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**A REVIEW OF THE DISTRIBUTION, MIGRATIONS, FOOD, REPRODUCTION,
EXPLOITATION AND PRESENT ABUNDANCE OF HUMPBACK WHALES (MEGAPTERA
NOVAEANGLIAE) IN THE NORTHEAST ATLANTIC**

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ABSTRACT

Most available knowledge about northeast Atlantic humpback whales (Megaptera novaeangliae) is based on information and experience gained during the pioneer period of modern whaling in Norwegian waters in 1868-1904 when almost 1,500 animals were taken. A literature review reveals that these humpbacks stayed in their northern feeding areas during most of the year (May-January), migrating out only during a short period in spring for breeding purposes. Recent incidental sightings data confirm these migration patterns. Seemingly, euphausiid crustaceans were their main prey items when they arrived in Norwegian waters (mainly in the Bear Island area) in late spring, whereas capelin (Mallotus villosus) became more and more important throughout the season when the humpbacks proceeded eastwards into the Barents Sea. The collapse in the Barents Sea capelin stock may have contributed to a reduction in these eastwards autumn migrations after 1985. The humpback's breeding migration in early spring were observed to be directed westwards from the Barents Sea and towards the Norwegian Sea, but the migration routes and the localisation of the breeding areas were and are still unknown. Between 1904 and 1955, when the humpback was given total protection in the North Atlantic, less than 50 humpbacks were caught in Norwegian waters. The number of humpbacks in the northeast Atlantic has probably never been large. Results from more extensive sightings surveys in 1988 and 1989 seem to indicate a present abundance of about 1,000 humpback whales in Norwegian and adjacent waters.

INTRODUCTION

Humpback whales (*Megaptera novaeangliae*) are distributed in all world oceans. It is fairly well known that their general seasonal behaviour includes feeding during spring and summer, and fall travelling to a winter range over shallow tropical banks where they calve and do not feed (Winn and Reichley, 1985). This seems also to be the case for humpbacks in the North Atlantic where, however, both the stock identities and wintering grounds are rather unclear and unresolved (Mitchell and Reeves, 1983; Balcomb, 1984; Katona, 1986).

Over the past decades scientists and resource managers as well as the general public have all been increasingly interested in the ecology and status of whale stocks, including also the stocks of humpback whales. Certainly, the controversies connected with whaling activities have contributed to this development, and have also encouraged the application of benign research methods, i.e. methods that do not necessarily imply that the whales have to be killed to be studied. A project using such methods (in particular individual identification from photographs and genetic analyses based on biopsy samples) is now being prepared for the study of humpback whales in the North Atlantic (YONAH: Years of the North Atlantic humpback whale; suggested to be running in 1992 and 1993). The YONAH program will include an overall umbrella with coordinated sub-projects suggested to cover the entire North Atlantic area. Thus, it is assumed that Norwegian scientists take responsibility for the coordinated studies of the eastern North Atlantic humpback whales.

Benign study methods have already been applied to humpback stocks in the western North Atlantic, whereas no such efforts have been made in the eastern parts (Winn and Scott, 1981; Katona, 1986). There are, however, some biological information available also from the northeast Atlantic humpbacks in the literature. As a first Norwegian contribution to the planned YONAH program we therefore find it appropriate to present a review of this information which is mainly drawn from experience and samples collected during humpback hunting which took place in Norwegian waters in the period 1881-1955. Furthermore, data from recent incidental sightings from various sources and from sightings surveys conducted in the North Atlantic in 1987-1989 are presented in order to attempt to evaluate the status of abundance of humpback whales in the eastern North Atlantic.

MATERIAL AND METHODS

Biology and exploitation of the northeast Atlantic humpback whales have been reviewed from available literature.

Incidental sightings of humpback whales in the actual area have been recorded at the Institute of Marine Research (IMR), Bergen, since 1968. The sightings are drawn from various sources: IMR research vessels (30% of the total number of sightings), inspectors on certain small type whaling vessels (21%), reports from fishing and small type whaling vessel crews (46%), and reports from coast guard vessels (3%). These reports, entered into IMR computer files and continually updated, include all or some of the following information: observation date and position, school size and additional comments about activity and behaviour. The information given in this paper is drawn from these IMR computer files. As there are no quantitative information on the effort involved in searching for marine mammals, the data from incidental sightings cannot be used for estimating trends in abundance. Nevertheless, such incidental sightings, recorded on opportunistic basis, appear to yield useful information on distribution. A preliminary presentation of the incidental humpback sightings was given by Christensen (1985).

Line transect surveys have been conducted in Norwegian and adjacent waters each of the years 1987-89. Minke whales (*Balaenoptera acutorostrata*) was the target species of these surveys but sightings of other species were recorded as well. In this paper is included abundance estimates based on the survey carried out in July 1989. Standard line transect analyses have been applied where hazard-rate detection functions have been fitted to sets of perpendicular distance data to estimate effective search-widths. Abundances, N , have then been calculated as

$$N = (n/L) (1/w) (s) (A)$$

where n/L is sighting rate, w is effective search width, s is mean school size and A is the area of the block surveyed. For further details and information on block structure, see Øien (1990).

RESULTS AND DISCUSSION

Distribution and migrations

The geographic range of the humpback whale in the North Atlantic extends from the Arctic to tropical regions (Jonsgård, 1966). Stock identification of the North Atlantic humpbacks seems rather unclear

and unresolved, although it is acknowledged that several feeding substocks may exist (Mitchell and Reeves, 1983; Balcomb, 1984; Katona, 1986).

From analyses of catch statistics throughout the season, Ingebrigtsen (1929) suggested that humpbacks in the northeast Atlantic stay in their northern feeding areas during most of the year, migrating out only during a short period in spring for breeding purposes. During these migrations to the breeding areas, the humpbacks were frequently encountered in January-March, coming from their wintering areas along the edge of the pack ice in the southeastern Barents Sea and moving westwards very close to the coast of Finnmark before proceeding into the Norwegian Sea (Collett, 1912; Ingebrigtsen, 1929). In the last decade of the previous century humpbacks were said to occur frequently off the coast of western, to a certain extent also southern Norway in winter (January-April) in connection with the large abundance of herring (see Collett, 1912), whereas this seemed not to be the case after ca. 1920 (Ingebrigtsen, 1929). Ingebrigtsen (loc. cit.) suggested that the disappearance of humpbacks off western Norway during winter might be due both to heavy exploitation and to the increase in motor and steam boat traffic in the herring fisheries in the area. It was suggested that the humpbacks would return seasonally to Norwegian and adjacent waters in May, usually first in the waters around Bear Island (where they preyed upon available euphausiid resources), later also in coastal waters off Finnmark (Hjort, 1902; Ingebrigtsen, 1929). From Bear Island and Finnmark, the humpbacks would then proceed further north and east later in summer (August) to the areas between Spitsbergen, Franz Josefs Land and Novaya Zemlya, or towards the edge of the ice in the Barents Sea where they stay during the period September-January, feeding on the shoals of capelin. The occurrence of humpback whales in the Arctic regions during the whole winter in the Northeast Atlantic contradicts observations in other Arctic and Antarctic regions, and may be attributable to the plentiful abundance of capelin in the Barents Sea (Jonsgård, 1966). Ingebrigtsen (1929) emphasized that it was probably mainly the adult whales who took part in the breeding and feeding migrations as described above, whereas the younger animals were presumably more erratic in their (very little known) migrations.

There are as yet no certain evidence of either the migration routes to or the localisation of the breeding areas of the northeast Atlantic humpbacks. Due to the scarce occurrence of the species along the more southern coasts of the eastern North Atlantic and also because of recovery of an American bomb lance in a humpback whale caught off Finnmark in 1899, it has been suggested that humpbacks in the northeast Atlantic may constitute a feeding aggregation of the stock breeding further west in the North Atlantic, and that the migration route is through the Denmark Strait (Collett, 1912; Ingebrigtsen, 1929).

No certain evidence of the calving area exists, although Ingebrigtsen (loc.cit.) presumed that it might be located in an area not far from Ireland. Photoidentification studies of humpbacks in the western North Atlantic suggest the existence of several feeding substocks (including one in the Denmark Strait) which migrate to common breeding grounds at low latitudes in the northwestern Atlantic in winter (Balcomb, 1984; Katona, 1986). Additional photographic studies of humpbacks from the eastern North Atlantic is needed in order to discover whether also those whales breed in the western North Atlantic (a connection called into question by Mitchell and Reeves, 1983) or at some location in the eastern sector (see Katona, 1986).

Food

During the pioneer period of modern landbased whaling in Finnmark, North Norway, in the last decades of the 19th century it was well known that humpback whales fed upon capelin which they followed towards the coast in winter and early spring (Sars, 1881). Upon examination of a humpback captured off Finnmark in July 1879, Sars (loc.cit.) observed that the stomach content was completely comprised of the euphausiid species *T. inermis*.

The mixed diet of fish and euphausiids for northeast Atlantic humpbacks has later been confirmed by Ingebrigtsen (1929), and it is also reported to be typical for humpbacks in other areas (Winn and Reichley, 1985). From Norwegian waters Ingebrigtsen (1929) reports that humpbacks captured off Finnmark at the beginning of their winter migration (January/February) often had empty stomachs, whereas those taken in March/April might feed on capelin from time to time. Food did not seem to be of particular interest to the humpbacks during their winter migration towards the breeding areas. Upon arrival in the Bear Island areas in May, however, Ingebrigtsen (loc. cit.) reports that the humpbacks might stay for several weeks feeding upon the masses of euphausiids occurring in this area in early summer. When the euphausiids disappeared in the Bear Island area (by the end of August, according to Ingebrigtsen, 1929), the humpbacks presumably proceeded eastwards into the Barents Sea to pursue the shoals of capelin during the rest of the autumn and in the early winter. Upon arrival at the coast of Finnmark on their westward breeding migration in January/February the humpbacks were generally fat and in very good condition (Ingebrigtsen, 1929).

Reproduction

Very little systematic collection of material for studies of humpback whale reproduction biology appear to have been carried out in Norwegian and adjacent waters. Nevertheless, some observations of certain value have been made. Thus, both Collett (1912) and

Ingebrigtsen (1929) had observed that the majority of adult females captured on their westward migration in winter were pregnant with large (12-14 feet) fetuses. Upon arrival in Bear Island waters in May and later, some adult females were accompanied by calves whereas those not accompanied by calves contained small fetuses in the uterus (Ingebrigtsen 1929). It seems, thus, that the breeding season must be in winter and early spring, and that the sexual cycle must be more than annual. The latter is supported from observations in other areas where it has been observed that breeding usually occurs once every two years but may take place twice every three years (see Winn and Reichley, 1985). Ingebrigtsen (1929) suggested that female humpbacks must attain a normal length of at least 45 feet before it is sexually mature.

Exploitation

The first humpback whale catches in the area were made off North Norway in 1881 (Table 1). After this the species occurred more or less regularly in the catches taken in North Norwegian waters until the whaling operations were closed by Norwegian authorities in 1904 (Risting 1922, Jonsgård 1977). Humpback catches in other areas of Norwegian and adjacent waters were much lower and more fragmentary than those in North Norway. The total documented number of humpbacks taken during the period 1881-1904 was 1,084 animals. Due to the unspecified catch in certain years the real number taken is higher, probably totalling close to 1,500 animals (Ingebrigtsen 1929). Between 1904 and 1955, when humpbacks were given total protection in the North Atlantic, less than 50 humpbacks were caught in Norwegian waters.

Incidental sightings

The presented incidental sightings data appear to confirm previous suggestions of the migration routes of humpbacks in the area (Fig. 1). Thus, most humpback sightings made in May-July were recorded along the coast of Kola and North Norway southwards to Lofoten, and all the way northwards to Spitsbergen with particular dense occurrence in the Bear Island area. In August the situation seems to change in that no humpbacks were longer observed along the coast of Kola and parts of North Norway (Finnmark). The few observations from September/October were nearly all made in the areas northeast of Hopen Island and, thus, seems to support the trend also perceived in August that the humpbacks move to the north and east towards the end of summer and in the fall. Sightings recordings from winter and early spring are very few and inconclusive.

It has already been mentioned that capelin is a key prey species for humpback whales in the actual area (see Ingebrigtsen, 1929). A severe collapse occurred in the Barents Sea stock of capelin in 1985/1986 (Anon. 1990; Hopkins and Nilssen, 1990). Incidental sightings of

humpback whales made in the area before and after this crack (i.e., prior to and after 1986, Fig. 2) may indicate a change in distribution of this species. Before 1986 incidental sightings of humpbacks were frequently recorded along the coast of Finnmark and Kola and also to the east and northeast of Hopen Island throughout the season. After this year, however, almost no such observations were made. The capelin collapse may have contributed to this observed change. The Barents Sea capelin have been given protection from commercial exploitation for several years, and is now recovering (Anon., 1990). It will be interesting to observe if an increased capelin stock will lead to a shift back to the pre 1986 distribution of humpback whales in the area.

Average school size as observed at incidental sightings was 2.1. For comparison, during the sightings surveys the average humpback school sizes were calculated to 1.48 in 1988 and 1.43 in 1989.

Present abundance

Only 12 primary sightings of humpback whales were made during the 1989 survey; the observations were made in the northern part of the Norwegian Sea, around Bear Island and in the southeastern Barents Sea (Fig. 3). 10 of the primary sightings were useful for calculating perpendicular distances, and their distribution is shown in Fig. 4. The detection function fitted to this distribution has the form $g(y) = 1 - (-y/0.192)^{-1.0}$ which results in an effective search half-width of 0.4627 (c.v. 0.6617) nautical miles. The abundance estimates based on the 1989 data are given in Table 2. The estimate of total abundance in the survey area is 700 (c.v. 0.59) and this compares to the estimate for corresponding areas from the 1988 survey of 1,025 (c.v. 0.31) (Øien, 1990). Therefore, the recent survey results seem to indicate a present abundance of humpback whales of approximately 1,000 individuals in the Norwegian and Barents Seas.

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Table 1. Number of humpback whales caught in Norwegian and adjacent waters throughout the period 1881-1955. Humpbacks were taken also in 1883, 1884 and 1891-1895, but the catches were given as unspecified total numbers in the whaling statistics for these years. Data drawn from Jonsgård (1977).

YEAR	NUMBER OF HUMPBCKS CAUGHT			
	SVALBARD AREA	MURMAN COAST	NORTH NORWAY	WESTERN NORWAY
1881	-	-	9	-
1882	-	-	-	-
1883	-	-	?	-
1884	-	-	?	-
1885	-	4	92	-
1886	-	13	88	-
1887	-	8	22	-
1888	-	-	69	-
1889	-	-	5	-
1890	-	-	24	-
1891-1895	-	-	?	-
1896	-	-	174	-
1897	-	-	56	-
1898	-	-	53	-
1899	-	-	54	-
1900	-	-	68	-
1901	-	-	118	-
1902	-	-	155	-
1903	8	-	58	-
1904	15	-	39	-
1905	9	-	-	-
1906	5	-	-	-
1910	3	-	-	-
1918	-	-	1	1
1919	-	-	3	3
1926	2	-	-	3
1928	-	-	-	2
1930	-	-	-	1
1932	-	-	-	1
1933	-	-	-	1
1939	-	-	-	1
1949	-	-	1	-
1950	-	-	7	1
1951	-	-	5	-
1952	-	-	2	-
1953	-	-	4	-
1954	-	-	6	-
1955	-	-	1	-

Table 2. Abundance estimates (in absolute numbers) of humpback whales based on results from the 1989 sightings survey. The effective half search-width was estimated to be 0.4627 (c.v. 0.6617) nautical miles (nmi) from perpendicular distances pooled over blocks. Numbers in brackets are coefficients of variation. Density of whales is given as whales per square nmi, and area of block is given as square nmi. For a more precise definition of the blocks, see Øien (1990).

BLOCK	SIGHTING RATE	SCHOOL SIZE	WHALE DENSITY	AREA OF BLOCK	ABUNDANCE ESTIMATE
Bear Island area (BJ)	0.0012 (0.6622)	3.0 (0)	0.0039 (0.9361)	21,548	84 (0.9361)
Kola area (KO)	0.0015 (0.6141)	1.0 (0)	0.0016 (0.9028)	26,840	44 (0.9028)
Lofoten area (LO)	0.0020 (1.5259)	1.33 (0.2500)	0.0029 (1.6819)	35,784	103 (1.6819)
Eastern Norwegian Sea (NØ)	0.0032 (0.3625)	1.33 (0.1581)	0.0046 (0.7709)	101,823	468 (0.7709)
Total for all blocks:					698 (0.5867)

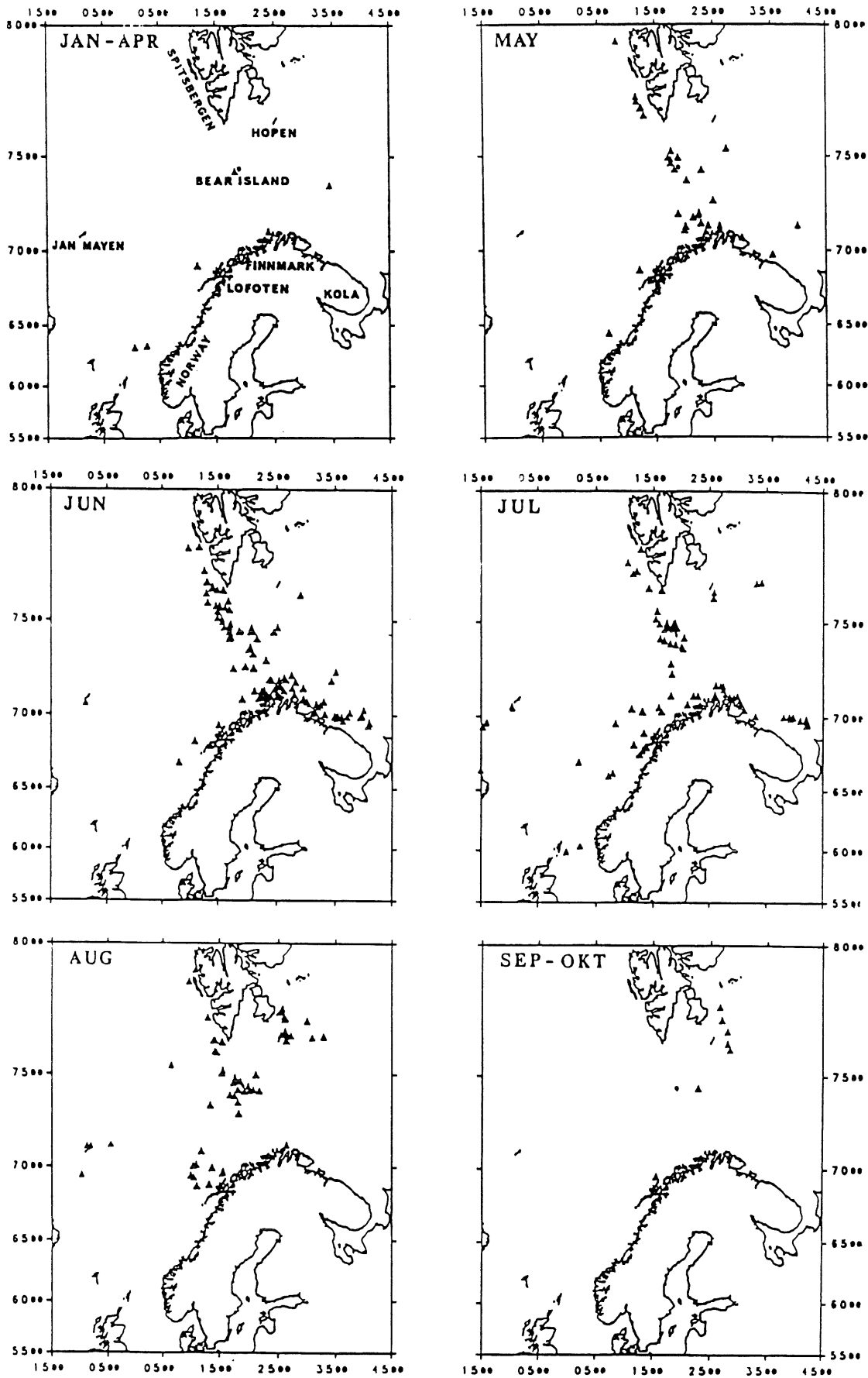
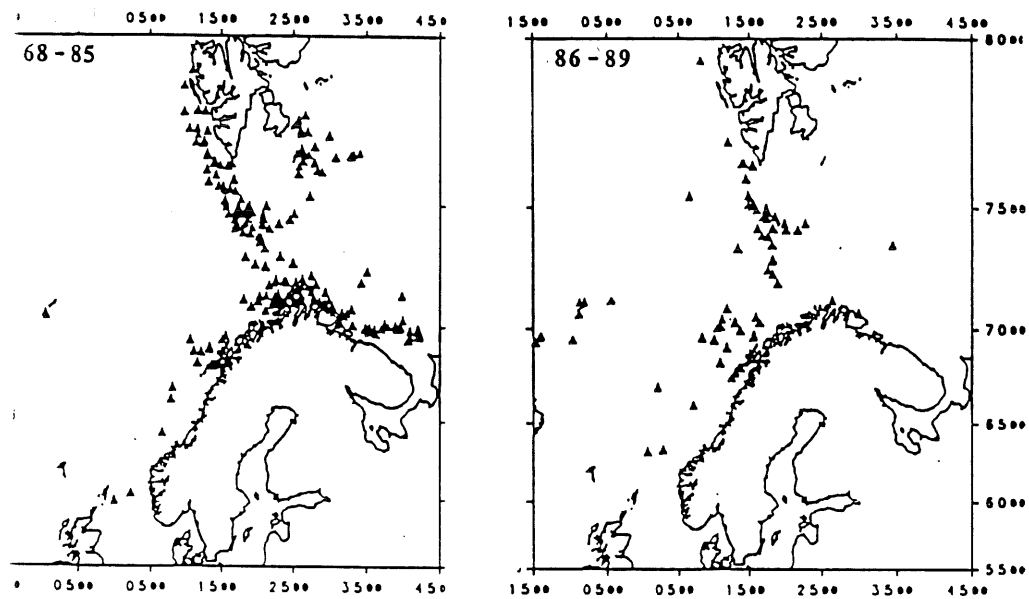


Fig. 1. Incidental sightings of humpback whales at different parts of the year during the period 1968-1989 in the Norwegian and Barents Seas.



2. Incidental sightings of humpback whales throughout the year in Norwegian and Barents Seas during the two periods 1968-1985 and 1989.

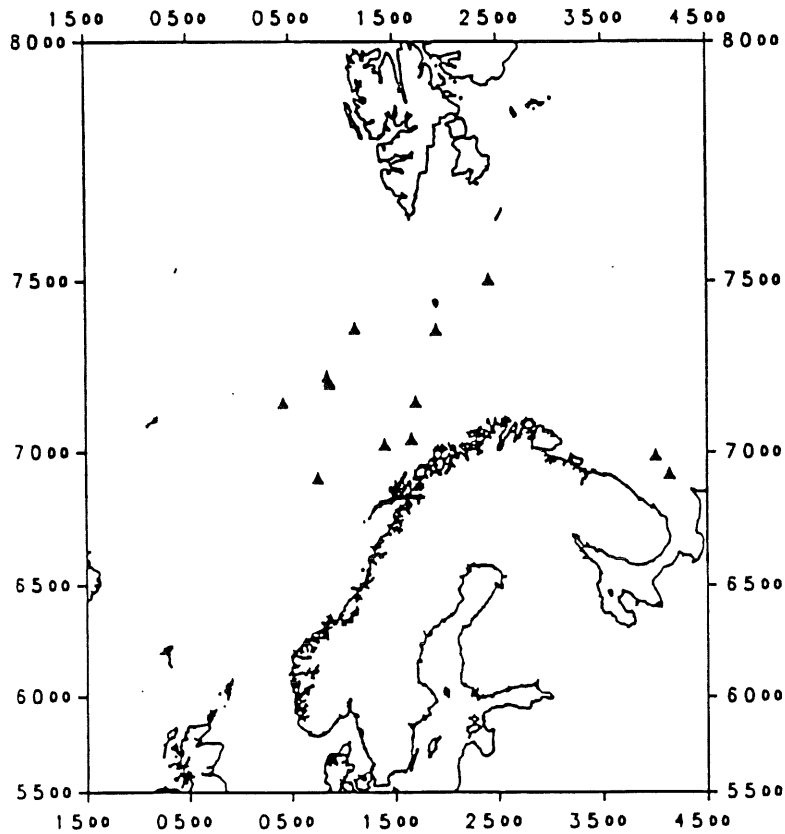


Fig. 3. Sightings of humpback whales during the July 1989 survey.

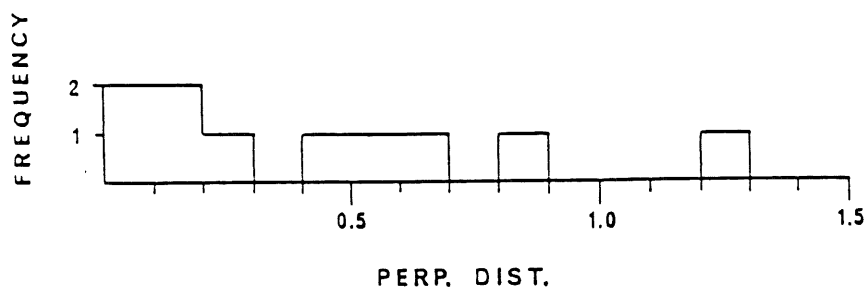


Fig. 4. Frequency distributions of perpendicular distances to primary sightings of humpback whales based on 1989 survey data. Perpendicular distances are grouped by 0.1 nautical miles.