ON THE BIOLOGY OF THE ARCTIC CHAR

by

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INTRODUCTION AND SURVEY OF LITERATURE

The object of this work is to record some of the facts known on the biology of the Arctic Char, Salvelinus alpinus (Linn.), found in the waters of the eastern Canadian Arctic. Data presented were collected by the writer during the summer of 1948, when operations were conducted off the Baffin Island coast for commercial fishing of this char. Observations were made on habits of Salvelinus, records compiled of length and sex from random samples of the catch, and collections made of stomach contents, from which something of local planktonic types was learned, and of otoliths and scales, for the determination of age in the char.

Taxonomy

The taxonomy of the Arctic Char has been a variable one, and remains somewhat so at the present time. Tendency towards division of the genus into several species, or the species into sub-species, has been balanced by the suggested reduction of the Arctic Char (or Chars) to one genus and species, pending further investigation (Dymond, in Manning 1942). It is in accordance with this latter point of view that the specimens treated here are considered collectively as Salvelinus alpinus, with no attempt made to sub-divide the group further.

Linnaeus (1758) wrote of many representatives of the genus to which he gave the name Salmo, and of one in particular, Salmo alpinus, which he called the red char.

Fabricius (1780) wrote of five species of the genus Salmo, found in Greenland, the most important of which, in a consideration of the Arctic Char, was Salmo alpinus Linn., referred to above. Among the others were Salmo carpio, considered since to be perhaps the same form as S. alpinus Linn., the former the char in sea garb, the latter the same in nuptial colours (Jordan 1896). S. stagnalis and S. rivalis were described as fresh water forms, and it has been suggested that they, too, represented the same fish, in and out of breeding-time coloration, and that they are similar to the form referred to at present as Salvelinus alpinus stagnalis (Fab.), the Greenland Char (Jordan 1896). The Salmo arcticus of Fabricius has become known as Mallotus villosus, the capelin of the smelt family.

Nilsson (1832) introduced the term Salvelini, to include the chars. Richardson (1836) described twenty-seven American species of the genus Salmo and included five of them among the Salvelini, characterized by the smallness of their scales, and the arrangement of the vomerine teeth in a cluster on the anterior extremity of this bone, not running backward along a median ridge in a single or double row, as in others of the genus. Among the chars of Richardson was Salmo alipes, the long-finned char, described as a characteristic inhabitant of rocky pools and streams, which may, or may not migrate to the sea. First described by Richardson, too, was Salmo nitidus, referred to as being similar to S. alipes Rich., but

with a thicker body, shorter upper jaw and fins, and different colouring. This species agrees closely with Fabricius' Salmo stagnalis, and may actually be the same as Salmo nitidus Rich., these two forms perhaps representing the same species under different conditions. Salmo hoodii, S. hearnei, and S. rossii, all described by Richardson, have been thought of as being the same species (Jordan 1896), differing in appearance as the two forms mentioned above.

Günther (1877) contributed Salmo arcturus to the growing list of chars, a species now considered as one of the sub-species of Canadian northern char, Salvelinus alpinus arcturus (Gün.). At the same time he described Salmo naresi. Dresel (1884) observed char, caught off the western Greenland coast which he classified as Salvelinus stagnalis (Fab.), although from their description they may have been Salmo alipes Rich. D. S. Jordan (1885) in a catalogue of fishes, described seven species of the genus Salvelinus as being inhabitants of North America. Excluding from this S. fontinalis (Mitchell), the common temperate zone brook trout, there are six northern species included: S. nitidus (Rich.); S. stagnalis (Fab.); S. arcturus (Gün.); S. rossii (Rich.); S. oquassa (Girard); and S. naresi (Bean), the latter similar to the previously mentioned Salmo naresi Gün.

Jordan and Evermann (1896) listed four species of the genus Salvelinus as inhabiting North American waters: S. fontinalis (Mitchell); S. malma (Walbaum), the western dolly varden char; S. naresi (Bean); S. alpinus (Linn.), the European char, salbing, saibling, Ombre Chevalier, or Greenland char. They indicate here the possible sub-division of the

species alpinus into S. alpinus alipes (Rich.), found in the sea as well as in fresh water; S. alpinus stagnalis (Fab.), similar to the form above, but not entering the sea; S. alpinus arcturus (Gün.), particularly evident in the far north; and finally a group geographically separated from the others, S. alpinus aureolus (Bean), representative of the genus in temperate zone lakes.

A list by Halkett (1913) of the fishes of Canada and Newfoundland contains reference to the four northern chars of the eastern Canadian arctic region. Salvelinus alpinus alipes (Rich.), the long-finned char, is described as lacustrine and fluviatile, S. alpinus stagnalis (Fab.), the Greenland char, lacustrine and fluviatile, the latter environment differing from Jordan and Evermann above, S. alpinus arcturus (Gün.), the arctic char, lacustrine in habitat, and finally S. oquassa naresi (Gün.), the nares char, also lacustrine.

Fowler (1915) published a description of Salvelinus alpinus marstoni (Garman), apparently similar to the arctic type chars, but an inhabitant of more temperate areas of eastern Canada.

It has been suggested that there may be as many as eleven species of alpinoid chars in America (DeLacy and Morton 1942). Two of the western arctic chars of the Pacific coast of Alaska are Salvelinus malma (Walbaum) and Salvelinus alpinus (Linn.), the former known as the dolly varden or Pacific char, as by a number of other names.

Johansen (1912) has referred to the arctic char of Greenland as Salmo alpinus Linn., common in most large lakes there.

The term Salmo stagnalis Fab. was used by Hildebrand (1939) in

reporting on char from eastern and northeastern Greenland, Fox Basin, and Cape Mumford in Labrador.

The char of Spitsbergen were described by Dahl (1926), as the "Spitsbergen salmon," Salmo umbla Linn., sub-species stagnalis Fab.

The four eastern Canadian arctic chars of Halkett (1913) might now be traced through earlier writers as follows: Salvelinus alpinus arcturus (Gün.), first described as Salmo arcturus by Günther (1877), and as Salvelinus arcturus (Gün.) (Jordan 1885); Salvelinus alpinus alipes (Rich.), described first by Richardson (1836), as Salmo alipes and Salmo nitidus (similar, see above), and referred to by Jordan (1885) as Salvelinus nitidus (Rich.); Salvelinus alpinus stagnalis (Fab.), described by Fabricius (1780) as Salmo stagnalis and Salmo rivalis (similar, see above), and referred to later by Richardson (1836) as Salmo hoodii, Salmo hearnei, and Salmo rossii (similar, see above), by Dresel (1884) as Salvelinus stagnalis (Fab.), by Jordan (1885) as Salvelinus stagnalis (Fab.), and Salvelinus rossii (Rich.); and Salvelinus oquassa naresi (Gün.), described by Günther (1877), as Salmo naresi.

Salvelinus alpinus belongs to the order Isospondyli, the genus one of the ten genera of the family Salmonidae. It is seen, therefore, that the char holds a position of close relative to such salmonids as the Atlantic Salmon and the trout, of the genus Salmo, the Pacific Salmon, Oncorhynchus, the Whitefish, and others.

Kendall (1914) gave as characteristics of the genus Salvelinus:

vomer boat-shaped, shaft strongly depressed, without teeth, teeth confined to the head or chevron, more or less prolonged backward, free from the shaft; scales comparatively small.

Jordan and Evermann (1896) who described four species of the genus Salvelinus in North America, differentiated between them by dividing the group into those with marbled backs, fontinalis, and those without, the other three species, Those with spotted backs included malma, leaving without spots oquassa and alpinus, differing in gill rakers and general body and head size. Salvelinus alpinus then was described as having gill rakers numerous 6 +12 to 16; head large, body stout; and belly orange in breeding season.

Dymond has written the following on the present state of taxonomy of the North American arctic chars. "Salvelinus alpinus from Arctic America has been given many specific names including Salvelinus stagnalis, S. alipes, S. rossii, S. hearnei, etc. 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. As in the case of salmonoid fishes, individuals differ widely depending on ecological conditions." (in Manning 1942).

Biology

Linnaeus (1758) described Salmo alpinus, the red char, as having a black back, pale blue sides, and an orange belly, as being a feeder on larvae of gnats, and an inhabitant of northern mountain lakes.

Among the species of the genus Salmo described by Fabricius (1780) was Salmo alpinus Linn., referred to above, described here as having a black back, blue sides, and a red-yellow belly. Among the others were Salmo carpio, dark, with a blue-green back, silvery white sides, and a white belly, this representing the non-breeding time, sea coloration of Salmo alpinus Linn., described by Fabricius in nuptial colours. A similar coloration difference caused Fabricius to differentiate between Salmo stagnalis and S. rivalis, probably both the same species.

Richardson (1836) aware of the development among European chars of red or orange bellies during the breeding season was uncertain as to whether or not the North American forms showed this change in coloration. This resulted in description of two species, Salmo nitidus and Salmo alipes, both possibly modifications of Fabricius' Salmo stagnalis.

Dresel (1884) observed two male and one female char, caught off the western Greenland coast, at the mouth of a mountain stream. These varied in length from fifteen to seventeen inches, and were classified by him as Salvelinus stagnalis (Fab.).

Two char from Southampton Island, taken by Henn (1932), were referred to as Greenland char, and classified as Salvelinus alpinus (Fab.). Description of migratory habits of these along with meristic counts

indicate similarity to the char of Baffin Island. The male measured 50.3 cm. overall, the female 46 cm.

Vladykov (1933) in an account of fishes of Hudson and James Bays described two types of what he called Salvelinus alpinus, with the possibility of sub-specific classification, one group anadromous, the other a landlocked form. The arctic char or arctic trout was classed as of definite economic importance in the Hudson Bay area, along with the brook trout, Greenland and Atlantic cod, salmon, cisco, and whitefish.

Among eighty-six anadromous forms examined by Vladykov were fourteen mature char, males from 27.8 to 49 cm., and females from 35 to 59 cm., long. Seventy-two immatures measured from 3.5 to 15.7 cm. in length. These fish were caught in coastal salt waters, and ascended streams to spawn during September. Observations on ovaries and eggs were made during the summer of 1929. On July 27, a char 50 cm. long showed ovaries 123 mm. in length, 13 mm. wide, and eggs 1 to 1½ mm. in diameter. On August 15 specimens bore eggs of approximately the same size. On August 19 a 70 cm. specimen weighing 4.2 kg. bore ovaries 153 mm. by 27 mm. and carried eggs 1½ to 2 mm. in diameter. Finally on September 2, a char of 65 cm. length, and 2.8 kg. weight, showed ovaries 22 mm. wide, and eggs 2 mm. in diameter.

Results of examination of stomach contents from fifteen specimens taken by Vladykov from July 27 to October 3 showed two principal groups of food: amphipods and fishes. In the first group were three types: Themisto libellula (150); Pseudalibrotus littoralis (42); and Gammarus

locusta (11). Among the fishes were: Lumpenus fabricii (75); Ammodytes sp. (73); Myoxocephalus sp. (75); M. groenlandicus (6); M. scorpioides (1); Gymnocanthus sp. (6); Cyclopterus lumpus hudsonius (5); and Thymallus signifer (1).

Four mature specimens of the landlocked form were examined, one male, 10.5 cm. and three females, from 10.9 to 18.2 cm. Characteristic of this type is precocious maturity, less forked caudal fin, larger eyes, and smaller size than the sea-going form. Their juvenile coloration was described as showing ten wide, dark cross bands on the sides. Spawning of these forms likely occurs during late August or early September, because of evidence of mature eggs, 5 mm. in diameter, from August 24 to August 31.

Soper (1934) has given the following description of Salvelinus alpinus as observed in the southern Baffin Island area. The char collect at river mouths during late July, often in great numbers. It is here that they are most easily caught, by net or spear, by the Eskimos (who also spear them through holes in the ice, most often in November, April, and May, while the char are wintering in fresh water). The average weight during the summer run from rivers is 3½ to 4 pounds, average length 48 to 50 cm. although weight may reach 9 to 10 pounds and length 71 cm. Adults are described as being dusky greenish above, ashy or creamy-white below, with numerous reddish or orange spots. Immatures up to 25 cm. are blackish above and pale red underneath. Very young specimens are dusky, with darker lateral transverse bars. The Eskimos claim to find adult "trout" in fresh water lakes, and insist that they

are different from the char of the salt water, externally, and in having flesh of a different colour. Some of these apparently remain permanently in these lakes.

Weed (1934) observed Salvelinus alpinus in Labrador streams during the summer, when only breeding individuals and first year char were present. Many young, three to four inches, were seen in shallow water of bays, often several miles from the nearest stream. One spawning bed was found, five miles from the sea, a wide, shallow, rapid flowing section of the river, in which the char lay motionless despite the swift current. From the condition of gonads it was considered probable that some spawn earlier than those seen, perhaps as early as July. Fishermen along the Labrador coast believe some of the sea trout spawn in the sea during the summer, and there is some evidence that this may occur. Nets were set in the sea on May 31, 1928, and in these nets, on June 13 and 14, while ice was still in the bay, sea trout were caught with free eggs in their oviducts. As a result of his observations Weed concluded that while some of the fish spawn in brooks late in the fall, others are, apparently, in a spawning condition far from fresh water spawning regions as much as five months ahead of the usual (fall) spawning time. It is this second group, apparently summer spawners, which may breed in the sea.

Thirty specimens of arctic char were taken from eastern arctic waters by Rogers (1937) and measured, to show an overall length range of 53.5 to 80 cm. These fish were observed to remain in lakes during the winter. Although it was not observed whether these char return to

fresh water during the late summer of the same year as their migration to sea, it was thought probable that they spend at least a year or more in salt water before re-ascending the rivers. At Lake Harbour, on the southern Baffin Island coast, return began about July 27, in 1937, and since the ice break-up occurred during the first week of July, and the fish grow most during the time spent in the sea, their return during the same year was considered unlikely. Because the thirty fish described above were taken early in September, and the sex ratio was about five males to one female, it was thought probable that the females enter the river before the males. Young char are apparently present at all times in the streams, from young fingerlings to parr of seven to eight inches. Suggestions of sufficient food supply are contained in accounts of no success in fishing for the char with rod and fly.

In fishing conducted in the area of Southampton Island (Manning 1937), nets were set thirty miles from shore, and no char were taken, while in the same locality those set three miles off the coast were regularly successful. As a result of observations made during these operations, it was concluded improbable that any char remain in the sea during the winter, an interesting conclusion when compared to the contrary suggestion above. This was thought probable because no char were observed off-shore immediately after the break-up of ice in the spring. None was seen along the coast until those from fresh water had migrated. Following are the dates of the first catch of the year in various Southampton Island regions. Nets had been set earlier in each case, but

without results until the following times :

1934, Gibbons Point - July 8
1936, Gibbons Point - July 14
1937, Anderson River, none between July 12 and July 14.
1938, Taverner Bay, West Baffin Island - July 14.

Manning believed that char could be caught at river mouths during the second half of June. Although it is probable that the date of leaving the rivers depends upon the time of ice break-up, he has seen them swimming among the ice. It was suggested that the probable date of char ascending the rivers depends upon the amount of water descending. On the west coast of Baffin Island, in 1938, the homeward run was recorded by Manning until September 10. Lake types showed a lower belly colour of bright red, differing from those of salt and river mouth water. Manning suggests that there is evidence that this colour is not seasonal or sexual, but rather characteristic of the non-migrating fish, a suggestion advanced by Johansen (1912) in discussing Greenland forms.

The arctic char Salvelinus alpinus (Linn.), of the most northern Pacific coast area, formerly said to be anadromous, was found by DeLacy and Morton (1942), through observing and tagging, not to be migratory, and to be seen rarely in salt water. Length of these char averages 35 to 45 cm. the largest between 1937 and 1942 reaching 55 cm. They are commonly olive-tan above, with scales showing golden-yellow tints. Older fish are not spotted, but younger ones are often marked dorsally with scattered, round, light dots. Olive-tan merges into yellow or orange ventrally on the sides, usually with irregular pinkish dots. The belly

of adults is rarely white, but usually yellow, orange, or deep red. No spawning had been observed in these forms up until 1942. Food is mostly insects, eggs, and smaller fishes.

In 1948 Hildebrand studied Salvelinus alpinus in the Ungava Bay region, where they occur in most suitable lakes and streams, and in coastal waters during the summer. Specimens in shallow lakes of the region are said to be mature at three to four inches, and were found up to 69 cm. Observations were made at Port Burwell and George River. At Burwell landlocked forms were found to spawn in lakes, after an upstream migration, where from July 28 until August 16 specimens 5.4 cm. to 17 cm. were parr-like in coloration, approaching maturity. Char in a lake outlet near George River ranging from 25 cm. to 50 cm. in length, arrive there in late July and remain until about the middle of September. Examination of thirty-five char in the lake outlet near George River showed length ranging from 35 cm. to 50 cm. and the presence of a few nematodes and parasitic copepods. Stomachs of landlocked forms contained mostly insect larvae and stickelbacks.

One of the few attempts to study the char during the winter was made by Hildebrand (1948) at Fort Chimo, when one specimen was taken through the ice. Present in the stomach was a number of fish, too badly mangled to allow identification. It is stated that char are inactive during the winter, and that winter caught specimens often have a fungal growth on their skin, and are in poor condition.

The spring run of the migrants of the Ungava Bay region begins

shortly after ice break-up in the rivers. Food of the migrating char is mostly fish and amphipods, Gammarus locusta and Ammodytes commonly found. Spawning probably extends from the end of September until about the middle of November.

Johansen (1912) has referred to Salmo alpinus Linn., as being common in most large lakes in Greenland. He observed with certainty seaward migration from only one lake, and concluded that two types of this species exist in Greenland, one migratory, the other not. In winter these fish could be seen under the ice, where they were extremely active, unlike those of Ungava Bay, and apparently in search of food, allowing themselves to be taken quite easily on baited lines. Migration began as soon as the ice was out of the stream leading to the sea; nets set in the river caught fish immediately after flow began following ice melting. Fishing during the summer months was successful near the mouth of the river. In August migration had apparently reached its maximum, and by September migratory movement was mainly in the direction of fresh water, ending with the start of freezing.

Eighteen males caught by Johansen measured 70, 69, 68, 67, 65, 64.5, 56.5, 55, 51, 49, 44, 41.6, 18.5, 17, 15, 12, and 11 cm., compared with five females of 62.5, 52, 18, 17.8, and 15.7 cm. Spawning was not observed, and exact time not definitely learned. Many large males taken during July and August had testes in various degrees of development, but no running milt. Conditions of ovaries and eggs varied. One 41.6 cm. male showed spawning coloration and the hooked jaw condition, and from

this it was concluded probable that spawning occurs in autumn. Stomachs of smaller forms (10 to 20 cm.) contained mud from the lake bottom and larvae and pupae of flies. Those over 40 cm. showed: small fishes, Salmo alpinus and Gadus saida fry; Entomostraca; and green algae. These fish in turn serve as food for a loon of North-East Greenland and the fjord seal, Phoca foetida (hispida), the latter often enticed far up the rivers after the char.

Johansen described two varieties of coloration, essentially similar to the two forms previously described, differing principally in belly colour, whitish in one, orange in the other. Most of the first group (white) were caught just before or during seaward migration, most of them males. The conclusion regarding relation of colour to spawning was that colour outside of spawning time (spring and early summer) is characterized by the whitish belly, and that when sea migration begins in July, colour gradually changes to the orange underside, more evident in the males than in the females. By the time of re-entrance into fresh water, coloration is near its peak, gradually fading towards the end of the year. Differing from these migratory forms, those always in fresh water retain throughout the year the darker, spawning-time colouring of the former.

On July 18 and 19, 1909, 280 char were taken with nets at Fiskenessfjord, Greenland (Jensen 1948). Of 252 of these measured and otherwise examined, 141 were males, 31.5 to 58 cm., and 111 females, 39 to 65 cm. long. The largest of the females was 3.5 kg., one kilogram heavier than the largest male. Colour of these specimens was black and

sea-green dorsally, with sides silvery, with a pinkish tinge, and small, indistinct yellow-white dots, and ventral surface milk white. Eggs varied in degree of development; some mature, amber-coloured, were up to 7 mm. in diameter. Testes varied, too, in some narrow and pink, in others broad and white. Examination of stomach contents showed presence of capelins and fish eggs. Small samples showed dark cross bands along the sides, distinct on individuals of 15 cm., and still evident on those up to 24 cm., and as small as 3 cm. On July 23, 1909, 55 char were taken in salt and river water, and examined, to show genital organs nearly ripe. One female carried 4,650 eggs. Bellies were of a reddish tinge. Those caught in the river had nearly empty stomachs, containing only a whitish slime. Males here had acquired nuptial colours: head and back dark; sides spotted red-yellow or red; bellies red; lower jaw prolonged into a hook. On July 30, 1909, the river individuals were either sexually developed or completely undeveloped, showing that unripe specimens ascend the rivers with the others,

According to Jensen the char of Greenland deposits its eggs between the middle and the end of September, when the eggs are the size of peas. The char stays the winter in lakes, and begins to descend near the middle of May, quite emaciated. Ascension of the rivers begins about July 20.

Otolith examination of Greenland char by Hansen (1940) has shown age of individuals to reach 20 years. It is probable that the first three years of life are spent in fresh water, with departure for the sea occurring during the fourth year. Frequency of spawning is not known.

The permanent fresh water char of Greenland was described by Jensen (1948) as being dark, grey-brown, with light lateral spots and belly. No coloration similar to the orange belly referred to by Johansen is mentioned. Stomachs of these specimens examined contained midges and remains of sticklebacks.

The char of Spitsbergen have been described by Dahl (1926), as the "Spitsbergen salmon" (Salmo umbla Linn., sub-species stagnalis Fab.). Examination was made of eighty-four char, ranging from 20 cm. to 72 cm. in length. Observations on scales showed that 43% of these migrated for the first time to the sea after two winters in fresh water, 50% after three winters, and 7% after four winters. It was thought probable that all migrate to the sea before reaching a length of 20 cm. Of the eighty-four char examined, one had not survived the first winter following first migration (20 cm.); one had lived through one winter (29 cm.); twenty-two, two winters (average 34.9 cm.); twenty-four, three winters (average 38.7 cm.); thirteen, four winters (average 45.2 cm.); twelve, five winters (average 52.9 cm.); six, six winters (average 60 cm.); four, seven winters (average 69 cm.); and one, eight winters (70 cm.). Poor representation of smaller individuals likely resulted from the size of the nets used in taking the fish. Dahl has concluded that the growth rate in the sea is dependent upon length of time spent in fresh water before the first seaward migration, the longer the parr-life, the greater the growth in the sea. He considered that the majority spend at least three winters after migration before reaching sexual maturity.

Examination of stomach contents of Spitsbergen char in fresh water

showed presence of larvae and pupae, mostly Chironomidae. Stomach contents of sea species showed: Mallotus villosus; Cottus scorpius; Triglops Pingellii; Icelus hamatus; Liparis Reinhardti; Gammarus locusta; Mysis oculata; Amanthille homari; Rhoda inermis; and Nereis pelagica.

In 1927 Saemundsson encountered two forms of arctic char in Iceland, one migratory, the other landlocked. The former, fairly common, vary in length from 40 cm. to 60 cm. Return to rivers begins in July, lasts until September, with spawning probably occuring from September until November. Food of migrants is mostly Gammarus locusta, while fresh water forms live chiefly on insect larvae and pupae. It is thought likely that sexual maturity is reached at about sex years.

Yessipov (1935) found that char of Novaya Zemlya spawn in lakes every second year, during October and November, with attainment of sexual maturity in the sixth or seventh year. They probably enter the sea for the first time during the third or fourth year, migration occurring from the end of June until about the middle of July, with return from the middle of August until about the middle of September. Stomach contents showed young Gadus callarias, capelins, sand eels, cottids, crustaceans and worms.

Distribution

The arctic Char is distributed throughout a circumpolar region, from the northern limit of freely running water to a few cold water areas in the northern temperate zone.

North America. Salmo hearnei was described by Richardson (1823) from Coppermine River. Richardson (1836) described Salmo rossii, a migrant species, and S. nitidus and S. alipes, from a fresh water lake, both from Boothia Felix. Günther (1877) described Salmo arcturus, taken at Floeberg Beach, Ellesmere Island, and S. naresi, from Discovery Bay. Jordan and Evermann (1896) referred to Salvelinus alpinus aureolus (Bean) as occurring in lakes of Maine and New Hampshire.

Halkett (1913) listed the distribution of four northern Canadian chars. Salvelinus alpinus alipes (Rich.) was recorded from lakes on Regent's Inlet and Boothia Felix; S. alipes stagnalis (Fab.), from Regent's Inlet, Boothia Felix and Labrador; S. alpinus arcturus (Gün.), from Victoria Lake, Floeberg Beach, and from as far north as latitude 82° 34'; and S. oquassa naresi (Gün.), from Discovery Bay and Cumberland Gulf.

Fowler (1915) described Salvelinus alpinus marstoni (Garman) from temperate areas of eastern Canada. Salvelinus alpinus (Fab.) was taken from Southampton Island by Henn (1932). Dymond (1932) reported Salvelinus alpinus in the Gulf of St. Lawrence, as far west as Trinity River, occurring in many streams with Salvelinus fontinalis (Mitchell).

Vladykov (1933) gave the following occurrence of S. alpinus in the Hudson and James Bays region: Great Whale River, 1919; peninsula at Boat Opening, 1920; Cape Merry Peninsula, 1929; and Churchill, 1930. Distribution in the Hudson Strait area: Nottingham Island, Wakeham Bay and Port Burwell, 1927.

According to Soper (1934) char have been taken in quantity as far north as Pond Inlet, off northern Baffin Island. The arctic char is locally common along most of the coast of southern Baffin Island, at least from Cape Dorset as far north as Cumberland Sound. It is probably the species numerous in streams of Baffin Island's east coast from Cumberland peninsula to Pond Inlet, and in Netilling Lake and others of the southern Baffin Island region.

Weed (1934) recorded Salvelinus alpinus from streams of Labrador. Rogers (1937) reported char from eight stations in the eastern Canadian arctic: Hebron, Port Burwell, Lake Harbour, Arctic Bay, Fort Ross, Pond Inlet, Clyde River, and Pangnirtung. The presence of the Greenland Char, Salmo stagnalis Fab., in the Melville Peninsula region of Fox Basin and the Cape Mumford area of Labrador was shown by Hildebrand (1939). Manning (1942) reported char in several areas about Southampton Island, including Gibbons Point and Anderson River. Specimens also were taken from Taverner Bay on western Baffin Island (Manning 1942).

Two char have been recorded from Alaska by DeLacy and Morton (1942), Salvelinus alpinus and Salvelinus malma. Wynne-Edwards (1947) found char to ascend the MacKenzie River in small numbers during the summer, as far as Good Hope. In 1948 Hildebrand observed Salvelinus alpinus in the

region of Ungava Bay, particularly at Port Burwell, George River and Fort Chimo.

Greenland. Fabricius (1780) described five species of char from lakes and streams of Greenland. Dresel (1884) observed char off the western coast of Greenland. Salmo alpinus Linn., was referred to by Johansen (1912) as being common in most large lakes in Greenland, as a landlocked form, and as being present in at least one stream as a migrant. Hildebrand (1939) reported the Greenland Char, Salmo stagnalis Fab. from eastern and northeast Greenland. According to Jensen (1948) Salvelinus alpinus of Greenland has undergone more extensive exploitation along the west than the east coast and has been found commonly in fjords, rivers and lakes, from the southern Julianhaab district to 74° N. on the west, and taken as far north as a lake about 79° N., in 1939. Special reference was made by Jensen to fishing in Fiskenesfjord. The char of east Greenland have been less exploited than those of the west, but are similar, and extend from southern Greenland to about 77° N.

Further distribution. Char of Spitsbergen, Salmo umbla Linn. (subspecies stagnalis Fab.) have been described by Dahl (1926). Saemundsson (1927) has referred to two forms in Iceland, one landlocked, found in many lakes, the other a migrant, common in streams everywhere but on the south coast. Reference was made by Yessipov (1935) to the char of Novaya Zemlya.

Jensen (1948) gives as additional areas inhabited by the arctic char,

Bear Island, northern Norway and northern Siberia. The stationary form also occurs in lakes in Sweden, southern Norway, Finland, the Alps, England, Ireland, Scotland, the Orkneys, the Shetlands, and the U.S.S.R.

ECONOMIC IMPORTANCE

Bethune (1937) described the char as the most abundant and valuable food fish found along the arctic coasts of Canada. For some years the Hudson Bay Company shipped annually 150-200 tierces of pickled char from the eastern Canadian arctic, but this was given up about 1930. Many natives of the eastern arctic subsist on char alone for weeks during the July and August return to fresh water, spearing or netting the fish as they ascend the rivers to spawn.

In the Franklin District, in the western Canadian arctic, Dymond (in Bethune 1937) referred to the Arctic char as "the most important food fish". In the western arctic as in the east, Eskimo fishing is done with gill nets and spears, the latter used principally during large runs. During winter considerable fishing is done under the ice. Of the number of fish taken by the western arctic Eskimos, for the char as well as all others available, Bethune (1937) wrote: "They eat huge amounts themselves and require large quantities for their dogs, and an Eskimo who starts the winter with less than 8,000 or 10,000 fish can look forward to lean days ahead."

Salmon (Salmo alpinus Linn.) fishing is one of the summer pastimes of Greenlanders who take them from the rivers during the July and August return to fresh water, according to Jensen (1928). Part of the catch is eaten at the time, dried for the winter, or sold fresh or smoked to Denmark. In Greenland only a few rivers are large enough to allow fishing for export. In 1914 at a fjord into which several suitable

rivers empty, an experimental station was established for preserving char, but was given up after three summers, because the number of fish was too small to begin with, and numbers decreased rapidly. Some commercial fishing is still conducted, but on a relatively small scale, by salting fish at the rivers, sending them to nearby settlements, and exporting them from there. In this way from 100 to 550 barrels are shipped annually. Salted char is not sufficiently fat for smoking, so must be used otherwise, and a further decrease in market value is caused by all the char not having red flesh, but many being white or an intermediate colour.

In Frobisher Bay fishing by Eskimos is done in a way similar to other regions, with nets and spears, chiefly during periods of river migration. Taking of char from Frobisher Bay presents a problem similar to that described in Greenland. Rivers are not large, and consequently over-fishing might easily occur. It would seem then that commercial utilization of the eastern Canadian arctic char would be accomplished best by limited fishing from a number of these small rivers, rather than extensive fishing from one region, which would almost certainly result in a serious drop in char population, thus a substantial decrease in food available to the natives of the area.

DESCRIPTION OF THE CHAR

The description by Soper referred to previously describes the mature fish as they appeared in Frobisher Bay during the summer of 1948, the principal difference occurring in size, those of the latter group averaging about 66 cm., overall, and attaining a maximum length of 85 cm., lengths of some 15 cm. greater than the average and considerably in excess of the maximum of the former group. As most of the char taken in Frobisher Bay were on their return migration, considerable evidence of breeding characteristics was noticed in the males, the customary change in coloration, and acquisition of the hooked lower jaw the most conspicuous.

As members of the salmonid group the char show an appearance much like others of the group, one the common Atlantic Salmon, Salmo salar Linn. Differences in coloration, and in the relative size of the head and head structures, along with conspicuous dissimilarity between size of scales form perhaps the principal features of external differentiation between the two. In the char the mouth is larger than that of the salmon, with the maxillary bone extending at least as far posterior as a point below the center of the eye. While the char has no teeth on the shaft of the vomer, Salmo shows a double zig-zag series of teeth in this region. The scales, cycloid, the largest of which do not exceed 3 mm. in diameter, and are securely embedded under the overlying epidermis in such a way as to make removal fairly difficult, serve as a significant identification feature of the char. Meristic counts from a 74 cm. female were: dorsal fin, 11; anal fin, 11; pelvic fin, 10; pectoral fin, 15; branchiostegals,

10. On the same individual rows of scales above the lateral line, at the level of the adipose fin, numbered 26-27, below the lateral line, at the same level, 23-24. Because of the variation which commonly occurs between individuals in such counts as these, they are not in any way considered as a statistical average, but merely as descriptive of one individual.

It seems probable that coloration provides the best means of description of these fish, and of differentiation between possible sub-groups. Colour of Frobisher Bay char seemed consistent throughout the season, except for previously mentioned nuptially garbed males, and on the basis of this and the absence of any other conspicuous differentiation between individuals seen and examined, both in structural and behaviour characteristics, it is assumed that all represent a single type of Salvelinus alpinus, either merely the species, or one sub-group of it.

FISHING METHODS

Commercial char fishing in which the writer took part was conducted during the summer of 1948 in Frobisher Bay on eastern Baffin Island in the eastern Canadian Arctic. Fishing began shortly after the middle of July and continued until the end of August, when char were present in too small numbers to warrant a continuation of operations. Four regions in the bay were tried for char, and in only one of these was any success attained, near Koojesse Inlet, one of the two uppermost sections of Frobisher Bay. (See fig. 1.) On July 17, one net was set in Kneeland Bay, about half way along the south-western coast of Frobisher Bay, and failed to show the presence of char. No fish were seen anywhere in the bay, where the presence of floating ice would have made extensive fishing difficulty. Absence of suitable rivers, only fairly small streams being present, which dropped from great heights to the inlet, made presence of char in such a locality unlikely at any time, unless their migratory route follows closely the coast, allowing brief entries into such locations.

On July 29 three attempts were made using a 50 fathom salmon net, 6½" mesh, for drifting. This was done about ten miles southward from Koojesse Inlet, near the north-east coast, near the south-west coast, and in an area about half way between. Results of these endeavours were nil and no char were seen in the region.

On August 1 three nets were set near the north-east coast of Frobisher Bay, about 15 miles south-east of Koojesse Inlet. On August 3 twelve char were removed from these nets, which had undergone considerable damage because of scattered ice. This location was about 15 miles from a

river of any appreciable size, so it is probable that the char caught in this area were from the Sylvia Grinnell River, nearer the mouth of which the best fishing occurred.

The remainder of fishing was carried on in the vicinity of this river, in the area of Koojesse Inlet. Here about seven thousand, seven hundred char were taken from July 19 until near the end of August, all apparently migrants from this small river, less than one hundred feet wide above the falls which drop from ten to thirty-five feet into the inlet. Used principally were 6 inch and 6½ inch mesh gill nets, either extended at right angles from the shore to which one end was fastened, or set entirely free from land.

DESCRIPTION OF THE FISHING AREA

The mouth of the Sylvia Grinnell River is located at 62° 43' N., 68° 35' W., in the southeastern Baffin Island region, where hydrographic data indicate presence of water of an arctic coastal nature. Observations on temperature and salinity made in early August, 1940 in Frobisher Bay (Dunbar 1942), were recorded as follows:

Depth	Temperature	Salinity
surface	1.15° C.	30.69°/••
10 meters	0.10° C.	32.34°/••
25 meters	-0.04° C.	32.34°/••
50 meters	-0.06° C.	32.24°/••
75 meters	-0.13° C.	32.34°/••

The predominantly arctic nature of the environment of the char is indicated further by the nature of the specimens found on examination of stomach contents, although there is the possibility of influence of southern Greenland water, suggested by the finding of a male specimen of Themisto libellula in a char stomach, the amphipod showing exceptionally long antennae. (Length of antennae is 15 mm., the remainder of the specimen 23 mm.).

Jesperson (1937) in discussing Calanus hyperboreus (Krøyer) distribution in Baffin Bay and Davis Strait found largest specimens in the polar water of Baffin Bay, medium size individuals off southeastern Baffin Island, in mixed arctic and Atlantic water, and smallest specimens off southwestern Greenland, in predominantly Atlantic water. This would indicate that growth rate increases according to the temperature of the water, with smaller adults present in Atlantic and mixed arctic and Atlantic water than in purely arctic regions.

The finding, then, of this specimen of Themisto libellula in Frobisher Bay might be interpreted as evidence of warmer water influence in this region, the most probable source of which would be the mixed polar and Atlantic current from south Greenland which flows past southeast Baffin Island.

Similar was the finding by Dunbar (1940) of Sagitta elegans in Ata Sound (Disko Bay), maturing at a smaller size than most of the same species. These were considered as possibly having come from warmer, perhaps Atlantic, water.

Tidal rise and fall of the fishing area showed a normal variation of between twenty-five and thirty feet, the affect of which was particularly noticeable in changing the height of the water fall at the mouth of the river. This meant that the char could ascend only at high tide, when even then a leap of several feet was necessary to reach the river above. This was probably responsible in part for the char lingering about the mouth of the river before ascending.

BIOLOGY OF THE FROBISHER BAY CHAR

Fishing began in the region of Koojesse Inlet on July 19, 1948, and continued until near the end of August. During this time from about the second day of fishing until approximately August 25, the number of nets in use remained fairly constant (about 14). On August 10 three nets in the region of the river falls were removed, accompanied by an extreme drop in the catch, which from that time receded daily as shown below.

Table 1. Daily Char Catch:

Date	No.	Date	No.	Date	No.
July 19	60	July 31	225	Aug 13	106
20	114	Aug 2	175	14	104
21	119	3	168	15	60
22	178	4	150	16	46
23	642	5	299	17	47
24	619	6	455	18	39
25	350	7	576	19	35
26	368	8	438	20	8
27	210	9	705	21	16
28	117	10	116	22	0
29	294	11	192	23	8
30	182	12	159		

According to information received at Frobisher Bay, the char had been out of the river since about the middle of June. It was said, too, that the movement occurred approximately two weeks later than usual, apparently normally early in June, and that it seemed to be correlated with a general lateness in arrival of the spring season shown by a correspondingly tardy breaking-up of the ice in Koojesse Inlet. For the first week of fishing, until about July 27, fish showed an apparently healthy and well-fed state. From this until near the end of the first week in August, a difference in quantity rather than quality

of stomach contents was noted, many nearly empty, although, except for one specimen, nothing was observed externally to distinguish these fish from those of the first week. This suggested drop in food, thus planktonic numbers, coincides with observations by Dunbar (1946) of a drop in Themisto libellula numbers in the upper 40 meters of fjord waters in southern Baffin Island during August.

Differing from the other char during this period was one extraordinarily different from the others, a relatively large-headed specimen with a conspicuously emaciated body, at least superficially similar to a pair of males described from Greenland (Jensen 1948) as having spawned in a river just before descending to the sea. During this period little activity could be observed at the falls or in the river except for occasional glimpses of char in the general region of the river mouth, and groups of small fish, presumably young char, generally too small to be caught in the 6" mesh nets used. A few, however, were taken, and were identified as young of the char.

From August 5 until August 8 spring tides of six to eight feet above normal for the rest of the fishing period occurred, in company with an abrupt increase in the number of char taken, mostly from nets closest to the river falls, After this the return to fresh water seemed definitely underway, and continued in gradually decreasing numbers until the end of fishing operations. Stomach contents after the first few days in August appeared as during the early period, and remained essentially similar in nature until the end of fishing. Individuals of the late part of the upstream migration appeared generally less robust than those of the

remainder of the catch.

From this it would seem that most of the seaward run is completed during June, varying from the first to about the middle of the month, but that some may emerge from the river during at least a part of July. Those returning, meanwhile, apparently collect in the region of the river mouth in late July, and after a period of lingering in this area, re-ascend the river, possibly at a time of spring tides, this return diminishing in volume towards the end of August. Whether there might be a later up-river run of char which descend later than others, whether individual char return to fresh water during the same year as they migrate from it, or whether all, or any, return to the same river from which they first migrate, are questions which can be answered only by additional observations and the collection of more data than at present available.

Statistical data on size increase in eggs and testes are almost entirely wanting from 1948 Frobisher Bay char. The presence of eggs, however, from approximately 2 mm. to 5 mm. in diameter was observed in almost all the female char examined, Testes too, had taken on the characteristic appearance of pre-spawning time, conspicuously thickened and whitish in colour. These characteristics, along with the reddish belly and hooked jaw condition of many of the individuals suggest proximity to spawning time which probably occurs sometime fairly soon after return to fresh water, during September, or October.

Three hundred and eighty-six char were measured, and sex determination

done on all but ten of these. Average overall length for the whole period was 66.4 cm. Of the three hundred and seventy-six sexed, one hundred and seventy-two (44.3%) were males and two hundred and four (55.7%) were females. Largest fish caught were two males, taken on July 23 and July 24, both 85 cm., overall. Average length of males was 68 cm., noticeably greater than that of females, 64.7 cm. Of importance in a consideration of these length measurements is the nets used in fishing, 6" and 6½" mesh, sufficiently large to eliminate small specimens from the sample. (See table 5, and figure 2.)

Table 2. Weekly Average Length Measurements:

Period	Average of Total	Av. ♂	Av. ♀
July 20 - July 26	69 cm.	69.7 cm.	68.4 cm.
July 27 - Aug 3	65.1cm.	65.7	64.5
August 4 - August 10	62.3	63.9	60.7
Aug 11 - Aug 17	69.2	72.9	65.5
	66.4	68	64.7

No fishing Aug 1.

From this it may be seen that length did not vary appreciably between the beginning and the end of the four weeks fishing, t abled above. While during the first two weeks the average lengths of males and females remained about one centimeter apart, evidence of the third and fourth weeks suggests that the average length of males increased relatively over the females, although data based on such small numbers cannot be considered as totally valid. If significant, however, it

could mean that larger females ascend the river before smaller individuals in accordance with previously mentioned observations in which females were considered to ascend the rivers before males. Variation in averages of both sexes is in accordance with observations made at the time of fishing, when it was noticed that individuals taken during early August appeared generally smaller than those of the remainder of the time.

Table 3. Weekly Sex Ratio of the Catch:

Period	Total	♂	♀	% ♂	% ♀
July 20 to July 26.	121	58	63	47.1	52.9
July 27 " Aug 3.	193	37	56	39.7	60.3
Aug. 4 " Aug 10.	124	61	63	49.1	50.9
Aug 11 " Aug 17.	38	16	22	42.1	57.9
	376	172	204	44.3	55.7

No fishing Aug. 1.

Noticeable is the fairly constant sex ratio which remained throughout three of these four weeks of fishing, with suggestion of a possible relative increase in females during the second week. Throughout the period females remained consistently more numerous than males. There is no indication of either group ascending the river before the other, at least until August 17. This need not contradict the statement above regarding the possibility of larger females ascending the river before larger males, as this table does not distinguish between large and small individuals in either sex group.

STOMACH CONTENTS

Stomach contents of two hundred and twenty-four char were examined and identification made of as many individuals as were in condition to allow recognition. Attempts were made to select samples at random, most of those taken for stomach contents used, too, for measurements and sex determination. Material was removed from the stomachs and put immediately into 5% formalin in sea water. This was brought to McGill University where some eighteen thousand specimens were examined. Of these, twelve species were recognized, along with three other forms identified only to a more general taxonomic position, to serve as indications of the feeding habits, and consequently the faunal characteristics of the region inhabited by the char. (See table 6.)

Specimens from the char stomachs are mostly crustaceans, the great majority of these of the Order Amphipoda. Added to these are some small fishes and a few worms, Polychaeta. In addition to the free-living individuals a number of apparently parasitic worms were found in the digestive tracts of many of the fish examined.

The condition of the crustaceans, particularly the amphipods, was noticeably better than the other forms found. Most of the fishes had deteriorated beyond recognition, thus of about three hundred taken from stomachs, only twenty-nine specimens were identifiable to species, and about sixty more without certainty to genus.

In discussion of specimens to follow, under distribution, general range is described first, followed by reference to more specific areas in arctic North America.

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Order Amphipoda
Suborder Hyperiidea
Family Hyperiidae

Themisto libellula (Mandt). This is one of the most numerous of the forms taken from char stomachs (1075 specimens), a species found abundantly throughout arctic waters and as far south as 43° N. (Schellenberg 1927); Greenland, Spitsbergen, Jan Mayen, Novaya Zemlya, Siberia (Sars 1895); from stomachs of Phoca hispida Schreber and Salvelinus malma (Walbaum) at Bernard Harbour and Dolphin and Union Strait (Shoemaker 1920); from stomachs of P. hispida (Dunbar 1941); from stomachs of Salvelinus alpinus in the Hudson Bay region (Vladykov 1933); and from Hebron, Port Burwell, Gabriel Strait, Frobisher Bay, Lake Harbour, Pangnirtung, Cape Walsingham, Clyde River, Pond Inlet, Arctic Bay, Fort Ross, and Hantzsch River in the eastern Canadian arctic, and Disko Bay and Holsteinsborg in western Greenland (Dunbar 1942).

This species was taken from one hundred and sixty-five stomachs between July 20 and August 21, present fairly consistently throughout the fishing period. Of possible significance is the single male specimen, taken on July 20, with exceptionally long antennae, referred to above.

Themisto sp. Presence of these paralleled quite closely Themisto libellula, and it is likely that many are of this species. Certain identification of these (297 specimens) was not accomplished because of the condition of specimens.

Hyperia galba Montagu. This is another typically arctic form, two specimens of which were taken, one on July 29, the other August 2.

Distribution: Arctic Ocean, North Atlantic, Spitsbergen, Novaya Zemlya, Greenland, Kattegat, Baltic, Kara Sea, Murman coast (Sars 1895); North Pacific (Schellenberg 1927); Alaska (Shoemaker 1920); Hudson Bay (Shoemaker 1926); Lake Harbour, Gabriel Strait (Dunbar 1942).

Suborder Gammaridea
Family Lysianassidae

Pseudalibrotis littoralis (Krøyer). This is probably the most abundant species in the region of the char fishing operations, where three hundred and seventy-two specimens were identifiable as belonging to this species, and several thousand small and incomplete individuals placed in the genus, probably representatives of the same species but not identified with certainty. P. littoralis is an arctic and sub-arctic form, found characteristically in the latter region in marine areas where there is fresh water influence (Madsen, in press). This species was present in about one hundred and forty stomachs, and like T. libellula, in fairly constant numbers during the fishing period.

Distribution: Widely found in arctic seas (Schellenberg 1927); Hudson Bay (Shoemaker 1926); Alaska, Bernard Harbour, Dolphin and Union Strait (Murdoch 1885); stomachs of Salvelinus alpinus in Hudson Bay (Vladykov 1933); Fort Ross and Pangnirtung (Dunbar 1942).

Pseudalibrotus sp. About fifteen hundred small or incomplete members of this genus were observed, many of which are probably of the species above. The finding of neither Pseudalibrotus nanseni (Sars) nor P. glacialis (Sars), both recorded from Frobisher Bay (Dunbar 1942), among the identifiable specimens of the genus makes it all the more probable that those in this group belong in the species littoralis. Present in great numbers in the Koojesse Inlet area, these might indicate certain fresh water influence of the adjacent Sylvia Grinnell River.

Family Gammaridae

Gammarus locusta (Linn.). A typically littoral and sublittoral form of arctic and temperate regions, this species, often found above the low tide mark, has appeared frequently as food for the arctic char; Dahl 1926 (Spitsbergen); Saemundsson 1927 (Iceland); Vladykov 1933 (Hudson Bay); Hildebrand 1948 (Ungava Bay). One hundred and ninety-five specimens were taken, with numbers fairly constant during the fishing period.

Distribution: Arctic Ocean, North Atlantic, North Pacific (Sars 1895); Alaska (Murdoch 1885; Shoemaker 1920); Cumberland Gulf (Smith 1879); Labrador (Smith 1884); Dolphin and Union Strait, Melville Island, Ungava (Shoemaker 1920); Lake Harbour, Pangnirtung, Pond Inlet, Arctic Bay, Fort Ross, free and in the stomachs of ringed seals (Dunbar 1942).

Gammarus sp. Nineteen specimens were identifiable only to genus.

Gammaracanthus loricatus (Sabine). Twelve specimens of this pelagic, circumpolar form were taken, from July 21 and 23, and August 2, 6 and 12.

Distribution: Arctic Ocean, Greenland (Sars 1895); Alaska, Bernard Harbour (Shoemaker 1920); eastern Baffin Island, free and from a ringed seal stomach at Lake Harbour (Dunbar 1942).

Family Jassidae

Ischyrocercus anguipes Krøyer. Three specimens were taken on July 24.

Distribution: Arctic Ocean, Bohuslan, Kattegat, North Sea, North Atlantic, Norway, Baltic (Sars 1895); Bernard Harbour (Shoemaker 1920); Fort Ross (Dunbar 1942).

Family Haustoriidae

Pontoporeia affinis Lindström. Four hundred and eighty-three specimens were taken, four hundred and eighty on August 2, one on August 3 and two on August 6. Four hundred and seventy-nine of those from August 2 were taken from one char. This species has become adapted in some regions to a fresh water environment.

Distribution: Lakes in Scandinavia, Russia and North America, Baltic, Kattegat, Kara Sea, North Atlantic (Sars 1895); Alaska, free and from stomachs of Salvelinus malma (Walbaum) (Shoemaker 1920).

Order Mysidacea
Family Mysidae

Mysis oculata Fabricius. Six hundred and ninety-four specimens of this littoral form, typical of all arctic and northern sub-arctic regions (Schellenberg 1927) were taken during the fishing period.

Distribution: Arctic seas; Labrador (Smith 1884); Alaska, Bernard

Harbour, Dolphin and Union Strait, Banks Island (Schmitt 1919); stomachs of Spitsbergen char (Dahl 1926); Canadian northwest (Tattersall 1933); Newfoundland (Tattersall 1939); Fort Ross, Hebron, Gabriel Strait, Pangnirtung (Dunbar 1942); stomachs of Phoca hispida at Lake Harbour, Clyde River and Frobisher Bay (Dunbar 1941).

About forty-five incomplete specimens of the order were taken, not identifiable with certainty.

Order Copepoda
Suborder Calanoida
Family Calanidae

Calanus hyperboreus (Krøyer). Eight specimens were taken from the char: one on July 22, two on July 23; one on July 29, one on August 2; two on August 6; and one on August 12.

Distribution: Polar seas, Behring Strait (Sars 1903); Greenland, Denmark, Iceland, Faeroes, Norway (With 1915); Alaska, Bernard Harbour, Dolphin and Union Strait (Willey 1920).

Calanus finmarchicus (Gunnerus). Eight of these were taken: five on July 22; two on July 23; and one on July 24.

Distribution: Common in Atlantic, Arctic and North Pacific (Sars 1903); Greenland, Denmark, Iceland, Faeroes, Norway, Jan Mayen (With 1915); Alaska, Bernard Harbour, Dolphin and Union Strait (Willey 1920).

Family Euchaetidae

Euchaeta glacialis Hansen. Two specimens were taken, on August 6 and 7.

Distribution: Abundant in areas of the Polar basin, Kara Sea (Sars 1903);

north of Iceland, Denmark Strait (With 1915); Davis Strait (Jespersen 1934); innermost parts of fjords of eastern Greenland (Jespersen 1939).

Order Acanthopteri
Suborder Loricati
Family Cottidae

Myoxocephalus groenlandicus (Cuvier and Valenciennes). Twenty-two of these were identifiable to species: five on July 20; five on August 6; two on August 7; and ten on August 9. This littoral form is common in the area, and was likely present in far greater numbers in the char stomachs, but not in condition to allow certain identification.

Distribution: From Greenland to the Gulf of Maine; Arctic, Baltic northern Europe, Spitsbergen, Novaya Zemlya, northern Asia, many regions in Hudson Bay, James Bay, and Hudson Strait (Vladykov 1933); Cumberland Gulf (Bean 1879); Labrador (Kendall 1909).

In addition to the specimens described above, there were three other forms present in the char stomachs, incomplete specimens, thus not classified to species.

Class Acanthocephala
Order Echinorhynchoidea
Family Echinorhynchidae ?

One specimen was taken from a stomach July 20.

Suborder Cladocera

Three specimens were taken July 21, all badly mangled.

Class Polychaeta
Order Errantia
Family Nereidae ?

Eighteen of these were taken, between July 22 and August 17. Only fragmentary anterior portions were found.

AGE DETERMINATION

Scales and otoliths were taken from the char for the purpose of age determination. Scales were removed from some two hundred and fifty specimens, and readings attempted using techniques with varied light and media, all without success. These scales were then sent to the Atlantic Biological Station at St. Andrews, N. B. where attempts at reading from impressions made on celluloid were also unsatisfactory. The principal difficulty lies in the small size of these scales, which makes clear differentiation of growth rings extremely difficult. A similar conclusion was reached by Hansen (1940) in unsuccessful attempts to interpret scales of Greenland char, although Dahl (1926) apparently was successful in learning age of Spitsbergen char from them.

Reading of otoliths proved more satisfactory, although the number of dark or light rings cannot be interpreted definitely as indicating the number of years of growth. In other fish in which age has been computed from otoliths dark rings have been considered as regions of late summer and autumn growth, with the lighter areas alternating with them as indications of spring and early summer growth (Reibisch 1899, and others). Exception to this, however, was found by Dannevig (1933) who observed otoliths of cod in two Norwegian fjords, in one of which the light rings formed from December to May, and in the other from March to July. On the assumption, however, that the region between the centers of two adjacent dark rings in the otoliths of Salvelinus alpinus indicates one year of growth, then the figures in Table 4 on the number of dark rings per otolith might be taken as indicative of the age of the samples.

Readings of otoliths, too, were done by Miss Peterson, at St. Andrews, following unsuccessful attempts at their interpretation by the writer, and were found particularly difficult, because of inexperience in working with this species. Each of the readings is to be considered as only approximate because of difficulty in interpretation of marginal rings.

Otoliths were removed from the char and preserved in a 50% solution of glycerin and sea water. They are approximately 8 mm. long and 3 mm. wide, flattened, with one end prolonged, tapering to a point, and the other rounded. A groove extends longitudinally from one side of the base of the extension to the opposite extremity, dividing the base of the otolith into two sections as seen from the lower surface. Opposite this the upper face is fairly smooth, slightly convex. Best observations are made on this upper surface, with readings in some facilitated by grinding this face. Reflected light was used in otolith examination.

If the otolith readings in Table 4 are to be interpreted as being indicative of age, then these char survive at least twenty-seven years, with distribution of these few samples ranging from this maximum down to fourteen years. From this group then the average age based on these otoliths is 21.4 years. If this interpretation is true then it indicates a substantially greater age than that reached by the char of Greenland, twenty years, referred to previously (Hansen 1940).

Hansen's investigation of six hundred and seventy-one char showed the following correlation between age and length of the Greenland char:

SUMMARY OF THE LITERATURE

1. Linnaeus (1758) described the red char, Salmo alpinus.

2. Fabricius (1780) described Salmo carpio, probably S. alpinus Linn. in breeding-time coloration, and S. stagnalis and S. rivalis, likely, too, the same species.

3. Nilsson (1832) introduced the term Salvelini to include the chars.

4. Richardson (1836) described Salmo nitidus and S. alipes probably similar to S. stagnalis Fab., and S. rossii, S. hearnei and S. hoodii.

5. Günther (1877) described Salmo arcturus and Salmo naresi.

6. Dresel (1884) observed 3 char in west Greenland, 15 to 17 inches in length.

7. Jordan (1885) referred to seven North American species of the genus Salvelinus: S. nitidus (Rich.); S. stagnalis (Fab.); S. rossii (Rich.); S. oquassa (Girard); S. naresi (Bean); S. arcturus (Gün.); and S. fontinalis (Mitchell).

8. Jordan and Evermann (1896) listed four sub-species of the species alpinus in North American waters: S. alpinus alipes (Rich.); S. alpinus stagnalis (Fab.); S. alpinus arcturus (Gün.); and S. alpinus aureolus (Bean).

9. Johansen (1912) in western Greenland, wrote of presence of a migrant and a landlocked form of char. Char were seen in winter under the ice, apparently active, Migration began with breaking up of ice. Return to fresh water occurred in September, Eighteen males were taken, 11 to 70 cm., with 6 females, 15.7 to 62.5 cm. It was considered probable that

spawning occurs in the autumn. Two types of coloration were described in the migrants, one characteristic of breeding time. Johansen claimed non-migrants maintain colour similar to the breeding colour of the others.

10. Halkett (1913) listed four northern Canadian chars, the first three of Jordan and Evermann (paragraph 8) and S. oquassa naresi (Gün.)

11. Fowler (1915) described Salvelinus alpinus marstoni (Garman).

12. Dahl (1926) observed 84 Spitsbergen char, 20 to 72 cm. All migrate to sea between the second and fourth winter, probably before reaching 20 cm. Dahl concluded that the longer the parr-life, the greater the growth rate in the sea.

13. Saemundsson (1927) described migrant and landlocked char of Iceland. The former, from 40 to 60 cm., return to fresh water from July to September, spawning between September and November. They are probably sexually mature at 6 years.

14. Henn (1932) observed two char off Southampton Island, the male 50.3 cm. and the female 46 cm.

15. Vladykov (1933) in Hudson and James Bays measured 86 anadromous char, 14 of them mature, males from 27.8 to 49 cm., females from 35 to 59 cm. These ascend streams to spawn during September. Observed, too, were landlocked char, 1 male 10.5 cm. and 3 females 10.9 to 18.2 cm., precociously mature, spawning likely in August or early September.

16. Soper (1934) found char of Baffin Island 48 to 50 cm. long, and up to 71 cm. collect at river mouths late in July to ascend. Eskimos

claim presence of a landlocked form.

17. Weed (1934) considered it possible that some Labrador char spawn earlier than autumn, during the summer and perhaps in the sea.

18. Yessipov (1935) observed Novaya Zemlya char to spawn in lakes every second year, during October and November. Maturity is reached in the sixth or seventh year. Char probably enter the sea for the first time in the third or fourth year, migrating from the end of June until mid-July, and returning from the middle of August until mid-September.

19. Rogers (1937) in the eastern Canadian arctic measured 30 char, 53.5 to 80 cm., and observed them in lakes during the winter. Rogers considered that the char possibly spend a year or more in salt water at one time, and that the females enter fresh water ahead of the males.

20. Hansen (1940) found that Greenland char reach an age of 20 years, with the first 3 years likely spent in fresh water.

21. Manning (1942) observed Southampton Island char, and concluded it improbable that any remain in the sea during the winter. On western Baffin Island the run was recorded until September 10. Manning suggested the red belly coloration of the landlocked forms not to be seasonal or sexual, but rather characteristic of non-migrants.

22. DeLacy and Morton (1942) found Salvelinus alpinus of Alaska non-migratory, average length 35 to 45 cm., and as great as 55 cm.

23. Hildebrand (1948) observed char in Ungava Bay area, where specimens in shallow lakes were said to be mature at 3 to 4 inches, and to be found up to 69 cm. Landlocked forms were found to spawn in lakes, after an upstream migration. Winter work at Fort Chimo included

observation of one char. During the winter they are said to be inactive, bearing fungal growths. The spring run begins soon after ice break up.

24. Jensen (1948) observed char in west Greenland. On July 18 and 19, 1909, 252 char, 141 males, 31.5 to 58 cm., and 111 females, 39 to 56 cm. were taken. On July 30, migrants in rivers were sexually mature. Spawning probably occurs from the middle to the end of September, after which winter is passed in lakes, with migration to the sea taking place near the middle of May, and return to fresh water about July 20.

GENERAL SUMMARY

1. A review is given of the literature of the Arctic Char, from its description by Linnaeus in 1758, as Salmo alpinus, the introduction of the group name Salvelini by Nilsson in 1832, and the establishment by Richardson in 1836 of the genus name Salvelinus, to the present. More particular notice is taken of previous investigations in the Canadian arctic, with reference, too, to work done in Alaska, Greenland, Spitsbergen, Iceland and Novaya Zemlya.

2. Because of the uncertain taxonomic breakdown of this species into sub-species, Frobisher Bay specimens are considered merely as Salvelinus alpinus (Linn.), with no attempt made at sub-specific classification.

3. Description is given of the young and adult char, under normal and breeding conditions, with comparison of external appearance of the char to the Atlantic Salmon, Salmo salar (Linn.).

4. Fishing operations in Frobisher Bay are described, with data on daily char catch.

5. Reference is made to hydrographic observations made at Frobisher Bay, as indicating it to be of an arctic coastal nature. Possible south Greenland influence is suggested by the finding in a char stomach of a male specimen of Themisto libellula with exceptionally long antennae.

6. Char breeding migration is discussed, with conclusions that most of the seaward run is completed usually during the first half of June, although some may emerge from fresh water at a later date, perhaps as late as July, and that return to fresh water extends from late July until near the end of August, or early September, with breeding probably occuring [illegible] in October.

7. Overall measurements of 386 char are recorded, with average length 66.4 cm., and maximum length 84 cm. (2 males). Males averaged 68 cm. and females 64.7 cm.

8. Sex determination of 376 char are given, showing 55.7% were females and 44.3% males.

9. Results of examination of stomach contents of 224 char are given, revealing presence of 12 recognizable species, and 3 other forms, identifiable only to a more general taxonomic position. Predominant are amphipods, with fewer copepods, mysids, fishes and worms. All species are of a typically arctic or north temperate nature.

10. Scales and otoliths were examined, the scales unsuccessfully because of small size, the otoliths with more success, but not with certain interpretation, because of difficulty in reading and inexperience with this species. (Readings were done by a technician at the Atlantic Biological Station, at St. Andrews, N. B.) On the assumption that each dark ring in the otolith indicates one year of growth, then the average age of 44 char is 21.4 years, with range of these few samples from 14 to 27 years, definitely in excess of previously recorded data on the age of the arctic char.

Table 4. Otolith Readings
Giving Number of Dark Rings
And Length Of Sample

Sample	Otolith	Length
109	21	—
111	15	—
112	20	—
113	21	65cm.
114	27	68
115	21	64
116	23	77
124	23	78
125	17	60
127	24	67
130	20	71
140	21	68
144	22	77
148	21	64
149	27	66
151	23	53
157	25	70
158	17	60
160	20	65
203	20	65
204	24	78
206	25	—

Sample	Otolith	Length
239	20	—
263	14	61cm.
264	24	68
266	20	65
268	24	59
269	20	77
270	22	70
271	23	68
272	19	—
273	20	—
274	25	—
275	21	—
276	20	—
284	22	66
285	24	64
286	21	63
290	22	—
291	22	—
292	25	—
293	27	—
295	22	66
296	21	67

Table 5 Showing Overall Length Measurement
And Sex Of Samples:

Sample Number	Date	Length	Sex
4	July 20	63 cm.	♂
5		76	♀
6		70	♀
7		73	♀
12	July 21	70	♀
13		57	♂
14		72	♂
15		78	♂
16		70	♀
17		71	♂
18		78	♂
19		70	♀
21	July 22	65	♂
22		67	♀
23		79	♀
24		46	♀
25		82	♂
22a		71	♀
23a		78	♂
24a		74	♀
25a		78	♀
26		38	♂
29	July 23	74	♀
30		59	♂
31		69	♂
32		68	♂
33		75	♀
34		72	♂
35		62	♀
36		75	♀
37		82	♂
38		48	♂
39		67	♀
40		55	♀
41		72	♀
42		85	♂
43		74	♂
44		67	♀
45		79	♂
46		76	♂
47	July 23	74 cm.	♂
48		72	♀
50	July 24	70	♀
51		77	♂
52		69	♂
53		78	♂
54		73	♀
55		74	♀
56		81	♂
57		76	♀
58		81	♂
59		62	♂
61		85	♂
62		73	♀
63		64	♀
64		76	♂
65		67	♂
66		74	♀
67		74	♀
68		67	♀
69		72	♀
70		73	♂
71		66	♂
72		41	♀
73		66	♀
74		71	♀
75		73	♀
76	July 25	71	♂
77		65	♂
78		75	♀
79		77	♂
80		61	♀
81		70	♀
82		65	♀
83		68	♂
84		68	♂
85		68	♂
86		62	♀
87		75	♀
89	July 26	75	♀

Table 5. Showing Overall Length Measurement
And Sex Of Samples: (cont.)

Sample Number	Date	Length	Sex
90	July 26	71 cm.	♂
91		71	♂
92		58	♀
93		55	♀
94		47	♀
94-1		80	♂
94-2		65	♂
94-3		68	♂
94-4		68	♀
94-5		64	♂
94-6		76	♀
94-7		76	♀
94-8		61	♂
94-9		75	♀
94-10		74	♂
94-11		77	♂
94-12		72	♀
94-13		71	♀
94-14		79	♂
94-15		83	♂
94-16		69	♀
94-17		77	♂
94-18		74	♀
94-19		74	♂
94-20		73	♂
94-21		76	♀
94-22		69	♀
94-23		74	♀
94-24		76	♂
94-25		62	♀
94-26		60	♂
94-27		70	♂
94-28		66	♀
94-29		59	♀
94-30		70	♀
97		67	♀
98		64	♂
99		61	♀
100		69	♂
100-1		67	♂
100-2	July 26	63 cm.	♂
104	July 27	66	♀
105		78	♂
106		69	♀
107		66	♀
108		70	♀
104a		66	♀
105a		78	♂
106a		69	♀
107a		66	♀
108a		70	♀
113		65	♀
114		68	♀
115		64	♀
116		77	♂
118		62	♂
119		62	♀
120		77	♂
121		62	♀
122		61	♀
123		54	♀
123-1		57	♀
123-2		66	♀
123-3		60	♂
123-4		53	♀
124	July 28	78	♂
125		60	♂
126		74	♂
127		67	♀
130		71	♀
131		60	♂
132		70	♂
133		69	♀
134		79	♂
135		72	♂
136	July 29	71	♀
137		54	♀
138		71	♀
139		73	♀
140		68	♀

Table 5. Showing Overall Length Measurement
And Sex Of Samples: (cont.)

Sample Number	Date	Length	Sex
141	July 29	67 cm.	♀
142		69	♀
143		76	♂
144		77	♂
144-a		72	♂
144-1		58	-
144-2		61	-
144-3		55	-
144-4		62	-
144-5		82	-
144-6		72	-
144-7		63	-
144-8		53	-
144-9		53	-
144-10		69	-
146	July 30	66	♀
147		65	♂
148		64	♀
149		66	♀
150		74	♀
151		53	♀
152		71	♀
153		55	♀
154		76	♂
155		70	♂
156		59	♂
157	July 31	70	♀
158		60	♂
159		67	♀
160		65	♂
161		77	♂
162		61	♂
163		70	♀
164		65	♂
166		60	♀
167		61	♀
168		55	♀
169		57	♀
170	Aug 2	58	♂
171		76	♂

Sample Number	Date	Length	Sex
172	Aug 2	56 cm.	♀
173		67	♀
174		65	♀
175		62	♂
176		77	♂
177		60	♂
179		54	♀
180		61	♀
181		55	♀
182		49	♀
183		62	♀
184		63	♀
185		62	♀
186		66	♂
189	Aug 3	64	♂
190		66	♀
191		76	♂
192		66	♀
193		44	♂
194		65	♀
195		50	♂
196		57	♂
197		54	♂
198		60	♀
200-1	Aug 4	71	♂
200-2		78	♂
200-3		71	♂
200-4		63	♀
200-5		69	♀
200-6		68	♀
200-7		55	♀
200-8		71	♀
200-9		62	♀
200-10		76	
200-11		49	♂
200-12		77	♀
200-13		68	♀
200-14		60	♂
200-15		49	♂
200-16		68	♂

Table 5. Showing Overall Length Measurement And Sex Of Specimen: (cont.)

Sample Number	Date	Length	Sex
200-17	Aug 4	68 cm.	♂
200-18		63	♂
200-19		57	♂
200-20		65	♂
200-21		67	♀
200-22		64	♀
200-23		69	♀
200-24		62	♀
200-25		62	♀
200-26		67	♀
200-27		78	♂
200-28		70	♂
200-29		64	♀
200-30		62	♂
200-31		66	♀
200-32		57	♂
200-33		67	♂
200-34		66	♂
200-35		72	♀
200-36		62	♀
203	Aug 5	65	♂
204		78	♂
205		69	♀
206		60	♂
207		59	♀
208		47	♂
209		77	♀
210		67	♀
211		51	♀
211a		60	♂
211b		60	♀
211c		54	♀
211-1	Aug 6	65	♂
211-2		71	♀
211-3		77	♂
211-4		51	♂
211-5		53	♀
211-6		51	♀
211-7		56	♂
211-8		53	♂

Sample Number	Date	Length	Sex
211-9	Aug 6	57 cm.	♀
211-10		65	♀
211-11		53	♂
211-12		58	♂
211-13		59	♀
211-14		66	♂
211-15		59	♂
211-16		56	♀
211-17		50	♀
211-18		55	♂
211-19		57	♂
211-20		52	♂
215		67	♀
216		80	♂
217		75	♂
218		57	♀
219		60	♀
220		67	♀
221		56	♀
222		75	♂
223		51	♂
224		59	♂
225		63	♂
226		65	♀
229	Aug 7	62	♂
230		66	♀
231		70	♀
232		52	♂
233		79	♂
234		76	♂
235		59	♀
236		52	♀
236a		58	♂
236b		59	♀
236c		63	♀
236d		67	♀
242-1		55	♂
242-2		56	♀
242-3		60	♂
242-4		52	♀

Table 5. Showing Overall Length Measurement And Sex of Samples: (cont.)

Sample Number	Date	Length	Sex
242-5	Aug 8	54 cm.	♀
242-6		52	♀
242-7		51	♀
242-8		51	♀
242-9		52	♂
242-10		47	♀
242-11		53	♀
242-12		56	♂
242-13		52	♀
242-14		56	♀
242-15		59	♂
242-16		57	♂
242-17		62	♀
242-18		51	♂
243-1	Aug 9	64	♂
243-2		48	♀
243-3		49	♀
243-4		63	♂
243-5		55	♀
243-6		67	♀
243-7		60	♀
243-8		62	♀
243-9		54	♀
249	Aug 10	77	♂
250		74	♂
251		60	♂
252		70	♂
253		79	♂
254	Aug 11	75	♂
255		44	♂
256		67	♀
257		64	♀
258		61	♂
259	Aug 11	72 cm.	♀
260		63	♀
261		78	♂
262		71	♀
263	Aug 12	61	♀
264		68	♀
265		65	♂
266		65	♀
266-1	Aug 13	68	♂
266-2		77	♂
266-3		63	♀
266-4		54	♀
266-5		68	♂
266-6		46	♀
266-7		63	♂
266-8		53	♀
266-9		65	♂
266-10		69	♀
268	Aug 14	59	♂
269		77	♂
270		70	♀
271		68	♀
278	Aug 15	71	♀
279		69	♀
280		54	♀
281		56	♀
282		78	♂
284	Aug 16	66	♂
285		64	♀
286		63	♀
295	Aug 17	66	♂
296		67	♀
297		84	♂

Table 6. Stomach Contents

Sample Number	Date	Contents
4	20/7	P. littoralis (26); G. locusta (1)
5		P. littoralis (8); T. libellula (5); G. locusta (1); Themisto sp. (5); Acanthocephala
6		Pseudalibrotus sp. (150); T. libellula (3)
7		Pseudalibrotus sp. (27); M. oculata (4)
9		P. littoralis (34); Pseudalibrotus sp. (18) T. libellula (12); M. oculata (45); M. groenlandicus (5)
12	21/7	P. littoralis (6); Pseudalibrotus sp. (207); T. libellula (55); Themisto sp. (27); A. glacialis (3)
13		Pseudalibrotus sp. (252)
14		Pseudalibrotus sp. (124); T. libellula (193); G. locusta (2)
18		Pseudalibrotus sp. (2); P. littoralis (3); T. libellula (3)
19		Pseudalibrotus sp. (101)
21	22/7	P. littoralis (1); T. libellula (6)
22		Pseudalibrotus sp. (60); T. libellula (23); M. oculata (14); Cladocera (3)
23		P. littoralis (35); Pseudalibrotus sp. (137); T. libellula (68); Themisto sp. (2); M. oculata (23)
24		P. littoralis (9); Pseudalibrotus sp. (138); T. libellula (5); Themisto sp. (24); G. locusta (1); M. oculata (2); Polychaeta (1)
25		Pseudalibrotus sp. (16); T. libellula (3)
26		Pseudalibrotus sp. (72); T. libellula (175); G. locusta (4); C. finmarchicus (5); C. hyperboreus (1)
29	23/7	P. littoralis (1)
30		Gammarus locusta (32); P. littoralis (5)
31		Pseudalibrotus sp. (951); T. libellula (1); G. locusta (1)
32		Pseudalibrotus sp. (1); P. littoralis (2)
33		T. libellula (5); Themisto sp. (6)
35		P. littoralis (2); Pseudalibrotus sp. (78); T. libellula (1); M. oculata (2)

Table Of Stomach Contents (cont.)

Sample Number	Date	Contents
37	23/7	P. littoralis (1); Pseudalibrotus sp. (29); T. libellula (7); Themisto sp. (7); M. oculata (8)
38		Themisto sp. (19); T. libellula (4)
39		Pseudalibrotus sp. (22); T. libellula (11); Themisto sp. (1);
40		Pseudalibrotus sp. (336); C. hyperboreus (1); C. finmarchicus (2); G. locusta (10); Polychaeta (2)
43		Pseudalibrotus sp. (446); M. oculata (22); G. locusta (3); A. glacialis (1)
45		Pseudalibrotus sp. (180); A. littoralis (10); T. libellula (25); Themisto sp. (24); M. oculata (1); G. locusta (1); A. glacialis (1).
46		Pseudalibrotus sp. (15); Themisto sp. (2); Gammaracanthus loricatus (1)
47		Pseudalibrotus sp. (24); T. libellula (1)
48		Pseudalibrotus sp. (401); P. littoralis (7); T. libellula (7); Themisto sp. (1); M. oculata (3); C. hyperboreus (1)
50	24/7	Pseudalibrotus sp. (6); T. libellula (1)
51		Pseudalibrotus sp. (48); A. littoralis (14); M. oculata (8); G. locusta (1)
52		Pseudalibrotus sp. (463); Themisto sp. (4); M. oculata (1); C. finmarchicus (1)
53		Pseudalibrotus sp. (1); T. libellula (1); M. oculata (3).
54		Pseudalibrotus sp. (29)
56		Pseudalibrotus littoralis (4); Pseudalibrotus sp. (433)
57		Pseudalibrotus sp. (19)
58		Pseudalibrotus sp. (82); P. littoralis (1); T. libellula (21); Themisto sp. (15); I. anguipes (3)
59		Pseudalibrotus sp. (176)
91	26/7	Pseudalibrotus sp. (192)
100		Pseudalibrotus sp. (130)
124	28/7	Pseudalibrotus sp. (71); T. libellula (28)
126		T. libellula (25)

Table Of Stomach Contents (cont.)

Sample Number	Date	Contents
127	28/7	Pseudalibrotus sp. (1000); G. locusta (2)
130		P. littoralis (38); Pseudalibrotus sp. (44); M. oculata (9)
136	29/7	T. libellula (19); Themisto sp. (8)
137		P. littoralis (13); Pseudalibrotus sp. (5); M. oculata (8); H. galba (1)
138		T. libellula (2); M. oculata (1)
139		Pseudalibrotus sp. (105); P. littoralis (4); T. libellula (51)
140		P. littoralis (46); T. libellula (6); M. oculata (2)
145[a]		Pseudalibrotus sp. (246); T. libellula (24); Themisto sp. (6); C. hyperboreus (1); Gammarus sp. (11); Polychaeta (1)
165[b]	31/7	Pseudalibrotus sp. (3122)
178[c]	2/8	P. littoralis (34); Pseudalibrotus sp. (80); T. libellula (9); Themisto sp. (23); P. affinis (479); G. locusta (79); G. loricatus (1); M. oculata (200); A. glacialis (1); H. galba (1); C. hyperboreus (1)
187[d]		P. littoralis (1); Pseudalibrotus sp. (928); T. libellula (2); G. locusta (1); P. affinis (1)
199[e]	3/8	Pseudalibrotus sp. (828); T. libellula (8); M. oculata (10); G. locusta (1); P. affinis (1); A. glacialis (2)
212[f]	5/8	Pseudalibrotus sp. (582); T. libellula (5); Themisto sp. (11); A. glacialis (2); P. affinis (1)
213[g]		Pseudalibrotus sp. (65); P. littoralis (17); Themisto sp. (9); T. libellula (16); M. oculata (33); C. hyperboreus (2); Polychaeta (1); Euchaeta glacialis (2)

a from 10 char, 144-1 to 144-10
b from 7 char, 157 to 163
c from 8 char, 170 to 177
d from 8 char, 179 to 186
e from 10 char, 189 to 198
f from 6 char, 203 to 208
g from 6 char, 209 to 211c

Table of Stomach Contents (cont.)

Sample Number	Date	Contents
214[a]	6/8	Pseudalibrotus sp. (202); G. locusta (31); T. libellula (1); M. oculata (2)
227[b]		Pseudalibrotus sp. (413); T. libellula (20); Themisto sp. (7); A. glacialis (3); P. affinis (1); M. oculata (2); Polychaeta (10); M. groenlandicus (5)
228[c]		T. libellula (54); Pseudalibrotus sp. (112); M. oculata (24); G. locusta (1)
237[d]	7/8	P. littoralis (2); T. libellula (68); M. oculata (102); Euchaeta glacialis (1); M. groenlandicus (2)
243[e]	8/8	P. littoralis (1); Themisto sp. (5); M. oculata (2)
244[f]	9/8	T. libellula (51); Themisto sp. (39); M. groenlandicus (10)
264	12/8	Pseudalibrotus sp. (400); T. libellula (21); C. hyperboreus (1)
271	14/8	P. littoralis (39)
279	15/8	P. littoralis (1); Pseudalibrotus sp. (700); T. libellula (3); Themisto sp. (5); G. locusta (5)
280		Pseudalibrotus sp. (86)
281		M. oculata (52)
283		Pseudalibrotus (42)
284	16/8	Pseudalibrotus sp. (148)
286		Pseudalibrotus sp. (57)
288[g]		P. littoralis (1); Themisto sp. (31)
289[g]		Pseudalibrotus sp. (400); T. libellula (4)
295	17/8	Pseudalibrotus sp. (25); Polychaeta (1); M. oculata (81)
296		
298	19/8	Pseudalibrotus sp. (166); T. libellula (8); G. locusta (15)

a from 20 char, 211-1 to 211-20
b from 6 char, 215 to 220
c from 6 char, 221 to 226
d from 12 char, 229 to 236d
e from 18 char, 242-1 to 242-18
f from 9 char, 243-1 to 243-9
g each from 6 char

Table Of Stomach Contents (cont.)

Sample Number	Date	Contents
301	19/8	P. littoralis (1); Pseudalibrotus sp. (84);
302	20/8	T. libellula (4)
306[a]	21/8	T. libellula (4); M. oculata (28)
307[a]		Themisto sp. (24); M. oculata (2)

a from 16 char

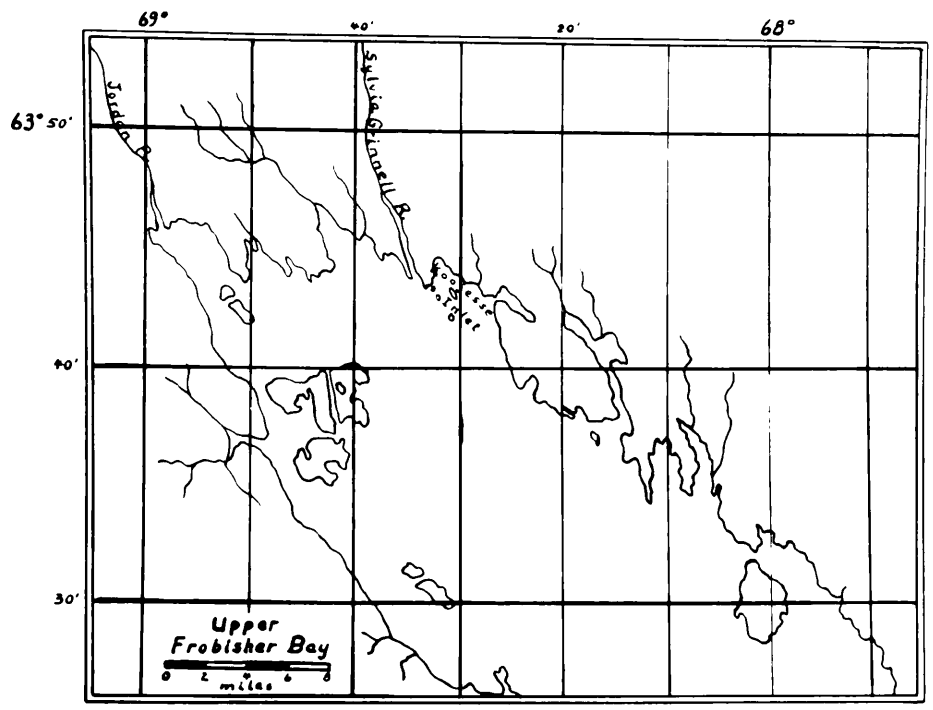
69°
40'
20'
68°
63° 50'
40'
30'
Upper
Frobisher Bay
0 2 miles 6 8

Fig. 1

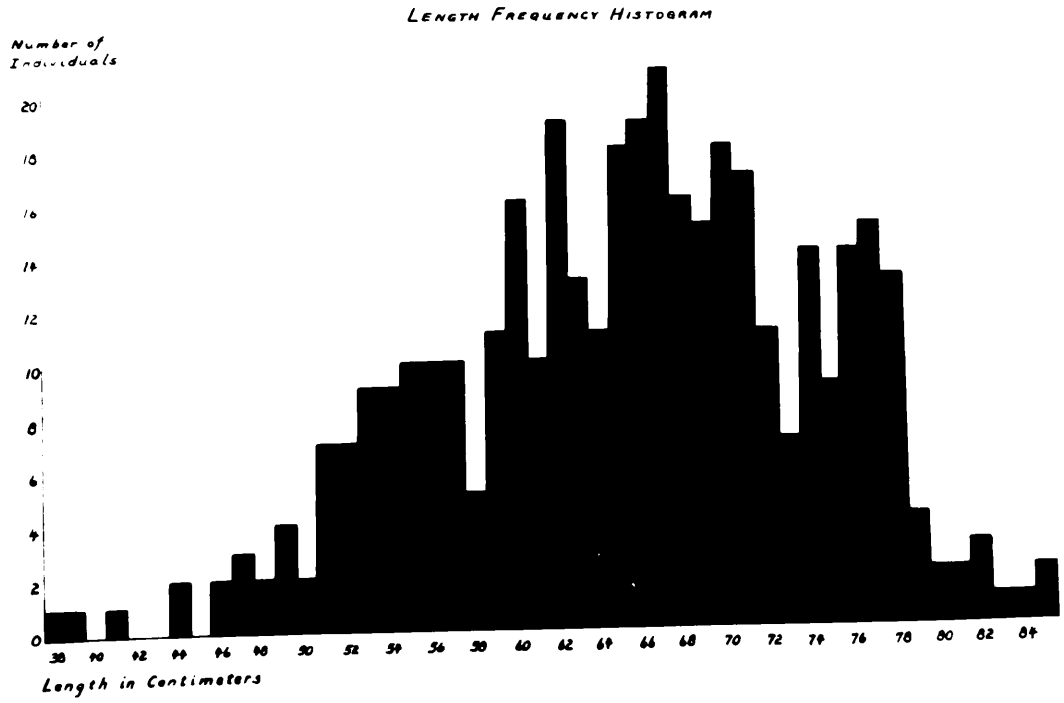
Length Frequency Histogram
Number of Individuals
20
18
16
14
12
10
8
6
4
2
0
38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84
Length in Centimeters

Fig. 2

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