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of the

International Whaling Commission

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Minke Whales

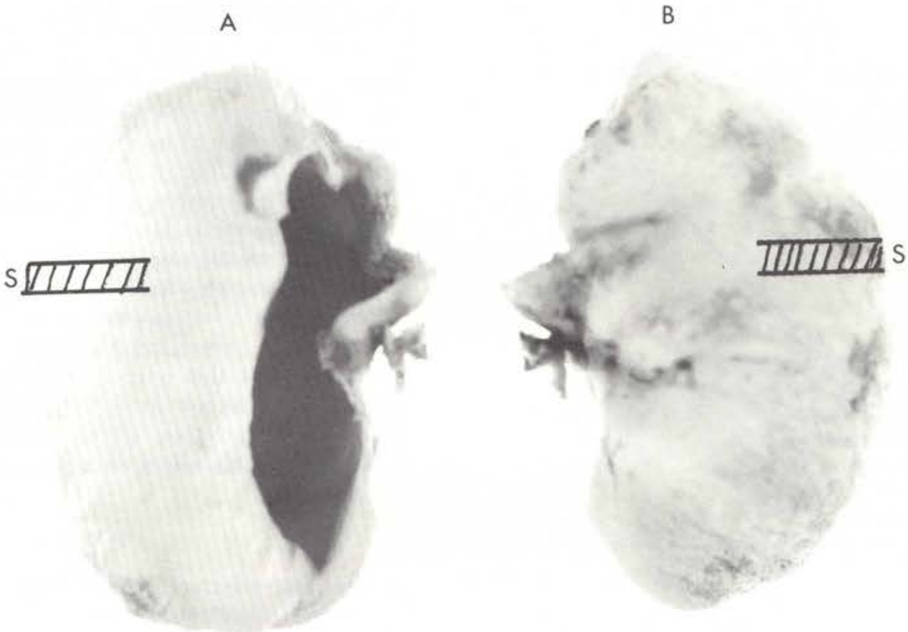


Fig. 1. Tympanic bullae from minke whales shown from (A) the dorsal and (B) the ventral side. Cutting area is indicated at s.

Growth layers in the ear plug

A growth layer in the ear plug consists of two adjacent laminae, one light and one dark. Fig. 3 shows the relationship between the number of growth layers in ear plugs and the number of growth layers in the corresponding bullae tympanica. As shown in the figure, the number of ear plug layers corresponds fairly well with the number of layers in the bullae. A linear regression calculated from these data gives:

$$y = 1.01\ (\pm 0.07)x - 0.73\ (\pm 0.55)$$

where

y = number of ear plug growth layers
x = number of bulla growth layers

The correlation coefficent for the line is $r = 0.89$

Growth in bodylength

None of the animals from the Barents Sea had only one growth layer in the bulla, nor were any newborn calves or near term foetuses included in the material. Bertalanffy's (1938) growth curve as modified by Beverton and Holt (1957) was used to describe the growth:

$$L_t = L_\infty(1-e^{-k(t-t0)})$$

where L_t = length at age t, $L\infty$ = length at age ∞ (physical maturity in mammals), k = growth rate constant, t = age t_0 = age constant.

The available age/length data of animals older than two growth layers (Table 1) gave the growth model shown in Fig. 4a and b. The curves were fitted by eye from birth to two growth layers and for age-groups older than 14 growth

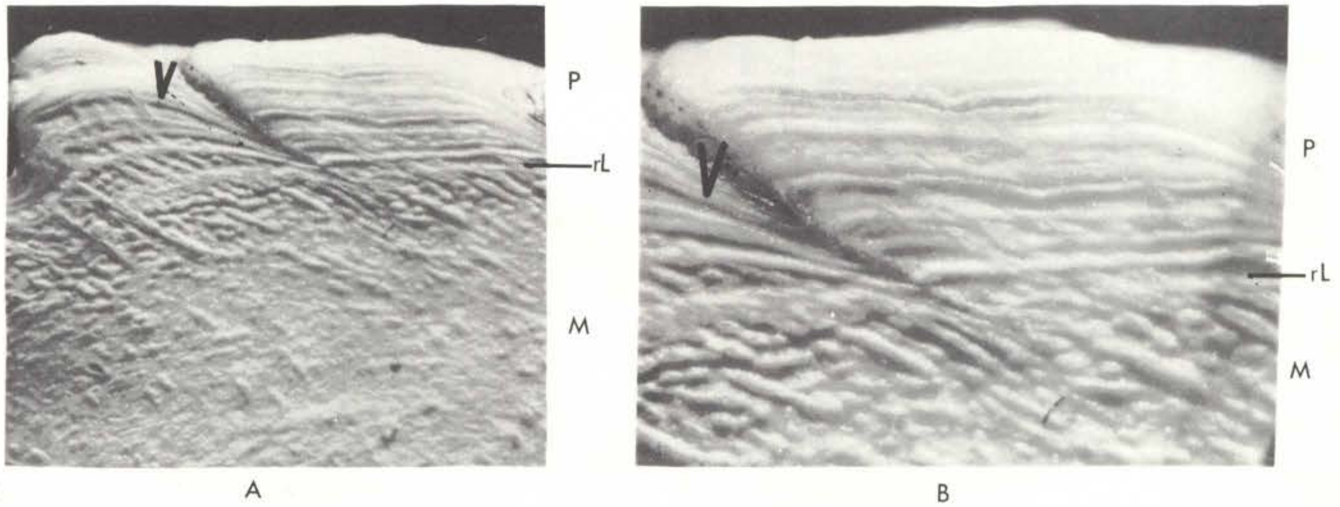
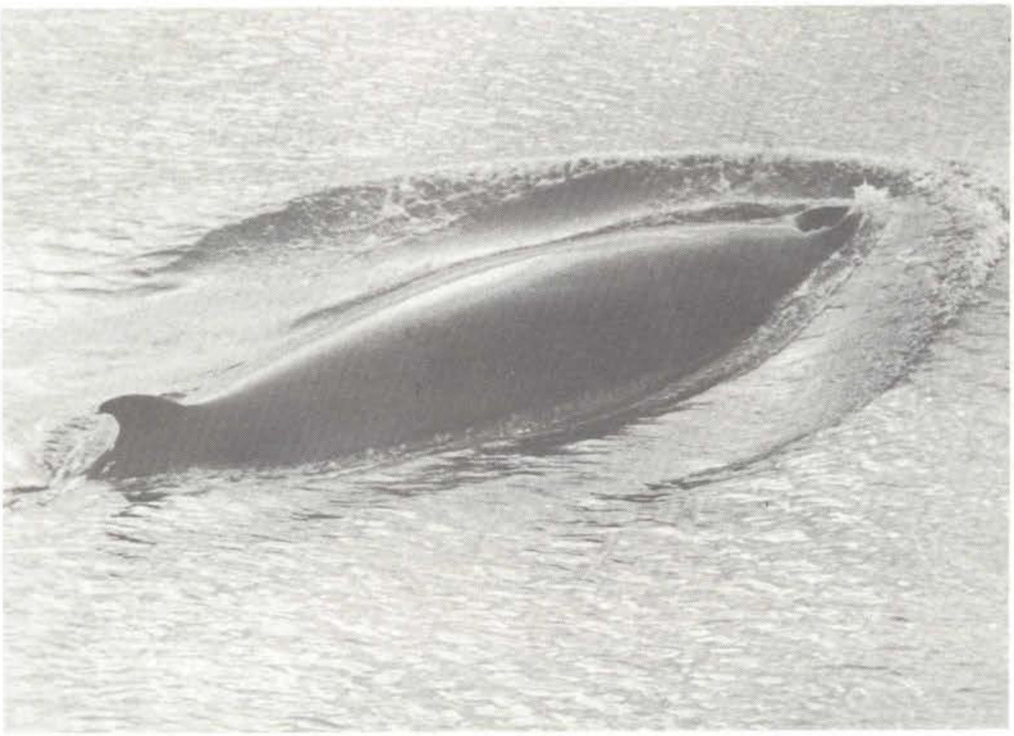


Fig. 2a. Etched segment of a minke whale tympanic bulla showing (p) the periosteal zone, (m) the mesosteal zone, (rl) resorption line and (V) a Volksman's canal. The Haversian system shows up as parallel lines in the mesosteal zone (×12).

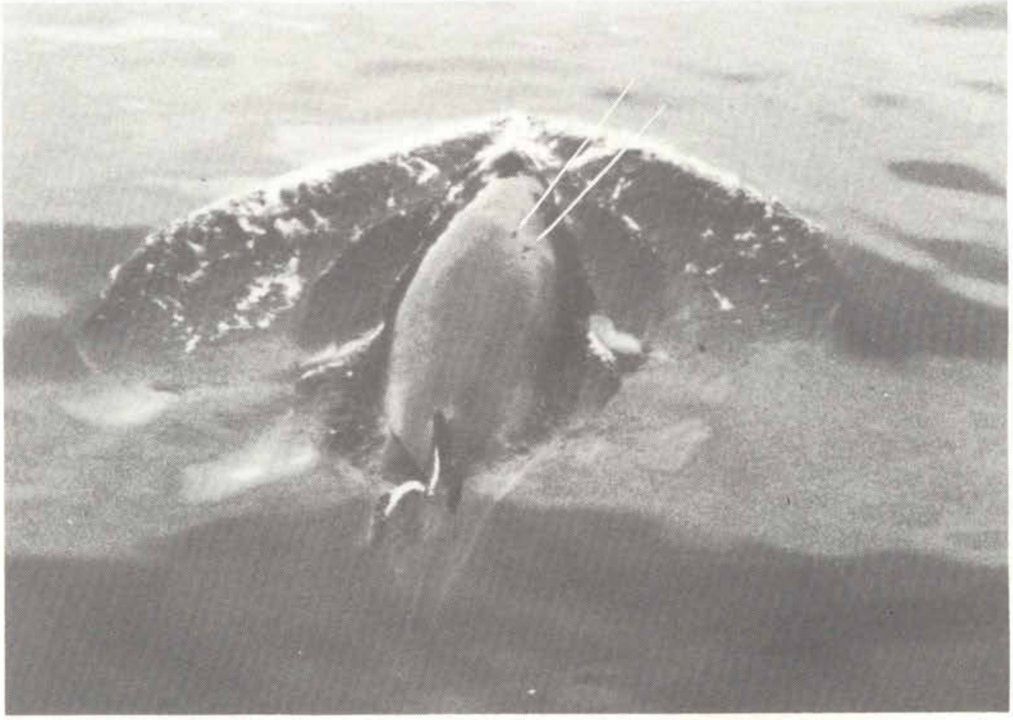
Fig. 2b. 12 ridges and furrows show up in the periosteal zone of the bulla segment shown in (A)(×50).

PLATE 1



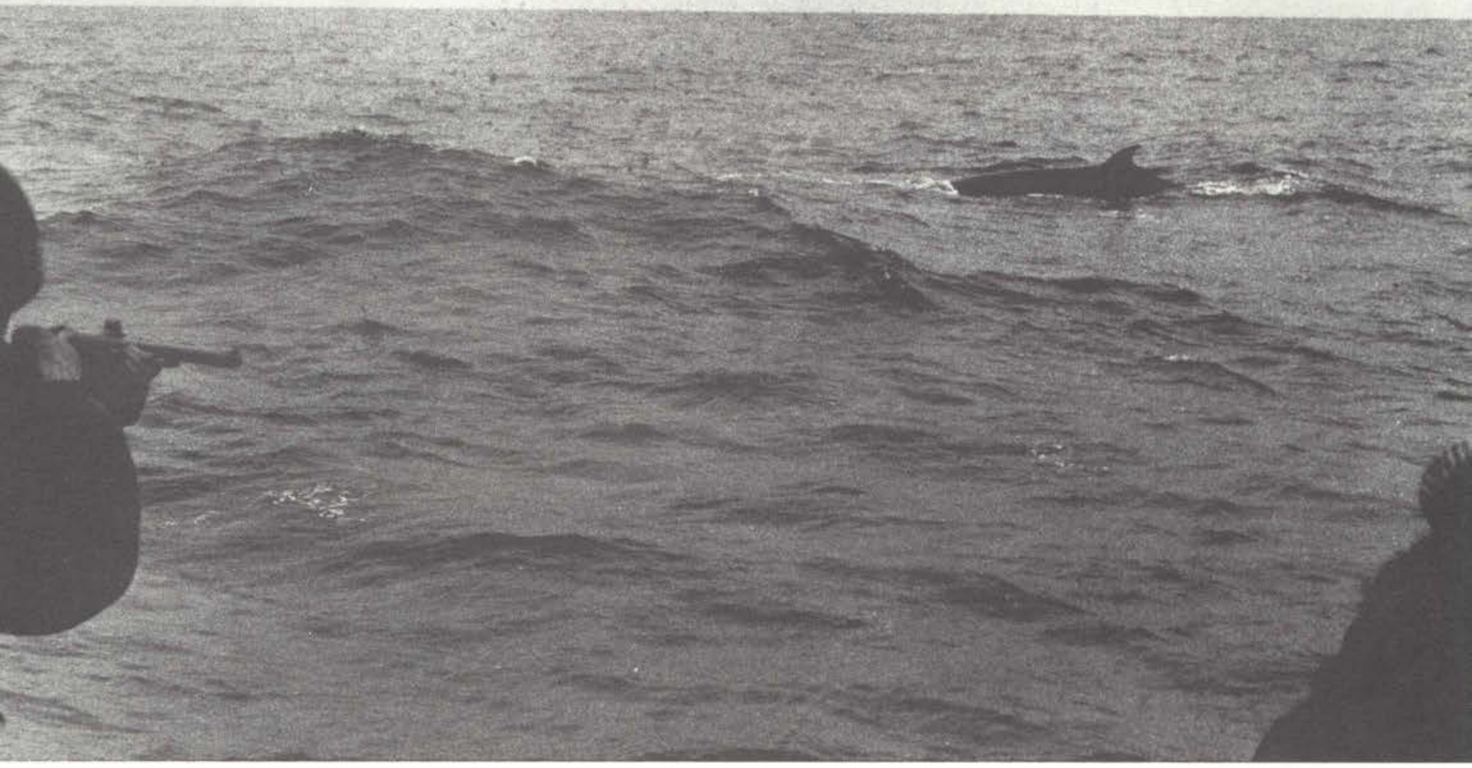
A minke whale swimming at the surface.

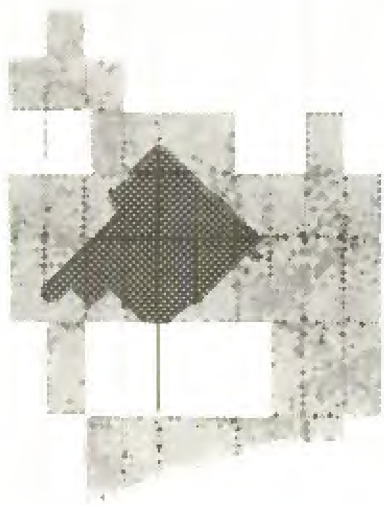
PLATE 2

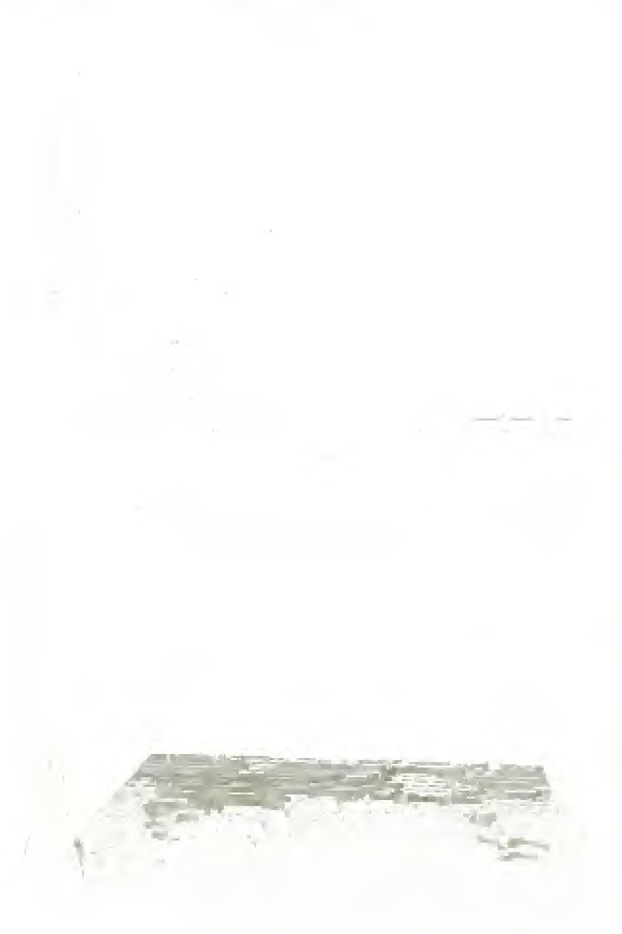


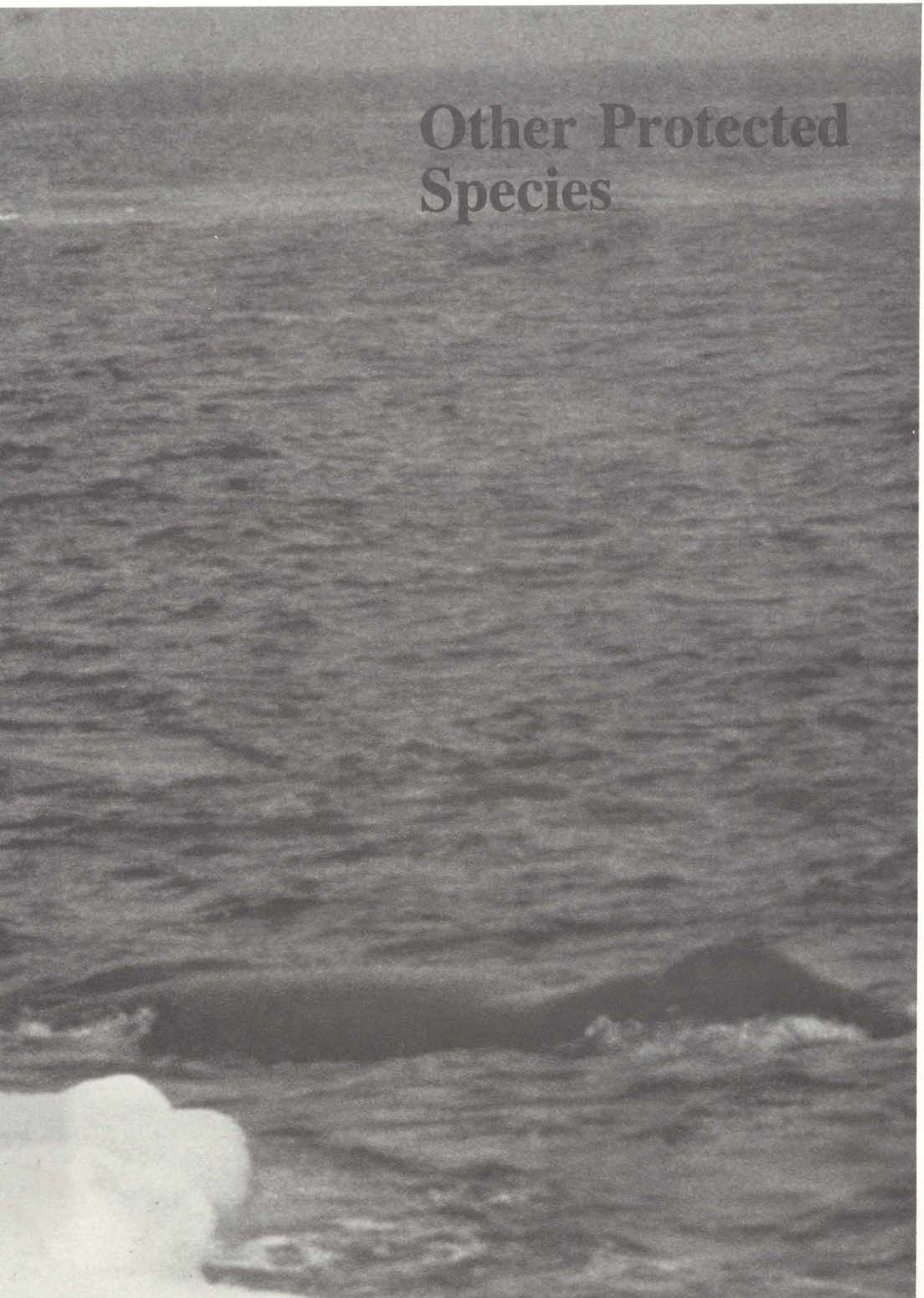
A minke whale that has just surfaced whilst being chased during marking. The white of the flippers is easily seen. This whale was marked on 29 December 1979 at 67°08′S 36°43′E and resulted in two protruding marks. These can be seen just right of the mid-line, anterior to the white stripe. Two other black dots, one immediately anterior to a mark and a second on the mid-line, may be the plastic sheaths of the marks.

Other Baleen Whales








Other Protected Species

reasons caution is recommended in assigning even relative densities to the geographic locations of the sightings. Some apparent feeding behavior was observed. The ship did not remain long enough with any one group of bowheads to establish migratory movement, but results of past Soviet surveys suggest these whales were probably returnees from the Beaufort Sea (Braham and Krogman, 1977).

Small biopsies of skin tissue and blubber were collected from four bowheads by maneuvering the ship to within 25 m of the whale, then launching from a crossbow an arrow with an attached coring tube 70 mm long by 13 mm diameter. Arrow and tube are retrieved with an attached nylon fishing line. A flange at the base of the tube prevents penetration deeper than 70 mm. Analysis of fatty acids contained in the blubber, compared with samples taken in the Alaska Eskimo harvest in May, are expected to show whether fatty acids and lipids change seasonally and help answer questions related to energy storage mechanisms of the bowhead.

Zooplankton samples were collected daily throughout the cruise, and water samples were taken for measurement of particulate organic carbon and chlorophyll-a. Data from these samples will be compared with observed distributions of whales and the several thousand walruses sighted during the cruise.

Autumn 1979 aerial survey

Because of poor weather conditions only one aerial survey was flown during autumn 1979. On 25 September between 1130 and 1550 hours, approximately 650 km were flown by two NMFS biologists from Barrow to Lonely (70°7′N, 153°20′W) and then to 73°30′N along the 155°W longitude line and finally south to Barrow on the 156°W longitude line. The ice front was reached at approximately 73°N, and the heavy multi-year pack ice edge at 73°30′N. No bowheads were observed during the survey. Visibility was fair to poor near the coast and became good to excellent as we reached the ice front.

Approximately 100 white whales (*Delphinapterus leucas*) were observed near 73°30′N, 156°W as a group covering approximately 1 km^2 of open water surrounded by large to medium-sized ice floes. Eighty-seven white whales were seen, including 17 calves, 18 gray-coated (presumably) subadults, and 52 white-coated (presumably) adults. We believe we underestimated the count of calves and gray-coated whales by at least 25–30%. The calves were extremely small, no more than 1/3 to 1/2 the size of adults they accompanied, and were comparable in size to newborns we have seen in the spring. If these were newborns, then calving in white whales must occur from at least April to September.

Spring 1980 aerial surveys

Spring 1980 migration

Although few aerial surveys were flown near St Lawrence Island because of poor flying weather, some information regarding the migration near there was obtained from Eskimos. The timing of the spring migration near St Lawrence Island did not appear different from past years. But whales were reported as being farther offshore than usual near Gambell and greater numbers of whales appeared off Southwest Cape than anytime during the past decade.

Of significance was the delay in the spring migration at the Bering Strait because of heavy ice blockage. Bowheads were prevented from moving northward until 13–16 May when a narrow lead finally opened. Leads were intermittent throughout April and May from Point Hope to Barrow but apparently only a few whales moved north past these villages before late May. Two bowheads were reported off Kivalina about 19 April. Two blows from whales were reported by Eskimos from one whaling crew at Barrow on 29 April but no other whales were seen in either area until 20 May.

The Bering Strait just north of the Diomede Islands was completely covered with medium to thick ice until 13 May (Fig. 6). Persistent wind from the north and northeast was reported as stronger than usual. From 5–7 and 12–13 May we systematically surveyed the area from approximately 10 km south of Little Diomede Island due east to the Alaska coast and north to the ice edge. The greatest number of bowheads observed in the area in one day was on 12 May when 90 whales were counted.

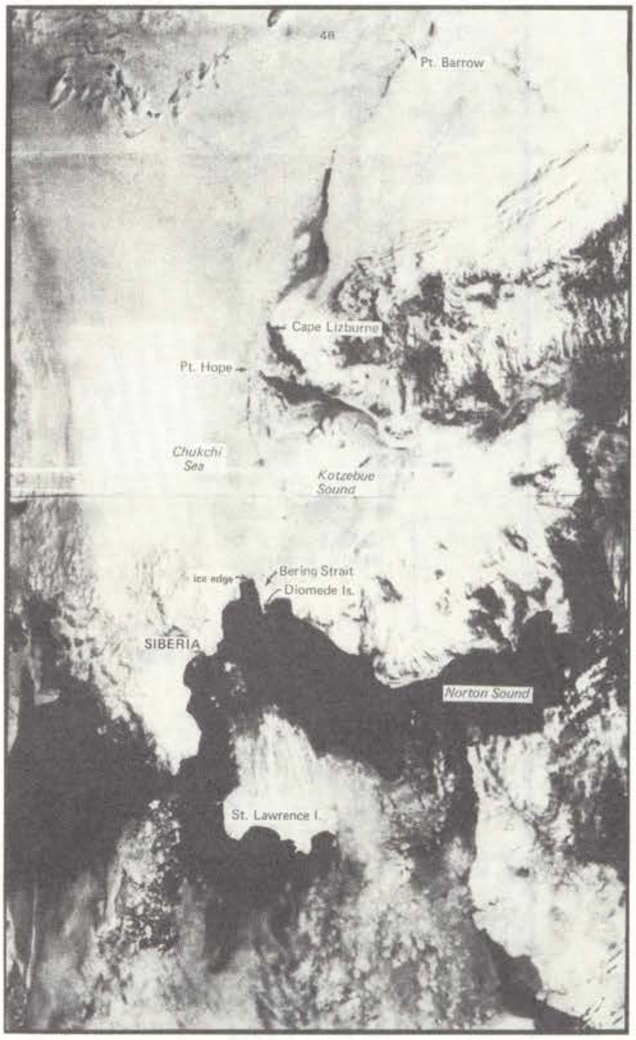


Fig. 6. NOAA satellite photo image of the northern Bering and southern Chukchi Seas, taken at 0900 on 5 May 1980. The dark areas are open water or thin, refrozen ice, and the light areas are ice or snow-covered land masses. Clouds partially obscure Kotzebue Sound.

We also obtained permission to fly into Soviet territory where we surveyed south from the ice front to determine the distribution of bowheads in the western portion of the Strait. On 12 May approximately 82 bowheads were counted, making a total of approximately 172 bowheads seen on one day from the ice edge to 10 km south. Almost

searched for whales, always keeping within sight of each other. When a whale was sighted, 2–3 boats only would try to approach the whale. The time this approach took depended on the behaviour of the whale and the experience of the hunters. The aim was to cut the whale off from the open sea and drive it towards the coast. If the approach was a success the whale was harpooned with a hand harpoon to which several buoys were attached. It was at this stage that firearms were usually first used, although if a large whale was seen the whalers might try to wound it first with a gun to weaken it before hand harpooning and then finishing the whale off at close range.

Naukan whalers were famous for their skill and fearlessness in whaling. The hunting team consisted of seven: the team leader, the harpooner, his assistant and four sailors. Usually five crews in their own boats went out whaling together, all the time searching for whales. As soon as whales were sighted the boats began to chase the nearest whale. Usually all boats chased the same whale which would try to remain under water for longer, coming up to the surface to blow and rapidly trying to dive again. To successfully wound a whale the boats had to approach to within 3–4 metres of the animal. Each boat would in turn approach to within this distance and harpoon the whale. Up to 5–10 buoys were attached to the line to help to keep the whale to the surface, interfering with its movements and making it less manoeuverable. The whalers continued to chase the whale, firing a volley from each boat, ideally trying to hit its head. Sometimes hundreds of shots were required to kill the animal.

This type of hunting was difficult and dangerous and required a good deal of experience and care. It was not a rare occurrence for whaling boats to be upturned and broken by a whale before it was harpooned. The attempts of other boats to render them help might be too late or even be impossible depending on the behaviour of the whale. Native whalers believed that the touch of the palm of the hand to the skin of this whale would calm the animal which would then swim away. It was because of these dangers that motor boats began to accompany the whaling boats to ensure the safety of the whalers.

The gray whaling season usually started in June and lasted until the ice set.

The use of seiners

During the 1950s, seiners were introduced to make harvesting easier and more safe. Hand harpoons were still used although the home-made *pykh pykh* was replaced by factory buoys made of rubberized tarpaulin and the leather line was replaced by a thinner, synthetic rope. The factory buoys were lighter, could be pumped with air while at sea and required no special drying after use. Firearms were used and in the late 1950s large calibre rifles were introduced.

The use of firearms

Any hunting method which involved the use of firearms caused a large number of animals to be wounded, many of which were lost. Under the operational conditions it was not surprising that not all shots hit the ideal position—the head; bullets often hit the body, the majority of which did not pierce the blubber. The introduction of large-calibre rifles in the late 1950s increased the number of injured whales and in some cases fatally wounded whales were lost. Although whaling techniques had successfully been improved over the years, the problem of lost and injured whales remained. As a result of this, the harvesting of whales by whaling boats and seiners using hand harpoons and firearms was stopped.

Present method

Since 1969 the Chukotka collective farmers have chartered a modern catcher boat thereby eliminating the problem of struck and lost animals and relieving the people of a rigorous and dangerous job.

Fig. 2. Hand harpooning a gray whale.

Fig. 3. Use of rifles in gray whaling.

Fig. 4. Towing a gray whale to shore.

Small Cetaceans

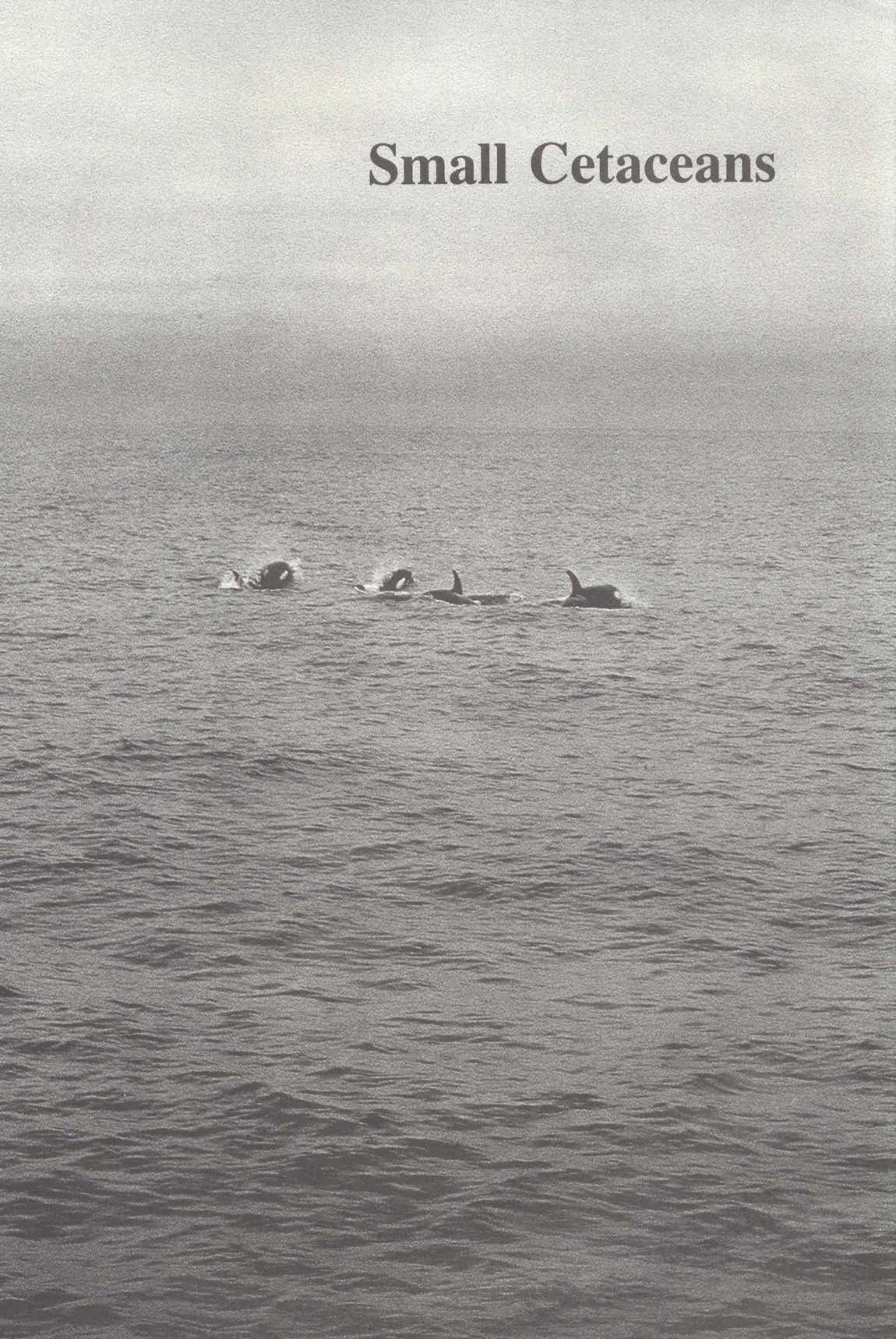


Table 1

Food organisms found in the stomachs of common killer whales taken in temperate and Antarctic waters

Prey species	Occurrence (%) in stomachs	Author	Notes
Temperate/warm water zone (30–50°S)			
Dolphin	47.3	Shevchenko, 1975	30 stomachs, killer whales taken in March–April
Pinnipeds	20.1	Shevchenko, 1975	
Fish	42.1	Shevchenko, 1975	
Cold waters (south of 50°S)			
Minke whales	84.2	Shevchenko, 1975	49 stomachs, killer whales taken in November–March
	70.0–85.0	Doroshenko, 1978	
Dolphins	100	Our materials	Killer whale taken in April to the north-west of the Bouvet Island
Pinnipeds	45.4	Shevchenko, 1975	Killer whale taken in February in the immediate proximity of Enderby Land
Fish	6.8	Shevchenko, 1975	
Squids	2.3	Shevchenko, 1975	

killer whales on sperm whales (65%), fin whales (53.4%), sei whales (24.4%) and minke whales (6.4%). Shevchenko believed that the small number of minke whales taken with killer whale teeth marks was a consequence of their lack of success in escaping attack rather than because they were attacked less often. As is evident from direct observations, killer whales can attack large whales (e.g. Berzin, 1971: Zemsky and Budylenko, 1973), however many of these larger whales manage to escape.

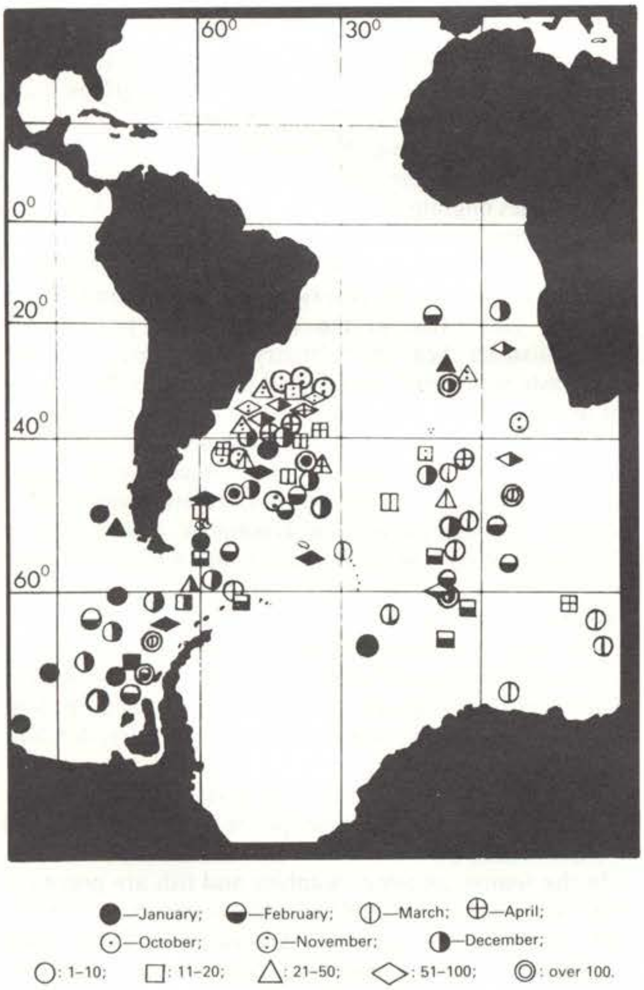


Fig. 1. The data on the killer whale distribution in the southern Atlantic.

All these facts are indicative of a certain trend in killer whale feeding behaviour and thus killer whale concentrations can be expected to be associated with aggregations of minke whales, dolphins and pinnipeds. If this is true, then the timing of the killer whale migration should coincide with that of the minke whale.

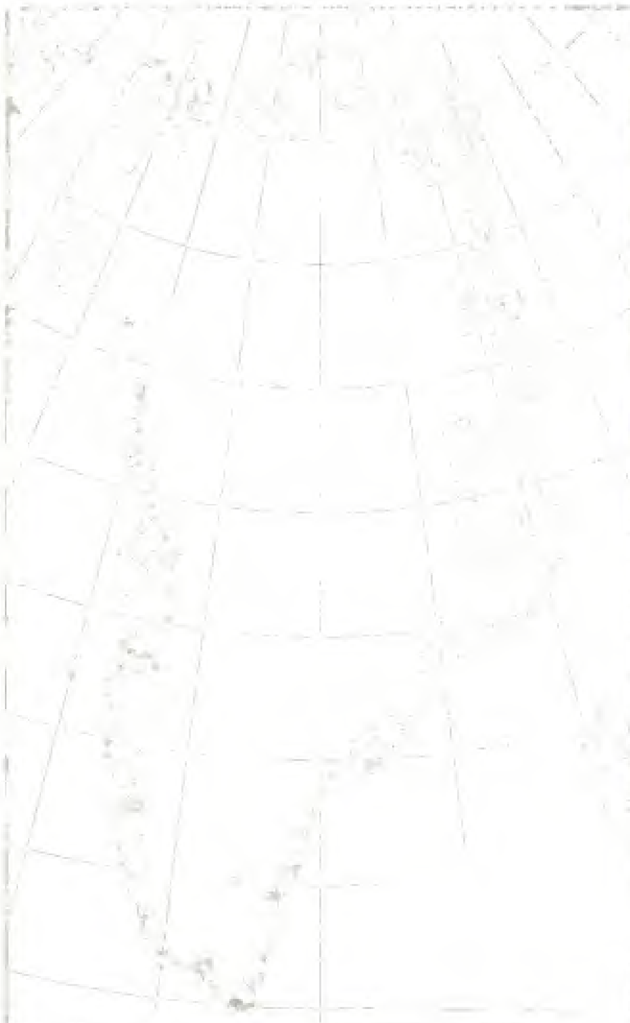
According to Doroshenko (1972), small groups (30–40 animals) of minke whales begin to arrive in the Antarctic waters in late November–early December. Simultaneously, groups of killer whales numbering 10, 20 and 50 animals begin to arrive. Larger killer whale groups of 100 or more can be observed with the increasing numbers of minke whales in January. With the decrease in minke whale abundance in the high latitudes of the Antarctic in late March due to their migration to the temperate waters, the number of killer whales is also reduced.

The southwestern Atlantic area, where killer whales form relatively stable and sometimes large concentrations, is of special interest. Observations made between latitudes 40°S and 50°S in this area in November–January (Budylenko *et al.* 1973; Budylenko, 1975; Budylenko, 1978), revealed stable concentrations of sperm whales, sei whales, pilot whales, common dolphins and other cetaceans feeding on *Calanus*, fish and cephalopods. This area also includes part of the main minke whale migration routes (Budylenko and Pervushin, 1975). Considerable killer whale aggregations have been reported from the same area (Fig. 1).

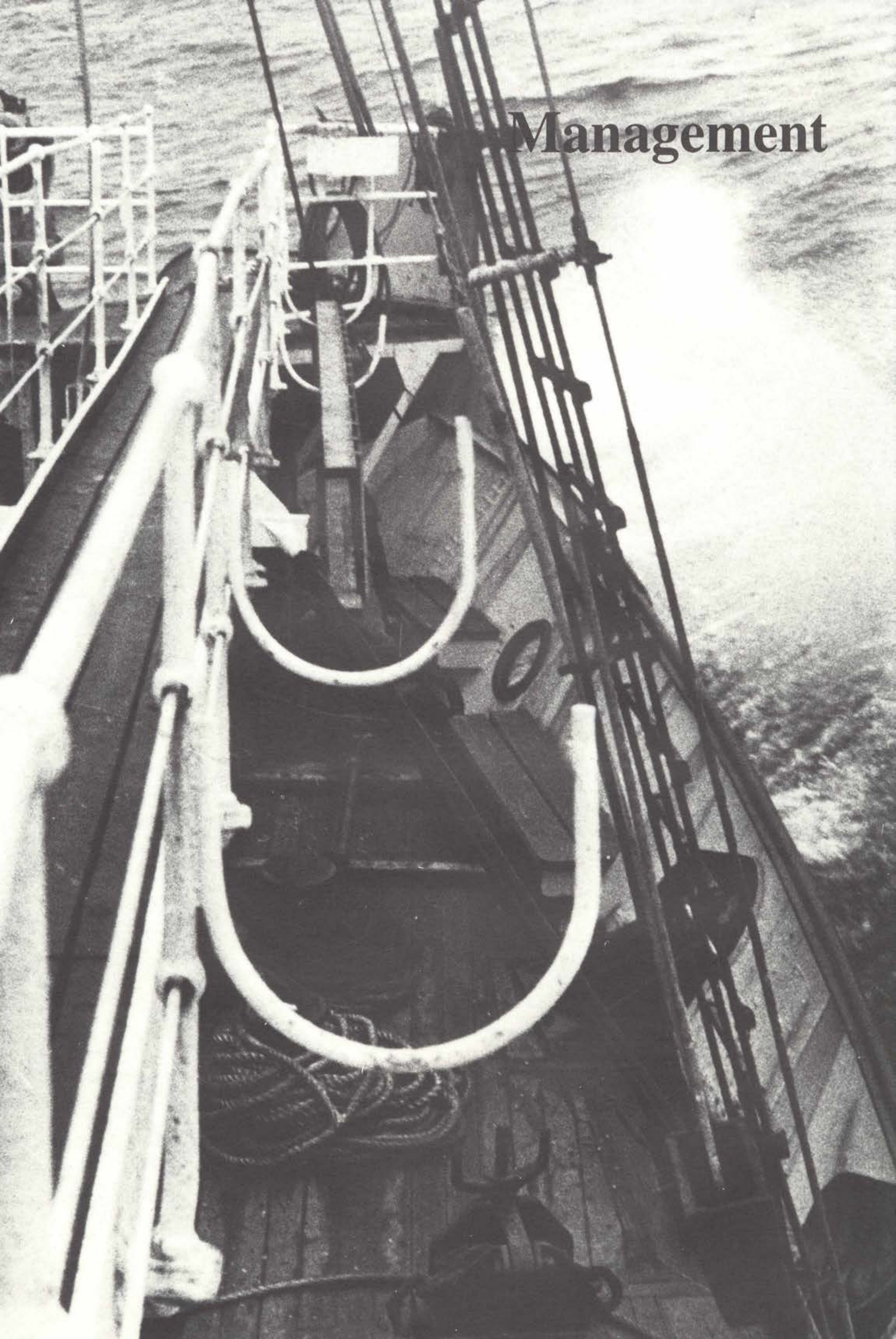
In areas of cetacean and pinniped concentrations, killer whales form groups (schools) of various sizes. According to some investigations (e.g. Sleptsov, 1965; Shevchenko, 1975; Doroshenko, 1978), killer whales assemble in schools from 6–10 to 30 animals, although, occasionally, they form aggregations numbering 200–400 or more in Antarctic waters.

A study of the literature yields no information as to the frequency of occurrence of killer whale groups of different sizes or the causes of their varied occurrence. Our observations have shown that killer whale groups of 10 animals are the most common (55.0%), and are apparently based on a family unit. Groups of 10–20 animals were the next most common (15%) followed by groups of 20–50 and 50–100 (10 and 11% respectively). Groups of 100 or more animals were far from common.

When speaking of such large groups of killer whales it should be noted that within these large groups, smaller



Management



Other

Fig. 2. A bowhead whale being worked up aboard the *Maud* of Dundee in Davis Strait, July 1889. One of the whale's flippers has been hoisted above the deck, across which large chunks of meat are scattered. In the 1889 season the *Maud,* under Captain William Adams, captured 3 large bowheads in Davis Strait, yielding 60 tons of oil and 50 cwts. of baleen (Lubbock, 1937, p. 421). Photo courtesy Public Archives Canada, No. C–88347.

to 1814, he added 2,000 whales to his total commercial catch for all years and all areas between Alaska and Greenland.

Two volumes by the Danish historian Finn Gad (1971; 1973) are useful in documenting the 17th century whaling and trading activity in West Greenland. In 1656 the Dutch trader Nicholas Tunes made a noteworthy voyage to West Greenland, returning with 'several loads of unusually long whale bones' as well as 'a number of narwhal tusks,' the latter deemed the most valuable part of the cargo (Gad, 1971, pp. 255–6). It is of course difficult to be sure that these were taken by the native Greenlanders from caught, rather than drift, whales. In 1636 another Dutchman, Joris Carolus, had returned from West Greenland with some narwhal ivory but no mention of whalebone (p. 232). There was some whaling by Dutchmen off West Greenland in the 1620s, but there is little indication of frequent visitation by the Dutch until late in the century. However, in 1673 a Bergen ship captained by a Dutchman was sent to Davis Strait, and the captain was said to have visited Davis Strait 15 times theretofore. This implies that traffic may have been more regular than available written statements suggest (p. 311). A Danish–Norwegian whaling and trading permit was issued in 1670, and a Norwegian actually set sail in 1673 or 1674 with the intention of establishing a whaling station in West Greenland (p. 312–3). A 'more or less regular and modest barter trade' was established in West Greenland by the Dutch in 1670 (De Jong, 1978, p. 14). Whale blubber and baleen were among the products sought by Dutch merchants. This trade declined in the mid-18th century as Denmark consolidated its trade monopoly. Much of the record is confused by the fact that 'Greenland' was an appellation shared by both the Spitsbergen/East Greenland area and the Davis Strait/West Greenland area.

Ross (1979) stressed that the 'smug, self-confident appearance' of the numbers in his catch tables could 'suggest a degree of accuracy that is entirely unwarranted.' His figures certainly represent no more than a minimum estimate of the catch. In his summary he fails to mention the whale products secured in trade from the Greenland Eskimos by Danish–Norwegian merchants throughout the 18th century. A quick reading of Gad (1973) uncovered evidence (i.e. blubber and baleen landings) to indicate that at least 15 whales, almost certainly bowheads, were taken between 1723 and 1748 in West Greenland by the Eskimos on behalf of the traders. The Greenland Eskimos preferred to trade with the Dutch during this period, so it is possible that the actual aboriginal catch (to be traded commercially) was considerably higher. Of course, some, possibly most, of the whale products traded to the Dutch could have shown up in the returns on the Amsterdam Lists used by Ross (1979) and in van Sante (1770).

Other portions of the catch that are left out of Ross's (1979) analysis are the whales struck and lost by the whalers, and the oil and baleen from landed whales that ultimately sank or burned with lost vessels. For example, Ross's table shows a total of 161 whales landed in 1830. In that year the whalers were within sight of large numbers of whales in Lancaster Sound, and many were struck and lost (Tillotson, 1869). Even those that were secured often failed to be brought on board due to changing ice conditions and heavy swells. The *Juno* was wrecked and burned with a cargo of 36 whales, shortly after which the crew of the *Traveller* helplessly watched 'some forty' bowhead carcasses drift away with the fast-moving ice. Clearly the number of whales killed in 1830 was much higher than 161. In 1830 there were 91 British ships in Davis Strait; 19 of these were lost (Lythe, 1964). Aberdeen lost 12 ships between 1813 and 1835 (Pyper, 1929). In 1834 alone, 6 of the 8 Hull ships sent to the northern whale fishery were lost; in 1821, 10 of 61 were lost (Monroe, 1854). Between 1819 and 1843 at least 82 ships were lost at the Davis Strait fishery (Lubbock, n.d.). Although some are known to have had 20–50 tons of oil on board, the average cargo lost per ship may be estimated as 10 tons of oil and 10 hundred-weight of baleen (Lubbock, n.d.).

Among the complexities of trying to ascertain the catch more accurately is the fact that the Eskimos often used part of a carcass, then traded what was left to European traders or whalers. So the amount of oil and baleen secured from the natives may in some cases not reflect the total kill. It is not always clear whether a given quantity of oil or baleen obtained in trade from the natives has been counted in, for instance, the Amsterdam Lists, although it would probably be fair to assume in most cases that it has. For example, in 1750 the natives of Egedesminde, West Greenland, caught 21 whales along with more than 1,000 belugas in a *savssat* (Gad, 1973, p. 405). This would be a significant addition to the total European catch of 60 bowheads listed for that year in Ross's Table 3. However, Gad indicated that the blubber and baleen were in this case traded to the Dutch, so there is a good chance that these were included in the calculation by which Ross arrived at his figure of 60 whales killed for 1750 (or 71 for 1751) (Ross, pers. comm., 16 January 1980).

Another portion of the Davis Strait fishery often overlooked in catch summaries (e.g. Ross, 1979) involves the Danish factories established along the west coast of Greenland between 60°N and 73°N. These developed during the early to middle 1700s as an outgrowth of trading activity and colonization attempts (Gad, 1973). By 1860 only one station remained in operation (at Holsteinsborg), although during at least some percentage of the previous century the whaling had been very profitable at most of the factories (Eschricht and Reinhardt, 1866, p. 4).

We know of no attempt to extract whaling statistics in a systematic way from records of the Danish fishery at West Greenland. According to Eschricht and Reinhardt (1866, p. 4), the 'annual reports, sent down to the Colonial Department at Copenhagen, will be found to contain, not only statements about every single whale killed, or lost after having been harpooned, but most commonly also, of those which were observed from the look-out rocks, even though the weather did not permit the boats to put to sea.' If these detailed records have not been lost or destroyed, they surely would provide a useful addition to existing compilations. Narwhal and beluga catches should be extracted simultaneously, a practice which unfortunately has not been followed by most whaling historians to date.

Catch history (Hudson Bay stock)

We have not gone beyond the analysis of Hudson Bay whaling presented by Ross (1973, 1974). However, we would stress that his derived estimate of 688 whales taken in the Bay between 1860 and 1915 is probably conservative. It does not include whales struck and lost, and does not account for cargoes lost in shipwrecks and other disasters.

Elsewhere (Mitchell and Reeves, in press) we have reviewed whaling efforts in Hudson Bay and Davis Strait subsequent to the period investigated by Ross (1974, 1979). It is our belief that continued opportunistic whaling by Eskimos and others in the Eastern Arctic after 1915 has inhibited the bowhead's recovery there (Fig. 3). The whaling tradition was especially persistent in northern Hudson Bay, where natives at Southampton Island, Coats Island, and Cape Fullerton continued to hunt bowheads with gear left behind by American and Scottish whalers. More recently, settlements in Foxe Basin have been particularly active with captures and attempts at capture being made sporadically at the least through 1976 (Figs 4 and 5).

Fig. 3. One of two bowhead whales killed within an hour near Cape Fullerton, southern Roes Welcome Sound, in 1919. Photo by W. O. Douglas, courtesy *North/Nord* magazine.

Cumulative catch estimate (Davis Strait/Baffin Bay)

Although the catch history is still incomplete, Ross's (1979) work in British and Dutch archives allows us to re-evaluate the cumulative catch estimate made by Mitchell (1977 MS) for the Davis Strait bowhead stock. Mitchell identified the period 1729–38 as the peak of the Dutch fishery at Davis Strait, based on good published documentation, and Ross's Table 3 is in agreement on that point. However, Mitchell assumed that the Dutch fleet of 975 ships (968 according to Ross) represented only 60% of the international Davis Strait fleet, an assumption that allowed him to extrapolate to a total of 1,625 voyages to Davis

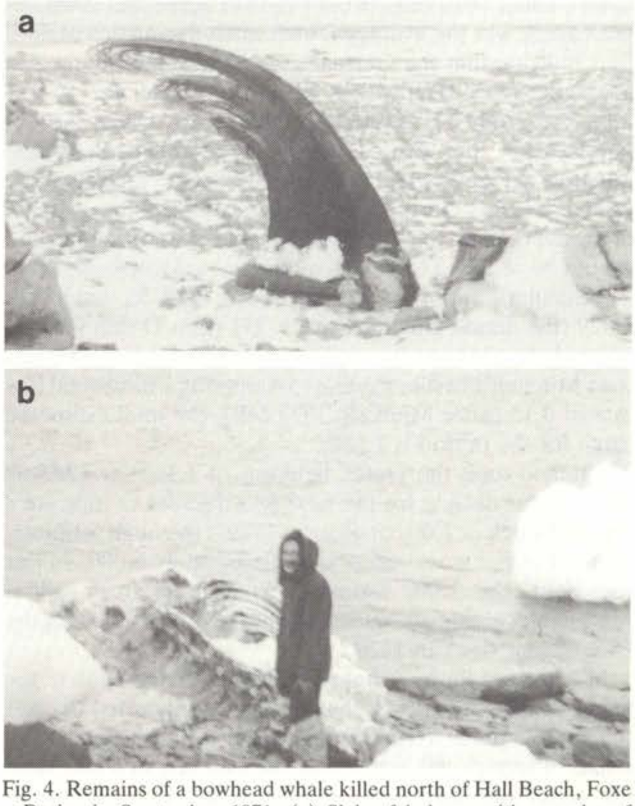


Fig. 4. Remains of a bowhead whale killed north of Hall Beach, Foxe Basin, in September 1971. (a) Slab of baleen, with a cache of muktuk to the right. (b) Skeleton, flensed of meat and blubber. Photos by Dr. Mary Lobban, courtesy Father G. Mary-Rousseliere.

Fig. 5. Skull of a bowhead whale killed by the Inuit of Jens Munk Island, northern Foxe Basin, in 1965. Four families and their 35 dogs consumed the skin, meat, and blubber of this whale during a period of more than one year. Photo by F. Bruemmer.

Strait during the peak decade. Ross's total of German vessels at Davis Strait for this period is 71 ships (a figure corroborated by De Jong, 1977). He did not attempt to estimate the size of the American fleet at Davis Strait in this period. According to Clark (1887a), however, the first American vessel was sent there in 1732; in 1736 there were 'several'; and in 1737, 50–60. A reasonable guess at the number of American voyages might be 100 for the decade. If we add 100 more to account for the Danish fleets, then the total of whaling voyages for the period is 1,246 (rather than 1,625).

Mitchell also assumed that the average catch per voyage was roughly equal for all countries. Based on the calculated catch of 2 whales per Dutch voyage, he multiplied the number of vessels by 2 to arrive at an estimated total landed catch. Although Ross's figures agree that 2 whales per voyage was the average Dutch catch during this period, they indicate that the Germans were much less successful, averaging considerably less than one whale per voyage (also see Table 1). As for the Americans, Clark (1887a) implied that they were not very successful in their first attempts at Arctic whaling due to their usual arrival on the grounds too late in the season. Surely Mitchell's estimate of the average catch per non-Dutch vessel was too high and should be reduced to 1. Using this new information, then, a recalculation of the total catch for 1729–38 would be: 1,929 (the actual Dutch catch) + 271 (non-Dutch vessels) × 1 (whale per vessel) = 2,200 whales, or about 1,000 less than Mitchell's earlier estimate. Assuming a moribund loss rate of 0.15 (after Mitchell, 1977 MS), the total estimated catch for the period is 2,588.

Mitchell took the Dutch landings of 1,162 for 1739–48 and 900 per decade for the next two decades to indicate a residual stock of 2,000 or more in 1739. His rough estimate, then, of initial stock size was approximately 6,000. In our judgment, the 2,000 estimate for residual stock still is reasonable, giving a revised estimate of 4,500–5,000 for the Davis Strait stock in 1729.

Mitchell recognized that there was a second peak in the fishery in the 1820s after the whaling fleet learned to clear the 'middle pack' to reach northwestern Baffin Bay and its adjacent sounds. He noted that the estimate of 6,000 'does not cover the entire stock area.' Using the statistics in Leslie *et al.* (1835), he estimated an annual catch, mainly British, of 648 per annum for the period 1815–34. Although this estimate was made by pro-rating the total catch for the period on the basis of the ratio of voyages to Spitsbergen vs. Davis Strait, it is very close to Ross's mean annual catch for the same period (717), based on the Kinnes Lists and Hull Lists, which give actual landings for the two fisheries separately.

Using Ross's data for the peak decade of this 19th century British-dominated fishery centered in Baffin Bay, we have calculated a new cumulative catch estimate for the stock. The period 1825–34 was the most productive ten years, yielding a total landed catch of at least 8,510 whales. It should be noted that during the ten years preceding this period, 5,831 whales were taken, and in the ten years following, 1,141. The catch definitely fell off dramatically after 1834, as the following decade-by-decade summary indicates:

1835–44	1,141 whales
1845–54	1,177
1855–64	1,133
1865–74	1,081
1875–84	707
1885–94	169
1895–1904	111

Correcting the peak 10-year catch to account for a moribund loss rate of 0.15, the cumulative catch estimate for the population in 1825 is approximately 10,000 whales. Adding a residual stock of 1,000 gives a conservative revised minimum estimate of approximately 11,000.

Assuming that the Davis Strait/Baffin Bay population is a single stock, how do we explain its apparently 'fished out' condition in the late 18th century and the great catches in Baffin Bay during the two decades after 1814? An important change in the sailing schedule took place as the British grew to dominate Arctic whaling in the last half of the 18th century. The British sailed to the grounds earlier than the Dutch had, arriving often before the ice had begun its spring breakup and recession in earnest. Perhaps, as De Jong (1978, p. 23) asserted: '. . . by leaving early they (the British) captured nursing and immature Greenland whales and slaughtered them in great numbers before the animals escaped into the densest drift ice in the north.' Had the first intensive, Dutch-dominated episode only affected a non-reproductive component of this bowhead population?

Gray (1939) argued along such a line. He believed bowhead migratory behavior to differ according to age class and reproductive condition. Young whales and 'breeding females' presumably press north and west into Lancaster Sound as early as possible. Since the whalers did not regularly clear Melville Bay and the 'middle pack' until the 1820s, the young and productive components of the population were for the most part spared during the peak fishing period of the 1700s. Even after the grounds on the west side of Baffin Bay were 'opened up', many young whales were able to 'escape' westward among sounds and inlets of the Canadian Arctic Archipelago—except in what Gray called 'close seasons'. In 1823, 1832, 1833, 1845, 1884, 1889, and 1893 there was what the whalers called a 'land-floe across', when the mouths of Lancaster Sound and Pond Inlet were blocked by ice. The catch in such years was characterized by a high number of whales and a low oil yield, i.e. young whales were relatively well represented.

Had there been a hiatus in whaling effort, there would be a case for arguing that the stock recovered and, as in the case of the gray whale (*Eschrichtius robustus*) in the eastern Pacific (Ohsumi, 1976), that the earlier whaling episode had a less severe effect on the stock than is

Fig. 8. One of Captain J. E. Bernier's whaling stations near Pond Inlet. Bernier was an important figure in the narwhal trade at Pond Inlet between 1912 and 1918. Photo courtesy Public Archives Canada, No. C–10972.

Pond Inlet and that rivalry for the trading allegiance of local natives was acute. The HBC post journal entry dated 14 April 1923 mentions that two natives had 'about 180' narwhal tusks at their camp which they intended to hoard until the following winter. Munn (referred to as 'the Opposition') apparently was trying to get the Eskimos to trade these tusks to him, but the HBC manager reminded them that 'they [had] already promised [the tusks to] us' (HBC Archives, B.465/a/2, Fo. 22).

Munn's importance to the establishment of a commercial narwhal hunting industry in northern Baffin Island is indicated in the following extracts from an early Hudson's Bay Company report dated 1923 (HBC Archives, D.FTR/15, Fos. 258–70):

'. . . it is essential to operate the Narwhal industry, so as to successfully compete with our competitors. . . .'

'Even now our opponent [Munn] keeps about a dozen families of Eskimos around his place, feeding them all winter without working, or hunting, merely so as to have them for hunting Narwhal in the Spring.'

'The Narwhal industry has been developed by the whalers almost to its limit, in fact this is the item on which they depend almost entirely, and Furs are merely a side issue. *Five or six hundred Narwhal would be considered as only an ordinary year's hunt* [our italics], the Oil, Ivory and Skins of which would be worth approximately $18,000. There is, I understand a special market in Peterhead for Narwhal skins and that they are finally sold in France for making very fine gloves. Narwhal oil is of equal value to the oil of the ordinary whale, while the horns fetch three times the price of walrus tusks, or about $1.00 per pound. This is an industry which we would rather leave for the present and concentrate on furs alone, but as it is the main support of our opponent, it is imperative that we interest ourselves in it and endeavor to take as much of it as possible, so as to eventually make it not worth our opponent's while to continue coming to the country.'

'Considering the present market for Oil and other Narwhal products, and the quantity of these annually obtained by our competitor, amounting to about $10,000 at the market valuation, which costs them roughly seven or eight thousand dollars, I do not see how it is possible to continue business on a profitable basis.'

'Our anticipated returns per annum for the next three or four years may not exceed say . . . thirty tuns oil and one hundred Narwhal skins.'

The Company's efforts to squeeze Munn out of business were successful, and in 1923 he sold all his Arctic holdings to them (Munn, 1932; White, 1977). From then until the establishment of Eskimo-run cooperatives during the early 1960s, the HBC enjoyed a *de facto* trade monopoly in the North Baffin region.

Hudson's Bay Company records

Trading post journals of the Hudson's Bay Company provide one of the few sources of information about narwhal hunting in the Canadian Arctic after 1923 and prior to 1953 (when the RCMP Game Reports began; see Mansfield *et al.*, 1975, and our Table 3). Although the data in these journals are incomplete, they do provide certain useful impressions concerning the magnitude and character of the hunt, utilization patterns, loss rates, etc. We should stress that journal entries were made at the discretion of the diarist, and they probably describe a small fraction of the events—e.g. sightings, kills, losses, unsuccessful hunts, etc.—that would be of interest in this study.

There are 16 extant journals for the HBC post at Pond Inlet. These cover the years 1921–39. The Pond Inlet post has been active continuously since 1921 (Usher, 1971). Narwhal catch and sighting data from available journals are presented in Table 5.

The narwhal fishery at Pond Inlet clearly was active in 1921, and some of its products, including oil, hides and tusks, were traded to the HBC (and see Mathiassen, 1928, p. 35). Although a detailed description of hunting methods is lacking, it appears that these were similar to recent or present-day practices (as described by Wilkinson, 1955; Kemper, 1980; and Finley *et al.*, 1980).

Sinking losses appear to have been significant. Of the eight entries that mention numbers killed, two also note sinking losses. In one case, one of two killed whales was retrieved; in the other, one of 'several' killed was landed. These admittedly fragmentary observations are consistent with loss rate estimates made by Mansfield *et al.* (1975), Kemper (1980), and Finley *et al.* (1980) based on present-day hunts.

The capture of one narwhal in a seal net is noteworthy,

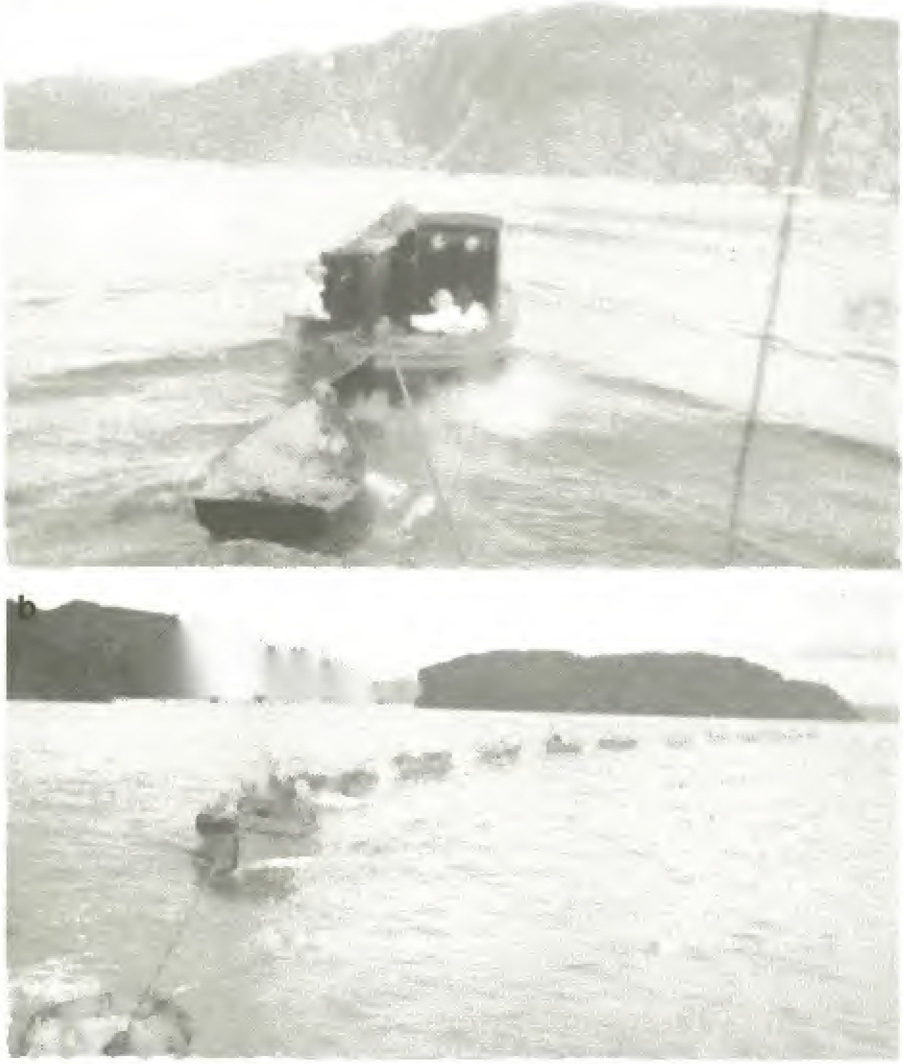


Fig. 12. The Pangnirtung processing plant in operation, August 1, 1929. White whale products are being hauled up the ramp by a team of men, while women and some men prepare the blubber for cooking. Note that the man immediately behind the leader of the hauling team in the photo (a) is the left-most individual in the photo (b) on p. 669. Photos by L. D. Livingstone, courtesy Public Archives Canada. Nos. PA-102680 and PA-102682.

at Durban Harbour on the outer coast of Cumberland Peninsula north of Cumberland Sound (Usher, 1971). It is not clear that this post would have acquired significant amounts of beluga products. However, the Kinnes station at Kekerton, established in about 1915, probably did. In 1922 the *Easonian*, Kinnes's supply ship, burned and sank at the head of Cumberland Sound, apparently while involved in a white whale drive (Harper, 1974). The HBC journal entry for August 18, 1922, refers to 'the Kikkerton schooner [being] up at "Kingua" waiting to make a drive of whales at next high tide' (HBC Archives, B.455/a/3, Fo.13). It was customary for this vessel to 'take on the produce collected during the winter's trading by the local company agent, and engage in some white-whaling near the head of the sound before heading back to Scotland prior to freeze-up' (Harper, 1974). In September 1923 there was a consignment of about 26 porpoise half-hides (skins from *c.* 13 white whales) shipped out of Cumberland Sound (Netchilik Post) by the Hudson's Bay Company's *Nascopie* on behalf of the Cumberland Gulf Trading Co., which was run by Kinnes (HBC Archives, Unclassified Documents).

The third active trading concern in Cumberland Sound during this early trading period was the Arctic Gold Exploration Syndicate under Henry Toke Munn (White, 1977; also see Narwhal 'Catch History' section). Munn bought Kinnes's Durban Harbour station in 1914, and in approximately 1918 he established a post called Oshualuk (spelled variously) near the head of Cumberland Sound (Usher, 1971). Munn had diverse interests, and there is little doubt that his company traded in beluga products.[1] There is evidence that he organized his own white whale drives. During the drive conducted by the HBC in 1923 (see below), for instance, the Pangnirtung post manager expressed concern about 'the opposition' (meaning Munn) getting to the whales first. On 6 August 1923 he noted in the post journal (HBC Archives, B.455/a/4, Fo.10): 'The natives tell us that the opposition at Ooshooalik [Oshualuk] has made three attempts to get whales at Kingoa [Clearwater Fiord] and Ooshooalik but failed. They are now out of ammunition.'

1921–39

During the early 1920s the Hudson's Bay Co. eliminated competition for Baffin Island trade and established a near-monopoly (Usher, 1971; White, 1977) which lasted in Cumberland Sound until 1965 (Anders, ed., 1967, p. 55). Stations were established at Blacklead Island (1921–36?), Livingston Fiord (1924–25), Sirmilling Bay (=Clearwater Fiord) (1921–25?) and Pangnirtung (1921–present) (Usher, 1971). In addition, the HBC bought out Munn's interests at Oshualuk in 1923 and operated his station as an outpost of Pangnirtung until about 1933. Kinnes's Kekkerten Island post was bought out in 1923 and maintained for about two more years. Although the Sabellum Company's post near Cape Mercy lingered until 1927, by that time it was in financial ruin and prepared to sell what little was left of its holdings to the HBC (White, 1977).

The late summer white whale drive became a regular feature of the yearly cycle at the Pangnirtung post (Fig. 11). In addition to several published accounts describing these hunts (Soper, 1928; Anderson, 1934; Stewart and Kwee-enna, 1940; Ruskin, 1972; Copland, 1974; photos in Millward, ed., 1930, pp. 24–5), information is available in the 15 extant journals of the Hudson's Bay Company post at Pangnirtung, covering the years 1921–39 (HBC Archives, B.455/a/1–15). This organized drive un-

Sperm Whale