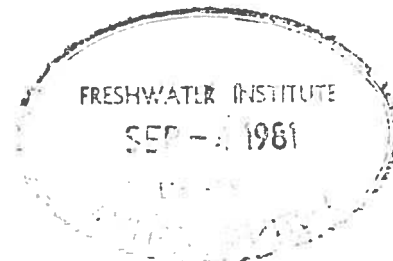


**FISHERIES RESEARCH BOARD
OF CANADA.**



**ARCTIC UNIT,
Montreal, Que.**

CIRCULAR NO. 8.

**THE BIOLOGY AND HUNTING OF BELUGA OR
WHITE WHALES IN THE CANADIAN ARCTIC.**

by

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February 1962

CONTENTS

	Page
SUMMARY	1
BIOLOGY	
Recognition and appearance	2
Relationships	2
General distribution	2
Distribution in Canadian waters	2
Food and feeding	3
Growth	4
Reproduction	5
Social behaviour	5
Movements	6
THE PRESENT FISHERY	
Catching	6
Processing	7
Conservation	8
FUTURE DEVELOPMENT OF THE FISHERY	
Economics	8
Processing	8
Catching	9
Recommendations	10
ACKNOWLEDGMENTS	11
SELECTED BIBLIOGRAPHY	12

SUMMARY

This Circular offers a short account of the biology of white whales (Delphinapterus leucas) and gives some details of their distribution and feeding habits as observed up till now in the Canadian arctic. It recounts the history of the beluga fishery in our arctic waters, outlines the present status and areas of possible expansion of the fishery, and suggests some techniques suitable for this expansion.

BIOLOGY

Recognition and appearance

The beluga or white whale is a dolphin-like Cetacean measuring from 5 to 10 or even 15 feet in length according to age, sex and race. The general form is shown in the Frontispiece photographs: the species is one of those Cetaceans having a ridge in place of a back-fin. The colour is dark brown or dark blue-grey at birth, becoming light grey and finally white in the adult animal; this change is the result of loss of pigment cells in the skin. The flipper is short and wide. In the adult male it becomes rolled up outwards, a character which will separate the old males at a glance, though determination of sex should be confirmed by examination of the genital slit which is placed further forward in the male, with only small vestigial nipples on each side.

Relationships

All beluga are now considered to belong to the same species Delphinapterus leucas Pallas, although there are probably many local stocks or races. The species is not closely allied to the true dolphins and the only close relative is the narwhal Monodon monoceros Linnaeus. Both seem to have been restricted to the arctic by the more successful true dolphins, yet share with the true dolphins a highly developed social behaviour, as well as the ability to produce a wide range of sounds. Some of these are used for communication between the animals, and some as sonar for detecting food and avoiding obstacles.

General distribution

White whales occur throughout the arctic and subarctic, reaching their furthest north at about 80°N, off Ellesmere Island, west Greenland and Spitsbergen, and their furthest south as resident animals in the subarctic waters of the St. Lawrence River estuary, the White Sea, Okhotsk Sea and off southeast Alaska.

Distribution in Canadian waters

The well-known population of beluga inhabiting the St. Lawrence estuary appears to be virtually cut off from the arctic populations, since beluga occur but rarely on the Labrador coast and very rarely off Newfoundland. Occasionally this population sends stray animals south round Nova Scotia to the Bay of Fundy, so that it may itself receive strays from the north. In post-glacial

times when the St. Lawrence was a longer arm of the sea, beluga penetrated at least to Ottawa, and the present population of the St. Lawrence estuary is a relic of these times, surviving in an unusually cold-equable body of water.

On coasts of the Canadian eastern arctic, white whales occur in Davis Strait and Baffin Bay north to at least 80° in Hall Basin in some summers, in Ungava Bay, Hudson Strait and Hudson Bay, Foxe Basin, Lancaster Sound, Prince Regent Inlet, Barrow Strait and Peel Sound (Map 1). In the western arctic they occur in the Beaufort Sea, Amundsen Gulf and McLure Strait (Map 2). The western and eastern arctic whales therefore appear to be separated by some 20° of longitude, the width of Viscount Melville Sound.

Greatest concentrations in summer in the eastern arctic occur in western Hudson Bay, Cumberland Sound, Lancaster Sound and Jones Sound. The first two of these concentrations have long been exploited commercially, while the last two have recently begun to support subsistence fisheries. In other areas of the eastern arctic, numbers are smaller, or not regular from season to season. In all areas, beluga have the habit of concentrating in summer in the estuaries of rivers and streams, some of them quite small.

In the western arctic white whales are reported in summer throughout Amundsen Gulf, while largely transient groups pass along the coast of the Mackenzie delta, concentrating there to some extent.

In the eastern arctic, some white whales are known to winter in western and northern Hudson Bay (though more appear to migrate through Hudson Strait in the fall, presumably returning in the spring), and in the eastern part of Cumberland, Lancaster and Jones Sounds. In the western arctic, white whales are believed to winter in Amundsen Gulf, since they are seen off the floe edge in spring, and appear at all mainland points simultaneously at break-up. Stefansson met with groups in loose ice in May-June west of Banks Island.

Food and feeding

Beluga eat a variety of food in mid-water and at the bottom. Young beluga after weaning feed largely on small bottom-living crustaceans, while older animals change to a diet largely of fish and squid. The movement inshore to river estuaries which is such a feature of

beluga in summer appears to be, at least in part, a migration to feed on shoals of fish. At Churchill at this time, stomachs of adults contain almost entirely capelin Mallotus villosus which spawn just off the river mouth, while cisco Leucichthys species and pike Esox lucius, river fish which pass into the estuary, are eaten rarely, as well as Nereis paddle-worms in years when capelin are apparently scarce. North of Churchill, char Salvelinus alpinus, capelin, small cod Gadus ogac, sculpins Myoxocephalus sp., worms and crustaceans have all been reported. At Cape Dorset, polar cod Boreogadus saida has been identified in stomachs and it is inferred that this fish, which is found in great numbers below floating ice, is an important food in the Canadian arctic. In the high arctic, summer concentrations in river estuaries doubtless seek char, but have not yet begun to compete with man for this resource. In the estuary of the Mackenzie River also, stomachs of the large majority of beluga examined in summer are empty, only a few containing remains of river fish which pass along the coast at the time, while other stomachs contain beaks of squid which must be taken in the oceanic water. In the St. Lawrence estuary, V. D. Vladykov found capelin, sand lance Ammodytes americanus, Atlantic cod Gadus morhua, tomcod Microgadus tomcod and sculpins as the main fish species eaten, with Nereis worms and Illex squid as the main invertebrates. In all areas, mud, sand and stones are frequently swallowed.

Growth

The growth-rate of beluga is not settled. Soviet workers, on the basis of length-frequencies, believe beluga to become white in colour and the females to mature sexually as early as the third year, males in the fourth. The discovery of growth-layers in the teeth has begun to allow accurate age determination; but the rate of deposition of the layers, and hence the absolute age which they represent, has not yet been determined. They may prove to support a growth rate as rapid as claimed by Soviet investigators, or a much slower one.

Whatever the absolute growth rate, male beluga grow to a considerably larger size than females, e.g. to 11 ft (3.3 m) for males as against 9½ ft (2.9 m) for females on average at full growth in the stock sampled at Churchill. This stock is small-sized, few males reaching 13 ft (4 m), while the length attained in the Beaufort Sea is considerably greater, males frequently reaching 15 ft (4.6 m) and females 13 ft (4 m) in small samples. The animals of the St. Lawrence population are about as large as those from the Beaufort Sea, while animals from west Greenland are somewhat larger. Similar differences are known to exist in stocks of beluga in Soviet seas. Animals from the White Sea are smaller than

animals from the Kara Sea and elsewhere in the Soviet arctic, while those in the Okhotsk Sea are the largest of all, males reaching 17 ft (5.2 m) and females 15 ft (4.6 m) in samples of several hundred animals.

Reproduction

Birth takes place over a short season which varies from region to region, beginning in late March in west Greenland and ending in July or August in Hudson Bay. The peak in Hudson Bay is probably in June. In the Soviet arctic the peak becomes later from low to high arctic, and it is probably geared to break-up of the sea-ice. From the size of small fetuses, mating is calculated to take place in spring, so that gestation lasts 13 or 14 months. As in all Cetaceans, there is one calf, rarely two. The length at birth is about 5 ft (1.5 m).

As to frequency of reproduction, material collected in Canada shows a low percentage of females pregnant, a high percentage lactating. In all cases, however, the catches from which study material came selected the larger, older animals and consequently this material is not suitable for accurate calculation of reproductive rate. Some Soviet workers using net-caught material have found more frequent incidence of females simultaneously pregnant and lactating than in Canadian studies, suggesting a calf every two years or sometimes annually. However, in view of the length of gestation, an annual calf can hardly be the rule. Further studies are needed to settle this question.

Until the problems of growth rate and reproductive frequency are settled, the intensity of exploitation which could be borne by a population of given size cannot be assessed. These questions will likely be solved in the near future from study of netted samples and captive animals.

An aerial survey carried out at Churchill in late June 1956, when births were virtually complete but calves of the year could be distinguished from older animals, showed a birth rate of 11.4%. On a similar survey in early August more confusion resulted between calves and older animals, giving possible birth rates of from 9 to 15%, in line with the first estimate.

Social behaviour

Beluga may travel in groups of from 2 and 3 to hundreds of animals. Small groups often consist of a female with calves of different ages. Groups of 10 to 20 often consist of large white males, which in some regions may be found far from the rest of the herds, like males of the sperm whale. Since the beluga is polygamous, and since there is

little difference in age at sexual maturity between the two sexes, there must be a large surplus of males. Consequently a catch selective of the larger animals, comprising chiefly males and the older females, will tend to conserve the stock. Such a selective catch is commonly found to be taken by harpoon, but netting is less selective.

Movements

Difficulties of marking small Cetaceans up to now have prevented direct knowledge of distances travelled by individual animals, and the degree of mixing of stocks. Intensive aerial observations in the Soviet arctic indicate numbers of small groups, each of which makes quite restricted movements throughout the year, and the size variation between adjoining regions discussed above indicates lack of wide-spread mixing. Many groups of beluga winter in relatively ice-choked seas, apparently even in coastal regions where tide, current and wind maintain some open water.

THE PRESENT FISHERY

Catching

Table I shows catches of white whales in arctic Canada in recent years. The total catch in the eastern arctic averages about 1,000, in the western arctic about 200. The catch in Greenland, obtained mainly on the west coast, averages about 1,000 annually. The level of catch in the Soviet arctic at present is about 2,000. White whales are also taken in the Soviet far east (up to 1,000 in some years around Sakhalin), by Norwegian ships at Spitsbergen (a few hundred annually) and at Alaska. Scottish whalers took many hundreds irregularly in the eastern Canadian arctic when bowhead or Greenland whales became scarce in the late nineteenth century.

Hunting in the Canadian arctic in the past has been carried out largely by harpoon, with some netting. In the Mackenzie River estuary, where the water is as shallow as one fathom (2 m), shallow-draft inboard-powered craft capable of about 6 knots are adequate to pursue the whales. In the eastern arctic the water is generally deep, allowing the whales to sound. Here the canoe is the only craft fast enough for chasing, while the whaleboats and decked Peterhead boats are suitable only for casual hunting. At Churchill, large freighter canoes with powerful outboards kept the factory supplied with whales taken within, rarely outside, the river estuary, and smaller-scale whale hunting is carried on with canoes at many other settlements.

At Cumberland Sound up to at least 1936 many herds of white whales were driven into the heads of the inlets and stranded at low tide, much as pilot whales Globicephala melaena are taken in Newfoundland and the Faeroe Islands. This practice was derived from the whalers, who used to drive beluga also in Prince Regent Inlet. It appears to have been discontinued because the whales fell off in numbers.

Nets have been used at many different points. Nylon nets were used experimentally by the Arctic Unit of the Fisheries Research Board at the Belcher Islands in 1960 to take beluga and seals, with considerable success. They have been used more recently, and with equal success, by the Department of Northern Affairs and National Resources in northwest and eastern Hudson Bay. At the Belcher Islands, nets of 14- and 18-inch stretched mesh caught beluga by the head, flippers and flukes and sometimes became badly tangled by the animals' struggles. A 24-inch mesh was used by the hunters at Churchill and took animals as small as 7 ft (2.1 m), but could still become entangled by them.

Processing

The plant at Churchill, built in 1948 and operated till 1960, was the only integrated plant for processing beluga in Canada (See Frontispiece). Winch and cable hauled the whales up a ramp on to a cutting platform, below which lay the cookers for steam-cooking the fat and heads. The oil thus rendered was then centrifuged before storage. The remainder of the carcass was minced in a hogger, and frozen in cartons in a mechanically refrigerated freezer. The meat was used as food for mink in the prairie provinces.

At Pangnirtung, the Hudson's Bay Company operates an oil-rendering plant and the hides are salted for export. The meat is used locally.

Elsewhere, white whales are used for local consumption by Eskimos. They eat the meat and muktuk, which consists of the skin and outer layer of fat, fresh or sun-dried, boiled and re-dried. The oil is used for cooking and mixing with dogfood. The meat is usually dried or preserved in permafrost pits. Recently the Department of Northern Affairs and National Resources has experimented with preserving meat and oil in drums for dogfood. However, a more promising technique has been the development by the Technological Unit of the Fisheries Research Board at London, Ontario, in collaboration with that Department, of a portable reduction plant, the main elements of which are a cooker and press. The cooker may also be used as a dryer to produce a semi-dried meal which when mixed with dry cereal requires no refrigeration. The

prototype of this plant is now under trial in the western arctic for fish and beluga products.

Conservation

Beluga hunting is limited to local residents in the Canadian arctic. Licensing of hunters is under the control of the Department of Fisheries. However, it appears that sport hunting will be permitted on a limited and controlled scale in future, the sport hunter turning the catch over to his guide.

The total catch at Churchill was limited by the Department of Fisheries first to 600, later to 800. This quota was never reached in practice. Similar quotas are placed on local operations elsewhere as needed.

With a 12-year average annual catch at Churchill of about 450 animals, there was no visible diminution of numbers in the local herds, and in spite of considerable selection of large animals by harpooning, no detectable decrease in average size of the more heavily hunted males. In view of the success of this fishery over 12 years, there is a strong suspicion that reports of failure of beluga fisheries over two or three years in the past, both here and in other areas (e.g. Great and Little Whale Rivers), may have been due to natural fluctuations in whale populations due to marginal food supplies, and not to depletion or scaring away of the whales by man.

FUTURE DEVELOPMENT OF THE FISHERY

Economics

The fishery for beluga in the St. Lawrence ended in 1939, supported at the end only by a bounty. The Churchill fishery ended in 1960, apparently because of low oil prices, lack of capitalisation, which prevented installation of more modern machinery, e.g. diesel generators and oil-fired boilers, and the inescapable problem of a short, concentrated catching season. It may thus be concluded that the beluga fishery in Canada is a marginal activity for private enterprise, even at Churchill with its rail link to the south, and that beluga fisheries in the future will mainly be conducted under Government auspices for local benefit.

Processing

The development of a portable reduction plant represents the greatest potential advance in technology for

the fishery in recent times. It appears that such a plant may be mounted on a barge or boat and moved from place to place. Suggestions for expansion of the fishery are based on the assumption that such a portable plant will be used where feasible. Hitherto the main limitation to development of marine mammal fisheries in the Canadian arctic has been the lack of efficient methods of rendering the oil and preserving the meat in summer.

It is assumed that other sea mammals of value for dogfood will be processed as well as beluga. Stocks of walrus and of seals, which are caught in surplus in spring and summer, could not withstand additional hunting but their meat could perhaps be used more efficiently by processing in the same way as beluga. Narwhal where they occur could be used just like beluga. Reduction plants might be moved seasonally from site to site, and areas suitable for their use should be chosen after considering all available sources of supply of raw materials.

Catching

The most suitable method of catching beluga varies from coast to coast, and the methods used do not matter so long as a steady catch can be obtained. The following considerations, however, seem in order:

(a) In the shallow water of the Mackenzie River estuary, hunting can readily be carried out with boats capable of about 6 knots. Improvement of existing boats is much needed here. If boats are to go out for longer than one day, they should be decked boats with cabin space. Netting is useful in windy weather, but improvement of boats will allow not only chasing but also net-tending on more days than at present. The disadvantage of netting here is the rapidity of spoilage after death in the relatively warm estuarine water.

(b) In the deeper waters of most of the eastern arctic, and especially in the windy southern or subarctic half, netting could probably be greatly expanded from its present level. Nylon greatly decreases the weight and drag of the large nets needed, and its higher cost as compared with manilla is offset by its longer life. However, since even nylon nets become torn from tangling of animals and fouling on the bottom, experienced net-mending is still necessary if the net is not to lose its effectiveness. Nets made of galvanised steel wire and cable, as used in the U.S.S.R., may prove to be useful, for these do not tangle as much as fibre nets and can therefore be set for longer periods.

(c) Canoes powered by outboard motor are the only craft fast enough, among those currently used, to run down white whales

in deep water. Also, they alone can be used in rocky river estuaries and shallow bays. A 7-horsepower motor is about the smallest that will allow effective chasing with a 20-foot freighter canoe. The seaworthy Peterhead boat with powered canoe tender forms a good combination for reaching distant catching fields and for tending nets on exposed coasts. From Churchill, Peterheads with canoes in tow have been used to reach the 30-mile distant Seal River where beluga are concentrated in shallow water outside the stream mouth, and this sort of combined operation has been used also in eastern Hudson Bay.

(d) In general, hunting for this small species hardly justifies the use of commercial whaling gear such as the 40-mm harpoon cannon; hand harpoons are perfectly adequate in the hands of skilled Eskimo hunters given suitable boats. Neither does it seem worth while, under present conditions in the Canadian arctic, to advocate the use of the large weirs or seines which are used in Soviet and Norwegian commercial hunting for beluga, since these require large investments in equipment, and a high degree of organisation in their use.

Recommendations

Considering only availability of animals, coastal topography and climate, the following areas are suggested as the most suitable for development of new beluga fisheries or expansion of existing ones:

1. In the western arctic, Kendall Island in the estuary of the Mackenzie River is recommended as the best site for expansion of the present Eskimo fishery, on the grounds that it

(a) is the central one of the three regular catching sites in the estuary, and thus the one least likely to suffer fluctuation in catch due to changes in distribution of the animals season by season,

(b) has the most sheltered approach by river,

(c) has the greatest unused catching field of the 3 sites.

Cape Parry is also recommended as a suitable site for beluga hunting in an area not at present inhabited by Eskimo hunters, (See Map 2).

2. In the eastern arctic, western Hudson Bay offers the best catching field. Within this area, Churchill offers the best site, not only because of its relatively sheltered river

estuary, but also because the season of open water is longer, and more white whales are present longer than at more northerly sites. The industrial fishery here could be reinstated for local benefit by injection of the capital necessary to modernise the factory. Native fisheries along the coast to the northward most likely draw upon the same stock of whales, so that total development should stay within the expected safe quota of 800.

3. In eastern and northern Hudson Bay, in Hudson Strait and in Ungava Bay, white whales seem to be present in small numbers, or to fluctuate in numbers from season to season. Moreover all areas are windy. Expansion of hunting in these areas is probably best served by development of netting for local use of products. It is doubtful whether any local stock in this area could stand up to the relatively intensive fishery that would be needed to feed a processing plant.

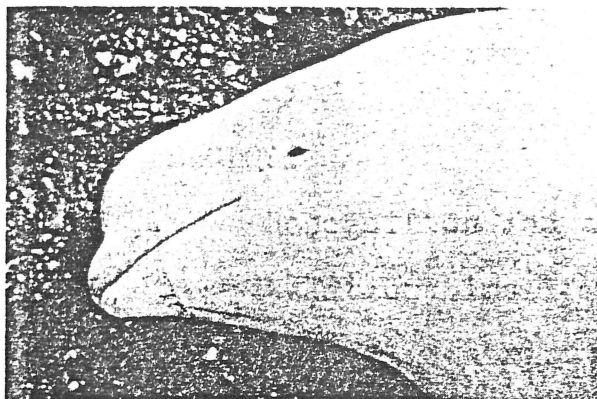
4. In the high arctic, the great numbers of white whales in summer in western Lancaster Sound have allowed increase of catch at Resolute Bay to about 100 annually, presumably enough to meet local demand. Since the ice-free season here is probably too short to justify provision of larger boats to operate further afield, it is suggested that stocks of whales might well be exploited from a new settlement. It is understood that Somerset Island is well provided with land game; the numbers of beluga round it in several successive summers lend support to its suitability for Eskimo resettlement.

ACKNOWLEDGMENTS

The writer acknowledges his debt to a great number of published works on beluga and beluga fisheries. The Selected Bibliography lists many of these. He is grateful also to a number of persons who in unpublished manuscripts, letters or conversation have contributed to the information contained in this Circular. The arrangement and interpretation of this material, and the opinions expressed, however, are entirely the writer's. Particular thanks are due in this way to Messrs T. W. Barry, K. H. Doan, C. W. Douglas, J. G. Hunter, I. A. McLaren, A. W. Mansfield, P. A. C. Nichols, T. M. Nicholl, W. F. Shields, all in Canada; Carleton Ray in the United States, P. Øynes in Norway, and V. M. Bel'kovich in the U.S.S.R. Drs. A. L. Pritchard and O. C. Young kindly criticised the manuscript from the technical standpoint and Dr. N. M. Carter from the editorial side.

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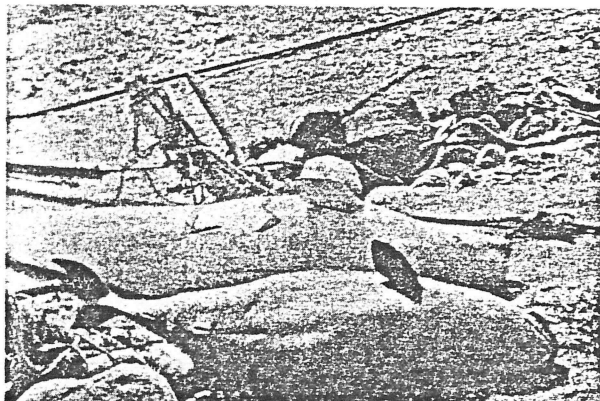
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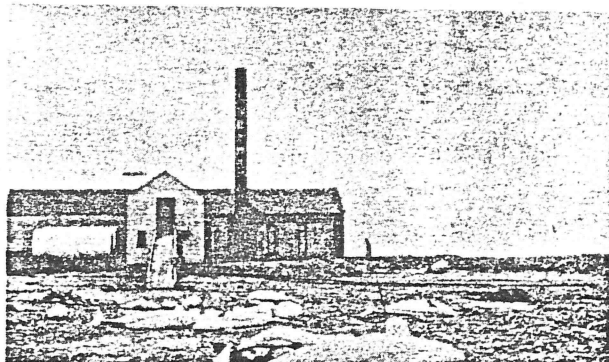
Head of an adult beluga.



Hunters with catch, Churchill, 1955.



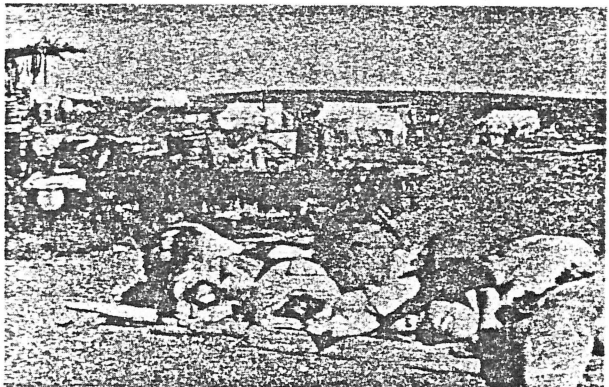
Adult and young beluga, Churchill, 1956. The hunter's initials are carved on the hide to identify his catch for payment.



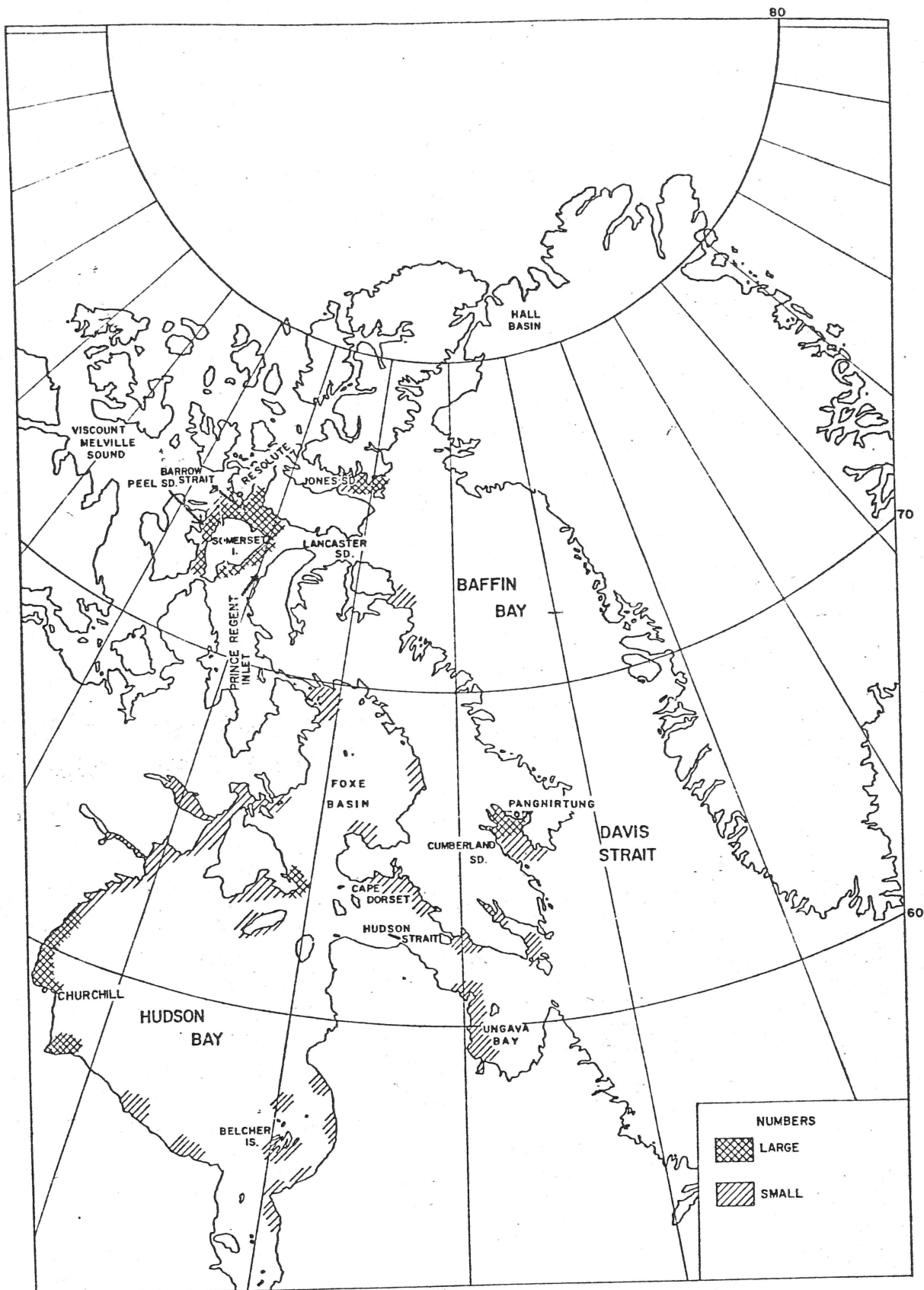
The whaling factory at Churchill, 1956. The ramp up which the whales are hauled leads to the cutting platform with oil cookers below, refrigerated space at left behind oil storage tanks, boilers, coal storage and net loft at right.



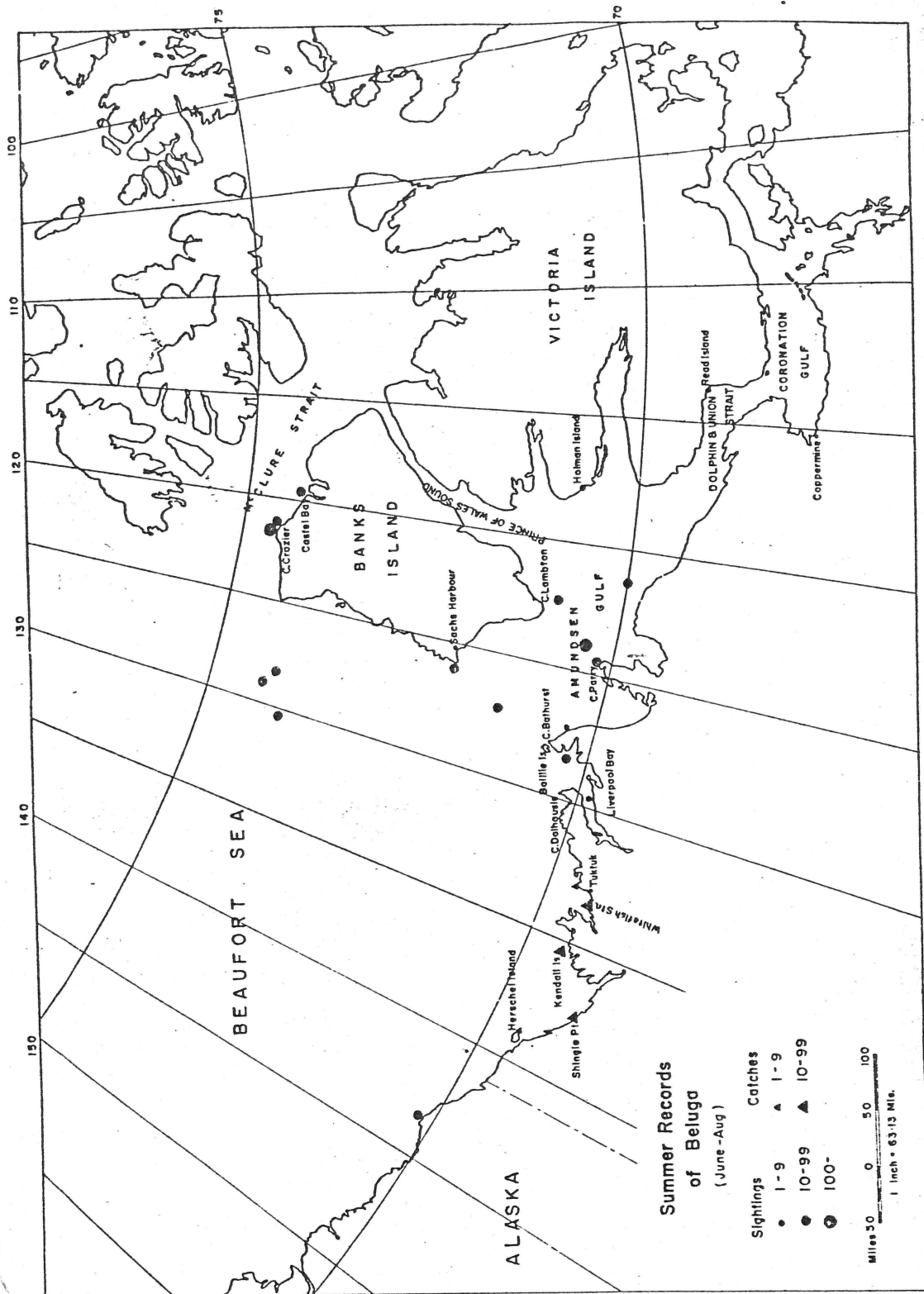
Flensing a beluga, Kendall Island, 1961. The woman uses an ulu, the universal Eskimo woman's knife.



Dried strips of beluga meat, heads and tails, Kendall Island, 1961. A whale net is seen in front of the tent encampment.



Map 1. Summer distribution and abundance of white whales in the Canadian eastern arctic.



Map 2. Summer records from Canadian sources of white whales in the Canadian western arctic and adjoining Alaska.