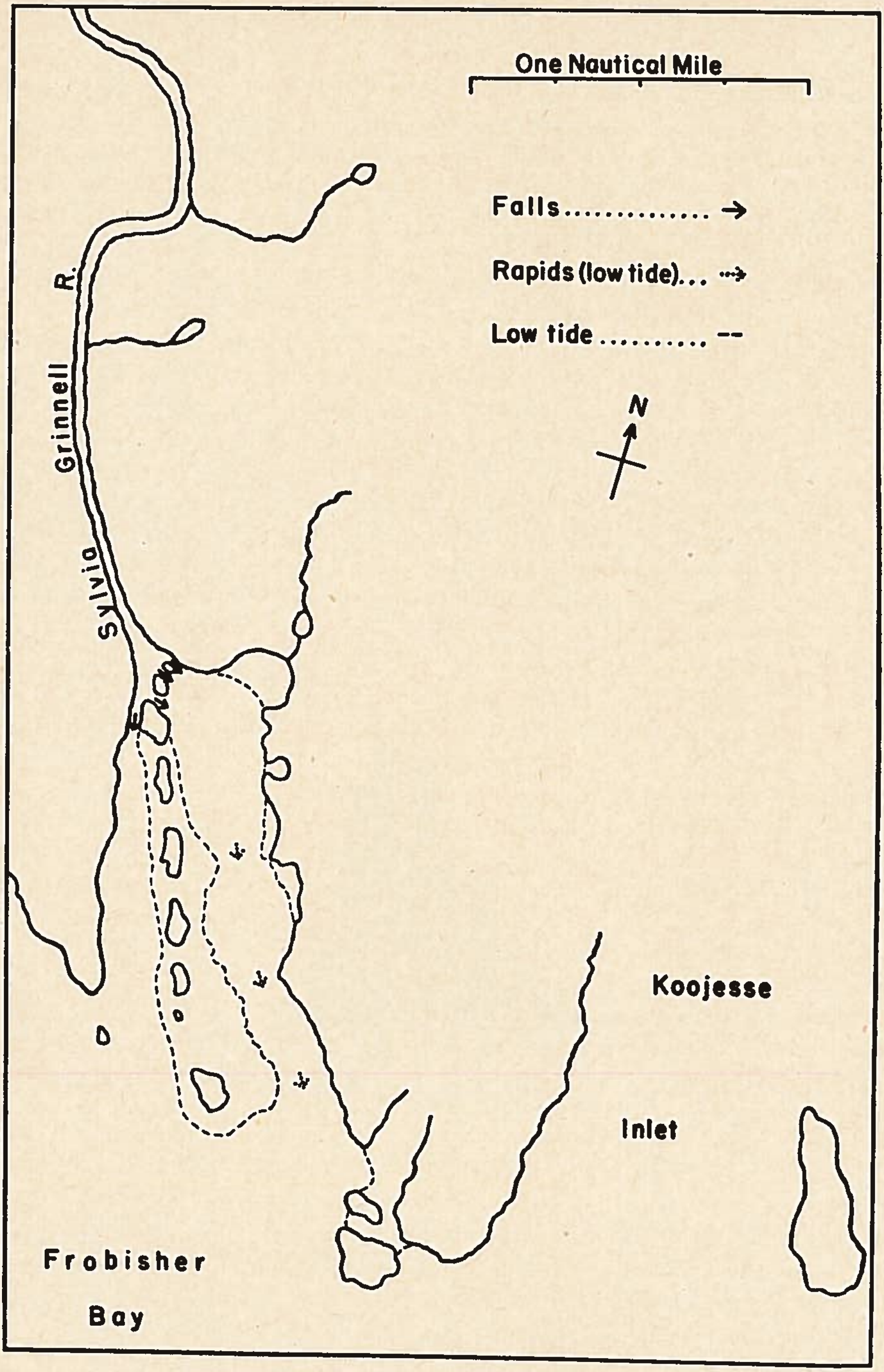

FIGURE 1. Map showing the mouth of the Sylvia Grinnell River, Frobisher Bay, Baffin Island.

nearby parts of the bay and in the river above the falls, also from small pools and streams leading into the river.

Examination of the char was carried out as soon as possible after their capture. In 1948 and 1950, when most of the specimens were acquired from commercial fishing nets and only a part of the catch could be studied, care was taken to secure a random sample for examination. Following each visit to the nets the fish were taken to the cutting tables. They were placed in large containers under the tables, and were selected for examination by the observer thrusting one finger into the fish container, which he could not see, and taking the fish which had been touched first. In 1951 all the fish collected were examined. Length measurements were made to the nearest half centimetre, and are expressed throughout as fork length, that is length from the anterior extremity of the fish to the foremost point on the posterior indentation of the caudal fin.

Fishing was done principally with gill nets, also with minnow traps, hand nets, gaffs and jigs. Gill nets used during the three seasons of fishing were of 1-, $2\frac{1}{2}$-, 4-, 5-, $5\frac{1}{2}$-, 6- and $6\frac{1}{2}$-inch stretched meshes, of both linen and cotton. Minnow traps were of the common mouth-to-mouth type of fine wire mesh, with apertures at either end of about one-inch diameter. Gaffs used were fashioned by attaching jigs or large hooks to wooden poles and cod jigs were used with a length of line.

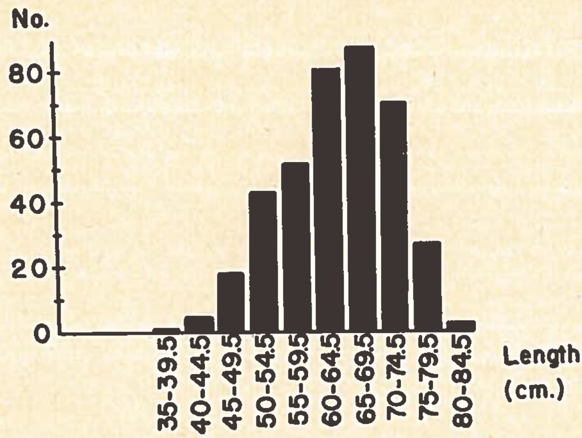

FIGURE 2. Frequency histogram of the 1948 sample.

Identical fishing equipment was not used during each of the three seasons, and it is probable that the smaller individuals were not sampled adequately, as will appear below. Because of this variety in the sampling methods used, and the probability of inaccurate sampling of the smaller specimens, a consideration of the sampling methods of each of the three seasons is necessary, in order to correct possible misinterpretations of the observed mean age-length relationship of some of the younger age groups.

Histograms showing the size frequency of samples from each of the three fishing seasons appear in Figures 2, 3 and 4, and one of the combined frequencies for the three years is shown in Figure 5. In these diagrams the bars above the base line indicate fishing results almost entirely from the use of gill nets (a small number of large specimens were taken by gaffs and jigs), while those below the base line represent fish taken by minnow traps, hand nets, jigs and gaffs (except for the few large specimens above). These raw data are given in Table I.

In 1948 gill nets of 4-, 6- and 6½-inch meshes only were used. By far the greatest use was made of the 6-inch mesh nets, and comparatively little of the other sizes, the resulting mode in the 65- to 70-cm. size group reflecting this use of nets of a size selected for commercial fishing.

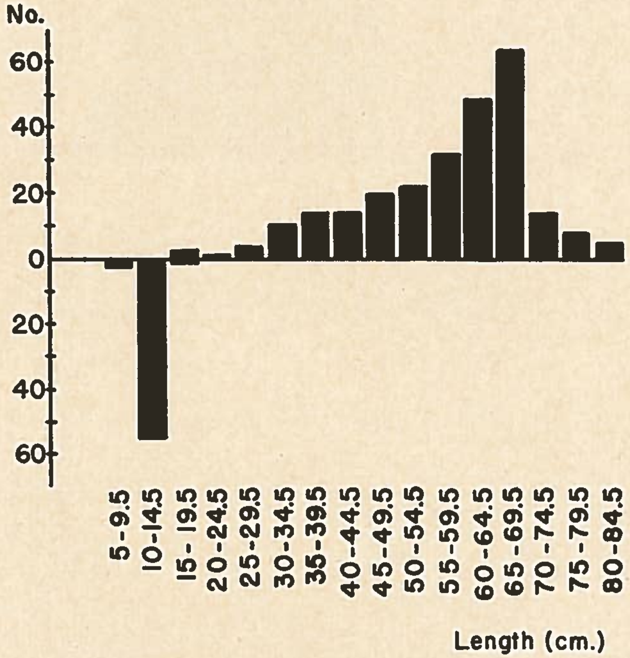

FIGURE 3. Frequency histogram of the 1950 sample. Fish taken in gill nets are represented above, those taken by other methods below the base line.

In 1950 a greater variety of techniques was utilized, including gill nets of 1-, 4-, 5- and 6-inch meshes, and in addition, minnow traps and hand nets. As in 1948, 6-inch meshes were used much more extensively than were other gill nets, and again the length group 65 to 70 cm. appears as the largest. A more rapid falling off of numbers of those fish exceeding in length 70 cm. in 1950, compared with 1948, may be accounted for by the absence of nets of 6½-inch mesh in 1950, although the maximum length was not reduced by using no 6½-inch mesh in 1950. As in 1948 much less use was made of nets smaller than 6-inch, but 1- and 4-inch meshes accounted for the capture of some smaller fish than had been taken in 1948. Shown by the inverted bars in Figure 3 are those fish captured by methods other than gill nets, that is by minnow traps and hand nets, largely the

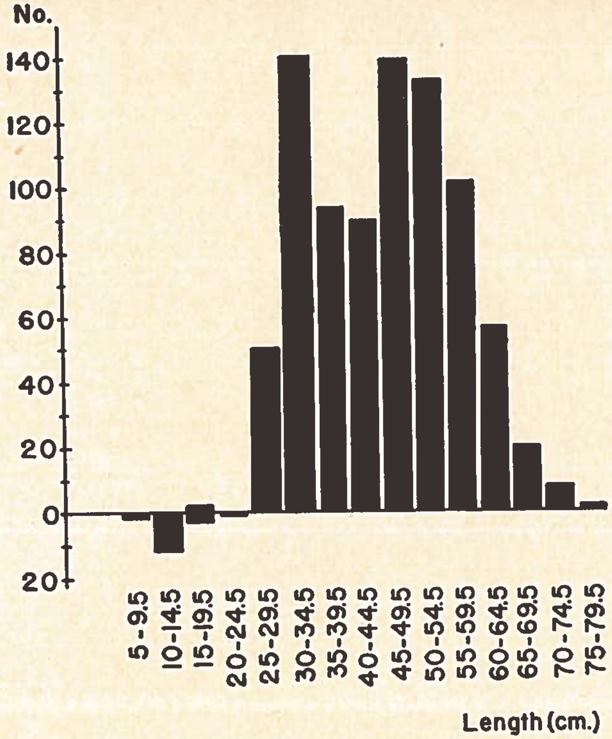

FIGURE 4. Frequency histogram of the 1951 sample. Explanation as in Figure 3.

TABLE I. Length frequency, Sylvia Grinnell River, 1948, 1950 and 1951.

Length group	1948				1950				1951				Total			
	♂	♀	?	T	♂	♀	?	T	♂	♀	?	T	♂	♀	?	T
cm.																
0– 4.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5– 9.5	0	0	0	0	0	1	2	3	1	1	0	2	1	2	2	5
10–14.5	0	0	0	0	21	24	10	55	6	6	0	12	27	30	10	67
15–19.5	0	0	0	0	0	3	1	4	1	4	0	5	1	7	1	9
20–24.5	0	0	0	0	0	0	1	1	0	2	0	2	0	2	1	3
25–29.5	0	0	0	0	2	1	1	4	21	30	0	51	23	31	1	55
30–34.5	0	0	0	0	4	3	4	11	75	66	0	141	79	69	4	152
35–39.5	0	1	0	1	5	4	5	14	44	50	0	94	49	55	5	109
40–44.5	3	2	0	5	4	7	3	14	43	47	0	90	50	56	3	109
45–49.5	7	11	0	18	3	12	5	20	70	69	1	140	80	92	6	178
50–54.5	10	30	3	43	5	11	6	22	73	60	1	134	88	101	10	199
55–59.5	29	21	2	52	16	11	5	32	63	39	0	102	108	71	7	186
60–64.5	32	46	2	80	29	11	9	49	34	23	0	57	95	80	11	186
65–69.5	29	57	1	87	43	9	12	64	12	8	0	20	84	74	13	171
70–74.5	36	33	1	70	8	5	1	14	7	1	0	8	51	39	2	92
75–79.5	24	2	1	27	6	1	1	8	2	0	0	2	32	3	2	37
80–84.5	3	0	0	3	4	0	1	5	0	0	0	0	7	0	1	8
	173	203	10	386	150	103	67	320	452	406	2	860	775	712	79	1,566
	♂, 46.0% ♀, 54.0%				♂, 59.3% ♀, 40.7%				♂, 52.7% ♀, 47.3%				♂, 52.1% ♀, 47.9%			

former. The traps were used effectively only in fresh water and captured fish from the minimum size taken (8.5 cm.) to 15 cm. only, the only larger specimen (16.5 cm.) having been taken by hand. While during the 1950 season, which lasted from about the middle of July until near the end of August, most of the fishing was done as a commercial venture, additional gear was taken to the field in order to sample the smaller individuals in the population, smaller fish than had been taken in 1948.

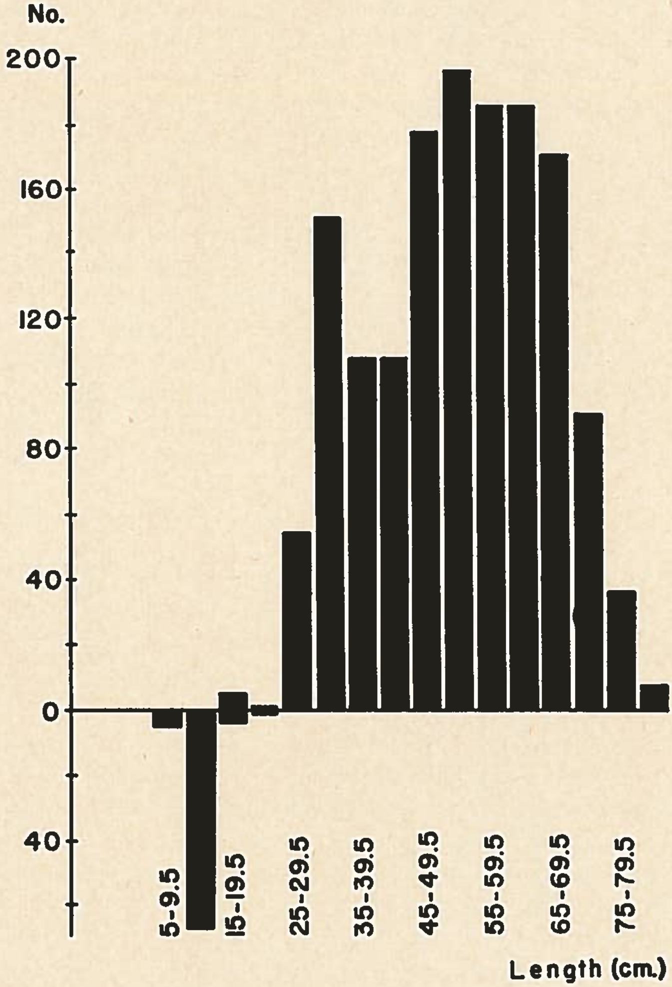

FIGURE 5. Frequency histogram of the 1948, 1950 and 1951 samples combined. Explanation as in Figure 3.

In 1951 gill nets of 2½-, 4- and 5½-inch mesh sizes were used. In Figure 4 the frequency of the gill-net-caught fish shows extensive use of the three net sizes. The presence in the sample of fewer fish in the 35- to 44.5-cm. group than in size groups both smaller and larger may be attributed to the size difference between the 2½- and 4-inch meshes, which resulted in less efficient fishing for the members of this size group than for those slightly smaller and larger.

The 2½-inch meshes, although used extensively, captured only one fish in the 15- to 19.5-cm. group (18.5 cm.) and no others less than 26.5 cm. (The 1-inch mesh used in 1950, used much less frequently, took only three fish, to a minimum of 16.5 cm.) In the inverted section of Figure 4 the single specimen of the 20- to 24.5-cm. group and two of the three between 15 and 19.5 cm. (17 cm. each) were taken by jigging, while all smaller fish were obtained either in minnow traps or by hand. As in 1950 no fish longer than 15 cm. was taken by a minnow trap.

Figure 5 shows combined frequencies for the three years. It is evident that a disproportionately small number of fish was sampled from the lower part of the size range, particularly those between 15 and 26.5 cm. in length. The gap in the size range from 20.5 to 26.5 cm., and the small sample taken between 15 and 20 cm. may be due to one of two things: inadequate sampling of fish of this size, or a real gap in the population. The most probable explanation for any real gap in the population would be rapid growth of the fish of this size, compared with the rate of growth of those immediately smaller and larger. This does not appear to be so, as is pointed out below in the discussion on the growth rate.

Between the specimens taken by a 1-inch net and all but one of those obtained from 2½-inch nets there is a gap in length, from 20.5 to 26.5 cm., from which no fish were taken. This may be explained on the limitations of these two net sizes which permitted this size group to remain immune from capture, the largest fish taken by a 1-inch mesh net being considerably smaller than the smallest fish which normally would fall prey to a 2½-inch mesh net. Although no fish were taken in minnow traps in salt or brackish water (below the falls), three specimens of less than 15 cm. were caught in the area by hand. Fish were present, therefore, in the area where gill nets were used, which were smaller than the net sampling would indicate, but were sampled inadequately, available fishing gear not being suitable for their capture. Similarly, larger fish were taken by hand in fresh water, during the sea-run period, than could be sampled by the minnow traps, although none of this size was taken by the 2½-inch mesh nets. Thus fish of a size group which the fishing gear was not suitable for sampling were present in fresh water, during the period following migration to the sea.

It is evident that by the use of more varied gear many more fish than those obtained could have been taken in salt water, down to at least 15 cm. Similarly among those sampled in fresh water, it is probable that the use of traps suitable for the taking of larger fish would have provided a larger sample greater than 15 cm. in length from fresh water. The 5- to 9.5-cm. length group appears not to be numerous in the lower portion of the freshwater system, as suggested by the capture of very few specimens in the minnow traps, the taking of none smaller by hand, and the observation of none in the field. The 8.5-cm. minimum size taken by the minnow traps in fresh water seems to be somewhat in excess of the minimum effective size of the traps, in that the traps might be expected to capture smaller char than those taken in them, their mesh being small enough to confine fish of less than 8.5 cm. (Sticklebacks of less than 5 cm. were taken in the traps.) Thus it is probable that fish approaching the smallest present in this part of the freshwater system were obtained.

From this there is good reason to suspect that the sampling of fish in the 15- to 26.5-cm. size range lacked the intensity of that applied to smaller and larger sizes, therefore that a gap in the population need not exist to explain the frequency distribution. It is evident that the estimation of the mean lengths of age groups from the sample, the length ranges of which are interrupted by this length gap, cannot be accomplished by a mere averaging of the sampled lengths within a year group. This requires the estimation of calculated mean lengths for specimens of these age groups, and is discussed below.

THE OTOLITHS OF THE CHAR

The otoliths were taken from the fish as soon as possible after capture. Most were kept dry, in envelopes, while a small number was preserved in an equal

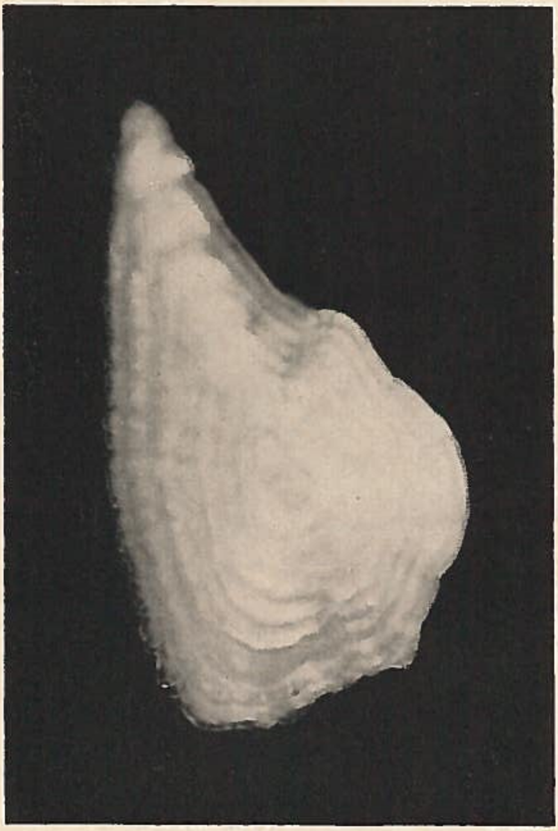

FIGURE 6. The left otolith of a 9-winter specimen. A light area appears in the dark core because of cracks crossing the otolith.

mixture of glycerine and sea water. The largest otolith of the char is the sagitta, one being found in the sacculus of each inner ear. Because of their large size, compared to the other otoliths present, they were selected for age determination.

Whenever possible readings were made on both ear-stones of a pair, and good agreement was found usually between the two readings. When, however, only a single otolith was available or one showed itself to be distinctly clearer than the

FIGURE 7. Otolith from an 11-winter specimen.

other, only one reading was taken. In all cases where any real uncertainty existed concerning the count of rings, the readings were discarded, so that while otoliths from some 1,000 char were collected from the Sylvia Grinnell fish, ring counts were made on 807. Those kept dry proved greatly superior to those preserved in glycerine, in the clarity of the rings, especially the narrow marginal rings of the larger otoliths. It was possible to read most of them without cutting; others either were ground on their convex surface, or were cut transversely through the centre.

Determinations on the otoliths collected in 1948, and preserved wet, were carried out by Miss R. I. Peterson of the Atlantic Biological Station, St. Andrews, N.B. The others were read by the author.

The otoliths collected range in size from about 1.5 mm. by 0.9 mm. to about 7.3 mm. by 3.5 mm. They are similar in general shape, the larger otoliths being relatively slightly longer than the smaller. As the otolith lies in the sacculus, a pointed projection, the rostrum, is directed dorsally and anteriorly. The medial

FIGURE 8. A 13-winter otolith.

surface is made up of two lobes, the larger of which is continuous with the rostrum, and separated from the smaller by a deep fissure. Laterally the otolith is fairly smooth and slightly convex. It is through this lateral surface that the readings are made most satisfactorily, either with or without grinding.

The otoliths were examined under a binocular microscope, using reflected light. They were viewed submerged either in water or in a water and glycerine mixture. The measurements were made with a micrometer eye-piece, and are expressed in units of the micrometer (one unit equals 0.064 mm.).

In the centre of the otolith is a dark core (under reflected light) around which are arranged concentric alternating light and dark rings, these extending to the margin and becoming narrower towards the otolith edge. Some confusion arises in ring interpretation of many otoliths due to the presence of one or more cracks which cross the structure, passing in nearly all cases through the centre. Johnston (1938) has suggested that this is a common finding in otoliths. They may be due to the setting up of unequal stresses within the otolith during drying following

FIGURE 9. The right otolith of a 19-winter specimen.

removal from the fish. The light rings are considerably wider than the dark rings, and are interpreted as indicating periods of relatively rapid growth ("summer" growth). The dark rings are interpreted as representing periods of relatively slow growth ("winter" growth).

The year's cycle undergone by the char is in accordance with this interpretation. The winter months are spent in ice-bound fresh water, where feeding evidently is greatly reduced. During the summer, on the other hand, the environment is changed conspicuously. The fish leave the fresh water and migrate into coastal marine areas where the supply of food is abundant.

The otolith markings of the char appear to coincide with these two environmental phases, those taken during the early summer showing marginally a narrow, dark, "winter" growth band as the portion most recently deposited. With the progress of summer a light area appears on the margin, as evidence for more rapid "summer" growth. This light region, however, in the otoliths collected latest in the season (early September) had not reached a width com-

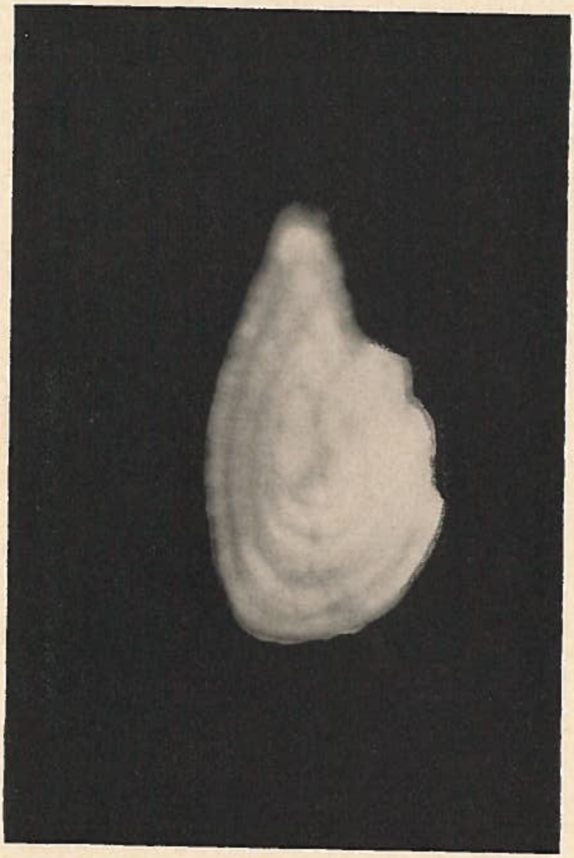

FIGURE 10. A 5-winter otolith. Evidence of the laying down of the fifth "summer" ring appears at the bottom and on the right side of the otolith.

parable to that of the previous "summer" band (allowing for the "summer" band being slightly narrower than the one preceding it in accordance with a reduced rate of growth with increasing age), so it appears that this deposition continues at least briefly during the early, autumn phase of freshwater life. There seems from this to be a slight delay in the laying down of the "summer" ring, in that its deposition is not fully in phase with the marine period of the char, but commences shortly after entrance into the sea, and continues apparently for a short time after entrance into fresh water. As the dark rings may be seen at their fullest during the early summer, it follows that the laying down of these occurs between the fall and the succeeding summer, while the fish are in fresh water.

Because no sufficiently small specimens were taken, it cannot be stated with certainty when the dark core of the otolith is deposited, or when the otolith begins to form in the char. It is probable that eggs are deposited in the autumn, but the time of hatching is not known. It has been shown that the dark areas of the

FIGURE 11. A 13-winter otolith. A thirteenth "summer" ring is shown forming along the right side and at the tip of the rostrum. The centre of the core appears light because of cracks.

otoliths are deposited between the autumn and the succeeding summer, and that the dark core appears to be a winter deposit. From extrapolation of the curve showing the relation between otolith width and fish length (below) it is suggested that the otolith begins to form almost as soon as the fish begins to develop. From this the dark core is considered as representing the first winter of growth.

Photographs of six char otoliths are shown in Figures 6 to 11. In Figure 6, the left otolith from a 9-winter char illustrates the appearance of the ear-stones from a lateral view of the convex surface. Part of the dark core appears light in the photograph because of cracks which radiate from the centre to the margin. In this otolith nine dark areas ("winter" growth), including the central core, are present, separating eight wider, light rings ("summer" growth). In Figure 7 an 11-winter otolith is shown, in which the rings appear clearly. Figure 8 shows a 13-winter otolith in which clear differentiation of the rings appears only on one side. Figure 9 is of a 19-winter right otolith. In Figure 10, a 5-winter otolith, the core is obscured by cracks. Along parts of the margin very slight evidence of a white area ("summer" growth) may be seen, at the bottom and on the right side, just above the centre. This fish was taken on July 15, 1951. In Figure 11, of a 13-winter specimen, further evidence of the laying down of the "summer" ring is shown, along the right side, and at the tip of the rostrum. This specimen was taken on August 11, 1951.

THE OBSERVED AGE-LENGTH RELATIONSHIP OF THE MATERIAL

Table II gives the results (expressed in winters of life) of otoliths read from 806 char of the Sylvia Grinnell River, also numbers of each year group, average length, and range in length of fish of both sexes in each year group.

Examination of the length range given for each age group shows interruptions in the ranges of the 7-, 8- and 9-winter fish, between those taken in 2½-inch-mesh nets and those obtained in the 1-inch-mesh net, in minnow traps and by hand.

TABLE II. Age, mean length and size range of the Sylvia Grinnell River char, 1948, 1950 and 1951 (11 specimens were not sexed).

Winters	No.	Average length	Length range	Males No.	Males Mean length	Females No.	Females Mean length
		cm.			*cm.*		*cm.*
4	3	9.0	8.5–10.0	1	8.5	2	9.2
5	18	13.0	11.0–14.5	5	13.4	11	12.9
6	7	13.9	12.5–16.5	3	13.7	3	13.3
7	7	17.2	14.5–17.0; 28.5	2	14.5	5	18.5
8	25	30.2	17.0–19.0; 27.0–39.5	8	31.2	17	30.5
9	68	33.7	18.5–20.0; 26.5–46.5	34	33.7	34	33.0
10	68	36.3	26.5–52.0	36	37.1	32	35.4
11	73	41.4	29.5–55.0	34	41.3	39	41.5
12	85	42.5	30.5–57.0	36	42.2	49	42.7
13	96	48.4	30.5–65.0	57	48.5	39	47.5
14	71	51.0	36.0–63.0	40	52.1	30	50.0
15	48	55.3	31.0–67.5	29	58.1	18	51.0
16	38	55.7	44.0–68.5	25	56.9	12	52.5
17	31	55.9	36.5–70.0	22	57.4	9	52.2
18	19	60.0	46.0–70.5	11	61.7	7	56.1
19	23	61.3	46.5–74.0	12	65.6	11	56.6
20	35	64.9	55.0–76.5	17	66.2	16	62.8
21	35	64.2	50.0–76.5	17	66.9	18	61.6
22	19	65.8	44.0–78.5	13	66.3	6	64.6
23	16	67.8	51.0–81.5	11	70.9	3	59.0
24	9	67.8	58.5–78.5	5	69.7	4	65.5
24 plus	12	68.5	51.0–82.5	7	68.2	5	69.0
	806			425		370	

This length gap has been discussed above, where it was concluded that it arose from unrepresentative sampling. The observed length ranges of the sampled 4-, 5- and 6-winter char fall below this gap in the sample.

Figure 12 shows a frequency histogram of the entire 5-winter sample (18 specimens), three of which were taken in salt water (indicated by shaded areas in the figure). The observed length range (11–14 cm.) of the 5-winter freshwater sample, taken in minnow traps, falls clearly within the limits of effectiveness of the traps (8.5–15 cm.). It is probable that the capture, by minnow traps, of specimens well within the range of vulnerable sizes was approximately random, and therefore that the 5-winter specimens taken in this way were representative of this age group in the population. The mean length of these eight specimens is 12.9 cm., the mean length of the entire freshwater, 5-winter sample (15 specimens) is 12.9 cm., and the mean length of the 5-winter sample, taken by all methods, is 13.0 cm. From this it is concluded that the observed mean length of all the 5-winter fish may approximate closely the mean length of this age group in the population at the time of sampling.

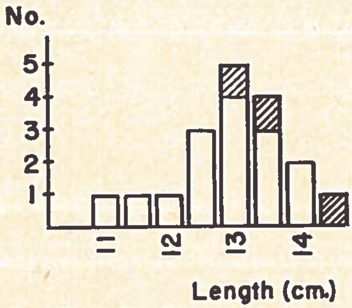

FIGURE 12. Frequency histogram of the 5-winter sample. Shaded areas represent specimens taken in salt water.

The mean length of the 6-winter fish of the sample is 13.9 cm., the length range being from 12.5 to 16.5 cm. This mean is derived from only seven specimens. The frequency distribution is strongly biassed in favour of the smaller fish, most being within the minnow trap size limit (15 cm. and less), and as the larger fish (15 and 16.5 cm.) were taken by hand, there is no reason to believe that the maximum size of the 6-winter fish of the population should be limited at 16.5 cm., fish between 15 and 26.5 cm. having been sampled very sparingly. The 6-winter mean of 13.9 cm., therefore, may be expected to be lower than the true mean of the 6-winter fish of the population.

The size range of the 7-winter fish sampled crosses the 20.5- to 26.5-cm. gap in the sampling (Table II, above), with one specimen of 28.5 cm. and six from 14.5 to 17 cm. It is apparent from this that the mean of 17.2 cm. for individuals sampled may well be short of the mean for the 7-winter fish of the population. On similar grounds the 8-winter mean of 30.2 cm., and that of the 9-winter group, 33.7 cm., the length ranges of which overlap the non-sampled size but are weighted heavily in the upper parts rather than in the lower parts of their ranges, may be considered as being probably higher than the 8-winter and 9-winter means of the population.

The minimum length range of the 10-winter specimens, 26.5 to 49.5 cm., coincides with what has been considered previously as the smallest effective size of the 2½-inch-mesh nets (with one exception, an 18.5 cm. specimen) used in their capture. This makes possible an extension of the range of the 10-winter fish of the population to a smaller size than the sample indicates, thus the mean may be slightly high for the group.

The sampling of the age groups older than 10 winters does not show such obvious faults as those described above, with the result that the means calculated from otolith readings may be considered at least as approximating those of the population.

From this it may be expected that the actual growth curve of the char will approximate the observed curve involving the 5-winter and 11- to 24-winter specimens on the basis of adequate sampling of these, but that it will depart from the points on the observed curve concerning the 6-, 7-, 8-, 9- and 10-winter specimens obtained.

THE RELATIONSHIP BETWEEN OTOLITH GROWTH AND FISH GROWTH

As fishing extended throughout the summer, the growing period of the char, the mean observed lengths, even of suitably sampled age groups, do not suffice to show the true lengths at different ages at a particular time of the year, although in the older, more slowly growing fish the difference may be slight. As sampling did not collect representatives of all age classes (none was taken less than 4 winters) and there is reason to believe that the observed lengths of some of the younger groups differ from the population, due to sampling inadequacies, it was required to construct a calculated growth curve, based upon length at the conclusion of successive winter periods.

Otolith widths were measured, along a line at right angles to the long axis, and these dimensions were related to fish length, to show the mean relationship between fish length and otolith width. In Table III are given mean otolith widths related to fish length. Otolith measurements are given for 195 individuals, and are correlated with average lengths of the fish from which they were taken. Otolith widths are given in units of the micrometer used in making the measurements (one unit equals 0.064 mm.).

The relationship given in Table III is presented graphically in Figure 13. From this it is apparent at once that this relationship cannot be expressed by a straight line, therefore that otolith growth does not proceed at a constant rate relative to fish growth. By plotting otolith widths against fish lengths on double logarithmic paper a straight-line relationship was shown. From this the following equation was derived:

$$\log \text{(fish length)} = -1.503 + 1.982 \log \text{(otolith width)}.$$

This curve is plotted in Figure 13, and the mean calculated otolith widths are given in Table III, below.

Table III. Otolith width (in 0.064 mm. units) related to fish length (in cm.).

Fish-length group	No.	Mean fish length	Mean otolith width	Calculated otolith width
cm.		*cm.*	*units*	*units*
5–14.5	20	12.7	20.7	20.7
15–24.5	6	17.1	24.7	23.2
25–34.5	26	31.2	31.8	32.5
35–44.5	24	40.1	36.5	36.9
45–54.5	37	50.0	41.5	41.3
55–64.5	33	59.5	44.5	45.0
65–74.5	39	68.9	48.0	48.5
75–84.5	10	80.4	53.5	52.4
	195			

A wide range in otolith size is apparent in various length groups, and is explained by older fish of a given length having larger otoliths than younger specimens of the same length. Molander (1918) found in the herring that older individuals of the same length as younger ones have larger scales. In view of this the equation proposed above must be interpreted as showing only the mean trend of otolith diameter growth as related to growth in fish length, and not as indicating the variation in otolith growth rate which exists among fish of similar length.

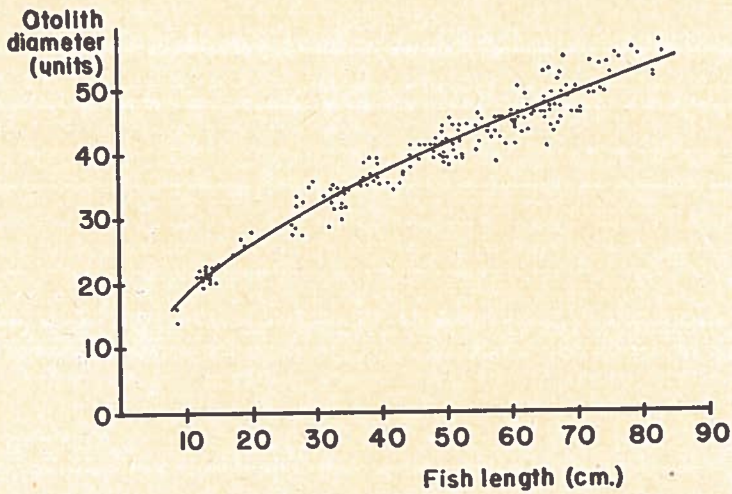

Figure 13. The relationship between otolith width and fish length. The dots represent values for individual fish, the curve the mean relationship.

From Figure 13 it is evident that otolith growth is relatively rapid during the early part of the fish's life, and that as fish length increases, otolith growth falls off gradually, the relationship becoming more nearly linear as the fish become larger. Reliability of the curve below the 10-cm. fish-length point cannot be shown from samples available, so use of this portion of the curve in further calculations must be done with full realization of the possibility of error involved. While no evidence was collected to show the time of formation of the otoliths in the char, extrapolation of the calculated curve suggests the probability of otolith formation taking place while the fish are very small, during the first winter of life, as suggested above.

THE RELATIONSHIP BETWEEN OTOLITH WIDTH AND FISH AGE

In order to measure the relationship between otolith width and fish age, otolith-ring width measurements were made from 313 char (Table IV, below).

It was obviously necessary to make the same otolith measurements in describing both this relationship and that between otolith width and fish length, above, so the greatest widths of rings along a line at right angles to the long axis of the otoliths were used. It became evident that such measurements on all rings could not be made successfully on all the otoliths tried because of lack of clarity in the structure of many of the rings along the required line. Suitable otoliths from 313 char were used in making the ring measurements, one ring diameter, selected at random, being measured in each. This permitted a wide selection of otoliths and a choice of the clearer rings present for measuring purposes. Only otoliths from fish of 10 winters or older were used, in order to eliminate error arising from sampling inadequacies in the younger specimens.

Shown in Table IV are observed mean otolith-ring measurements (expressed in units of 0.064 mm.) at the conclusion of successive winters, and calculated mean otolith-ring widths (in the same units) obtained by fitting a freehand curve to the observed points.

THE CALCULATED GROWTH RATE

The relationships existing between otolith width and fish length and otolith width and fish age having been shown, combination of these results were used to produce a calculated growth rate for the char. In Table V are shown calculated lengths for the ends of successive winters of growth, that is for the times when the depositions of dark rings are completed. These results were obtained from the equation described above:

$$\log\text{(fish length)} = -1.503 + 1.982 \log\text{(otolith width)}.$$

The calculated growth curve resulting from the figures in Table V is given in Figure 14, plotted together with the means of the observed fish lengths. Fairly close agreement is shown between the points representing larger fish in both curves. It is seen, however, that for fish of less than 12 winters the deviation in some age groups is considerable. This applies particularly to those sampled from the 8- and 9-winter classes, discussed above as being sampled probably from larger than average fish of the age groups in the population. Those from the 6- and 7-winter groups are seen to be smaller in the sample than in the calculated curve, these being too small for the 4-inch-mesh gill nets, and only small individuals having been collected, in minnow traps and by hand. In agreement with the earlier suggestion that the 5-winter char were sampled fairly adequately is

TABLE IV. Otolith-ring width (in units of 0.064 mm.) related to fish age.

Winters	Observed mean otolith-ring width	Calculated mean otolith-ring width	Number of otoliths
1	4.9	4.9	12
2	9.3	9.1	12
3	12.9	12.9	12
4	16.3	16.4	12
5	19.6	19.7	12
6	22.8	22.8	12
7	25.6	25.7	12
8	28.1	28.5	11
9	31.2	31.2	11
10	33.9	33.7	16
11	36.0	36.0	14
12	38.1	38.1	11
13	40.1	39.9	24
14	41.3	41.4	24
15	43.3	42.7	15
16	43.5	43.8	16
17	44.0	44.7	12
18	45.0	45.4	8
19	46.1	46.1	14
20	46.9	46.7	16
21	47.0	47.2	17
22	47.6	47.6	7
23	48.2	48.0	10
24	48.7	48.4	3
			313

TABLE V. Calculated lengths for various ages of the char, compared with observed lengths.

Winters	Mean observed fish length	Mean calculated fish length
	cm.	*cm.*
1	....	1.4
2	....	2.5
3	....	5.0
4	9.0	8.0
5	13.0	11.6
6	13.9	15.4
7	17.2	19.6
8	30.2	24.0
9	33.7	28.5
10	36.3	33.5
11	41.4	38.2
12	42.5	42.7
13	48.4	46.8
14	51.0	50.3
15	55.3	53.5
16	55.7	56.3
17	55.9	58.6
18	60.0	60.4
19	61.3	62.3
20	64.9	63.9
21	64.2	65.3
22	65.8	66.4
23	67.8	67.5
24	67.8	68.6

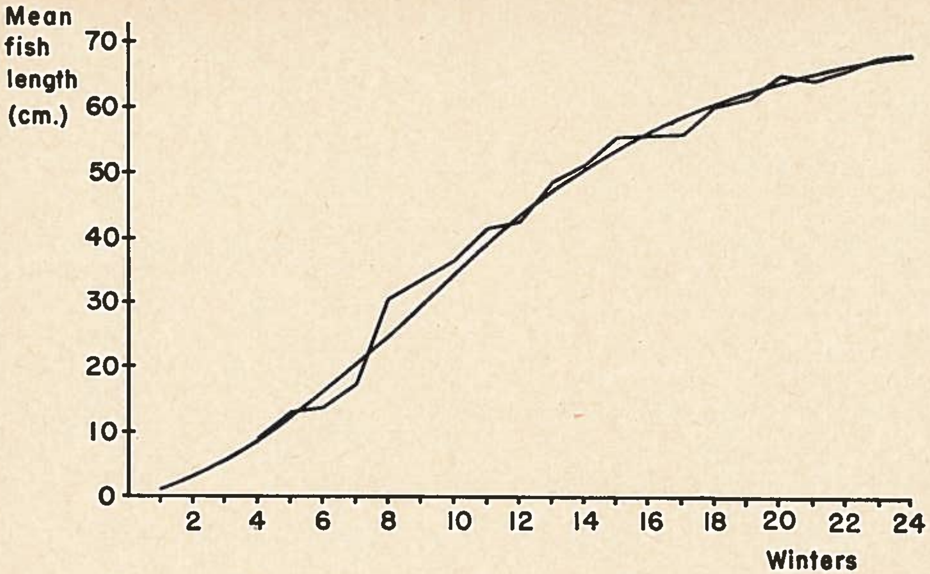

FIGURE 14. The observed and calculated growth curves. The smooth line shows the calculated growth curve of the population.

the closeness of the observed and calculated curves as they apply to this group. The end-of-winter lengths of the fish younger than four winters, as indicated by calculated lengths, are not supported by any observed fish lengths, and have been calculated by extrapolation from the fish length–otolith width curve.

In Figure 15 yearly growth increments are shown, lengths being given for the ends of successive winters, from the conclusion of the first to the twenty-fourth.

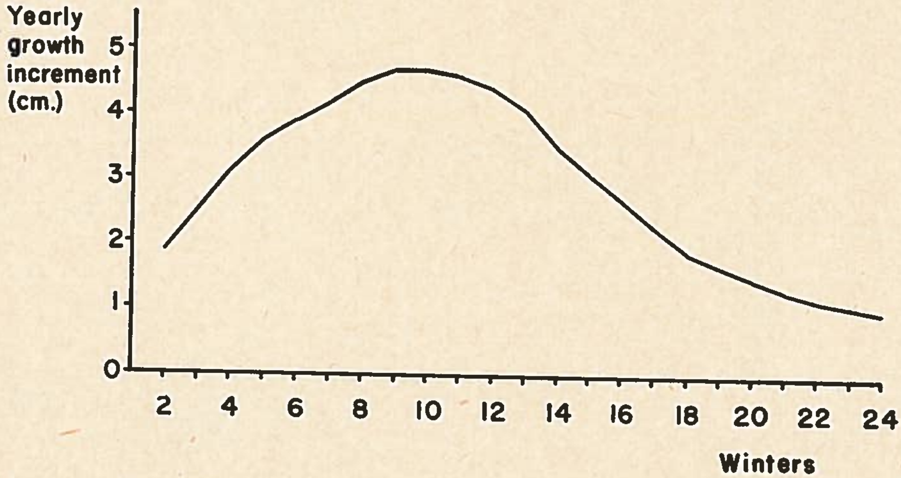

FIGURE 15. Yearly length increments in growth, taken from the calculated growth curve of the population.

From this it appears that length increase, relative to the preceding year's, is successively greater until the end of the ninth winter, after which the yearly length increment decreases. The summers of greatest growth are the eighth and ninth.

It is obvious that a calculated growth curve such as this, even if it succeeds in approximating the mean growth of the population, does not make altogether clear the growth of this fish. The range of sizes of different age groups has been shown to be large, with the result that 60-cm. fish, for example, are found in all age groups between 13 and 24 winters. This is due partly to the slow growth of the char, which gives time for the establishment of a wide range in length, and probably also to a variation in growth associated with different lengths of time spent in fresh water before the fish make their first migration to the sea. Dahl (1926) showed that the char of Svalbard which migrate after only two winters in fresh water reach a substantially greater length than those which remain three or four years in fresh water before migrating to the sea for the first time.

SEX DIFFERENCES IN THE GROWTH RATE

The mean fork length of males for the three seasons' fishing was 52.3 cm., of females 49.2 cm. The superiority in numbers of males over females sampled appears in the fish of about 55 cm. and longer, while more females than males were taken between 45 and 55 cm. In the smaller fish no apparent difference in numbers exists.

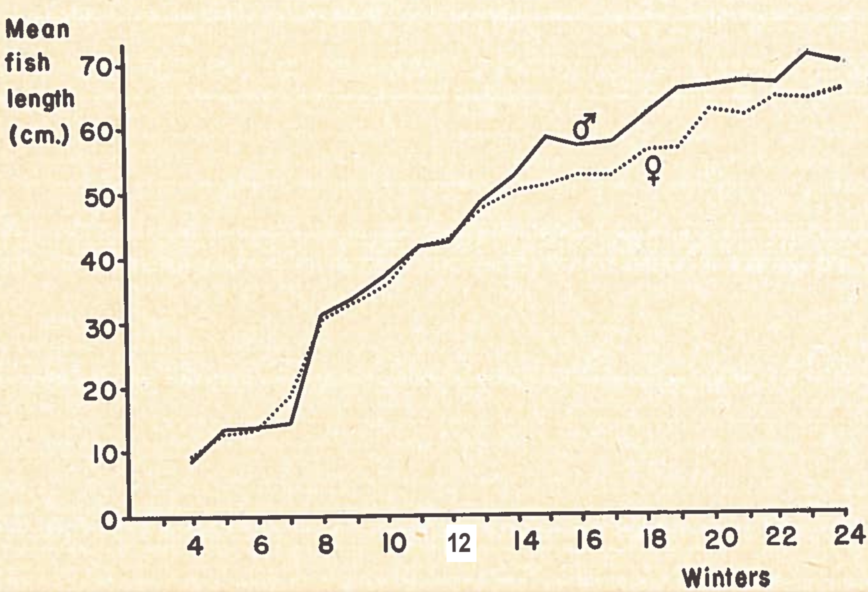

FIGURE 16. The growth curves of males (————) and females (. . . . .), taken from the observed lengths of the sample.

Given in Table II are the observed lengths of 425 males and 370 females from which age determinations were made. The observed age-length relationships of males and females are plotted in Figure 16. From these curves there is little evidence of a length difference before the completion of 12 winters, after which a noticeable divergence between the growth of the sexes appears, the males being distinctly larger in all age groups. This suggests that while during the first half of the lifetime of the char no appreciable length difference is evident between the sexes, after about 12 winters the males surpass the females in rate of growth, exceeding them in mean length by some 5 cm. in the oldest fish. This establishment of a difference in the growth rate between males and females after 12 winters of growth coincides with the probable mean age of sexual maturity being reached in the females, discussed below.

WEIGHT OF THE CHAR

Total fresh weights were taken of 693 char in the field during the 1951 season, using a scale graduated in tenths of pounds. In Table VI are shown weights compared with lengths of fish, averaged for both sexes and for each sex separately, for the entire fishing period, and for the periods June 26 to July 23 and July 24 to September 5. Average weight measurements are given for 5-centimetre length groups, of fish from 25 to more than 75 cm. fork length. Fish smaller than 25 cm. in length were not weighed, the scale graduations being too large to permit the required accuracy of measurement.

This comparison between the weights of males and females for the entire season shows little difference between the sexes in any of the size groups, except for the 75- to 79.5-cm. sample which is small. The weights of the fish taken from June 26 to July 23, compared with those from July 24 to September 5, indicate a substantial increase in weight in almost all length groups between the first and second periods. These data are shown graphically in Figure 17, the upper curve showing weights during the July 24 to September 5 period, the lower curve the June 26 to July 23 period.

Such an increase in weight may be attributed to at least two factors: enlargement of gonads and improvement in the general condition of the fish. While the gonads of both sexes showed an increase in size during a part of the summer season, the difference in weight indicated by these figures is well in excess even of the maximum gonad weight found in 1951. It is probable, therefore, that an improvement in the condition of the fish took place towards the end of the summer period in the sea, as a result of the rich food supply available during the summer in salt water.

The weights of 506 char are compared in fish from 9 to 24 winters, and conspicuous sexual differentiation is shown. In Table VII weight averages for males, females and both sexes combined are given for ages combined in two-winter groups. The weight increase with age of 264 males and 242 females is presented in Figure 18. This shows a distinct weight superiority in males over females from the 13-14 winter group on, which was approximately the age at which males were

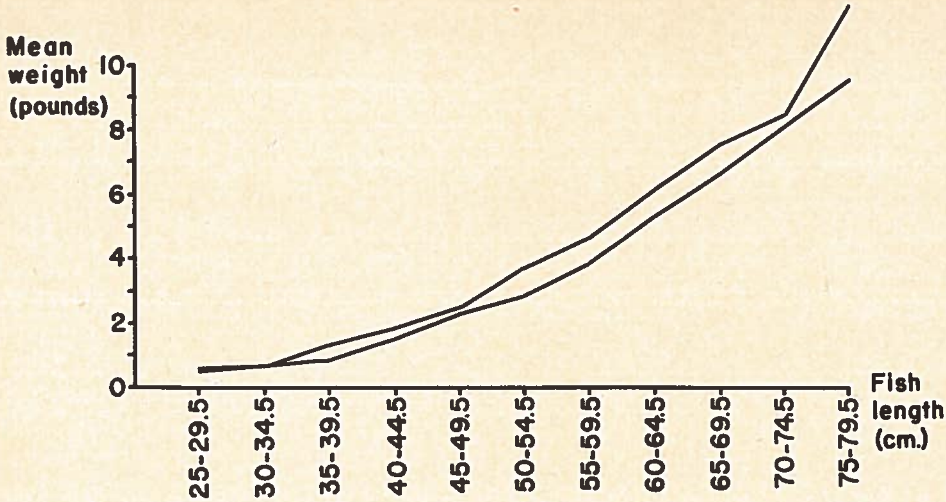

FIGURE 17. The relationship between fish weight and length shown for the period June 26 to July 23, by the lower curve, and for the period July 24 to September 5, by the upper curve.

shown to exceed females in length, above. Here, as in the age-length comparison, no appreciable difference is revealed between males and females of less than about 12 winters.

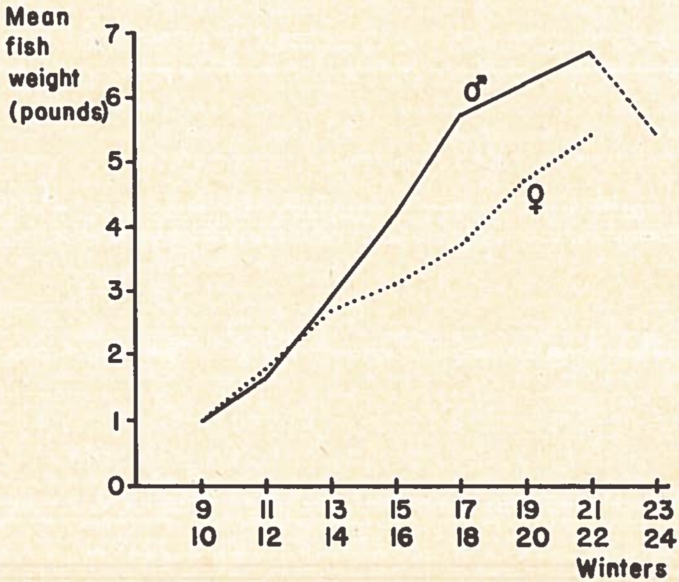

FIGURE 18. Mean weights of males and females in the different age groups.

TABLE VI. Weights based on fish length, for the entire 1951 season, and for the periods from June 26 to July 23 and July 24 to September 5.

Length group	Total No.	Total Av. wt.	Males No.	Males Av. wt.	Females No.	Females Av. wt.
			Entire season 1951			
cm.		*lb.*		*lb.*		*lb.*
25–29.5	37	0.5	16	0.5	21	0.5
30–34.5	103	0.6	54	0.6	49	0.6
35–39.5	81	1.1	39	1.0	42	1.1
40–44.5	72	1.7	33	1.7	39	1.7
45–49.5	121	2.4	59	2.4	62	2.4
50–54.5	113	3.3	65	3.3	48	3.3
55–59.5	88	4.4	55	4.3	33	4.5
60–64.5	50	5.8	29	5.8	21	5.8
65–69.5	17	7.2	9	7.2	8	7.2
70–74.5	7	8.4	7	8.4	0	...
75–79.5	4	10.2	3	10.2	1	8.4
			June 26–July 23, 1951			
25–29.5	14	0.4	7	0.4	7	0.4
30–34.5	27	0.6	15	0.6	12	0.6
35–39.5	37	0.8	19	0.8	18	0.8
40–44.5	22	1.5	7	1.4	15	1.6
45–49.5	45	2.3	21	2.2	24	2.4
50–54.5	46	2.8	26	2.7	20	2.9
55–59.5	26	3.8	16	3.7	10	3.9
60–64.5	16	5.3	9	5.2	7	5.4
65–69.5	6	6.6	5	7.1	1	4.5
70–74.5	..	...	0	...	0	...
75–79.5	2	9.5	1	10.7	1	8.4
			July 24–September 5, 1951			
25–29.5	23	0.6	9	0.6	14	0.6
30–34.5	76	0.6	39	0.6	37	0.6
35–39.5	44	1.3	20	1.2	24	1.3
40–44.5	50	1.8	26	1.8	24	1.8
45–49.5	76	2.5	38	2.5	38	2.4
50–54.5	67	3.7	39	3.7	28	3.6
55–59.5	62	4.6	39	4.5	23	4.7
60–64.5	34	6.1	20	6.1	14	6.0
65–69.5	11	7.5	4	7.3	7	7.6
70–74.5	7	8.4	7	8.4	0	...
75–79.5	2	11.9	2	11.9	0	...

TABLE VII. Weight related to age of the char.

Age group	Both sexes No.	Both sexes Mean weight	Males No.	Males Mean weight	Females No.	Females Mean weight
winters		*lb.*		*lb.*		*lb.*
9–10	122	1.0	62	1.0	60	1.0
11–12	136	1.8	61	1.7	75	1.8
13–14	129	2.8	75	2.9	54	2.7
15–16	61	2.8	37	4.2	24	3.1
17–18	29	5.0	20	5.6	9	3.7
19–20	14	5.1	4	6.2	10	4.7
21–22	14	5.8	4	6.7	10	5.4
23–24	1	5.4	1	5.4	0	...
	506		264		242	

GROWTH OF THE ARCTIC CHAR OF BAY OF TWO RIVERS, GEORGE RIVER AND HERSCHEL ISLAND

In addition to the collection of char from the Sylvia Grinnell River, small samples were obtained from three other regions: Bay of Two Rivers, about 15 miles southwest of the Sylvia Grinnell, in Frobisher Bay; George River, on the southeast shore of Ungava Bay, Quebec; and Herschel Island, N.W.T. Specimens from these three locations were collected respectively by John Wright in 1950, by M. J. Dunbar in 1951, and by A. H. Lawrie in 1951.

The Bay of Two Rivers sample included 16 fish from which age determinations were made. They were captured in gill nets set near the mouth of a pair of rivers which flow into northwestern Frobisher Bay. While it cannot be said at present whether these fish constitute a population distinct from those of the Sylvia Grinnell, their point of capture was in closer proximity to several apparently suitable char streams than to the Sylvia Grinnell River. Fishing was done in this area between August 20 and 27, 1950. The average fork lengths of age groups from 11 to 23 winters are given in Table VIII.

TABLE VIII. Age and length of the Bay of Two Rivers char, 1950.

Winters	No.	Mean fork length	Length range
		cm.	*cm.*
11	2	48.5	48.0–49.0
12	0	....	....
13	3	54.0	47.0–61.5
14	1	59.0	....
15	0	....	....
16	1	66.0	....
17	2	64.5	61.5–67.5
18	1	65.0	....
19	4	69.0	67.5–70.5
20	0	....	....
21	0	....	....
22	1	64.5	....
23	1	74.5	....
	16		

The George River char were fished on July 23, 1951, in fresh water. Age determinations were made on 10 specimens, all falling in the 7-, 8- and 9-winter groups. Average fork lengths are shown in Table IX.

TABLE IX. Age and length of the George River char, 1951.

Winters	No.	Mean fork length	Length range
		cm.	*cm.*
7	6	40.8	37.5–43.5
8	2	43.7	43.5–44.0
9	2	43.5	42.5–44.5
	10		

The sample from Herschel Island was obtained from gill nets in salt water on August 17, 18 and 19, 1951. Fifteen fish showed ages from 4 to 11 winters, as given in Table X. Standard lengths are given.

TABLE X. Age and length of the Herschel Island char, 1951.

Winters	No.	Mean standard length	Length range
		cm.	*cm.*
4	1	20.1	....
5	3	25.5	21.8–27.4
6	1	33.2	....
7	2	37.3	36.9–37.8
8	2	39.0	38.9–39.2
9	3	38.6	35.9–40.0
10	1	48.1	....
11	2	51.1	50.0–52.0
	15		

The age-length relationships of these three samples are shown in Figure 19, compared with the calculated Sylvia Grinnell population growth curve. As the Bay of Two Rivers sample was taken in the sea late in August, and only large-mesh gill nets were used, the apparent length differences of these few specimens from the Sylvia Grinnell char may be exaggerated. All the specimens fall within the length range of the Sylvia Grinnell sample. A real difference between the George River and Herschel Island char, and those of the Sylvia Grinnell does seem to exist, however. As the measurements of the Herschel Island sample are given in standard length, and fork length would mean an increase of roughly 2 to 3 cm., both these and those from George River fall well above the length range of the Sylvia Grinnell char of comparable age. There is a strong suggestion of a more rapid growth rate in both the Herschel Island and George River populations than in that of Frobisher Bay, at least the Sylvia Grinnell River.

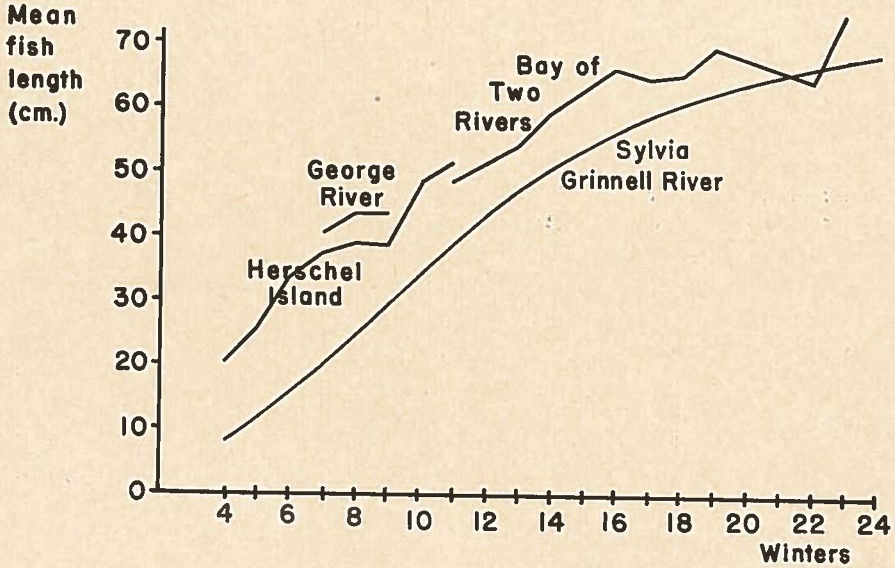

FIGURE 19. Comparison of the growth curves of the Sylvia Grinnell, Bay of Two Rivers, George River and Herschel Island samples. The Herschel Island lengths are expressed as standard length, the others as fork length.

GROWTH OF THE ARCTIC CHAR IN SVALBARD AND WEST GREENLAND

Age determinations of 84 specimens of the Arctic char of western Svalbard were carried out by Dahl (1926) on material collected in August, 1923, at the mouth of a river from Lake Dieset, and at Cape Starostin. Scales were used in this study, but "presented . . . certain difficulties mainly due to the minute size of the scales. The various summer and winter zones could, as a rule, be read with fair accuracy, except in the case of some of the largest and oldest fish." Scales were taken from fish of 20 to 72 cm. in length. The following age-length relationship of the sea-run char was constructed from Dahl's data on observed lengths.

Winters	*No.*	*Av. length (cm.)*
3	2	24.5
4	9	34.0
5	23	36.9
6	19	41.2
7	11	48.3
8	9	53.3
9	6	61.1
10	4	67.0
11	1	70.0
	84	

In addition to these anadromous char from Svalbard, Dahl reported the ages of a small number of char from Novaya Zemlya. One small specimen, 5.4 cm. long, had no readable scales, while another, of 5.8 cm., showed two to three growth rings. From Lommevand at Matoschkin, Novaya Zemlya, three fish, 18, 19 and 20 cm. in length, showed 4, 4 and 5 winters of growth respectively. These displayed no evidence of having been to sea, and appeared to be in spawning condition for that year. Also from the same area, but taken in the sea, was a 48 cm. male with 4 parr winters and 2 winters after migration showing on its scales.

In 1937 and 1939 otoliths from 671 anadromous char were collected in western Greenland by Paul Hansen (1940). The otoliths were used in age estimation and a maximum age of about 20 years was suggested. Fishing was carried out at the following stations: Kobbefjorden, Godthaab, June 28–29, 1937; Tylorshavn, Frederikshaab, July 22, 1937; Kangermiutsiait, Julianehaab, August 4, 1937, and August 8–9, 1939; Itivdlek, in Bredefjord, Julianehaab, August 10–11, 1939; and Kugssuak, in Tasermiutfjord, Julianehaab, August 25–28, 1939.

From these stations the following average lengths for age groups were recorded.

		Age in years						
Station	*Year*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Kobbefjorden	1937	....	....	....	....	....	43.0	48.0
Tylorshavn	"	19.0	20.1	23.7	27.5	26.8	....	....
Kangermiutsiait	"	....	....	34.2	35.6	....	....	....
"	1939	....	22.4	25.5	31.0	34.4	35.9	37.4
Itivdlek	"	....	....	....	....	42.1	45.5	48.9
Kugssuak	"	....	....	....	....	52.5	54.0	55.4

		Age in years					
Station	*Year*	*11*	*12*	*13*	*14*	*15*	*16*
Kobbefjorden	1937	48.9	51.9	53.0	....	53.6	....
Tylorshavn	"	....	....	....	....	....	....
Kangermiutsiait	"	....	....	....	....	....	....
"	1939	....	....	....	....	....	....
Itivdlek	"	49.7	53.0	53.5	....	54.5	....
Kugssuak	"	57.1	55.0	60.6	60.2	....	66.8

A comparison between the data on growth rate of the Svalbard, western Greenland and Sylvia Grinnell anadromous char suggests differences in the rate of growth in all three regions. That the char of Svalbard grow at a faster rate than those of Frobisher Bay is highly probable, the length averages of the Svalbard sample falling entirely outside (above) the maximum length range found in Frobisher Bay. Also maturity of the anadromous Svalbard char is known to occur in fish of 5 winters (Dahl, 1926), in much younger fish than in Frobisher Bay. It is difficult to compare the results from Greenland, which vary so among themselves, with the growth of the Svalbard and Sylvia Grinnell char. All the mean-length values of the Greenland samples fall between the mean lengths of the Svalbard and Sylvia Grinnell fish of comparable ages.

MIGRATION

The movements of migrating Arctic char conform to a general pattern throughout the parts of its range where migratory movements have been noted, in that the descent to salt water occurs usually at about the time of ice break-up in the spring or early summer, and the ascent into freshwater streams takes place in the late summer or early fall.

Mass downstream movements of the char of the Sylvia Grinnell River have not been observed by the author. The ice covering of the river broke just before June 10, 1951, and at that time only a small number of small fish was observed in the river, descending to the sea. With the first use of nets below the river mouth, immediately after the ice had cleared sufficiently from the river-mouth area to permit the use of nets, large fish were taken which evidently had entered the sea earlier. They were well fed and appeared to be in good condition. At this time the occasional small fish still was descending the river falls.

It would seem that the entrance of the larger fish into the sea precedes that of at least some of the smaller ones, and that it may occur in the spring before the break-up of the ice about the river mouth, that is under the ice. Although a thick ice covering forms over the Sylvia Grinnell River during the winter, unfrozen water is present at all times below it. Breaking up of the surface ice, therefore, need not occur in order to permit the fish to gain access to the sea.

It is not known whether any of the Sylvia Grinnell char spend the winter in the sea. The local Eskimos say they do not. Evidently they have taken none in the sea during the winter, while they have caught the char in the winter in the lake in which they are said to spend the winter.

Evidence for upstream movement in the Sylvia Grinnell River suggests that variations in the time of river ascent may be expected in different years. The conditions at the mouth of the Sylvia Grinnell are perhaps different from most char streams in that there is the necessity for the char to ascend a waterfall to gain access to the fresh water above. Near the mouth of the river, in the salt water, fish movements undergo periodic changes dependent upon the condition of the tide. During the time following migration of the fish to the sea, the incoming tides are accompanied by char which move as far upstream as the falls, then, with the falling tide, withdraw into the bay. Even after upstream migration begins many fish continue to return to the bay as the tide falls. These movements are readily apparent, particularly when the water is calm. Great numbers of the fish may be seen moving in with the tide, some jumping almost clear of the water, others breaking the surface with their dorsal fins and backs, almost all headed towards the falls. With the turn of the tide they reverse their direction of movement, and return to the bay, showing themselves again by frequent breaking of the water surface. The presence of the falls at the river mouth influences clearly the movements of these fish, in providing during much of the time a substantial barrier to the river.

The Arctic char do not seem to possess the jumping qualities of the Atlantic salmon found to the south. None was seen to succeed in ascending the falls at low tide, although on several occasions char were observed to leap upwards into the falls when the water was low, but at no time did they rise more than a few feet and they were always forced back into the water at the base of the falls. To gain access to the fresh water, headway must be made against a strong flow even at the best of times, that is when the tides are highest, and it is during the periods when the height of the falls is at its minimum that most upstream movement of the char takes place.

Spring tides occur twice each month, and it is at these times that the upstream movement takes place most abundantly. In 1951 the spring tides of the first week in August coincided with the first evidence of mass upstream movements of the fish. River ascent in 1950 began earlier than in 1951. The char were reported ascending the river at the end of July, and this time agrees with that of spring tides, which occurred during the last week of July. For 1948 precise data are not available on the time of the upstream run. Some ascent of the river occurred in late July, but relatively little upstream movement was noticed until the first week in August. Spring tides occurred at this time and were accompanied by what was probably the first large-scale upstream movement.

Females exceeded males in number in the 1948 sample; in 1950 and 1951 there were more males than females, but the ratios differed considerably (see Table I). During each of the three seasons of fishing more females than males were taken during the two to three weeks immediately preceding the commencement of upstream migration. Shortly after the migration began more males than females were observed. This suggests the possibility of the females ascending the river before the males. In 1948, when the sex ratio was 173 males to 203 females, 294 specimens were observed before and only 82 after upstream migration began. In 1950 the sex ratio was 150 males to 103 females, and only 42 fish were examined before and 211 after the beginning of upstream migration. In 1951 the sex ratio was 452 males to 406 females, and approximately the same number of fish were taken before as after upstream migration began.

The 1948 sex ratio favouring females may be attributed at least partly to the time of fishing which coincided with an abundance of females in the fishing area. The pronounced abundance of males in the 1950 sample may be due to fishing having occurred at a later time, most of it having followed the beginning of migration when more males than females were present in the region of fishing. Fishing in 1951 took more females than males during the period coinciding with most of the 1948 fishing season, more males than females during the time coinciding, with respect to migration time, with most of the 1950 fishing period.

While this does not preclude the possibility of yearly variation in the sex ratio, it does point out that the ratio of males to females, at least for the 1948 and 1950 samples, cannot be interpreted as showing the sex ratio of the population, because of the apparent movements at different times of the males and females. A slight variation from year to year in the sex ratio of the char may be expected in view of the situation which has been described for other anadromous salmonids. Pritchard (1937) in a four-year study of the pink salmon (*Oncorhynchus gorbuscha*) of British Columbia found significantly more females in one year, more males in another and no statistical difference in the sex ratio in the other two seasons, among migrating salmon.

Whether migration of the Sylvia Grinnell River char takes place every year or not cannot be stated with certainty. There is no evidence of any char having been taken in the sea in winter, and at the conclusion of the autumn migration to fresh water the Eskimo fishery in the sea and about the river mouth is concluded. Also whether char which have been to the sea are to be found in fresh water in the summer is not known.

Dahl (1926) from 84 scale observations was able to estimate the age of the first migration to the sea in the char of Svalbard by the presence in the scales of an abrupt increase in the size of the rings, occurring after the laying down of two winter rings (43 per cent of the sample), three winter rings (50 per cent), and four winter rings (7 per cent). From this he concluded that the first migration occurs after the second and before the fifth winter, probably in all cases before the char reach 20 cm. in length.

Regarding the time of first migration to the sea of the Sylvia Grinnell char there are grounds for concluding that migration occurs at various ages, from at least 5 to 7 winters. As pointed out above, no evidence of the first migration could be found in the otoliths examined. Only three 4-winter fish were taken, in July and August, all in fresh water and with parr markings. Of the eighteen 5-winter specimens, 15 were obtained in fresh water in July and August, and three were taken in salt water. The fish from fresh water ranged in length from 11.0 to 14.5 cm. (average 12.9 cm.), while those taken in salt water were from 13.0 to 14.5 cm. (average 13.8 cm.). None of the salt-water specimens (5-winter) was longer than the largest specimen from fresh water, and all were taken before July 23. The similarity of the lengths of these fish to the non-migrants of the same age suggests that they had migrated in the summer of their capture. All showed parr markings. Of the seven 6-winter specimens taken, five were collected in fresh water during July and August, and two were obtained in salt water. The freshwater fish were 12.5 to 15.0 cm. in length (average 13.6 cm.) and all showed parr markings. One of the salt-water fish was collected in the middle of July, was 13 cm. long and had parr markings. The other, 16.5 cm. in length, was taken on August 11, was considerably longer than any others of the age group, and showed no parr markings. While the first of these evidently had migrated after its sixth winter, the second probably had moved first to the sea at an earlier age. Seven

7-winter char were collected, five in fresh water during July and August, from 14.5 to 16.5 cm. long (average 15.0 cm.), all with parr markings, and two in salt water, one of 17.0 cm., the other of 28.5 cm. length. The latter two specimens were obtained at the end of August, and it is probable that the 28.5 cm. specimen had migrated at an earlier age than the 17.0 cm. char. Twenty-five 8-winter fish were observed, all in salt water, and all but two were 27 cm. or longer. Two small specimens, 17 and 19 cm. long, were taken, the former ascending to fresh water at the end of August. The explanation for the size gap in this sample has been discussed above. It is probable that the two small specimens had migrated first at a greater age than the others, possibly as late as seven winters.

It is to be expected that such a slowly growing fish as the Arctic char, which lives more than 24 years, should show a considerable size range within single year classes, as revealed in Table II. In the sample studied, however, there is no great increase in the size range of age groups with increase in age after the eighth winter. In the discussion of sampling, above, it was concluded that the 5-winter group was sampled to show the full freshwater range of this class. From the location of capture of the 4-winter specimens and the lengths of the 5-winter fish taken in salt water there is no evidence of migration occurring previous to the fifth winter. It appears that most of the variation in the growth rate occurs between the fifth and eighth years, during which time most of the first movements to the sea evidently take place.

The first entrance of anadromous fish into the sea usually is accompanied by an increase in the growth rate. This has been described by many workers, among them Dahl (1926), referred to above. This means that if the first migration to the sea occurs over several years in different individuals, the length range of the population increases rapidly within the age groups migrating for the first time. The establishment of such a range as this in the char of the Sylvia Grinnell because of first migration occurring in at least the 5-, 6- and 7-winter fish is probable, and would explain the development of this large length range within three years. Evidence for this in the Frobisher Bay char has not been discovered in the growth of individual fish, nor has it been shown by the calculated growth curve of the population. Such an increase in the growth rate, however, would be obscured in the population growth curve, if it occurs over a period of several years.

There seems to be a definite tendency for the char of Frobisher Bay to remain close to the river mouths throughout the summer. This applies to all size groups, but most particularly to the small fish, which in 1951 were present at all times during the entire summer about the base of the Sylvia Grinnell falls, and were taken only rarely at points in the fishing area away from the falls. The tendency for fish of all sizes to linger near the river mouths is shown by the carrying out of successful fishing in close proximity to the rivers long after seaward migration is completed and before the return to fresh water begins.

EGG SIZE AND FECUNDITY

As part of the field work done on the char of the Sylvia Grinnell River in 1950 and 1951 observations were made on ovaries, and samples were brought to the laboratory for examination. From the field observations on the ovaries it was evident that at least two size groups of eggs were present in many of the fish, this being readily apparent in the fish with the largest eggs. One group contained large eggs, yellowish in colour, the other small, white eggs. The diameters of the large eggs exceeded 4 mm. and were rarely less than 3 mm., while the diameters of the small eggs were all less than 2 mm. In the smaller fish no such clear differentiation existed, all the eggs being small and white.

The finding of eggs of two or more size groups is a common occurrence in fish during the period preceding spawning (Hickling and Rutenberg, 1936; Carbine, 1943). In the fish which spawn once a year a number of the eggs within the ovaries begin to enlarge previous to the spawning time. They acquire a quantity of yolk and become distinctly set apart from the remaining eggs, which remain small and immature. It is apparent that the differentiation in the eggs of the char is of this kind, the larger eggs being those which are in the process of maturing for the spawning period in the autumn, the smaller eggs being immature, destined not to mature that fall.

The measurements made of egg diameters of the char were of only the maturing eggs when they were present, the immature eggs being measured only when no maturing eggs were observed, that is when the immature eggs were the largest eggs present. The measurements of egg diameters done in the field were of one egg only in each of 165 fish sampled, and were expressed to the nearest millimetre. These were done in 1951. The measurements made in the laboratory, of the eggs of 185 fish, were done in a more precise fashion. Five eggs were picked from various parts of the ovaries of each fish and were measured, using an ocular

TABLE XI. Frequency of egg diameters, 1950 and 1951, in units of 0.064 mm.

Egg diameter	No.
units	
2–6.9	7
7–11.9	5
12–16.9	20
17–21.9	45
22–26.9	47
27–31.9	20
32–36.9	1
37–41.9	4
42–46.9	4
47–51.9	7
52–56.9	8
57–61.9	8
62–66.9	5
67–71.9	4
	185

micrometer. The mean of the five readings was used, and was expressed as units of the micrometer (one unit equals 0.064 mm.). Of the 185 specimens, 10 were collected in 1950, 175 in 1951.

Given in Table XI are the frequencies of egg sizes obtained from the samples measured in the laboratory, taken from fish of 8.5 to 75 cm. in length. Shown by the table is the small number of fish with eggs just over 30 units (about 2 mm.) in diameter, compared with those with smaller and larger eggs.

In Figure 20 are five frequency histograms of egg diameters, the first four representing two-week periods, the fifth a 17-day period, of the 1951 fishing season. In Period (1) (June 26 to July 9) the largest of the eggs from 23 fish were 44.4 units (2.8 mm.) in diameter, and the differentiation of the eggs into two size groups is not evident. This sample was taken from 5½ to 3½ weeks before

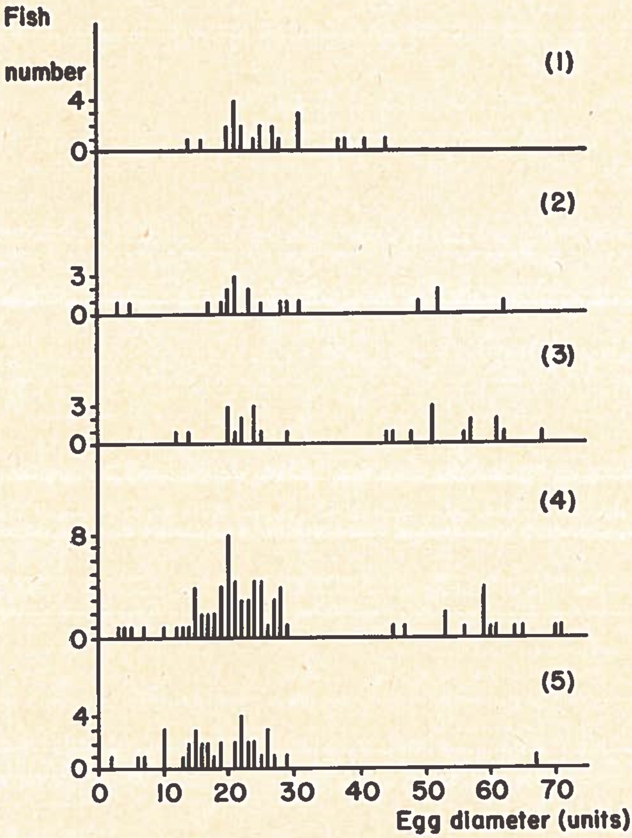

FIGURE 20. Development of the maturing eggs during the summer of 1951. Explanation in text.

upstream migration began. In Period (2) (July 10 to July 23) of the eggs from 19 fish the largest were 62.6 units (4 mm.) in diameter and an interval of 18 units (1.1 mm.) exists between the large (maturing) and the small (immature) eggs. The average diameter of the eggs from the four maturing fish was 54.2 units (3.4 mm.). This period ended about 1½ weeks before the beginning of migration. In Period (3) (July 24 to August 6) the eggs from 26 fish were measured. Two distinct size groups appear, the mean diameter of the maturing eggs being 54.9 units (3.5 mm.). During the latter part of this period upstream migration began. In Period (4) (August 7 to 20) the eggs from 73 fish were measured, two size groups of eggs appear, and the mean diameter of the maturing eggs was 59.1 units (3.8 mm.). This period extended over two weeks after the beginning of migration. In Period (5) (August 21 to September 5) measurements were made on the eggs of 36 fish, and only one specimen with maturing eggs was found, having eggs with a mean diameter of 67.5 units (4.3 mm.). Coinciding with this period was an apparent reduction in the number of larger females in the fishing area, referred to above.

This series of histograms demonstrates that growth in the size of the eggs occurred during the first half of July, during which time those eggs which were to mature for the next spawning period became differentiated from the other eggs destined to remain immature. By about the middle of July the two types of eggs were clearly distinguishable by size. The growth of the maturing eggs probably continued throughout the rest of the pre-spawning period, but there is no suggestion from these data of any noticeable growth in the immature eggs occurring during the summer.

In Figure 21 the diameters of the eggs of 185 fish are plotted against fish lengths. Clear distinction shows between the maturing and immature eggs. (The five encircled points represent eggs from the four partially matured ovaries of early July, 1951, shown in Figure 20 (1), and one specimen from early in the 1950 season.) There is evidence of a correlation between fish length and the diameter

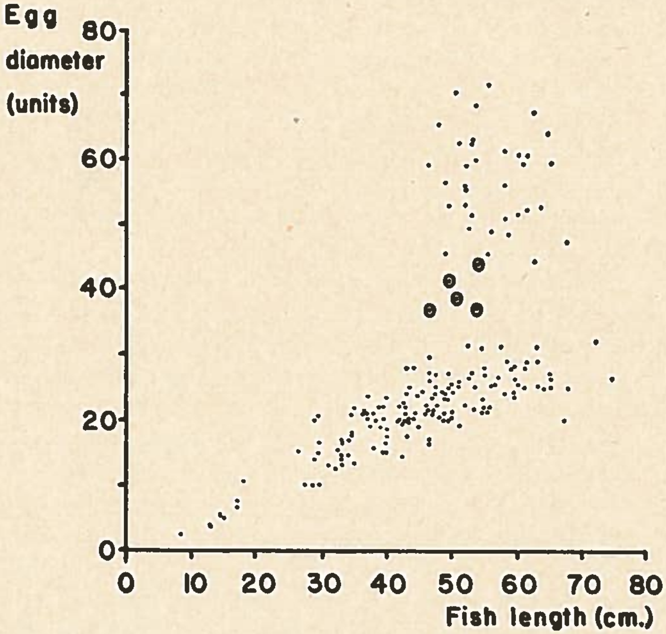

FIGURE 21. Egg diameter compared with fish length. The dots below the encircled points represent immature eggs, those above, maturing eggs.

of the immature eggs, in that egg diameter increases with the length of the fish. This relation is also shown in Table XII.

TABLE XII. The relation between fish length and immature egg diameter (in 0.064-mm. units).

Fish-length group	Average egg diameter
cm.	*units*
5– 9.5	2.6
10–14.5	4.3
15–19.5	7.3
20–24.5	...
25–29.5	14.6
30–34.5	16.1
35–39.5	19.8
40–44.5	20.8
45–49.5	23.1
50–54.5	24.7
55–59.5	25.9
60–64.5	27.6
65–69.5	24.7
70–74.5	29.5

With regard to the maturing eggs no such obvious relationship exists. In order to determine whether a correlation exists between fish length and the size of mature eggs a collection would have to be made at the spawning time.

In at least some of the char which have achieved a length of more than 45 cm. a portion of the eggs has undergone rapid development and commenced to mature. The length at which maturity is reached seems to be approximately 45 cm. in this sample. No maturing eggs were taken from fish less than 45 cm. in length, while in those exceeding this length maturing eggs were found in about 33 per cent of the specimens. Maturing at 45 cm., the females of the Sylvia Grinnell are somewhat larger at maturation than the female char of Svalbard, where Dahl (1926) found a mature female of 38 cm.

Table XIII shows the number of maturing and immature specimens in different length groups from 1951, based upon the examination of eggs from 340 specimens.

It is apparent that all the females within the size range of maturity do not spawn every autumn. For the fish of 45 cm. length and greater the ratio of maturing to immature specimens was about 1:2. From only nine measurements made on the eggs of the 1950 sample taken from fish greater than 45 cm. in length, three were maturing and six were immature, a ratio of 1:2.

There is little information available on the spawning frequency of the Arctic char. Yessipov (1935) suggested that the char of Novaya Zemlya spawn in lakes every second year. Jensen (1948) reported of the migrating char of western Greenland, that on July 30, 1909, at Tunugdliarfik Fjord, a number of individuals caught in a river had eggs up to 1 mm. in diameter and were in the company of others which had mature gonads; all were migrating into fresh water. Jensen concluded that unripe females probably ascend the streams with sexually mature individuals. This situation apparently is similar to what is found in Frobisher Bay, and suggests that spawning is not an annual autumn occurrence in each fish.

TABLE XIII. The number of maturing and immature females taken in 1951.

Fish-length group	Number of specimens Maturing	Immature	Total
cm.			
5–9.5	0	1	1
10–14.5	0	4	4
15–19.5	0	4	4
20–24.5	0	0	0
25–29.5	0	25	25
30–34.5	0	60	60
35–39.5	0	41	41
40–44.5	0	41	41
45–49.5	10	45	55
50–54.5	19	31	50
55–59.5	15	17	32
60–64.5	11	9	20
65–69.5	2	4	6
70–74.5	0	1	1
	57	283	340

The time of spawning of the Sylvia Grinnell char is not known definitely. Eskimos of the region say that it takes place in the fall and this is probable from the condition of the gonads in late summer. Various reports on the probable spawning time of the char in other parts of its range indicate that it occurs for the most part in the autumn. An exception to this was reported by Weed (1934) who believed, from gonad observations, that some of the char of Labrador spawn earlier than the usual late autumn spawning time, from the finding on July 13 and 14 of char with free eggs in their oviducts, a great distance from the usual spawning grounds.

Age determinations were done on 126 of the 185 specimens from which egg measurements were made. Of these one fish was found to be maturing at 10 winters, but this specimen was 52 cm. long, considerably larger than the mean for the 10-winter fish in their tenth summer which is about 35 cm. No maturing fish were found at 11 winters, but three were observed at 12 winters. As a length of somewhat over 45 cm. coincides with the mean length of the fish during their twelfth summer, it seems that maturity is reached most commonly after the twelfth winter, at a considerably greater age than that reported for the char in other parts of its range. Dahl (1926) found the first sign of maturity in the Svalbard char in a female of 5 winters. Saemundsson (1927) suggested that the char of Iceland probably are mature at 6 years. Yessipov (1935) found that maturity was reached in the sixth or seventh year in the char of Novaya Zemlya.

Counts of maturing eggs were made from 23 Sylvia Grinnell char. Actual counts were done on the eggs of three fish and calculated counts were made on all 23. The method of making the calculated counts was as follows. Ovaries were removed from the fish and superficial ovarian tissue was cleared. Three samples of eggs, each about 2 to 3 cubic centimetres in bulk, were removed from different parts of the ovaries. These were immersed in water and the displacement of each sample was measured. Counts then were made on the number of eggs in each of the three samples, and the number of eggs per cubic centimetre of ovary was computed. The remaining eggs then were immersed and the amount of water which they displaced was measured. Using the total water displacement of the ovarian eggs in cubic centimetres and the number of eggs per cubic centimetre of ovary, the total number of eggs in both ovaries was calculated.

Actual counts were made on the eggs of three fish and these are shown in Table XIV, compared with calculated counts on the same fish. The difference between the two counts in each is small.

TABLE XIV. Comparisons between actual and calculated egg counts.

Fish no.	Cal. count	Actual count	Difference	% difference
38 (1950)	3,107	3,130	−23	−0.73
310 (1951)	3,652	3,618	+34	+0.93
334 (1951)	3,734	3,765	−31	−0.82
				+0.62

In Table XV are given egg counts from 23 maturing char, compared with egg size, fish length, fish weight and fish age (when determined). The mean maturing egg count from these fish, ranging in length from 49 to 66.5 cm., and averaging 56 cm., was 3,589.

In Figure 22 maturing egg counts are compared with fish length. Within this sample there is an increase in the number of eggs with the growth of the fish.

TABLE XV. Maturing egg counts from 23 char, 1950 and 1951.

Fish no.	Egg number	Egg diameter	Fish length	Fish weight	Fish age
		units	*cm.*	*lbs.*	*winters*
214	2,256	62.6	53.0	3.5	..
310	3,618	68.4	53.5	3.9	14
334	3,765	51.0	58.0	5.9	19
340	2,338	56.6	49.0	3.0	..
471	2,696	60.0	53.5	3.4	16
6	2,323	41.4	49.5	2.2	16
505	5,158	64.4	64.5	6.7	..
29	3,511	38.8	50.5	2.8	15
472	3,366	61.4	58.0	4.4	15
222	5,367	52.2	61.5	6.6	21
71	4,218	44.4	62.5	5.9	17
419	2,507	59.0	52.0	4.3	17
487	4,355	59.8	65.0	6.3	15
452	2,816	53.0	49.5	3.3	..
508	2,173	59.2	46.5	2.3	..
342	3,049	51.4	53.0	3.6	..
476	2,745	53.0	52.0	3.7	..
808	4,687	67.4	62.5	4.6	16
278	4,716	51.8	60.0	5.2	13
447	7,223	37.4	66.5	6.9	..
488	3,653	71.8	55.5	4.4	22
184	2,896	63.0	53.0	...	17
38	3,130	56.4	58.0	...	19
	3,589	55.8	56.0		

The ovaries of eight specimens were collected from George River on July 23, 1951, and the eggs from these were measured in the same manner as the Sylvia Grinnell char, above. Of these eight char, six appeared to be maturing for spawning in the autumn of 1951, many of their eggs being definitely enlarged, up to 45.2 units (2.9 mm.) in diameter, and yolky. The largest eggs of the other two specimens averaged 32.4 units (2.1 mm.) and 30.0 units (1.9 mm.) in diameter, were light in colour, with only a small amount of yolk, and were only slightly differentiated from the small, white eggs in the ovaries. In Table XVI are shown egg diameters compared with lengths and ages of the maturing fish. Assuming maturation of at least the six fish with large eggs, it is probable that the George River char are mature as small at least as 37.5 cm. in length, and at as early an age as 7 winters; therefore that they mature at a smaller size and much younger than the Sylvia Grinnell River char.

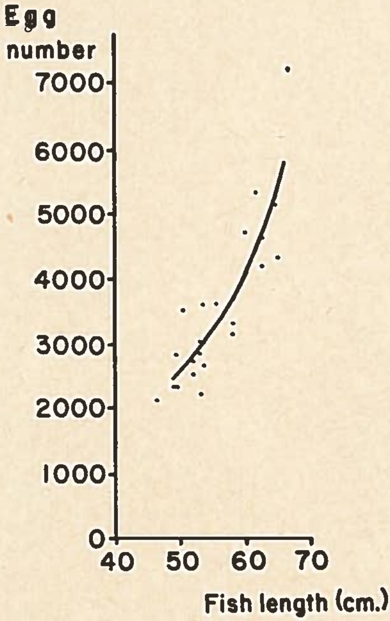

FIGURE 22. The relationship between the number of maturing eggs per fish and fish length.

TABLE XVI. Maturing egg diameters (in 0.064-mm. units) and egg counts of George River char, 1951.

Specimen no.	Fish length	Fish age	Egg diameter	Egg count
	cm.	*winters*	*units*	
1	41.5	7	42.1	2,455
4	42.5	9	44.3	2,596
7	42.0	7	45.2	2,646
9	43.5	7	45.2	3,039
11	43.5	8	41.6	3,266
12	37.5	7	44.6	2,352
	41.2		43.8 (2.8 mm.)	2,726

Counts were made on the eggs of six of the George River char which appeared to be maturing when collected. The method of counting was the same as was applied to the Sylvia Grinnell char, above. Egg counts are given in Table XVI, above, and are compared with fish length and age, and egg size.

The mean count was 2,726 eggs per fish of an average length of 41.2 cm., which is comparable to the egg count from the Sylvia Grinnell char of about 52 cm. in length. While no specimens of greater than 45 cm. in length were collected from George River, so that a direct comparison of maturing egg counts from fish of the same length cannot be made between specimens of the two regions, there is a suggestion of a higher relative fecundity (number of eggs per unit of fish length) in George River than in the Sylvia Grinnell River.

TABLE XVII. Food specimens taken from *Salvelinus alpinus* of Frobisher Bay in 1948, 1950 and 1951.

Food species	No. taken	Date
Themisto libellula (Mandt)	3,410	all years
Themisto sp.	305	"
Hyperia medusarum (O. F. Müller)	5	July 29, Aug. 2, 1948; Aug. 20 and 22, 1950
Hyperia galba (Mont.)	1	Aug. 6, 1950
Pseudalibrotus littoralis (Kröyer)	14,406	all years
Pseudalibrotus sp.	34,760	"
Anonyx nugax (Phipps)	2	Aug. 19, 1950
Anonyx sp.	1	Aug. 1, 1950
Orchomenella minuta (Kröyer)	3	Aug. 7, 1950
Gammarus sp.	1006	all years
Gammaracanthus loricatus (Sabine)	17	"
Pontoporeia affinis Lindström	525	"
Apherusa glacialis (H. J. Hansen)	28	"
Ischyrocerus anguipes Kröyer	3	July 24, 1948
Calanus hyperboreus (Kröyer)	699	all years
Calanus finmarchicus (Gunnerus)	183	"
Pareuchaeta glacialis (H. I. Hansen)	3	Aug. 6, 1948
Pareuchaeta norvegica (Boeck) ?	1	Aug. 8, 1951
Mysis oculata (Fabricius)	2,855	all years
Mysis mixta Lilljeborg	111	1950 and 1951
Small mysids (unidentified)	746	all years
Thysanoessa inermis (Kröyer)	34	"
Thysanoessa raschii (M. Sars)	2	Aug. 20 and 22, 1950
Thysanoessa sp.	1	1950
Cladocera (unidentified)	3	July 22, 1948
Isopoda (unidentified)	1	1950
Lebbeus groenlandicus (Fabricius)	16	1950
Argis dentata (Rathbun)	6	1950
Decapod larvae (unidentified)	183	all years
Nereis pelagica Linn.	16	1948
Nereis sp.	100	all years
Chaetognatha (unidentified)	75	Aug. 26, 1951
Diptera (unidentified)	35	1951
Insect larvae (unidentified)	131	1951
Salvelinus alpinus (Linn.)	3	July 4 and 10, 1951
Myoxocephalus groenlandicus (Cuvier and Valenciennes)	111	all years
M. groenlandicus ?	200	all years
Triglops pingeli Reinhardt	6	July 7 and 11, 1951
T. pingeli ?	7	1951
Small sculpins (unidentified)	220	all years
Eumicrotremus spinosus (Müller)	5	1950 and 1951
Liparis sp.	4	1951

FEEDING HABITS

Analysis was made of the stomach contents of about 490 char from Frobisher Bay, Adlorilik in eastern Ungava Bay, George River in southeastern Ungava Bay, and Herschel Island, N.W.T. In all about 60,900 food specimens were examined, comprising at least 34 species.

About 450 char stomachs from Frobisher Bay were examined, and were found to contain some 60,200 food specimens representing at least 30 species. These collections were made in 1948, 1950 and 1951, between June 26 and September 5. Table XVII lists the species which were found, all recorded previously from northern waters.

TABLE XVIII. Food species taken from a specimen of *Salvelinus alpinus* caught on July 4, 1951, at Adlorilik, eastern Ungava Bay, by the Fisheries Research Board vessel *Calanus*.

Food species	No. taken
Themisto libellula (Mandt)	13
Hyperoche medusarum (Kröyer)	1
Pseudalibrotus littoralis (Kröyer)	49
Apherusa glacialis (H. J. Hansen)	16
Westwoodilla megalops (G. O. Sars)	2
Thysanoessa inermis (Kröyer)	1
Decapod larvae (unidentified)	200
Myoxocephalus groenlandicus (C. & V.)	2
Small sculpins (unidentified)	200
Ammodytes sp.	3
Liparis sp. ?	3

TABLE XIX. Food species taken from 13 specimens of *Salvelinus alpinus*, collected on July 23, 1951, at George River, southeastern Ungava Bay, by M. J. Dunbar.

Food species	No. taken
Themisto libellula (Mandt)	6
Calanus hyperboreus (Kröyer)	1
Decapod larvae (unidentified)	5
Small sculpins (unidentified)	4
Triglops pingeli Reinhardt	2
Ammodytes sp.	24

TABLE XX. Food species taken from 23 specimens of *Salvelinus alpinus* collected by A. H. Lawrie at Herschel Island, N.W.T., between August 17 and 19, 1951.

Food species	No. taken
Themisto libellula (Mandt)	75
Hyperia medusarum (O. F. Müller)	1
Gammarus sp.	2
Decapod larvae (unidentified)	6
Myoxocephalus groenlandicus (C. & V.)	76
Boreogadus saida (Lepechin)	1

SUMMARY

1. As a result of the methods used in fishing for the Arctic char in Frobisher Bay, in 1948, 1950 and 1951, inadequate sampling resulted in the taking of a disproportionately small number of specimens between 15 and 20 cm., and none between 20.5 and 26.5 cm. in length, and necessitated the estimation of a calculated growth curve.

2. The calculated curve was constructed by showing the relationship between fish length and otolith width and expressing it in the form of the equation, log (fish length) = $-1.503 + 1.982$ log (otolith width). From otolith-ring measurements the relationship between otolith width and fish age was determined, and these values were substituted in the equation above to give a calculated fish length for each year, expressed as lengths at the ends of winters.

3. Close agreement is shown between the observed and calculated lengths except in the 6-, 7-, 8-, 9- and 10-winter specimens, which had been sampled in a non-random fashion.

4. The char of Frobisher Bay show increasing yearly growth increments until the end of the ninth winter, after which time the rate of growth diminishes yearly.

5. Males show a more rapid growth than females after about 12 winters.

6. Weight increase occurs in the char during the summer period spent in the sea. This increase is greater than the addition in weight of the gonads, and indicates an improvement in the condition of the fish. The weight of males exceeds that of females after about 12 winters.

7. The Arctic char of George River and Herschel Island show a more rapid growth rate than the Frobisher Bay population.

8. The Arctic char of Svalbard grow more rapidly than those from Frobisher Bay, while the char of western Greenland appear to grow at a rate intermediate to the Svalbard and Frobisher Bay populations.

9. The first migration to the sea of the Sylvia Grinnell char probably occurs for the most part during the fifth, sixth and seventh summers. Seaward migration takes place in late spring, most of it probably before the ice has broken about the river mouth. The return to fresh water begins in late July or early August and continues until at least early September, and its occurrence seems to be influenced by tidal conditions, most upstream movement taking place at high tides, and the first mass upstream migration beginning during high spring tides.

10. The length at maturity of the Sylvia Grinnell char is about 45 cm. Maturity occurs in the Sylvia Grinnell River at about 12 winters, and in George River at least as early as 7 winters, possibly younger. About 33 per cent of the Sylvia Grinnell char of 45 cm. and longer were in condition for spawning in the autumn of 1951. The char of the Sylvia Grinnell show a lower relative fecundity than those of George River.

11. At least 34 food species were taken from the Arctic char of Frobisher Bay, Adlorilik, George River and Herschel Island.

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Station List of the *Calanus* Expeditions, 1951-52, together with Frobisher Bay Stations, 1948, 1950 and 1951, and Resolution Island Stations, 1950[1]

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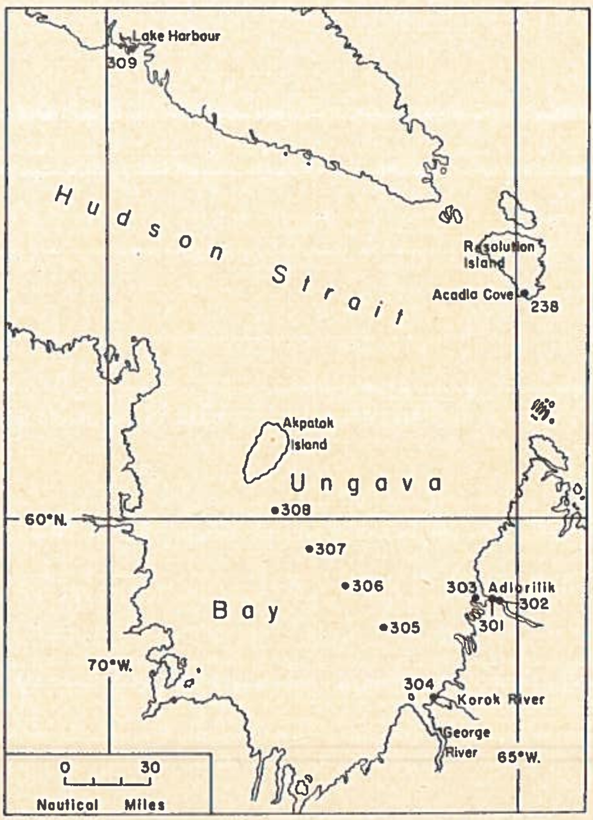
"CALANUS" SERIES, NO. 4

ABSTRACT

A list is given of 61 stations where biological or oceanographic observations or collections were made by the *Calanus* in Ungava Bay, Frobisher Bay, Cumberland Sound and adjacent waters, during the 1951 and 1952 seasons. Five additional stations, occupied independently from the *Calanus* in Frobisher Bay in 1948, 1950 and 1951, and at Resolution Island in 1950, are included.

INTRODUCTION

The "Station List of the *Calanus* Expeditions, 1947–50" has been published (*J. Fish. Res. Bd. Canada,* 9, 65–82, 1952), and included stations occupied in Ungava Bay and adjacent waters. In 1951 work was begun by the *Calanus* in Frobisher Bay, and was continued there and in Cumberland Sound in 1952. In 1948, 1950 and 1951 stations were occupied in Frobisher Bay, and in 1950 at Resolution Island, by investigations carried out independently from the *Calanus.*



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LIST OF STATIONS

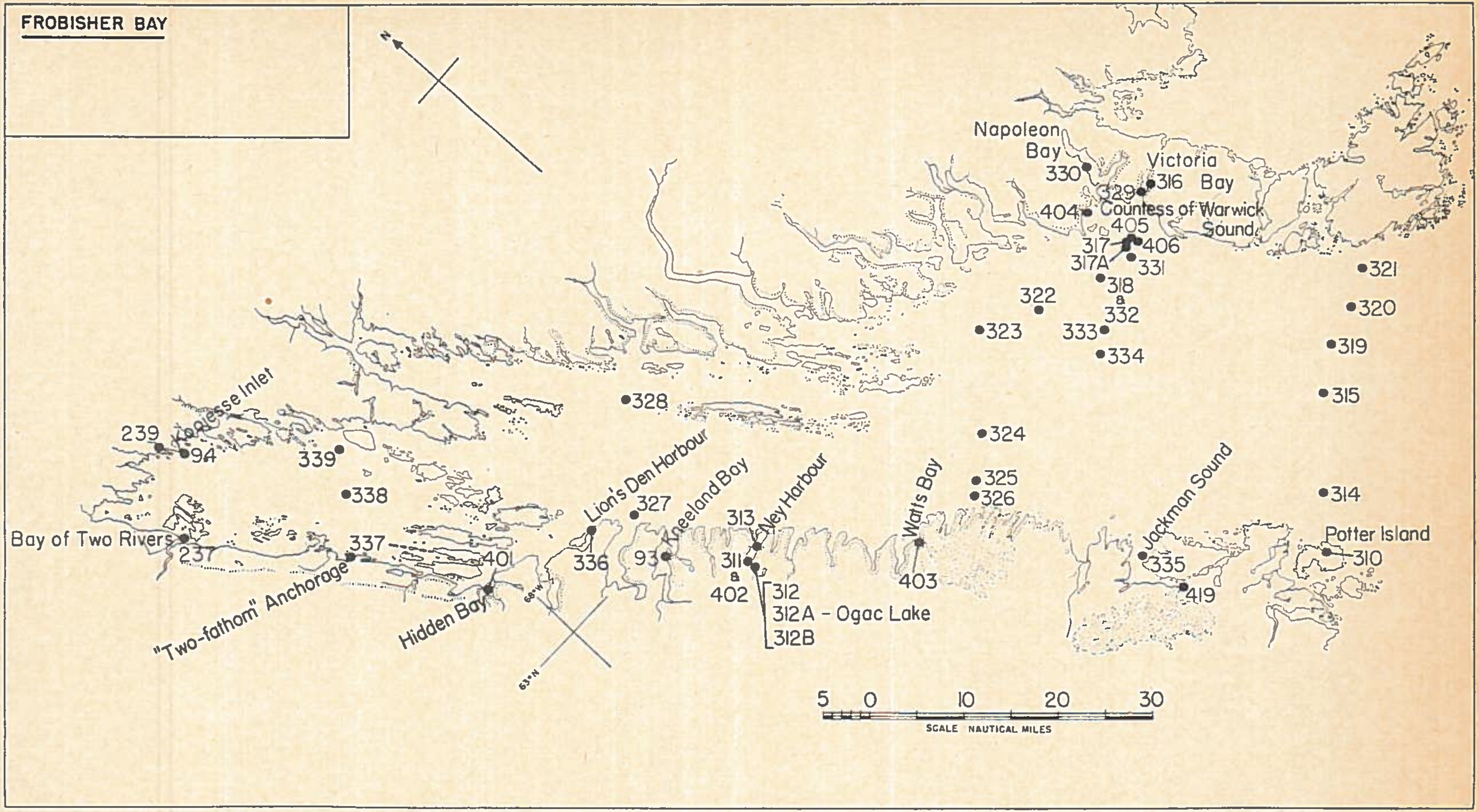
Station	Map location	North Latitude	West Longitude	Depth (*metres*)	Type of station (work done)
1951					
301	Adlorilik	59°29.5′	65°20′	110	plankton, hydrographic
302	Adlorilik	59°30′	65°16′	45–51	hydrographic
303	west of Adlorilik	59°30′	65°32′	120	plankton, hydrographic
304	mouth of Korok River	58°54′ (approx.)	66°03′ (approx.)	42	plankton
305	Hydrographic section from George River to Akpatok Island	59°19′	66°39′	128	hydrographic
306		59°34′	67°07′	320	hydrographic
307		59°49′	67°34′	255	hydrographic
308		60°03′	68°00′	64	hydrographic
309	Lake Harbour	62°45′ (approx.)	69°40′ (approx.)	22	plankton
				201	plankton
				165	hydrographic
310	Potter Island	62°06.5′	65°52′	—	littoral collecting
				27	plankton
311 & 402	Ney Harbour	62°51.5′	67°21′	9–27	hand line fishing, benthos collecting
312	Ogac Lake	62°51′ (approx.)	67°21′ (approx.)	62	plankton, hydrographic
312A	Ogac Lake	62°51′ (approx.)	67°21′ (approx.)	7–20	plankton, hand line fishing, hydrographic
312B	Ogac Lake	62°51′ (approx.)	67°21′ (approx.)	7–18	hand line fishing
313	Ney Harbour	62°52′	67°18′	183	hydrographic
314	mouth of Frobisher Bay	62°11′	65°42′	338	hydrographic
315	mouth of Frobisher Bay	62°18′	65°25′	263	hydrographic
316	Victoria Bay	62°46′	65°16′	—	littoral collecting
317	Countess of Warwick Sound	62°44′	65°29′	27–36	benthos (dredging)
317A	½ mile from 317	62°44′	65°30′	36	long line fishing

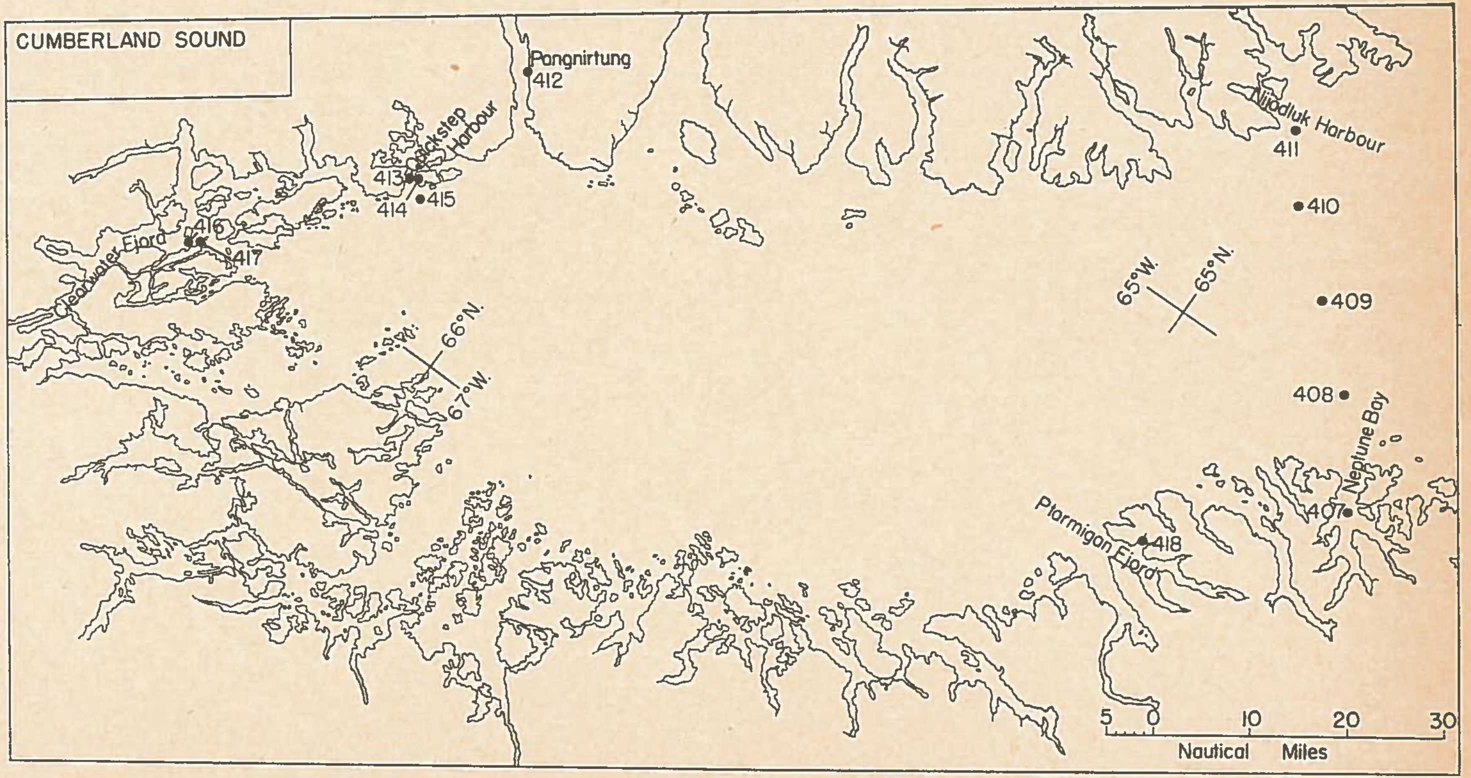
Station	Map location	North Latitude	West Longitude	Depth (*metres*)	Type of station (work done)
318 & 332	southwest of Countess of Warwick Sound	62°43′	65°38′	55	benthos (dredging and trawling), long line fishing, hand line fishing, hydrographic
319	mouth of Frobisher Bay	62°21′	65°16′	113–118 68	benthos (dredging) benthos (dredging)
320	mouth of Frobisher Bay	62°21.5′	65°05′	80	hydrographic
321	mouth of Frobisher Bay	62°23′	64°58′	71	benthos (dredging)
322	10 miles west of Countess of Warwick Sound	62°46′	65°55′	119	benthos (dredging and trawling)
323	hydrographic section across Frobisher Bay	62°49.5′	66°05′	146	hydrographic
324		62°42′	66°23′	329	hydrographic
325		62°39′	66°32.5′	549	hydrographic
326	southwest of 325	62°38′	66°35′	549–640	plankton
327	Upper Frobisher Bay	63°04′	67°31′	more than 640	hydrographic
328	Upper Frobisher Bay	63°12.5′	67°12.5′	274	hydrographic
329	Victoria Bay	62°46′	65°16.5′	183	plankton, benthos (dredging), hydrographic
330	Napoleon Bay	62°52′	65°21′	—	littoral collecting
				shallow	hand line fishing
331	southwest of Countess of Warwick Sound	62°42′ (approx.)	65°31′ (approx.)	77	benthos (trawling)
332 & 318	southwest of Countess of Warwick Sound	62°43′	65°38′	55	benthos (dredging and trawling), long line fishing, hand line fishing, hydrographic

Station	Map location	North Latitude	West Longitude	Depth (*metres*)	Type of station (work done)
333	southwest of Countess of Warwick Sound	62°39′	65°47.5′	104–137	benthos (trawling)
334	southwest of Countess of Warwick Sound	62°38′	65°52′	183–192	benthos (trawling)
335	Jackman Sound	62°21′	66°19′	320	plankton, long line fishing, hydrographic
336	mouth of Lion's Den Harbour	63°06′	67°40′	82	long line fishing
337	"Two-fathom" Anchorage	63°22.5′	68°23′	—	littoral collecting
338	Upper Frobisher Bay	63°27.5′	68°13′	128	hydrographic
339	Upper Frobisher Bay	63°31′	68°07′	109	hydrographic
1952					
401	Hidden Bay	63°10′	68°07′	24	plankton, hand line fishing
402 & 311	Ney Harbour	62°51.5′	67°21′	9–27	hand line fishing, benthos collecting
403	Watts Bay	62°39′	66°51′	14–18	plankton, hand line fishing
404	Countess of Warwick Sound	62°48.5′	65°28′	18	benthos collecting
405	Countess of Warwick Sound	62°46.5′	65°27′	55	long line fishing
406	Countess of Warwick Sound	62°74′	65°26.5′	46	benthos (dredging)
407	Neptune Bay	64°34′	65°17′	228	plankton
				118	hydrographic
408	Hydrographic section across the mouth of Cumberland Sound	64°41.5′	64°55′	396	hydrographic
409		64°49′	64°39′	640(?)	hydrographic
410		64°56.5′	64°22.5′	576	hydrographic
411	south of Nijadluk Harbour	65°01′	64°08′	83–91	plankton

Station	Map location	North Latitude	West Longitude	Depth (*metres*)	Type of Station (work done)
412	Pangnirtung	66°09′	65°44′	—	littoral collecting
				29	plankton
413	Quickstep Harbour	66°12.5′	66°24′	—	littoral collecting
				10	plankton hauling, hand line fishing, benthos collecting
414	2 miles off mouth of Quickstep Harbour	66°11′	66°28′	274–366	plankton
415	west of Quickstep Harbour	66°12.5′	66°23′	73	long line fishing
416	Clearwater Fjord	66°27′	67°11′	274–284	plankton, benthos (dredging), hydrographic
417	Clearwater Fjord	66°26′	67°07′	—	littoral collecting
				36	long line fishing
418	Ptarmigan Fjord	64°50′	65°51.5′	—	littoral collecting
				18–55	plankton, benthos collecting, hand line fishing
419	Jackman Sound	62°15.5′	66°18′	13–18	plankton, benthos collecting, whaling
1948					
93	Kneeland Bay, Frobisher Bay	62°58′	67°22′	18	plankton
94	Koojesse Inlet and mouth of Sylvia Grinnell River, Frobisher Bay	63°43′ (approx.)	68°32′ (approx.)	0–60	gill net fishing, hand line fishing, plankton, benthos collecting, littoral collecting
1950					
94	(above)				
237	Bay of Two Rivers, Frobisher Bay	63°37′ (approx.)	68°48′ (approx.)	—	gill net fishing, benthos collecting, littoral collecting
238	Acadia Cove, Resolution Island	61°20′	64°53′	18–36	hand line fishing, long line fishing, benthos collecting, plankton

Station	Map location	North Latitude	West Longitude	Depth (*metres*)	Type of station (work done)
239	Fresh water streams and ponds adjacent to the Sylvia Grinnell River, Frobisher Bay	63°45′ (approx.)	68°36′ (approx.)	—	fresh water collecting
1951					
94	(above)				
239	(above)				


FROBISHER BAY
N
Napoleon Bay
330
Victoria Bay
329
316
404
Countess of Warwick Sound
405
317
406
317A
331
318 & 332
321
322
320
323
333
334
319
315
328
324
Koojesse Inlet
239
94
339
338
325
326
314
Lion's Den Harbour
327
Kneeland Bay
313
Ney Harbour
Watts Bay
Jackman Sound
Potter Island
Bay of Two Rivers
237
337
401
336
93
311 & 402
312
312A - Ogac Lake
312B
403
335
419
310
"Two-fathom" Anchorage
Hidden Bay
68°W
63°N
5 0 10 20 30
SCALE NAUTICAL MILES



CUMBERLAND SOUND
Pangnirtung
412
Kekerten? Harbour
413
414
415
416
417
Clearwater Fjord
Nijadluk Harbour
411
410
409
408
Neptune Bay
407
Ptarmigan Fjord
418
66°N.
67°W.
65°W.
65°N.
5 0 10 20 30
Nautical Miles

Polychaetous Annelids of Ungava Bay, Hudson Strait, Frobisher Bay and Cumberland Sound[1]

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Eastern Arctic Investigations, Fisheries Research Board

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ABSTRACT

A collection of 74 species of polychaetous annelids, the greater part of which was obtained by the *Calanus* expeditions of 1947–1952 in Ungava Bay, Hudson Strait, Frobisher Bay and Cumberland Sound, is described. Twelve species are new records for the Canadian eastern arctic, and 2 are new for North America. The zoogeographical relationships of the known Canadian eastern arctic polychaete fauna are discussed.

INTRODUCTION

This paper deals principally with the polychaetes collected by the *Calanus* expeditions from 1947 to 1952, in Ungava Bay, Hudson Strait, Frobisher Bay and Cumberland Sound, in the Canadian eastern arctic. The material has been supplemented by a collection made during the summer of 1953 in Frobisher Bay, Cumberland Sound, Padloping Island and intermediate waters, made available to the author by the collector, D. V. Ellis. Also a list of 9 species, collected in Hudson Strait and Cumberland Sound and at Somerset Island, and identified by E. and C. Berkeley, has been provided by them for inclusion here.

The material includes some 1,800 specimens of polychaetes of 74 species, representing 27 families. None of the species is new, but 12 species are new records for the Canadian eastern arctic, and 2 species apparently have not been recorded formerly from North America. The specimens were collected chiefly by dredging, trawling and intertidal collecting, and additional forms were acquired from the stomachs of fishes and seals. The depth range of the collections is from the intertidal area to 274 metres.

During recent years reviews of the known polychaete faunas of various northern regions have appeared, including West Greenland (Wesenberg-Lund, 1950) and Alaska (Hartman, 1948), areas immediately adjacent to the Canadian north. The polychaetes of southeastern Canadian waters have been treated (Treadwell, 1948), but the records here are incomplete for the region north of the Strait of Belle Isle. For the great region extending from southern Labrador west to Alaska, however, no compilation of polychaete records has been published. Examination of the literature shows that at least 139 species of polychaetes are now known from this area, and that at least 134 of these species are recorded from the eastern part of the area, from Labrador west to and including Hudson Bay.

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In the following systematic account of the species, the collections are described giving station numbers and the numbers of specimens taken at each. For locations and depths of the *Calanus* stations reference may be made to the two station lists of the *Calanus* expeditions (Dunbar and Grainger, 1952; Grainger, 1954). The station list of the Ellis collections is given in Table I. The Berkeley

TABLE I. Station list of the Ellis collections.

Station	Date	Depth	Location
Frobisher Bay			
A6	19–21/6/53	intertidal	Becher Peninsula, 63° 24′ N., 67° 49′ W.
A6 dredge	"	not more than 4 m.	as above
A7	22/6/53	intertidal	island west of Culbertson Island, 63° 23′ N., 67° 59′ W.
A8	26/6–1/7/53	intertidal	Becher Peninsula, 63° 27′ N., 67° 51′ W.
A8h	"	not more than 4 m.	as above
A9	1–4/7/53	intertidal	Becher Peninsula, 63° 33′ N., 67° 59′ W.
A9f	"	not more than 4 m.	as above
A12	4/7/53	intertidal	inlet west of Burton Bay, 63° 38′ N., 68° 17′ W.
A12c	"	not more than 4 m.	as above
A14	6–24/7/53	intertidal	Koojesse Inlet, 63° 40′ N., 68° 28′ W.
A15	13/7/53	intertidal	Jordan River, 63° 46′ N., 68° 59′ W.
A17	25/7/53	intertidal	Chase Island, 63° 05′ N., 66° 55′ W.
A20	26/7/53	intertidal	bay east of Cape Carter, Loksland, 62° 25′ N., 64° 54′ W.
A20a	"	floating *Laminaria*	as above
A23	27/7/53	intertidal	near Cape Chapel, Loksland, 62° 25′ N., 64° 56′ W.
Between Frobisher Bay and Cumberland Sound			
A26	28/7/53	floating *Laminaria*	west of Cape Farrington, 62° 51′ N., 64° 49′ W.
A26b	"	intertidal	as above
A27	29/7–2/8/53	intertidal	Siniyah Harbour, 62° 54′ N., 64° 40′ W.
Cumberland Sound			
A32	4–13/8/53	intertidal	Pangnirtung, 66° 09′ N., 65° 45′ W.
A43	11/8/53	intertidal	mouth of Pangnirtung Fjord, 66° 04′ N., 65° 56′ W.
Davis Strait			
A44	14–26/8/53	intertidal	Padloping Island, 67° 03′ N., 62° 44′ W.
A44c	"	not more than 4 m.	as above

material, including 9 species collected by H. M. Rogers on the Eastern Arctic Patrol of 1937, at Fort Ross (Somerset Island), Lake Harbour (Hudson Strait) and Pangnirtung (Cumberland Sound), published for the first time here, is referred to under Canadian arctic distribution. In the distributional records of the species recorded by Berkeley and Berkeley (1943) additional data, provided by the Berkeleys and not included in the original publication, are given here.

Distribution records under "Canadian arctic" refer to the region from southern Labrador to Alaska. In distributional accounts under "further distribution", the terms "arctic", "subarctic" and "boreal" are used as defined by Dunbar (1953).

The following species apparently are recorded here for the first time from North American waters: *Autolytus prolifer* (Müller) and *Lysilla lovéni* Malmgren.

The following species are new records for the eastern Canadian arctic: *Eulalia bilineata* Johnston, *Eteone flava* (Fabricius), *Tomopteris planktonis* Apstein, *Autolyus prolifer* (Miller), *Autolytus verrilli* Marenzeller, *Haploscoloplos elongata* (Johnson) (identified by the Berkeleys), *Lysippe labiata* Malmgren, *Amphitrite groenlandica* Malmgren, *Amphitrite affinis* Malmgren, *Laphania boecki* Malmgren, *Lysilla lovéni* Malmgren and *Potamilla neglecta* (Sars).

POLYNOIDAE

Gattyana cirrosa (Pallas)

Fauvel, 1923, p. 49, fig. 17.

CANADIAN ARCTIC: Sabine (1824), Melville Island (*Polynoe scabra*); McIntosh (1879), Ellesmere Island (*Nychia cirrosa*); Ditlevsen (1909), Ellesmere Island; Moore (1909), Labrador; Chamberlin (1920), Bernard Harbour, Dolphin and Union Strait (*G. cirrhosa*); Treadwell (1937), Foxe Basin, Melville Peninsula, Cobourg Island; Berkeley and Berkeley (1943), Wakeham Bay.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 102 (1), 203 (2), Ogac Lake (7).

Gattyana amondseni (Malmgren)

Malmgren, 1867, p. 5, pl. I, fig. 4.

CANADIAN ARCTIC: Moore (1909), Labrador.

FURTHER DISTRIBUTION: Chiefly in subarctic and more southern areas of the Atlantic, but recorded as far west as Alaska (Hartman, 1948).

COLLECTION: 416 (1). This single specimen, a mud-encrusted individual about 28 mm. long, was taken from a depth of 274 m. in relatively warm Clearwater Fjord, Cumberland Sound.

Eunoe nodosa (Sars)

Fauvel, 1923, p. 51, fig. 18.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island (*E. oerstedi*); Ditlevsen (1909), Ellesmere Island (*Harmothoe nodosa*); Ditlevsen (1937), Jones Sound (*Harmothoe nodosa*); Treadwell (1937), northern Labrador, Foxe Basin, Melville Peninsula, Cobourg Island; Berkeley and Berkeley (1943), Hudson Bay.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern regions.

COLLECTIONS: 33 (1), 45 (1, from the stomach of *Gadus callarias*), 102 (2), 103 (1), 106 (1), 126 (2), 201C (3), 208 (3), 210 (1), 226 (1), 231 (6), 319 (2), 322 (1), 333 (1).

Harmothoe imbricata (L.)

Fauvel, 1923, p. 55, fig. 18.

CANADIAN ARCTIC: Sabine (1824), Melville Island (*Polynoe cirrata*); Packard (1863), Labrador (*Lepidonotus cirrata*); Packard (1867), Labrador; McIntosh (1879), Ellesmere Island; Verrill (1879), Cumberland Sound; Whiteaves (1885), Burwell; Fewkes (1888), Ellesmere Island; Ditlevsen (1909), Devon Island, Ellesmere Island; Moore (1909), Labrador; Chamberlin (1920), Burwell, Hudson Bay, Bernard Harbour, Dolphin and Union Strait;

Treadwell (1937), Labrador, Foxe Channel, Foxe Basin, Melville Peninsula, Cobourg Island; Berkeley and Berkeley (1943), Wakeham Bay, Hudson Bay; Berkeley and Berkeley (1944), Bernard Harbour, Dolphin and Union Strait, Coronation Gulf; the Berkeleys (pers. comm.), Lake Harbour.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern regions.

COLLECTIONS: 1A (1), 12 (1), 33 (1), 40 (19), 51 (4), 58 (5), 64 (18), 102 (1), 203 (8), 210 (2), 226 (2), 234 (1), 310 (4), 317 (2), 318 (1), 319 (5), 402 (21), 404 (2), 406 (2), 412 (2), A6 dredge (2), A6 (2), A7 (2), A8 (10), A9 (6), A9f (1), A12c (2), A15 (2), A17 (2), A20 (4), A20a (1), A23 (8), A26 (9), A26b (3), A44c (12).

Lagisca rarispina (Sars)

Fauvel, 1923, p. 76, fig. 28 (*L. extenuata*).

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island (*Harmothoe rarispina*); Ditlevsen (1909), Ellesmere Island (*Harmothoe rarispina*); Chamberlin (1920), Burwell; Ditlevsen (1937), Exeter Sound (*Harmothoe rarispina*); Berkeley and Berkeley (1943), Hudson Bay; Vibe (1950), Ellesmere Island (*L. extenuata*).

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 13 (1); 18 (11), 20 and 21 (1), 30 (3), 58 (3), 69 (1), 102 (2), 103 (9), 106 (1), 107 (1), 203 (1), 206 (1), 208 (5), 210 (7), 225 (1), 226 (13), 231 (2), 319 (2), 322 (3), 331 (2), 333 (1), 402 (1), 404 (1), 406 (3), 418 (2), Ogac Lake (2), A7 (3).

SIGALIONIDAE

Pholoe minuta (Fabricius)

Fauvel, 1923, p. 120, fig. 44.

CANADIAN ARCTIC: Packard (1867), Labrador; Ditlevsen (1909), Ellesmere Island; Chamberlin (1920), Bernard Harbour.

FURTHER DISTRIBUTION: Possibly circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 102 (1), 217 (2), Ogac Lake (18).

PHYLLODOCIDAE

Phyllodoce groenlandica Oersted

Fauvel, 1923, p. 153, fig. 54.

CANADIAN ARCTIC: Packard (1867), Labrador; McIntosh (1879), Ellesmere Island; Verrill (1879), Cumberland Sound; Chamberlin (1920), Bernard Harbour, Melville Island (*Anaitides groenlandica*); Treadwell (1937), Fury and Hecla Strait; Berkeley and Berkeley (1943), Wakeham Bay, Hudson Strait, Hudson Bay.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern regions.

COLLECTIONS: 11 (1), Burwell (3, from stomachs of *Gadus callarias*), 102 (4), 107 (1), 203 (1), 229 (1), A9 (1), A12 (1).

Eulalia bilineata Johnston

Fauvel, 1923, p. 162, fig. 58.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: New England (Hartman, 1942), western Canada (Berkeley and Berkeley, 1948), Jan Mayen, Spitzbergen and northern Europe (Wesenberg-Lund, 1953), North Sea to the Mediterranean (Fauvel, 1923).

COLLECTION: 103 (1).

Eteone longa (Fabricius)

Fauvel, 1923, p. 172, fig. 62.

CANADIAN ARCTIC: Packard (1867), Labrador (*E. cylindrica*); Ditlevsen (1909), Ellesmere Island (*E. cylindrica*); Chamberlin (1920), Bernard Harbour; Berkeley and Berkeley (1943), Burwell, Wakeham Bay; the Berkeleys (pers. comm.), Cumberland Sound.

FURTHER DISTRIBUTION: Probably circumpolar, predominantly in arctic and subarctic areas, also in more southern regions.

COLLECTIONS: 1 (1), 38 (2), 44 (1), 51 (2), 101 (2), Burwell (2, from stomachs of *Gadus callarias*), 107 (1), 216 (3), 222 (1), 229 (1), 310 (1), 319 (1), 402 (1), 413 (3), A8h (2), A8 (6), A9 (2), A12 (4), A14 (4), A20 (5).

Eteone flava (Fabricius)

Fauvel, 1923, p. 173, fig. 62.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: Possibly circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: A8 (2), A9 (1), A26 (1).

TOMOPTERIDAE

Tomopteris planktonis Apstein

Apstein, 1900, p. 42, pl. XI, figs. 22–23.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: This species is distributed widely in the middle part of the North Atlantic, most frequently over great depths (Wesenberg-Lund, 1950), also in the South Atlantic and Indian Oceans (Fauvel, 1923). It was taken off southeastern Canada at the outer stations of the Canadian Fisheries Expedition of 1914–15 (Huntsman, 1921). The most northern collection originated in Qarajags Isfjord, 70° N., West Greenland, where one specimen only was taken (Wesenberg-Lund, 1950).

COLLECTION: 103 (2).

With the exception of the length of the second cirri, which are about two thirds the length of the body in these specimens, excellent agreement exists between them and Apstein's (1900) description. The presence of these specimens in the northeastern corner of Ungava Bay points to an Atlantic influence in this area.

HESIONIDAE

Castalia aphroditoides (Fabricius)

McIntosh, 1908, p. 125, pl. LVIII, fig. 18 (*C. arctica*).

CANADIAN ARCTIC: Ditlevsen (1909), Ellesmere Island, Devon Island (*C. fabricii*); Ditlevsen (1937), Ellesmere Island (*C. fabricii*); Berkeley and Berkeley (1943), Wakeham Bay (*C. fabricii*). Chamberlin (1920) recorded *Psammate aphroditoides* (= *C. aphroditoides*) from Bernard Harbour and Alaska, stating, however, that it was not the same as McIntosh's (1908) *C. arctica*, which according to Chamberlin was not a synonym of *C. aphroditoides* at all but referable to another species. Wesenberg-Lund (1953), however, synonymizes the *C. arctica* of McIntosh with *C. aphroditoides* of East and West Greenland.

FURTHER DISTRIBUTION: This species is found chiefly to the north of the Atlantic area, possibly as far west as the Bering Sea, and appears to be limited principally to the arctic and subarctic regions.

COLLECTIONS: Ogac Lake (5), 402 (3), A6 dredge (1), A9 (1), A26 (1).

Syllidae

Syllis cornuta Rathke

Wesenberg-Lund, 1947, p. 6, fig. 1.

Canadian arctic: Fewkes (1888), Ellesmere Island (*Chaetosyllis oerstedi*); Ditlevsen (1909), Ellesmere Island (*S. fabricii*).

Further distribution: Possibly circumpolar, in arctic, subarctic and more southern waters.

Collection: 3 (1, planktonic).

Syllis fasciata Malmgren

Malmgren, 1867, p. 43, pl. VII, fig. 47, pl. VIII, fig. 52.

Canadian arctic: Ditlevsen (1909), Ellesmere Island.

Further distribution: Possibly circumpolar, predominantly arctic and subarctic.

Collections: 317 (1), 319 (3), 322 (1), 334 (1), 406 (1). These specimens, all atokous, were collected only in Frobisher Bay.

Eusyllis blomstrandi Malmgren

Wesenberg-Lund, 1947, p. 11, fig. 3.

Canadian arctic: Ditlevsen (1909), Ellesmere Island (*S. monilicornis*).

Further distribution: An arctic, subarctic and more southern form, this species is recorded from eastern Spitzbergen (Augener, 1928), Franz-Joseph Land (Annenkova, 1932), Novaya Zemlya, Kara Sea, Iceland, West Greenland, Scandinavia and south to the Mediterranean (Wesenberg-Lund, 1953), in the Pacific area from British Columbia (Berkeley and Berkeley, 1948) and from New England.

Collection: 226 (15). These specimens, all atokous, were taken only at the Button Islands, at the eastern end of Hudson Strait.

Autolytus prolifer (O. F. Müller)

Wesenberg-Lund, 1947, p. 19, figs. 8–9.

Canadian arctic: No previous record.

Further distribution: This is predominantly a subarctic and more southern species, recorded from West and East Greenland, Spitzbergen, Kara Sea, Scandinavia, Denmark and farther south in the Atlantic (Wesenberg-Lund, 1953), and from Franz-Joseph Land (Augener, 1913). There is apparently no record of this species from North America or from the Pacific area.

Collections: 1 (2, planktonic), 58 (1), 101 (3, planktonic), 103 (2, planktonic), 226 (2), 231 (1, planktonic).

Of these 11 specimens, 3 were atokous, 4 sacconereis and 4 polybostrichus forms. All but 2 of the atokous individuals were collected in Ungava Bay; the other 2 were taken at the Button Islands, at the eastern end of Hudson Strait.

The largest atokous specimen, 10 mm. long, had formed a bud on the stalk. This occurred on the fourteenth chaetiger, as was found by Augener (1928, p. 724) at Spitzbergen. A similar condition was found in one of the other atokous forms, an individual 9 mm. long.

In all the pelagic forms there were anteriorly 3 unmodified segments. Of these 8 specimens, 7 were collected between June 24 and July 20; one was taken on August 27. None of the 4 females bore eggs.

Autolytus prismaticus (Fabricius)

Wesenberg-Lund, 1947, p. 24, figs. 10–12.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island (*A. longisetosus*); Moore (1909), Labrador (*A. longisetosus*); Chamberlin (1920), Dolphin and Union Strait; Treadwell (1937), Foxe Basin (*Polybostrichus longosetosus*).

FURTHER DISTRIBUTION: From its known distribution this is apparently predominantly a subarctic species, recorded from West Greenland, East Greenland (southern part), Spitzbergen (common in the west, sparse in the east) and northwestern Iceland (Wesenberg-Lund, 1953), in the North Pacific, south to British Columbia (Berkeley and Berkeley, 1948) and on the American east coast, south to New England (Treadwell, 1948).

COLLECTIONS (all planktonic): 1 (9), 3 (14), 7 (29), 9 (54), 13 (10), 18 (2), 37 (3), 38 (1), 51 (2), 57 (1), 60 (38), 101 (13), 103 (20), 129 (1), 229 (1), 301 (3), 335 (1).

Of 202 specimens of this species, 201 were collected in Ungava Bay, and only one was taken elsewhere, in Jackman Sound, southern Frobisher Bay.

Both polybostrichus and sacconereis forms were collected, and in all there were 6 unmodified segments anteriorly. In at least some of the males, ramified dorsal cirri, similar to those shown by Wesenberg-Lund (1947, p. 30) were present, on the anterior segments of the modified portion.

In the 3 seasons during which most of the specimens were obtained, 1947, 1948 and 1949, almost all were collected before early August. In 1947, 118 individuals were taken between June 24 and the end of July, and only 6 were collected in August. In 1948, all 39 specimens were secured before August 2. In 1949, 33 individuals were taken between June 26 and July 6, and only one more was obtained on August 25.

In 1947, the first females were collected on June 24, were 2–3 mm. long, and did not appear to be carrying eggs. During early July of the same year the females were 4–5 mm. long, the bodies were curved, and within the arch, on the ventral surface, eggs were present. Individuals taken in late July and August were 7–10 mm. long, with the bodies curved and eggs carried ventrally. The maximum production of sacconereis and polybostrichus stages of this species would appear to occur during early July in Ungava Bay, and to be followed by a gradual diminishing of numbers in late July and August.

Autolytus verrilli Marenzeller

Wesenberg-Lund, 1947, p. 33, figs. 14–15.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: Principally an arctic and subarctic species, it occurs in West Greenland (Wesenberg-Lund, 1950), Iceland and Spitzbergen (Wesenberg-Lund, 1953, *A. alexandri*), Franz-Joseph Land (Annenkova, 1932), Bering Sea (Chamberlin, 1920, *A. alexandri*) and New England (Verrill, 1881, *A. alexandri*). Wesenberg-Lund (1950) refers to this species as being one of the most northerly distributed of the polychaetes.

COLLECTIONS (all planktonic): 1 (3), 7 (1), 9 (8), 60 (1), 101 (4), 103 (5), 201C (3), 301 (2), 335 (2).

The 29 specimens of this species included 22 sacconereis and 7 polybostrichus forms. Most of the females bore eggs on their incurved ventral surfaces. All but one of the specimens were collected in Ungava Bay, the other individual having been taken in Jackman Sound, southern Frobisher Bay. Thus the distributions of this species and of *A. prismaticus* appear to be almost identical in the *Calanus* region. Also the collection dates of this species are similar to those of *A. prismaticus*, all of the 27 Ungava Bay specimens having been taken between June 24 and August 2. It appears that the planktonic stages of *A. verrilli* too are most abundant in Ungava Bay in early July.

Nereidae

Nereis pelagica L.

Fauvel, 1923, p. 336, fig. 130.

Canadian arctic: Packard (1863), Labrador (*Heteronereis arctica*); Packard (1867), Labrador; Verrill (1879), Cumberland Sound; Chamberlin (1920), Burwell, King George's Sound, Bernard Harbour; Treadwell (1937), Labrador, Southampton Island, Foxe Basin, Melville Peninsula; Berkeley and Berkeley (1943), Diana Bay, Wakeham Bay, Sugluk; the Berkeleys (pers. comm.), Somerset Island.

Further distribution: Cosmopolitan.

Collections: 18 (4), 25 (1), 27 (1), 28 (3), 30 (3), 33 (4), 58 (8), 64 (1, epitokous), 103 (4, including 1 epitokous), 107 (7), 123 (1, epitokous), 124 (26, epitokous), 126 (2), 203 (4), 208 (3), 210 (5), 217 (1, epitokous), 225 (2), 226 (60), 317 (7), 406 (6), 413 (1), 418 (1).

In addition to these, 145 atokous specimens were taken from the Atlantic cod (*Gadus callarias*) at Burwell, and 2 epitokous forms were collected in the same way.

In all, 32 epitokous forms were collected, between July 4 and August 20. On August 20, 1949, 26 epitokous specimens were taken in a single surface plankton tow at station 124. Notable among the epitokous forms were 2 specimens taken from the cod. Both showed, in place of the usual paired prostomial tentacles, a single tentacle, tapering to a point from a wide base. In all other respects both of these individuals agreed well with descriptions of this species, so are considered as abnormal forms of *Nereis pelagica*. A similar condition was reported in the Californian species *Nereis neonigripes* by Hartman (1936, p. 471, fig. 48f).

Nereis zonata Malmgren

Fauvel, 1923, p. 338, fig. 130.

Canadian arctic: McIntosh (1879), Ellesmere Island; Ditlevsen (1937), Jones Sound; Berkeley and Berkeley (1943), Hudson Bay.

Further distribution: Widely spread in arctic, subarctic and more southern waters, this species is probably circumpolar. In the eastern Atlantic area it is found south to the Mediterranean, but along the North American coasts it has not been recorded south of the *Calanus* region in the east, or south of Alaska in the West. While it is considerably more common than *Nereis pelagica* in West Greenland, it appears to be much less abundant in northern Canada.

Collection: Ogac Lake (3).

Nephthydidae

Nephthys ciliata O. F. Müller

Fauvel, 1923, p. 371, fig. 145.

Canadian arctic: Sabine (1824), North Georgian Islands (*Nais ciliata*); Ditlevsen (1909), Ellesmere Island; Chamberlin (1920), Dolphin and Union Strait; Ditlevsen (1937), Jones Sound; Treadwell (1937), Melville Peninsula; Berkeley and Berkeley (1943), Hudson Bay.

Further distribution: Probably circumpolar, in arctic, subarctic and more southern regions.

Collections: 20 and 21 (2), 33 (11), Burwell (1, from stomach of *Gadus callarias*), 102 (10), 107 (6), 201C (12), 222 (2), 231 (69), 416 (4).

Nephthys ?longosetosa Oersted

Fauvel, 1923, p. 367, fig. 143.

Canadian arctic: Packard (1867), Labrador (*N. longisetosa*), Berkeley and Berkeley (1943), Hudson Bay.

Further distribution: This species is recorded from West and East Greenland, Iceland and the Faroes (Wesenberg-Lund, 1953), northern Russia (Zatsepin, 1948), south in the Atlantic to the English Channel (Wesenberg-Lund, 1950), and to New England (Treadwell, 1948), and south to Panama along the western American coast (Berkeley and Berkeley, 1948).

Collection: 231 (1). This single specimen was incomplete and could not be identified with certainty.

Sphaerodoridae

Ephesia gracilis Rathke

Fauvel, 1923, p. 377, fig. 148.

Canadian arctic: Ditlevsen (1909), Ellesmere Island; Berkeley and Berkeley (1944), Dease Strait.

Further distribution: Possibly circumpolar, found chiefly in arctic and subarctic waters and as far south as the Mediterranean.

Collections: 18 (1), 102 (1), 319 (1).

Glyceridae

Glycera capitata Oersted

Fauvel, 1923, p. 385, fig. 151.

Canadian arctic: Ditlevsen (1909), Ellesmere Island; Ditlevsen (1937), Jones Sound.

Further distribution: Cosmopolitan.

Collections: 103 (1), Ogac Lake (1).

Onuphidae

Onuphis conchylega M. Sars

Fauvel, 1923, p. 415, fig. 164.

Canadian arctic: Packard (1867), Labrador (*O. eschrichtii*); Ditlevsen (1909), Ellesmere Island; Moore (1909), Labrador (*Nothria conchylega*); Chamberlin (1920), Dolphin and Union Strait; Ditlevsen (1937), Exeter Sound, Jones Sound; Treadwell (1937), Jones Sound; Berkeley and Berkeley (1944), Dease Strait.

Further distribution: Probably circumpolar, in arctic, subarctic and more southern regions.

Collections: 107 (2), 126 (1), 226 (1).

Lumbrinereidae

Lumbrinereis fragilis (O. F. Müller)

Fauvel, 1923, p. 430, fig. 171.

Canadian arctic: McIntosh (1879), Ellesmere Island (*Lumbriconereis fragilis*); Ditlevsen (1909), Ellesmere Island; Moore (1909), Labrador; Chamberlin (1920), Hudson Bay; Ditlevsen (1937), Jones Sound (*Lumbriconereis fragilis*); Treadwell (1937), Labrador (*Lumbriconereis fragilis*); Berkeley and Berkeley (1943), Wakeham Bay, Hudson Bay.

Further distribution: Probably circumpolar, in arctic, subarctic and more southern waters.

Collections: 40 (1), 102 (30), 107 (1), 201C (2), 212 (2), 222 (3), 231 (16), 416 (1).

Ariciidae

Scoloplos armiger (O. F. Müller)

Fauvel, 1927, p. 20, fig. 16.

Canadian arctic: Ditlevsen (1909), Ellesmere Island (*Aricia armiger*); Moore (1909), Labrador.

Further distribution: Cosmopolitan.

Collections: 51 (1), 102 (3), 107 (1), 216 (2), 310 (3), 413 (1), 416 (1), A6 (1), A8 (3), A9 (2), A12 (7), A20 (18).

Haploscoloplos elongata (Johnson)

Johnson, 1901, p. 412, pl. X, figs. 105–110.

Canadian arctic: the Berkeleys (pers. comm.), Cumberland Sound.

Further distribution: This is a Pacific species, recorded from Alaska to California (Berkeley and Berkeley, 1952). Taken neither by the *Calanus* nor by Ellis, this species was collected at Pangnirtung in 1937 and was identified by the Berkeleys.

Spionidae

Spio filicornis (O. F. Müller)

Fauvel, 1927, p. 43, fig. 15.

Canadian arctic: Berkeley and Berkeley (1943), Diana Bay, Wakeham Bay, Nottingham Island.

Further distribution: Circumpolar, in arctic, subarctic and more southern waters.

Collections: 31 (19), A8 (1), A27 (1).

Polydora caeca (Oersted)

Fauvel, 1927, p. 52, fig. 18.

Canadian arctic: Berkeley and Berkeley (1943), Wakeham Bay.

Further distribution: Predominantly a boreal and more southern species, it is recorded from only a few locations farther north, West Greenland, East Greenland, Jan Mayen, Spitzbergen (Wesenberg-Lund, 1953) and northern Russia (Zatsepin, 1948).

Collections: A14 (1). Also a single specimen was taken by the *Calanus*, but the label was lost. However, as it was taken in 1952, it was collected either in Frobisher Bay or Cumberland Sound.

Cirratulidae

Chaetozone setosa Malmgren

Fauvel, 1927, p. 101, fig. 35.

Canadian arctic: Ditlevsen (1909), Ellesmere Island; Moore (1909), Labrador.

Further distribution: Probably circumpolar, in arctic, subarctic and more southern regions.

Collections: 13 (1), 20 and 21 (2), 94 (1), 102 (3), 234 (1), 319 (1), 416 (7).

Cirratulus cirratus (O. F. Müller)

Fauvel, 1927, p. 94, fig. 33.

CANADIAN ARCTIC: Packard (1867), Labrador; Ditlevsen (1909), Devon Island, Ellesmere Island; Moore (1909), Labrador; Chamberlin (1920), Bernard Harbour; Ditlevsen (1937), Jones Sound; Berkeley and Berkeley (1943), Burwell, Wakeham Bay.

FURTHER DISTRIBUTION: Cosmopolitan.

COLLECTIONS: 322 (1), 402 (2), A26b (1).

CHLORAEMIDAE

Flabelligera affinis M. Sars

Fauvel, 1927, p. 113, fig. 40.

CANADIAN ARCTIC: Ditlevsen (1909), Ellesmere Island; Moore (1909), Labrador; Chamberlin (1920), Bernard Harbour, Dolphin and Union Strait; Berkeley and Berkeley (1943), Nottingham Island, Hudson Bay; the Berkeleys (pers. comm.), Lake Harbour.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 203 (1), 322 (1), A44c (1).

Stylarioides plumosa (O. F. Müller)

Fauvel, 1927, p. 116, fig. 41.

CANADIAN ARCTIC: Packard (1863; 1867), Labrador (*Siphonostomum plumosum*); Ditlevsen (1909), Ellesmere Island (*Trophonia plumosa*); Ditlevsen (1937), Exeter Sound, Jones Sound.

FURTHER DISTRIBUTION: Probably circumpolar, in arctic, subarctic and more southern regions.

COLLECTIONS: 44 (2, from stomachs of *Gadus callarias*); 102 (1), 107 (1), 224 (1, from stomach of *Gadus callarias*), 406 (1).

Brada inhabilis (Rathke)

Malmgren, 1867, p. 85, pl. XII, fig. 71 (*B. granulata*).

CANADIAN ARCTIC: Moore (1909), Labrador (*B. granulata*); Ditlevsen (1937), Exeter Sound, Jones Sound (*B. granulata*).

FURTHER DISTRIBUTION: Probably circumpolar, in arctic, subarctic and more southern waters.

COLLECTION: A26b (1).

SCALIBREGMIDAE

Scalibregma inflatum Rathke

Fauvel, 1927, p. 123, fig. 44.

CANADIAN ARCTIC: Ditlevsen (1937), Exeter Sound.

FURTHER DISTRIBUTION: Cosmopolitan.

COLLECTIONS: 40 (1), 101 (2), 102 (2), 216 (4), 412 (1), A8 (1), A12 (4), A26 (2).

Eumenia crassa Oersted

Fauvel, 1927, p. 127, fig. 45.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island.

FURTHER DISTRIBUTION: A predominantly boreal species of the Atlantic, it extends into the subarctic and arctic north of the Atlantic.

COLLECTIONS: 203 (1), A12 (1).

OPHELIIDAE

Travisia forbesii Johnston

Fauvel, 1927, p. 138, fig. 48.

CANADIAN ARCTIC: Chamberlin (1920), Bathurst Inlet; the Berkeleys (pers. comm.), Lake Harbour.

FURTHER DISTRIBUTION: Probably circumpolar, in arctic, subarctic and more southern regions.

COLLECTION: 40 (1).

Ophelia limacina (Rathke)

Tebble, 1952, p. 561.

CANADIAN ARCTIC: Treadwell (1937), Cobourg Island; Berkeley and Berkeley (1943), Wakeham Bay, Hudson Bay; the Berkeleys (pers. comm.), Cumberland Sound, ?Lake Harbour.

FURTHER DISTRIBUTION: Possible circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 210 (2), 217 (2), 417 (1), A43 (2).

Tebble (1952) re-established *Ophelia borealis* Quatrefages and *O. rathkei* McIntosh, 2 species formerly considered by many as being synonyms of *O. limacina* (Rathke). In view of this work it becomes necessary to re-examine specimens recorded as *O. limacina* before the distribution of this species can be made clear.

Ammotrypane aulogaster Rathke

Fauvel, 1927, p. 133, fig. 47.

CANADIAN ARCTIC: Fewkes (1888) and Ditlevsen (1909), Ellesmere Island.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 20 and 21 (1), 107 (1), 216 (8).

CAPITELLIDAE

Capitella capitata (Fabricius)

Fauvel, 1927, p. 154, fig. 55.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island; Chamberlin (1920), Bernard Harbour; Berkeley and Berkeley (1943), Diana Bay, Wakeham Bay, Nottingham Island, Hudson Bay.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 94 (1), 229 (1), 412 (3), 418 (1), A6 (4), A8 (3), A8h (1), A9 (6), A12 (2), A15 (1), A17 (1), A20 (5).

ARENICOLIDAE

Arenicola marina (L.)

Ashworth, 1910, p. 5, fig. 1.

CANADIAN ARCTIC: Packard (1867), Labrador; Berkeley and Berkeley (1943), Hudson Bay. This species was reported by Chamberlin (1920) from Bernard Harbour, but the specimens later were shown by Ashworth (1924) to be *A. glacialis* Murdoch.

FURTHER DISTRIBUTION: Mainly of boreal and more southern distribution, it extends north of the Atlantic to West and East Greenland, Spitzbergen and northern Russia.

COLLECTIONS: 64 (3), 412 (1), A32 (several fragments, not definitely identified).

MALDANIDAE

Nichomache lumbricalis (Fabricius)

Ardwidsson, 1906, p. 86, pl. VIII, figs. 244–245.

CANADIAN ARCTIC: Packard (1867), Labrador.

FURTHER DISTRIBUTION: Possibly circumpolar, predominantly arctic and subarctic.

COLLECTION: 222 (3).

Axiothella catenata (Malmgren)

Malmgren, 1867, p. 99, pl. X, fig. 59 (*Axiothea catenata*).

CANADIAN ARCTIC: Chamberlin (1920), Burwell (*Paraxiothea catenata*); Berkeley and Berkeley (1943), Nottingham Island.

FURTHER DISTRIBUTION: Probably circumpolar, chiefly in subarctic waters.

COLLECTION: 216 (1).

Maldane sarsi Malmgren

Arwidsson, 1906, p. 251, pl. VI, figs. 192–199.

CANADIAN ARCTIC: Moore (1909), Labrador; Berkeley and Berkeley (1943), Burwell.

FURTHER DISTRIBUTION: Cosmopolitan.

COLLECTIONS: 102 (1), 107 (1), 201C (3), 231 (11), 416 (8).

OWENIIDAE

Owenia fusiformis Delle Chiaje

Fauvel, 1927, p. 203, fig. 71.

CANADIAN ARCTIC: Berkeley and Berkeley (1943), Nottingham Island (*Ammochares fusiformis*). Whiteaves (1885) recorded *Ammochares* sp. from Burwell.

FURTHER DISTRIBUTION: Cosmopolitan.

COLLECTIONS: 107 (2), 231 (3).

AMPHICTENIDAE

Cistenides granulata (L.)

Nilsson, 1928, p. 28, fig. 8 (*Pectinaria granulata*).

CANADIAN ARCTIC: Packard (1863), Labrador (*Pectinaria eschrichtii*); Packard (1867), Labrador; McIntosh (1879), Ellesmere Island; Verrill (1879), Cumberland Sound; Whiteaves (1885), Ashe Inlet (*Pectinaria granulata*); Chamberlin (1920), Hudson Bay, Bernard Harbour, Dolphin and Union Strait; Ditlevsen (1937), Exeter Sound (*Pectinaria granulata*); Treadwell (1937), Melville Peninsula (*Pectinaria granulata*); Berkeley and Berkeley (1943), Hudson Bay; Berkeley and Berkeley (1944), Bernard Harbour; the Berkeleys (pers. comm.), Lake Harbour.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 33 (1), 203 (1), 317 (2), 318 (1), 319 (1), 321 (1), 404 (1), 406 (3), 413 (1), 418 (1), Ogac Lake (7), Ogac Lake (*c.* 200, from stomachs of *Gadus callarias*); Koksoak River mouth (1, from stomach of bearded seal, *Erignathus barbatus*), Whale River (1, from stomach of bearded seal), head of Frobisher Bay (12, from stomach of ringed seal, *Phoca hispida*), A9 (1), A32 (1), A44 (1), A44c (2).

This species seems to be much more abundant in the northern part of the *Calanus* region than in Ungava Bay. Of some 240 specimens taken only 4 originated in Ungava Bay, all the others coming from north of Hudson Strait.

Counts made on the paleae of 11 individuals showed a range of from 7 to 9 on each side. Scaphal setae counts on 10 specimens varied from 8 to 12 per side.

Cistenides hyperborea Malmgren

Malmgren, 1865, p. 360, pl. XVIII, fig. 40.

CANADIAN ARCTIC: Ditlevsen (1909), Ellesmere Island (*Pectinaria hyperborea*); Moore (1909), Labrador (*Pectinaria hyperborea*); Berkeley and Berkeley (1943), Hudson Bay.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 231 (2), 329 (5), 416 (1).

This species is apparently far from being as abundant as *C. granulata* in northern Canadian waters. It appears also to be restricted to deeper water than the former species.

Counts made on 8 individuals showed the number of paleae ranging from 10 to 14 on each side, and the number of scaphal setae varying from 6 to 10 per side.

Ampharetidae

Ampharete grubei Malmgren

Fauvel, 1927, p. 227, fig. 79.

Canadian arctic: Packard (1867), Labrador.

Further distribution: Probably circumpolar, in arctic, subarctic and more southern waters.

Collections: 33 (1), 40 (1), 51 (1), 231 (1), 317 (1), A6 (5), A8 (1), A9 (9), A20 (3).

Ampharete arctica Malmgren

Malmgren, 1865, p. 364, pl. XXVI, fig. 77.

Canadian arctic: Berkeley and Berkeley (1943), Nottingham Island.

Further distribution: Circumpolar, predominantly of subarctic areas.

Collection: 416 (1).

Amphicteis sundevalli Malmgren

Malmgren, 1865, p. 366, pl. XXV, fig. 73.

Canadian arctic: McIntosh (1879), Ellesmere Island.

Further distribution: East and West Greenland, common only at Spitzbergen (Wesenberg-Lund, 1953), northern Russia (Zatsepin, 1948).

Collections: 102 (3), 231 (1).

Pseudosabellides littoralis Berkeley

Berkeley and Berkeley, 1943, p. 131.

Canadian arctic: Berkeley and Berkeley (1943), Burwell, Diana Bay, Wakeham Bay.

Further distribution: This species is known elsewhere only from eastern Vancouver Island (Berkeley and Berkeley, 1952).

Collections: 33 (1), Burwell (1), 203 (1), 310 (1), 402 (2), A20 (1), A26 (3).

This species is recorded here from Ungava Bay, Frobisher Bay and the coast between Frobisher Bay and Cumberland Sound, by 10 individuals. While previous records of the species are all from the intertidal region, specimens were found by the *Calanus* as deep as 30 metres.

Pseudosabellides lineata Berkeley

Berkeley and Berkeley, 1943, p. 131.

Canadian arctic: Berkeley and Berkeley (1943), Burwell, Nottingham Island; Berkeley and Berkeley (1944), Dease Strait.

Further distribution: Elsewhere this species is recorded only from Alaska and from Vancouver Island (Berkeley and Berkeley, 1952).

Collection: 102 (1).

Lysippe labiata Malmgren

Malmgren, 1865, p. 367, pl. XXVI, fig. 78.

Canadian arctic: No previous record.

Further distribution: West and East Greenland, Spitzbergen, Kara Sea, Novaya Zemlya, Iceland, Scandinavia, Denmark (Wesenberg-Lund, 1953), New England (Verrill, 1881, *L. lobata*), Alaska and British Columbia (Berkeley and Berkeley, 1952).

COLLECTIONS: 102 (1), 231 (1).

Melinna cristata (M. Sars)

Fauvel, 1927, p. 237, fig. 83.

CANADIAN ARCTIC: Berkeley and Berkeley (1943), Hudson Bay.

FURTHER DISTRIBUTION: Possibly circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 107 (1), 231 (3).

TEREBELLIDAE

Amphitrite cirrata O. F. Müller

Fauvel, 1927, p. 251, fig. 86.

CANADIAN ARCTIC: Packard (1867), Labrador; Ditlevsen (1909), Ellesmere Island; Chamberlin (1920), Burwell.

FURTHER DISTRIBUTION: Possibly circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 20 and 21 (1), 226 (1), 406 (1), Gyrfalcon Islands (12, from stomach of bearded seal, *Erignathus barbatus*), A12c (2).

Amphitrite groenlandica Malmgren

Fauvel, 1927, p. 250, fig. 86.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: This species is confined largely to arctic and subarctic areas of the Atlantic, and is recorded in North America from New England (Verrill, 1881).

COLLECTION: 201C (1).

Amphitrite affinis Malmgren

Fauvel, 1927, p. 246, fig. 84.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: This species is found in arctic, subarctic and more southern waters. In North America it has been recorded from New England (Verrill, 1881, *A. intermedia*).

COLLECTION: A9 (2).

While these 2 individuals differ in certain respects from published descriptions of *Amphitrite affinis*, they are placed in this species. The larger individual is about 90 mm. long, the smaller, incomplete, slightly shorter. Both have 13 rather than 17 thoracic bristle-bearing segments, and both have only 2 rather than 3 pairs of gills. Posterior to the thirteenth chaetigerous segment the ventral tori of the next 4 segments bear 2 rows of uncini, posterior to which they assume the characteristics of abdominal tori, having only one row of uncini. Thus it appears that in these specimens dorsal chaetae have failed to develop in the 4 posterior thoracic segments, although all other features of this region comply with descriptions given for this species. Only the first 2 pairs of gills are present, and these differ from Fauvel's figure (which is, however, of the third and thus the largest pair) only in having fewer ramifications. Apart from these characters these specimens show excellent agreement with this species, and therefore are referred to as aberrant individuals of *Amphitrite affinis*.

Nicolea zostericola (Oersted)

Fauvel, 1927, p. 261, fig. 90.

Canadian arctic: Ditlevsen (1909), Devon Island, Ellesmere Island; Moore (1909), Labrador; Chamberlin (1920), Bernard Harbour (*N. venustula*); Berkeley and Berkeley (1943), Wakeham Bay, Nottingham Island; Berkeley and Berkeley (1944), Bernard Harbour, Coronation Gulf.

Further distribution: Circumpolar, in arctic, subarctic and more southern waters.

Collections: 18 (1), 58 (1), 319 (1), 331 (1), 333 (1), 418 (1), A26 (1).

Pista maculata (Dalyell)

Fauvel, 1927, p. 263, fig. 91.

Canadian arctic: McIntosh (1879) and Ditlevsen (1909), Ellesmere Island (*Scione lobata*); Ditlevsen (1937), Jones Sound (*Scione lobata*); Berkeley and Berkeley (1943), Hudson Bay.

Further distribution: Circumpolar, principally of arctic and subarctic waters.

Collections: 13 (2), 33 (3), 103 (4), 329 (1).

Pista cristata (Müller)

Fauvel, 1927, p. 266, fig. 93.

Canadian arctic: Ditlevsen (1909), Ellesmere Island.

Further distribution: This species is recorded from neither West nor East Greenland. It occurs in Iceland (Wesenberg-Lund, 1951), Spitzbergen (Augener, 1928), northern Russian seas (Zatsepin, 1948), south Atlantic and Antarctic (Fauvel, 1927), and in North America from Alaska to California (Berkeley and Berkeley, 1952), in the Gulf of St. Lawrence (Treadwell, 1948) and in New England and south to Virginia (Verrill, 1881).

Collection: A12 (2).

In these 2 specimens only one pair of gills was present in each, in one the right, and in the other the left being considerably the larger.

Pista flexuosa (Grube)

Malmgren, 1865, p. 384, pl. XXIV, fig. 68 (*Axionice flexuosa*).

Canadian arctic: McIntosh (1879), Ellesmere Island (*Axione flexuosa*); Ditlevsen (1909), Ellesmere Island (*Axionice flexuosa*); Moore (1909), Labrador (*Axionice flexuosa*).

Further distribution: Circumpolar, predominantly of arctic and subarctic waters.

Collection: 203 (1).

Laphania boecki Malmgren

Fauvel, 1927, p. 269, fig. 94.

Canadian arctic: No previous record.

Further distribution: This species is found in arctic, subarctic and more southern waters. It is not recorded from West Greenland. The only North American record appears to be from the Gulf of St. Lawrence (McIntosh, 1922).

Leaena abranchiata Malmgren

Malmgren, 1865, p. 385, pl. XXIV, fig. 64.

Canadian arctic: Ditlevsen (1909), Ellesmere Island; Moore (1909), Labrador; Berkeley and Berkeley (1943), Wakeham Bay.

Further distribution: Possibly circumpolar, predominantly an arctic and subarctic species.

Collections: A20a (1), A23 (5), A26 (1).

Thelepus cincinnatus (Fabricius)

Fauvel, 1927, p. 271, fig. 95.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island (*T. circinnatus*); Verrill (1879), Cumberland Sound; Whiteaves (1885), Burwell (*T. circinatus*); Ditlevsen (1909), Devon Island, Ellesmere Island (*T. circinnatus*); Moore (1909), Labrador; Chamberlin (1920), King George's Sound; Ditlevsen (1937), Jones Sound; Treadwell (1937), Hudson Strait, Melville Peninsula, Fury and Hecla Strait, Jones Sound.

FURTHER DISTRIBUTION: Cosmopolitan.

COLLECTIONS: 25 (1), 27 (2), 30 (2), 103 (3), 106 (1), 107 (1), 126 (3), 206 (1), 208 (3), 210 (2), 222 (2), 226 (19), 317 (5), 319 (15), 321 (1), 404 (1), 406 (1), 413 (2).

Lysilla lovéni Malmgren

Wesenberg-Lund, 1934, p. 26, figs. 7–8.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: East Greenland, western Norway, Faroes, Shetlands, Finmark (Wesenberg-Lund, 1953), North Sea (Fauvel, 1927). It appears not to have been recorded formerly from North America.

COLLECTIONS: 102 (1), 416 (1).

Terebellides stroemi M. Sars

Fauvel, 1927, p. 291, fig. 100.

CANADIAN ARCTIC: Ditlevsen (1909), Ellesmere Island; Moore (1909), Labrador; Treadwell (1937), Melville Peninsula; Berkeley and Berkeley (1943), Burwell.

FURTHER DISTRIBUTION: Cosmopolitan.

COLLECTIONS: 102 (6), 107 (1), 201C (1), 231 (8), 416 (7).

SABELLIDAE

Sabella fabricii Kröyer

Fauvel, 1927, p. 300, fig. 103.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island (*S. spetzbergensis*); Ditlevsen (1909), Ellesmere Island; Berkeley and Berkeley (1943), Wakeham Bay (*S. crassicornis*).

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 33 (2), 103 (1), 203 (1), 225 (1), 317 (1), A20a (1).

Potamilla neglecta (M. Sars)

Malmgren, 1865, p. 401, pl. XXVII, fig. 84.

CANADIAN ARCTIC: No previous record.

FURTHER DISTRIBUTION: Possibly circumpolar, of predominantly arctic and subarctic distribution.

COLLECTION: 334 (1).

Chone infundibuliformis Kröyer

Fauvel, 1927, p. 334, fig. 116.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island; Ditlevsen (1909), Ellesmere Island; Ditlevsen (1937), Jones Sound; Berkeley and Berkeley (1943), Hudson Bay.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 20 and 21 (1), 28 (1), 102 (2), 203 (1), 208 (1), 334 (1), 406 (1).

Euchone analis (Kröyer)

Malmgren, 1867, p. 114, pl. XIII, fig. 80.

CANADIAN ARCTIC: McIntosh (1879), Ellesmere Island; Chamberlin (1920), Bernard

Harbour; Berkeley and Berkeley (1943), Burwell, Wakeham Bay; Berkeley and Berkeley (pers. comm.), Cumberland Sound.

FURTHER DISTRIBUTION: Circumpolar, mainly of arctic and subarctic regions.

COLLECTIONS: 203 (1), 412 (6), A9 (1), A14 (2), A23 (1).

Fabricia sabella (Ehrenberg)

Fauvel, 1927, p. 325, fig. 113.

CANADIAN ARCTIC: Berkeley and Berkeley (1943), Diana Bay.

FURTHER DISTRIBUTION: It occurs in arctic, subarctic and boreal regions of the Atlantic (Wesenberg-Lund, 1953), in North America south to Vancouver Island (Berkeley and Berkeley, 1952), and to New England (Verrill, 1881, *F. stellaris*).

COLLECTION: 413 (1).

SERPULIDAE

Spirorbis spirillum (L.)

Fauvel, 1927, p. 392, fig. 132.

CANADIAN ARCTIC: Packard (1863; 1867), Labrador; Verrill (1879), Cumberland Sound (*S. lucidus*); Moore (1909), Labrador; Chamberlin (1920), Burwell, Bernard Harbour, Dolphin and Union Strait (*Circeis spirillum*); Treadwell (1937), Southampton Island; Berkeley and Berkeley (1943), Burwell, Wakeham Bay, Diana Bay, Sugluk, Nottingham Island, Hudson Bay.

FURTHER DISTRIBUTION: Circumpolar, in arctic, subarctic and more southern waters.

COLLECTIONS: 217 (12), A7 (3), A8h (2), A9f (7), A17 (1).

This species is almost certainly more abundant than these collections would suggest. Many small serpulids collected in the field, on rocks and plants, were not retained, and many of the tubes were broken or empty.

Spirorbis borealis Daudin

Fauvel, 1927, p. 399, fig. 135.

CANADIAN ARCTIC: Packard (1863), Labrador (*S. nautiloides*); Chamberlin (1920), Dolphin and Union Strait (*S. spirorbis*); Ditlevsen (1937), Exeter Sound (*S. spirorbis*).

FURTHER DISTRIBUTION: Probably circumpolar, in arctic, subarctic and more southern waters.

COLLECTION: 319 (1).

ZOOGEOGRAPHICAL CONSIDERATIONS

The polychaetous annelids are characterized by the extremely widespread distribution of many of the species of the group, and, in fact, they appear to be unique among marine invertebrates in the degree to which this characteristic is shown. Great variability in methods of reproduction and development has been suggested as one factor instrumental in permitting such wide dispersion.

Of the 74 species discussed here, 42 species (56.7%) are circumpolar or probably so. Nine species (12.2%) are referred to as cosmopolitan. Five species (6.8%) are found north of the Atlantic and as far west as Alaska or the Bering Sea, but not in the Pacific. Five species (6.8%) are confined to the region north of the Atlantic. Three species (4.1%) are recorded elsewhere only from the western Canadian arctic, Alaska or the Pacific. Some 49 species (66.2%) occupy an arctic, subarctic and boreal range, at least, and only 15 species (20.3%) are predominantly arctic and subarctic in distribution.

The polychaetes of the eastern Canadian arctic show a close relationship with those of West Greenland, and with the entire arctic-subarctic region north of the Atlantic. Of 134 known eastern arctic species, 98 (73%) are recorded from West Greenland, 93 (69%) from Spitzbergen, 89 (66%) from northern U.S.S.R., and 82 (61%) from East Greenland.

A much less close relationship is shown with Alaska, where 54 eastern arctic species (40%) have been recorded. However, a Pacific faunal element is present which comprises nearly 6% of the eastern arctic species. The following 8 species recorded from the eastern arctic are reported elsewhere only from the Pacific (except *Pseudosabellides lineata* Berkeley, which has been taken also in the western Canadian arctic):

Eunoe depressa Moore, *Evarnella triannulata* (Moore), *Eulalia levicornuta* Moore, *Haploscoloplos elongata* (Johnson), *H. kerguelensis* (McIntosh), *Pseudosabellides littoralis* Berkeley, *P. lineata* Berkeley and *Scionella estevanica* Berkeley.

In the 134 known species of polychaetes of the Canadian eastern arctic, the predominantly arctic-subarctic element ranges from 14 species (23.0% of the 61 known species) in the Ellesmere Island–Jones Sound region to only 5 species (9.1% of the 55 known species) in Labrador and 2 species (8.3% of the 24 known species) in Hudson Bay. The following 21 (15.7%) eastern arctic species are predominantly arctic and subarctic in distribution:

Harmothoe senta (Moore), *H. badia* (Théel), *Melaenis lovéni* Malmgren, *Castalia aphroditoides* (Fabricius), *Paranaitis wahlbergi* Malmgren, *Syllis fasciata* Malmgren, *Autolytus prismaticus* (Fabricius), *A. verrilli* Marenzeller, *Nichomache lumbricalis* Malmgren, *Axiothella catenata* (Malmgren), *Ampharete arctica* Malmgren, *Amphicteis sundevalli* Malmgren, *Lysippe labiata* Malmgren, *Glyphonostomum palescens* (Théel), *Amphitrite groenlandica* Malmgren, *Pista maculata* (Dalyell), *P. flexuosa* (Grube), *Leaena abranchiata* Malmgren, *Potamilla neglecta* (Sars), *Dasychone infarcta* Kröyer and *Euchone analis* (Kröyer).

The following 9 notably southern species are recorded from the Canadian eastern arctic: *Tomopteris planktonis* Apstein (North Atlantic and south), *Syllis hyalina* Grube (North Atlantic, British Columbia and south), *Lumbrinereis hebes* Verrill (New England), *Tharyx acutus* Webster and Benedict (Maine), *Brada granosa* Stimpson (Gulf of St. Lawrence and south), *Stylarioides aspera* (Stimpson) (Bay of Fundy and south), *Praxillella affinis* (Sars) (south Norway and south), *Spirorbis validus* Verrill (Nova Scotia and south, Alaska) and *S. pagenstecheri* Quatrefages (North Sea and south).

Of these 9 species, all but *Brada granosa*, which is recorded from Jones Sound, are reported only from the southern part of the eastern arctic area (Labrador, Ungava Bay and eastern Hudson Strait), and all but *Brada granosa*, *Syllis hyalina* and *Praxillella affinis* are recorded only from Labrador and the northeastern corner of Ungava Bay.

SUMMARY

1. The material consists of some 1,800 specimens representing 74 species of polychaetous annelids, the majority of which were collected by the *Calanus*

expeditions of 1947–1952, in Ungava Bay, Hudson Strait, Frobisher Bay and Cumberland Sound. Additional specimens were obtained from Frobisher Bay, Cumberland Sound, Padloping Island and intermediate waters, and a list of 9 species from Hudson Strait, Cumberland Sound and Somerset Island, identified by E. and C. Berkeley, is included.

2. Two species are new records for North America and 12 species are new for the Canadian eastern arctic, bringing the known polychaete fauna of this region to at least 134 species.

3. It is apparent that the polychaete fauna of the eastern Canadian arctic shows a closer relationship to that of west Greenland and to the entire arctic-subarctic region north of the Atlantic, than to Alaska and the Pacific. However, a Pacific faunal element is present which comprises nearly 6% of the eastern arctic species. The extent of the predominantly arctic-subarctic element in the fauna diminishes generally from north to south, and is found in its lowest concentration in Hudson Bay. Distinctly southern invaders within the fauna are limited almost entirely to the southernmost part of the region, Labrador and northeastern Ungava Bay.

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The Amphipod Crustacea of Ungava Bay, Canadian Eastern Arctic[1,2]

"CALANUS" SERIES NO. 6

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ABSTRACT

One hundred and fourteen species of amphipods are recorded from Ungava Bay, most of them for the first time from that area; 21 are new for North America, 5 new to science. Many of them show variations from the types, the types having been described from European or Greenland material. Such variations are to be expected in the Ungava Bay material since it represents a large extension in the known distribution of most of the species, and especially in groups such as the Gammarid and Caprellid amphipods which have no pelagic larvae.

In two cases (*Westwoodilla megalops* and *Haploops setosa*) pairs of amphipod forms known from Europe as separate species are represented in Ungava Bay by forms which cannot without qualification be referred to either European form, showing characteristics of both, and the two species have therefore been brought into synonymy in each case, since the situation does not warrant the establishment of new species for the Ungava Bay specimens. Since in both cases the European forms were very close together in the first place, each of the two species now exists as three geographic variants; subspecific names have not been given to the variants. Evidence is produced in favour of bringing three species of *Ischyrocerus* (*I. latipes, I. assimilis* and *I. pachtusovi*) together into a similar species complex.

The distribution of the Ungava Bay amphipods is analysed. They can be divided into (1) an Atlantic group, possibly endemic to the Atlantic, (2) a group whose distribution lies within the subarctic marine zone as here defined, (3) a large group which does not appear to extend south of the subarctic on the western side of the Atlantic but which is widely distributed in the boreal on the eastern side, in the North Sea area, (4) a small number of arctic forms which become less abundant in the subarctic, and (5) species probably of Pacific origin which are not known east of Greenland nor west of the Kara Sea.

INTRODUCTION

The *Calanus* expeditions of 1947–50, which provided the material described here, operated mainly in the waters of Ungava Bay. The station list for these four years has already been published (Dunbar and Grainger, 1952), together with the necessary maps. All station numbers and place names in this present paper, unless specifically qualified, will be found in the station list.

The collection includes planktonic, littoral and benthonic forms, taken with non-closing plankton nets (one-metre stramin, and silk nets numbers 0, 5, 6 and 18) towed for the most part horizontally, dredges and to a much lesser extent beam-trawls and otter-trawls; and shore collecting by hand. Amphipods from stomachs of Atlantic cod and from seals are also included here.

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Apart from the new species described, there are many examples of variation from the types and from standard descriptions. Since the latter are based very often on specimens from northwest Europe, such variations are to be expected in material from an area hitherto very little investigated, especially in the amphipods, whose systematics are complicated by post-maturation moults. Whenever possible, the variants have been compared directly with specimens from Europe, Iceland and Greenland contained in the very large collections of the Zoological Museum, Copenhagen University. The terms "Copenhagen material" and "Copenhagen specimens" in the present paper refer to that collection.

There is still a lack of unanimity in naming the limbs of the Amphipoda. The matter is discussed by Spooner (1947), with whose conclusions and practice I am in agreement. Gnathopods 1 and 2, being the first limbs of the peraeon, are peraeopods, and should therefore be numbered in series with the other five peraeopods, as is done by Stephensen, but not by Stebbing (1906). Sars (1895) numbers the appendages of the mesosome (peraeon) "pes 1 to pes 7", but in the text he divides them into "gnathopods 1 and 2" and "peraeopods 1 to 5", thus repeating the confusion found in Stebbing. In this present paper the limbs of the mesosome are numbered from 1 to 7, and they are called peraeopods, or abbreviated to "per."

All measurements given are made from the front of the head, or tip of the rostrum, to the tip of the last uropods.

The terms "arctic" and "subarctic" are here used according to the criterion and practice already published (Dunbar, 1951, 1953); "arctic" referring to marine areas of shelf depths in which the water is of polar (Arctic Sea) origin (ignoring land drainage) unmixed with Atlantic or Pacific water; "subarctic" referring to areas in which the water of shelf depths consists of both polar and non-polar (Atlantic or Pacific) water. South of the subarctic is the large boreal marine region, extending to the subtropics. For the delimitation of these arctic and subarctic regions, see the papers quoted.

Sub-order *Gammaridea*

Family LYSIANASSIDAE

Opisa eschrichti (Krøyer)

One mature female, dredged in 18–20 metres at station 216, Diana Bay, from rocky bottom with mud, July 24, 1950.

The specimen differs from the original description, from the synopsis in Stebbing (1906) and from the Sars figure (Sars, 1895) in that the second joint of the mandibular palp is not "strongly setiferous"; the third joint, on the other hand, is richly supplied with setae. Specimens examined from Godthaab, west Greenland, in the collection of the Zoological Museum of Copenhagen, have a few setae on the second joint, but nothing like the setation shown in Sars, and a slight, not strong, setation of the third joint. In the Diana Bay specimen the second joint is almost naked and the third joint shows as rich setation as Sars and Stebbing describe for the second joint.

The species appears to be boreal and subarctic in distribution, being known from west Greenland (Godthaab and Holsteinsborg, 1892), east Iceland, the Faeroes, the North Sea and the Norwegian coast, Kola Bay and the White Sea (Stephensen, 1923, 1935; Derjugin, 1915, 1928). It is also recorded from Monterey Bay on the Pacific coast (Shoemaker, 1930a), the Korea Sea and the Sea of Japan (Derjavin, 1930). Shoemaker (1930a) recorded it for the first time from eastern North America (Gulf of St. Lawrence and coast of Nova Scotia). Stephensen (1935) calls it "probably circumpolar", but it has not been found yet either in east Greenland or in the arctic part of the Siberian shelf, and its present known distribution does not show it in any truly arctic region.

Onisimus edwardsi (Krøyer)

Taken both planktonically and in the dredge; in plankton nets, at stations 9, 51, 101 and 123, hauling at depths from 5 to 13 metres in shallow water, one specimen in each haul. Twenty-five specimens were dredged at station 125A (Payne Bay) on August 23, 1949, in 14 metres, and 42 specimens were taken on the skull of a beluga (*Delphinapterus leucas*) lowered to the bottom overnight in 20 metres at station 212, for cleaning. Many hundreds were taken in a similar manner on a seal skull at station 124. All specimens taken were immature.

Onisimus edwardsi is probably circumpolar, although there are still gaps in its known distribution, notably on the Siberian shelf and in the Canadian central arctic. It is found in both arctic and subarctic regions, and extends also into the boreal, in southwest Norway and the Kattegat. In eastern Canada, it has been taken in northwest Hudson Bay, the Labrador coast and the Gulf of St. Lawrence (Shoemaker, 1930a), southeast of Cape Sable and on the Grand Bank (Shoemaker, 1930b).

Onisimus plautus (Krøyer). (Fig. 1)

Forty-five specimens were taken altogether, at stations 20, 45, 102 and 216, all in the benthos at depths varying from 10 to 70 metres. Mature females with eggs were taken at station 102, June 6, 1949 (one specimen), and at station 216, July 7, 1950 (one specimen). Four specimens were taken from stomachs of the Atlantic cod (*Gadus callarias*) at Port Burwell.

The Ungava Bay specimens differ from the type and from other specimens from west Greenland in the Copenhagen University collection in the shape of joint 6, pes 1, which is somewhat longer in proportion to width in the present material, and with a slightly more sloping palm. In this character the specimens are in agreement with the figure published by Shoemaker (1930b) from specimens from Newfoundland and Nova Scotia, and it is probable that we have here an eastern North American variant of the species, which was first described from Greenland. The two forms of the joint in question are shown in Figure 1.

Onisimus plautus is probably circumpolar, arctic and subarctic. In arctic water it is known from northeast Greenland, from east of the 90th meridian on the Siberian shelf, from western Baffin Bay, Prince Regent Inlet, Foxe Basin and Dolphin and Union Strait (Gurjanova, 1932; Shoemaker, 1920). It is widely distributed in the subarctic, including Bering Strait, and like the preceding species it extends south of the subarctic into the Skagerak, possibly as an arctic relict. Shoemaker (1930a, 1930b) has recorded it from the Gulf of St. Lawrence, Newfoundland and Nova Scotia.

FIGURE 1. *Onisimus plautus*, per. 1, from Greenland (left) and Ungava Bay (right).

Onisimus affinis H. J. Hansen

Syn.: *Onisimus botkini* Birula.

Six specimens were taken at station 229 (Adlorilik Inlet), on August 28, 1950, collected by hand at low tide on a sandy shore with rocks and seaweed, and with small freshwater streams. Numbers of *Pseudalibrotus littoralis* were collected at the same station. The specimens are all immature, the largest 14 mm. long.

Stephensen (1923) suggested tentatively that the *Onisimus affinis* of Hansen, of which the type is in Copenhagen, is a young *botkini*. Working later on the Fifth Thule Expedition material (Stephensen, 1937) he put the two species unequivocally together. Gurjanova (1932), however, keeps them apart, separating them on the shape of the last epimeral plate (pleon 3), acutely upturned in *affinis* and rounded in *botkini*. After examining the material in the Copenhagen Museum, including the Fifth Thule specimens from King William Island, and the present specimens from Ungava Bay, I agree with Stephensen that the two should be considered synonymous. The shape of pleon 3 shows variation from fairly sharp to rounded, and the extent to which it is produced may be great or small. In the present material it is produced to a rounded point, as in the type specimen of *affinis*, and as figured by Shoemaker (1920) for *botkini*.

This species is known from the Kara Sea, the Siberian coast to the Bering Strait, northeast Greenland and Jan Mayen (Stephensen, 1923; Gurjanova, 1932); from Demarcation Point and Collinson Point, Alaska (Shoemaker, 1920), King William Island (Stephensen, 1937) and now from Ungava Bay. Gurjanova (1935b) states that, together with several other species of *Onisimus*, it is found in brackish water regions along the coast, especially at the mouths of rivers and streams. The Ungava Bay station agrees with this, but it has been found elsewhere in greater depths, down to 40 metres, occasionally deeper still (Stephensen, 1923). It is circumpolar arctic, also invading the subarctic.

Pseudalibrotus littoralis (Krøyer)

A very abundant species, especially in shallow water and in the intertidal zone. In Ungava Bay it was taken, often in large numbers, at the following stations: In plankton nets, at stations 1, 6, 18, 31, 40, 43, 44 and 51; and in the littoral zone at stations 107A, 107B, 215, 217 and 229. It was never taken far from the shore, and at all littoral stations at which it was collected there was a strong freshwater influence; often the specimens were collected in freshwater streams. It appears to be the rule that in the subarctic, which is the southern limit of the distribution of *Pseudalibrotus littoralis,* it is found in brackish areas only.

The species is arctic and subarctic in distribution, but it is not strictly speaking circumpolar. However, the form which replaces it between Novaya Zemlya and eastern Siberia, i.e. *P. birulai*, which has been given full specific rank by Gurjanova (1929), is very close to *littoralis*. The southern limit of *littoralis* in Canada is not known, but is presumably on the Labrador coast. It is not known from the Gulf of St. Lawrence. It was taken in northern Alaska and the Canadian central arctic by the Canadian Arctic Expedition (Shoemaker, 1920).

Specimens over 20 mm. in length were taken in Ungava Bay, but no specimen was mature. Specimens taken on August 29, 1947, had the lengthening antennae of the male, and there may be a breeding period late in the season.

Pseudalibrotus glacialis G. O. Sars

Fifty-six specimens of this species were taken, all in the plankton, at stations 1, 6, 7, 9, 13, 18, 41, 57, 203 and 221. Most were captured in 1947; not a single specimen was taken in 1949, although the total amount of plankton collected during that season was almost as large as in 1947. One specimen was taken from a cod stomach at Port Burwell.

This species is always more abundant than *P. nanseni* in Ungava Bay. Both are pelagic; *P. glacialis* is the more southerly of the two. Since their first description by Sars (1900), the diagnostic characters have been slightly revised, by Stephensen (1923) and Dunbar (1942). The presence of apical spines on the telson in the male is not invariable, and the female, which was described by Sars as without the spines, very often has them. The largest specimens taken had the third epimeral plate somewhat more acute than figured by Sars (1900) and drawn out slightly into a fine point. All specimens were immature, in the months of July and August. Mature females have been taken in southeast Baffin Island in September (Dunbar, 1942), and it is clear that there is a breeding period late in the summer. The species has recently been recorded from the Strait of Belle Isle (Bousfield, 1951).

Pseudalibrotus nanseni G. O. Sars

Five specimens were taken in Ungava Bay, all immature. Two were caught in plankton nets, at stations 9 and 18; three in cod stomachs at Port Burwell.

This is an arctic pelagic species, and is possibly a useful indicator of arctic water when found in the surface layers. The distribution, which is circumpolar, is given in a map published by Gurjanova (1932), to which should now be added the present record from Ungava Bay and previous records from Hudson Strait and Frobisher Bay (Dunbar, 1942).

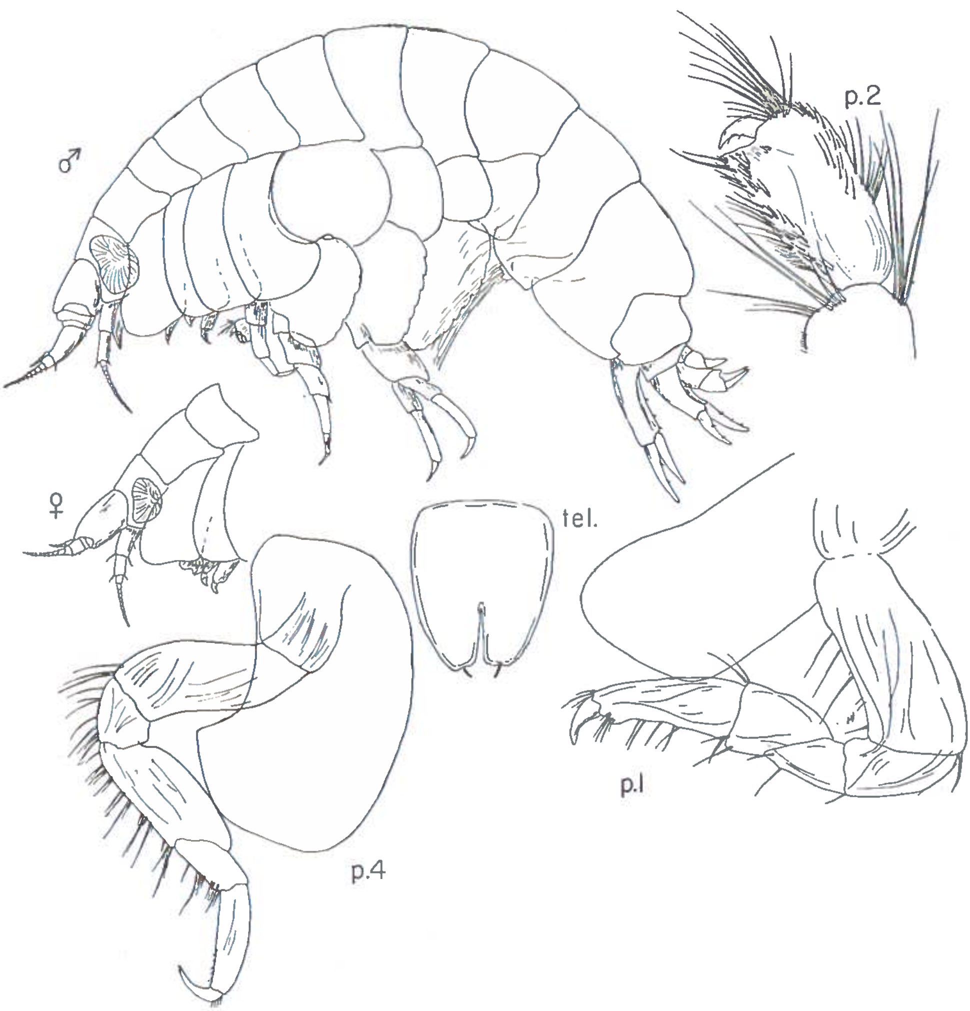

FIGURE 2. *Paronesimus barentsi.* In this and many of the following figures abbreviations are used as follows: ant., antennae: u.l., upper lip: l.l., lower lip: md., mandible: mx.1, mx.2, maxilla 1 and 2: mxp., maxillipeds: p.1, 2, 3, etc., peraeopod 1, 2, 3, etc.: sp., side-plate: pl.3, pleon 3: ur. uropod: tel., telson.

Paronesimus barentsi Stebbing. (Fig. 2 and 3)

This rare species was taken three times in the dredge and once in the shrimp beam-trawl, as follows: station 20 (60 metres, July 18, 1947, 4 specimens); station 45 (about 12 metres, August 23, 1947, 1 specimen); station 102 (90–120 metres, June 30, 1949, 5 specimens). Both the beam-trawl and the dredge were used at the latter station. In all four hauls, *Onisimus plautus* was also taken. The specimen taken on August 23, 1947, is a female, almost mature.

This species has been recorded only twice in the past, both records being from the vicinity of Novaya Zemlya. The type specimen was described by Stebbing (1894) from west of Novaya Zemlya, and Gurjanova (1936a) has recorded it from the Kara Sea. Its presence in Ungava Bay is therefore of great interest. Stebbing's original description and figures are very full, and the variations which the present specimens show from the original are detailed below and are illustrated in the accompanying figures. They might, in the hands of another systematist, be considered sufficient to justify the erection of a new subspecies.

Stebbing (1894) describes the genus, erected by him, as follows:

The genus stands near to *Onisimus* Boeck and *Chironesimus* Sars. It is distinguished from *Onisimus* by having the palp much longer than the trunk in the mandibles, by having the

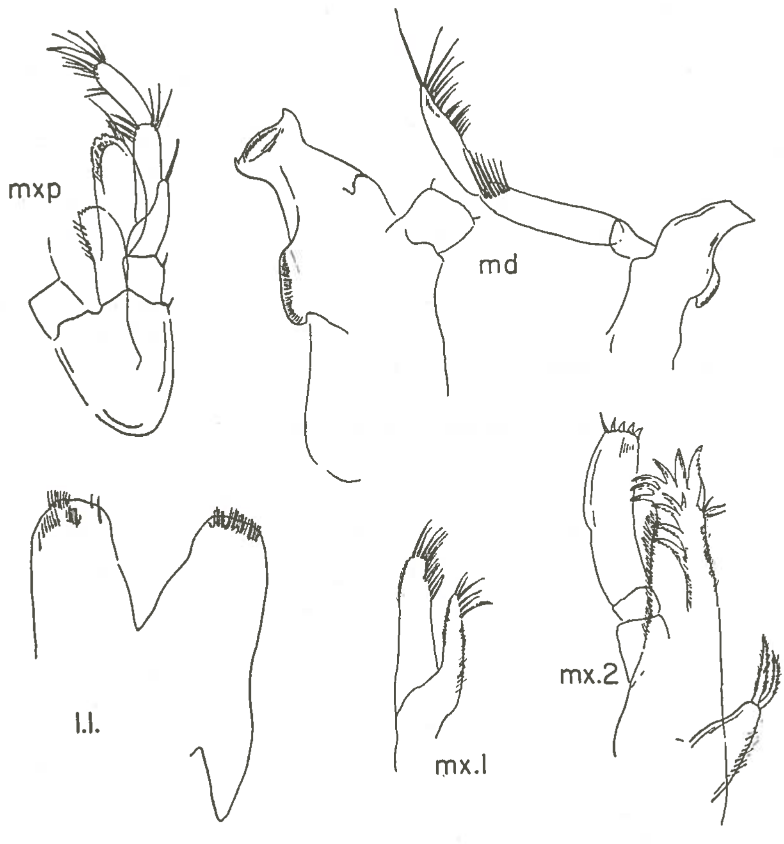

FIGURE 3. *Paronesimus barentsi*, mouthparts.

palp of the first maxillae more elongate and with fewer spines on the apex, by the truncate palm of the second gnathopods, and by the telson which is much longer than broad and incised for more than a third but less than half of the length. From *Chironesimus*, which it strongly resembles in general appearance, it is distinguished by fewer spines on the palp of the first maxillae, by narrower second maxillae, by a different shape and armature of the outer plate of the maxillipeds, by the less deeply cleft telson and the smaller uropods.

In all these characters the Ungava Bay specimens are in agreement, and they agree also in detail with Stebbing's description and figures of *barentsi*, except for the following three points: In the female, the first joint of the flagellum of the first antenna is not as long as the next three joints; in the male, this joint is longer than the next three joints, as described by Stebbing. The apices of the lower lip are hairy, although not richly so. Stebbing describes them as "apparently smooth", suggesting that his specimen was slightly damaged in this respect (it was apparently damaged also in the eyes and the first antennae). In per. 2 the finger, or seventh joint, is not so strongly curved as in Stebbing's specimen.

Quoting again from Stebbing: "The shape of the eyes is believed to be the same as in the species just mentioned" (*Chironesimus debruynii* (Hoek)). The eyes in the present material are fairly large, broader than in *Chironesimus*. The general appearance, as Stebbing records, is similar to *Chironesimus*, except for the shape of the eye, the much shorter head, the blunter and less produced lateral angles of the head, and the shape of side-plate 4, which is characteristically narrow, with the posterior expansion short and blunt.

The presence of this species in Ungava Bay agrees with the distribution of certain other species described below (see summary). It is probably a species of Pacific origin which has spread both east and west from the Bering Sea along the Siberian and North American coasts, and it is to be expected that it will be taken in due course in eastern Siberia and Alaska.

Stebbing gives no size for his type specimen. The Ungava Bay specimen drawn here (Fig. 2) is 11.25 mm. in length, and the largest specimen taken, a female, measures 14.75 mm.

Orchomene macroserrata Shoemaker. (Fig. 4)

Five specimens, taken at stations 3, 20, 28 and 203, in the dredge. One badly damaged specimen, almost entirely eaten away on one side, was taken in a plankton net at station 18. All the specimens are immature, one female with incompletely developed brood lamellae.

Shoemaker (1930b) established this species on material from the vicinity of Grand Manan, Bay of Fundy. It is very close to *O. tschernyschevi* Brüggen, 1909, recorded from Jugor Strait, between the island of Waigatsch and the mainland of Siberia. It is in fact so close to the Siberian species as to be another example of the type of distribution mentioned above, for *Paronesimus barentsi*. *O. macroserrata* differs from *tschernyschevi* only in the shorter lobe on joint 5, per. 1 (gnathopod 1), and the larger and fewer serrations on the postero-lateral margin of pleon 3. These characters in both species are illustrated in Figure 4. *O. macroserrata* is known so far only from the Bay of Fundy and from Ungava

Bay; *O. tschernyschevi* has not been recorded since the original record from Jugor Strait.

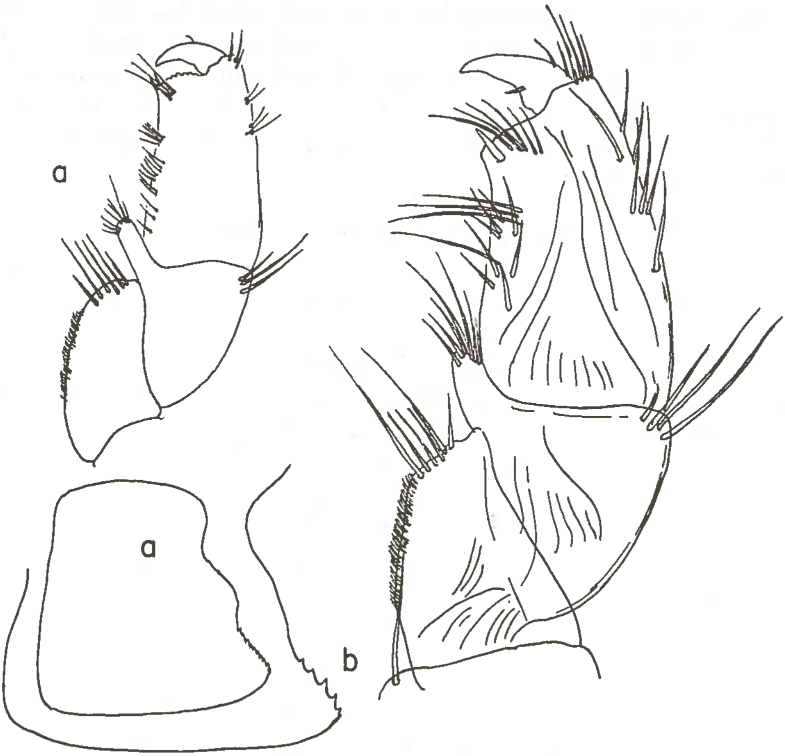

FIGURE 4. a: *Orchomene tschernyschevi*, per. 1 and telson, after Brüggen, 1909.
b: *Orchomene macroserrata*, per. 1 and telson.

Aristias tumidus (Krøyer)

Ten females, apparently not quite mature, and three immature specimens, were dredged on August 13, 1950, at station 226 (Button Islands) in 90–100 metres.

This species is circumpolar arctic and subarctic in distribution, known from the Newfoundland banks, west Greenland, east Greenland, Jan Mayen, west and north Svalbard, north Norway, the Barents and Kara Seas, Kola Bay, always in fairly shallow water. For details of localities see Stephensen (1935).

Anonyx nugax (Phipps)

This very common species was taken in the dredge at the following stations: 11, 20–21, 27, 102, 201C, 216, 225 and 231, in depths between 5 and 130 metres. Specimens were also taken from seal and beluga skulls in process of cleaning at stations 124 and 125A, and 64 individuals, some fully mature, were found in the stomach of an eider duck female (*Somateria mollissima*) at Port Burwell, July 3, 1949. Six specimens were taken from cod stomachs at Burwell and three from a bearded seal; the latter were mature, taken northeast of the Gyrfalcon Islands on July 15, 1948. A few, usually small specimens, were caught planktonically at stations 51, towing in shallow water from 0 to 6 metres; 22, towing in the upper 3 metres; 13, towing at 40 metres; 40, towing in the upper 3 metres; 101, at about 6–7 metres; and

228, at the surface. Specimens over 30 mm. long were taken in the dredge, but the only mature individuals were found in the seal and eider duck stomachs.

Anonyx nugax is a circumpolar arctic and subarctic species, confined to fairly shallow water on the shelf, and extending also into the boreal region in the North Sea and Skagerak. It is recorded from Cumberland Sound and Hudson Bay (Shoemaker, 1920) and from the Japan Sea (Derjavin, 1930). Stephensen (1923) has discussed its distribution, breeding cycle and maximum size attained in different parts of its range.

Socarnes bidenticulatus (Bate)

Three specimens were taken: one small immature individual taken pelagically at station 33, one larger immature specimen dredged at station 231, and one mature female, 37 mm. long, at station 203 (July 8, 1950).

An arctic and subarctic species, probably circumpolar, known from south of Newfoundland (Shoemaker, 1930b) but not yet from the Gulf of St. Lawrence, and from the Japan Sea (Derjavin, 1930). It has been recorded from Melville Island (N.W.T.) (Shoemaker, 1920).

Socarnes vahli (Krøyer)

Thirteen specimens, all but one immature, at stations 20, 28, 225, 226 and 231; all taken in the dredge. An almost mature female was taken on August 13, 1950 (station 226). In addition to these thirteen specimens, five were taken in Atlantic cod stomachs at Port Burwell.

The distribution of this species is similar to that of *S. bidenticulatus*, but it extends farther south, especially in Europe, where it is known from southwest Norway. Like the previous species, it is also known from the Japan Sea.

Tmetonyx orchomenoides Stephensen

Three specimens were taken in Ungava Bay, at stations 103 and 234, both on occasions when the one-metre stramin net was allowed to touch bottom, in depths between 80 and 275 metres.

This species, erected by Stephensen (1925), is very close to both *T. cicada* (O. Fabr.) and *T. similis* (O. Sars), distinguished by the produced epistome, the shape of side-plate 4 and the length of per. 5, which is almost as long as per. 6. I have examined the material of all three species in the Copenhagen Museum, and am forced to the conclusion that only breeding experiments could decide whether or not they should be kept separate. Two specimens in the Copenhagen collection marked "*Tmetonyx* (*cicada* O. Fabr.?)—(epistome reaches too far forward; fourth plate posterior expansion deep); SE Greenland, Tasiusarsik 21–7–33" belong to this species, and were probably overlooked by Dr. Stephensen.

The species is known only from southwest and southeast Greenland and Ungava Bay. *T. cicada* is arctic and subarctic, possibly circumpolar, and *T. similis* is known from the Norwegian coast, Iceland, the Faeroes, Scotland and west Svalbard (Stephensen, 1925).

Orchomenella pinguis (Boeck)

Many hundreds of this species, all immature, were taken at station 125A, August 23, 1949, from a seal skull left to be cleaned in 12 metres of water. Sixty-seven specimens, including some mature females, were taken from a shark skeleton similarly treated, in Mission Cove, Port Burwell, on August 8, 1949. Several hundred, including many females close to maturity, came from a beluga skull at station 212 on July 22, 1950, and 23 specimens, many of them ovigerous females, were dredged from 20 metres at station 216 on July 24, 1950. A few immature specimens were caught in plankton nets at stations 22 and 123, in the upper 10 metres in shallow water. One specimen was found in the stomach of a ringed seal at Port Burwell in June 1949.

The last epimer (pleon 3) of *O. pinguis* is, according to Sars (1895), serrate, but Della Valle (1893) describes it as smooth. In specimens from west Greenland in the Copenhagen Museum collection pleon 3 is smooth, as it is in the present Ungava Bay material.

The species has a wide north-south distribution, and is possibly also circumpolar. It is known from the Siberian shelf as far east as longitude 124°E (Brüggen, 1909) and from the Japan Sea (Derjavin, 1930), from the White Sea, the Norwegian coast, and as far south as Mediterranean in Europe and Cape Hatteras in North America (Shoemaker, 1930a). In the Canadian north it has already been recorded from west Hudson Bay (Shoemaker, 1920).

Orchomenella minuta (Krøyer)

Nine specimens were taken. Two females with eggs were caught in the dredge at station 102, June 30, 1949; two immature individuals were dredged at station 216, July 24, 1950; four were collected by hand in the intertidal zone at station 217 July 30, 1950; and one was caught planktonically at station 123, August 10, 1949, in shallow water.

An arctic and subarctic form, circumpolar, and extending down the coast of Norway to the Skagerak, Kattegat and Øresund (Dahl, 1946b), and south on the eastern North American seaboard to Nova Scotia (Shoemaker, 1930a, 1930b). Known from Hudson Bay (Shoemaker, 1920) and also recorded from the Okhotsk Sea (Derjavin, 1930).

Orchomenella groenlandica (H. J. Hansen)

Five immature specimens, all but one approaching maturity, were taken by dredge at station 226, August 13, 1950.

An arctic and subarctic species, known from north Norway and the White Sea (Derjugin, 1928), both coasts of Greenland (Stephensen, 1925), Bay of Fundy and south of Newfoundland (Shoemaker, 1930b).

Family STEGOCEPHALIDAE

Stegocephalopsis ampulla (Phipps)

Syn.: *Phippsia ampulla* (Phipps); Stebbing, 1906.
Stegocephalus ampulla (Phipps); Brüggen, 1909.

One large male specimen of this species was taken in the dredge at station 45, August 23, 1947.

There is disagreement in the literature about the number of joints in the palp of the first maxilla in this species. Brüggen (1909) and Schellenberg (1924) describe it as one-jointed, while Stebbing (1906) and Stephensen (1925) are equally certain that it is two-jointed. After an examination of the present specimen and of the material in the Copenhagen collection from east and west Greenland, it has become clear that the palp in question is open to both interpretations. It is waisted, or constricted in the middle, giving the appearance of two joints although consisting (in my opinion) of only one in fact.

S. *ampulla* is not a common species. It is predominantly arctic in distribution, but has been taken also in the subarctic. Shoemaker (1920) recorded it for the first time in arctic Canada, at Bernard Harbour. For details of distribution, see Stephensen (1935, 1925, 1933).

Stegocephalus inflatus Krøyer

Three specimens were found in the stomach of a bearded seal, 15 miles ENE of the Gyrfalcon Islands, July 15, 1948. One mature female, with eggs, was dredged at station 103, July 6, 1949.

This is an arctic and subarctic species of wide distribution, circumpolar, recorded from the western, central and eastern arctic of Canada, south on the eastern seaboard to Cape Cod; west and east Greenland, Iceland, Svalbard, west and north Norway, south to the Skagerak; Barents, Kara and Laptev Seas; Plover Bay (east Siberia), Sea of Okhotsk and the Gulf of Tartary (Shoemaker, 1930a) and the Sea of Japan (Derjavin, 1930).

Family AMPELISCIDAE

Ampelisca eschrichti Krøyer

A common species, taken benthonically at stations 20, 45, 102, 107, 201, 203, 126, 216 and 231, in depths ranging from 20 to 130 metres, and planktonically at stations 13 and 18. One specimen came from a cod stomach at Burwell. Mature ovigerous females were taken on July 18, 1947, July 7, 1949, and July 24, 1950.

Stephensen (1935) gives several characters which distinguish this species from *A. macrocephala* Lilljeborg, one of which, the presence of long setae on the lower hind corner of joint 5, per. 7, in the latter but not in the former species, is not valid for the present material. Many of my *eschrichti* possess the long setae, some do not. The two species, however, are easily separated on the shape of the posterior expansion of joint 2, per. 7, and of joint 5 of the same limb. Another good character, which Stephensen does not mention, is that the posterior margin of pleon 3 is far more strongly bisinuate in *macrocephala* than in *eschrichti*.

A. eschrichti is a circumpolar arctic and subarctic species, extending even into the boreal west of the British Isles. In Canada it extends south to the Bay of Fundy and south of Newfoundland, and it has been recorded from Hudson Bay (Shoemaker, 1920, 1926). There is a possibility that it occurs also in the southern hemisphere (Barnard, 1932), or at least that there is a very closely related southern species (Stephensen, 1925). For the northern hemisphere distribution see Stephensen (1933).

Ampelisca macrocephala Lilljeborg

Three specimens of this species were taken in the dredge at station 45 on August 23, 1947. One was an ovigerous female.

The distribution is similar to that of *A. eschrichti*, but the present species extends farther south in the North Sea area. A very closely related form is recorded from the southern hemisphere, possibly the same species (Chilton, 1917). It has been recorded from the Japan Sea (Derjavin, 1930).

Byblis gaimardi (Krøyer)

Altogether 218 specimens of this species were obtained, most of them in the dredge, at stations 45, 102, 107 and 231; 118 specimens were taken in one haul at station 102. The species was also caught in plankton nets at stations 13 and 18, and 77 specimens were found in stomachs of the Atlantic cod at Port Burwell. Ovigerous females were taken on August 23, 1947, and June 30, 1949. There is great variation in the size of the mature females.

The species is probably circumpolar, arctic and subarctic, extending also into the boreal on the Scottish coasts, the North Sea and the Danish Belts. It is also known from Monterey Bay, California (Holmes, 1908) and from South Africa (Barnard, 1916) and Japan (Derjavin, 1930). In eastern North America it is recorded from Jones Sound and northeast Baffin Island (Sars, 1909), Hudson Bay, Labrador, the Gulf of St. Lawrence and the New England coast (Shoemaker, 1930a). For details see Oldevig (1917) and Stephensen (1935).

Haploops tubicola Lilljeborg

One hundred and eight specimens were taken, all benthonically, at stations 45, 102, 106, 201C and 231. Ovigerous females were taken on July 7, 1949, and June 29, 1950.

A circumpolar arctic, subarctic and boreal species, ranging south to the Mediterranean. Known from the Gulf of St. Lawrence and the Bay of Fundy (Shoemaker, 1930a) and recorded from depths down to 1200 metres in the Norwegian Sea (Sars, 1885). Also known from the Californian coast and the Sea of Japan (Derjavin, 1930).

Haploops setosa Boeck

Syn.: *Haploops robusta* G. O. Sars. **New Synonymy.**

Altogether 466 specimens were taken, all but five of them in stomachs of Atlantic cod at Port Burwell during the 1947, 1948, 1949 and 1950 seasons. One individual was taken in the dredge at station 30 and two in plankton nets at station 41, towing at about 230 metres close to the bottom, and at station 103, towing close to the bottom in 92 metres. Two specimens came from the stomach of a ringed seal at Burwell.

Haploops setosa is here combined with *H. robusta*. Sars's species (*robusta*) was erected on a single specimen taken off the coast of Finmark (Sars, 1895) differing from *setosa* in larger size, more robust form, evenly rounded lateral corners of the cephalon, shorter antennae, the shape of pleon 3, which was more rounded and with less marked pointed production at the corner, by the slightly shorter expansion of joint 2, per. 7, shorter second joint in the peduncle of antenna 1 and a deeply cleft telson. Shoemaker (1931), discussing material from the Bay of Fundy, writes: "I believe that *H. robusta* is but a large form of *H. setosa*, but have hesitated to place it in synonymy for want of authentic specimens of *H. robusta* with which to compare my material". Norman (1900a) expressed similar doubts about the same material.

Most of the Ungava Bay specimens are large, from 25 to 27 mm. in overall length, and they cannot be referred without reservation and qualification to either species, having characters of both, as the two are described in the European literature. Nor would it be at all proper to describe a new species. The solution, therefore, is to place the two species in synonymy, the species being then represented by geographic variants in different parts of the range; possibly the Ungava Bay population represents a hybrid form, or (more probably) the common ancestor of the two European variants. The same procedure is proposed below for another pair of European species, *Westwoodilla caecula* and *W. megalops,* which presented the same problem when compared with the Ungava Bay material.

The Ungava Bay specimens, some of which are mature, show lateral cephalic corners that are distinctly quadrate, a character of *setosa* Boeck; the telson, however, is cleft almost to the base, a character of the *robusta* form; joint 2, per. 7 reaches to halfway along joint 4, resembling *setosa*; the hind margin of pleon 3 is rounded and only very slightly produced at the corner (*robusta*); joint 2 of the peduncle of antenna 1 is much longer than joint 1 (*setosa*); and the large size is a character of the *robusta* of Sars.

In point of fact, the two forms are very close even within north-western Europe. Stebbing (1894) describing specimens of *robusta* from the Barents Sea, says that the angles of the head "are not so strongly rounded off as in Sars's figure, but more so in some specimens than others. The angles of the third pleon segment are minutely produced, at least in some of the specimens including the largest. The proportions of the antennae do not differ much from those of *Haploops setosa* . . . The telson is much more deeply divided then in *Haploops setosa.* In the fifth peraeopods the fourth and fifth joints are rather longer in proportion to their breadth than in the species just named, but with all the differences allowed for, the resemblance between the two species remains extremely close". Stephensen (1925) described a specimen of *robusta* from west Greenland (the only specimen from that whole coast referred to that species) as differing from Sars's original description "in having a tooth at the hind corner of the epimeral part of the 3rd metasome segment", a variation resembling the *setosa* pattern.

I have not seen any European specimens of *H. robusta* Sars, nor the Greenland specimen just mentioned. Judging from the statements of Stebbing (1894) quoted above, the two are close together in Europe, but not identical; and they apparently do not show the mixture of distinctive characters described here for the Ungava Bay specimens. The nomenclatural problem raised is the same as in the case of the species of *Westwoodilla* already mentioned (see below) to which discussion the reader is referred. With the addition of the Ungava Bay material and the extension of range involved, the two European forms must be regarded as of subspecific rank or as geographic variants and not as full species.

Haploops setosa Boeck has not so far been taken east of the Kara Sea nor west of Ungava Bay, and it may therefore be of strictly Atlantic origin. It has been taken in the subarctic from the Kara Sea, Barents Sea, Iceland and west Greenland, and also in the arctic region in Scoresby Sound and Franz Joseph Fjord, and in the boreal waters of Scotland, the Faeroe-Shetland Channel and southwest Norway, usually in deep water. *H. robusta* Sars is known only from the Barents Sea, west Greenland (Nordre Strømfjord, one specimen only) and from the Bay of Fundy.

Family HAUSTORIIDAE

Pontoporeia femorata Krøyer

Only one specimen of this species was taken, an immature individual caught in a plankton net towing at the surface at night, station 125, August 21, 1949.

The species is circumpolar, arctic and subarctic, usually found in shallow water. A presumably relict population is present in the Baltic Sea. It has already been recorded from northern Canada in Jones Sound and northeast Baffin Island (Sars, 1909) and in James Bay (Shoemaker, 1926), and it is known from the New England coast (Holmes, 1905) and from the Japan Sea (Derjavin, 1930; Yashnov, 1948); New Siberian Islands (Brüggen, 1909), Kara Sea (Stuxberg, 1882), Laptev Sea (Gurjanova, 1932), Bernard Harbour (Shoemaker, 1920).

Pontoporeia affinis Lindström. (Fig. 5)

Twenty-two specimens are in the collection, all taken in plankton nets, at stations 1 (hauling at 5 metres), 31 (surface haul), 44 (hauling at about 80 metres) and 51 (upper 5 metres). All but station 44 are in regions of strong freshwater influence, and since closing nets were not used it is impossible to tell at what depth the specimen at station 44 was actually caught. A mature ovigerous female was taken at station 51, on August 5, 1947.

The telson (Fig. 5) is not broader than long as described in the older European literature; it is leaf-like, each half ovally rounded. The pleon is not hirsute, again in contrast to the European freshwater specimens. This is in

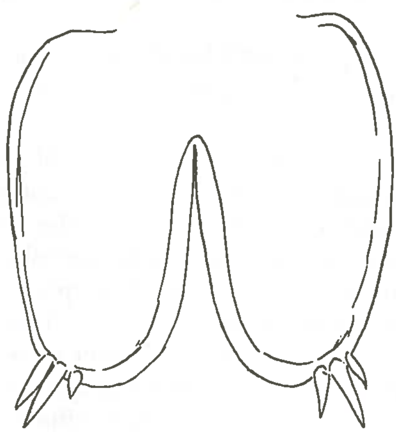

FIGURE 5. *Pontoporeia affinis*, telson.

agreement with the general rule of loss of sensory hairs as the environment becomes more saline, found to a very high degree, for instance, in the species of the genus *Gammarus*. The genus has recently been revised by Segerstråle (1937) who has reduced the number of species to two, *affinis* and *femorata*, the former embracing several earlier species including the North American freshwater forms *P. filicornis* Smith and *P. hoyi* Smith. The largest specimen in the Ungava Bay material measures 14 mm., which is 3 mm. longer than the maximum length given by Segerstråle (1937) for arctic specimens.

P. affinis was taken by the Canadian Arctic Expedition at Collinson Point, Alaska (Shoemaker, 1920) in very shallow water, and it is known (following Segerstråle's revision) from numerous freshwater lakes in Canada and the northern United States (Larkin, 1948). The present records from Ungava Bay, however, appear to be the first for the eastern seaboard and the Canadian eastern arctic, in salt water. It is a widespread species in the north but not circumpolar, often found in brackish regions such as the mouths of the Siberian rivers (Yashnov, 1948) and it is known as a glacial relict in freshwater in Europe and Asia as well as in North America. It does not appear to have been recorded from Greenland. For a more detailed account of its distribution see Stephensen (1938). It is probably of Pacific origin.

Family AMPILOCHIDAE

Gitanopsis arctica G. O. Sars

Two females of this species were taken in the stramin net at station 18, towing at depth of about 50 metres on July 17, 1947.

The species has not often been found; the known localities so far are: North Norway (Varangerfjord; Sars, 1895), east of Iceland, southwest Greenland (Bredefjord; Stephensen, 1925), southern Novaya Zemlya (Stappers, 1911) and now Ungava Bay.

Family STENOTHOIDAE (including METOPIDAE)

Metopa sinuata G. O. Sars. (Fig. 6)

Three females were dredged at station 210, July 21, 1950, and one male and one female at station 226, August 13, 1950.

This species is close to both *M. bruzelii* and *M. propinqua*. It is separated from *bruzelii* by the sinuous side-plate 4, shorter antennae, slightly longer projection downwards of joint 4, per. 6 and 7, and the serrate palm of the second gnathopods (per. 2), which otherwise closely resemble the second gnathopods of *bruzelii* (Fig. 6). It is closer still to *M. propinqua*, and it is not possible always to be certain of the determination of the females (the males are easily separated by the different form of the sixth joint of per. 2 (see next species)). In the female the palm of per. 2 is somewhat more sloping than in *propinqua* and there are two pairs of spines on the telson (three in *propinqua*). Spines on the telson are variable characters in many amphipod species, and they cannot be considered reliable characters. The shape of joint 4, per. 6 and 7, which is used by Sars (1895) and Stebbing (1906) to separate the two species (straight hind margin in *sinuata,* curved in *propinqua*) does not seem to be a useful character in the present material, nor for the Greenland specimens examined in the Copenhagen collection; the hind margin is curved to about the same degree in both species. The lower margin of side-plate 4, however, does show a slight but recognizable difference, being more obviously sinuate in *sinuata* than in *propinqua.* The antennae in the present specimens, and also in the Greenland (Copenhagen) material, are slightly longer than figured and described for this species by Sars (1895).

This is a subarctic species which has been recorded also from one arctic station (Scoresby Sound–Stephensen, 1931, 1944a) and from the Norway–Faeroe–Scotland area just south of the subarctic proper. It is probably a species of the Atlantic subarctic and not of the Pacific side, being known from many localities in west Greenland, Svalbard and Franz Joseph Land, but not recorded from the Siberian coast or from the Bering Sea region. It is here recorded for the first time from North America.

FIGURE 6. *Metopa sinuata*, per. 2, female.

Metopa ?propinqua G. O. Sars. (Fig. 7)

Two males and one female were dredged at station 226, August 13, 1950.

The determination is not quite certain, but the differences between these specimens and the typical *propinqua* may be due only to local variation. The male was not described by Sars (1895), but male specimens from the Barents Sea were referred to this species by Brüggen (1909), who gave a figure of the only important difference from the female, namely the form of joint 6, per. 2. My two male specimens show precisely the same form of per. 2 (Fig. 7) and are in agreement in all other characters except in the relative lengths of the antennae. In Sars (1895) the anterior antennae of the female are described as slightly longer than the posterior antennae. In the female specimen from Ungava Bay the anterior antennae are slightly shorter, and they are much shorter in the males, as shown in Figure 7. Brüggen gives no information on the relative length of the antennae in his specimens, which have not been available during the present study; he says that the "antennae are longer, about three quarter the length of the body", which applies also to the second antennae of the present specimens but not to the first. Brüggen describes the anterior margin of joint 5, per. 2, as "sehr fein gesägt"; there are in fact several rows of very small tubercles

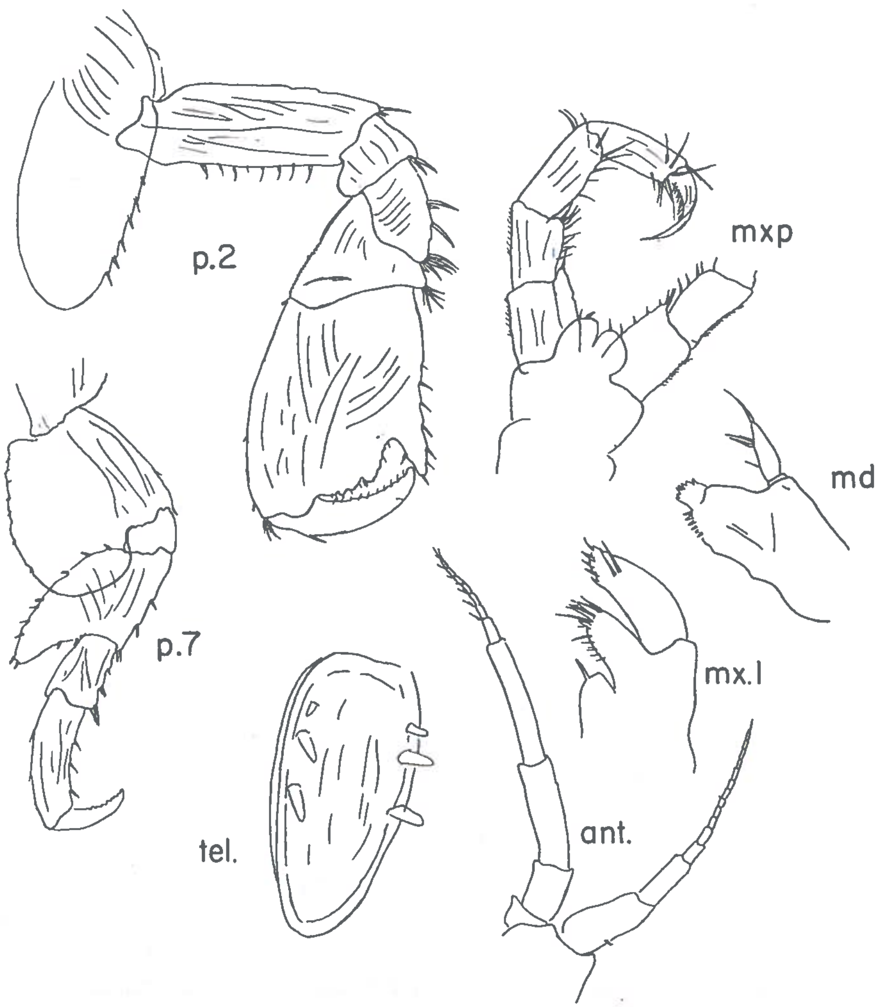

FIGURE 7. *Metopa ?propinqua*, male.

on the joint in question, one of which appears in profile when seen from the side.

In view of the acknowledged complexity and variability of the family Stenothoidae, and especially of the genus *Metopa,* it is wiser to refer these specimens to *propinqua,* with appropriate notes of differences, than to describe a new species or even subspecies. It will be noted that there are rudimentary, or vestigial, outer plates in the maxillipeds, and that the expansion of joint 2, per. 7, is similar in the two sexes but more strongly formed in the male. The third joint of the mandibular palp is missing and the first joint is very small, almost vestigial.

The larger of the two males measures 4.25 mm., over one millimetre longer than the length given for the female (Stebbing, 1906). It is subarctic and boreal in distribution, known from the Barents Sea and northern Norway, the North Sea, Firth of Forth and Bohuslän (Oldevig, 1933), and the Gulf of St. Lawrence (Shoemaker, 1930a). The latter record was the first in North America.

Metopa bruzelii (Goës)

Thirteen specimens, all females, were taken in the dredge at stations 210 and 226, on July 21 and August 13, 1950. Mature females were taken at both stations.

The projection of joint 4, per. 6 and 7, is longer than described and figured by Sars (1895), extending almost to the end of joint 5. Stebbing (1906) describes it as "below the middle of the 5th". Specimens from Greenland in the Copenhagen collection show variation in the length of this joint, sometimes to the end of the fifth, in agreement with the Ungava Bay specimens.

Stebbing (1906) put this species in the genus *Proboloides,* in the belief that the first maxilla had a two-jointed palp. (It is doubtful whether the sturdy reliance on the mouthparts shown by the classical amphipod systematists gives a true natural classification.) Stephensen (1926) put the species back in *Metopa,* where it belongs, commenting on the shift and stating that his *bruzelii* had one-jointed palps in the first maxillae, as have the present specimens from Ungava Bay.

This is an Atlantic subarctic species, extending both south into the boreal (British Isles, Norman, 1900b) and north into the arctic (Smith Sound, Sars, 1909); Norway, Skagerak (Enequist, 1949), Faeroes, Iceland, west Greenland and the Gulf of St. Lawrence (Shoemaker, 1930a).

Metopa cariana Gurjanova. (Fig. 8)

The collection includes 20 specimens of this species, new for North America. Two were taken in plankton nets at stations 13 and 44; the remainder were dredged at stations 203, 226 and 231. One mature ovigerous female was taken on August 7, 1950.

Metopa cariana is known from the Kara Sea, the Sea of Japan (Gurjanova, 1929, 1938), northeast Greenland (Schellenberg, 1935), southeast Greenland (Stephensen, 1944a) and now from Ungava Bay. It is extraordinarily close to *Proboloides glacialis* (Krøyer), and if, as I suspect, the two species are synonymous, in which case the name should be changed to *Metopa glacialis* (Krøyer), the distribution would include records of *P. glacialis* from the White Sea, west Greenland, Iceland, Svalbard and Norway (Stephensen, 1931, 1938).

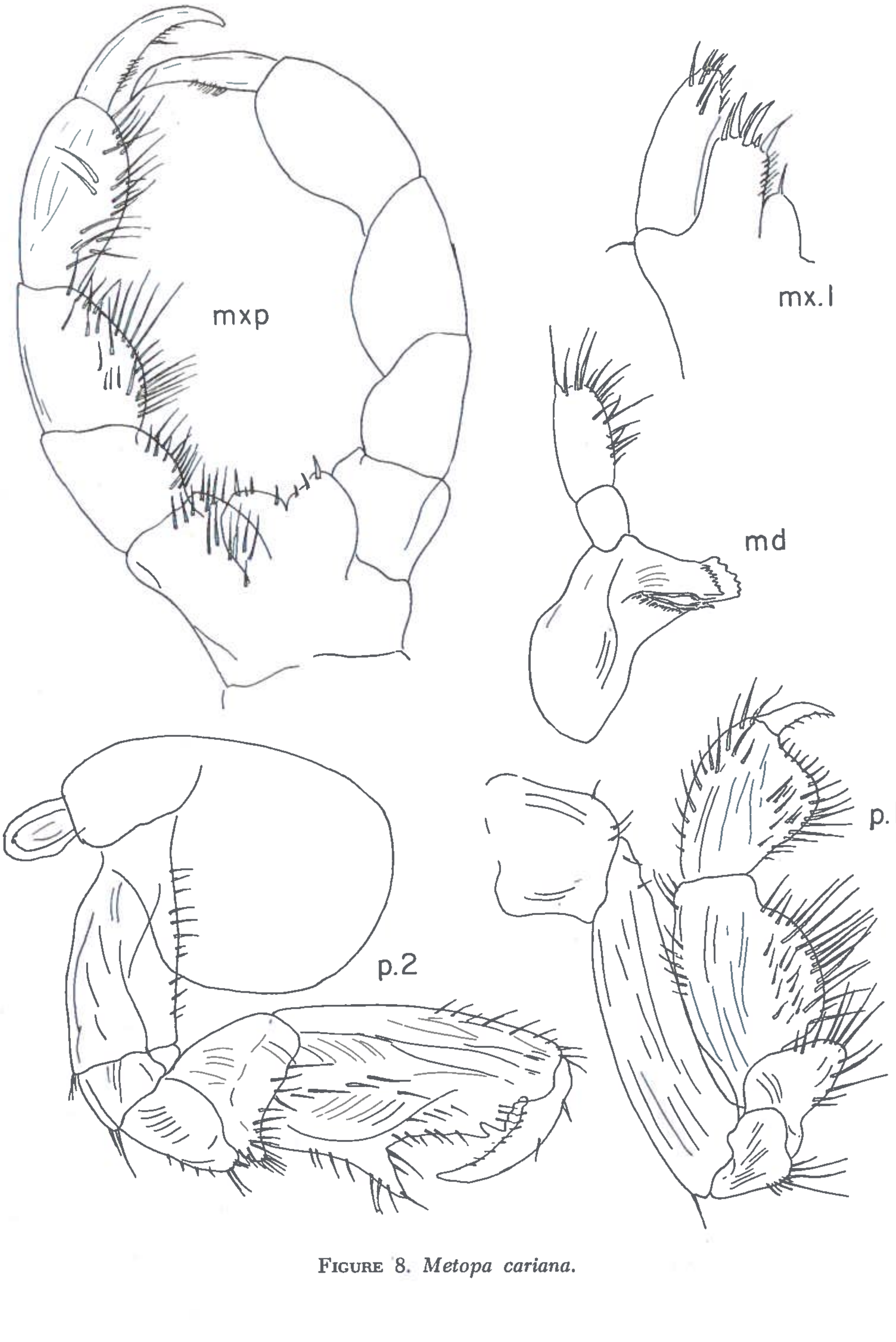

FIGURE 8. *Metopa cariana.*

The present species was established in a very short description (Gurjanova, 1929) with figures of the gnathopods, telson and last uropod. The palp of the first maxilla is described as one-jointed, and the inner plates of the maxillipeds as being fused together. In both these characters the present specimens are in agreement, placing them firmly in the genus *Metopa* as at present defined. Schellenberg (1935), however, describes specimens from Franz Joseph Fjord as having the inner plates of the maxillipeds separate, "fast bis zum Grunde gespalten". Schellenberg also points out that the only significant difference between this species and *Proboloides glacialis* (Krøyer) lies in the one-jointed palp of the first maxilla (two-jointed, according to the literature, in *Proboloides*). That two forms, otherwise identical, should be separated not simply into two species but into two genera, on the basis of the number of joints in maxillary palp, is contrary to the very foundations of systematics and zoogeography. Unfortunately "*Proboloides glacialis*" has not been taken often and there is no specimen in the Copenhagen collection that has the first maxillae intact; the preparation of the first maxillae of the type specimen has deteriorated to such an extent that it is no longer possible to decipher their structure. The question of the possible identity of *glacialis* and *cariana* must therefore be left in abeyance for the time being.

Metopa alderi (Sp. Bate). (Fig. 9)

Syn.: *M. spectabilis* G. O. Sars.

In putting these two species together I am following Dahl (1946a) who has shown that in specimens from the North Sea, Skagerak and Kattegat it is impossible to distinguish them statistically on a variety of measurements, and that the only real difference between the smaller form (*alderi*) and the larger (*spectabilis*) is the time of onset of maturity, a matter which appears to be controlled by the temperature of the water. Three mature females, with eggs, taken at station 226, August 13, 1950, referred to the smaller *alderi* type, measured 5.0, 6.5 and 6.5 mm. Sixteen of the *spectabilis* type were taken at stations 103 (July 6 and 8, 1949)

FIGURE 9. *Metopa alderi*, per. 2, male.

and 226 (August 13, 1950), of which the mature specimens measured 8.75, 10.25, 11.75, 12.0, 13.0, 13.0, 14.5, 14.5, 15.0, 15.0, 15.25, 15.5, 17.0 and 17.5 mm. These figures suggest a bimodal distribution, but the number of measurements is very small. Since the species is quite frequently taken planktonically it is not impossible that we have here a size-distribution of the same sort as is known in the Calanoid *Calanus finmarchicus* and other copepods in Greenland waters, which may be related to development in two different types of water, polar and Atlantic. Enequist (1949) keeps *alderi* and *spectabilis* separate, without however answering the evidence offered by Dahl for their unification.

The Ungava Bay specimens show one constant variation from type, in the form of the palm of the sixth joint of per. 2 in both sexes. The bight in the palm, which is more marked in the male than in the female, is partly filled in, when compared with the typical form (Sars, 1895; Stebbing, 1906), by the development of one or more small additional lobes, as shown in Figure 9. Specimens in the Copenhagen collection, from the *Ingolf* Expedition station 31 (66°35′N, 55°54′W), show the same variation, but five specimens taken in the Skagerak in November 1952 showed the typical pattern. The variant is possibly a western Atlantic form.

The species is known in the *alderi* form from west Svalbard, the Murman coast, White Sea (Yashnov, 1948), north Norway, east Greenland, southwest Iceland, Bohuslän and the coast of Wales; in the *spectabilis* form from north Norway and the deep water of the Norwegian Sea, the Kara Sea, southeast Svalbard, Skagerak and Kattegat, North Sea, west Greenland and the Gulf of St. Lawrence. It is thus predominantly a subarctic species, extending both north and south of the subarctic zone proper.

Metopa longirama Dunbar. (Fig. 10)

Two specimens, one male and one female, were taken planktonically at station 9, on July 11, 1947, towing at approximately 15 metres.

The original specimen of this species (Dunbar, 1942) was also taken in the plankton. The original description is adequate for the recognition of the species, with the following addition: The coxal plates were described as "similar to

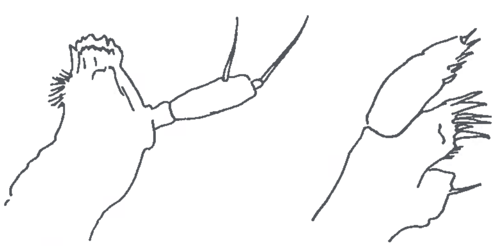

FIGURE 10. *Metopa longirama*, mandible and first maxilla.

M. alderi"; this should be amended to the extent of noting that side-plate 4 is a little smaller than in *alderi*. Pleon 3 is almost quadrate, slightly less than a full right angle. Figures of the mandible and first maxilla, which were slightly damaged during dissection in the type specimen, are given here (Fig. 10).

The species is known so far only from Clyde River (Baffin Island) and Ungava Bay.

Metopa norvegica (Lillj.). (Fig. 11)

Seventeen specimens were taken in the plankton at station 18 and five were dredged at tations 103 and 106. One of these was a mature female, taken on July 6, 1949.

This material shows the changes which take place in the second gnathopod (per. 2) during the life of the individual. The deep notch in the palm, a diagnostic character of the species, is not present in the small immature specimens at all; the palm is almost straight, at right angles to the hind margin, and almost smooth. The beginning of the appearance of the notch is shown in Figure 11, drawn from a young female with small brood lamellae. The shape of the notch at the next moult stage following the stage at which the individual was caught, in which the notch is much deeper, can also be seen in the drawing.

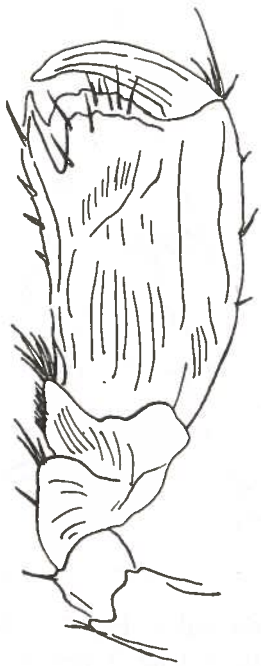

FIGURE 11. *Metopa norvegica*, immature female, showing two moult stages in the development of the palmar notch of per. 2.

This is apparently another Atlantic subarctic species, not so far recorded from the Pacific or Siberian side. It is known from the White Sea and the Murman coast, north and west Norway, west Greenland, Iceland and the Faeroes; North Sea and off St. Ives in Cornwall; Skagerak (Stephensen, 1931, 1938). It has not hitherto been reported from North America.

Metopa nordmanni Stephensen. (Fig. 12)

Three specimens in all, a male and a mature female at station 226, August 13, 1950; a mature female at station 210, July 21, 1950.

These specimens have been carefully compared with the type specimen in the Copenhagen Zoological Museum. The distinctive features are the shape of

FIGURE 12. *Metopa nordmanni*, per. 2 from two different individuals.

joint 6, per. 2, and especially the palm (Fig. 12), the rather square lower margin of side-plate 3, and the length of joint 5, per. 1 (longer than in most *Metopa* species, but not as long as in *M. leptocarpa* G. O. Sars).

The species is known so far only from three subarctic localities—west Greenland (Nordre Strømfjord, the type locality (Stephensen, 1931), the Kara Sea, or more accurately Yugorskii Shar (Gurjanova, 1935a, 1935b; Yashnov, 1948), and Ungava Bay.

Metopa longicornis Boeck

Three specimens, two from station 226 and one from stations 103. A female taken at the former station on August 13, 1950, was almost mature. This specimen has two pairs of spinules on the telson, not three as in the original description and as figured by Sars (1895). The male taken at station 103 has three pairs.

The species is known from west Greenland (Stephensen, 1931), Laptev Sea (Yashnov, 1948) and Norway (Sars, 1895). This is the first North American record.

Metopa invalida G. O. Sars

Taken at station 226, August 13, 1950; 22 mature females. This particular dredge haul was very rich in Metopids, and many immature specimens and males have not been sorted out for identification.

As this species has never been recorded hitherto since its original description from Hammerfest and Selsøvig (Sars, 1895), the identification was carefully checked against specimens from Sars's original material from Selsøvig in the Copenhagen collection, with which the present specimens agree in all details. In the Copenhagen material there is the same variation in the length of joint 4, per. 6 and 7, as in the Ungava Bay specimens; in some the projection reaches almost to the end of joint 5. The long and unarmed telson is especially distinctive.

*Metopa **hearni*** n. sp. (Fig. 13)

Five females, some of them mature, were dredged at station 210, July 21, 1950; one mature female was taken at station 226, August 13, 1950, together with other species of the same genus; and one immature specimen (male?) was taken at station 102, June 6, 1949.

Body rather compressed. Head, lateral corners produced, bluntly pointed. Side-plates deep, fourth side-plate large and a little deeper than broad. Pleon 3 produced, bluntly acute. Eyes round, medium in size. Antennae short, equal. Antenna 1, first joint of peduncle equal to second and third together. Antenna 2, joints 4 and 5 of peduncle equal. Mouthparts normal for the genus, but first joint of mandibular palp very small, evanescent, third joint missing. Per. 1 stout, short, joint 5 about three-quarters of joint 6 in length. Per. 2 fairly heavy, hand (joint 6) broad, palm well defined by two spines at the angle, smooth. Per. 3 and 4 rather long, slender, per. 5–7 of medium weight, posterior process of joint 4 reaching to end of joint 5 on per. 6 and 7, not so far on per. 5. Per. 5, joint 2 linear; expanded in per. 6 and 7. Telson almost oval, unarmed. Length 3 to 4 mm. The species is named after Hearn, after whom Hearn Island, Diana Bay, is named.

This species is fairly close to *M. invalida* G. O. Sars, but differs in the broader and more rounded telson, the more acute pleon 3, the longer projection of joint 4, per 6 and 7, and the shape of per. 1 and 2. The distinctive spine on the posterior margin of joint 6, per. 1, of *invalida* is not found in *hearni.* The type (No. MJD–001) and cotypes are deposited in the Redpath Museum, McGill University. The type specimen comes from Station 210, July 21, 1950.

Metopella nasuta (Boeck)

One mature female, with eggs, was taken in the stramin net at station 18, July 17, 1947. The net touched bottom during the haul.

The species is known from north and west Norway, Skagerak, Scotland, southeast Iceland, southwest Greenland and the Gulf of St. Lawrence.

Metopella neglecta (H. J. Hansen)

Four specimens were taken; in the benthos at stations 226 and 210, and in the plankton at station 5, towing at about 20 metres. The latter specimen, taken on July 27, 1948, is mature.

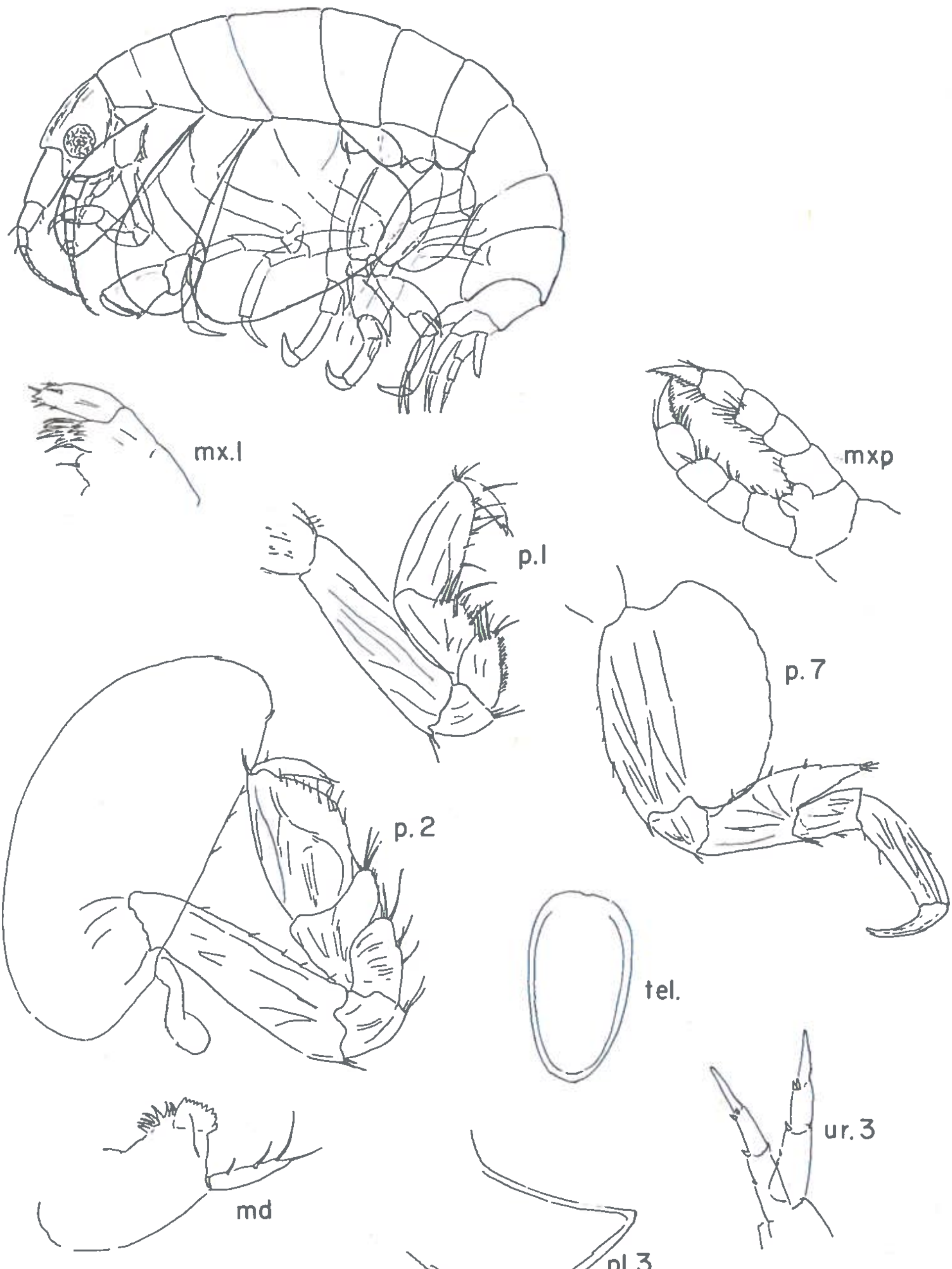

FIGURE 13. *Metopa hearni* n. sp., female.

The species is known from Franz Joseph Land, west Norway (Haugesund) and west Greenland. This appears to be the first record for North America.

Metopella carinata (H. J. Hansen)

Altogether 14 specimens of this species were obtained, all in the plankton, at stations 33 (towing at 10 metres), 40 (towing at 2 metres) and 123 (towing in the upper 5 metres). Mature ovigerous females were caught at the latter station, August 10, 1949.

This species is arctic and subarctic, known so far only from Greenland and eastern Canada: west Greenland, from Umanak southward; east Greenland, near Angmassalik; Canada, Gulf of St. Lawrence, Ungava Bay (present records) and Jones Sound, southwest Ellesmere Island.

Metopella longimana (Boeck)

Six females of this species were dredged at stations 103, 210 and 226; ovigerous specimens at the latter station only, August 13, 1950.

The species is known from west Greenland, from Egedesminde to the Julianehaab district, from Angmassalik in east Greenland, from northeast Iceland and west Norway (Oslofjord and Haugesund) (Stephensen, 1931). This is the first record for North America.

Stenothoe brevicornis G. O. Sars, var. **canadensis**, n. var. (Fig. 14)

Three ovigerous females and two males were taken at station 226, August 13, 1950.

Like *Metopa invalida*, above, this species has not hitherto been recorded elsewhere than at the Norwegian coast (Hardangerfjord, Bekkervik, Trondheimfjord). In the Ungava Bay specimens there are a few small variations from the

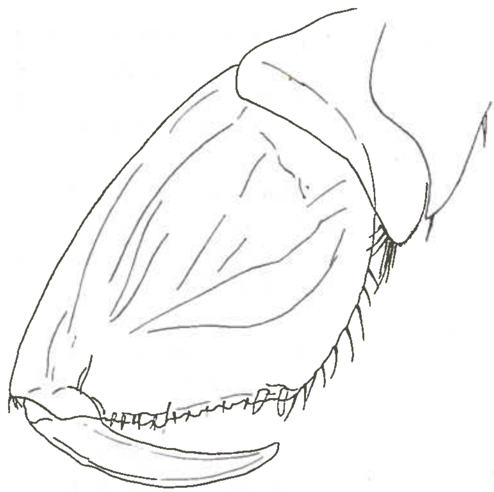

FIGURE 14. *Stenothoe brevicornis* var. *canadensis*, n. var.; per. 2, female.

Norwegian originals which justify the establishment of a new variety, as follows: Head, lateral corners rounded, not "obtusely angular" (Sars, 1895); side-plate 3, not distally widened, sides almost parallel; per. 2, angle of palm is hardly produced at all (Fig. 14); uropod 3, peduncle unarmed, not provided with "five very minute denticles", as described by Sars. Otherwise the Ungava Bay specimens agree with Sars's description and figures.

Family ACANTHONOTOZOMIDAE

Odius carinatus (Sp. Bate)

One small specimen was dredged at station 103, and a larger specimen, apparently an immature male, was taken at station 226.

This is predominantly a subarctic form, like many such species found also in west Norway and the North Sea. It has been recorded also from the Bering Sea (Holmes, 1910). Known from west Svalbard, White Sea, Skagerak and the Northumbrian coast, west Iceland and west Greenland. This is the first recorded find in the waters of eastern North America.

Acanthonotozoma serratum (O. Fabr.)

One immature specimen was taken in the plankton at station 13, towing at 40 metres; another came from the dredge at station 33, and one was taken in the stomach of an Atlantic cod at Port Burwell.

This is an arctic and subarctic (panarctic) species of wide depth range, known from the New Siberian Islands (Yashnov, 1948), the Kara Sea and west to Cumberland Sound in Baffin Island, from northern Svalbard to the Skagerak, Jan Mayen, Iceland, northeast and west Greenland, southern Labrador and the Bay of Fundy. It has been taken in the Norwegian Sea at 753 metres; the other records are from shallower water.

Acanthonotozoma inflatum (Krøyer). (Fig. 15)

Two specimens, a male and a female, were taken, the male at station 18, in a stramin net which touched bottom, the other in the dredge at station 58 on July 28, 1948. The female has well developed oostegites, but there is clearly at least one more moult to come before maturity.

The male agrees well with the full description and figures given by Stebbing (1894), but the female differs in the shape of the first four coxal plates. Plates 1 to 3 are less sharp than in Stebbing's description and plate 4 lacks the second emargination of the posterior edge. The claws (joint 7) of per. 1 and 2 have fewer teeth than shown and described by Stebbing. Per. 1, 2 and 4, with their coxal plates, are shown in Figure 15. Since in all other characters the specimen agrees with Stebbing, the differences illustrated can probably safely be ascribed to immaturity.

This an arctic and subarctic circumpolar species, not yet taken in Iceland. It is known from the Laptev and Kara Seas (Gurjanova, 1936a), White Sea, Svalbard, Barents Sea, Labrador and the Gulf of St. Lawrence, northeast Greenland (Schellenberg, 1935), west Greenland and Baffin Bay. There is a station in Hudson Strait on the chart of distribution published by Stephensen (1931) for which I have been unable to find the authority. The species has also been reported from Collinson Point, Alaska (Shoemaker, 1920).

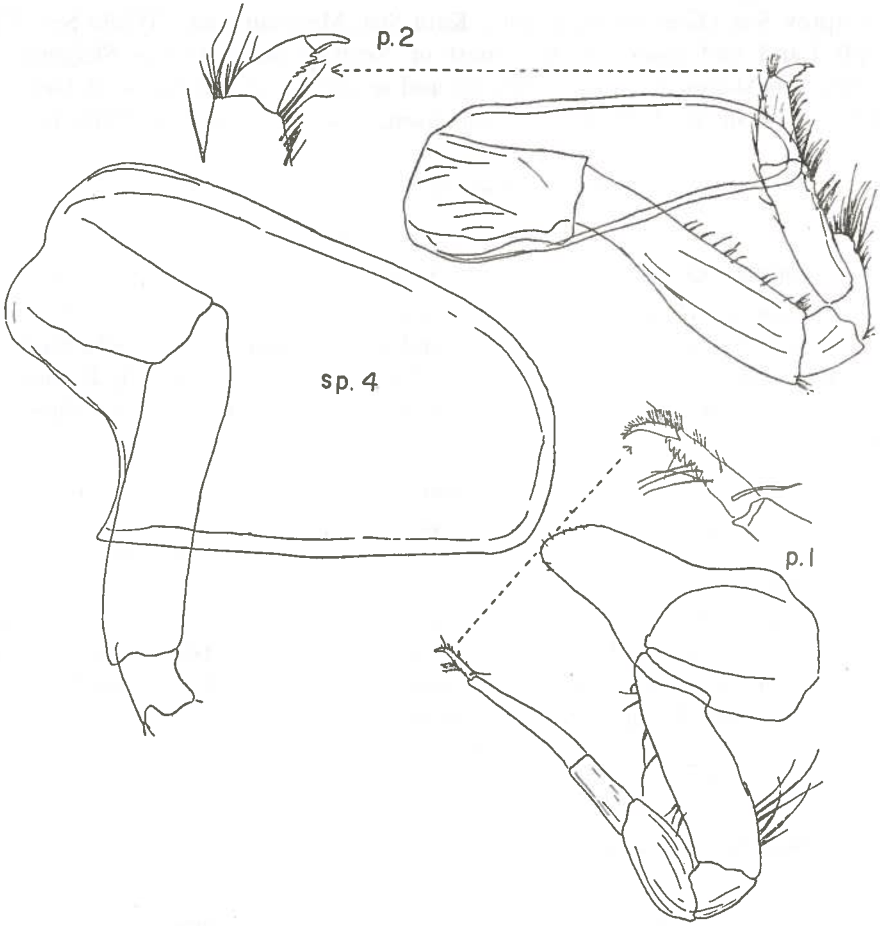

FIGURE 15. *Acanthonotozoma inflatum*, female with well developed brood lamellae, but not quite mature.

Family PARDALISCIDAE

Pardalisca cuspidata Krøyer

Eight specimens in all, six taken in the plankton at station 13, towing at 40 metres; one taken in the stramin net at station 18 when the net touched bottom, and one taken in the dredge at station 234. All specimens are immature.

There are certain small variations from the figures and description in Sars (1895), owing to the immaturity of the specimens. In particular, the spination of the telson is less than in the adult and the subdorsal lobes on metasome segment 3 are rounded, not sharp as in the adult. In these differences the Ungava Bay specimens agree with specimens in the Copenhagen collection from Lindenowfjord, southeast Greenland, which are also immature.

This is an arctic and subarctic species, found both in the plankton and benthonically at depths down to 550 metres (Norwegian Sea). It is known from the Laptev Sea (Gurjanova, 1935a), Kara Sea, Murman coast, White Sea, Franz Joseph Land and Svalbard, the coast of Norway down to the Skagerak, the Faeroes, Jan Mayen, Iceland, northeast and southeast Greenland, west Greenland and the Gulf of St. Lawrence (Stephensen, 1944a; Shoemaker, 1930a).

Family OEDICEROTIDAE

Oediceros saginatus Krøyer

Ten immature specimens were taken in the plankton, at stations 1, 9, 40 and 124.

The species is known mainly from the subarctic, but three records (northeast Greenland, northeast Baffin Island and the Siberian coast close to East Cape (Stuxberg, 1882)) are arctic. Otherwise known from Jugor Strait, Barents Sea, Svalbard, north and west Norway, west Greenland and Hudson Bay (Shoemaker, 1926).

Paroediceros lynceus (M. Sars)

Twenty-four specimens, all immature, were taken in Ungava Bay, planktonically at stations 1, 18, 13, 101, 123 and 124, and in the benthos at stations 45, 102, 201 and 203. Five specimens were found in Atlantic cod stomachs at Port Burwell.

This species has already been recorded from the eastern arctic of Canada, in Jones Sound (Sars, 1909) and the east coast of Baffin Island (Ohlin, 1895). It has also been taken already in Ungava Bay, at Burwell (Shoemaker, 1920). Probably circumpolar arctic and subarctic, it is known from the Siberian coast as far east as longitude 173°W (close to East Cape) (Stuxberg, 1882), from the Japan Sea (Gurjanova, 1938), Alaska (Shoemaker, 1920) and south in the Atlantic area to New England (Holmes, 1905), Cape Farewell, Iceland and northwestern Norway; Kara and Laptev Seas (Gurjanova, 1932, 1935a).

Arrhis phyllonyx (M. Sars)

Four immature specimens were dredged at station 201, June 29, 1950.

This is a circumpolar arctic and subarctic species, known from the New Siberian Islands and from the Canadian central arctic (Dolphin and Union Strait (Shoemaker, 1920)), and from many arctic and subarctic stations in the Atlantic sector. See Stephensen (1931) for chart of distribution in this sector, and (Stephensen, 1944a) for east Greenland records. It has already been taken in the eastern arctic (northeast Baffin Island (Ohlin, 1895)) and it is known from the Gulf of St. Lawrence (Shoemaker, 1930a).

Westwoodilla brevicalcar (Goës)

Three immature specimens, one a juvenile male, were taken in the plankton at stations 101, 123 and 124, towing between the surface and 10 metres.

The identification has been checked against specimens in the Copenhagen collections. The curvature of the second joint of the mandibular palp is not so striking as is figured by Sars (1895) for the genus, and as implied by Stebbing (1906) in the generic description. This applies also to the next species below, and has been confirmed by examination of specimens of both species in the Copenhagen material. The present species of *Westwoodilla* are very close together morphologically (see below); *brevicalcar*, in eastern Canadian arctic and subarctic waters, is separable from *megalops* and *caecula* only on the slightly larger size of per. 1 and 2, and the sharper frontal process of the head.

The species is apparently subarctic, recorded from Svalbard, the Barents Sea, northwest Norway, southeast Iceland, west Greenland, Hudson Strait and the Gulf of St. Lawrence. It has not been taken outside the Atlantic subarctic region, and its distribution fits closely the definition of the subarctic marine region employed in the present series of papers (see above, introduction).

Westwoodilla megalops (G. O. Sars). (Fig. 16)

Syn.: *W. caecula* (Bate) (*Halimedon mülleri* Boeck and *Westwoodilla hyalina* Stephensen, 1926). **New synonymy.**

Eleven specimens were taken in the stramin net at station 18, on July 17, 1947. The net touched bottom during the haul.

The fusion of *W. megalops* and *W. caecula* is here proposed on the grounds that it is impossible to place the present specimens, and specimens from the Gulf of St. Lawrence (see below) in one species or the other, characters of both forms being present. The two species were originally described from European (Norwegian) specimens, and it is clear from European work that the population can be separated into two in that region. It apparently cannot be split into two in North America. Three possible solutions to the resulting taxonomic problem appeared to be available: (1) to leave *W. megalops* and *W. caecula* as full species and to make a new species on the present specimens from Ungava Bay; (2) to place *megalops* and *caecula* in synonymy for the North American seaboard only, which would be a departure from nomenclatural practice; (3) to place all three forms in synonymy, with or without the use of subspecific names. The obvious identity of the present specimens with the *megalops-caecula* group in Europe made the first possibility inadvisable, and the second solution might lead only to confusion. I have therefore decided to place all three in synonymy, without using subspecific names to distinguish them. Individuals may be referred to as belonging to the "*megalops*" or "*caecula*" form, or populations may be distinguished geographically. According to Stephensen (1931) the *caecula* form dominates in the southern part of the range in west Europe (Kattegat, Skagerak, North Sea) while *megalops* dominates in the northern part (northwest Norway, Iceland and Greenland).

Stephensen (1931), who kept the two forms distinct as species as the result of study of European specimens, showed that his specimens of the two forms from Norway and Denmark could be separated on the following characters:

W. megalops	*W. caecula*
Telson transversely truncated or slightly emarginate	Telson oval, evenly rounded
Joint 2, per. 7, upper hind corner rectangular with rounded point. Margin sparsely setose	Joint 2, per. 7 evenly rounded, "making part of a circular arch". Margin densely setose
Antennae shorter	Antennae longer
Body form in female stout (slender in male)	Body form in female slender (slender in male)

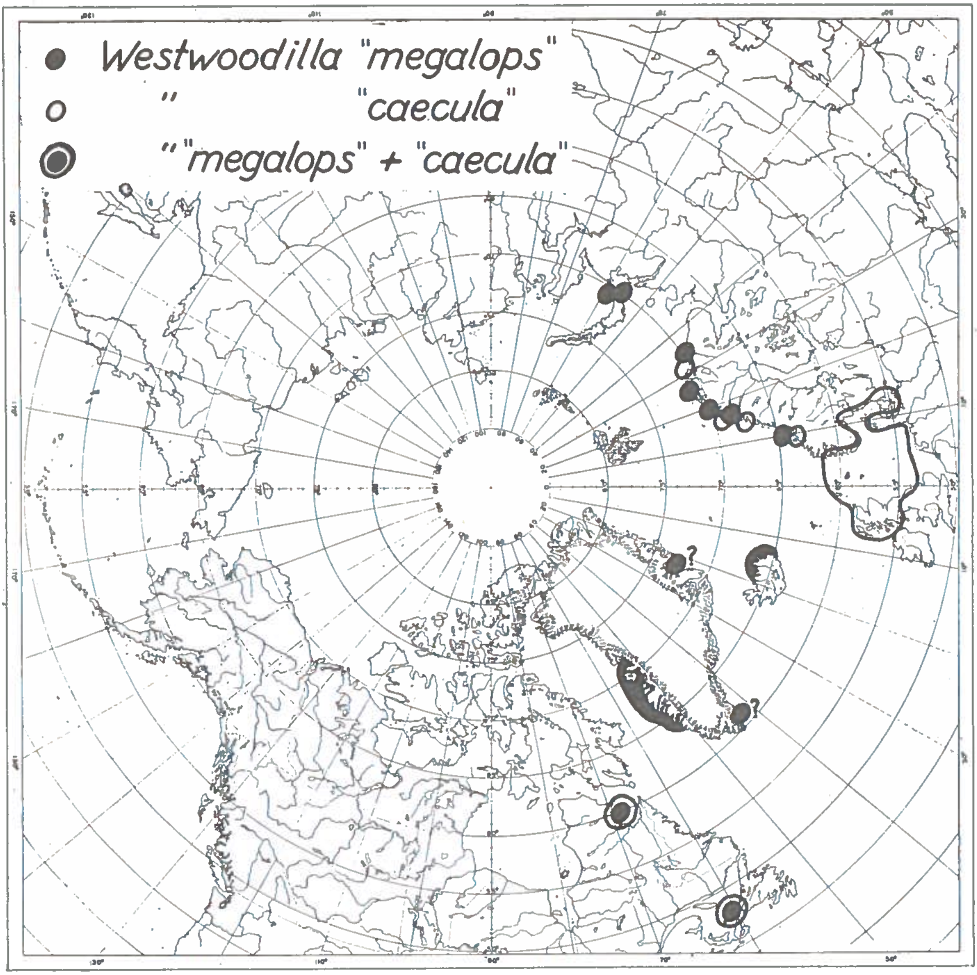

FIGURE 16. Distribution of *Westwoodilla megalops* and *W. caecula,* which are brought into synonymy in this paper (see text). Stephensen (1944a) was uncertain to which form his east Greenland specimens should be referred.

In the Ungava Bay specimens the females show the slender form described by Stephensen for *caecula*. The telson in eight of the specimens is rounded at the tip (*caecula*) but in three it is slightly emarginate (*megalops*). The antennae are short, and joint 2, per. 7, in all the specimens, is of the *megalops* shape, precisely as figured by Stephensen.

Stephensen (1944a), writing long after his 1931 paper just quoted, was unable to be certain of the indentification of specimens from east Greenland, owing to the shape of the frontal process of the head, which was intermediate between the two forms. The specimens in question have been examined by the present writer; they have the telson and joint 2, per. 7, of the *megalops* form, and since Stephensen (1931) placed specimens from west Greenland in *megalops* on the basis of the telson, not on the shape of the head, it is possible that Stephensen himself, by 1944, was no longer certain that the species should be separated. The head shape in the Oedicerotidae is highly variable, as is abundantly shown by the studies of Enequist (1949) on material from the Skagerak. At all events the Ungava Bay specimens cannot be split into two species or even into two variants, but show characters of both the European forms. It may be that they represent the original common stock from which the two western European forms evolved.

Shoemaker (1930a) recorded both forms, referred to distinct species, from the Gulf of St. Lawrence. Examination of them shows that the population in the Gulf of St. Lawrence is similar to that in Ungava Bay. I have seen 21 specimens of the Gulf material, 15 labelled *megalops* and 6 labelled *caecula*, borrowed from the Smithsonian Institution. They were determined according to the old system of Sars (1895) and Stebbing (1906), based on the shape of the eyes and rostrum. These characters, however, as already mentioned, have since been shown to be highly variable in this family, and Stephensen (1931) reported numerous specimens which took an intermediate position in these characters. An examination of the Gulf of St. Lawrence material in the light of the distinctions proposed by Stephensen and tabulated above gives the following result:

Four specimens labelled *W. caecula* from *Prince* station 53a (see Shoemaker, 1930a):

1. Mature female. Telson slightly emarginate; per. 7 joint 2, quadrate. Body form intermediate — ?*megalops*
2. Immature female. The same — ?*megalops*
3. Male. Telson truncate; per. 2, joint 7, quadrate — *megalops*
4. Ovigerous female. Telson truncate; per. 7 as above; body form intermediate — ?*megalops*

Two specimens labelled *W. caecula* from *Prince* station 30:

1. Male (mature?). Telson truncate but damaged; per. 7, joint 2, quadrate — *megalops*
2. Immature female. Telson rounded (*caecula*); per. 7, joint 2, quadrate (*megalops*) — mixed

Six specimens labelled *W. megalops* from *Prince* station 43:

1. Male. Telson truncate; per. 7, joint 2, quadrate, less markedly so than normal for *megalops* form — ?*megalops*
2. Male. Telson missing; per. 7, joint 2, rounded — ?*caecula*
3. Mature female. Telson slightly convex, not as rounded as in typical *caecula* form; per. 7, joint 2, quadrate — mixed
4. Ovigerous female. Telson truncate; per 7, joint 2, quadrate — *megalops*
5. Ovigerous female. Same as No. 4 — *megalops*
6. Mature female. Telson as in No. 3; per. 7, joint 2, quadrate — mixed

Nine specimens labelled *megalops* from *Prince* station 33:

1. Ovigerous female. Telson truncate; per. 7, joint 2, quadrate — *megalops*
2. Male. Antenna 1 longer than normal for *megalops* type; telson truncate, per. 7 quadrate — ?*megalops*

3. Male. Ant. 1 as in No. 2; telson truncate; per. 7 not so markedly quadrate — ?*megalops*
4. Male. Telson slightly emarginate; per. 7 quadrate — *megalops*
5. Male. Ant. 1 long; telson narrower than normal, slightly emarginate; per. 7 not markedly quadrate — ?*megalops*
6. Male. Ant. 1 long (11 joints); telson as in No. 5; also per. 7 — ?*megalops*
7. Male. Ant. 1, 10 joints; telson long, rounded; per. 7 as in No. 5 — mixed
8. Male. Ant. 1, 10 joints; telson intermediate; per. 7 as in No. 5 — mixed
9. Male. Ant. 1, 9 joints; telson truncate; per. 7, joint 2, more rounded than in the above — mixed

In this material, the males were apparently mature. In all the Gulf of St. Lawrence specimens, as well as in the Ungava Bay material, side-plate 1 is more expanded than is described for *megalops* by Stephensen, approaching the condition described as typical for the *caecula* form.

The above analysis shows that the North American population of the species resembles the *megalops* form more than the *caecula* form, both of which are found in the "pure state" only in Europe, and somewhat separated in distribution there. Enequist (1949) has brought *W. caecula* and *W. acutifrons* together into one species; on the present showing, both should therefore now be included in *W. megalops*. *W. brevicalcar*, as mentioned above, lies suspiciously close to *megalops*. Further work may well show that all four forms represent a complex of variants which appear in slightly different manifestations in the various parts of the common range or in different ecological conditions.

The species, under the name *W. caecula*, has been recorded from the Japan Sea by Gurjanova (1938). The distribution of both *megalops* and *caecula* forms, as at present known, is shown in Figure 16.

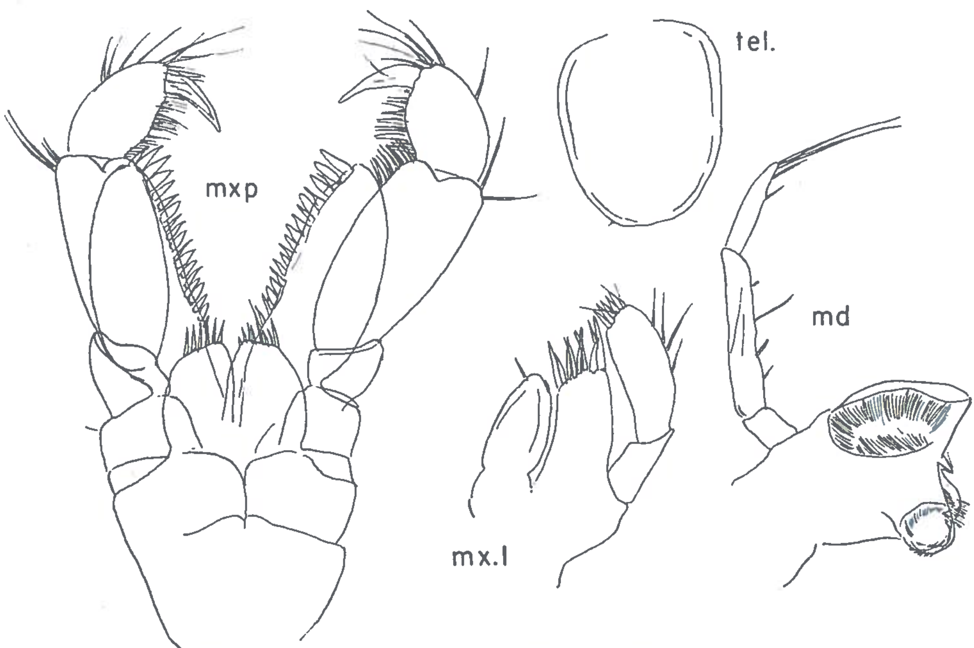

FIGURE 17. *Bathymedon ?obtusifrons*, ovigerous female.

Aceroides latipes (G. O. Sars)

One immature specimen was dredged at station 234, August 31, 1950.

The species is arctic and subarctic, circumpolar; only once before recorded from the North American arctic, from Collinson Point, Alaska (Shoemaker, 1920). Known from the East Siberian Islands, Kara Sea, Svalbard, north Norway, east and west Greenland.

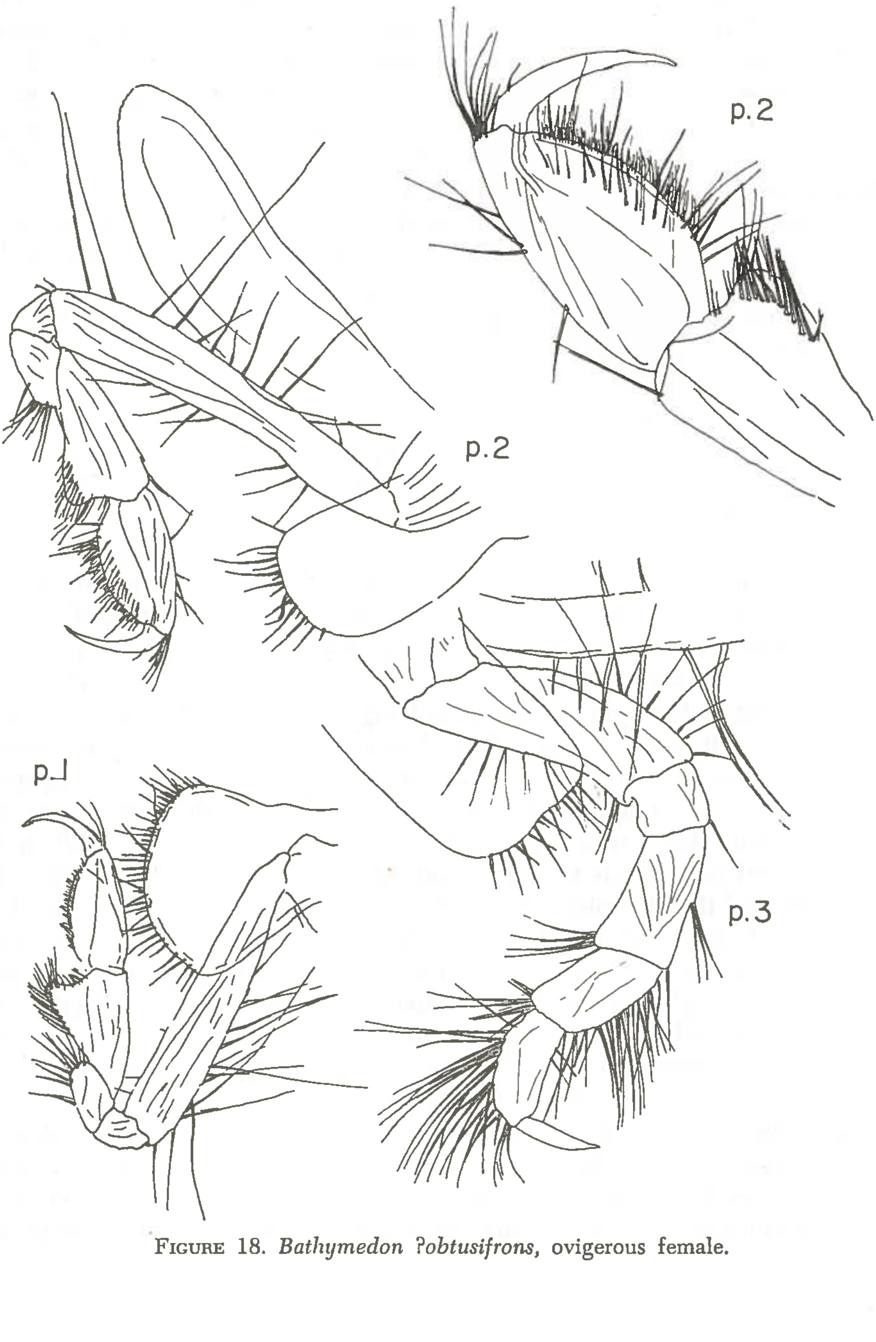

FIGURE 18. *Bathymedon* ?*obtusifrons*, ovigerous female.

Bathymedon ?obtusifrons (H. J. Hansen). (Fig. 17, 18)

Three specimens were caught, an immature female at station 18, July 17, 1947, and two ovigerous females, one 8 mm. long at station 102, June 30, 1949, and one 4 mm. long at station 234, August 31, 1950. The difference in size at maturity may be due to the different season of growth.

The determination has been queried because all three specimens, especially the larger of the two mature females, show differences from the original description and from Sars's (1895) figures. None of the specimens has the long spinule on the palm of per. 1 and 2. The larger female has a somewhat sharper rostrum than is normal for the species, and the telson is rather more rounded. All three specimens show a less expanded fifth joint in per. 2 (but much more expanded than in *B. longimanus* (Boeck)). These may be, probably are, local geographic variants, or they may be in part due to differences in post-maturity moults, which are well known to be complicating factors in amphipod systematics.

This species is both arctic and subarctic, being known from northeast and west Greenland, the Gulf of St. Lawrence, Franz Joseph Land and Novaya Zemlya, Iceland and north Norway. A specimen is also recorded from the Skagerak (Stephensen, 1931) and it is reported from the Japan Sea (Yashnov, 1948), and from the Kara Sea.

Monoculodes longirostris (Goës). (Fig. 19)

A mature female was dredged at station 201, June 30, 1950, and an immature specimen was taken in the plankton at station 40, August 16, 1947. The determination of the immature specimen is not certain.

The mature specimen shows deviations from the typical *longirostris* which are strikingly in the direction of *M. hanseni* Stebbing, which is known from the Kara Sea and the New Siberian Islands. In the original description of *hanseni*, Stebbing (1894) writes as follows: "The present species stands very close to *Monoculodes longirostris* Goës, but . . . the apex of the rostrum is more depressed, the second joint of the upper antennae is longer than the first instead of shorter than or equal to it, and the sides of the telson are insinuate instead of straight. The differences in the mouth-organs are very slight, but *Monoculodes longirostris* has no spines on the outer margin of the outer plates of the maxillipeds. The gnathopods of the latter species are also less widened at the palms, while in the first and second peraeopods the sixth joint is more widened distally than in the new species, and the side-plates of the third peraeopods are less wide and have the front margin straighter." In the text of the description Stebbing also described *hanseni* as having a transverse groove on the dorsal surface of the head near the base, and a slight discontinuous carina on the first three segments of the pleon, neither of which are found in the typical *longirostris*. The reader is reminded that Stebbing numbered the peraeopods posterior to the gnathopods 1 to 5 instead of 3 to 7 (see introduction of this paper).

Specimens of *M. longirostris* from east Iceland and from east Greenland in the Copenhagen collection have been compared with the Ungava Bay specimen. The latter shows the following similarities to *M. hanseni*: transverse grooves on the dorsal surface of the head; rostrum tip depressed, not so much as in Stebbing's

FIGURE 19. *Monoculodes longirostris,* per. 3.

description and figure of *hanseni,* but quite different from the typical *longirostris* specimens; antenna 1, joint 2 of peduncle longer than joint 1 (joint 2 is also longer in the *longirostris* specimens from Iceland and Greenland, but not to the same extent. In this character these specimens do not agree with the original description); telson, sides definitely insinuate (straight in the *longirostris* specimens); per. 1 and 2, hand slightly wider than in *longirostris,* but not significantly so; slight carina on pleon segments 1–3, more marked on the third segment than on the other two. The carina is absent from the Iceland and Greenland specimens.

In other diagnostic characters, however, the Ungava specimen agrees with the typical *longirostris*, differing from *hanseni*: no spines or hairs on the outer margins of the outer plates of the maxillipeds; antenna 1, joint 1, of peduncle a little shorter than the rostrum (longer in *hanseni*); side-plate 5, front margin straighter (in agreement with the Copenhagen collection specimens).

Joint 6, per. 3, is intermediate between the two species (Fig. 18). It is not so wide distally as in the typical *longirostris*, the pattern shown in the Iceland specimens (the Greenland examples are closer to the Ungava specimen in this character). Joint 6, per. 4, however, is similar to per. 3, and quite unlike the *hanseni* form, in which it is longer, strongly curved, and tapered to a narrow tip.

It is apparent that the Ungava Bay specimen lies between the two species; there appear also to be slight differences from the type in the Iceland and Greenland specimens, more marked in the latter. The possibility therefore arises that we have here a good example of a geographic gradient of type between the two, and since both species are known from the Siberian coast (but in different ecological conditions (Gurjanova, 1935a)) the pattern of distribution and relation is that of the "rassenkreiss" or "artenkreiss", in which, at the two ends of the circumpolar distribution, the products of dispersal are specifically different. Such a pattern of distribution could well have occurred by means of the mechanism of dispersal from the Bering Sea region suggested by Gurjanova (1935b).

Monoculodes hanseni is at present known only from the Kara Sea and the New Siberian Islands. *M. longirostris* is known in the palaearctic as far east as longitude 117°E, to which, if the rassenkreiss pattern applies to these two species, it should have come from the west and not from the east. One specimen of *longirostris* is also recorded from Bernard Harbour in the Canadian central arctic (Shoemaker, 1920); this specimen borrowed from the National Museum of Canada, has been examined and turns out to be quite immature and therefore not referable to species with certainty. The species is also known from the Gulf of St. Lawrence (Shoemaker, 1930a) east Greenland (not west Greenland), Iceland, Svalbard, Jan Mayen, north Norway, Barents Sea and Kara Sea. It is thus an arctic and subarctic species; the lack of record from west Greenland is most probably due to the fortunes of collecting; it would be surprising if it were not there.

Monoculodes ?krøyeri Boeck and *Monoculodes ?schneideri* G. O. Sars

Immature specimens probably belonging to these two species were taken in the plankton and in the intertidal zone, but they cannot be assigned to either species with certainty.

Monoculodes latimanus (Goës)

Twenty-one specimens of this species, all immature except for one mature female, were taken in the plankton at stations 13, 22, 18 and 51. The mature female was caught on July 17, 1947.

The species is arctic and subarctic, known from Kara Strait (Stappers, 1911), Franz Joseph Land, west and north Svalbard, the Murman coast and the White Sea, north Norway, east Iceland and the Gulf of St. Lawrence, west and east Greenland. It is also recorded from the Sea of Japan (Derjavin, 1930; Yashnov, 1948).

Monoculodes edwardsi Holmes

Six specimens were taken in the plankton at station 51, in very shallow water.

M. edwardsi was described by Holmes (1905) from specimens taken on the New England coast. Shoemaker (1930a) recorded about 500 specimens from the Gulf of St. Lawrence, and it has been found also on the east coast of Hudson Bay (Shoemaker, 1926). Holmes (1905) describes joint 7, per. 5 and 6, as being over half the length of the propodus (joint 6); in the present specimens the dactyl is longer than the propodus. Otherwise they agree closely with Holmes's description and figures.

Monoculodes tuberculatus Boeck

Seven specimens, including two almost mature females, were taken planktonically at stations 13, 18, 101.

An arctic and subarctic species, recorded from the Barents Sea, Kara Sea and the New Siberian Islands, west Svalbard, north and west Norway, east and west Greenland and the Gulf of St. Lawrence. There is also a record from the Firth of Clyde, western Scotland (Norman, 1900).

Family TIRONIDAE

Syrrhoë crenulata Goës

This species was taken in the plankton at stations 13, 18 and 101, 19 specimens in all. Mature specimens were taken on July 17, 1947, and June 26, 1949. The net touched bottom at station 18.

The specimens differ from the description and figures of Sars (1895) in having only one dorsal tooth on peraeon segment 7. Specimens in the Copenhagen collection, from east Greenland, agree with the Ungava Bay material in this respect.

The species is arctic and subarctic, from Novaya Zemlya and Franz Joseph Land to the Bay of Fundy (Whiteaves, 1901); Svalbard, north and west Norway, Skagerak, Iceland, east and west Greenland, Sea of Japan.

Family CALLIOPIIDAE

Amphithopsis longicaudata Boeck. (Fig. 20)

Two ovigerous females were dredged at stations 103 and 226, on July 6, 1949, and

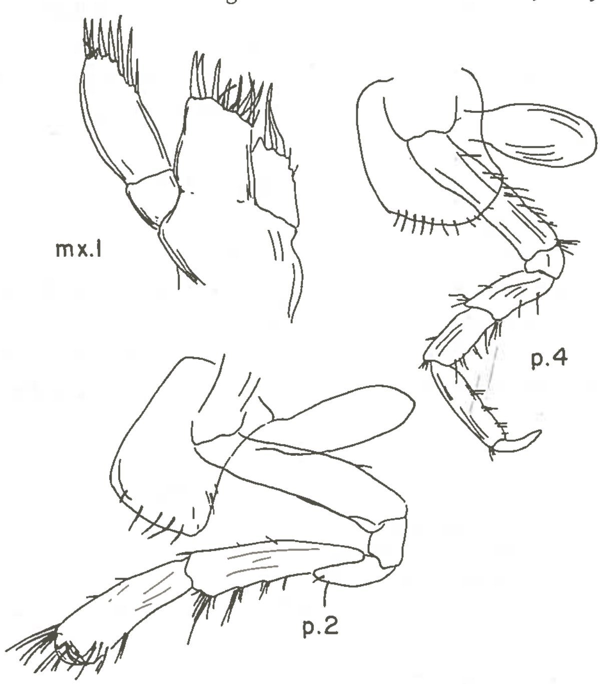

FIGURE 20. *Amphithopsis longicaudata.*

August 13, 1950. One immature female came from the stomach of a ringed seal, June 30, 1949, at Port Burwell.

These specimens differ from the descriptions of Boeck (1876) and Sars (1895) in the first maxilla, which has only two large setae on the inner plate instead of 4 (Boeck) or 7 (Sars), and in side-plate 4, in which the posterior excavation is very slight. They are not important differences, and in the case of side-plate 4 the specimens in the Copenhagen Museum collection show considerable variation; there is in fact a difference in the extent of excavation even between the two mature Ungava Bay specimens. The individual with the lesser excavation is shown in Figure 20.

The species has been recorded from the subarctic only: White Sea, north and west Norway, Iceland, west Greenland, Gulf of St. Lawrence and Hudson Bay.

Haliragés mixtus Stephensen

Seven specimens, six immature and one maturing female, were taken in the plankton at station 40, August 16, 1947.

The species was established by Stephensen (1931) on specimens from Ingolf's Fjord, east Greenland, latitude 66°15′N. The present record from Ungava Bay is the first outside the type locality. The maturing female differs from Stephensen's description only in the telson, which has a single notch at the tip instead of a triple notch (the two outer notches are missing). The immature specimens have the telson as described by Stephensen. The telson in the genera *Halirages* and *Apherusa* is inclined to be highly variable. Apart from the telson, the agreement with *mixtus* is complete, including the diagnostic characters given by Stephensen, namely the process on joint 3, antenna 1, the quadrangular subantennal corner of the head and the broad second joint in per. 5–7. The eyes, which were damaged in Stephensen's type specimen, are round and black.

Halirages fulvocinctus (M. Sars)

One female, not quite mature, was taken in the dredge at station 33. Six specimens were taken in cod stomachs (*Gadus callarias*) at Port Burwell.

This species is arctic and subarctic, present also in the Skagerak. Kara Sea, Barents Sea, Franz Joseph Land, New Siberian Islands and "far eastern seas" (Yashnov, 1948), coast of Norway, Svalbard, Jan Mayen, Iceland, east and west Greenland, northeast Ellesmere Island, southeast Baffin Island, Gulf of St. Lawrence, Hudson Bay and the coast of Nova Scotia.

Halirages megalops (Bucholtz)

Syn.: *Paramphitoë megalops* Bucholtz, 1874.
Apherusa megalops Shoemaker, 1930a; Dunbar, 1942.
Halirages megalops Stephensen, 1931, 1944a.

This species was taken in the plankton only, 70 specimens in all, at stations 7, 9, 33, 51, 101, 123 and 225.

There seems to be no good reason to keep the genera *Halirages* and

Apherusa separate. As Stephensen (1931) has pointed out, it has been necessary to modify the descriptions of both to such an extent that there remains only one small difference between the two—the presence of calceoli on the antennae in *Halirages* and their absence in *Apherusa,* and in some cases, as in the present species, the calceoli are few.

This species is common where found, but it has been recorded so far only from east and west Greenland, the Barents Sea (Yashnov, 1948), various stations in the Canadian eastern arctic (Dunbar, 1942), the Gulf of St. Lawrence (Shoemaker, 1930a) and Bernard Harbour in the central arctic (Shoemaker, 1920). Stephensen (1944a) calls it a "low-arctic" (subarctic) species. The records from northeast Greenland and the Canadian central arctic cannot be called subarctic on the criteria used here, but these records are all from shallow water, probably above the thermocline, and therefore from water which is heated in summer by insolation. If, therefore, the limiting distributional factor is the temperature during the breeding period, it may be that this species is to be looked upon as a subarctic form which has invaded shallow water farther north, or as a relict of a warmer part of the climatic cycle. This pattern may also fit other species. Stephensen uses the term "low-arctic" to include such shallow water areas in regions otherwise purely arctic, following Hofsten (1915), Lemche (1941), etc. (see below, discussion).

In Ungava Bay, ovigerous females were taken on July 3, July 7, July 11 and August 10, 1947, and June 26 and August 10, 1949.

Apherusa glacialis (H. J. Hansen)

Seventy-three specimens of this common pelagic species were taken in the plankton, at stations 1, 7, 9, 13, 18, 41, 56, 103, 203 and 303. There were no ovigerous females in the material.

This is a circumpolar species, arctic and to a lesser extent subarctic, pelagic, usually in the upper layers. Known from the Arctic Sea in the north to the tip of south Greenland, and from Jones Sound to the Gulf of St. Lawrence. Hudson Strait, north coast of Alaska and Bernard Harbour, N.W.T.; Kara and Laptev Seas, and Svalbard.

Calliopius laeviusculus (Krøyer)

Syn.: *Calliopius rathkei* (Zadd.)

Eighty-seven specimens, all immature, were taken, all but one in plankton nets. The single specimen caught on the bottom was found on a seal skull left in seven fathoms overnight at station 125A. The others were taken at stations 31, 40. 43, 51, 125, 129 and 304. All these are shallow water stations close to shore.

C. laeviusculus and *C. rathkei* were brought together to a single species by Stephensen (1931), who showed that the small distinguishing features were found in all degrees of intergradation. Both forms occur in the Ungava Bay material.

The species is arctic, subarctic and boreal, predominantly subarctic. It does not appear to have been recorded yet from the Siberian coast east of the Barents Sea, but it is known from the north Pacific including the Japan Sea; the

Canadian central arctic and eastern arctic, west Greenland, Iceland, Faeroes, the British Isles, the North Sea and the Baltic, the coast of Norway east to the White Sea, west Svalbard and Franz Joseph Land.

Family PLEUSTIDAE

Pleustes panoplus (Krøyer)

Seven specimens were taken. Two immature individuals were caught in plankton nets at stations 18 and AS-28 (Acadia Cove, Resolution Island); two females approaching maturity were dredged at stations 11 and 216; and three specimens were taken from the stomach of a bearded seal off the mouth of the Whale River.

A circumpolar arctic and subarctic species, recorded from the New England coast to Ungava Bay (Smith, 1884) and Baffin Bay and eastwards over Greenland, Svalbard, Franz Joseph Land to the New Siberian Islands and the Japan Sea, south in northwest Europe to Bohuslän.

Pleustes medius (Goës). (Fig. 21)

Five specimens were dredged at station 102.

Brüggen (1909) considered that this species, together with others, was a variation or immature stage of *P. panoplus*. This has not been followed by later authors, and indeed the evidence upon which Brüggen based his opinion was

FIGURE 21. *Pleustes medius*, mandible.

very slight. *Pleustes medius* differs widely from *panoplus* in size at maturity, lack of body ridges, strong molar in the mandible, characteristic side-plates 1 and 2, different form of per. 1 and 2 and of pleon 3; side-plate 4 is also entirely different. Even allowing for the pitfalls of amphipod systematics the two cannot be put together.

Since the original description of Goës, the species has been redescribed by Stephensen (1938) and Shoemaker (1930a), the latter with new figures. Neither author mentions the fact that the mandibular molar is strongly developed, in contrast to *panoplus* and also in disagreement with the generic description of Stebbing (1906) and others. The mouthparts have in fact never been described. The strong molar, which requires a restatement of the generic description, is illustrated in Figure 21, and the character has been confirmed by the examination and dissection of specimens (co-types) in the Copenhagen Museum collection, in which the mandibular molar is equally stout, the left with a larger triturating surface than the right.

This species has not often been recorded. It is known from west and northwest Svalbard, the White Sea and the Murman coast, the Kara Sea (Gurjanova, 1935a), and the Gulf of St. Lawrence (Shoemaker, 1930a).

Parapleustes pulchellus (Krøyer)

Syn.: *Neopleustes pulchellus* Stebbing, 1906; Shoemaker, 1930a.
Parapleustes pulchellus Stephensen, 1938, 1944a, 1944b.

Five immature specimens of this species were taken in the benthos at stations 103 and 226.

This species is recorded from the subarctic belt and to a lesser extent from arctic areas, from the Maine coast to Davis Strait, Iceland, Svalbard and Franz Joseph Land, the Barents and White Seas, north and west Norway and the deep water of the Norwegian Sea; New Siberian Islands. It is not known from east Greenland.

Parapleustes boecki (H. J. Hansen)

Syn.: *Neopleustes boecki* Stebbing, 1906.

Four specimens were dredged at stations 58, 208 and 226. Two of them were mature females, taken on July 28, 1948, and July 20, 1950.

Della Valle (1893) put this species together with *P. pulchellus* and other species of the genus, but this has not been followed by others, nor is it at all reasonable; the species does not agree with Della Valle's own description and it is easily and immediately separable from *P. pulchellus.*

P. boecki has been reported hitherto only from west Greenland, from Disko Bay southwards (Hansen, 1887), and from the New Siberian Islands (Yashnov, 1948).

Parapleustes bicuspis (Krøyer)

Syn.: *Neopleustes bicuspis* Stebbing, 1906.

Six immature specimens were taken in the plankton at station 123.

According to Stephensen (1917) this is one of the commonest amphipods on the southwest Greenland coast. In Canada, it has already been recorded from Ellesmere Island (Sars, 1909), Baffin Bay (Ohlin, 1895), Labrador (Packard, 1867) and Hudson Bay (Shoemaker, 1926). It is a species of wide distribution in the Atlantic boreal, subarctic and arctic, and it is known from the Barents Sea, Franz Joseph Land, White and Kara Seas (Yashnov, 1948); east and west Greenland, Iceland, Svalbard, Norway, Skagerak and Øresund (Dahl, 1946b), northwest France.

Parapleustes assimilis (G. O. Sars). (Fig. 22)

Syn.: *Neopleustes assimilis* Stebbing, 1906.

Twelve specimens were taken in the benthos at stations 18, 103 and 226. Ovigerous females were found on July 6, 1949, and August 13, 1950.

The specimens differ from Sars's description and figures in two characters: in per. 2 the hind margin of joint 6 is more rounded, with the palm poorly defined. The tooth on the palm is present, but a little larger. The finger is slightly longer (Fig. 22). In these variations from the type the Ungava Bay specimens are in agreement with specimens in the Copenhagen collection from southwest Greenland (Bredefjord).

FIGURE 22. *Parapleustes assimilis*, per. 2.

Predominantly a subarctic species, but found also in the boreal (off Liverpool, near Helgoland, Firth of Forth and Shetlands Islands), and in the arctic (Scoresby Sound, New Siberian Islands). West Greenland, Hudson Bay, Faeroe Islands, Skagerak (Enequist, 1949), Barents and White Seas. It is a shallow water species, and as regards the records from Hudson Bay, Scoresby Sound and the New Siberian Islands, the same considerations may apply here as in the case of *Halirages megalops* (above).

Parapleustes ***sinuipalma*** n. sp. (Fig. 23, 24)

One ovigerous female was dredged at station 11, July 12, 1947. An immature male which may belong to the same species (see below) was taken in the plankton at station 33, August 10, 1947.

Body not carinate, without dorsal teeth in the female, but with pleon segments 1 and 2 dorsally bluntly produced. Head as long as the first two thoracic segments, lateral angles produced, rounded, lower angles sharp. Side-plate 1 very little expanded distally, side-plates 1, 2 and 3 with minute notch and tooth at lower hind corner. Pleon segment 3, postero-lateral corner produced into a small tooth. Eyes large, almost round. Antenna 1, first joint of peduncle as long as second and third combined, flagellum long, over half body length. Mouthparts typical of the genus. Left mandible with accessory plate, maxilla 1 with 2 setae on inner plate. Maxillipeds, third joint of palp not distally attenuated beyond the finger (this agrees with other species of the same genus established since Stebbing, 1906 (Holmes, 1908; Gurjanova, 1938), and the generic description should be altered accordingly). Per. 1 and 2 alike, hand (joint 6) rather long, slightly larger in per. 2 than in per. 1, palm slightly sinuous and richly armed with spinules; finger long. Telson oval, more or less smoothly rounded

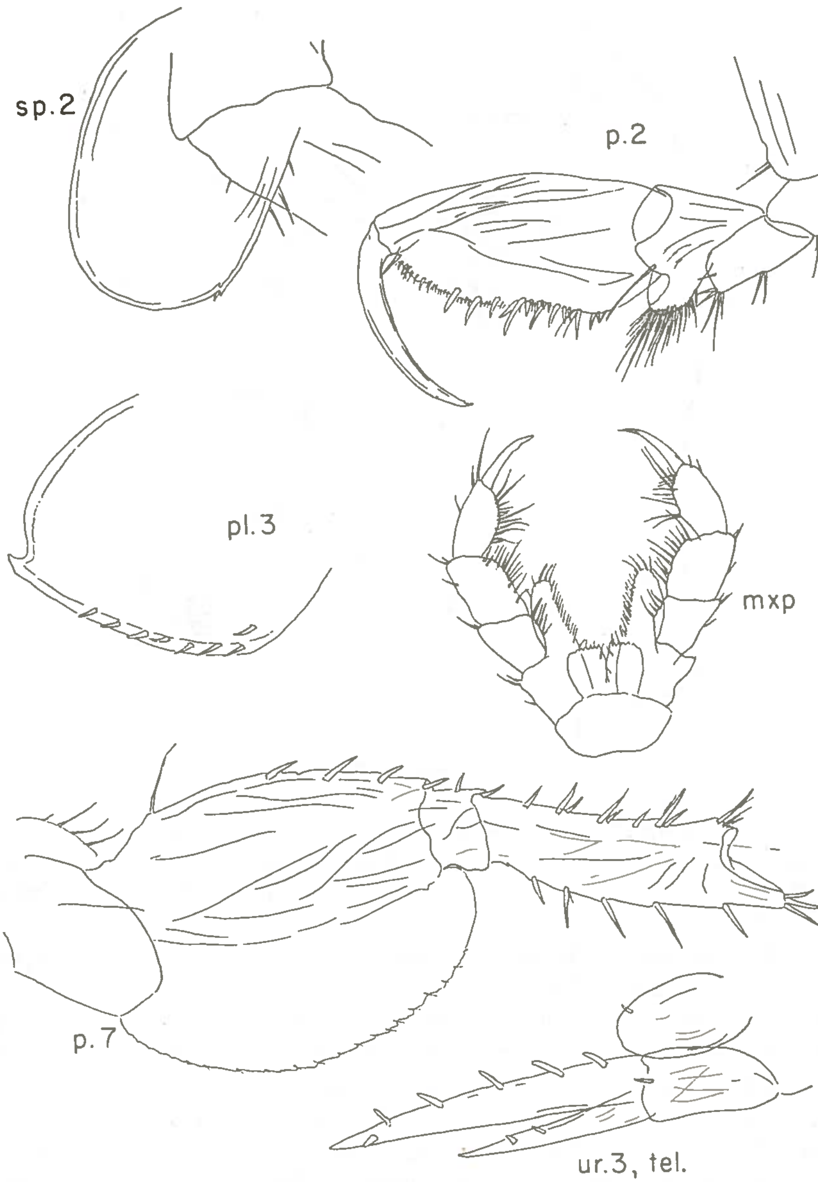

FIGURE 23. *Parapleustes sinuipalma* n. sp., ovigerous female.

at the tip and (in the type specimen) asymmetrically armed with one small spinule. Length 12.5 mm.

An immature male specimen taken in the plankton at station 33 agrees with this description in every detail except that there are three dorsal teeth. It is possible that this is the male of the species, but the matter is uncertain. The type specimen (No. MJD–002) is in the collection of the Redpath Museum, McGill University.

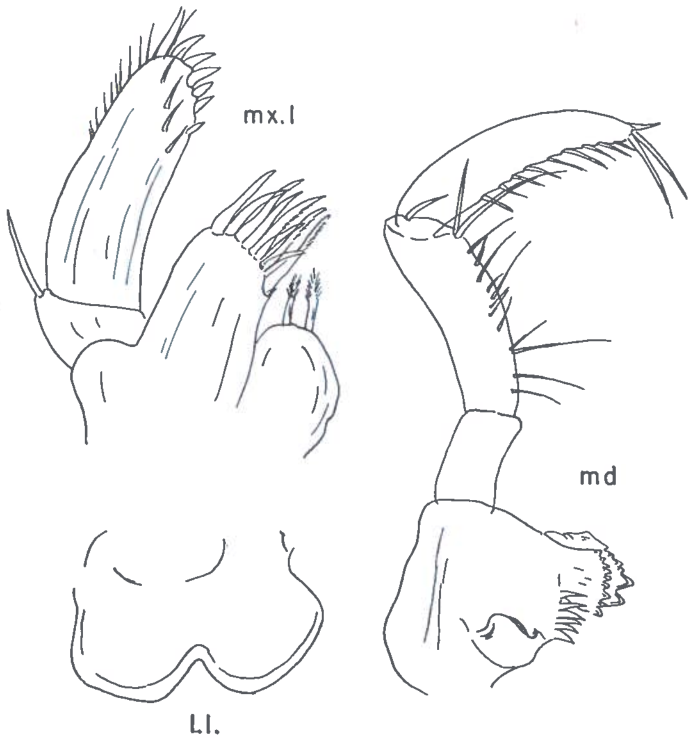

FIGURE 24. *Parapleustes sinuipalma* n. sp., ovigerous female.

Parapleustes **glabricauda** n. sp. (Fig. 25, 26)

Six specimens, including an adult male and two ovigerous females, were dredged at station 208, July 20, 1950; one male was taken at station 103, also in the benthos, on August 7, 1949.

Small but robust, back broadly vaulted, smooth. Side-plate 1 expanded below, rounded. Rostrum short, blunt; head a little shorter than first two body segments, lateral angles broadly rounded, lower angles recessive. Side-plates 1–3 without denticle, side-plate 4 only slightly deeper than broad. Pleon 3 quadrate, corner rounded. Eyes not large in the female, reniform, large in the male. Antenna 1, joint 1 of peduncle almost as long as the next two joints together, flagellum a little over half the body length. Antenna 2 shorter, fourth and fifth joints of peduncle of equal length, peduncle reaching beyond the peduncle of the first antenna. Upper lip asymmetrically bilobed. Mandibular palp sturdy, molar fairly prominent, but without triturating surface, much weaker than in the genera *Stenopleustes* or *Sympleustes*. Maxilla 1, inner plate with only one seta. Maxillipeds, outer plate very small, third joint of palp produced beyond the insertion of the finger; finger strong. Per. 1, fifth joint a little longer than sixth, sixth at least twice as long as broad, hind margin richly supplied with long setae, 4 to 5 small spinules at angle of palm. Per. 2, joint 6, broad, fore and hind margins almost parallel, palm well defined, more uneven in outline in the male

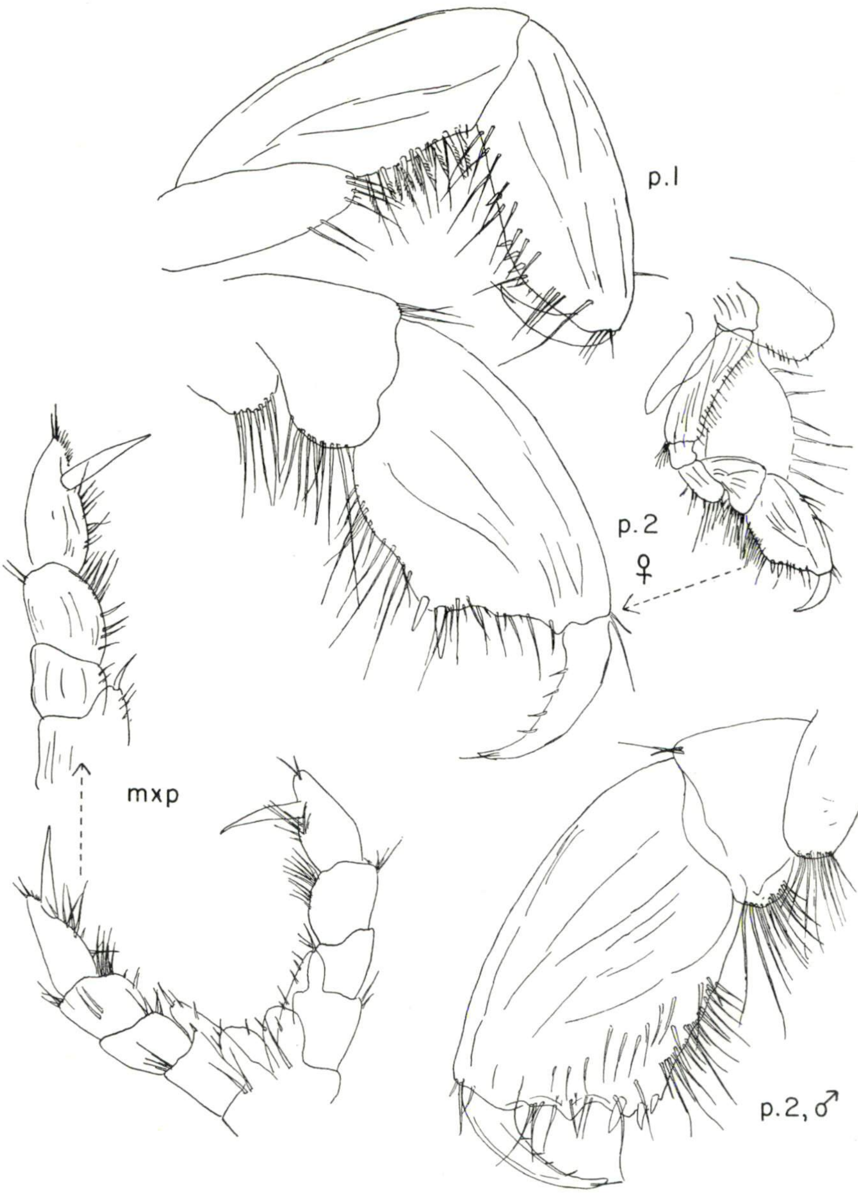

FIGURE 25. *Parapleustes glabricauda* n. sp.

than in the female. Per. 3–7 moderately sturdy. Uropods glabrous in appearance, poorly armed with small spinules, uropod 3 with only 1–2 setae on each ramus; the outer ramus a little over two-thirds of the inner length. Telson oval, small terminating in a rounded point, armed with two small setae. Length (female) 4–5 mm., male a little larger. The species is distinguished from others of the genus by the small outer plates of the maxillipeds, the shape of per. 1 and 2, and

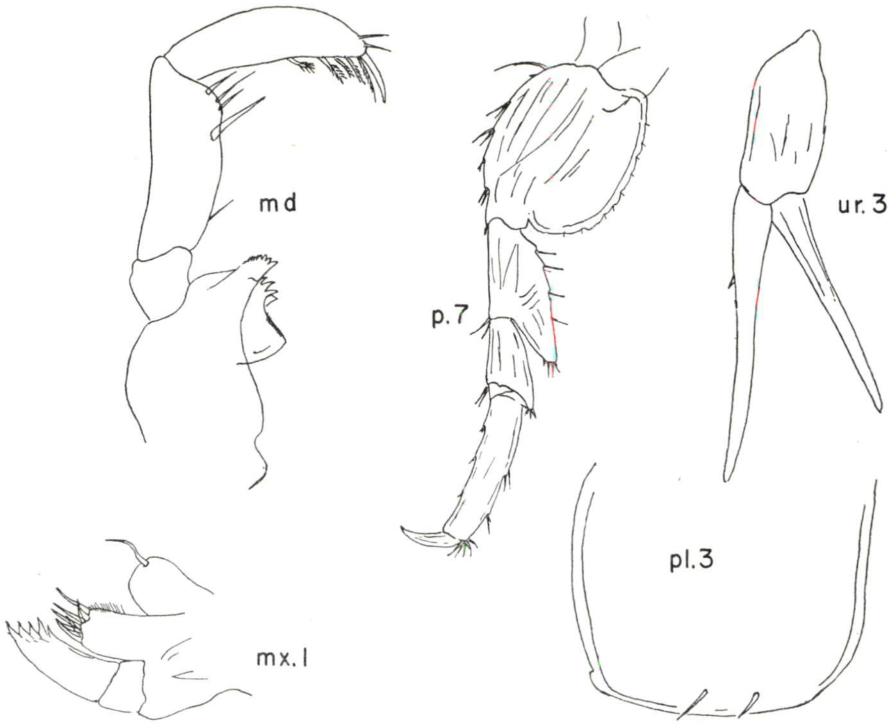

FIGURE 26. *Parapleustes glabricauda* n. sp.

the poorly armed uropods. The type (No. MJD–003) and co-types are at the Redpath Museum, McGill University; one co-type has been deposited in the Zoological Museum of Copenhagen University.

Sympleustes olriki (H. J. Hansen). (Fig. 27)

One female and one immature specimen were taken at stations 13 and 18, in both cases in stramin nets which touched bottom.

Like *Parapleustes boecki*, this species was found and described originally by Hansen (1887) from west Greenland (Prøven), and has been recorded since only from the northern Russian coast (Kara Sea, Yashnov, 1948). Also like *P. boecki* it was lumped together with another species (in this case *S. latipes* M. Sars) by Della Valle (1893), and immediately separated again by later authors, including Stebbing (1906). The reasons for Della Valle's fusion of the two species are obscure, and are in fact not expressed at all. The deep incision, or bight, on the palm of per. 2 (Fig. 27) is an adult character in both species, but the form of the incision and of the whole hand is quite different in the two. Moreover in his description of *S. latipes*, Hansen (1887) specifically stated that in younger specimens the incision is much less, as in other instances of the same sort in the amphipods (for instance in *Metopa norvegica* above), and it is therefore very unlikely that *S. olriki* can be looked upon as a sub-adult stage of

FIGURE 27. *Sympleustes olriki*, per. 2.

latipes, as Della Valle suggested. There are other clear differences between the two species, for example the total absence of a dorsal keel in the present species.

This species has been taken only in west Greenland, the type locality, in the Kara Sea (Yashnov, 1948) and now in Ungava Bay.

Sympleustes **buttoni** n. sp. (Fig. 28, 29)

Four mature females of this species were taken in the benthos at stations 40 (August 10, 1947) and 226 (August 13, 1950).

Body fairly slender, back smooth. Side-plates typical of the genus in general shape and size, rounded below, numbers 1–3 with a minute notch and tooth, armed with a spinule, at lower hind corner. Pleon 3, postero-lateral corner produced into a very small tooth. Eyes subcircular, large. Head a little longer than the first two body segments, rostrum small, blunt, lateral corners produced but rounded, lower corners prominent and sharp. Antenna 1, peduncle joints 2 and 3 together a little shorter than joint 1, flagellum reaching about half length of body. Antenna 2 shorter, peduncle joints 4 and 5 equal. Mouthparts typical of the genus, but inner plate of maxilla 1 has only one seta, not two. Mandible, molar strong, cylindric. Per. 2, hand (joint 6) as long as head, per. 1 only slightly shorter, of similar shape. Palm smooth, convex, with one small tooth in the middle, defined by a heavier armament of spinules in per. 2 than in per. 1. Per. 3–7 rather slender. Uropods, third the longest, all three pairs well armed with short strong spinules. Telson oval, margin rounded, armed with two very small short setae. Length (female) 9 mm.

This species is fairly close to S. *glaber* (Boeck), but after close comparison of these specimens with S. *glaber* from southeast Greenland and from southeastern Canada (St. Andrews, N.B.), it is clear that both they and those described in the next species do not belong to *glaber*, unless that species is a

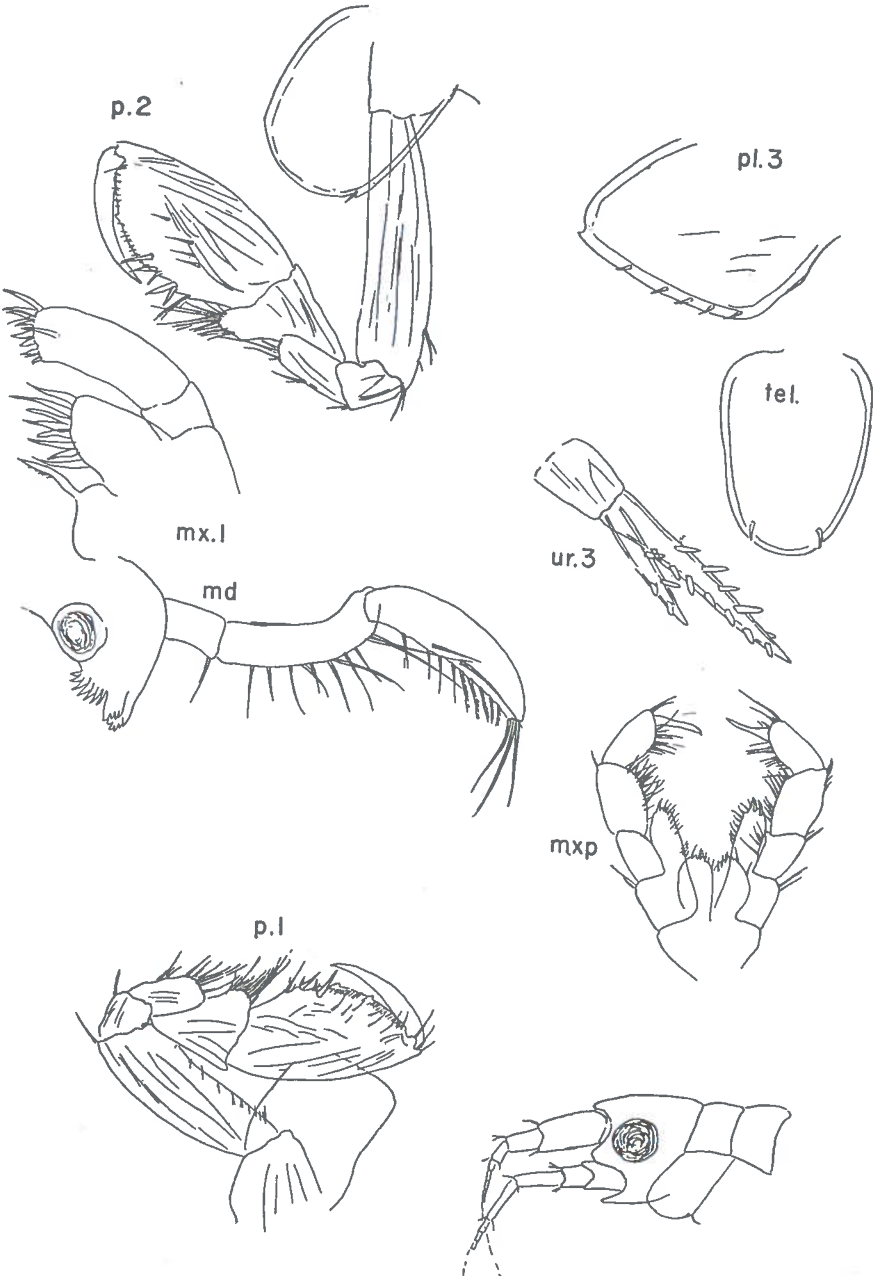

FIGURE 28. *Sympleustes buttoni* n. sp., ovigerous female.

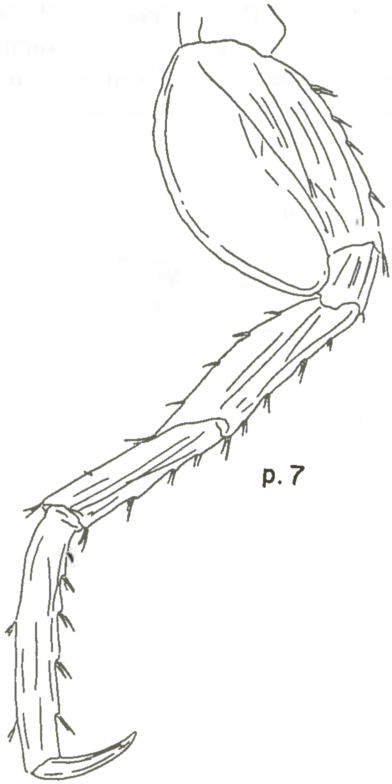

FIGURE 29. *Sympleustes buttoni* n. sp.

great deal more variable than our present knowledge of it indicates, and much more variable than other species of the family Pleustidae. *S. buttoni* differs from *glaber* in a variety of characters: There is no process on the first joint of the peduncle of antenna 1; the lateral angles of the head are more rounded; there is only one seta on the inner plate of the first maxilla (in this the species differs from the generic description in Stebbing (1906), as do two of the three new species of the genus described by Gurjanova (1938) and one by Chevreux (1927)); the notch and tooth on side-plates 1–3 are much smaller; in per. 7 the expansion of the second joint is smaller and of a different shape; and the relative length of the uropods is not the same. The type specimen (No. MJD–004) and one co-type are at the Redpath Museum, McGill University, and two co-types have been deposited in the Zoological Museum, Copenhagen.

Sympleustes ***glabroides*** n. sp. (Fig. 30)

Four ovigerous females and five immature specimens were dredged at station 226, August 13, 1950. One immature specimen was dredged at station 103, and one small immature individual, possibly belonging to the same species, was taken in the plankton at station 40.

Body fairly robust, back smooth and broadly vaulted. Head small, about as long as the first two body segments. Rostrum small and blunt, lateral angles of head produced and acute, lower angles acute, forming large sinus. Eyes large, almost round or with hint of kidney-shaped anterior margin. Side-plate 1 small; side-plates 2–4 very deep, rounded, angular below. Side-plates 1–3 with very strongly developed hooked tooth on lower hind angles. Pleon 3 produced with rounded tip, without tooth. Antenna 1, first joint of peduncle longer than second and third together, produced medio-ventrally into a sharp point more than half

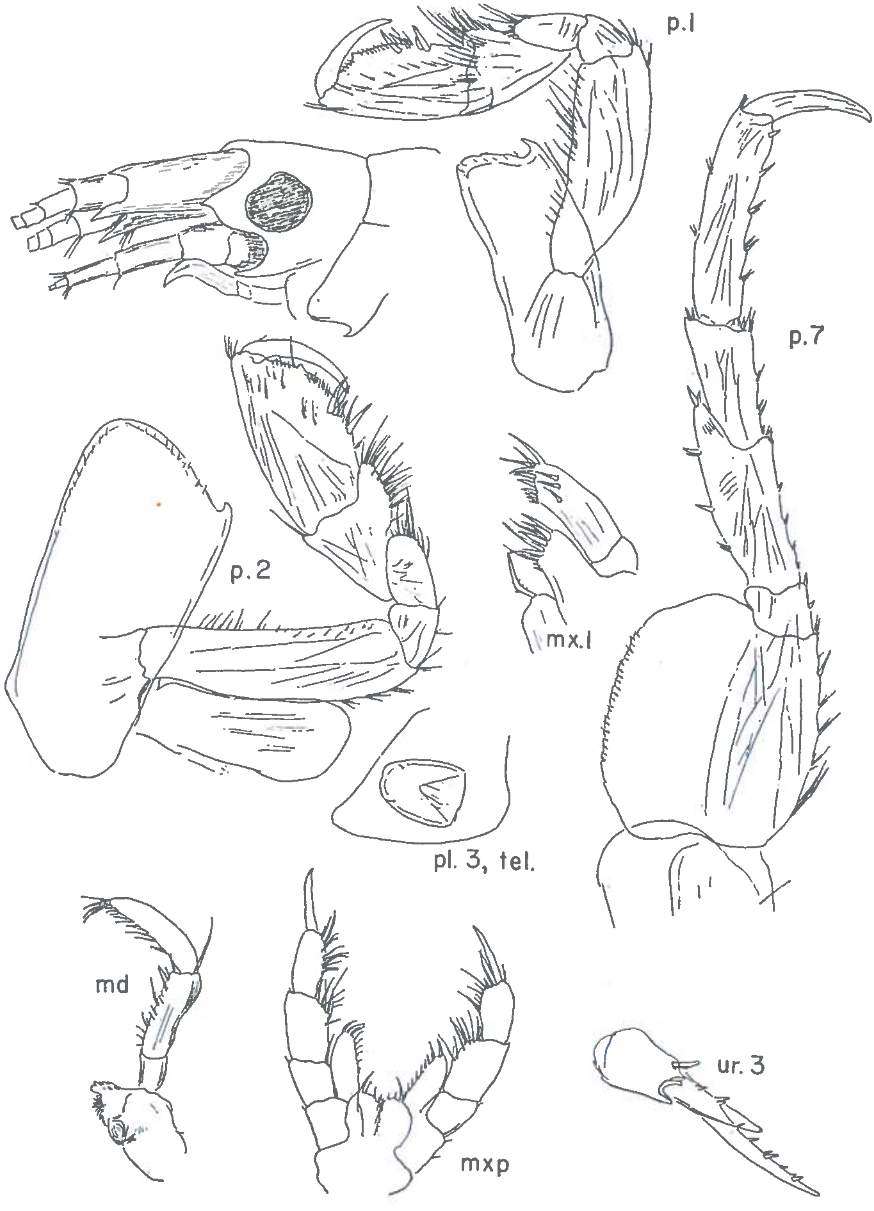

FIGURE 30. *Sympleustes glabroides* n. sp., ovigerous female.

as long as joint 2. Flagellum broken in present specimens, probably a little over half body length. Antenna 2 shorter, joint 5 of peduncle somewhat shorter than joint 4. Mouthparts typical of the genus, but maxilla 1 with only one seta on inner plate. Maxillipeds, finger of palp strong. Per. 1 and 2 similar in shape, per. 2 the larger, hand almost as long as head. Palm smooth except for one tooth, fringed with setae (similar to *S. buttoni*), palm defined by strong spines. Per. 3–7 fairly robust. Uropods, second pair the longest, all armed with spinules. Telson rounded, with two small setae on dorsal surface near the tip. Length 7.5 mm. The type (No. MJD—005) and co-types are lodged at the Redpath Museum, McGill University; two co-type specimens are in the collection of the Zoological Museum, Copenhagen.

In going through Dr. K. Stephensen's collection of Pleustids in the Copenhagen Museum, I found a vial containing six specimens marked "?S. *pulchellus*?" and "all?", from Tasiusak, east Greenland, 22/10/98, taken by the Amdrup Expedition in 6 to 10 metres, stony bottom with algae. These turned out to belong to the present new species. The explanation may be that the specimens of *pulchellus* were removed from the vial after Stephensen's label was written, and the information not corrected. At all events, there are very great differences between *pulchellus* and *glabroides*.

Like S. *buttoni*, this species has points in common with S. *glaber*, although different points. S. *glabroides* and S. *glaber* agree in having rather strong teeth on side-plates 1–3, and in the produced point on the first joint of the peduncle of antenna 1. Both these characters, however, are much more pronounced in *glabroides*, and the present species is further separated from *glaber* in the setation of the inner plates of the first maxillae, in the shape of pleon 3, and in the relative length of the uropods.

The new species is also fairly close to S. *uncigera* Gurjanova (1938), resembling it in the strong teeth on side-plates 1–3 and in the shape of per. 1 and 2. It differs from *uncigera* in pleon 3, in the shape of the uropod rami (short and broad in *uncigera*), and in the eyes, which are smaller in *uncigera*. Specimens of *uncigera* in the Copenhagen collection, incidentally, show sharp lower angles in the head, not recessive as figured by Gurjanova (1938).

In present systematic practice, there is no doubt that these two last-described forms must be established as new species. The possibility that they (and also S. *uncigera* Gurjanova) represent extreme variations of S. *glaber* is remote but not out of the question; the matter could only be settled by breeding experiments or perhaps by much more intensive collecting over the whole range.

The family Pleustidae is in need of revision, especially as regards the generic descriptions. In *Pleustes* the molar of the mandible may be strong or weak; in *Parapleustes* (*Neopleustes*) the third joint of the palp of the maxilliped is not always produced beyond the articulation of the fourth joint, and there may be one or two setae on the inner plates of the first maxillae; in *Sympleustes* there may be the same inter-specific variation in the setation of the inner plates of the first maxillae. It appears that the only character that separates the genera *Parapleustes*, *Stenopleustes* and *Sympleustes* is the structure of the mandibular molar.

Family PARAMPHITHOIDAE

Paramphithoe hystrix (J. C. Ross)

Fourteen specimens, including seven females and four males approaching maturity, were dredged at station 203, July 8, 1950; one mature male was taken at station 221, August 3, 1950. One specimen came from the stomach of a bearded seal 15 miles ENE of the Gyrfalcon Islands.

The species is arctic and subarctic, probably circumpolar, not yet reported from the Canadian central arctic nor from Alaskan waters, but known from Jones Sound and Ellesmere Island (Sars, 1909), the Gulf of St. Lawrence, Newfoundland and the Bay of Fundy, west and east Greenland, Iceland, Svalbard, Norway south to the Skagerak, Barents and Kara Seas, Franz Joseph Land and the eastern Siberian shelf (Runnstrøm, 1928).

Family ATYLIDAE

Atylus carinatus (J. C. Fabr.)

Eight specimens were taken, one male at station 51, in very shallow water in a plankton net; three immature specimens from the stomach of an eider duck at Port Burwell, three from the stomach of a bearded seal at the mouth of the Koksoak River, and one from a ringed seal at the Button Islands.

This is a circumpolar arctic and subarctic species, of similar distribution to the last species, *Paramphithoe hystrix*. It has already been recorded from several localities in the Canadian arctic (Oldevig, 1917; Shoemaker, 1920, 1926; Stephensen, 1944a). It has not been recorded from the Gulf of St. Lawrence, nor does it extend so far down the Norwegian coast as *P. hystrix*. It is reported from the Sea of Okhotsk (Derjavin, 1930).

Family EUSIRIDAE

Eusirus cuspidatus Krøyer

Seven specimens were obtained, all immature, five in the benthos at stations 18, 33, 103 and 231; one in the plankton at station 101, and one from a cod stomach at Port Burwell.

E. cuspidatus is an arctic and subarctic species, known in North America from Jones Sound, Newfoundland (Frost, 1936) and the Bay of Fundy; west and east Greenland, Iceland, Svalbard, etc., south to Tromsø in Norway, east to the New Siberian Islands. Probably circumpolar.

Rachotropis aculeata (Lepechin)

Sixty-seven specimens were taken, eleven of them at stations 18, 102, 107 and 203. Mature females were caught on June 30 and July 7, 1949, and July 8, 1950. The remainder were taken from bearded seal stomachs at Burwell, the mouth of the Koksoak River, the Gyrfalcon Islands and at station 202.

Juvenile specimens in the material show the following differences from the adults: the hind margin of peraeon segment 7 has five blunt projections, which develop in the adult into three sharp dorsal points and two sharp hind corners; the point on joint 2, per. 7, is present but not sharp; joint 2, per. 5 and 6, has a backward expansion, not found in any other species of the genus, which develops into the distinctive sharp point of the adult.

This is again an arctic and subarctic species of wide, probably circumpolar distribution recorded from the Gulf of St. Lawrence and from an uncertain station in the Hudson Strait or Labrador area (Shoemaker, 1920, 1930a). For details of distribution see Stephensen (1940a), Stappers (1911) and Oldevig (1917). It is known from the Japan Sea and the Laptev and Kara Seas (Gurjanova, 1938, 1935a; Yashnov, 1948).

Rachotropis inflata (G. O. Sars)

Thirteen specimens of this species were taken, probably in the benthos, on two occasions when the stramin net touched bottom, at stations 13 and 18. Females and males approaching maturity were caught at the latter station on July 17, 1947.

This is a subarctic species, according to present knowledge, extending also into the arctic regions in northeast Greenland. It is known from the Gulf of St. Lawrence, west and east Greenland, west and north Norway, Svalbard, the Skagerak, the Kara Sea and the Sea of Japan.

Family PONTOGENEIDAE

Pontogeneia inermis (Krøyer)

This is a very abundant species in Ungava Bay. Altogether 267 specimens were taken, all but two in the plankton, at stations 1, 7, 9, 33, 38, 40, 37, 51, 101, 123, 124 and 228. These are all quite shallow water stations, all under 30 metres and most of them much less (see stations list—Dunbar and Grainger, 1952). The single specimen taken in the dredge was found at station 3. Ovigerous females were caught on July 3, August 10, June 29 and August 29, 1947; and June 26, August 10, 1949. One specimen was taken from the stomach of a ringed seal at the mouth of the Koksoak River, July 1, 1948, an ovigerous female.

This is probably a Pacific subarctic species which has spread from the Bering Sea eastwards as far as east Greenland but not to Iceland, Svalbard or Norway; and westward only to the eastern Siberian shelf. There is a gap in its distribution between east Greenland and eastern Siberia. It is recorded from the New England coast, Newfoundland and the Gulf of St. Lawrence, Gabriel Strait (Hudson Strait), Labrador, Hudson Bay, Bernard Harbour, west and east Greenland, the Japan Sea and the Bering Sea. For details see Stephensen (1944a). A former record from the coast of Norway has been found to be incorrect (Stephensen, 1940a).

Family GAMMARIDAE

Weyprechtia pinguis (Krøyer)

Nine specimens of this species were taken, of which only one, an apparently mature male, was dredged from the benthos, at station 45 (August 23, 1947). Seven were immature specimens except for one maturing female, and were all taken in plankton nets at stations 123 and 128. One immature individual came from the stomach of a ringed seal at Port Burwell.

There is a sex difference in this species which is not mentioned in the literature. Per. 1 and 2, joint 6, is somewhat heavier in the female than in the male, and the palm is a little less oblique. Specimens from east Greenland

(Denmark Strait at Hvalrosnaes) in the Copenhagen collection showed the same differences between the sexes.

This is a circumpolar species, arctic and subarctic, already recorded from several localities in arctic and subarctic Canada: Ellesmere Island, west Baffin Bay and Davis Strait, Bernard Harbour and Hudson Bay. Greenland, Svalbard, Barents Sea, Kara Sea and Laptev Sea, eastern Siberia and the Pacific subarctic.

Gammarellus homari (J. C. Fabr.)

Twenty specimens were taken. Most of them are small, taken in the plankton at stations 1, 3, 7, 103, 124, and at Acadia Cove, Resolution Island. A large female, not mature, was dredged at station 3. One was taken in a ringed seal stomach, station 210A, and two from cod stomachs at Port Burwell.

In the large female the last epimer (pleon 3) was more rounded than in the adult Norwegian specimen figured by Sars (1895) and the telson showed two notches instead of one, with a small spine in each notch. Specimens from Iceland in the Copenhagen collection also had two notches, without spines. These specimens were mature.

This is a shallow water form of wide distribution in the boreal, subarctic and arctic zones, known from the Canadian eastern arctic (Ellesmere Island, Jones Sound) south to the Bay of Fundy; Greenland, Iceland, Svalbard, Franz Joseph Land and Novaya Zemlya, the White Sea and the Murman coast, and along the Norwegian coast to the southern Baltic, the British Isles and western France. It does not appear to have been recorded from east of Novaya Zemlya nor from the Pacific region.

Melita dentata (Krøyer)

One large but immature specimen of this species was taken in the dredge at station 126, August 23, 1949.

An exceedingly widely distributed species, taken in all depths down to 300 metres in the boreal, subarctic and arctic zones from the Gulf of Mexico to the arctic archipelago, and from the British Isles to Svalbard and the Kara Sea; both coasts of Greenland. It is also known from the Pacific (Kamchatka, Japan Sea, Puget Sound). For details of localities and references see Stephensen (1940a) and Oldevig (1917).

Gammarus spp.

The systematics of the species of *Gammarus* have undergone revision in the past few years owing to (1) the final recognition of *Gammarus zaddachi* Sexton, which was first described many years ago (Sexton, 1912) but which was stubbornly overlooked by zoologists (including the writer) until recently; (2) the subdivision of *G. zaddachi* into three subspecies (*G. zaddachi zaddachi* Spooner, 1947; *G. z. salinus* Spooner, 1947; and *G. z. oceanicus* Segerstråle, 1947); (3) the establishment of *Gammarus setosus* by Dementieva (1931) as a species separate from *Gammarus locusta* (L.). (*setosus* was described fully for the first time by Stephensen (1940a) as a subspecies of *locusta*, but Segerstråle (1947) demonstrated that it is as different from *locusta* as is *zaddachi*); and (4) the final establishment of *Gammarus wilkitzkii* Birula as a separate species by Gurjanova (1930) and Segerstråle (1947) (but not by Stephensen and others (see below)).

All of these species were confused with *G. locusta* in the past, and consequently all former records of *locusta*, before 1947, especially in northern regions, become suspect. According to Segerstråle (1947) the most northerly records of the true *locusta* are from northeast Iceland and north Norway, latitude 70.5°N. It is probably absent from Greenland (see below) and also from North America. All records of *locusta* from North America, so far examined, have turned out to refer to *zaddachi*, to the subspecies *oceanicus* (Spooner, 1951; Segerstråle, private communication). *Gammarus locusta* is not present in the *Calanus* expeditions' material from Ungava Bay, nor in any of the McGill University collections from Baffin Island.

Gammarus zaddachi Sexton, subsp. *oceanicus* Segerstråle 1947. (Fig. 31)

This is exceedingly abundant in Ungava Bay, and was taken by hand in the intertidal zone and also in plankton nets over shallow bottoms. It was not taken in the dredges or trawls. In the intertidal zone it was collected in large numbers at stations 1A, 5, 8, 64, 107B, 112, 205, 212, 217, 229 and 235, and generally in the estuary of the Koksoak River at low water. Planktonically it was obtained at stations 31, 40, 37, 51, 201C. Ovigerous females were taken on June 24, 1947, July 11, 1949, and July 30, 1950. A few specimens were taken in cod stomachs at station 224, Port Burwell (this was the only fishing station at which cod stomachs were found to contain either *G. zaddachi or setosus*). Seven specimens were taken from ringed seal stomachs.

Spooner (1947), in establishing the subspecies *G. z. salinus* and *G. z. zaddachi*, showed that the two subspecies could not produce fertile eggs on crossing. No such breeding experiments have so far been done on the subspecies *salinus* and *oceanicus*, and indeed the two are very close together morphologically, as is admitted by Segerstråle (1947). *G. z. salinus* is a brackish water form, so far reported only from northwestern Europe, whereas *oceanicus* is found mainly in fully marine localities; where the two overlap they are sometimes difficult to distinguish. According to Segerstrale, they are separable on the setation of the second and third joints of the peduncle of the first antenna, and on the colour; *salinus* showing the banded colour pattern found also in the subspecies *zaddachi* but absent in *oceanicus*, and *salinus* having as a rule six tufts of setae on the ventral surface of joint 2, antenna 1 (only four in *oceanicus*), and at least three tufts on the ventral surface of joint 3 (only two in *oceanicus*). These figures exclude the apical tufts of hair at the distal ends of the joints.

On these criteria the Ungava Bay specimens belong to the subspecies *oceanicus*. Table I gives the counts for various diagnostic characters for six mature males and two mature females. These counts were made on large specimens, up to 36 mm. overall length. The number of joints in the flagellum of antenna 1 is lower than those given by Segerstråle (1947), who quotes 57 as the maximum number for the male (38 for the female) and 10 in the accessory flagellum. The Ungava Bay specimens differ also from the description given by Sexton (1942) for the species *zaddachi*, and agree with the descriptions of the *oceanicus* form (Segerstråle, 1947; Spooner, 1951), in the depth of the sinus of the head, which is considerable, owing to the projection of the lower angles, and in the development of the dorsal humps on pleon 4–6, which approaches the condition found in *locusta*. These characters are illustrated in Figure 31. Specimens from Greenland in the Copenhagen collection agree with the Ungava specimens in both characters, also in the lower margin of pleon 3, which is straighter than in *G. z. zaddachi*. There seems to be much variation in the shape of the postero-lateral corners of pleon 3, which may be produced to a greater or lesser degree, even in adult individuals. In immature specimens the corners are more pointed, resembling those of *locusta*.

With the exception of the variations mentioned above, the Ungava Bay specimens agree with the descriptions of Sexton, Segerstråle and Spooner. The lateral lobes of the head are obliquely truncate, side-plate 4 is rounded, not

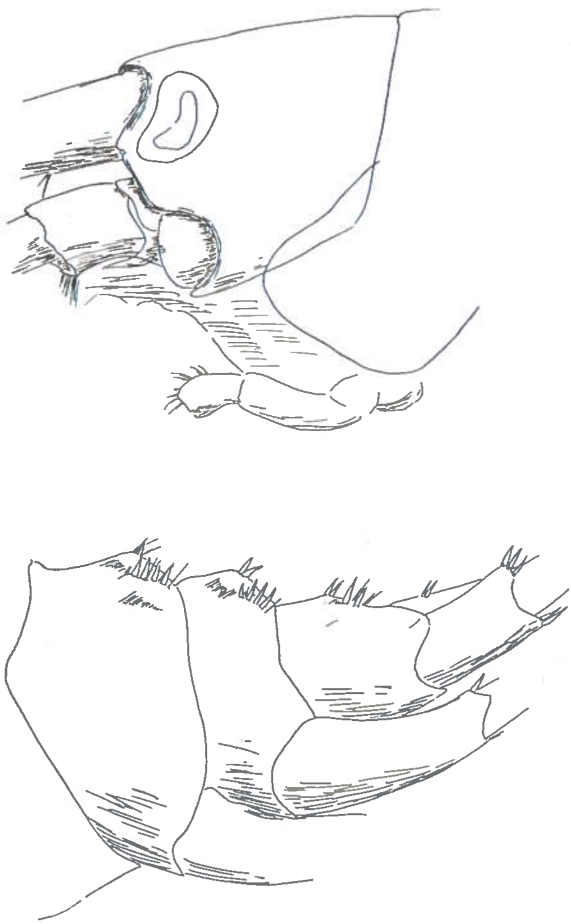

FIGURE 31. *Gammarus zaddachi oceanicus*, cephalon and pleon segments 4, 5 and 6. Male specimen, 31 mm. long.

TABLE I. Counts of diagnostic characters in *Gammarus zaddachi oceanicus*. In the last three columns, figures in brackets refer to setae, the others to spines. Horizontal rows bracketed together represent asymmetrical setation or spination, both sides of the animal being given. The numbers for the tufts of hair on the ventral surface of the peduncle of antenna 1 do not include the apical (distal) tufts on each joint.

Sex	Hair tufts, ant. 1, joint 2	Hair tufts, ant. 1, joint 3	Flagellum, ant. 1	Accessory flagellum	Spines on pleon segments 4	5	6	Telson spines and (setae) Apical	Sub-apical	Sub-basal
♂	4	1	39	9	5–2–5	4–2–4	3–2–3	3 (5)	0 (1)	2 (0)
♂	4	1	40	9	4–2–4	4–2–4	2–2–2	3 (4)	0 (1)	2 (0)
♂	5	1	40	8	4–2–4	3–2–4	2–2–2	3 (3)	1 (0)	1 (0)
♂			38	8	4–2–3	4–2–3	2–2–2	3 (5)	0 (1)	2 (0)
♂	4	1	45	9	4–2–4	4–2–4	3–2–4	3 (3)	0 (1)	2 (0)
♂	4	1	39+		4–2–4	4–2–3	2–2–2	3 (6) 3 (4)	0 (0) 0 (2)	2 (0) 1 (1)
♀	4	1	41	7	5–2–5	5–2–4	3–2–3	3 (3)	1 (1)	2 (0)
♀	5	2	33	9 8	5–3–5	4–2–3	2–2–2	3 (3)	2 (1) 1 (1)	2 (0)

almost rectangular as in *locusta*, and the indentation of the frontal organ is of the *zaddachi* form. The peduncle of antenna 1 reaches just beyond the distal end of joint 4, antenna 2, which is a little shorter than described for *salinus*, but correct for *oceanicus*. The shape and spination of joint 6, per. 1 and 2, agree with *zaddachi* Sexton and with subspecies *oceanicus* Segerstråle, except that there are often only three spines instead of four at the angle of the palm in per. 2. In uropod 3, the inner ramus is four-fifths of the outer in length. The females do not appear to differ from the males in the diagnostic characters, except in the shape and spination of gnathopods, especially per. 2, in which the palm is more clearly defined and less oblique than in the male, and has no spine in the middle of its margin. The whole limb is smaller than in the male.

Owing to the taxonomic difficulties described above, the distribution of *Gammarus locusta* and *Gammarus zaddachi oceanicus* in North America and Greenland has not yet been fully established. The Copenhagen Museum collection contains large numbers of the genus, including specimens labelled "*Gammarus locusta* (L) sens. str." by Dr. K. Stephensen, from both coasts of Greenland. I have examined 132 of these specimens, and find that they all belong to *G. z. oceanicus*, some of them with certain slight variations mentioned below. Stephensen determined them before Sexton's (1942) paper appeared, and he was clearly interested at the time only in separating *Gammarus setosus* Dementieva from the others, which he labelled *G. locusta* "sensu stricto". He did the same with the Norwegian and Svalbard material, and some of the results of this work appeared in the third part of his study (1940a) of the amphipods of north Norway and adjacent waters, in which *Gammarus zaddachi* Sexton is tentatively equated with *G. wilkitzkii* Birula, and does not appear in the key to the species of *Gammarus* at all.

The Greenland specimens which I have examined in the Copenhagen collection were taken at Angmagssalik, Upernavik, Sakrak on the Vaigat, Ravns Storø, Lindenowfjord, Karajakfjord, Diskofjord, Nordre Strømfjord, Prøven, Clavering Island, Faeringerhavn, Sukkertoppen, Hvalrosodden, Danmarks Island, Kagssimiut (southwest Greenland), Kungmiut and Jakobshavn. Many of them were mature specimens. All of them agree in detail with the specimens from Ungava Bay. The shape of side-plate 4 in *G. z. oceanicus* is sometimes variable, occasionally approaching the more quadrate shape typical of *locusta*, and the depth of the expanded part is usually greater than in *G. z. zaddachi*, again a character found in *locusta*. One ovigerous female and three males, probably mature, in the Greenland specimens, showed a spination of the palm of per. 2 resembling the *locusta* pattern, in which the spines are arranged at evenly graded intervals (see Spooner, 1947). These are all minor variations from the typical *oceanicus* which do not disturb the determination of any of the specimens.

The evidence for the absence of *Gammarus locusta* from the coasts of Greenland and from Ungava Bay is thus considerable. As far as Greenland is concerned, this is also the conclusion of Spooner (1951) who appears to have examined some of the same material in the Copenhagen collection. The probability is that *G. z. oceanicus* is to be found everywhere along the coasts of arctic and subarctic North America and that *locusta* does not occur in the north at all. *G. z. oceanicus* is now known from Novaya Zemlya, the Murman coast, Svalbard, the coasts of Norway, the Kattegat and the Baltic, Scotland, Iceland, east and west Greenland and the Canadian and United States eastern seaboard from Baffin Island to southern New England.

There is a point of interest in the fact that several of the divergences from *Gammarus zaddachi zaddachi* shown by *G. z. oceanicus*, and to a lesser extent by *G. z. salinus*, are in the direction of *G. locusta*. These are: (1) the shape of pleon 3, which is much straighter along the lower margin than in *G. z. zaddachi*; (2) the lesser setation of antenna 1; (3) the shorter peduncle of antenna 1; (4) the variability in shape of side-plate 4, which can sometimes strongly resemble the more square and deeper pattern of *locusta*; (5) the longer inner ramus of the third uropods, which can be four-fifths or more of the outer ramus; (6) the variability of the spine pattern on the palm of per. 2, which can sometimes resemble the *locusta* type; (7) the higher spine number on pleon segments 4–6; and (8) the greater development of the dorsal humps on pleon segments 4–6.

No doubt some of these resemblances, especially the lesser setation, can be put down either to the direct effect of the full salt-water environment in which both *locusta* and *oceanicus* live, or to an indirect effect of that environment manifested in a parallel evolution. In the southern part of the *oceanicus* range in Europe there is a large overlap with *locusta*. Nevertheless the resemblances are striking enough to suggest that *locusta* and *oceanicus* (and probably also *setosus* and *wilkitzkii*–see below) are northern derivatives from a common ancestor resembling *locusta* and living in full salt water, and that *salinus* and *zaddachi* are stages in a brackish-to-freshwater evolution from that ancestral form, an evolution which has taken place in the varied coastal environments of northwestern Europe.

Gammarus setosus Dementieva. (Fig. 32)

Syn.: *Gammarus locusta setosus* Stephensen, 1940a.

About 400 specimens of this species were collected, and in addition a large number of small immature individuals which could not be determined with certainty. Specimens were taken in the intertidal zone at stations 1A, 8, 65, 107A, 112, 201A, 205, 208B, 212, 215, 217, 224, 227 and 235. It was caught in plankton nets over very shallow water at stations 31 and 51. About 200 of the total number of specimens were taken in cod stomachs at Port Burwell, station 224, the only station at which the species was found in the cod. It was not taken in seal stomachs in Ungava Bay.

Gammarus setosus is closely related to *G. z. oceanicus*, being easily separated however by the rich endowment of feathered setae on peraeopods 5–7, pleon segments 4–6 and the telson. There is also a small number of less striking differences; the apical hairs on the telson are longer than in *oceanicus*, the ventral surfaces of antenna 1, peduncle joint 2 and 3, bear rather more hair tufts, and the hand of per. 2 is broader. All the differences except the abundance of feathered setae, even taken together, are not of any great significance, and moreover they are found to overlap with the *oceanicus* type. Add the fact that the two species are very often found together at the same stations, and the need for breeding experiments becomes clear. There may be ecological differences separating the two, but the littoral collecting of the present series of expeditions was unfortunately not designed to bring such differences to light.

Stephensen (1940a) and Segerstråle (1947) both describe the posterolateral corners of pleon segments 2 and 3 as acute and produced, more so than in *G. zaddachi.* This is not the case in the Ungava Bay specimens, in many of which, especially the mature specimens, the corners of these two segments are almost quadrate (Fig. 32).

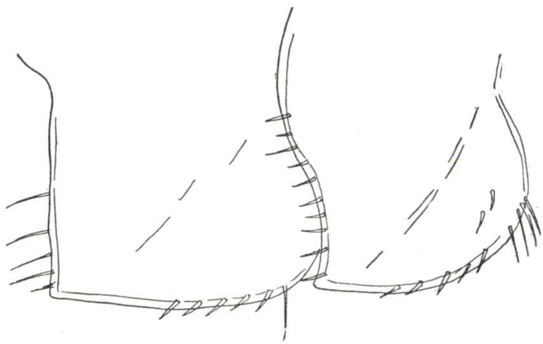

FIGURE 32. *Gammarus setosus*, epimeral plates of pleon segments 2 and 3. Adult male specimen.

The species is recorded from both arctic and subarctic regions: Winter Harbour, Cape Sabine, west and east Greenland, Jan Mayen, Iceland, Svalbard, north Norway and the Barents Sea, Novaya Zemlya and eastward to East Cape Siberia. It is recorded from Baffin Island up to Pond Inlet, and from Ellesmere Island: Craig Harbour (Ellis, unpublished); Alert Bay (in seal stomachs; McLaren, unpublished).

Gammarus wilkitzkii Birula

Seven specimens were taken in plankton nets at stations 7, 44, 57, 60 and 209. One specimen, 28 mm. in length, was taken in the intertidal zone at station 107B. In addition, nine specimens were found in the stomachs of ringed seals from station 29, from the mouth of the Koksoak River and in Leaf Bay, and seven were taken in cod stomachs at Burwell.

Gammarus wilkitzkii has been confused in the past with *G. locusta.* It is however immediately recognizable as distinct from all other species of the genus, even in quite immature stages, by the elongated third joint of the peduncle in antenna 1, and the long and abundant setae on the ventral surface of all three peduncle joints; also by the fact that the lateral groups of spines on pleon 4–6 lie farther back on the segments than the median groups. The spine number is also somewhat lower (in the present specimens 2-2-2; 3-2-3; 2-2-2 and 3-2-3; 3-2-3; 3-2-3). The spines themselves are longer than in other species. Furthermore, the pelagic habit is distinctive. (On the Siberian coast it appears to be found also in brackish water areas, which may explain the littoral record in

Ungava Bay at station 107B, at the mouth of a freshwater stream running across the beach.)

The tangled taxonomic history of the northern species of *Gammarus* is well illustrated by this species. First proposed as a variety of *G. duebeni* (Birula, 1897), it was raised to full specific rank by Gurjanova (1930). The following year it was proposed to make it a form of *setosus* (Dementieva, 1931), a suggestion repeated by Birula in 1937. Stephensen (1940a) considered it as possibly synonymous with *G. zaddachi*, and finally Sexton (1942) and Segerstråle (1947, 1948) confirmed Gurjanova's decision to make it a separate species.

G. wilkitzkii is probably circumpolar, predominantly arctic but also subarctic, known from Alert Bay, northern Ellesmere Island, Jones Sound and Winter Harbour, the east Greenland waters from Germania Land to Cape Farewell, Denmark Strait and the Greenland Sea, north Iceland, the waters of Svalbard and northern Norway, Barents Sea, Kara and Laptev Seas and along the Siberian coast to East Cape. It is possibly a good indicator of the presence of arctic water.

Gammaracanthus loricatus (Sab.)

One ovigerous female was collected at Port Burwell, close to low water mark at spring tide, August 8, 1948.

This is a shallow water arctic and subarctic circumpolar form, recorded from Hudson Bay (Shoemaker, 1926), Jones Sound (Sars, 1909), Prince Regent Inlet, Baffin Bay and Davis Strait (Ohlin, 1895), Collinson Point, Alaska, Bernard Harbour and Melville Island (Shoemaker, 1920), Lake Harbour (Dunbar, 1942), east and west Greenland, Svalbard, White Sea, Barents, Kara and Laptev Seas, New Siberian Islands and East Cape.

Family DEXAMINIDAE

Guernia nordenskiöldi (H. J. Hansen)

One male was taken in very shallow water in a plankton net at station 51.

This species was established by Hansen on specimens from West Greenland (Sukkertoppen and Christianshaab, in depths down to 60 fathoms), and it has since been recorded only in eastern Canadian waters. It was taken in the Gulf of St. Lawrence, when the male was found for the first time (Shoemaker, 1930a).

Family PHOTIDAE

Photis tenuicornis G. O. Sars

The material includes nine specimens of this species taken in the benthos at stations 18 and 202. The latter station produced two mature females on June 30, 1949, and at station 18 an almost mature female was taken on July 17, 1947.

The telson in the mature specimens lacks the setae and slight indentations figured and described by Sars (1895), but there is little doubt that the determination is correct.

The species is known mainly from the subarctic: north Norway, Franz Joseph Land, north and east Iceland and west Greenland (not east Greenland). This is the first record for North America.

Eurysteus melanops (G. O. Sars). (Fig. 33)

Twelve specimens were obtained at stations 18 and 226. Ovigerous females were taken at both stations, on July 17, 1947, and August 13, 1950.

According to Sars, the palm of per. 2 in both sexes is sinuous; in the present material only the immature females show this character. In the ripe females the palm is straight (Fig. 33).

FIGURE 33. *Eurysteus melanops*, per. 2, ovigerous female.

A subarctic and boreal species, taken also in the arctic, known from the Kara and Laptev Seas, White Sea, New Siberian Islands (Gurjanova, 1935b; Yashnov, 1948), Norway, Denmark (Stephensen, 1940a), west and east Greenland, Iceland. The record from the Gulf of St. Lawrence (Shoemaker, 1930a) probably applies to this species, but it is given under the name *E. maculatus,* as in Stebbing (1906), whose synonymy includes *E. erythrophthalmus,* a separate species.

Goësia depressa (Goës)

Taken at station 102, in the dredge; eight specimens including two females almost mature.

The species is new to North America. It is apparently predominantly subarctic, but is recorded from northeast Greenland (Franz Joseph Fjord and Scoresby Sound, in depths down to 54 metres (Stephensen, 1944a)); Novaya Zemlya (Barents Sea coast), Svalbard, west and east Greenland.

Protomedeia fasciata Krøyer

One ovigerous female and one immature female were taken in the dredge at station 33, August 10, 1947.

This species is of wide distribution, possibly circumpolar, and found in arctic, subarctic and boreal zones, known from the New Siberian Islands westward to Dolphin and Union Strait, but not yet recorded from east Greenland (Stephensen, 1942), south to the Gulf of St. Lawrence in North America and to the Skagerak and the Northumberland coast in Europe.

Protomedeia grandimana Brüggen

Eleven specimens were dredged at stations 20, 45 and 102. One very small specimen of the same genus was also taken at station 102, too small for certain determination. Six of the specimens, one male and five females, were close to maturity, caught on June 30, 1949.

This species is sometimes difficult to determine owing to the great changes that take place during the later moult stages, especially in the shape of per. 2 (Stephensen, 1942). The present specimens have been compared with specimens in the Copenhagen collection.

It is a predominantly subarctic species, but recorded also from the arctic: New Siberian Islands, Kara and Barents Seas, north Norway, Svalbard, Iceland, the southern tip of Greenland and eastern Baffin Bay. This is the first record from North America.

Family ISCHYROCERIDAE (Jassidae Stebbing, 1906)

Ischyrocerus nanoides (H. J. Hansen)

Five immature females were taken at station 102.

This is evidently not an abundant species. It has been recorded only from Baffin Bay, off west Greenland, and off the north of Svalbard (Stephensen, 1942). This is the first record for North American waters.

Ischyrocerus anguipes Krøyer. (Fig. 34)

Syn.: *I. minutus* G. O. Sars, 1895.

Several hundred specimens of this very common species were taken, both in the plankton and in the benthos. Planktonically the species was obtained at stations 1, 7, 18, 9, 51, 63, 103, 123, 124, 203, 206, 234 and 303; benthonically, at stations 58, 102, 203, 210 and 226. Ovigerous females were caught on the following dates: June 24 and 26, July 3, 11, 17, 18 and 20, August 10, 11 and 29, 1947; July 28, August 16, 1948; August 10 and 20, 1949; July 8 and 15, August 13 and 31, 1950; July 4, 1951. One female was taken from a ringed seal stomach on June 30, 1949, at Burwell.

Both Stebbing (1906) and Stephensen (1942) consider *I. anguipes* and *I. minutus* synonymous, the latter being a smaller and more southern form without the concave hind margin in joint 6, per. 2, in the male. Both forms of the species, if indeed they should be considered the same, were found in Ungava Bay, and there was considerable variation in the size of the ovigerous females. It is possible that the smaller ovigerous individuals belonged to the *minutus* form (the two are indistinguishable in the female), but the whole matter of size at maturity in cold-water invertebrates is very complicated. A similar, and greater, range of size at maturity is found in *Ischyrocerus latipes* (below). The now classical work of Orton (1920) on the temperature characteristics of breeding in northern marine organisms may be relevant in this connection. Orton found that the onset of maturity could occur at almost any size once the environmental temperature rose above a critical minimum figure characteristic of each species.

There is a remarkable error in the description of this species in Sars (1895) which is repeated by Stebbing (1906). Both authors write that it is the inner ramus of the last uropods which carries the teeth on its upper margin; Stebbing even says "inner (not outer) rather broader, apically bent, having on upper margin 3 or 4 denticles". It is nevertheless the *outer*, not the inner ramus which is so formed.

FIGURE 34. *Ischyrocerus anguipes*, per. 2 of the male variant form described by Stephensen (1917), and found in Ungava Bay.

Stephensen (1917) described a variant of *I. anguipes* from southwest Greenland, having per. 2 shaped as in the female, although much larger, with longer antennae, and (in the male) peculiarly shaped joints in the peduncle of antenna 2. This variant also occurred among the Ungava Bay material (Fig. 34). Gurjanova (1934a) suggested that this variant was in fact identical with her new species *enigmaticus* from the Kara Sea, but with this I cannot agree. In all respects other than those mentioned the specimens in question (also Stephensen's specimens which I have examined) are typical *anguipes*, and are not in agreement with Gurjanova's description of *enigmaticus*. The shorter accessory flagellum, the serrated edge of the finger of per. 1, the form of the rami of uropod 3, and other characters place them unequivocally in *anguipes*. Moreover, I have a male specimen showing the variant antennae described by Stephensen but with the typical elongated hand of per. 2 of *anguipes* (*minutus* form), indicating that the species is variable and that other variants, or combinations of variant characters, besides those described by Stephensen, are to be found.

This is an arctic and subarctic species, extending also into the boreal and known also from the southern hemisphere (South Africa and possibly Ceylon; for details see Stephensen, 1942). It is recorded from Bernard Harbour and Hudson Bay (Shoemaker, 1920, 1926), the Gulf of St. Lawrence (Shoemaker, 1930a), Labrador, Bay of Fundy, Cape Cod and Cape Hatteras, Jones Sound, west and east Greenland, Iceland and Jan Mayen, Svalbard, the whole Norwegian coast and the Kattegat, North Sea and British Isles, Barents, Kara and Laptev Seas and the Sea of Japan.

Ischyrocerus ?megacheir (Boeck)

One immature female, probably of this species, was taken at station 18.

The specimen is not mature, but has the long accessory flagellum of *megacheir*, the rami of the last uropods without denticles, and the gnathopods of the *megacheir* shape. The lateral angles of the head are almost acute, and pleon 3 rounded-quadrate.

An arctic and subarctic species, already recorded from Hudson Bay and the Gulf of St. Lawrence (Shoemaker, 1926, 1930a) and Hudson Strait (Dunbar, 1942); west and north Norway, Skagerak (Enequist, 1949), the deep water of the Norwegian Sea, west and east Greenland, Svalbard, White Sea, Jugor Strait and the Kara Sea, and the "far eastern seas" (Yashnov, 1948; probably referring to the Okhotsk and Japan Seas).

Ischyrocerus latipes Krøyer. (Fig. 35)

Syn.: ?*Ischyrocerus assimilis* (G. O. Sars).
?*Ischyrocerus pachtusovi* Gurjanova. New Synonymy.

Eighty-nine specimens were taken benthonically at stations 18, 33, 38, 102, 103, 203, 210, 226, 231 and 301. Ovigerous females were taken on August 13, 1950, at station 226. Two large males were taken in the stomach of a bearded seal off the mouth of Whale River.

There seems to be no reason to keep *I. latipes* and *I. assimilis* separate, and it is very probable that *I. pachtusovi* Gurjanova, 1933 (with figures in Gurjanova, 1935a), also belongs to the same species. The differences between *assimilis* and *latipes* which appear in the descriptions given by Stebbing and others do not appear in the specimens themselves, and after reviewing the whole of the Copenhagen Museum material of both species, and especially after *assimilis* has been redescribed by Stephensen (1944b), it appears that there is only one species involved.

In the descriptions in Stebbing (1906), the differences between *latipes* and *assimilis* are the following:

	I. latipes	*I. assimilis*
Head	lateral corners rounded	lateral corners sharp
Pleon 3	quadrate	obtusely rounded
Accessory flagellum (length relative to first joint of primary flagellum)	1:2	1:3
Per. 2 (male)	palm convex	palm straight
Per. 6	joint 2 broad	joint 2 oblong
Size	15 mm.	8 mm.

Given the known variability of species of *Ischyrocerus*, these are small differences in the first place, and examination of the Ungava Bay and Copenhagen material reveals that they are not correct, and that the original description of *latipes* (Krøyer, 1842) was inadequate. In specimens labelled *latipes* from Greenland, the lateral corners of the head have small sharp produced points; the accessory flagellum is much less than half as long as the first joint of the primary flagellum; the shape of the hand in per. 2 is indistinguishable from that of *assimilis* (both show the groove on the inner surface into which the finger fits), and the extent of the setation of the palm is related to the size of the animal; the shape of joint 2, per. 6, is variable, sometimes as broad and sometimes as narrow as the same joint in per. 5 and 7 respectively. A characteristic of both forms, one

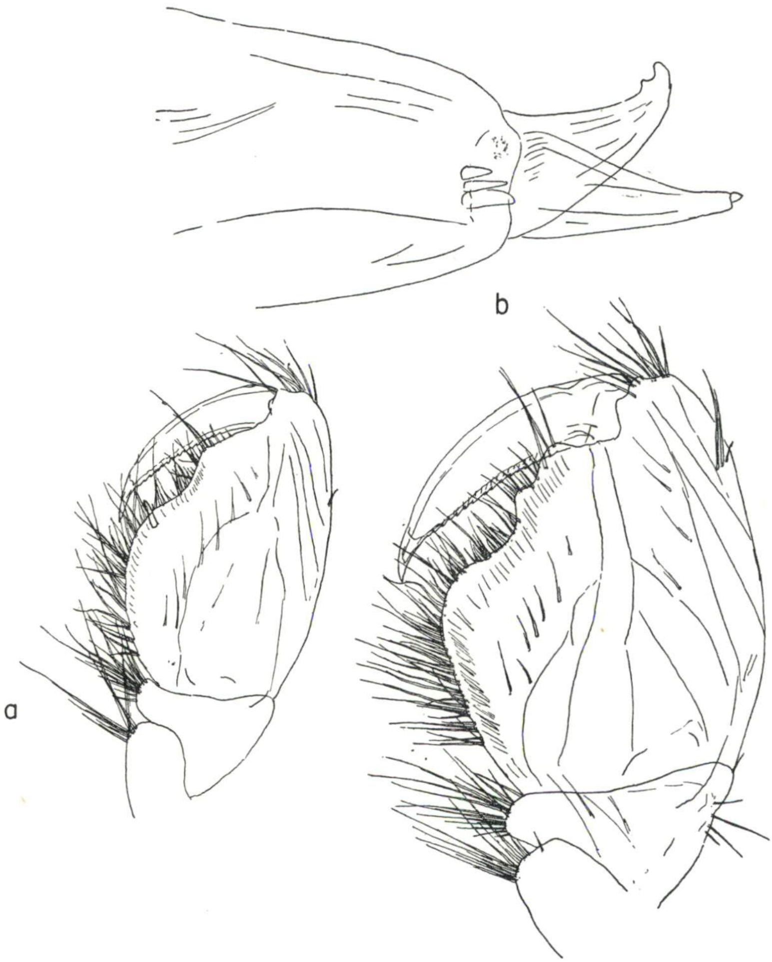

FIGURE 35. *Ischyrocerus latipes*. a: per. 2 of an ovigerous female of the *assimilis* form, from the *Ingolf* expedition material. b: per. 2 and third uropod of a typical female of *latipes* from Ungava Bay.

not found in other species of the genus, is the armament of the outer ramus in uropod 3 (Fig. 35) which consists of usually two, sometimes more, rather blunt denticles on the distal upper margin.

In the *Ingolf* report Stephensen (1944b) described specimens referred to *assimilis* which were slightly larger (9 mm.) than the specimens described by Sars, and differing in characters which strongly increase the probability of the identity of *latipes* and *assimilis*. In that material pleon 3 is quadrate, and the palm of per. 1, which is often sinuous in *latipes*, is also described as such in *assimilis*. Furthermore, the palm of per. 2 in the female has the indentation which is described by Hansen (1887) as characteristic of *latipes*, although the whole hand is somewhat slimmer than in the typical *latipes* (Fig. 35).

The description and figures of *Ischyrocerus pachtusovi* given by Gurjanova (1933, 1935a) are not quite detailed enough to make it possible to be sure of the identity of *assimilis* (as revised by Stephensen), *latipes* and *pachtusovi*, but the latter would appear to belong to the same complex. The accessory flagellum and the rami of the third uropods are not described, and there may be slight differences in the structure of per. 1. Most of the differences, however, which Gurjanova gives as distinguishing *pachtusovi* from *assimilis*, are nullified by the revised description of the latter species by Stephensen, particularly in the antennae, the second gnathopods and the shape of pleon 3. Differences in the structure of the head, the telson and the uropods, which Gurjanova mentions but does not amplify, are not apparent from the description. The length of *pachtusovi* is given as 17 mm. (male), which agrees with the present Ungava Bay specimens.

The conclusion reached tentatively here, on the base of the above study, is that there is only one species complex involved, consisting of three forms of very close affinity. *I. assimilis* G. O. Sars is a variety distinguished by slightly more slender build and with longer and slimmer antennae. This difference is more apparent in the female than in the male. In the male, the highly characteristic shape of per. 2 is the same throughout. The double row of setae on the ventral surface of the antennae is longer in the *assimilis* form, and no sign has been found, in the latter form (Copenhagen specimens) of the special sense organs at the base of these setae described by Schellenberg (1924) for *latipes*. Only a very few of these structures were present in the *latipes* specimens examined, both among the Copenhagen collection and in the Ungava Bay material. They appear to be easily lost in handling. No typical *assimilis* specimens were found in Ungava Bay.

The wide variation in size in the mature females in *latipes*, recorded by Hansen (1887) and observed also in the present collection from Ungava Bay, is possibly also a manifestation of the evolution of the species complex proposed here (but see also above, under *I. anguipes*, on the matter of size variation at maturity). *I. pachtusovi* Gurjanova, described from the Kara Sea, is very much larger than *assimilis* as heretofore described. Two large males in the Ungava Bay material agree in detail with Stephensen's 1944b) description of *assimilis*, but are the size of *pachtusovi* (15–16 mm.) and *latipes*. In short, the addition of material from the *Ingolf* expedition area, described by Stephensen as *assimilis*, and of the present material from Ungava Bay, to the former known range of the group, makes it no longer possible to keep *assimilis* and *latipes* separate. And the agreement between these two forms and *pachtusovi*, on the basis of the present material and Gurjanova's description and figures, is exceedingly close, and covers the most striking and unusual structure and rich feathered setation of the hand of the second gnathopod in the male.

Ischyrocerus latipes Krøyer is recorded from west and east Greenland, Svalbard, Barents Sea, Kara and Laptev Seas and the New Siberian Islands. *I. assimilis* (G. O. Sars) is known from the deep water of the Norwegian Sea, Bear Island and north of Svalbard, and from Hudson Bay (Shoemaker, 1926). *I. pachtusovi* Gurjanova is known so far only from the type locality in the Kara Sea.

Ischyrocerus megalops G. O. Sars. (Fig. 36)

Fifteen specimens were obtained at stations 208 and 226. The material from the latter station included seven ovigerous females, August 13, 1950.

These specimens agree with the description and figures of Sars (1895) and with the specimens in the Copenhagen collection, from Norway and from the *Ingolf* expedition, except that they are noticeably more compact in general body

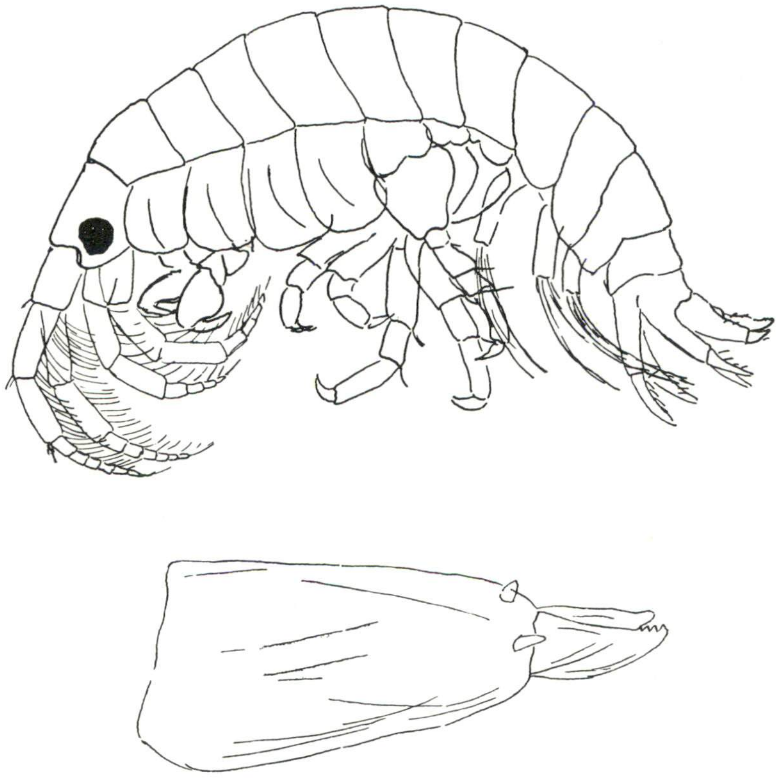

FIGURE 36. *Ischyrocerus megalops*. See text.

form, with antennae and per. 5–7 shorter and stouter. Perhaps the difference would justify the establishment of a subspecies, the more so since this is the first record of the species in North America. The uropod 3 illustrated in Figure 36 is atypical, lacking the terminal tooth. Normally the armature of the outer ramus is approximately the same as in *I. anguipes.*

This species has been recorded hitherto from north Norway, eastern Svalbard and Franz Joseph Fjord in northeast Greenland (down to 35 metres at the latter station–Schellenberg, 1935). It is thus apparently both arctic and subarctic in distribution.

Ischyrocerus commensalis Chevreux

Twenty-four specimens were taken in the benthos at stations 18, 102, 103 and 226; ovigerous females were obtained at the latter station on August 13, 1950.

Some of the immature individuals do not have the distinctive pair of tubercles at the distal end of the palm, per. 2, but show instead an undifferentiated wide protuberance. Shoemaker (1930a) says that the female of this species is at once separable from the *anguipes* female by the form of per. 2, but that the males of the two species are more alike. Nevertheless the males are also immediately separable, not only on account of the pair of tubercles on the hand of per. 2, but also because of the distinctive heel on the same segment, which is absent in *anguipes.* The rami of the third uropods, also, are much longer in *commensalis.*

This species is known chiefly from the subarctic: Gulf of St. Lawrence, off St. John's, Newfoundland (type locality, Chevreaux, 1900), west Greenland and two *Ingolf* stations in Denmark Strait off southeast Greenland, and from the Kara Sea (Gurjanova, 1935a, 1935b).

Family COROPHIIDAE

Ericthonius tolli Brüggen

One hundred and twelve specimens of this species were dredged at stations 11, 18, 20, 33, 102, 103, 106, 126, 201, 203 and 231; ovigerous females were taken on July 18 and August 8, 1947; September 2, 1948; June 30, July 6 and 7, 1949; July 8 and August 27, 1950. Two specimens were found in a bearded seal stomach from off the mouth of Whale River, and six in Atlantic cod stomachs at Port Burwell.

One variant specimen does not have the tuberculated palm typical of the species, but instead a broad lobate protuberance resembling the palm of *E. hunteri*; it is otherwise typical *tolli.* One male individual is asymmetrical in this respect, having the tuberculated palm on the right hand (per. 2) and the broader lobate structure on the left.

This species was first described by Brüggen (1909) from the Siberian shelf at longitude 147°27′E. It has since been recorded from the Laptev Sea (Gurjanova, 1932) and from the Kara, Chukchi and Japan Seas (Yashnov, 1948), Hudson Bay (Shoemaker, 1926) and north Baffin Bay (Stephensen, 1933), in depths down to 70 fathoms. Like *Paronesimus barentsi* this is probably a Pacific species which has spread a certain distance both west and east from the Bering

Sea, but has not yet achieved circumpolarity. Where found it seems to be fairly abundant.

Siphonoecetes typicus Krøyer

One specimen was taken at station 18, July 17, 1947.

This species has been redescribed from Krøyer's type material by Stephensen (1944a). The present specimen is in agreement with that description, except that the palm of per. 2 is not defined by an angle as figured by Stephensen from the type specimen. Other specimens in the Copenhagen material do not show this angle so well developed. The difference may be due to immaturity.

This is probably a subarctic species, known hitherto only from west and southeast Greenland (Stephensen, 1944a). This is the first record from North America. The species is very close to *S. colletti* Boeck.

Family PODOCERIDAE

Dulichia spinosissima Krøyer

Two ovigerous females were dredged at stations 33 and 203, on August 8, 1947, and July 8, 1950, respectively.

This species is apparently predominantly arctic in distribution, known from the White, Kara and Laptev Seas and east Svalbard, also the west coast of Baffin Bay. It is also recorded from present subarctic areas, as northwest Iceland, west Greenland between 60° and 72°N, and the Barents Sea. These latter records, however, were made before the recent warming of the marine climate, so that to consider this species as also of subarctic distribution might be misleading. Ungava Bay itself, on the other hand, is within the subarctic region, especially station 33, which is shallow and on the northeast side of the Bay.

Dulichia porrecta (Bate). (Fig. 37)

Eight specimens, including three males and one ovigerous female, were taken at stations 18 and 226, in the benthos. The mature female came from the latter station on August 13, 1950.

Figure 37 illustrates the development of per. 2 in the male, a most important diagnostic character. In immature individuals the hand is relatively much stouter than in the adult, there are two well-marked tubercles or lumps on the inner margin of the finger, joint 2 is short and the projection on the coxal plate is quite small and blunt. The distal tubercle on the finger is almost lost in the adult. In the immature condition the species strongly resembles *D. knipowitschi* Gurjanova (1933, 1934b), which Gurjanova (1936b) has equated with *D. aspina* Stephensen (1933). *D. knipowitschi* grows to a larger size then *porrecta,* so far as is known (a specimen 12 mm. long is in the Copenhagen collection), and does not develop the sharp process on coxal plate 2. Otherwise the two species are remarkably close.

The differences between *D. porrecta* and *D. spinosa* Stephensen (1944b) are exceedingly small. The latter species has a longer process on side-plate 2 than is at present known in *porrecta* and joint 2 of per. 2 is somewhat less elongated. In the female, the joints of per. 1 and 2 are a little broader than figured for *porrecta* by Sars (1895), but the contrast with the actual specimens in the Copenhagen collection is less marked; in the Ungava Bay females, the width of these segments lies between *porrecta* and *spinosa* according to present descriptions, and the finger is fully half as long as joint 6, as described for *spinosa*. The only remarkable difference between the two species, if species they are, is the much greater depth at which spinosa was found (1,026 metres, *Ingolf*

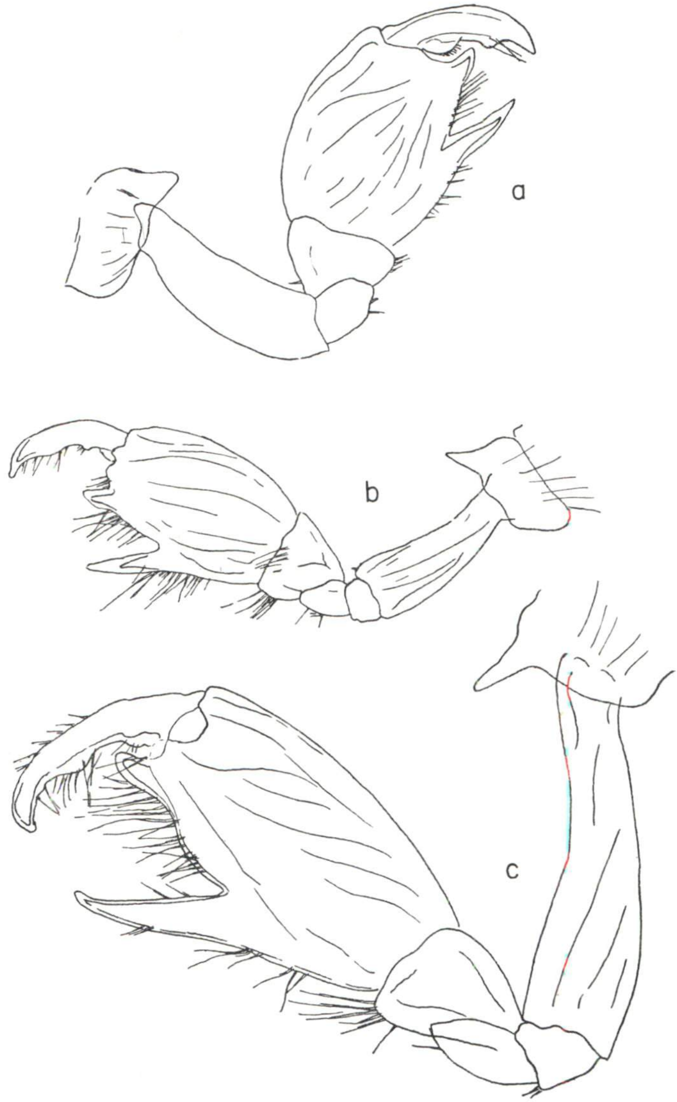

FIGURE 37. The development of the coxal plate and joint 6 of the second gnathopod in the male *Dulichia porrecta*. See text.

station 44). *D. porrecta* has not been recorded from depths greater than 120 metres.

Dulichia porrecta is subarctic and boreal, Atlantic and Pacific; known from the north Pacific (Chevreaux and Fage, 1925), Point Barrow, Alaska (Shoemaker, 1920), Hudson Bay (Shoemaker, 1926), west Greenland, Iceland, west and north Norway, north and east Scotland and northeast England, and the Danish waters (Stephensen, 1942).

Dulichia ?tuberculata Boeck

One male specimen, probably of this species, was taken in the plankton at station 101. It is not mature, but it is referred to this species on the basis of the single tubercle on the finger of per. 2.

This species is subarctic and boreal, like the foregoing species, but not known from the Pacific. It is recorded from the Gulf of St. Lawrence, west Greenland, west Svalbard, west and north Norway and the British Isles.

Sub-order ***Hyperiidea***

Family HYPERIIDAE

The sequence Gammaridea, Hyperiidea, Caprellidea, which is followed by Shoemaker (1930a) and by Stephensen (1935-42) is preferred to the older habit of placing the Hyperiidea first on the amphipod list. There seems to be little doubt that the Gammaridea represent the more primitive amphipod stock, and that the Hyperiidea and the Caprellidea are specialized, the former pelagically and the latter towards parasitism.

Hyperoche medusarum (Krøyer)

Syn.: *Hyperoche krøyeri* Bovallius (G. O. Sars, 1895).

Ten specimens were taken, all in the plankton, at stations 5, 13, 18, 41, 103, 222 and 231. A mature female was obtained on July 27, 1948, at station 5.

This is an arctic, subarctic and boreal species, and also bipolar, being known from the waters of South Georgia (Barnard, 1932). Recorded from the north Pacific (Monterey Bay), Alaska (Shoemaker, 1920), north, east and south coasts of Baffin Island (Dunbar, 1942), Norway, the Barents and White Seas and the Polar Basin (Yashnov, 1948), Svalbard, west and east Greenland, and generally in the north Atlantic "north of a line from the Gulf of St. Lawrence to south of Madeira" (Stephensen, 1944a); Japan Sea (Behning, 1939).

Hyperia medusarum (Müller)

Only two specimens of this species were obtained in the plankton at stations 13 and 57. Four were taken from cod stomachs at Burwell.

This species is predominantly subarctic in distribution, being unknown from east Greenland up to the present. No record of it from the Siberian shelf east of the Barents Sea has been found. It is known from the Pacific (Schellenberg, 1927; Holmes, 1908) including the Sea of Japan, and from Norway and Denmark, west Svalbard, the Faeroe-Shetland Channel and west of Ireland, Iceland, the Irminger Sea and southwest Greenland, Hudson Strait and Hudson Bay, Cumberland Sound, north coast of Alaska (Murdoch, 1885), Labrador (Smith, 1884), the Strait of Belle Isle (Bousfield, 1951) and the Gulf of Maine (Bigelow, 1926).

Hyperia galba (Montague)

Seventeen specimens in all, twelve taken in the plankton and five in cod stomachs at Port Burwell. The planktonic specimens came from stations 41, 44, 123 and 128. One ovigerous female was taken in this material, on August 24, 1949.

This species is also predominantly subarctic, but it is recorded from northeast Greenland and from the Angmagssalik area, and from the Siberian shelf; Barents Sea, Norwegian coasts, Svalbard, Iceland, Denmark Strait and the Labrador Sea, southeast Baffin Island, Hudson Bay, Strait of Belle Isle, Gulf of Maine. Also from the north Pacific and the Sea of Japan, probably circumpolar, and recorded from the antarctic.

Themisto abyssorum (Boeck)

Syn.: *Parathemisto oblivia* (Krøyer).

Thirty specimens were taken in the plankton at stations 1, 13, 18, 41, 128 and 231. All were immature.

The species is mainly subarctic but also arctic, and probably circumpolar. Known from Alaskan waters (Holmes, 1910; Shoemaker, 1920), Hudson Strait, Labrador (Dunbar, 1942), Strait of Belle Isle (Bousfield, 1951), Gulf of St. Lawrence (Shoemaker, 1930a), Gulf of Maine (Bigelow, 1926), Davis Strait and off southwest Greenland, east Greenland coast, Norwegian and Greenland Seas, Franz Joseph Land, Novaya Zemlya and the Siberian shelf east to 105°E (Brüggen, 1909).

Themisto libellula (Mandt)

Several thousand of this very abundant pelagic arctic species were taken in the plankton, at stations 1, 3, 7, 9, 13, 18, 33, 37, 41, 44, 53, 54, 56, 57, 60, 62, 63, 101, 103, 104, 106, 123, 125, 126, 128, 129, 201, 202, 206, 209, 211, 221, 226, 228, 231, 234, 301, 303, and 304. No mature specimens were caught. The specimens were taken at all depths from the surface to close to the bottom. It was also taken in numbers in seal stomachs and in the stomachs of Atlantic cod at Port Burwell.

Themisto libellula is arctic and subarctic, much more dominant in the former than in the latter, and can usually be relied upon as an indicator of arctic water. It becomes much less abundant in the southern parts of its range. It has been recorded from all arctic seas explored, and the most southerly records are the Strait of Belle Isle (Bousfield, 1951), off Cape Farewell and the southeast coast of Iceland (Stephensen, 1923), the Norwegian Barents and Murman Seas, Kara Sea, Bering and Okhotsk Seas (Behning, 1939). The Canadian Arctic Expedition of 1913–18 recorded it from several localities in the Canadian central and western arctic (Shoemaker, 1920).

Themisto gaudichaudi (Guérin)

Syn.: *Euthemisto compressa* G. O. Sars, 1895.
Euthemisto bispinosa G. O. Sars, 1895.
Parathemisto (*Euthemisto*) *gaudichaudi* Barnard, 1930, 1932.

Sixteen small immature specimens were caught planktonically at stations 18, 33, 41 and 44. They were taken only in 1947, not in any of the four succeeding seasons, a fact which may conceivably have some relation to variations in hydrographic conditions from year to year.

These specimens belong to the *compressa* form, following the scheme of Mogk (1927). The two forms were brought together to the same species by Stephensen (1924) and have since been shown to be identical with *T. gaudichaudi* (Barnard, 1930, 1932; Mogk, 1927). The species can be separated from both *libellula* and *abyssorum* even in very young stages. Long before the dorsal denticles develop, characteristics of *gaudichaudi* are the lack of the tuft of hairs on the finger of per. 5 (these tufts being characteristic of *libellula*), the longer finger on the same leg, the different armature of joint 6, per 5, the quite unequal rami of uropod 3 (almost subequal in *libellula*), the presence of a slight keel on the back on the segments which will later develop denticles, and a somewhat different body form, being more hunched anteriorly. *Themisto abyssorum*, even in young stages only 2 mm. long, is distinguished by the lack of elongation of per. 5, the lack of tuft of hair on the finger (as in *gaudichaudi*), and the armature of joint 6, per. 5.

T. gaudichaudi is found in both hemispheres in temperate regions, extending into the subarctic and subantarctic. It is rare in arctic water, but has been recorded from northeast Greenland and from Smith Sound (Stephensen, 1944a, 1933).

Sub-order *Caprellidea*

Family CAPRELLIDAE

Aeginina longicornis (Krøyer)

Syn.: *Aegina echinata* G. O. Sars.
Aegina spinosissima Stimpson.

For full synonymy and discussion see Stappers (1911).

The material includes seventeen specimens of this species, dredged at stations 22, 33, 203 and 231, and taken in the plankton at station 201 at the surface. Ovigerous females were taken on July 8 and August 27, 1950. In addition to these, eleven specimens came from the stomach of a bearded seal, off the mouth of the Whale River, September 2, 1948.

This is widely distributed in the arctic and subarctic, found also in the boreal. Not yet recorded west of Jones Sound in arctic Canada, but known from the Siberian shelf. It has been recorded from the Gulf of St. Lawrence and south to Chesapeake Bay.

Caprella septentrionalis Krøyer

Ten specimens were taken at stations 1, 19, 37 and 40, all in the plankton, and two were dredged at stations 53 and 203.

The distribution is similar to that of the last species; arctic, subarctic and boreal, probably circumpolar.

DISCUSSION

The list of amphipod species at present known from Ungava Bay, and described in this paper, is given in Table II, together with certain details of maturity and distribution. The list contains 114 species, five of which are new to science, 21 (not including the new species) new to North America, and one new to eastern North America. Certain matters of general interest arising out of the material, zoogeographical and systematic, should be summarized here.

ZOOGEOGRAPHY

Ungava Bay lies in the subarctic zone as defined in the introduction to this paper (see Fig. 38), and almost all the species listed here are known to be fairly widely distributed in the subarctic belt. A few more northerly forms, however,

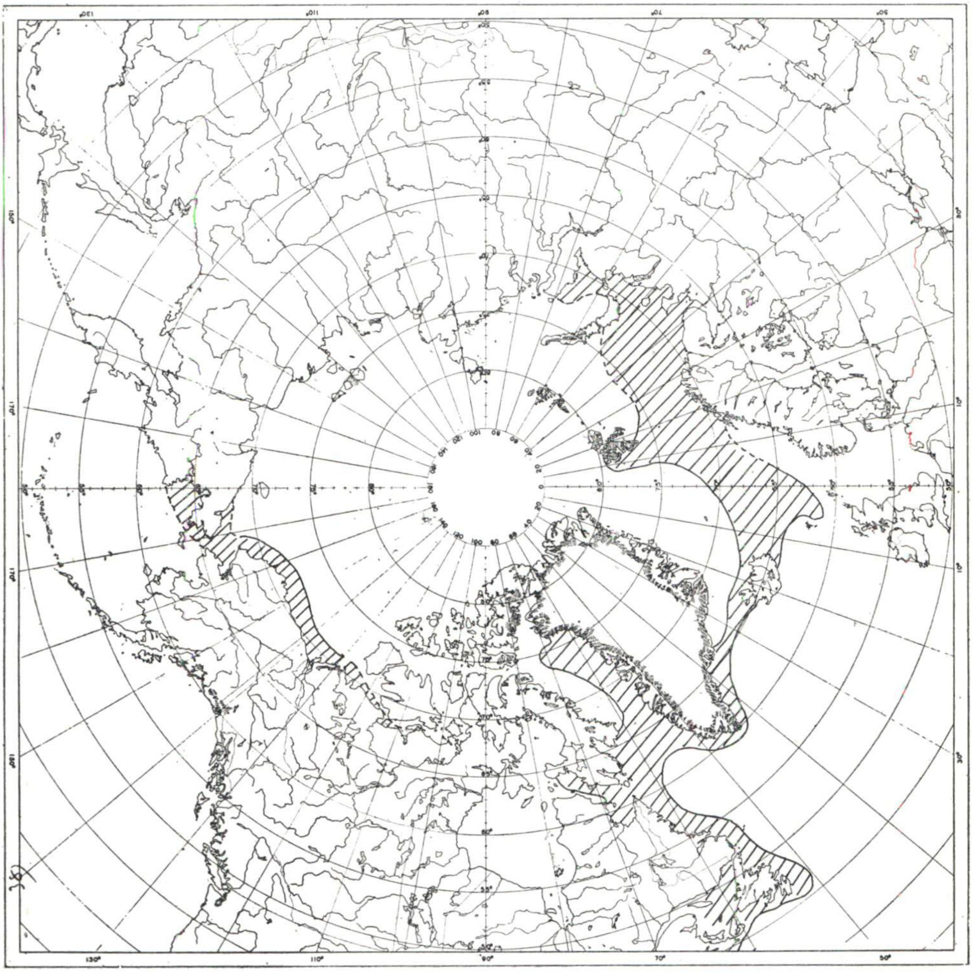

FIGURE 38. The approximate limits of the arctic, subarctic (shaded) and northern part of the boreal zones as defined and used in the present paper.

TABLE II. Summary of the distribution of the species treated. The first column of data, following the specific names, gives the numbers of the months (June, July, August) in which ovigerous females were found in Ungava Bay. A query in the "circumpolar" means "probably circumpolar." Queries in the following two columns mean that the species is recorded from the arctic zone as here defined but that depth data are missing from the record.

	Ovigerous ♀ ♀ (months)	New for North America	Circumpolar	Arctic, above 25 m.	Arctic, below 25 m.	Subarctic	Boreal	Japan or Okhotsk Seas
1. *Opisa eschrichti*	7		?			x	x	J
2. *Onisimus edwardsi*			?	x	x	x	x	
3. *Onisimus plautus*	6, 7		?	x	x	x	x	
4. *Onisimus affinis*			x	x	x	(x)		
5. *Pseudalibrotus littoralis*				x	(x)	x		
6. *Pseudalibrotus glacialis*			x	x	x	x		
7. *Pseudalibrotus nanseni*			x	x	x	x		
8. *Paronesimus barentsi*		x				x		
9. *Orchomene macroserrata*						x		
10. *Aristias tumidus*			x	x	x	x		
11. *Anonyx nugax*	7		x	x	x	x	x	J
12. *Socarnes bidenticulatus*	7		?	x	x	x		J
13. *Socarnes vahli*			?	x	x	x	x	J
14. *Tmetonyx orchomenoides*		x				x		
15. *Orchomenella pinguis*	7		?	?	x	x	x	J
16. *Orchomenella minuta*	6		x	x	x	x	x	O
17. *Orchomenella groenlandica*				?	x	x		
18. *Stegocephalopsis ampulla*			x		x	(x)		
19. *Stegocephalus inflatus*	7		x	x	x	x	(x)	J
20. *Ampelisca eschrichti*	7		?	x	x	x	x	J
21. *Ampelisca macrocephala*	8		?	x	x	x	x	J
22. *Byblis gaimardi*	6, 8		?	x	x	x	x	J
23. *Haploops tubicola*	6, 7		x	x	x	x	x	J
24. *Haploops setosa*	8				x	x	x	
25. *Pontoporeia femorata*			x	x	x	x	x	J
26. *Pontoporeia affinis*	8					x	(x)	
27. *Gitanopsis arctica*		x				x		
28. *Metopa sinuata*		x			(x)	x	(x)	
29. *Metopa ?propinqua*						x	x	
30. *Metopa bruzelii*	7, 8			?	(x)	x	x	
31. *Metopa cariana*	8	x	?		x	x		J
32. *Metopa alderi*	7, 8				?	x	x	
33. *Metopa longirama*				x		x		
34. *Metopa norvegica*	7	x				x	x	
35. *Metopa nordmanni*	7	x				x		
36. *Metopa longicornis*		x			x	x	(x)	

TABLE II (*Continued*)

	Ovigerous ♀ ♀ (months)	New for North America	Circumpolar	Arctic, above 25 m.	Arctic, below 25 m.	Subarctic	Boreal	Japan or Okhotsk Seas
37. *Metopa invalida*	8	x				x		
38. *Metopa hearni* n. sp.	7, 8	x				x		
39. *Metopella nasuta*	7					x	x	
40. *Metopella neglecta*	7	x			(x)	x	(x)	
41. *Metopella carinata*	8			?	?	x		
42. *Metopella longimana*	8	x				x	(x)	
43. *Stenothoe brevicornis*	8	x				x	x	
44. *Odius carinatus*						x	x	
45. *Acanthonotozoma serratum*				x	x	x	x	
46. *Acanthonotozoma inflatum*			x	?	x	x		
47. *Pardalisca cuspidata*				x	x	x	x	
48. *Oediceros saginatus*				x	x	x	(x)	
49. *Paroediceros lynceus*			x	x	x	x		J
50. *Arrhis phyllonyx*			x	x	x	x	x	
51. *Westwoodilla brevicalcar*						x		
52. *Westwoodilla megalops*					?	x	x	J
53. *Aceroides latipes*			x	x	x	x		
54. *Bathymedon obtusifrons*	6, 8		?	x	x	x	x	J
55. *Monoculodes longirostris*	6		?	x	x	x		
56. *Monoculodes latimanus*	7			x	x	x		J
57. *Monoculodes edwardsi*						x	(x)	
58. *Monoculodes tuberculatus*				x	?	x	x	
59. *Syrrhoe crenulata*	6, 7			x	x	x	x	J
60. *Amphithopsis longicaudata*	7, 8					x		
61. *Halirages mixtus*						x		
62. *Halirages fulvocinctus*				x	x	x	x	
63. *Halirages megalops*	6, 7, 8			x		x		
64. *Apherusa glacialis*			x	x	x	x		
65. *Calliopius laeviusculus*			?	x		x	x	J
66. *Pleustes panoplus*				x	x	x	x	J
67. *Pleustes medius*					?	x		
68. *Parapleustes pulchellus*					x	x		
69. *Parapleustes boecki*	7	x		?	?	x		
70. *Parapleustes bicuspis*				?	?	x	x	
71. *Parapleustes assimilis*	7, 8			x	?	x	x	
72. *Parapleustes sinuipalma* n. sp.	7	x				x		
73. *Parapleustes glabricauda* n. sp.	7	x				x		
74. *Sympleustes olriki*		x				x		
75. *Sympleustes buttoni* n. sp.	8	x				x		

TABLE II (*Continued*)

	Ovigerous ♀ ♀ (months)	New for North America	Circumpolar	Arctic, above 25 m.	Arctic, below 25 m.	Subarctic	Boreal	Japan or Okhotsk Seas
76. *Sympleustes glabroides* n. sp.	8	x				x		
77. *Paramphithoe hystrix*			?	x	x	x	x	
78. *Atylus carinatus*			?	x	x	x		OJ
79. *Eusirus cuspidatus*			?	x	x	x		
80. *Rachotropis aculeata*	6, 7		?	x	x	x		J
81. *Rachotropis inflata*				x		x	x	J
82. *Pontogeneia inermis*	6, 7, 8			x	x	x		J
83. *Weyprechtia pinguis*			x	x	x	x		OJ
84. *Gammarellus homari*				x		x	x	
85. *Melita dentata*				x	x	x	x	O
86. *Gammarus zaddachi oceanicus*	6, 7		?	x		x	x	
87. *Gammarus setosus*	6, 7		x	x	x	x		
88. *Gammarus wilkitzkii*			x	x	x	(x)		
89. *Gammaracanthus loricatus*	8		x	x	(x)	x		
90. *Guernia nordenskiöldi*						x		
91. *Photis tenuicornis*	6	x				x		
92. *Eurysteus melanops*	7, 8			?	?	x	x	
93. *Goësia depressa*		x		x	x	x		
94. *Protomedeia fasciata*	8		?	x	x	x	x	
95. *Protomedeia grandimana*		x		?	?	x		
96. *Ischyrocerus nanoides*		x			x	x		
97. *Ischyrocerus anguipes*	6, 7, 8		x	x	x	x	x	J
98. *Ischyrocerus ?megacheir*					x	x	x	OJ
99. *Ischyrocerus latipes*	7, 8	x		x	x	x		
100. *Ischyrocerus megalops*	8	x		x	x	x		
101. *Ischyrocerus commensalis*	8				(x)	x		
102. *Ericthonius tolli*	6, 7, 8			?	x	x		J
103. *Siphonoecetes typicus*		x				x		
104. *Dulichia spinosissima*	7, 8				x	x		
105. *Dulichia porrecta*	8					x	x	
106. *Dulichia ?tuberculata*						x	x	
107. *Hyperoche medusarum*	7		?	x	x	x	x	J
108. *Hyperia medusarum*						x	x	J
109. *Hyperia galba*	8		?	x	x	x	(x)	
110. *Themisto abyssorum*			x	x	x	x		
111. *Themisto libellula*			x	x	x	x		O
112. *Themisto gaudichaudi*				(x)	(x)	x	x	
113. *Aeginina longicornis*	7, 8		?	x	x	x	(x)	
114. *Caprella septentrionalis*			?	x	x	x	x	

are rare in the subarctic and may therefore be called arctic species. The most obviously arctic forms are *Onisimus affinis, Stegocephalopsis ampulla* and *Gammarus wilkitzkii. Themisto libellula, Pseudalibrotus littoralis, P. nanseni* and *P. glacialis* also show strong arctic preference but are nevertheless abundant, though not dominant, in the subarctic.

Thirteen of the Ungava Bay species are restricted entirely or almost entirely to the subarctic zone, namely (new species excluded):

Orchomene macroserrata (Bay of Fundy, Ungava Bay).
Tmetonyx orchomenoides (southwest Greenland, Ungava Bay).
Pontoporeia affinis (as marine species: north Alaska, Bering Sea, Ungava Bay; relict in Baltic and in fresh water).
Gitanopsis arctica (north Norway, east Iceland, southwest Greenland, southern Novaya Zemlya, Ungava Bay).
Metopa invalida (Hammerfest, Ungava Bay).
Westwoodilla brevicalcar (west and south Svalbard, Finmark, northwest Norway, southeast Iceland, west Greenland, Hudson Strait, Ungava Bay, Gulf of St. Lawrence).
Monoculodes edwardsi (Woods Hole, Gulf of St. Lawrence, Ungava Bay, Hudson Bay).
Amphithopsis longicaudata (White Sea, northwest Norway, Iceland, Gulf of St. Lawrence, Hudson Bay, Ungava Bay, west Greenland).
Haliragés mixtus (southeast Greenland, Ungava Bay).
Sympleustes olriki (west Greenland, Ungava Bay, Kara Sea?).
Guernia nordenskiöldi (west Greenland, Ungava Bay, Gulf of St. Lawrence).
Ischyrocerus commensalis (south Kara Sea, Denmark Strait, west Greenland, east Newfoundland, Gulf of St. Lawrence, Ungava Bay).
Siphonoecetes typicus (west and southeast Greenland, Ungava Bay).

The known distribution of some of these species, as will be seen, is restricted, and further work may well reveal arctic localities for some of them. It should also be mentioned that only one of them is known from the Pacific sector (*Pontoporeia affinis*). All the rest are restricted, so far as is known at present, to the Atlantic subarctic.

There is no strictly boreal species in the Ungava Bay list, but many of them extend south into the boreal zone. A category of special interest is formed of those species (36 in all) which are found in the subarctic and arctic (panarctic forms) and which, in the eastern Atlantic region, extend southward into the North Sea, the west and south coasts of Norway, and most of them as far as the Skagerak. This group, which is represented in Figures 39 and 40, includes the following:

Onisimus edwardsi, O. plautus, Anonyx nugax, Socarnes vahli, Orchomenella minuta, Stegocephalus inflatus, Haploops setosa, Metopa sinuata, M. propinqua, M. bruzelii, M. alderi, M. longicornis, Metopella nasuta, M. neglecta, M. longimana, Stenothoe brevicornis, Acanthonotozoma serratum, Odius carinatus, Pardalisca cuspidata, Arrhis phyllonyx, Monoculodes tuberculatus, Bathymedon obtusifrons, Syrrhoe crenulata, Calliopius laeviusculus, Pleustes panoplus, Parapleustes assimilis, P. pulchellus, Paramphithoe hystrix, Ranchotropis inflata, Gammarellus homari, Gammarus zaddachi oceanicus, Eurysteus melanops, Protomedeia fasciata, Ischyrocerus anguipes, I. megacheir, Dulichia tuberculata.

These species present an anomalous distribution, since they extend well down into the boreal zone in the North Sea area and (in some cases) the coasts of the British Isles, but are not found south of the subarctic boundary on the North American side, the subarctic boundary being the limit of penetration of arctic water. This type of distribution in the Atlantic area is shown by very many species of other groups, including isopods, decapod crustacea, and even birds. The explanation is not immediately apparent, and cannot be discussed at length here. One possibility is that species with this distribution are relicts, in the North Sea area, of former colder climatic conditions in that region, perhaps early post-glacial.

The large number of Ungava Bay amphipods which are recorded from the Japan Sea or the Sea of Okhotsk are also very probably relicts. The two seas concerned are cold water areas, somewhat analogous to the Baltic, and there is little if any evidence of the invasion of arctic water into them at the present

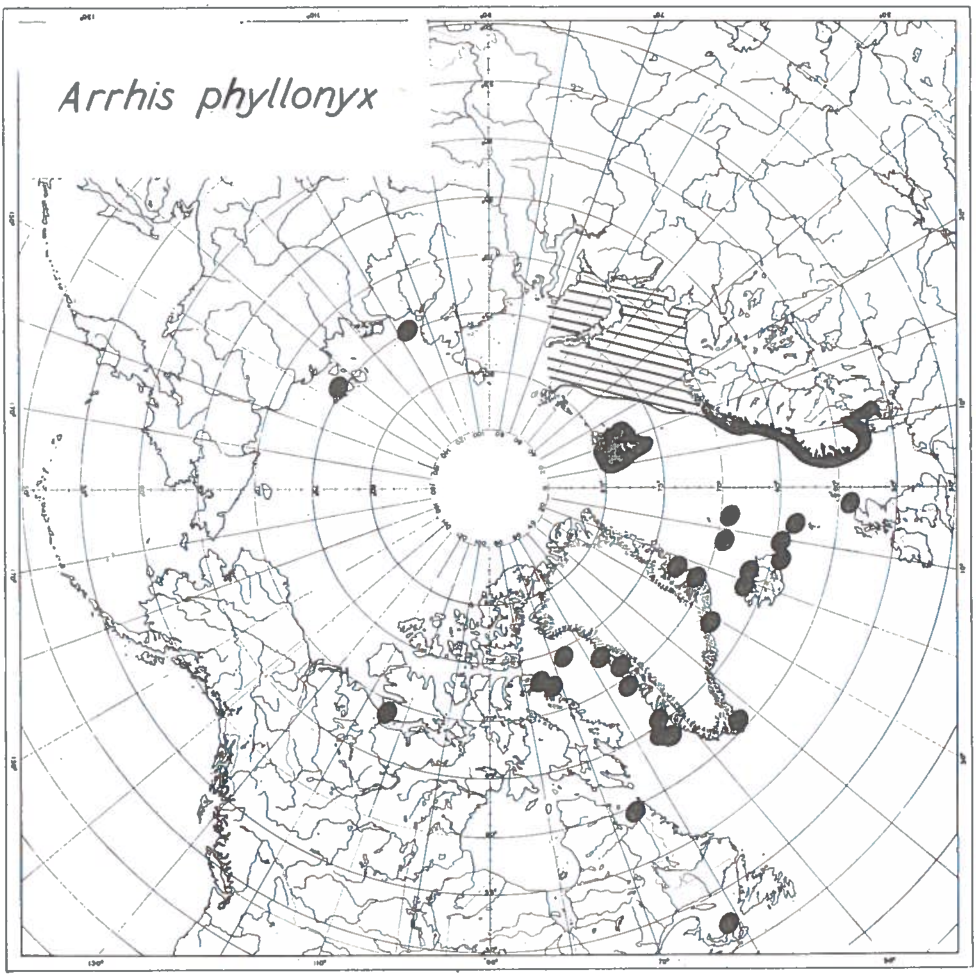

FIGURE 39. See text.

time. Altogether 32 of the present list of Ungava Bay species are known from one or other of these far eastern seas; the species themselves may be read off from Table II.

No less than 29 of the species so far found in Ungava Bay are not known from outside the region of Atlantic influence. They are thus not known to be circumpolar, and may be endemic to the Atlantic. In the list given here the new species described in this paper are not included. Four of the list, marked "K" are known from the Kara Sea but not from farther east. None of them is at present known from localities west of the Canadian eastern arctic, including Jones Sound and Hudson Bay. Most of them do not appear to have penetrated eastward beyond Novaya Zemlya: *Tmetonyx orchomenoides*, *Haploops setosa* (K), *Gitanopsis arctica*, *Metopa sinuata*, *M. propinqua*, *M. bruzelii*, *M. alderi* (K), *M. longirama*, *M. norvegica*, *M. invalida*, *Metopella nasuta*, *M. neglecta*, *M. carinata*,

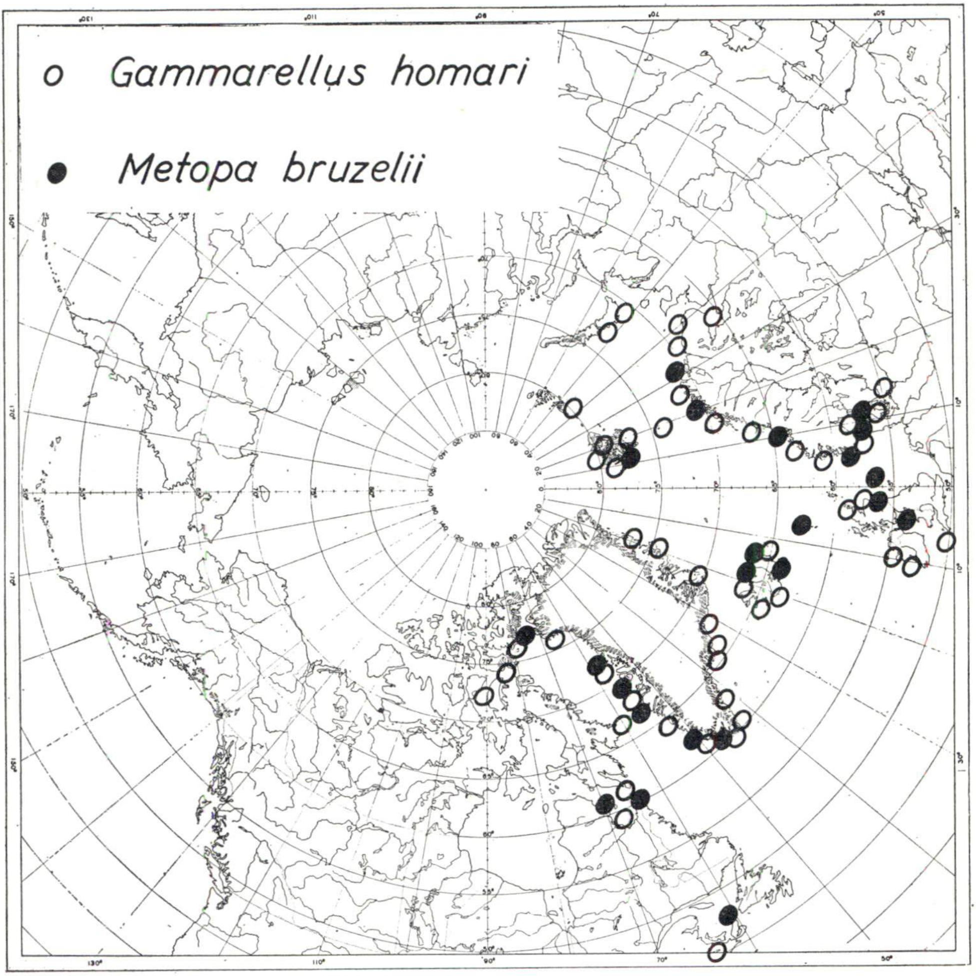

FIGURE 40. See text.

M. longimana, Stenothoe brevicornis, Westwoodilla brevi-calcar, Monoculodes edwardsi, Amphithopsis longicaudata, Haliragges mixtus, Pleustes medius (K), *Gammarellus homari, Guernia nordenskiöldi, Photis tenuicornis, Goësia depressa, Ischyrocerus nanoides, I. megalops, I. commensalis* (K), *Siphonoecetes typicus, Dulichia tuberculata.*

Perhaps most interesting of all are the species which are apparently of Pacific origin and which have not yet penetrated far into the Atlantic area from either direction. These are not known west of the Barents Sea nor east of Greenland, and may be supposed to have followed dispersal routes from the Bering Sea, both westwards and eastwards, as suggested by Gurjanova (1935b). There are five such species, whose distribution is illustrated in Figures 41 and 42: *Paronesimus barentsi, Pontoporeia affinis, Metopa nordmanni, Pontogeneia*

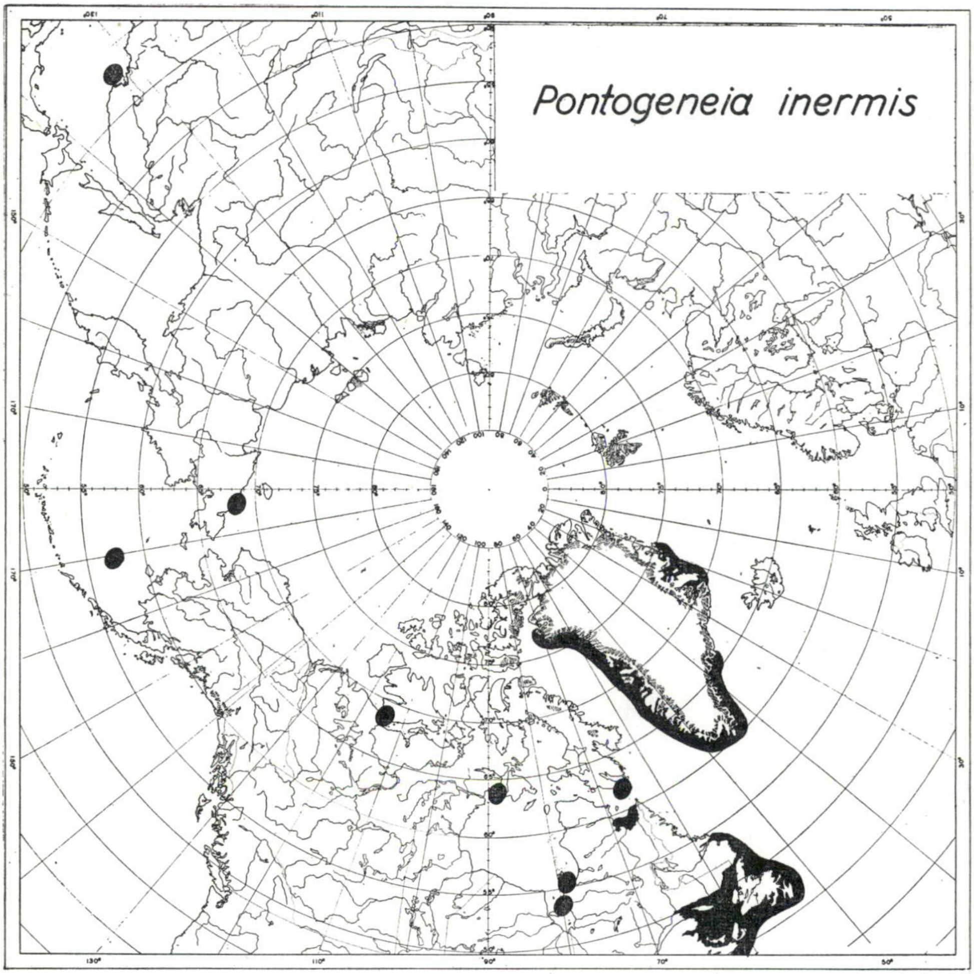

FIGURE 41. See text.

inermis and *Ericthonius tolli*. To these should be added the species pair *Orchomene macroserrata* Shoemaker and *O. tschernyschevi* Brüggen, which are very closely similar.

Many of the Ungava Bay amphipods which are found widely in the subarctic are also known from the arctic zone, and are therefore to be classified as panarctic. Among these panartic forms there is a small number which, according to their present known distribution, fall into the "low arctic" category of Lemche (1941), followed by Stephensen (1944a), defined as species which prefer summer temperatures between 0° and 7°C., distributed generally in the subarctic area and extending into the high arctic but only in the upper 25 metres, where summer temperatures, during the breeding season, are high. The number of such species in any one taxonomic group never appears to be very large.

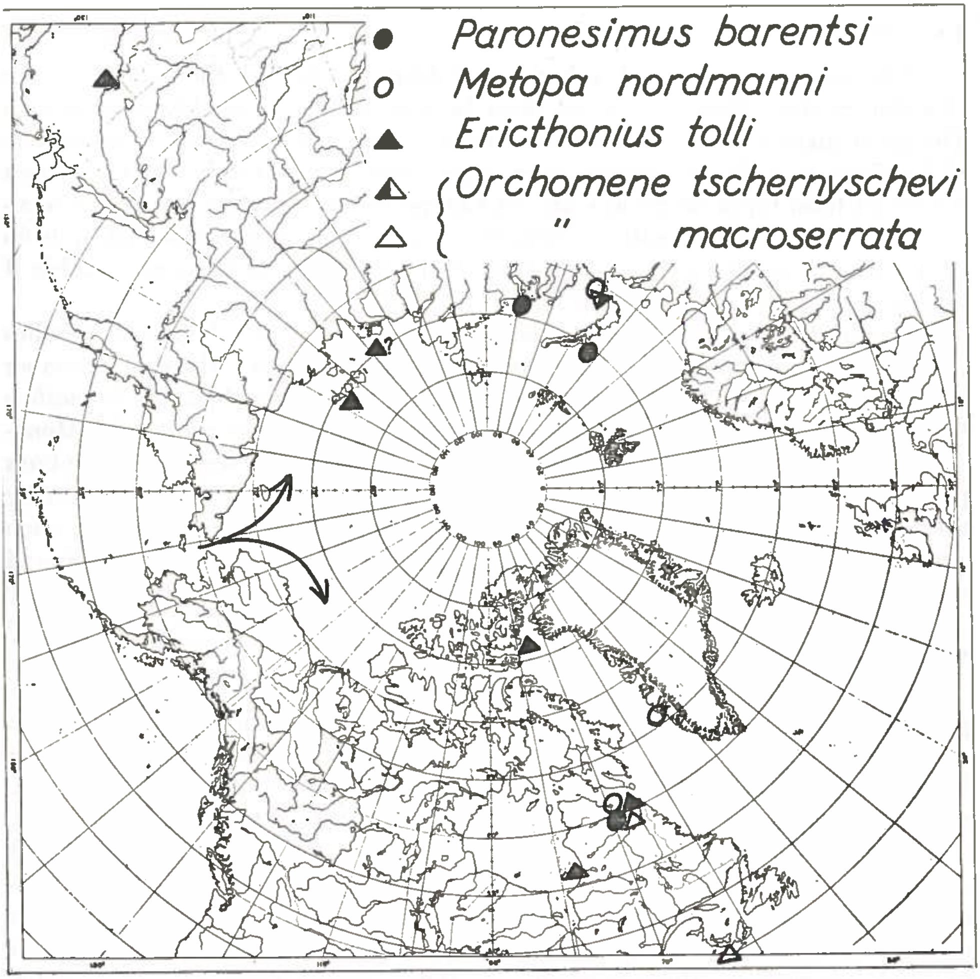

FIGURE 42. See text.

Lemche (1941) has two Opisthobranch molluscs out of 16 recorded from east Greenland; Stephensen (1944a) has 16, plus a similar doubtful number, out of 153 amphipods from east Greenland. As our knowledge of the distribution of these species advances, it is more than possible that deeper records will be made which will reduce the number still further. Of the 114 amphipods recorded from Ungava Bay, only four can be put in this category with reasonable certainty, as Table II shows: *Haliragcs megalops, Calliopius laeviusculus, Parapleustes assimilis* and *Rachotropis inflata.* If this "low arctic" group is really valid, it should perhaps properly be looked upon as a relict group in the arctic zone, remaining from a post-glacial slightly warmer period. For obvious reasons, planktonic surface forms and littoral forms are excluded from this group, since other ecological factors apply; this includes such species as *Metopa longirama, Gammarellus homari* and *Gammarus zaddachi oceanicus.*

Taxonomy

The eastern arctic and subarctic of Canada, indeed the whole of the Canadian waters, have not as yet been by any means thoroughly investigated. The great majority of marine animals, including amphipods, found in the waters of northern Canada are known from other parts of the north and have been described from types found in northern Europe and to a certain extent in Greenland. It follows that variations from the types, among specimens taken from Canadian waters, are to be expected; it would indeed be signally remarkable if at least slight variations were not found.

Besides the five new species described here, all of which belong to families (Stenothoidae and Pleustidae) of notoriously high variability, there is a number of variants from the typical form, the most noticeable of which are *Stenothoe brevicornis, Monoculodes longirostris* and *Ischyrocerus megalops.* In *Monoculodes longirostris* there is the suggestion of a typical rassenkreiss or artenkreis pattern of variation involving a species from the Kara Sea, *M. hanseni.* Among the benthonic amphipods, which have no pelagic larval development, such patterns of variation are to be expected in greater numbers as our knowledge of the full circumpolar fauna increases. As would be expected, the holoplanktonic amphipod species of the Hyperiidea offer far less taxonomic difficulty than do the predominantly benthonic and littoral Gammaridea.

The extension in the known range of some of the species has resulted, in the present work, in the bringing together of certain pairs or groups of species in synonymy. Thus evidence is brought forward which suggests that *Ischyrocerus latipes, I. assimilis* and *I. pachtusovi* are all variants of a single species complex; and in two cases, *Westwoodilla megalops* and *Haploops setosa,* the Ungava Bay material (and in the former case, also material from the Gulf of St. Lawrence) shows characters of two closely allied European forms hitherto described as separate species (*Westwoodilla megalops* and *W. caecula*; and *Haploops setosa* and *H. robusta*). These two pairs of species have therefore been brought together to single species, in which in each case the eastern Canadian form probably represents the common stock from which the European variants diverged.

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The Cirripede Crustacea of the Hudson Strait Region, Canadian Eastern Arctic[1, 2]

"CALANUS" SERIES NO. 7

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ABSTRACT

The distribution, bathymetrical occurrence and spawning periods of three widely distributed arctic-boreal species of barnacles, *Balanus balanoides*, *B. balanus* and *B. crenatus*, are given from Ungava Bay, Frobisher Bay, Cumberland Sound and Hudson Strait.

INTRODUCTION

THE present account provides a station list of barnacle species taken by the *Calanus* expeditions of 1947–52 in the waters of Hudson Strait and contiguous areas. The station lists, with place names, bathymetrical records and maps, are given by Dunbar and Grainger (1952) and Grainger (1954). The collection includes littoral and benthic forms taken by hand along the shore and by dredges and nets along the bottom.

The diagnostic features of the species in the present material show little variation from those in published descriptions. The wall plates (parietes) are notoriously variable in shape and external sculpturing and on this account the external morphology is of little taxonomic value. Three main *ecophenotypes* or growth forms were noted in *Balanus*: the typically conical shape of isolated specimens, the columnar form of specimens closely crowded in the same plane, and the "curved" form of individuals growing one upon the other.

The dearth of published information on the spawning periods of barnacles in arctic and subarctic regions has prompted the present analysis of the ovigerous condition of adult barnacles and seasonal occurrence of the newly attached and metamorphosed larvae (basal diam. < 3 mm.). The findings are consistent with the known seasonal occurrence of the larvae obtained in plankton hauls of the *Calanus* expeditions (H. Barnes, personal communication), and in eastern and western Greenland (Madsen, 1936; Thorson, 1936), and with spawning periods in Labrador (Bousfield, 1954).

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SYNOPSIS OF THE SPECIES

Suborder Balanomorpha

FAMILY BALANIDAE

(i) *Balanus* (*Semibalanus*) *balanoides* (L.)

More than 320 adult specimens and many newly metamorphosed young barnacles were taken at 24 intertidal and 3 benthic stations in Ungava Bay and Hudson Strait, 1947–50, Frobisher Bay, 1951, and Cumberland Sound, 1952:

1947: Stn. 1A (June 24)–32 spec.; Stn. 5 (June 29)–17 spec.; Stn. 8 (July 5)–15 spec.
1948: Stn. 65 (July 12)–7 spec.
1949: Stn. 107A (July 9)–10 spec.; Stn. 112 (July 18)–19 spec.; Stn. 123 (Aug. 10)–22 spec.
1950: Stn. 201A (June 27)–4 spec.; Stn. 203 (July 8) 30 m. dredge–1 spec.; Stn. 204 (July 9)–15 spec.; Stn. 205 (July 14)–4 spec.; Stn. 208 (July 21)–wall frags.; Stn. 212 July 21)–6 spec.; Stn. 217 (July 30)–8 spec.; Stn. 224A (Aug. 18)–8 spec., 22 newly metamorph.; Stn. 227 (Aug. 18)–70 spec., 4 newly metamorph.; 1 attached cyprid; Stn. 227 (Aug. 18)–1 spec.; Stn. 229 (Aug. 26)–6 spec., 2 newly metamorph.; Stn. 229 (Aug. 28)–6 spec., 6 newly metamorph.; Stn. 231 (Aug. 27) 63–75 m. dredge–3 spec.; Stn. 235 (Sept. 1)–11 spec.
1951: Stn. 310 (July 29)–2 spec.; Stn. 316 (Aug. 8)–11 spec.; Stn. 330 (Aug. 21)–2 spec.
1952: Stn. 406 (July 27) 25 fath. dredge–1 spec., frags., 3 newly metamorph.; Stn. 413 (Aug. 5)–4 spec.; Stn. 418 (Aug. 14)–6 specimens.

DISTRIBUTION: "From latitude 66°34′ north in the Atlantic Ocean to the ocean coast of France and to Delaware Bay; in the Pacific–from Unalaska to Stitka" (Pilsbry, 1916). The species is known from Greenland south of latitude 66°N. on the east coast and 73°N. on the west coast, (Madsen, 1936), southern Baffin Island (Ellis, unpublished), Labrador (Rathbun, 1910), and the entire Atlantic coast of Canada (Bousfield, 1954).

From the northeastern part of Hudson Bay the following material in the collections of the Royal Ontario Museum of Zoology and Palaeontology has been examined:

Nottingham Island; inlet at base "B" on south end, "Loubyrne" expedition, Aug. 6, 1927. F. Johansen coll.–12 specimens.

The occurrence of *B. balanoides* at depths of 30, 46 and 63 metres (Stns. 203, 406 and 231) in the Hudson Strait region is in accord with the subtidal bathymetrical distribution of the species in the Gulf of Maine (Bousfield, 1954).

(ii) *Balanus balanus* (L.) Syn: *Balanus porcatus* Da Costa

More than 225 adult specimens and numerous newly metamorphosed young were obtained at 24 benthic stations in depths ranging from 27 m.–300 m. as follows:

1947: Stn. 13 (July 13)–old wall frags.; Stn. 18 (July 17)–1 spec. parietes only, frags.; Stn. 25 (July 19)–3 spec., frags.; Stn. 27 (July 19)–19 spec., 1 newly metamorph.; Stn. 28 (July 19)–2 spec.; Stn. 30 (July 20)–10 spec., 2 newly metamorph.; Stn. 33 (Aug. 8)–37 spec., numerous newly metamorph., 1 cyprid; Stn. 33 (Aug. 10)–8 spec.
1949: Stn. 102 (June 30)–2 spec., 2 newly metamorph.; Stn. 103 (July 6)–9 spec., 3 newly metamorph.; Stn. 126 (Aug. 23)–2 spec.

1950: Stn. 203 (July 8)—5 spec., numerous newly metamorph.; Stn. 206—(July 15)—3 frags.; Stn. 208A (July 20)—8 spec., 6 frags.; Stn. 222 (Aug. 3)—4 spec., 1 frag., a few newly metamorph.; Stn. 226 (Aug. 13)—more than 100 spec., 10 newly metamorph.

1951: Stn. 317 (Aug. 9)—2 spec. (1 very large—4.0 cm. basal diam.); Stn. 318 (Aug. 9)—1 frag.; Stn. 322 (Aug. 12)—4 spec.. 14 newly metamorph.; Stn. 331 (Aug. 22)—9 spec., a few newly metamorph.; Stn. 333 (Aug. 24)—8 spec., 35 newly metamorph.; Stn. 334 (Aug. 24)—2 frags.

1952: Stn. 406 (July 22)—1 spec., frags. only; Stn. 413 (Aug. 5)—1 large spec., parietes only.

DISTRIBUTION: "Arctic and North Atlantic Ocean, from 80°N. Latitude, Franz Joseph Archipelago, to the English Channel, and in America south to Nantucket and Long Island Sound. Not located off the Grand Banks of Newfoundland." (Pilsbry, 1916). North Pacific south to Puget Sound (Cornwall, 1954). Known from both east and west coasts of Greenland (Weltner, 1900; Thorson, 1936), eastern Baffin Island (Ellis, unpublished), Labrador (Rathbun, 1910) and the Atlantic coast of Canada (Bousfield, 1954).

In the collections of the National Museum of Canada are specimens, identified by H. A. Pisbry, from the following localities in Arctic Canada:

Hudson Strait: Ashe Inlet, Big Island, 1884, R. Bell coll.—several dried specimens.

Dolphin and Union Strait, N.W.T., Canadian Arctic Expedition Stn. 43c, 10–75 fath., Sept., 1915, F. Johansen coll.—fragments (dried).

Ibid., Stn. 43a, 50 fath., fragments (dried).

Bernard Harbour, N.W.T., C.A.E. Stn. 37p, washed up on beach, Oct., 1914, F. Johansen coll.—fragments (dried).

B. balanus was taken in depths from 15–200 metres, mainly 30–100 metres. This species, occurring in 24 of 30 benthic stations at which barnacles were taken, appears to be more common and more abundant than *B. crenatus* in the Hudson Strait region.

(iii) *Balanus crenatus* Bruguière

Approximately 225 adult specimens and many newly metamorphosed young were obtained at 14 benthic and 2 intertidal stations, in depths ranging from 0 to 252 m., as follows:

1947: Stn. 18 (July 17)—wall frags. only; Stn. 33 (Aug. 8)—11 spec.; Stn. 33 (Aug. 10)—138 spec., a few newly metamorph.; Stn. 48 (Aug. 23)—1 spec.

1948: Stn. 58 (July 28)—2 spec., some newly metamorph.; Stn. 65 (July 12) intertidal—4 specs.

1949: Stn. 103 (July 6)—3 frags.; Stn. 126 (Aug. 23)—1 spec.

1950: Stn. 201c (June 29)—30 spec., a few newly metamorph.; Stn. 208A (July 20)—2 frags.; Stn. 208 (July 21) intertidal—1 frag.; Stn. 210 (July 11)—1 spec.; Stn. 226 (Aug. 13)—30 spec., 13 newly metamorph.

1951: Stn. 321 (Aug. 11)—numerous wall frags. columnar type; Stn. 322 (Aug. 12)—3 specs.

1952: Stn. 406 (July 22)—3 newly metamorph.

DISTRIBUTION: "Arctic ocean; North Atlantic south to Long Island Sound; Bering Sea and North Pacific south to Santa Barbara, California, and Northern Japan" (Pilsbry, 1916). Known from Greenland (Weltner, 1900), Labrador (Rathbun, 1910) and the entire Atlantic coast of Canada (Bousfield, 1954).

In the National Museum of Canada are specimens, identified by H. A. Pilsbry, from two localities in Arctic Canada:

Hudson Strait, Ashe Inlet, Big Island, 1884, R. Bell coll.—several (dried) specimens.
Hudson Bay, east side, mouth of Povungnituk R., 1898, A. P. Low coll.—several (dried) specimens.

B. crenatus was taken from the tide lines down to 200 metres, mainly about 30 m. As few dredgings were made in depths of less than 15 m., no reliable estimate of abundance with depth can be made from the present material. However, in this subarctic region *B. crenatus* apparently inhabits waters that are somewhat shallower and presumably warmer than those of *Balanus balanus.*

SPAWNING SEASONS

The present material provides clues to the times of spawning of adults and occurrence of barnacle larvae in the plankton in the Hudson Strait region. Because of complicating factors, however, a clear picture of the time of spawning, particularly of *Balanus balanoides*, is difficult to derive. The number of samples is small, and the samples were taken from widely separated localities and various levels of the littoral and sublittoral zones having different water temperatures and different degrees of exposure to frost, ice and wave action. These factors are thought to be important in determining the development and release of the eggs. Also, the lots represent but three months of the year (mid-June to mid-September), a time when few or no eggs and larvae are present either in the ovaries or in the ovigerous lamellae. Moreover the samples were taken in different years when, at corresponding dates, ecological conditions were different.

The following notes were made on the barnacle material:

Balanus balanoides

Ovaries were thin or very thin in most specimens taken during June and early July, thickening in late July and early August, and thick and yellowish in late August and early September.

Segmenting eggs were observed in three specimens only, taken July 9/49, July 20/50 and Aug. 22/51. Nauplii were found in specimens taken June 24/47, July 9/49, July 9/50 and July 29/50.

Nauplii and segmenting eggs were found in a single specimen from Stn. 6A, Frobisher Bay, D. V. Ellis coll., June 19–21, 1952.

Newly attached cyprid larvae and newly metamorphosed young barnacles (basal diam. less than 3 mm.) occurred on Aug. 18/50; the latter also on Aug. 26 and Aug. 28, 1950.

In this species spawning normally takes place only once per year, commencing in the second year. From the above observations it may be deduced that the eggs develop in the ovaries during the months of July and August and are probably deposited and fertilized in the ovigerous lamellae in September and October. The eggs develop to the nauplius stage during the long winter period, and spawning takes place mainly in June and early July, when ice first disappears from the shore areas. Attachment of cyprids takes place chiefly in July and August.

Balanus balanus

Although several year classes (including the non-spawning first-year class) have been examined, none containing eggs or developing nauplii was observed. Ovaries were thin in late June and early July, somewhat thicker in late July and early August, and moderately thick in late August.

Newly metamorphosed young barnacles occurred in lots taken June 30/49, July 6/49, July 8/50, July 18/47, Aug. 3/50, Aug. 8/47, Aug. 12/51, Aug. 13/50, Aug. 22/51 and Aug. 24/51, and a cyprid on Aug. 8/47.

The reproductive cycle is much as in *B. balanoides*, but spawning may take place slightly earlier in the season. The eggs are probably deposited and fertilized in September, develop to the nauplius stage during the winter, and are liberated into the water during late May, June and early July. Attachment of cyprids commences about the end of June and continues through July into August.

In a study of 15 specimens of *B. balanus* from Scoresby Sound, Northeast Greenland (lat. 70°N.), Thorson (1936) found none containing eggs. Nauplii were taken in the plankton on June 17 and July 11, with most occurring later. The larval sequence in *B. balanus* is complete (6 nauplius stages and a cyprid stage), but under abnormally poor breeding conditions the larvae may be retained in the mantle cavity until reaching the cyprid stage of development.

Balanus crenatus

Ovaries thin and watery in June and July; thickening in August. One lot (Aug. 23, 1947) with thick ovaries.

Segmenting eggs were found in a single specimen at Stn. 126, 70–91 m., Aug. 23/49. Nauplius stage 1 occurred in two specimens taken Aug. 11/47 and Aug. 13/50.

A newly attached cyprid was taken Aug. 13/50, and newly metamorphosed barnacles on July 22/52, July 28/48, Aug. 11/47 and Aug. 13/50.

In material from Frobisher Bay and Cumberland Sound collected in 1952 by D. V. Ellis, nauplii and segmenting eggs in many adults and newly metamorphosed young were taken June 22, and the former occurred in one adult taken July 29–Aug. 1.

During July and August the ovaries become thick and eggs are probably deposited in September and October. Spawning takes place in first-year individuals of this species. Nauplii are released in June and July; those from deep-lying barnacles in August. Cyprids attach mainly in late June, July and August. The normal reproductive cycle contains two broods per year near the southern limit of distribution. Here, near its northern limit, more than one brood per year is unlikely. The spawning season appears to be slightly later than that of *Balanus balanus.*

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