FISHERIES RESEARCH BOARD OF CANADA

ANNUAL REPORT

Arctic Biological Station

Ste. Anne de Bellevue, P.Q.

1968 – 69

C. J. KERSWILL, Director

With Investigators' Summaries

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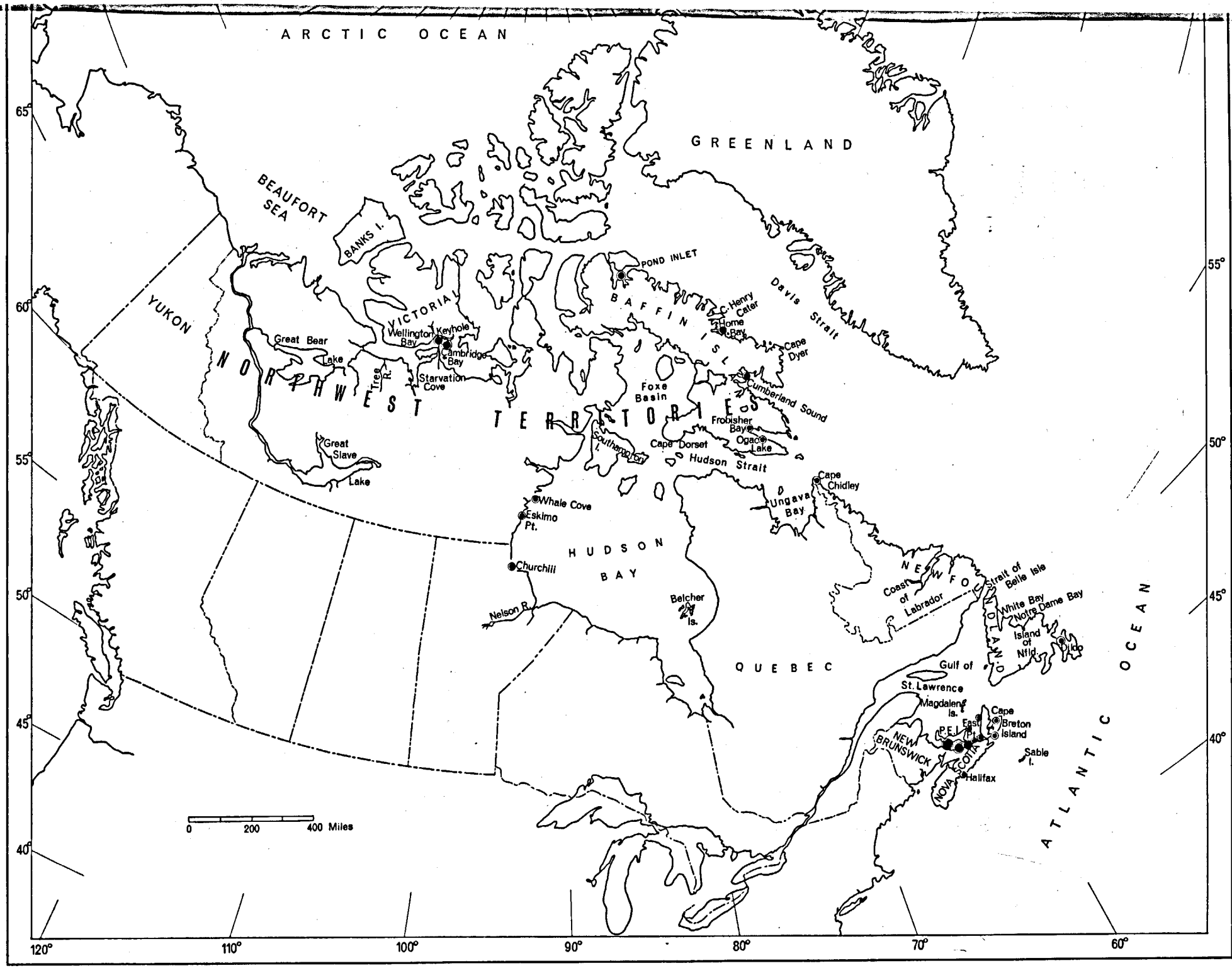
ARCTIC OCEAN
GREENLAND
BEAUFORT SEA
BANKS I.
POND INLET
Davis Strait
BAFFIN I.
C. Henry Cater
Home Bay
Cape Dyer
YUKON
VICTORIA
Wellington Bay
Keyhole
Cambridge Bay
Great Bear Lake
Tree R.
Starvation Cove
Foxe Basin
Cumberland Sound
NORTHWEST TERRITORIES
Frobisher Bay
Ogac Lake
Great Slave Lake
Southampton I.
Cape Dorset
Hudson Strait
Cape Chidley
Ungava Bay
Whale Cove
Eskimo Pt.
HUDSON BAY
Churchill
Belcher Is.
Nelson R.
NEWFOUNDLAND
Coast of Labrador
Strait of Belle Isle
White Bay
Notre Dame Bay
Island of Nfld.
Lido
QUEBEC
Gulf of St. Lawrence
Magdalen Is.
Cape Breton Island
P.E.I.
NEW BRUNSWICK
NOVA SCOTIA
Halifax
Sable I.
ATLANTIC OCEAN
0 200 400 Miles
65°
60°
55°
50°
45°
40°
120°
110°
100°
90°
80°
70°
60°

CONTENTS

INTRODUCTION

Since 1965 the Arctic Biological Station has been accommodated in a new laboratory building at Ste. Anne de Bellevue, Quebec. Previously, since 1955 when this research group was established as the Arctic Unit of the Fisheries Research Board, it occupied rented quarters on the McGill University campus in downtown Montreal. The Arctic Unit was an outgrowth of the Board's Eastern Arctic Investigations, established in 1947 under the direction of Dr. M. J. Dunbar of McGill University who started northern field work in 1948 using the 48-foot M.V. Calanus provided by the Board. This series of annual reports was inaugurated in 1955 to record activities in the various investigations, and more details on the early history of the group can be found in the 1966-67 report.

Activities of the Station now include investigations of marine and anadromous fish north of the 60th Parallel as well as studies on marine mammals of the Pacific and Atlantic coasts. Studies on Atlantic harp and hood seals and on grey seals have been the responsibility of our staff for many years. An intensive investigation of North Atlantic whales was started in 1966, and in 1967 the Pacific mammal research group was transferred here from the Biological Station at Nanaimo, B.C.

By Act of Parliament, 1937, the Fisheries Research Board is responsible for all fisheries research stations in Canada, conducts and controls investigations of practical and economic problems with marine and freshwater fisheries, flora and fauna, and undertakes such other work as may be assigned by the Minister (now of Fisheries and Forestry). This broad program of aquatic renewable resources comprises three areas of research activity: (a) commercial and recreational fisheries research; (b) environmental research; (c) products and processing research. The activities of this Station are limited to (a), including investigations on harvesting and management of marine and anadromous fishes, shellfish, etc. as occur in the Arctic, and marine mammals generally, and (b), including biological aspects of oceanography and limnology as they relate to productivity of arctic marine and adjacent waters, and to the fitness of the aquatic environment.

Besides the above three research functions the Board supports fisheries-oriented activities at Canadian universities to encourage development of centres of research excellence and sound professional training in sciences related to aquatic renewable resources. This Station participates through providing laboratory facilities, opportunities for field work, biological material and program supervision to several graduate students who are proceeding to advanced degrees.

Biological investigations on fresh waters and the associated freshwater fisheries north of the 60th Parallel, formerly mainly the responsibility of this Station, were transferred in 1966 to the newly established FRB Freshwater Institute at Winnipeg. There is, however, considerable overlap of anadromous species (e.g. arctic char) and freshwater species (e.g. lake trout) in the North, and in such cases close cooperation of activities is maintained between the Winnipeg and Ste. Anne de Bellevue laboratories.

This Station is active in providing scientific information and management advice, mainly concerning marine mammals, to several international commissions. These include the International Whaling Commission (IWC) for Atlantic whales; the International Commission for the Northwest Atlantic Fisheries (ICNAF) for harp and hood seals; the North Pacific Fur Seal Commission (NPFSC); and the International Council for the Exploration of the Sea (ICES).

In 1968-69 vessel facilities were provided by (a) the 48-foot M.V. Calanus serving as the summer working platform for biological oceanography at Frobisher Bay, and wintering for refit and inspection at St. Anthony, Newfoundland; (b) the 37-foot M.V. Salvelinus working in Starvation Cove (Victoria Island) and Bathurst Inlet, and wintering at Cambridge Bay; (c) the 151-foot M.V. Polarstar chartered by the North Atlantic whale investigation for cruises from mid December 1968 to mid January 1969 and all of February 1969.

General transportation of staff and equipment on field work was by commercial airlines supplemented by chartered aircraft as required.

Construction of a two-storey, 33-ft X 50-ft storage and workshop building behind the main laboratory was nearly completed.

The Station staff, classified by function, is shown in Appendix I. The fiscal year started with 10 scientists including the Director, and ended with nine because of the sudden death of Mr. Gordon C. Pike on December 24th. Ten full-time technicians supported the scientific staff through the year. In addition there were four continuing term technicians who assisted the North Atlantic whale program, four technicians employed for shorter terms, two graduate assistants working towards the Ph.D. degree and three student assistants. The general austerity program and restrictions on employment prevented staff increases that had been included in long-term plans for development of Station research activities.

RECENT ACTIVITIES AND PLANS FOR 1969

The Arctic Biological Station's program is organized under three major investigations: Marine Mammals, Biological Oceanography, and Arctic Fisheries. Their common objective is to develop a sound biological basis for optimum sustainable yield of the aquatic resources for which this Station is responsible.

1. Marine Mammal Investigations

Species such as fur seal, ringed seal, harp seal and large North Atlantic whales have considerable economic value for their pelts, meat, oil or other products. Two species of seals, the harbour and grey, are a nuisance to Atlantic coast fishermen in disrupting trap and gill net fisheries for salmon and other pelagic fishes. Also they contribute to the infestation of fish by codworm, since they are host to one stage of the parasite.

Following are highlights of recent work on some of the marine mammals, described in greater detail in the section comprising summary reports by the staff.

Ringed seal. Recent studies of large collections of specimens from Baffin Island show pronounced difference in age structure between populations from Pangnirtung in Cumberland Sound (mostly immature) and Broughton Island on the east coast (mostly mature, age 6 years and older). Consistently high catches in Cumberland Sound suggest extensive annual immigration of immature seals from other coastal areas, possibly as far distant as Broughton Island.

Harp seal. There are two herds; in spring one whelps and moults in the Gulf of St. Lawrence, the other east of Newfoundland (the "Front"). Tagging has shown that these herds mix in summer in arctic waters off Baffin Island and West Greenland.

In the Gulf, sealing is restricted to Canada. There is an annual quota of 50,000 young seals in all but the northernmost area, and adults are protected. Studies include analysis of survival of year classes after known kills of young, and of reproductive rates, believed to be density-dependent. These indicate a maximum sustainable yield of about 90,000 young seals per year, and recently the annual kill has averaged about 80,000. On the "Front," Canada and Norway participate in the fishery, and management is under consideration by the International Commission for the Northwest Atlantic Fisheries. Some recent catches are believed to be excessive. Annual catches of 133,000 or more young have been followed by low survival of those year classes, while catches of 95,000 in two recent years have been followed by good survival.

White whale. Tagging started in 1967 in western Hudson Bay, was continued in 1968 when 700 harpoon tags were applied. From the 800 tags applied to date, 3 recoveries show migratory movements up to 600 miles in the Bay. Also in 1968, 4 white whales were tagged in the Mackenzie Delta and 2 in Cumberland Sound. Ninety animals were injected with tetracycline and tagged, in an attempt to study the rate of development of growth layers in teeth and to facilitate aging specimens.

North Atlantic whales. Since 1964 interest in whaling has revived in eastern Canada; two plants now operate in Newfoundland and one in Nova Scotia. Present research is aimed at determining existing whale populations and how they are affected by hunting pressure. The annual stock assessment includes (1) use of the chartered vessel over a large area of the Northwest Atlantic for systematic sightings and random tagging of specimens; (2) search for tags in whales taken by the industry; (3) recording detailed information on whales landed for processing at the plants, to permit year-by-year comparison of the age composition and reproductive potential of stock. At present commercial interest is mainly in the fin whale and total annual quotas for it were 800 in 1967 and 700 in 1968. Detailed biological information is recorded also on other species of whales, e.g. minke and sei, which may be caught and processed, and also on dolphins and porpoises which are encountered during the sighting and marking research cruises.

Pacific mammals. In 1968 FRB continued pelagic fur seal research in the Northeast Pacific for the tenth consecutive year under the Interim Convention on Conservation of North Pacific Fur Seals which involves Canada, Japan, U.S.A., and U.S.S.R. A hunting vessel chartered by this Station collected the required 500 seals for research purposes off British Columbia and Alaska from March through June, 1968.

2. Biological Oceanography

The marine ecology station at Frobisher Bay has operated on a continuing basis since August 1967, using M.V. Calanus and a shore-based laboratory. Data have been compiled on meteorological features; sea ice and snow cover; water movements; temperature, salinity, dissolved oxygen, nutrients and chlorophyll, phytoplankton, zooplankton and zoobenthos quantities and species composition; primary productivity rates. The station is ice-covered for about 8 months of the year. Primary and secondary production rates are low by North Atlantic standards.

Progress was made on cataloging all the known dinoflagellates of arctic Canada. Lipid development in arctic dinoflagellates and diatoms has been studied, and the large amount of oil produced

has been considered from the point of view of possible future exploitation. Intensive work has been done on the taxonomy of copepods in arctic and North Atlantic waters.

3. Arctic Fisheries Investigations

The sustainable yield of landlocked arctic char in a small 20-acre lake on Victoria Island was estimated to be 5.3 lb/acre. The low trophic status of feeding appeared to be responsible for the unexpectedly high yield potential. Many small lakes near settlements have a similar arctic char potential which might be utilized.

A basis productivity survey was made of a small 10-acre lake on the south coast of Victoria Island. Fish were absent and small arctic char were introduced experimentally.

The marine productivity study, started in 1966 at Starvation Cove 40 miles west of Cambridge Bay, was continued.

Over 100 arctic char were transferred from Victoria Island to the laboratory at Ste. Anne de Bellevue where they are undergoing food intake and growth studies with controlled light and temperature.

4. Plans for 1969

Continue the marine mammal investigations at about the same levels as in 1968, including: white whale population studies in Hudson Bay and off Baffin Island; an aerial and ground survey of ringed seals on eastern Baffin Island, and laboratory analysis of a large body of data on this species; harp seal population and behaviour studies, Gulf of St. Lawrence and Labrador "Front"; population studies on large North Atlantic whales; pelagic research on the northern fur seal in Pacific Ocean off British Columbia and State of Washington.

Continue long-term marine ecology study, Frobisher Bay, Baffin Island, as in 1968. Work up data on arctic phytoplankton for publication.

Terminate marine fisheries productivity study, started 1966, near Cambridge Bay, Victoria Island.

SUMMARY REPORTS BY INVESTIGATORS

1. Occurrence of the harbour seal in the Thlewiaza River, N.W.T.

The presence of the harbour seal in the Thlewiaza River was suspected following reports from G. W. Malaher, former director of Wildlife, Department of Mines and Natural Resources, Winnipeg, that seals had been seen in two lakes forming part of the river system. In order to substantiate these reports and identify the species of seal concerned, B. Beck and T. G. Smith carried out a field study during the period 20 August-7 September 1968.

Nets were set near the river's source in Sealhole Lake (876 ft above sea level) and downstream in Edehon Lake (540 ft). Seals were found only in Edehon Lake and of five individual animals seen, one was captured in the nets. This was an immature male harbour seal which had been feeding heavily on lake trout and whitefish and was in excellent condition.

It is likely that seals overwinter in the lakes since there are rapids and areas of upwelling where the river flows into and out of the lakes and where ice does not form. However there appear to be no impassable rapids or other obstacles which might impede the free passage of seals to and from Hudson Bay.

Examination of the skull and lower jaw show that this specimen does not appear to differ from other harbour seals in our collection from arctic and eastern Canada.

A. W. Mansfield

2. Ringed seal observations, eastern Baffin Island

The 1968 field work on the ringed seal involved making counts of seals on the fast ice of Ekalugad Fiord in the Home Bay region of Baffin Island. The object of those counts was to obtain a measure of seal density and to determine the time of the peak haul-out period.

Camp was set up in Ekalugad Fiord 120 miles north of Broughton Island on 25 May. Counts were begun on 27 May and lasted until 28 June when ice conditions made it necessary to return to Broughton Island.

Ekalugad Fiord is approximately 35 miles long. It is bounded by steep walls rising to 2200 feet. The area surveyed encompassed a total of 67.49 square miles. Counts were made with 35 X 7 binoculars and a 40X spotting telescope from four observation points situated above the ice.

Figure 1 shows the increase of seals per square mile during the season. The maximum density reached was 6.48 seals/square mile recorded on 28 June.

On the return journey it was found that ice conditions between Kivitoo and Broughton Island were still quite good for travel. On 3 July counts were made in all bays and fiords as well as around islands between Broughton Island and Kivitoo. A total area of 20.37 square miles was counted yielding a figure of 13.40 seals/square mile. This figure which is higher than the Ekalugad Fiord maximum density, indicates that the peak of haul-out had not yet occurred in Ekalugad Fiord when the work terminated. The higher numbers may also be partially due to the fact that the Kivitoo counts also included areas of ice around islands which are known to be highly productive.

T. G. Smith

3. Whale and dolphin strandings, Sable Island

The following cetaceans were recorded during our visits in June 1968 and January-February 1969.

Date	Species	Length
14 June 1968	Globicephala melaena (pilot whale)	520 cm
28 Jan. 1969	Kogia breviceps (pygmy sperm whale)	240 cm
13 Feb. 1969	Lagenorhynchus acutus (white-sided dolphin)	186 cm
13 Feb. 1969	Lagenorhynchus acutus (white-sided dolphin)	246 cm

The pilot whale had been washed up on the south beach in February 1968 according to staff at the Weather Station. The pygmy sperm whale and the white-sided dolphins were both eroded by wave action from the sand of the north beach. Their date of stranding is uncertain.

A. W. Mansfield
B. Beck

4. Grey and harbour seal survey, Maritime Provinces

Both grey and harbour seals still continue to disrupt trap and gill-net fisheries for salmon, herring and mackerel in

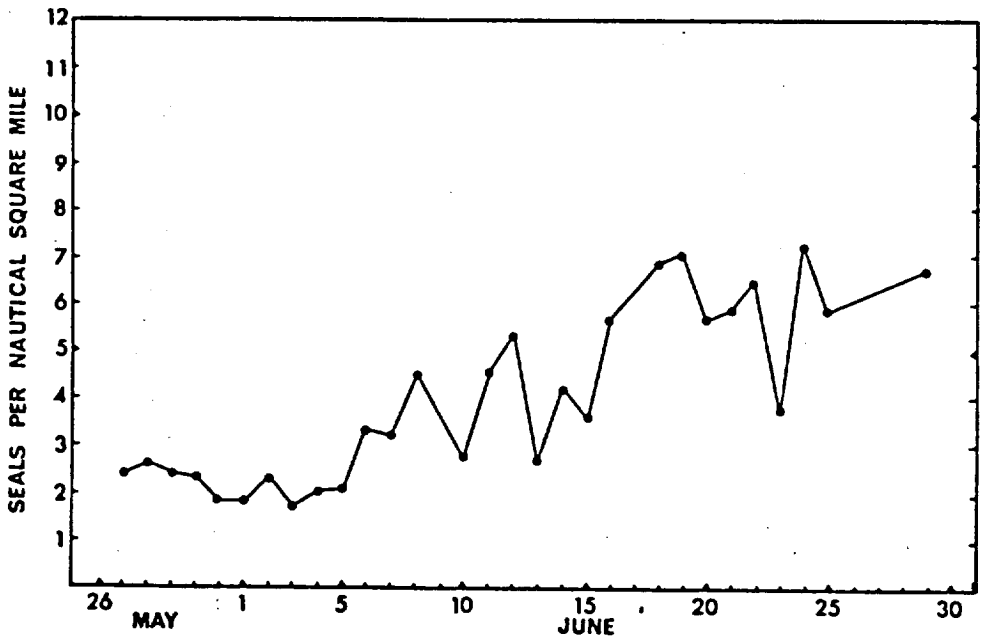

Fig. 1. Numbers of seals hauled out per square nautical mile of fast ice, during May and June of 1968.

eastern Nova Scotia, particularly along the coast from Liscomb to Fourchu. The seals kill and eat the netted fish and cause much damage to nets. Lobster traps are also opened and often broken, especially when they have been freshly baited.

Concern over the depredations of seals on these inshore fisheries has led the Department of Fisheries and Forestry to reduce the grey seal population in this area by culling pups at the Basque Islands each year. Harbour seals are kept down by the bounty system, but this has not been extended to the grey seal except in the Miramichi estuary.

In order to improve our knowledge of the life histories of these two species, we have trained fishermen to collect specimens for us. While we have concentrated on studying the grey seal, which is the more numerous species, sufficient material will soon be available for a detailed study of the harbour seal's life history.

Observations on the breeding behaviour of grey seals continue at Sable Island. In June 1968 Beck and Mansfield erected a prefabricated observation hut overlooking the main breeding colony on the east spit and set out numbered stakes to serve as reference points for the pup counts and behavioural studies. Several days were also spent repairing the abandoned lightkeeper's house at Eastlight to make it a more comfortable and efficient field station.

In early January Beck and Mansfield returned to Sable Island to make detailed counts of pups and collect specimens for further studies on the reproductive cycle. On 1 February G. Sleno and I. Gidney arrived, leaving Mansfield to return to Montreal. In the following two weeks 354 moulted pups out of a total of at least 831 born were branded individually using standard cattle brands heated in a portable forge. Though tagging has yielded valuable information on movements of seals in the first year, it is of no use for long-term studies since the tags are evidently soon lost. Branding is hopefully permanent and should yield important data on mortality rates. It may also play an equally important role in future behaviour studies.

Since this is the first year in which a field party has been present at Sable Island throughout most of the breeding season, it has been possible to obtain reasonably accurate counts of the number of pups born. By colour marking all new-born pups at each count, a minimum pup production of 831 has been estimated. This is about 200 more pups than were born in 1967 and 1968, an increase which may have resulted from disturbances of breeding seals at the Basque Island colony.

One of the highlights of the breeding season at Sable Island was the finding of 9 seals which had been branded as moulted

pups in 1963 and 1964: five females and one male branded at Sable Island in 1963; one female branded at Sable Island in 1964 and two females branded at Basque Island in 1964. One of the latter two females had been seen in the breeding season of 1968, presumably with her first pup. Several of the branded females were taken as specimens and will prove of great value in validating the method of ageing from the structure of the teeth.

A. W. Mansfield

5. Pelagic fur seal research, North Pacific

This investigation was directed by G. C. Pike until his untimely death on 24 December 1968. The field work was carried out by J. M. Henderson under the supervision of Ian B. MacAskie. During the period 20 March to 8 July 1968 five hundred seals were taken off the coasts of Washington, British Columbia and Alaska from the chartered seiner Belina. Data were obtained on distribution, feeding habits, reproductive condition, pregnancy and mortality rates (Pike and MacAskie, 1969) and a further collection of pituitary glands was made for the Department of Zoology, University of British Columbia.

Reference

Pike, G. C., and I. B. MacAskie. MS. 1969. Report on Canadian fur seal research in 1968. Fish. Res. Bd. Canada MS Rep. 1011: 20 p.

A. W. Mansfield

6. Harp seal, Front

1 April 1968 to 31 March 1969. From 22 April to 5 May 1968 the sealing vessel M.V. Brandal was chartered in order to collect samples of moulting harp seals from the "Front" icefields east of Belle Isle. A moulting group was located through information given by the departing sealing fleet after the last legal date of killing (25 April), it was then reached through the ice and 350 animals were sampled on 29 and 30 April. For a sub-sample taken on deck, length, girth, fat thickness, weight and pelage condition were analysed. The remainder were sampled for age and state of female sexual maturity. The resulting age sample showed very low numbers of animals of year classes 1962 to 1964, following heavy

total kills of young (250,000-300,000) in those years. Since these ages, 4 to 6 years, are those when female sexual maturation occurs, it proved impossible to estimate accurately the mean age of maturation of "Front" females from this sample and to compare this age with that found for various samples taken in the Gulf of St. Lawrence.

D. E. Sergeant

7. Harp seal, Escoumins, Que.

From 16 January to 31 March (and beyond, to 24 April) 1969, samples of harp seals were obtained from hunters at Escoumins, Que., who shoot them in the water. This sample enabled us to make a first study of winter feeding habits. The region just downstream from Tadoussac is characterised by intense upwelling and was found to be an important feeding area for harp seals, which proved to feed almost exclusively on Osmeridae (capelin and smelt) throughout the sample period. Mature animals disappeared during the whelping period of mid March but reappeared in late March, followed by juveniles. Segregation between adults upstream and underyearlings (and to a lesser extent, older immatures) downstream, was an interesting discovery. Underyearlings were abundant, although as usual not found at net fisheries further east along the north shore. Their abundance was reported to be unusually great by the hunters and this is doubtless associated with good survival of the 1968 year-class following late starting ship based hunting, leading to lower than average catches of young seals (155,000) at the icefields in 1968.

D. E. Sergeant
T. G. Smith
W. Hoek

8. Harp seal, oil pollution

During late January and February of 1969 it became apparent that abnormally light ice conditions were developing in the Gulf of St. Lawrence. Such conditions had last been met with in 1953, and their effects on harp seals were not then observed closely. In March 1969 fewer than the usual number of harp seals whelped on the small amount of available ice around Prince Edward Island; our estimate from catches and subsequently observed seals being about 50,000 as compared with a normal 150,000 or more. Enquiries to offices of the Department of Fisheries and Forestry

Erratum:

Page 6, last paragraph should read:

The experiments at Clearwater Fjord and Kidluit Bay resulted in the tagging of 2 and 10 animals respectively. The lack of success at these localities in comparison with Seal River is attributed to smaller numbers of whales, differences in natural conditions (deep or very turbid water), and less skilled local crews.

in the expected areas of downstream drift showed no evidence of loss of young seals due to drowning. It is surmised that the majority of harp seals normally whelping in the southern Gulf moved to the Labrador coast in 1969.

Oil pollution affected many of the young which were produced in the Gulf and survived the early fishery. From 1000 tagged animals about one third of recoveries included reports of oiling. The catch of young seals in the Gulf in 1969 was about 32,000. If production was about 50,000, of 18,000 survivors about 6000 were oiled. Oiling was seen by Fisheries Officers to occur around Prince Edward Island, young animals becoming fouled while adults avoided most of the oil patches, which were below the surface. Since many of the oiled young seals, even those heavily fouled, reached the Strait of Belle Isle in early April, their swimming ability was not greatly impaired. They do not feed at this time (late March to early April), but probably the heavily fouled young succumbed later through a variety of direct (toxic) and indirect effects of the oil. Carcasses were also found around Cape Breton Island and southern Newfoundland.

D. E. Sergeant
B. Beck

9. White whale

Tagging was attempted in 1968 at three localities: at Seal River, Manitoba, in western Hudson Bay, 30 July-7 August, by P. F. Brodie; at Kidluit Bay, Mackenzie Delta, 24 July-2 August, by W. Hoek; and at Clearwater Fjord, Cumberland Sound, Baffin Island, 8-9 September, by P. F. Brodie.

At Seal River 673 animals were tagged, 600 by harpoon tags and 73 by Peterson tags pierced through the dorsal ridge. This adds to 100 animals tagged the previous year. In an attempt to study absolute rates of tooth layering, 93 tagged animals were injected with tetracycline. Recoveries during 1968 included one 1968 tag taken at Whale Cove, N.W.T. (300 km to the north) on 5 September 1968, and one 1967 tag seen *in situ* at Seal River. The results of this two-year experiment were written up for publication (and subsequently published).

The experiments at Clearwater Fjord and Kidluit Bay resulted in the tagging of 2 and 10 animals respectively. The lack of success to smaller numbers of whales, differences in natural conditions (deep *or* very turbid water), and less skilled local crews.

D. E. Sergeant
P. F. Brodie
W. Hoek

10. North Atlantic Cetacea

For the first time an extensive series of cruises were undertaken to tag and census larger whales in the western North Atlantic through the winter and spring months. The 151-foot-long steel-hulled sealing vessel Polarstar was chartered for three cruises.

The first cruise departed Halifax approximately mid December 1968 and returned in mid January 1969. Waters searched for whales included those between the Nova Scotian shelf and Bermuda, between Bermuda and the United States coast, and between the east central U.S. coast and Halifax. The cruise was not successful. Almost 85 percent of the working days of the cruise were spent in heavy weather, in waters rougher than Beaufort 4. Only a very few whales were sighted and none were certainly marked on this cruise.

Having demonstrated that Winter whale marking in northern waters was unprofitable, a 28-day cruise (through the entire month of February 1969) was undertaken. The ship was directed south from Halifax after running south by east for a few days, and waters east of Bermuda and the West Indies were surveyed. Weather conditions were generally good and there were many encounters with Minke, Humpback and other large whales. The Leeward Islands and the Windward Islands were extensively surveyed, waters around Trinidad and south on the South American coast (to Surinam) were searched, and a number of Sperm, Humpback, Sei and Brydes whales were marked. On the return leg of this voyage, parts of the Caribbean Sea (particularly Mona Passage and the area of Navidad Bank near Puerto Rico) were surveyed with great success. On one particular day, on Navidad Bank, approximately 30 Humpback whales were marked successfully. The eastern coast of the United States and Canada was searched on the return to Halifax. No Fin whales were seen in tropical waters, on this southern winter cruise.

Although it properly belongs to the report for next year (1969-70), it is desirable to mention here a third cruise run from mid May to the end of June 1969 using the same ship. The object of this cruise was to count and mark Fin whales on the Nova Scotian shelf, in the Gulf of St. Lawrence and the Strait of Belle Isle, as well as survey parts of the Labrador and Newfoundland coasts. This was a most successful cruise with a number of Fin whales being marked in the Gulf and on other coasts, a major school of Sei whales being discovered in the Labrador Sea and an old fishing ground for Bottlenose whales being found to be still productive off Cape Chidley (Labrador).

Marking and census data from these three cruises are now being analysed.

E. D. Mitchell

11. M.V. Calanus operation, 1968

The M.V. Calanus was launched at Frobisher on 30 July. The main collecting effort was confined to the head of Frobisher Bay, with the exception of a single voyage of 5 days' duration to near the mouth. The season of field work was ended on 24 August when the voyage south for inspection and re-fit was begun. St. Anthony, Newfoundland, was reached on 1 September, and the vessel was left there for the winter in the hands of the International Grenfell Mission.

E. H. Grainger

12. Marine ecology study, Frobisher Bay

Station 5, 63°40'N, 68°27'W, approximately 5 miles SSE of the Frobisher settlement, was occupied 13 times between 1 April 1968 and 1 April 1969 in a continuation of the program begun there in the summer of 1967. Collections and observations were made from the M.V. Calanus during the open-water season, and from the sea-ice surface during the remainder of the year. Operations were carried out essentially in the same way as described in the 1967-68 Annual Report, except for the replacement of the wooden shelter used formerly on the sea-ice for winter collecting by a portable, aluminum-frame tent, which was shown to be highly suitable for work in this inclement environment.

Air temperatures were cooler from May until August, and considerably warmer from September until December, in 1968 than in 1967. These differences were associated with later sea-ice break-up in the summer of 1968 than in 1967, and later surface freezing in the winter of 1968 than in 1967. Continuation of higher air temperatures through January, February and March of 1969 than during the corresponding period of 1968 (differences in monthly means of about 7°C) was accompanied by considerably less sea-ice formation in the winter of 1969, the thickness having reached only 110 cm on 1 April 1969 compared with about 150 cm on the same date in 1968. Corresponding snow cover thicknesses were about 13 and 30 cm on the same dates. Markedly greater sunshine in July of 1967 than in July of 1968 was followed by an equally marked reversal by September of both years. The atmospheric and surface features may be related meaningfully to sub-surface events.

Water temperatures were higher until early September in 1967 than in 1968, after which time cooling occurred rapidly at the surface in 1967 and much more slowly in 1968. The warmer surface water of early winter 1968 was of lower salinity than during the same period of the previous year.

Absence of data from the early summer of 1967 makes direct comparison of the summer cycles of many of the parameters measured impossible. However, phytoplankton, (as assessed, temporarily, from Chlorophyll a) appears to have persisted at higher levels into the early winter of 1968 than it did in 1967; nitrate and phosphate recovery, following early summer minima, was more rapid in the early winter of 1967 than in 1968; and carbon production (from C^{14} measurements) was continued farther into early winter in 1968 than in 1967. It was assessed as 53 g/m^2 for the entire 1968 productive season.

The beginning of summer primary production in 1968 appeared to be clearly related to the disappearance of snow cover from the sea-ice surface and the first significant penetration of light to the water beneath the ice. This was of course the time of year of maximum potential light in terms of hours of daylight per day and the angle of incidence of solar radiation. Production rates appear to have dropped to winter levels well before the sea-ice formed in early winter. By November, however, light penetrating the sea surface had been reduced to a level probably inhibitory to photosynthesis; and by that time too, chlorophyll a values had declined to around 10 percent of maximum summer values.

The herbivorous zooplankton showed an approximately 10-fold increase in quantity between the winter minimum and the summer maximum (mid August) of 1968, ranging in dry weight from 250 to 2500 mg/m^2. Quantity during August exceeded that found in the same month of 1967 by a factor of more than 2, and declining values during September and October of 1968 were higher than during the comparable period of 1967. Species composition was similar during the 2 years, with Pseudocalanus (copepod) the dominant species both numerically and by weight for most of the year. Cirripede nauplii were significant contributors from June until August, and polychaete larvae from April until September.

E. H. Grainger

13. Other zooplankton studies

Work was continued on Pseudocalanus (copepod) in the Canadian arctic, on the seasonal cycles of the Archipelago Survey stations, on Calanus (copepod) from West Greenland, and on the medusae of the Canadian arctic.

E. H. Grainger

14. Phytoplankton studies

The study on starch and paramylum in arctic lakes has been prepared for publication. It deals with amylo-taxonomy of freshwater algae, extracellular standing crops of carbohydrates, and morphological types of starch of the Cryptophyceae and Dinophyceae. A newly developed method of intracellular measurement of reserve products, such as starch stored in different algal species, has many applications, and permits total quantitative assessment of assimilates in phytoplankton populations.

A typescript on "Phytoplankton lipids in arctic seas" has been completed by the addition of new chapters on cytotaxonomic designs formed by lipids in diatoms and dinoflagellates; excretory function of valvar pores and ectoplasmatic organs of Centricae and Pennatae diatoms; lipids in dinoflagellates; coacervation of lipids; thermoecology and light-nutrient effects on lipids; extracellular lipids; crystallization of lipids in situ; and intracellular assessment of lipids in diatoms. Extrusion of lipids from zooplankton is caused by endo- and ectoparasites Blastodinium Chatton, Syndinium Chatton, Atelodinium Chatton, Ellobiocystis Coutiere, and other species. Mass infection of copepods is associated with abundance of extracellular lipids. The potential bulk of lipids in arctic habitats depends primarily on the quantities of phytoplankton, cryoflora, and the microflora of the mud-water interface.

Highly calorific phytoplankton lipids are basic to the economy of arctic seas, and it is upon these that the animal food chain depends. Mass accumulation of lipids by all arctic diatoms appears to be induced by low light intensity and temperature and by long hibernation periods. Under such ecological conditions the primary lipids synthesized by phytoplankton represent a vital factor for survival of animals, depositing deep subcutaneous layers of fat indirectly derived from algal cells.

General information obtained from studies on phytoplankton production by C^{14} analysis, photosynthetic pigments, and dynamics of standing crops are fairly reliable from unfrozen seas. Observations by these methods in ice-covered arctic seas have not yet been fully carried out, because there has not yet been a single study concerned with the interrelationships between the cryoflora, the phytoplankton, and the algal cells of the mud-water interface. The transitional groups of benthic Pennatae diatoms, and many Cryptophyta, Chrysophyta, Chlorophyta and some dinoflagellates existing in polar regimes are still little known, since only diatoms have normally been studied from preserved samples. At last a start has been made on the problem, with the beginning of a study on a number of living benthic and ice phytoflagellates and dinoflagellates at our Frobisher field station and at Ste. Anne de Bellevue.

Special attention has been paid to the taxonomy of ultramicroplankton organisms, ingested but not digested by copepods, and passed unaltered in fecal pellets. The most resistant against digestion are endoparasitic species of dinoflagellates which appear to be unharmed following ejection. Some small holozoic Gymnodinium and Gyrodinium also may pass through the alimentary canals of zooplankters completely unharmed. Nearly 34 species of the ultramicroplankton were found. The majority of these appear to continue their development in decomposed fecal pellets, which in the final stage of decomposition are mainly large conglomerates of bacteria enclosing cysts of diatoms and phytoflagellates. The astronomical numbers of organisms living in fecal pellets create a counting problem, particularly significant in the Frobisher Bay material.

A. S. Bursa

15. Benthic studies, Frobisher Bay and Starvation Cove

Frobisher Bay. Station 5 (63°40'N, 68°27'W) was occupied 11 times for collecting benthic invertebrates. Three of the occupations were made during the winter when only grabs were taken through the ice. Three occupations were made from a canoe or "peterhead." Six grabs were taken during each of the six occupations. Remaining collections were made from the M.V. Calanus in which 18 grabs and 5 trawls (small balloon trawl) were taken. A sufficient number of grabs are now available to provide seasonal information over an annual period for two depth ranges; Station 5 (45-62 m) and Station 5A (25-35m).

Four trawls were obtained from the Calanus Shelf at the mouth of Frobisher Bay on 12 August 1968.

Separation and identification of benthic invertebrates, excluding the protozoans, from previous collections of 1967-68 has yielded about 280 species. Some of these species are recognizable as separate species but have not been identified. The sponges and ascidians are the two major groups that remain to be taxonomically treated. A list of the major taxa and the number or approximate number of species represented in each category is presented in Table 1. This list is thought to be over 75 percent complete.

Starvation Cove. A mechanical breakdown of the M.V. Salvelinus prevented the use of the vessel for sampling benthic invertebrates at a location (69°10'N, 105°51'W) west of Cambridge Bay, Victoria Island in the summer of 1968. A few grabs were taken in shallower depths (8-45 m) from a rubber boat.

Approximately 170 species of invertebrates, exclusive of the protozoans, have been identified or recognized from trawls and grabs taken in 1966 and 1967. The major taxa with their number of represented species are presented in Table 1.

Comparison of faunas. The fauna of Frobisher Bay is more diverse than that of Starvation Cove (see Table 1) and the faunal compositions are different. In both locations the polychaetes and molluscs are the best represented, but the echinoderms contribute more to the biomass of the fauna at Starvation Cove, whereas ascidians and sponges make up most of the bulk of the fauna at Station 5 in Frobisher Bay.

J. W. Wacasey

Table 1. Major taxa with number of represented species from Frobisher Bay and from Starvation Cove.

Taxon	Number of species	
	Frobisher Bay	Starvation Cove
Porifera	ca. 10	1
Coelenterata		
Hydrozoa	several	few
Anthozoa	3	5
Platyhelminthes		
Turbellaria	1	1
Nemertina	ca. 4	2
Aschelminthes		
Nematoda	ca. 4	
Priapulida	1	1
Annelida		
Polychaeta	88	52
Hirudinea	1	1
Mollusca		
Amphineura	2	
Cephalopoda	2	1
Gastropoda	33	25
Pelecypoda	19	19
Arthropoda		
Crustacea		
Amphipoda	ca. 30	20
Cirripedia	2	2
Cumacea	9	8
Decapoda	8	6
Isopoda	4	1
Mysidacea	1	
Ostracoda	1	
Tanaidacea	2	
Pycnogonida	ca. 8	4
Sipunculida	4	1
Ectoprocta	ca. 10	few
Brachiopoda	2	1
Echinodermata		
Asteroidea	11	4
Crinoidea	1	1
Echinoidea	1	1
Holothuroidea	5	4
Ophiuroidea	7	2
Chordata		
Ascidiacea	ca. 12	2
Total	ca. 280	ca. 170

16. Marine and freshwater fisheries studies, Central Arctic, 1968

Location: Cambridge Bay and Starvation Cove, Victoria I.
Time: 7 July to 16 September
Location: Bathurst Inlet
Time: 5-9 August
Facilities: Shore-based laboratory in Starvation Cove occupied from 27 June to 16 September;
M.V. Salvelinus launched 13 July
Marine gear breakdown 14 August
Temporary gear repair 11 September
Haul-out 14 September
15-ft inflatable rubber boat with 40 HP outboard engine

Personnel:

Time:		
I. G. Gidney	7 July	- 11 August
J. Boulva	15 June	- 8 September
S. T. Leach	7 July	- 8 September
M. I. Joynt	22 June	- 8 September
K. M. Muth	22 June	- 1 September
J. W. Wacasey	18 August	- 1 September
E. G. Atkinson	18 August	- 1 September
J. G. Hunter	28 July	- 16 September

Studies: Measurements of (1) bottom fauna, (2) phytoplankton, (3) zooplankton, (4) oxygen concentrations, (5) chlorophyll concentrations, (6) light penetration, (7) C^{14} productivity, (8) temperature, (9) salinity, (10) benthic fish biomass.
Similar measurements excluding salinity and fish biomass were taken from a small unnamed lake at Starvation Cove. Between 100 and 200 arctic char were introduced into this lake by K. M. Muth.

Measurements and Collections: Fishing and dredging activities were restricted after the breakdown of the M.V. Salvelinus but hydrographic measurements and plankton collecting were continued with hand operated equipment from a rubber boat.
Samples were taken jointly from two locations at Starvation Cove at near-weekly intervals from 1 July to 4 September and at five locations in Bathurst Inlet from 6-8 August and consisted of:

	Starvation Cove	Bathurst Inlet
Salinity	70	49
Temperature	70	49
Oxygen	70	
Nitrate	70	
Phosphate	70	
Chlorophyll	70	
C^{14}	70	
Light penetration	9	
Microplankton	70	49
Net plankton	29	5
Benthic trawl fauna	6	2
Peterson grabs	20	1

Results: Material has been distributed to interested persons or agencies and in some cases is reported elsewhere or remains in a state of being worked up.

Temperature, salinity and oxygen measurements made in the years 1966, 1967 and 1968 are shown in Figures 1, 2 and 3.

The lake in which freshwater studies were carried out was found to have an area of 4.35 ha, a maximum depth of 8.1 m, and a mean depth of 3.7 m. Samples were taken from the lake at four-day intervals from 28 June to 28 August and consisted of:

Temperature	165
Oxygen	78
Nitrate	91
Phosphate	91
Silicate	50
Alkalinity	91
pH	91
Carbon dioxide	90
C^{14}	139
Light penetration	91
Chlorophyll	75
Microplankton	78
Net plankton	60
Bottom samples	28
Outlet flow measurements	10

No fish were found in the lake but 63 arctic char between 10 and 15 cm fork length were introduced from Keyhole Lake on 4 August. Another group of fish held in live traps in the lake, were subsequently transferred to

Summary 16

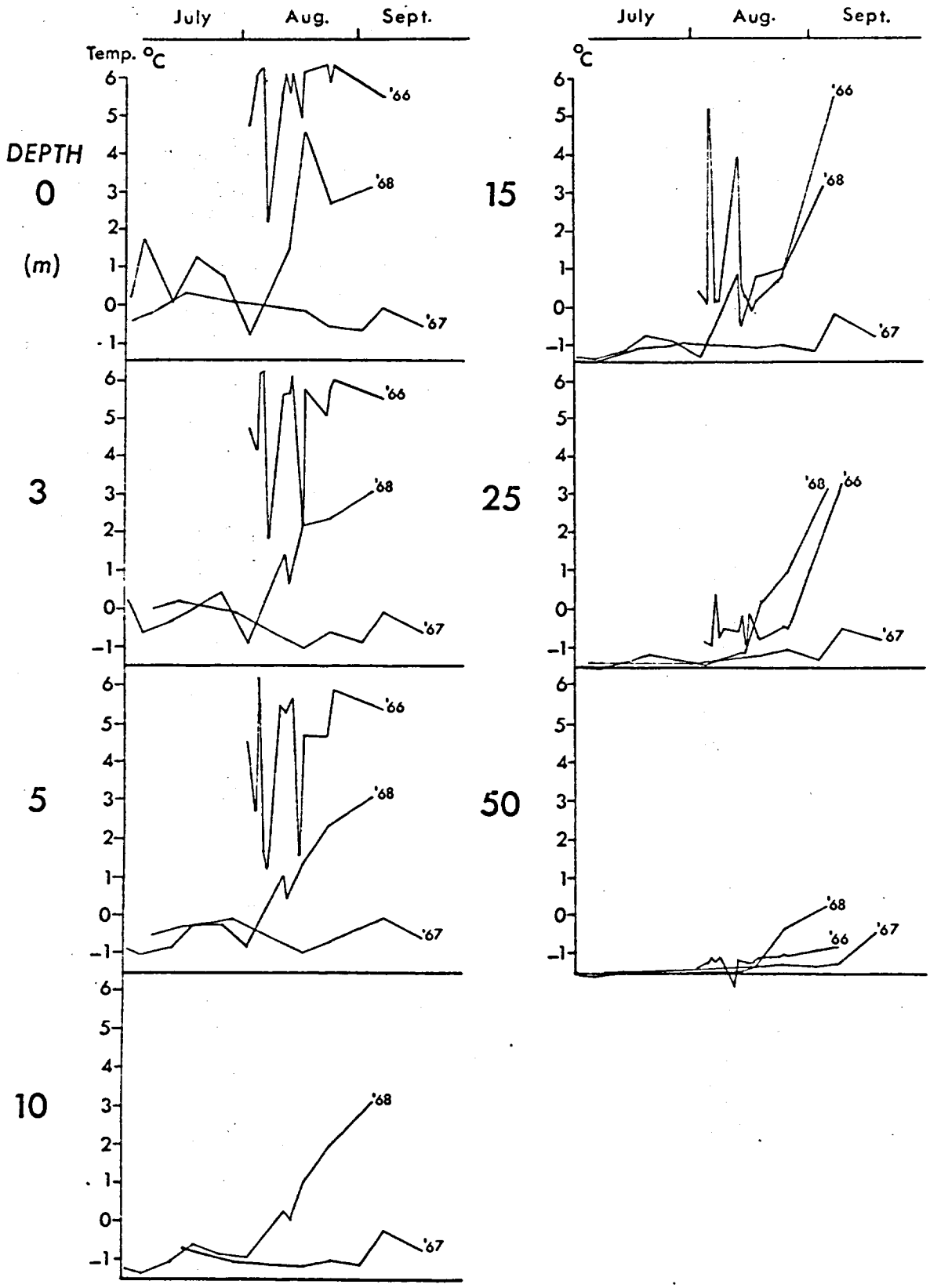

Fig. 1. Temperature structure of water column at Starvation Cove in years 1966, 1967 and 1968.

Summary 16

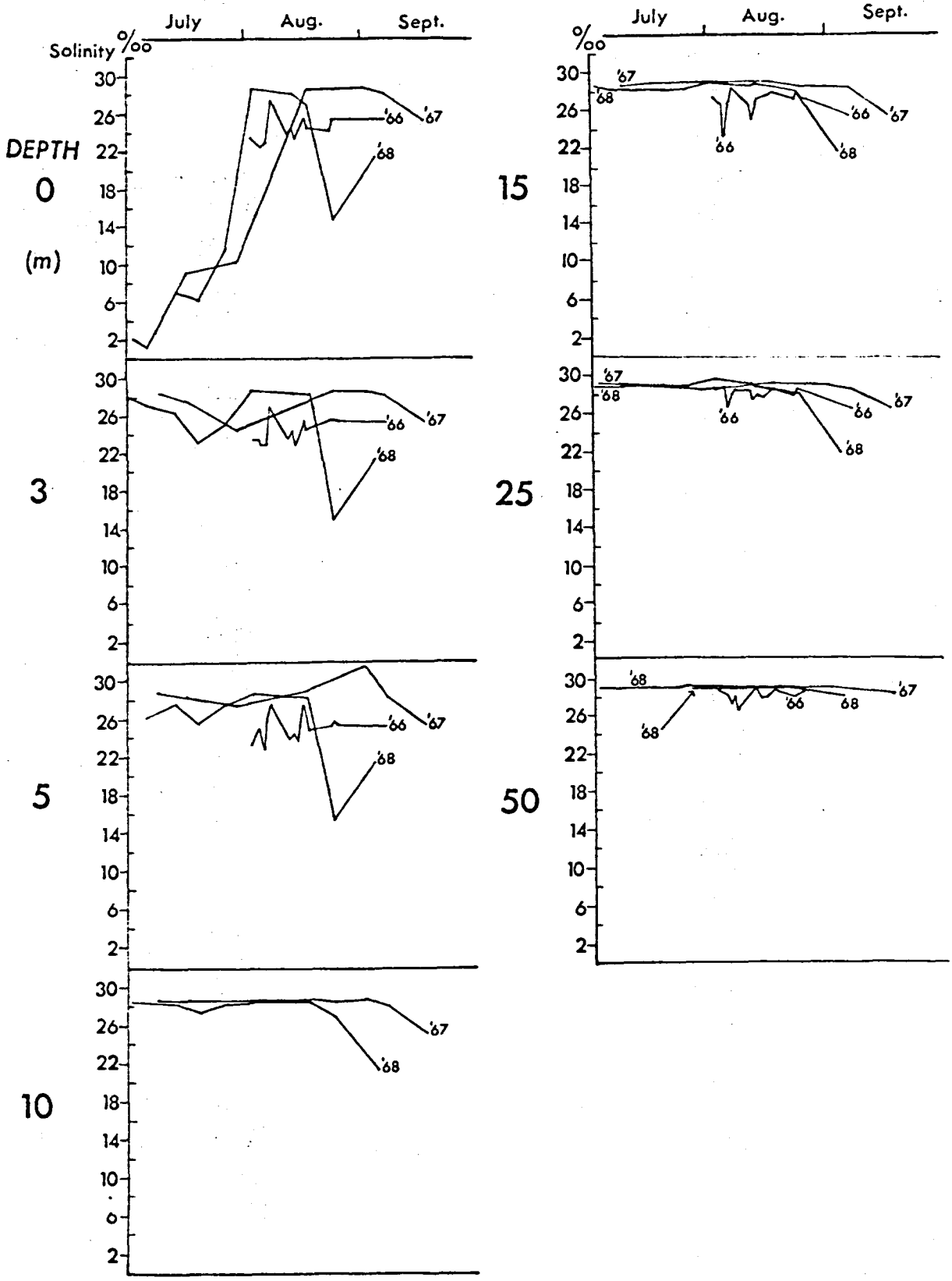

Fig. 2. Salinity structure of water column at Starvation Cove in years 1966, 1967 and 1968.

Summary 16

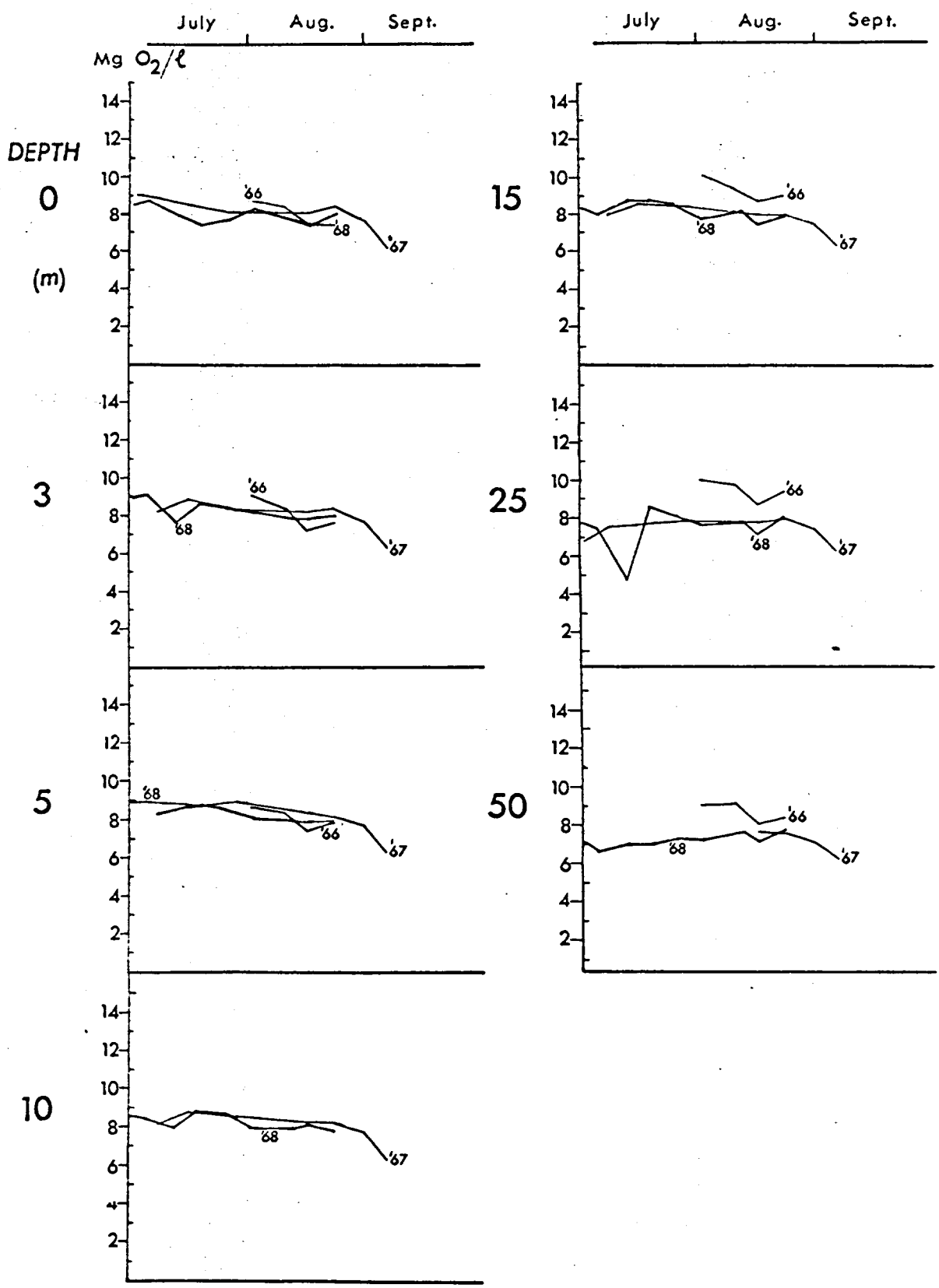

Fig. 3. Oxygen structures of water column at Starvation Cove in years 1966, 1967 and 1968.

Montreal and featured as test animals in a series of feeding experiments designed to measure maintenance food requirements. Samples and data have been taken to the University of Minnesota for analysis by Mr. Muth.

J. G. Hunter

17. Arctic char fishery, Wellington Bay

Ferguson Lake on Victoria Island is approximately 200 square miles in area and prior to 1962 supported an arctic char fishery of about 65,000 pounds. Age-length and age-frequency curves from a sample of the migratory stock taken with 3 1/2-, 4 1/2- and 5 1/2-inch gill net meshes showed comparatively good growth and, until the fish had reached asymptotic size, low mortality (Figure 1).

Since 1962 the catch has increased to 100,000 pounds and is used entirely for commercial purposes and its development has resulted in the use of only 5 1/2-inch mesh gill nets and fishing in both distant feeding areas and in and near the mouth of the Ferguson River when the fish return from the sea. Catch/unit of effort from fishing in or near the river mouth has declined since the increased level of fishing began but the decrease corresponds to an increase in the number of fishing units employed (Figure 2). Catch/unit of effort statistics from fishing in distant feeding areas, available only for 1969, show an average fishing success (132.4 pounds) similar to the initial catch from the Ferguson area in 1962 which suggests the apparent stock decline is not real. Observations on catch from this important fishery are being continued.

J. G. Hunter

Summary 17

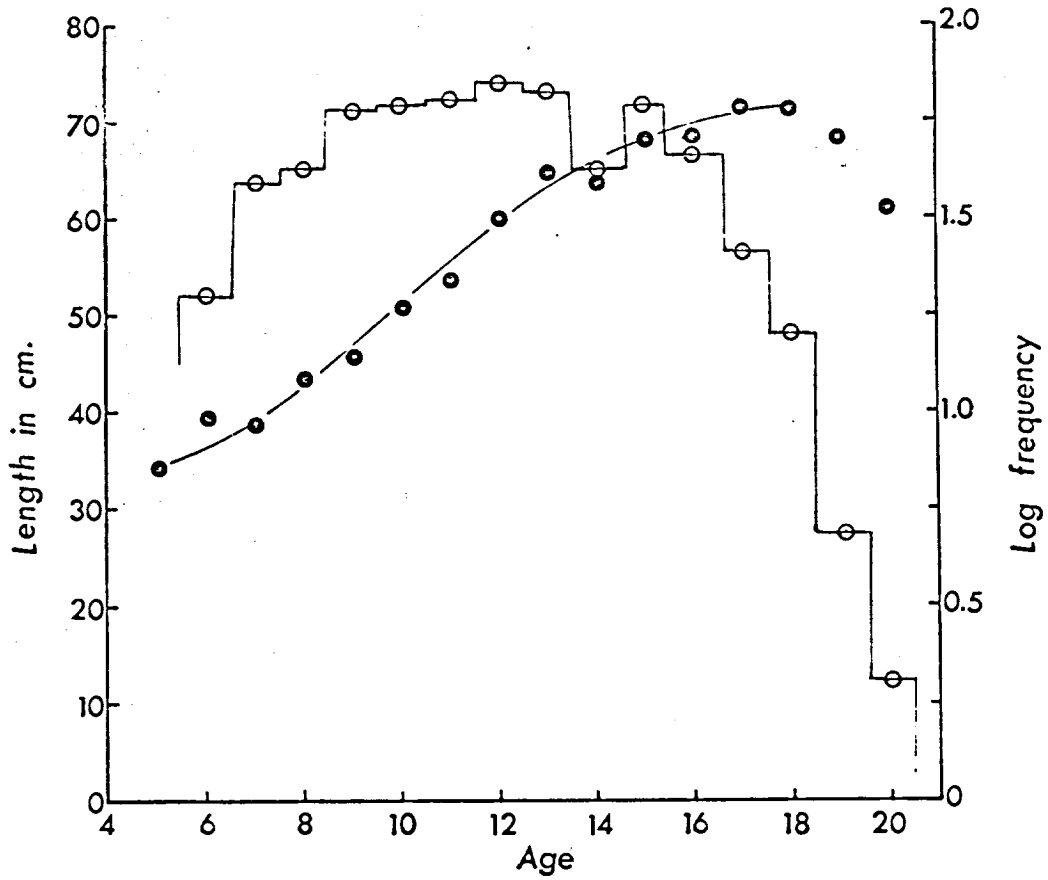

Fig. 1. Age-length and catch curve of arctic char from Ferguson River in 1962.

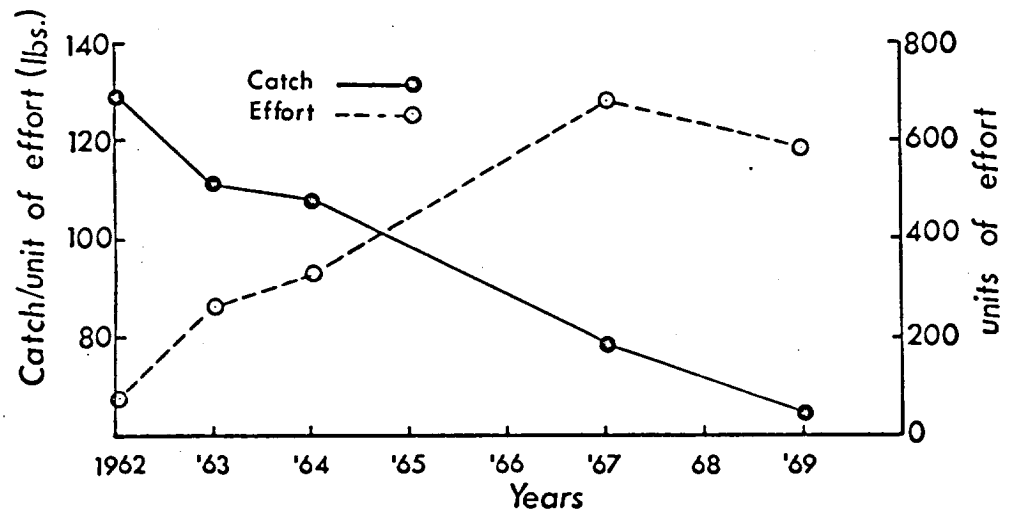

Fig. 2. Catch/unit of effort and number of units of effort employed in arctic char fishery in the Ferguson River.

APPENDIX I

SCIENTIFIC STAFF

(on 31 March 1969)

C. J. Kerswill, Ph.D. (Toronto), Director

A. S. Bursa, Ph.D. (Krakow)
E. H. Grainger, Ph.D. (McGill)
J. G. Hunter, Ph.D. (McGill)
A. W. Mansfield, Ph.D. (McGill)
E. D. Mitchell, Ph.D. (California, Berkeley)
K. M. Muth, M.S. (Maine)
D. E. Sergeant, Ph.D. (Cantab.)
J. W. Wacasey, Ph.D. (Michigan State)

Appendix I

PERSONNEL CLASSIFIED BY FUNCTION

(1 April 1968 to 31 March 1969)

Administration

C. J. Kerswill, Ph.D.	Scientist 5, Director
G. F. Hart	AS 5
H. W. McNeill, B.A.	CR 5
Lois G. McMullon	ST 6, Secretary to Director
Margaret C. Claremont	ST 4, Secretary to Admin. Officer (to 31 December 1968)
	CR 3 (from 1 January 1969)
Barbara E. Hubert	ST 3 (to 15 July 1968)
Nadia A. Bjorklund	ST 3 (from 1 August 1968)
Michelle Besner	ST 3

Buildings and Grounds

C. Chartre	GL 10
L. Pellan	GL 5
M. Martin	Maintenance Helper (Term) (from 13 November to 31 December 1968)
R. Desforges	Carpenter (Term) (from 3 March 1969)

Library

June A. Currie, B.A.	CR 5

Marine Mammal Investigations

A. W. Mansfield, Ph.D.	Scientist 3 (to 30 September 1968)
	Scientist 4 (from 1 October 1968)
D. E. Sergeant, Ph.D.	Scientist 3
G. C. Pike, M.A.	Scientist 3 (to 23 December 1968)
E. D. Mitchell, Ph.D.	Scientist 2 (to 30 September 1968)
	Scientist 3 (from 1 October 1968)

Appendix I

Marine Mammal Investigations (Continued)

M. W. Cawthorn	Technician 4
I. B. MacAskie	Technician 4
B. Beck	Technician 4
G. A. Sleno	Technician 2 - half time (to 31 December 1968) Technician 3 - half time (from 1 January 1969)
W. Hoek	Technician 2
P. F. Brodie, M.Sc.	Graduate Assistant (Term) (from 10 June to 13 September 1968)
T. G. Smith, M.Sc.	Graduate Assistant (from 1 May to 10 September 1968) (from 8 January to 31 January 1969)
D. M. Casson	Student Assistant (from 27 May to 2 September 1968)
J. Henderson	Technician 1 (Term) (from 1 April 1968 to 16 November 1968)
G. Horonowitsch	Technician 1 (Term) (from 27 May to 21 October 1968)
H. Wong	Technician 1 (Term) (from 27 May to 13 September 1968)
B. Peers	Technician 2 (Term) (from 18 December 1968 to 13 January 1969)
Barbara J. Mason, B.Sc.	Technician 1 (Term) (from 1 April 1968)
Elaine R. Sloan, B.Sc.	Technician 1 (Term) (from 1 April 1968)
Betty I. Osborne, B.I.D.	Technician 1 (Term) (from 23 April 1968)
H. P. L. Kiliaan	Technician 2 (Term) (from 1 April 1968)
A. F. Spence, B.A.	Draftsman 5 (Term) (from 16 April to 19 April 1968)

Biological Oceanography

E. H. Grainger, Ph.D.	Scientist 4
J. W. Wacasey, Ph.D.	Scientist 3
A. S. Bursa, Ph.D.	Scientist 3
J. E. Lovrity	Technician 3
A. A. Mohammed, B.Sc.	Technician 2 (to 30 June 1968) Technician 3 (from 1 July 1968)
G. A. Atkinson	Student Assistant (from 3 June to 13 September 1968)

Appendix I

Arctic Fisheries Investigations

J. G. Hunter, Ph.D.	Scientist 3
K. M. Muth, M.Sc.	Scientist 1 (to 30 September 1968) Scientist 2 (from 1 October 1968)
I. G. Gidney	Technician 4 - half time
Marsha I. Joynt	Technician 1 (to 18 September 1968)
Shirley T. Leach	Technician 1
J. Boulva, B.Sc.	Student Assistant (from 10 June to 13 September 1968)

M.V. Calanus

D. B. Fleet, B.A.	Technician 4 (Term) (from 17 June to 4 September 1968)
G. A. Sleno	Technician 2 - half time (to 31 December 1968) Technician 3 - half time (from 1 January 1969)

M.V. Salvelinus

I. G. Gidney	Technician 4 - half time

APPENDIX II

PUBLICATIONS

(1 January to 31 December 1968)

Bursa, A. S. Epicenoses on Nodularia spumigena Mertens in the Baltic Sea. Acta Hydrobiologica 10(3): 267-297.

_____ Marine plants, p. 343-351. In C. S. Beals [Ed.] Science, History and Hudson Bay, Vol. 1, Chap. 7, part 1. Department of Energy, Mines and Resources. Queen's Printer, Ottawa.

_____ Starch in the oceans. J. Fish. Res. Bd. Canada 25(6): 1269-1284.

Grainger, E. H. Invertebrate animals, p. 351-360. In C. S. Beals [Ed.] Science, History and Hudson Bay, Vol. 1, Chap. 7, part 2. Department of Energy, Mines and Resources. Queen's Printer, Ottawa.

Hunter, J. G. Fishes and fisheries, p. 360-378. In C. S. Beals [Ed.] Science, History and Hudson Bay. Vol. 1, Chap. 7, part 3. Department of Energy, Mines and Resources. Queen's Printer, Ottawa.

Mansfield, A. W. Seals and walrus, p. 378-387. In C. S. Beals [Ed.] Science, History and Hudson Bay. Vol. 1, Chap. 7, part 4. Department of Energy, Mines and Resources. Queen's Printer, Ottawa.

_____ [Review of] Terrestrial life of Antarctica. By S. W. Greene, J. L. Gressitt, D. Koob, G. A. Llano, E. D. Rudolph, R. Singer, W. C. Steere, and P. C. Ugolini. Antarctic Map Folio Series 5, New York. American Geographical Society, 1967. Arctic 21(1): 55.

Mitchell, E. D. Date of early Tertiary Arctic opening into the North Pacific. Geol. Soc. America Spec. Pap. 101: 141.

_____ Eastern North Pacific fossil pinnipeds. Dissert. Abstr. 28(12), pt. 1, Zoology, p. 5250-B.

_____ North Atlantic whale research. Fish. Council Canada, Ann. Rev. 1968: 45, 47-48.

_____ Northeast Pacific stranding distribution and seasonality of Cuvier's Beaked Whale Ziphius cavirostris. Canadian J. Zool. 46(2): 265-279. 1 plate.

Appendix II

_____ The Mio-Pliocene pinniped Imagotaria. J. Fish. Res. Bd. Canada 25(9): 1843-1900. 12 plates.

Lipps, J. H., and E. D. Mitchell. Climatic regulation of factors controlling otariid pinniped origins and diversification. Geol. Soc. America, Ann. Meeting, 1968, Program, p. 176 [Abstract].

Lipps, J. H., J. W. Valentine, and E. D. Mitchell. Pleistocene Paleoecology and Biostratigraphy, Santa Barbara Island, California. J. Paleontology 42(2): 291-307.

Fenderson, O. C., W. H. Everhart, and K. M. Muth. Comparative agonistic and feeding behavior of hatchery-reared and wild salmon in aquaria. J. Fish. Res. Bd. Canada 25(1): 1-14.

Pike, G. C. Whaling in the North Pacific--the end of an era. Canadian Geog. J. LXXVI(4): 128-137.

Sergeant, D. E. Preliminary report on Canadian research on harp seals in 1968. Int. Comm. Northwest Atlantic Fish., Serial No. 2057; Res. Doc. 68/70, 4 p.

_____ Tagging beluga whales in Hudson Bay. Canadian Soc. Wildlife and Fisheries Biologists Newsletter 25(1): 14.

_____ Whales, p. 388-396. In C. S. Beals [Ed.] Science, History and Hudson Bay. Vol. 1, Chap. 7, part 5. Department of Energy, Mines and Resources. Queen's Printer, Ottawa.

APPENDIX III

STAFF PARTICIPATION IN SPECIAL ACTIVITIES

(1 April 1968 to 31 March 1969)

Hunter, J. G.	Second National Conference on Northern Research, Whitehorse, Y.T.
	Nineteenth Alaskan Conference, Whitehorse, Y.T.
	American Association for the Advancement of Science, Whitehorse, Y.T.
Kerswill, C. J.	North Pacific Fur Seal Commission, Tokyo, Japan.
Mansfield, A. W.	Symposium on Antarctic Ecology, Scientific Committee on Antarctic Research, Scott Polar Research Institute, Cambridge, England.
Mitchell, E. D.	International Whaling Commission, Tokyo, Japan.
Pike, G. C.	North Pacific Fur Seal Commission, Moscow, U.S.S.R.
Pike, G. C., and I. B. MacAskie.	U.S. Fish and Wildlife Service, Seattle, Washington, U.S.A. (Discussion of cooperative long- and short-term plans for pelagic fur seal research with U.S. and Canadian representatives.
Sergeant, D. E.	International Commission for the Northwest Atlantic Fisheries, London, England.
	University of Rhode Island Marine Station, Narragansett, R.I., to join cruise of their research vessel Trident.

Members of both scientific and technical staffs have been cooperative in responding to numerous requests for lectures and seminars from scientific societies, service clubs, universities, high schools and elementary schools.