CONSERVATION VALUE ASSESSMENT AND DISTRIBUTION OF SELECTED MARINE MAMMALS IN THE NORTHERN BARENTS SEA

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Cover photo: A large concentration of harp seals *(Phoca groenlandica)* on ice floes off Bjørnøya in the Barents Sea. Photo: Fjellanger Widerøe A/S.

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PREFACE

Parts of the northern Barents Sea may be opened for test drilling for oil and gas in the future. In connection with this an assessment of the impacts of petroleum activity on marine mammals in the area will be performed. The work with the impact assessment is organised by the Working Group on Environmental Impact Assessments of Petroleum Activities on the Norwegian Continental Shelf (AKUP). The present report is a part of this work and presents results from a project organised by the Norwegian Polar Institute. The Institute of Marine Research has been responsible for one part of the project. The project has been financed by the Ministry of Industry and Energy.

Previously, Det Norske Veritas Industry AS performed an analysis of the potential effects of oil spills on the populations of the ringed seal (*Phoca hispida*) and the harp seal (*Phoca groenlandica*) (Jødestøl & Ugland 1993), and on the minke whale (*Balaenoptera acutorostrata*) and the walrus (*Odobenus rosmarus*) (Jødestøl et al. 1994) in the assessment area. Those reports also contain assessment of the conservation value and distribution of each species in the northern Barents Sea. This report covers two topics which were not covered in the Jødestøl & Ugland (1993) and Jødestøl et al. (1994) reports: the conservation value and the distribution of marine mammal species with regular occurrence in the northern Barents Sea.

Tore Haug, Norwegian Institute of Fisheries and Aquaculture, is thanked for reviewing the manuscripts.

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CONSERVATION VALUE ASSESSMENT OF SELECTED MARINE MAMMALS IN THE NORTHERN BARENTS SEA

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Harbour seals (*Phoca vitulina*) at Prins Karls Forland. Photo by Ian Gjertz.

Abstract – The conservation value of harbour seals (*Phoca vitulina*), bearded seals (*Erignathus barbatus*), white whales (*Delphinapterus leucas*), white-beaked dolphins (*Lagenorhynchus albirostris*), bowhead whales (*Balaena mysticetus*), fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*) and polar bears (*Ursus maritimus*) in the northern Barents Sea is assessed in connection with an environmental impact assessment of petroleum activity in the area (four other important species have been treated elsewhere). The population of a species in the northern Barents Sea is considered to have a special national conservation value if it constitutes at least 5% of the Norwegian population and to have a special international conservation value if it constitutes at least 2.5% of the world population of the species. The basis for the assessment is weak for several species as the knowledge on population size is poor.

INTRODUCTION

The present assessment of the conservation value of selected marine mammals was made as a part of an environmental assessment analysis related to petroleum-related activity in the northern part of the Barents Sea. Similar assessments have also been made for the ringed seal (*Phoca hispida*) and the harp seal (*Phoca groenlandica*) by Jødestøl and Ugland (1993) and for the walrus (*Odobenus rosmarus*) and the minke whale (*Balaenoptera acutorostrata*) by Jødestøl et al. (1994). Both these assessments estimated the recovery potential of the population based on a population model. Although this method is more sophisticated than ours, we believe that the conclusions from the two methods would be the same.

METHODS

The background principles for the conservation value assessments are described by Anker-Nilssen (1987) (see also Jødestøl et al. 1994). The sizes of the populations in the study area of the species concerned are compared with the sizes of the Norwegian and the world populations of the same species. For many of the species involved estimates of population sizes for the area concerned are non-existing or very poor. The conservation value assessments are therefore based on a poor data background and more or less subjective judgements of relative population sizes and distributions. In addition some of the species concerned, such as many of the whales, inhabit the study area for a small fraction of the year, while others, such as many seal species, are found in the area all year round. No evaluation has been conducted concerning how much of the year the various species are found in the study area.

Marine mammal populations are in general considered to have a poor restitution ability. They are typical k-selected species; they mature at a high age, they are slow in reproducing and long lived, and they can potentially exist in numbers close to the limits set by resources (McLaren 1990). Based on these considerations and Anker-Nilssen (1987), a marine mammal population is considered to have a special national conservation value if it constitutes at least 5% of the Norwegian population and to have a special international conservation value if it constitutes at least 2.5% of the world population.

EVALUATION OF SPECIES

HARBOUR SEAL *Phoca vitulina*

General biology

The harbour seal is only found in the Northern Hemisphere. It is one of the most widespread pinnipeds; it inhabits temperate, subarctic and arctic regions. At least four different subspecies are recognised (King 1983), two in the Pacific Ocean and two in the Atlantic Ocean. The subspecies which inhabits the eastern Atlantic waters, *P. v. vitulina*, is found from the northern coast of Portugal all the way up to the Barents Sea (Bigg 1981). This species is also found around Iceland and in Svalbard.

Harbour seals tend to be solitary in the water, but highly gregarious at haul-out sites. Haul-out sites are normally small rocks or sandy beaches, and these chosen areas are frequently visited, especially at low tides.

Harbour seals are relatively small seals. The average adult size for both sexes is about 150 cm in length with a body mass between 70 and 90 kg (Markussen et al. 1989). In Norwegian waters the harbour seal females reach sexual maturity when they are around four years old, while males become sexually mature between five and seven years of age (Bjørge 1992). The females give birth to a single pup every June (Temte et al. 1991; Gjertz & Børseth 1992), and average birth rates for females older than eight years of age from Norwegian waters is estimated to be 0.9 (Bjørge 1992).

Harbour seals in Norway are totally protected from the Swedish border to Sogn and Fjordane county (approximately 62°N), while in the area from Møre and Romsdal county to the Russian border they are protected only in the period of 1 May–30 November. The harbour seal population on Svalbard is totally protected.

The International Union for the Conservation of Nature and Natural Resources (IUCN) status of the world's harbour seal population is *insufficiently known* (Jefferson et al. 1993). However, rough estimates of the world population size have been conducted, and the result of this estimation is a population size of about 500,000 individuals (Bigg 1981). The total Norwegian population size of harbour seals has been estimated to be in excess of 4,000 animals (Bjørge 1991). Harbour seals inhabiting the Barents Sea area are mainly found along the coast of Finnmark and in Svalbard. In addition about 50 animals have been recorded along the Kola peninsula (Mishin et al. 1992). The population in Finnmark numbers about 350 individuals (Henriksen & Haug in press), while between 500 and 600 animals are found in Svalbard (Prestrud & Gjertz 1990). The Finnmark population is spread throughout the entire county, while the Svalbard population has a very limited geographical distribution and is almost exclusively confined to the area around Prins Karls Forland (Prestrud & Gjertz 1990).

Conservation value assessment

A reasonable estimate for the harbour seal population inhabiting the Barents Sea including Svalbard would be about 1,000 animals. About 400 of these are found in the southern Barents Sea (Finnmark and Kola) and should thus be excluded from the present evaluation. The population in the northern Barents Sea therefore numbers about 600 animals which constitutes about 15% of the Norwegian harbour seal population, and it is therefore of national conservation value. As the population represents only 0.12% of the world population, based on pure number considerations, it is of no special international conservation value. However, as this population is the world's northernmost harbour seal population and it has a very limited geographical distribution, it is very sensitive to local disturbances. Harbour seals are more or less continuously distributed from Portugal to Finnmark, before the span of almost 1,000 km to the Svalbard population. This population thus represents a unique opportunity for different comparative studies and should therefore be considered of the highest conservation value both nationally and internationally.

BEARDED SEAL *Erignathus barbatus*

General biology

Bearded seals have a circumpolar distribution and are found all along the European, Asiatic and North American coasts of the Arctic Ocean (King 1983). Two subspecies are generally recognised: one from the Laptev Sea in Siberian Russia and westwards across the Atlantic into Hudson Bay; the other from the Laptev Sea and eastwards through the Canadian Arctic.

Bearded seals are normally associated with drifting ice floes, but they are also able to maintain breathing holes in fast ice and in some areas they also haul-out on land. Their general benthic food habits restrict their range to relatively shallow waters (Burns 1981). Bearded seals are thought to move great distances during the year mainly to keep in contact with the ice, but in areas where the ice melts such as in the White Sea, they may haul-out on shore (Heptner 1976). In addition some animals, mainly subadults, may summer in the open seas (Burns 1981). Bearded seals are solitary animals and do not form herds neither at sea nor when hauled out.

The adult bearded seal can reach a length of about 230 cm and is the only seal species in which the females are larger than the males. This difference is only slight in terms of body length, but marked when body masses are compared (Burns 1981); adult females may weigh more than 350 kg. In the Barents Sea area females are sexually mature when 3–7 years old, while males mature when 5–7 years old (Potelov 1975a). The peak pupping period is at the end of April and the beginning of May (Chapskii 1938). The pups are born on ice floes and are able to enter the water and swim at once if necessary.

Subsistent hunting of bearded seals takes place in many local villages throughout the seals distribution area, and a small-scale commercial hunt takes place in Russia (Jefferson et al.

1993). Bearded seals in the Svalbard area are protected between 15 March and 15 April, and the annual catch is in the order of magnitude of about 100 seals, mainly taken by local hunters.

The IUCN status of the world bearded seal population is *insufficiently known* (Jefferson et al. 1993). In an earlier FAO report the world bearded seal population is estimated to be at least 500,000 individuals (Stirling & Archibald 1979). In *Handbook of marine mammals* (Burns 1981) it is estimated that there are about 750,000 bearded seals in the world, and the north Atlantic region (including the Barents, White, Kara and Laptev seas) is estimated to be inhabited by about 300,000 animals (Chapskii 1966; Bychov 1971). Potelov (1975b) states that a large part of the population of bearded seals that inhabit the White, and southern Kara and Barents seas during winter migrate to the northern Barents and Kara seas during the summer and autumn.

Conservation value assessment

A reasonable estimate for the bearded seal population in the Barents Sea including Svalbard would be in the order of magnitude of between 10,000 and 100,000 animals. This is based on the total estimate of 300,000 animals inhabiting the Barents, White, Kara and Laptev seas altogether, and on the knowledge that many of the animals which winter in the White and Kara seas migrate into the Barents Sea during summer and autumn (Potelov 1975b). Another indicative consideration for the order of magnitude of the Barents Sea bearded seal population could be to apply the ringed seal/bearded seal ratio found in Baffin Island of 13:1 (Smith, T. G. cited in King 1983). The ringed seal population in the northern Barents Sea including Svalbard is assumed to consist of about 200,000 individuals (Jødestøl & Ugland 1993). The bearded seal population in the same area using the ratio between these two species as mentioned above would therefore be about 15,000 individuals. In addition, as stated earlier, there is a summer immigration into the Barents Sea from the south and the east. It is assumed that 100% of the Norwegian bearded seal population is found in the Barents Sea area when Svalbard is included, and this population should therefore be of high national conservation value. This bearded seal population constitutes between 1.3–13% of the world bearded seal population and should therefore also be ranked as having international conservation value.

WHITE WHALE *Delphinapterus leucas*

General biology

White whales or belugas are only found in high latitudes on the Northern Hemisphere. They have an almost continuous distribution across the Russian Arctic, limited in the Pacific to the Sea of Okhotsk and in the Atlantic to the northern coast of Norway (Kleinenberg et al. 1969). They are also present on the eastern coast of Greenland and in North America extending from Alaska across the Canadian Arctic and into the Gulf of St. Lawrence (Brodie 1989).

Based on morphological, genetic and distributional differences, 15 stocks of white whales have so far been recognised (Jefferson et al. 1993). White whales are highly gregarious and are normally found in pods consisting of a mixture of different age and sex groups or in all male groups. There is a general seasonal movement of herds; they move into coastal waters and river estuaries during the summer, and then move back to winter in off-shore areas in the pack-ice or in polynyas (Brodie 1989). During the summer stay in shallow waters, white whales undergo an annual, apparently unique, process in whales; they shed their epidermis in a moult-like manner (St. Aubin et al. 1990). These shallow areas are thus very important habitats for white whales, and since the animals seem to return to the same areas year after year (Caron & Smith 1990), moulting areas should be identified, managed and preserved in order to conserve the species.

Female white whales are sexually mature at six years of age and stay fertile till the age of 21 (Brodie 1989). There is a 14-month gestation period followed by a lactation period of up to two years. In other words, the white whale females give birth to a new calf only every third year.

For the time being there is no commercial hunting for white whales (Jefferson et al. 1993). However, native Alaskans, Canadians, Greenlanders and Russians catch several thousand all together each year (Jefferson et al. 1993). In the Svalbard waters the hunting of white whales ended in the 1960s. The most 'famous' hunting grounds were the western coast of Spitsbergen and the Hinlopen Strait (Gjertz & Wiig 1994).

During summer in the Barents Sea white whales can be found all along the coast near areas of Svalbard, Zemlja Franca Iosifa and Novaja Zemlja (Kleinenberg et al. 1969; Gjertz & Wiig 1994). There is some discussion in the literature about whether these animals winter in the Barents Sea or off southern Greenland, and it seems that they do both (Hjort 1902; Kleinenberg et al. 1969). Some Barents Sea white whales winter south of Novaja Zemlja and along the Murmansk coast, and others in polynyas further north (Kleinenberg 1969).

The IUCN status of the world white whale population is *insufficiently known* (Jefferson et al. 1993). Only one population is considered endangered and that is the St. Lawrence estuary population which is mainly threatened by chemical pollution (Jefferson et al. 1993). According to *Handbook of marine mammals* (Brodie 1989), the world population of white whales is estimated to be about 60,000 individuals. This is definitely much too few.

Brodie (1989) states that the Svalbard population is 10–12,000 animals based on references to Lønø and Øynes (1961) who are claimed to have stated this and in addition interpreted this number to be an overestimate. Lønø and Øynes (1961) have not produced any estimate of the Svalbard white whale population. However, they mention a report of *one* large group of whales of about 10–12,000 animals, and they indicate that this number may be an overestimate. Recent estimates of white whale numbers are 39–58,000 individuals in Canadian waters (Smith et al. 1990) and 4,500–6,500 individuals in Alaskan waters (Frost & Lowry 1990). The Baffin Bay population (eastern Canada & Greenland) has recently been estimated to be at least 30,000 individuals (Heide-Jørgensen 1994). Based on the sporadic

reports of groups of 1,000 and more animals (Lønø & Øynes 1961; Kleinenberg et al. 1969), and the relatively common occurrence of white whales in the Barents Sea area, including Svalbard and Zemlja Franca Iosifa, it is reasonable to assume a population size of approximately 10,000–100,000 individuals.

Conservation value assessment

A reasonable estimate for the white whale population in the Barents Sea including the Svalbard waters is 10,000–100,000 individuals. The white whale population in this area is considered to constitute 100% of the overall Norwegian population and is thus of national conservation value. The IUCN status of white whales is *insufficiently known*. In North American waters where the best (and only) censuses of population sizes have been conducted, the total number of individuals is in the range of 50,000–100,000 whales. The 'Norwegian' population is therefore in the same order of magnitude as that of total North America. Nothing is known about the population size of white whales in the White Sea, the Kara Sea and areas further eastward into the Russian Arctic. However, it is reasonable to assume that the 'Norwegian' white whale population constitutes at least 10% of the total world population and is therefore also of international conservation value.

WHITE-BEAKED DOLPHIN *Lagenorhynchus albirostris*

General biology

White-beaked dolphins are found in the northern, subarctic and arctic parts of the north Atlantic (Reeves 1990). Their range extends from the ice edge in the Greenland and Barents seas to the Davis Strait and North Sea in the summer (Watson 1981). In winter they migrate as far as Cape Cod in the western Atlantic and the Bay of Biscay in the east. White-beaked dolphins are normally found in groups of less than 50 animals, but herds consisting of more than 1000 individuals are occasionally reported. Few habitat details are known. They are scattered widely across the continental shelves, but are present in especially large numbers along the shelf edges and over the continental slopes (Reeves 1990).

White-beaked dolphins have a varied diet consisting mainly of squid, cod, herring, whiting and capelin (Watson 1981). The animals grow to a length of about 3 m and their average body mass is about 200 kg. Mating takes place in autumn in the southern part of the range, and most calves are born on the northern feeding grounds in mid-summer. The gestation period is about 10 months (Watson 1981).

White-beaked dolphins have never been hunted on a major scale, although commercial catches have been made in the Davis Strait and in Norway (Leatherwood et al. 1983). In the Norwegian waters the white-beaked dolphins have been totally protected since 1983.

Nothing is known about stock identities of this dolphin and no estimates have been made of the total population size. The IUCN status on this species is *insufficiently known* (Jefferson et

al. 1993). Evans (1987) states that the total population size of white-beaked dolphins is unknown, but is probably in tens to lower hundreds of thousands. Several estimates of local populations have been made. A recent report on *Lagenorhynchus* spp. (which includes the Atlantic white-sided dolphin *L. acutus* in addition to the white-beaked dolphin) estimates the number in Norwegian waters to be 132,000 animals (95% C. I. 79,000–220,000) (Øien 1993). These two dolphins have been grouped together because of the difficulty in identifying the species in the field, especially at some distance. In cases of accurate identification, however, the majority of the animals were found to be white-beaked dolphins. There are two main areas where white-beaked dolphins are found concentrated in Norwegian waters; one in the Barents Sea and one in the North Sea. The largest of these two concentrations is the northern one, which is located mainly in the area from the coast of Finnmark northwards to Bjørnøya (Øien 1993).

Conservation value assessment

Based on the report from Øien (1993) the majority of the white-beaked dolphins in the Barents Sea are found south of Bjørnøya. The waters west of Spitsbergen were found to be inhabited by about 2,000 animals, and the rest of the area in the Barents Sea down to about 72°30'N is inhabited by about 22,000 animals. A reasonable estimate of the white-beaked dolphin population inhabiting the northern Barents Sea would be about 25,000 animals. This is about 20% of the total Norwegian population, and the white-beaked dolphins inhabiting the northern Barents Sea are thus of national conservation value. This fraction of the Norwegian white-beaked dolphin population constitutes probably only a couple of percentages of the world population and should therefore be rated as of no special international conservation value.

BOWHEAD WHALE *Balaena mysticetus*

General biology

Bowhead whales are only found in arctic and subarctic regions of the Atlantic, Bering, Beaufort, Chuchki and Okhotsk seas (Jefferson et al. 1993). They spend most of their time in pack-ice areas, migrating to the High Arctic in the summer and retracting southwards in the winter with the advancing ice edge.

Bowhead whales are slow swimming and able to dive deeper than 1,000 m and stay submerged for more than one hour (Reeves & Leatherwood 1985). They are skim feeders and mainly swim on or near the surface with open mouth, feeding on small to medium-sized zooplankton (Lowry & Burns 1980). Findings of stones and benthic amphipods in some stomachs indicate that some feeding also takes place near the bottom.

Bowhead whales can become more than 20 m long and attain body masses of over 100,000 kg (Reeves & Leatherwood 1985). They have the largest baleens of any whale, and baleen plates longer than 5 m has been recorded (Davis 1874). Most calving takes place in the spring. The

length of the gestation period is unknown, but is probably between 12–14 months. New-born are 4–4.5 m long (Nerini et al. 1984). The length of the lactation period is unknown. Bowhead whales reach sexual maturity at body lengths of 11.5 m for males and 14–14.5 m for females. A major problem in the study of the life history of bowhead whales, and in general of most baleen whales, is that adequate methods for age determination are not available.

At least four geographical stocks of bowhead whales are recognised (Mitchell 1977; Allen 1978). One is the Spitsbergen stock, which used to be centred in the Greenland Sea and distributed also into the Norwegian and Barents seas (Southwell 1898; Reeves 1980). This stock was the basis for an intensive commercial hunt which started in the 17th century. One individual bowhead whale could yield 32,000 litres of whale oil and 1,500 kg of baleens. By the late 19th century this stock was depleted to such a low level that catching them became unprofitable. The Spitsbergen stock has been estimated to have numbered about 25,000 animals in 1679 before the exploitation started (Allen 1978). The total world population today is probably less than 5,000 animals (Reeves & Leatherwood 1985). The IUCN status for bowhead whales is *vulnerable* (Jefferson et al. 1993). The part of the Spitsbergen stock which was centred in the Greenland Sea must be considered as almost extinct since only three observations of live bowhead whales have been made in this area since 1945 (Jonsgård 1981). In the eastern Barents Sea, however, bowhead whales are regularly observed, especially in the waters around Zemlja Franca Iosifa (Belikov et al. 1989; Wiig 1991; de Korte & Belikov 1994). The number of bowhead whales in this area is probably between 50–100 animals, and observations also of calves in this area may indicate a slow re-establishment of this stock (de Korte & Belikov 1994).

Conservation value assessment

The bowhead whale is an endangered species throughout its whole distribution area. It is generally totally protected, but some subsistent hunting is allowed in Alaska, Canada and Russia, even if this threatens to make this species extinct. Since the bowhead whales are threatened by extinction, they should be considered of both high national and international conservation value. The number of bowhead whales in the Barents Sea area is probably about 50–100 individuals. This is considered to constitute 100% of the 'Norwegian' bowhead whale stock and about 1–2% of the total number of bowhead whales in the world.

FIN WHALE *Balaenoptera physalus*

General biology

Fin whales are found in all major oceans of the world. They can be seen in tropical, temperate and polar regions of all oceans (Jefferson et al. 1993). They migrate seasonally between temperate waters, where they mate and calve, and polar feeding grounds (Macintosh 1965). The North Atlantic fin whales summer from the coast of North America to the Arctic, around Greenland, Iceland, North Norway, Jan Mayen, Svalbard and the Barents Sea (Gambell 1985). The wintering areas extend from the ice edge to the Caribbean and Gulf of Mexico in the

west, and from southern Norway, the Bay of Biscay and Spain in the east. Some fin whales also migrate into the Mediterranean Sea.

Fin whales grow to a length of 25–27 m in males and 22–24 m in females, and they can weigh up to 80,000–100,000 kg (Gambell 1985). Fin whales are fast swimming with maximum swimming speeds of above 20 knots. They are often found in small group of 3–10 individuals. They feed on crustaceans, fish and cephalopods. In Norwegian waters the main prey are euphausids, capelin and herring (Jonsgård 1966a). The gestation period is in excess of 11 months and the new-born whale is about 6.4 m long and weighs about 1,900 kg (Laws 1959). The new-born calves accompany their mothers on the poleward migration in the spring and are normally weaned after 6–7 months. They are then about 12 m long. In the Northern Hemisphere the males are sexually mature when they are about 17.7 m long and the females when they are about 18.3 m long (Gambell 1985). Based on age determination from earplugs fin whales are estimated to have a life span of 90–100 years (Roe 1967).

Fin whales have been commercially hunted since the development of the explosive grenade harpoon in 1964. The stocks in the eastern North Atlantic were especially heavily exploited. Today fin whales are totally protected, and the IUCN status for this species is *vulnerable* (Jefferson et al. 1993). Fin whales are divided into a number of stocks in each hemisphere. However, based on recoveries of marked animals, there is a degree of interchange between these stocks. For management purposes seven different stocks are recognised in the North Atlantic. Three of these have relevance to Norwegian waters (Christensen et al. 1992): the East Greenland–Iceland Stock, the North Norway stock and the West Norway–Faroe Islands stock. Today about 100,000 fin whales are thought to inhabit the Southern Hemisphere, and about 20,000 are found in the North Pacific (Allen 1980). A recent estimate on the number of fin whales in the North Atlantic is in excess of 50,000 individuals (Sigurjonsson 1994).

Conservation value assessment

The two stocks of fin whales inhabiting Norwegian territorial waters are the West Norway–Faroe Island and the North Norway stocks, which are estimated to number 1900 and 350 individuals respectively (Christensen et al. 1992). In the areas relevant to the present conservation assessment evaluation (Spitsbergen and down to the Kola coast) Christensen et al. (1992) estimated the number of fin whales to be about 125 individuals. This constitutes about 5.5% of Norway's total fin whale population, and this implies that the fin whales in the northern Barents Sea are of national conservation value. The fin whales in this area constitute less than 0.1% of the world fin whale population and are therefore considered not to be of any special international conservation value.

HUMPBACK WHALE *Megaptera novaeangliae*

General biology

Humpback whales are found in all oceans of the world. They generally feed in colder sub-polar or polar waters during spring and summer, and then migrate to more subtropical or tropical waters during fall and winter where they calve and do not eat (Winn & Reichley 1985). This annual cycle is six months out of phase between the Northern and Southern hemispheres, but in phase with the climatic cycle.

Humpback whales grow to a length of about 15 metres and reach body masses of 35,000–40,000 kg. The longest recorded individual was 18 m long (Tomilin 1957), and the oldest recorded specimen was 48 years old (Chittleborough 1965). Humpback whales feed on plankton and fish in large patches or schools. In the East Atlantic euphausids and capelin seem to be the main prey items (Hjort 1902; Ingebrigtsen 1929; Jonsgård 1966b). Humpback whales are lunge feeders that use bubble nets, bubble clouds, tail flicks and other techniques to help concentrate the crustaceans or schooling fish for easier feeding. Sometimes they gather in groups of up to 20 animals working together to herd and capture their prey. Humpback whale calves are born in the warm tropical or subtropical waters of each hemisphere. The gestation period is 11–11.5 months. New-borns are 4–5 m long, weigh about 2,000 kg and are nursed for about five months (Matthews 1937; Tomilin 1957; Nishiwaki 1959; Chittleborough 1965). Calves ingest a minimum of 43 litres of milk (fat content 20–40%) daily, and when the nursing period is over they are between 7.5–9 m long (Matthews 1937; Tomilin 1957). Humpback whales are sexually mature when they are between 2–5 years old, but not physically mature until about 10 years later (Matthews 1937; Nishiwaki 1959). Sexual maturity is attained at body lengths of 11.6 m for males and 12.1 m for females, while the corresponding figures for physical maturity are 13.4 m and 13.7 m for males and females respectively (Winn & Reichley 1985). Breeding occurs once every two years or twice every three years. In the latter case lactation may last longer than five months continuing through the first part of the next ovulation cycle. If the females are impregnated shortly after parturition, pregnancy and lactation may exist simultaneously (Matthews 1937; Chittleborough 1954).

It is generally believed that there are 11 different stocks of humpback whales: two in the North Pacific, two in the North Atlantic and seven in the Southern Hemisphere. This may be an oversimplified view since the number of stocks, especially in the southern hemisphere, is probably much higher. Humpback whales enter Norwegian waters in May, usually first in the area around Bjørnøya and later also into the coastal areas of Finnmark (Hjort 1902; Ingebrigtsen 1929). Then they proceed further north and east, and in late summer they are found in the areas between Spitsbergen, Zemlja Franca Iosifa and Novaja Zemlja where they may stay for some months feeding mainly on capelin. The IUCN status for the world humpback whale population is *vulnerable* (Jefferson et al. 1993). According to Borchers (1994) about 15,000 humpbacks inhabit the Southern Hemisphere. The North Pacific population is estimated to be about 1,000 animals (Winn & Reichley 1985), while the

Northwest and Northeast Atlantic populations are estimated to consist of 5,500 (Sigurjonsson 1994) and 1,000 (Christensen et al. 1992) whales respectively.

Conservation value assessment

It is assumed that all the approximately 1,000 humpback whales in Norwegian waters enter the northern Barents Sea each year. They therefore constitute 100% of the Norwegian humpback population and are of national conservation value. The total world population of this whale species is about 22,500 animals. The northern Barents Sea population constitutes 4.4% of the world humpback whale population and is therefore also of international conservation value.

POLAR BEAR *Ursus maritimus*

General biology

The polar bear (*Ursus maritimus*) has a circumpolar distribution and is confined to arctic and subarctic ice-covered sea areas. The bears are not evenly distributed, but are found in several more or less isolated populations (DeMaster & Stirling 1981). Eleven populations of polar bears in the Arctic were recognised at the latest meeting of the IUCN Polar Bear Specialist Group (Wiig et al. in press), and total population size was estimated to be between about 20,000 and 30,000.

The polar bear is common in the southern and eastern areas of Svalbard, travelling on both firm packed sea ice and in the drift ice. Polar bears on Svalbard, the western Soviet Arctic and East Greenland belong to one population (Larsen 1986). This population was estimated at 3,000–5,000 individuals in 1980–1983, and has been increasing since the protection by law in 1973. The part of the population inhabiting the Svalbard area was estimated at about 2,000 (Larsen 1986). According to Wiig (in press), however, the bears on Svalbard seem to constitute a relatively discrete population.

Female polar bears mature at an age of four years (Larsen 1986). They breed in spring and normally have two cubs by mid-winter. The cubs follow their mother for more than two years and therefore females usually breed every third year. The weight of adult females is normally about 200 kgs while the males are twice as large. Polar bears can reach an age of about 30 years.

Polar bears feed nearly exclusively on seals, with the ringed seal as the major prey.

Individual polar bears may roam extensively, but the marginal ice zone represents the most important hunting region (Stirling 1990). Wiig & Bakken (1990) suggested that the south-western ice-edge area in the Barents Sea is a very important winter habitat for polar bears. Bears move south- and westwards with the expanding winter ice during late fall and early

winter, with Bjørnøya as the southernmost extension. During spring and summer, the bears follow the retreating ice towards the eastern part of Svalbard (Larsen 1986).

Larsen (1986) assumed the northern limit of the Svalbard population of polar bears to be about 82°N, based on the fact that few tracks have ever been recorded farther north. Some bears do, however, appear in the Arctic Ocean.

The polar bears on Svalbard have been protected since 1973. Today the human impact on the population is increasing. Norway plans to open the Barents Sea for oil exploration, tourism on Svalbard is increasing, and some groups of people want to open polar bear hunting in Svalbard. The polar bears in the area are highly polluted, in particular from PCBs (Norheim et al. 1992; Wiig in press). All these points make it important to secure scientifically sound management and conservation of the population.

Conservation value assessment

The population of polar bears between East Greenland and the western Soviet Arctic was estimated at 3,000–5,000 individuals in 1980–1983, while the part of the population inhabiting the Svalbard area was estimated to be about 2,000 bears (Larsen 1986). The polar bears in the Barents Sea are probably from two populations: Svalbard and Zemlja Franca Iosifa/Kara Sea. A reasonable estimate for the size of the population is 3,000–5,000. The population in the Barents Sea constitutes 100% of the Norwegian population and is thus of national conservation value. The IUCN status of polar bears is *vulnerable*. The total world

Table 1. Conservation value assessment of marine mammal species in the Norwegian part of the northern Barents Sea. The species are either of international conservation value (I) or of national conservation value (N). See the indicated texts for assessments. Methods for conservation value assessments are after Anker-Nilssen (1987).

SPECIES	CONSERVATION VALUE
White whale *Delphinapterus leucas*[3]	I
White-beaked dolphin *Lagenorhynchus albirostris*[3]	N
Bowhead whale *Balaena mysticetus*[3]	I
Minke whale *Balaenoptera acutorostrata*[2]	I
Fin whale *Balaenoptera physalus*[3]	N
Humpback whale *Megaptera novaeangliae*[3]	I
Polar bear *Ursus maritimus*[3]	I
Walrus *Odobenus rosmarus*[2]	N
Harbour seal *Phoca vitulina*[3]	(I)
Ringed seal *Phoca hispida*[1]	N
Harp seal *Phoca groenlandica*[1]	I
Bearded seal *Erignathus barbatus*[3]	I

[1]Jødestøl & Ugland (1993)
[2]Jødestøl et al. (1994)
[3]This volume

population is 21,000–30,000. The Barents Sea population is at least 10% of the world population and therefore of international conservation value.

SUMMARY OF CONSERVATION VALUE

A summary of the conservation value of the species treated in this report, in Jødestøl & Ugland (1993) and in Jødestøl et al. (1994) is given in Table 1.

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SURVEY OF POLAR BEARS (*Ursus maritimus*) ALONG THE SPRING ICE EDGE IN THE BARENTS SEA

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Polar bear (*Ursus maritimus*) observed in connection with helicopter surveys close to Hopen in 1994. Photo by Kjell Isaksen.

Abstract – Line transect helicopter surveys were performed along the ice edge in the Barents Sea in April and May 1994, in order to explore the possibility of using line transect theory for estimating abundance of polar bears (*Ursus maritimus*) in the area. The survey was based on a systematic sample design within 50 km from the ice edge. In order to increase the number of observations this design was altered during the filed work to include about only the outer 10 km of the ice edge zone. During the original sample design nine bears were observed during 2609 km of survey. After redesigning, 22 observations were made during 998 km of survey. Loss of observations near the centre line and a low number of observations made it impossible to apply the line transect methodology to estimate density of polar bears in the area. A high concentration of bears along the outer ice edge was, however, documented.

INTRODUCTION

The polar bear has a circumpolar distribution and is confined to ice-covered sea areas. The bears, however, demonstrate habitat preferences and are not evenly distributed (Stirling et al. 1981; Ramsay & Stirling 1986). Lønø (1970) noted that the occurrence of polar bears in various areas around Svalbard is largely determined by the extension of the pack ice. According to Larsen (1986), polar bears in the Svalbard area are concentrated between the southern ice edge and 82°N, dependent on the seasonal change in the distribution of the sea ice. No differences in distribution within this zone have previously been detected (Larsen 1972, 1986). On Bjørnøya (74°30'N 19°00'E), which is at the very edge of the Svalbard pack ice area, most observations occur during February and March (Larsen 1986). Wiig and Bakken (1990) found, based on aerial strip surveys, that the concentration of bears near the southern ice edge in the Barents Sea was very high.

Estimating density and population size are central problems in polar bear research. Traditionally such research has involved sustainable kill estimates, mark-recapture techniques and aerial strip surveys. DeMaster et al. (1980) regarded mark-recapture as the most cost effective technique because it also gives information on other important properties of the population. However, in order to obtain a reliable population estimate from a mark-recapture study, between 10% and 20% of the population has to be marked and recovered each year. This is, in practice, impossible for large sparsely distributed species such as polar bears.

Also the strip transect method requires high input effort to reduce confidence intervals of estimates from surveys of low density populations (Eberhardt 1978; DeMaster et al. 1980). Several attempts have been made to estimate the density of polar bears from this method with varying success. The results have been treated more as relative abundance indices than absolute abundance estimates (Larsen 1972, 1986; Stirling et al. 1975, 1981; DeMaster & Stirling 1981; Amstrup et al. 1986; Ramsay & Stirling 1986; Belikov et al. 1990; Wiig & Bakken 1990). No work has been published on the use of line transect sampling of polar bears. In their literature review of population estimation methodologies applicable to the estimation of abundance of polar bears, Garner et al. (1992) pointed to the line transect

technique as promising – in particular when data is processed through the program *Distance* by Laake et al. (1993).

The Norwegian government is considering opening the northern parts of the Barents Sea for petroleum exploration. Before this is done an environmental impact assessment will be performed. The polar bear is the marine mammal species which is believed to be most vulnerable to oil exploration in the area (Griffiths et al. 1987). The present work was performed in order to further explore the possibility of using the line transect theory connected to helicopter surveys for estimating the density of polar bears along the spring ice edge in the Barents Sea.

MATERIAL AND METHODS

The fieldwork was performed along the ice edge area in the Barents Sea, between 76°15'N 15°00'E and 77°30'N 35°00'E in the period 19 March to 6 May 1994. Surveys were made by a one-engined helicopter (AS 350 B1) from the expedition ship 'R/V Lance'. The survey altitude was about 300 feet and the speed 100 knots. Three observers were in the helicopter in addition to the pilot. The two in the rear seats concentrated their efforts to their respective sides of the helicopter, but they were also allowed to observe in other directions. The observer in the left front seat was the leader of the survey. He concentrated his observations to the transect line in front of the helicopter and made all notes on observations. The pilot also observed in front of the helicopter. The rear observers were to concentrate their efforts within 500 m to each side of the helicopter. However, observations outside this range were also to be noted. The perpendicular distance between the survey line and the bear was calculated from radar altitude, and the angle between the horizon and the bear measured by a clinometer.

The survey was based on a systematic sampling design. The exact position of the ship along the ice edge was not selected by the polar bear project. The availability of the helicopter for polar bear surveys was determined by other activity on board and by the weather conditions. It was therefore not possible to determine the exact survey area a priori.

When surveys were possible, however, they were started at the ice edge at a predetermined distance from the ship. The distance was selected as a random number of kilometres between 0 and 20. Legs of about 50 km length were flown in a sawtooth pattern starting from the ice edge at an angel of 45°, turning 90° towards the edge again after 50 km, and flying to the edge. After two or three such 50 km legs the helicopter had to return towards the expedition ship. Therefore, 25 km were flown parallel to the ice edge towards the ship and then two or three legs in a sawtooth pattern again. When possible such surveys were planned to be performed along the ice edge on both sides of the expedition ship. These surveys covered an ice strip of about 35 km along the ice edge.

During the study this sample design had to be altered in order to increase the number of observations. This was due to the fact that most bears were found in the very outer region

along the ice edge. The legs were therefore redesigned to cover the outer about 10 km of the ice edge zone and larger leads.

RESULTS

The position of the ice edge varied considerably during the study period and was often undefined, dependent on the wind direction. A total of 32 sightings of polar bears were made for which the perpendicular distance from the transect lines were estimated. Distances ranged from 10 to 1430 m. The distribution of sighting distances indicates that sightings near the survey line were under-represented (Fig. 1). Due to the low sighting rate near the survey line and the low total number of observations made, it was not possible to calculate a reliable detection function.

The transects made according to the original sample design are shown in Fig. 2. The transects were in two areas called *Sørkapp* in the west and *Hopen-1* in the east. No observations of polar bears were made in the Sørkapp area during the 667 km survey length. In area Hopen-1 nine bears were observed during the 1942 km survey (encounter rate = 0.41 bear/100 km). The corrected survey design was used within area Hopen-1, but only within about 10 km from the ice edge and called *Hopen-2* (Fig. 3). A total of 22 observations were made here during 998 km survey length (encounter rate = 2.4 bears/100 km).

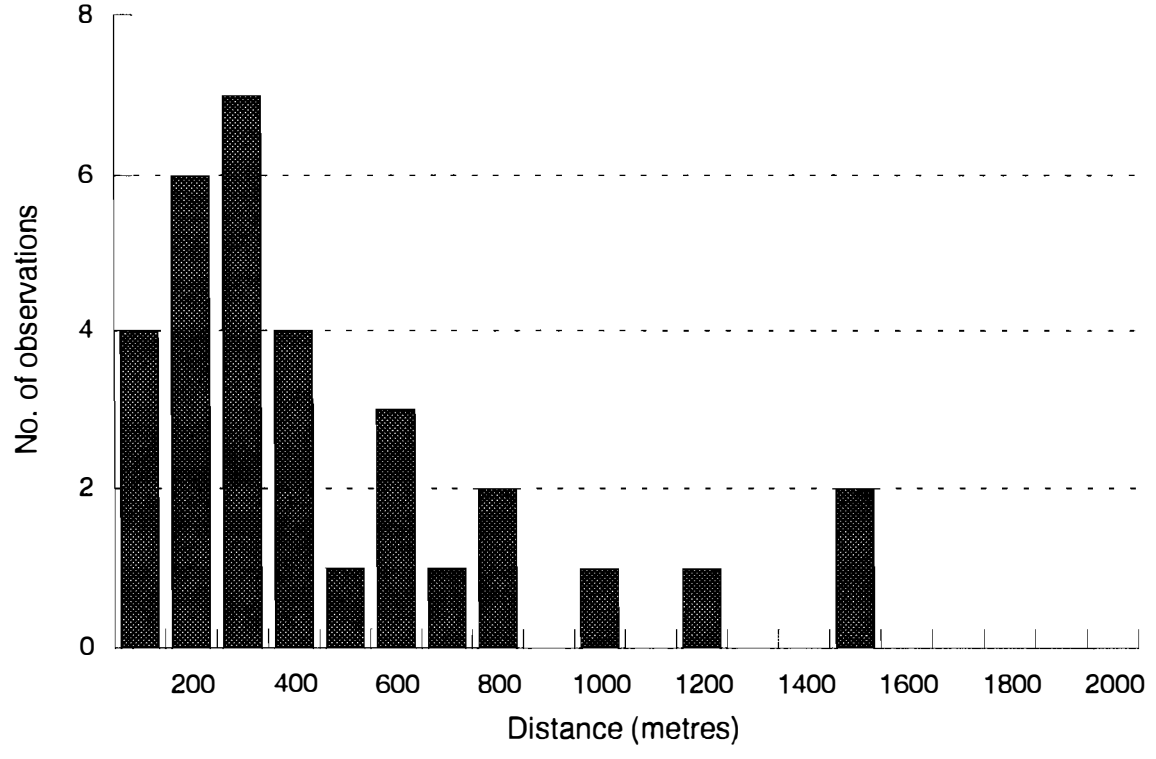

Fig. 1. Distribution of sighting distances of polar bears during helicopter surveys in the Barents Sea in spring 1994.

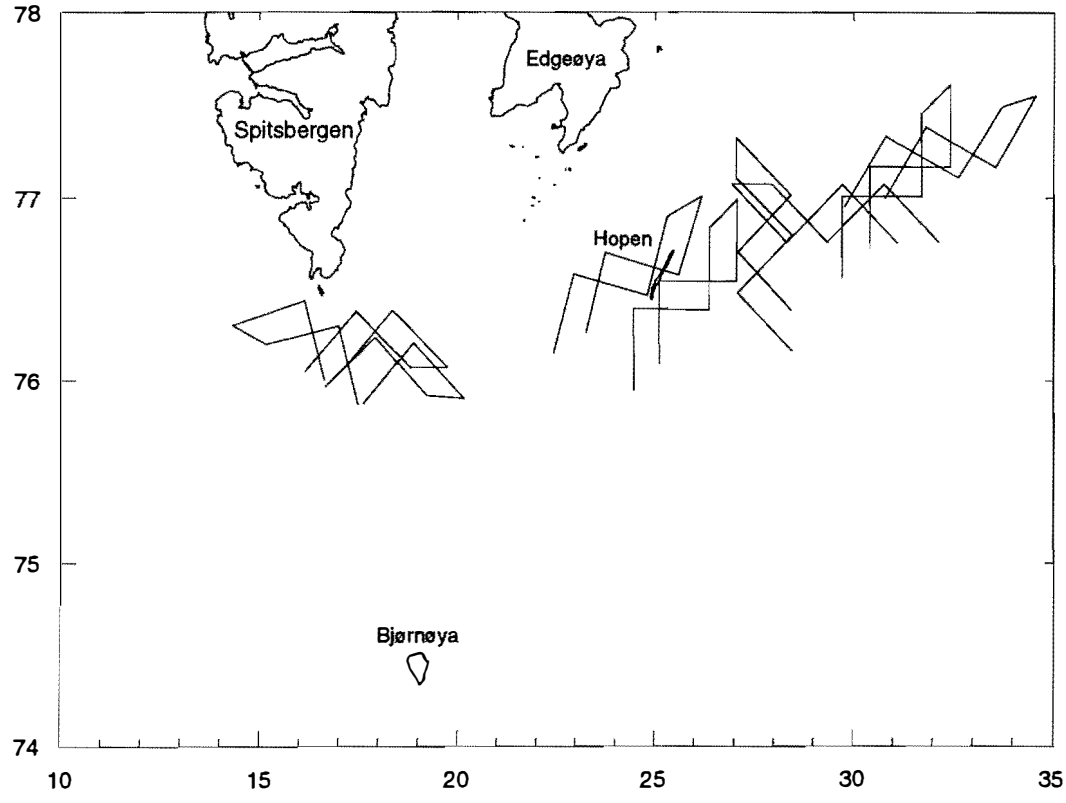

Fig. 2. Helicopter survey line for polar bears in the Barents Sea. The western survey area is named *Sørkapp* and the eastern area is named *Hopen-1*.

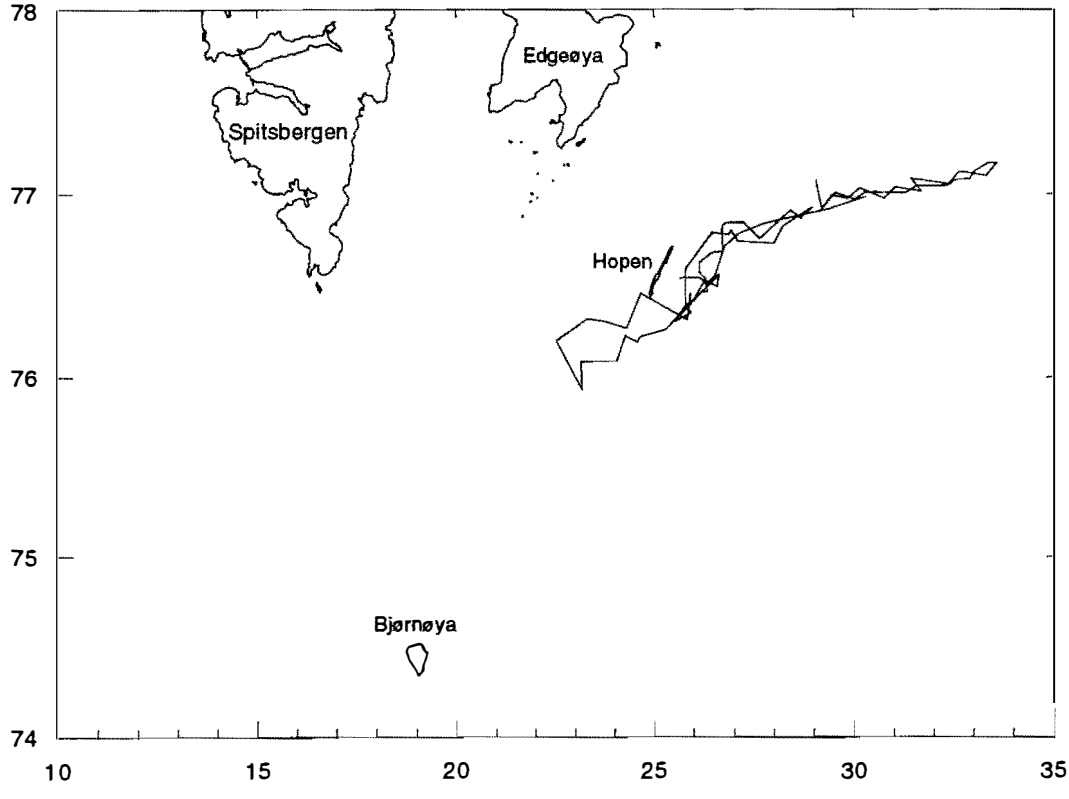

Fig. 3. Helicopter survey line for polar bears in the Barents Sea. The survey area is named *Hopen-2*.

DISCUSSION

The statistical treatment of distant sampled data rests on the validity of several assumptions (Buckland et al. 1993). The first is that the objects must be spatially distributed in the sample area according to some stochastic processes. It is, however, not necessary that they are randomly distributed as long as the lines from which the observations are made are placed randomly over the sampling area. A systematic grid of lines as used in the present survey satisfy this assumption.

Three other assumptions are essential for reliable estimation of density from line transect sampling:

1. Objects directly on the line are always detected.

2. Objects are detected at their initial location.

3. Distances are measured accurately.

One of the biases recognised for strip transect estimates is violation of the assumption that all objects in the strip are observed (Caughley 1974; Burnham & Andersson 1984). The problems involved in the process of detecting white bears on the ice should be obvious. In the present study every effort was made to ensure that the bears on the transect line were observed. This was done by the pilot and the front observer in the left seat, both of whom concentrated on the line in front of the helicopter. The distribution of the observation distances indicates that bears near the transect line were probably missed.

It is possible that some polar bears hear the helicopter and start to move before they are detected. This could lead to a lack of observation near the centre line. It is, however, believed that possible movements are slow in relation to the movement of the observer (helicopter). The few observations made near the line must therefore be attributed to the difficulty in detecting bears near the helicopter. This might indicate that the bears must be seen from a certain distance (or a certain angle) in order to be detected or registered by the observers' 'search image'.

The measurements were made exactly, based on clinometer and radar altitude measurements. There was no tendency to heaping in the data. For animals that were detected at very small angles, however, the estimated distances were inaccurate.

The number of observations made during the present study were far below the number recommended (60–80) by Buckland et al. (1993). The loss of observations near the centre line and the low total number of observations made, made it impossible to estimate a detection function and density. It seems therefore that line transect surveys as applied here are not applicable for estimation of absolute polar bear density.

Wiig and Bakken (1990) found very high densities of polar bears within about 100 km from the ice edge. In the present study we found most of the bears on very thin ice near the edge of the drifting ice. The ice was, in fact, such that it restricted the operation of the one-engined helicopter of security reasons. The results of the present survey show that the encounter rate in area Hopen-2 was much higher than in Hopen-1. Taking into account that Hopen-2 mostly constituted of the outer ice edge area of Hopen-1, the data from the present analysis show that the marginal ice zone in the Barents Sea is a very important habitat for polar bears during spring.

The distribution of polar bears is largely dependent on the distribution of their prey. The most important prey species for bears are ringed seals and bearded seals (DeMaster & Stirling 1981). A large number of seals were observed along the ice edge from the expedition ship and from the helicopter during the cruise. Bears preying on breeding bearded seals and their newborn pups were also observed. The reason for the high concentration of bears in the marginal ice zone might therefore be a high concentration of breeding bearded seals.

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DISTRIBUTION OF A SELECTION OF MARINE MAMMAL SPECIES IN THE NORTHERN PART OF THE BARENTS SEA

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Minke whale (*Balaenoptera acutorostrata*). Photo by Morten Ekker.

Abstract – Distributions of several marine mammal species in the northern part of the Barents Sea are given. The species are the minke whale (*Balaenoptera acutorostrata*), the harp seal (*Phoca groenlandica*), the humpback whale (*Megaptera novaeangliae*), the fin whale (*Balaenoptera physalus*), the harbour porpoise (*Phocoena phocoena*) and *Lagenorhynchus* spp. Summer occurrences of the species have been evaluated, but year around occurrences are established only for minke whales and harp seals. Two main sources of data, i.e. incidental observations and sighting survey data, have been used in assessing these relative densities. For summer distributions of a number of the whale species, results from sighting surveys conducted over the period 1987–1989 have permitted estimation of absolute abundance, while distributions at other time periods of the year, as well as harp seal occurrence, have been deduced from the incidental observations and from a Russian dataset from surveillance surveys with ships and aircraft in the Barents Sea. Generally, the marine mammal species investigated here are abundant during the summer and autumn periods in the northern parts of the Barents Sea, especially in association with the ice edge, while they are probably absent in the mid-winter period.

OBJECTIVE

The objective of this project has been to produce resource files of marine mammal distributions for use in AKUP simulations to evaluate impacts of oil pollution in the northern area of the Barents Sea, for this purpose defined as the area delimited by the latitudes 73°N and 81°N, and the longitudes 5°E and 60°E.

The distributions are presented as relative densities within the study area, allocated to squares of 25x25 km. The basic file with coordinates for these small squares was supplied by the Norwegian Polar Institute.

RELEVANT SPECIES

Minke whales and harp seals are the species of main interest to the AKUP project. In addition there are several other marine mammal species which visit the study area in periods of the year (summer feeding grounds). These species include humpback whales, fin whales, harbour porpoises and *Lagenorhynchus* spp. All these species have been considered in this report. There are also a few species which occur in very small numbers within the study area but which are important in terms of conservation aspects. These are the Greenland right whale (*Balaena mysticetus*) and the blue whale (*Balaenoptera musculus*). The former species has a pagophilic nature with recent known sightings from the northern and eastern Barents Sea which could potentially be of specific concern in the AKUP context. Recent blue whale observations within the study area described in this project have been made at the continental slopes off Spitsbergen. Because the observations generally, and especially during the sightings surveys, have been very few, there is no basis for evaluating the abundance of these species other than recognising it as being low.

Bottlenose whales (*Hyperoodon ampullatus*) are also associated with deep waters and continental slopes off western Spitsbergen, but their present abundance in this area is unknown. Few bottlenose whales have been seen during the recent Norwegian sightings surveys and those seen have been recorded in the Norwegian Sea. During *NASS-87* and *NASS-89* (*N*orth *A*tlantic *S*ightings *S*urveys) bottlenose whales were seen farther south, in the area between Jan Mayen, Iceland and the Faroe Islands, which also supports the idea that this species has its northernmost distribution rather early in the summer season and has already left the northern areas by the time of the sightings surveys, which were conducted in July/August.

TIME PERIODS WITHIN THE YEAR

Qualitative information exists (see below) which makes it possible for a few species to deduce fairly reasonable distributional maps throughout the year, but these are exceptions rather than the rule. The only quantitative information available is from the whale sightings surveys conducted in the years 1987–1989; abundance estimates from these surveys refer to the summer situation since the surveys were conducted in June/July/August.

DATA SOURCES

For the work presented here, two main sources of data have been used.

(i) Incidental observations

Incidental observations have been extracted from a database at the Institute of Marine Research (IMR), comprising data from various sources since 1968: IMR research vessels, reports from fishing and small-type whaling vessels and reports from coast guard vessels. The data mainly include date and position of the observation. No quantitative information on the effort involved has been recorded, thus making these data unsuitable for estimating abundance and trends in abundance. Nevertheless the data give useful information on distribution, eventually documenting the presence of a species in space and time.

The dataset of incidental observations also includes a set of Russian observations on harp seals collected during surveillance surveys with ships and aircraft in the Barents Sea from the 1960s onwards.

(ii) Sightings surveys

Sightings surveys with minke whales as the target species have been conducted in each of the years 1987–1989, with the 1989 survey as the most extensive with respect to covered area. That survey included the Barents Sea northwards to the ice edge as well as the Greenland Sea/northern parts of the Norwegian Sea. These surveys have permitted estimation of absolute

abundance for a number of whale species. However, the surveys have been conducted in the summer and only give information on the summer distribution and abundance.

METHODS

Sightings surveys give a mean abundance within the chosen stratum. It is, however, a matter of fact that marine mammals are not uniformly distributed throughout an area. On the other hand, local distributions change from year to year as they also change within seasons. Lacking detailed data to cope with this general problem (which would also require year specific modelling), uniform distributions have been generally assumed. Only areas with little positive evidence of occurrence of a species have been attributed zero abundance. Abundance estimates calculated from these surveys (see general references) have been used as reference points for summer distributions.

Incidental sightings have been looked at on a monthly basis to try to reveal changes in distributional patterns throughout a season. Although the data are not sufficiently detailed and comprehensive to justify extensive conclusions, they have been useful in some cases. Specifications are given below for each species. Generally, subjective judgement has been used to evaluate the incidental sightings data as it is apparent that these distributions are heavily influenced by the distribution of 'effort'; that is, some areas as well as time periods have received disproportionate amounts of coverage due to specific activities such as fishing. It is therefore meaningless to plot observations directly from the incidental sightings database to be used as distributional maps. While the summer distributions of whales are based on analyses of sightings surveys, the others are based on interpretations of available material and are therefore not to be cited as estimates of absolute abundance.

SPECIES IMPLEMENTED

MINKE WHALES *Balaenoptera acutorostrata*

Minke whales were the target species of the recent Norwegian sightings surveys. The summer distribution, which actually refers to July, is mainly based on the 1989 data, at least for the Barents Sea proper which was not surveyed in 1988. The numbers given are the uncorrected line transect estimates; these need to be corrected by dividing by the factor g(0) (0.36) if the absolute abundance numbers are wanted. The uncorrected estimate for the AKUP study area is 8,400 minke whales. This estimate has been distributed according to the densities calculated for corresponding blocks from the 1989 survey, with the ice edge at the time of that survey as the northern boundary in the Barents Sea.

In addition to a uniform distribution as assumed above, a file based on a non-uniform distribution within survey blocks has been supplied to investigate the effect of such a distribution as compared to the uniform one. The procedure has been to use the actual

sightings positions to bound the distributions and then establish a uniform distribution within these 'hot spots'.

Incidental sightings and to a large extent catch data from the minke whaling (catcher logbooks from 1938 onwards) have been used to assess densities at other times of the year. By subjective judgement, distribution areas have been bounded by actual catch and sightings distributions.

North of 73°N, the occurrence of minke whales as judged from incidental sightings and catch statistics is nil or negligible in the period from September to February.

HARP SEALS *Phoca groenlandica*

As a starting point, results from simulations made by the ICES Working Group on Harp and Hooded Seals in 1991 have served as basic population estimates of the White Sea/Barents Sea harp seal population. Incidental sightings, and especially the Russian sightings data, cover extensive periods and areas and form a useful basis for evaluation of relative abundance in areas and periods. The study area has been divided into blocks which seem to describe movements reasonably well, and abundance has been further bounded within blocks by actual observations. Within such bounded regions the density has been assumed to be uniform. This is clearly a simplification for such a gregarious and migrating species. There is also another problem with the harp seal distributions: Especially at certain times of the year the distribution is very closely related to the northern pack ice edge, and a dynamic modelling would have been more appropriate than the static geographic reference.

The data support that in December–February the number of harp seals north of 73°N is negligible. For the other periods the bases used are 120,000 harp seals (March–May) and 540,000 harp seals (June–November).

HUMPBACK WHALES *Megaptera novaeangliae*

This species typically shows large variations in abundance, probably due to the dependence of shoaling fish, especially capelin, as food. The variations are revealed in the incidental observation data as well as in the sightings surveys. The sighting survey estimate, which refers to July, indicates an abundance of about 210 humpbacks within the study area at that time. However, there seems to be an increasing availability of whales in the area from August onwards with a possible peak in late September. The increased availability is also followed by a change in distribution towards the Hopen area. Although there is evidence that some humpbacks stay in the area throughout the winter (as do other baleen whales), the information held is not sufficient to decide on distributions during this period.

FIN WHALES *Balaenoptera physalus*

Little is known about the northern distribution during the year, but some fin whales were observed during the sightings surveys with an approximate 300 whales within the AKUP

study area. They are mainly found in the western part of the study area, associated with the continental slopes. Only one file is submitted, strictly speaking referring to a July distribution.

HARBOUR PORPOISE *Phocoena phocoena*

Harbour porpoises were regularly observed during the sightings surveys in the Barents Sea, with an estimate of approximately (uncorrected abundance, i.e. not corrected for g(0)) 7,000 within the study area. Nothing is known of the distribution at other times of the year in this northern area.

Lagenorhynchus spp.

From the sightings surveys, an estimated 20,000 of these species (primarily thought to be *L. albirostris* – white-beaked dolphin) can be attributed to the study area. More than 90% of incidental sightings have been made from May to September, and the data are insufficient to elaborate on seasonal distributions. This species occurs in relatively large groups, which might put into question the approach taken here with uniform densities within bounded regions.

SUBMITTED FILES

All submitted files are listed in Appendix 1 and the distribution maps are presented in Appendix 2. The files have been tested with the *SIMPLOT* matrix mapping and conspicuous errors have been corrected. Although numbers in the instances referring to whale summer distributions are based on sightings survey data, the files should generally be considered as mapping relative densities of the species concerned. One should also bear in mind that the distributions themselves have been produced by applying subjective judgement to the data available.

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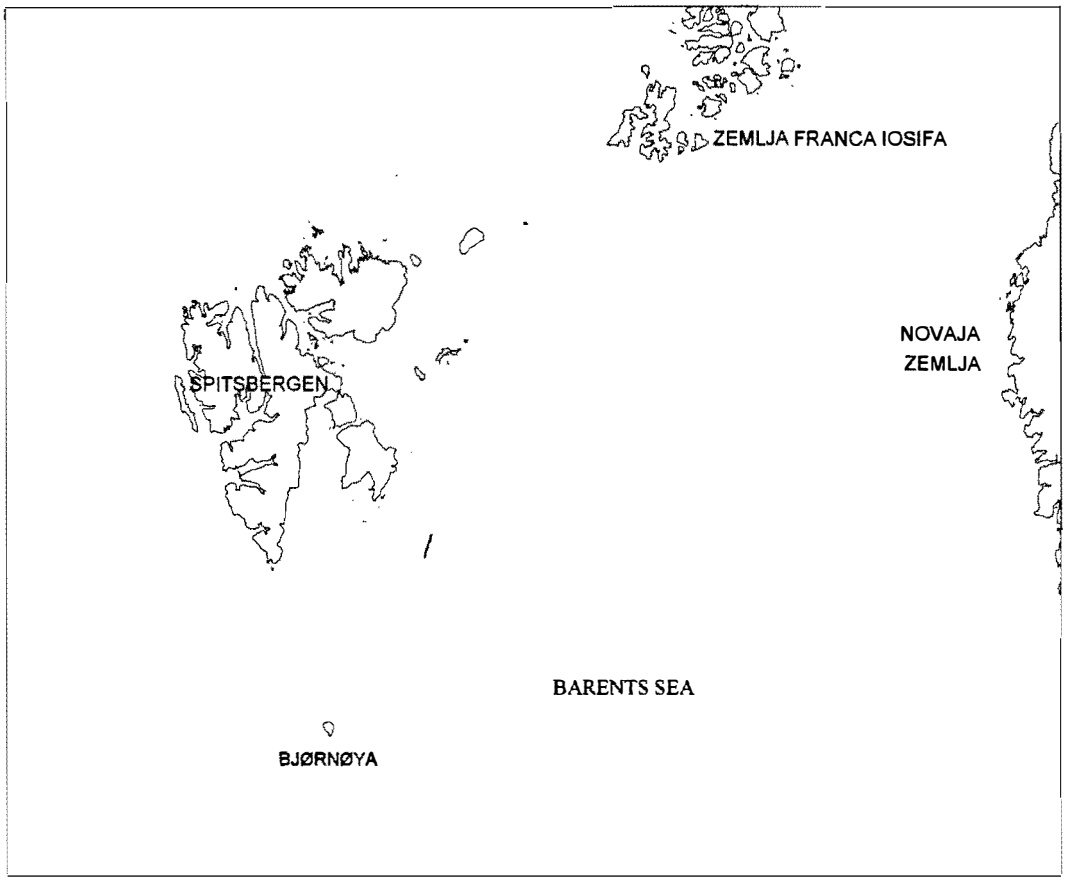
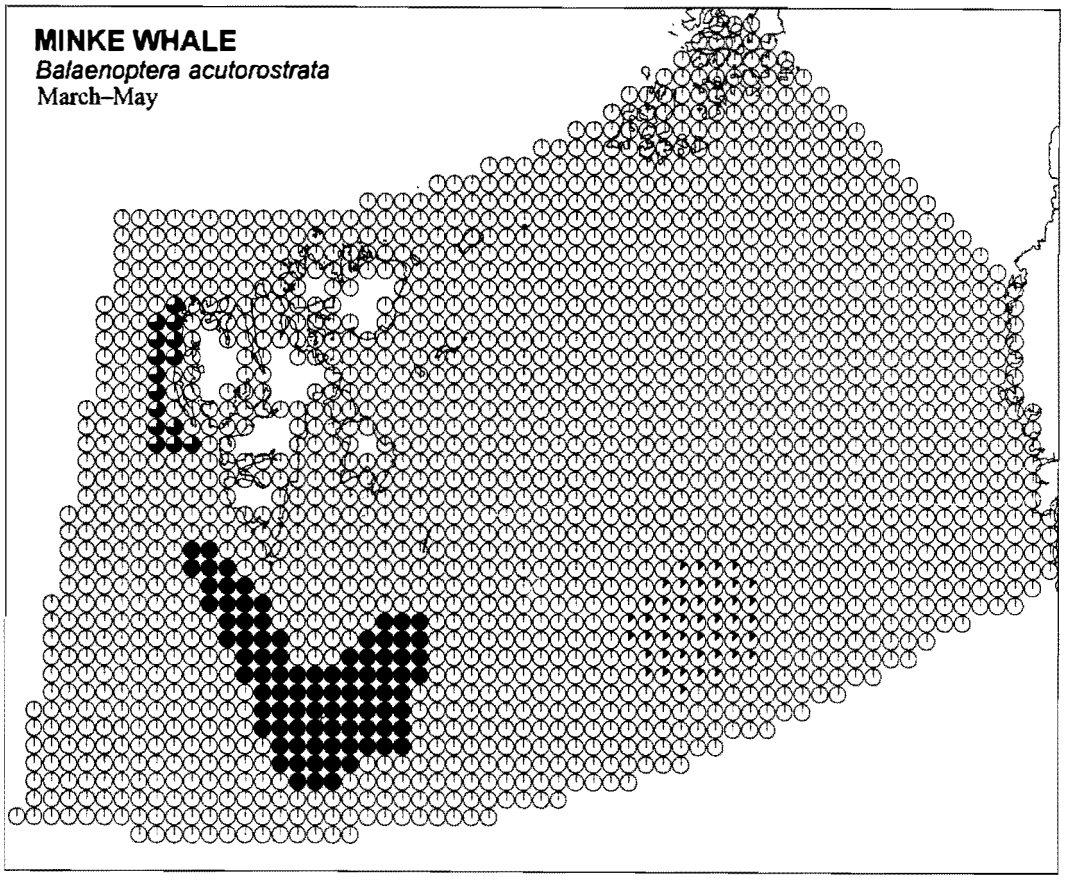
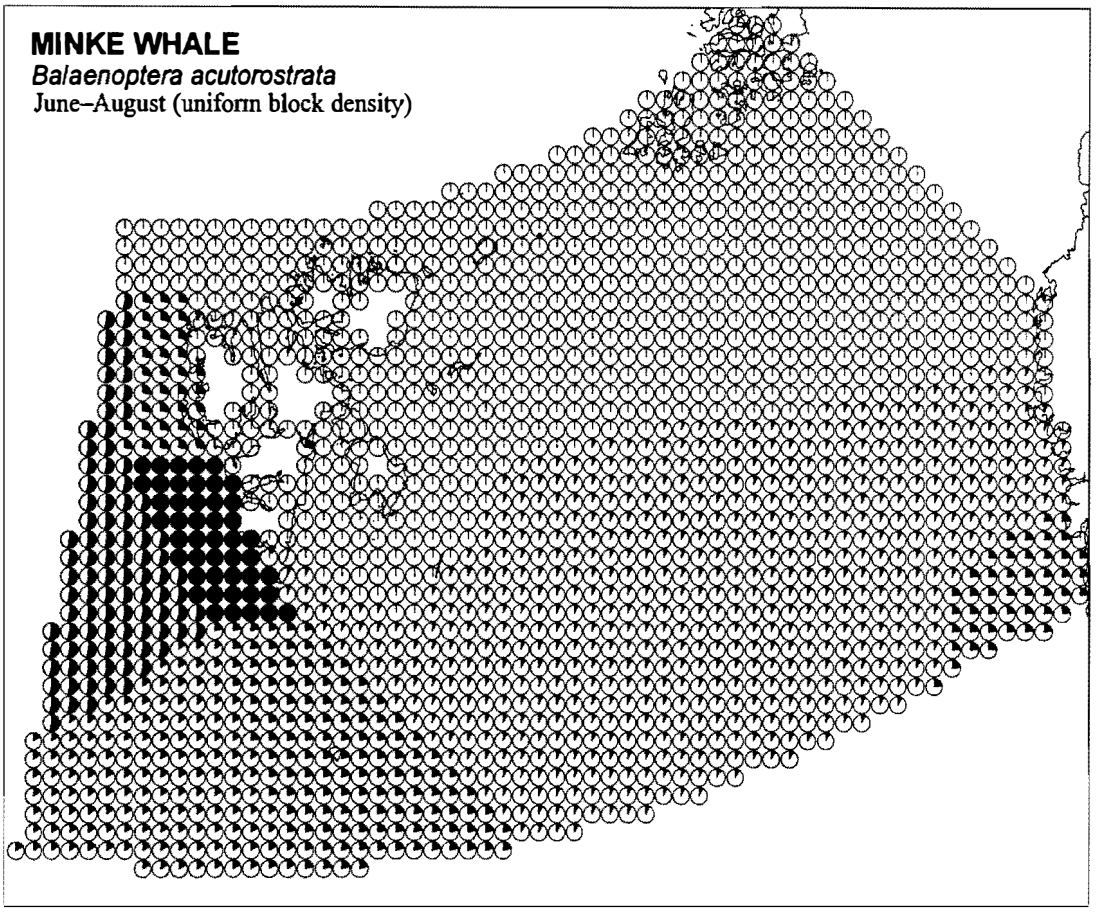
APPENDIX 1 (List of species and files)

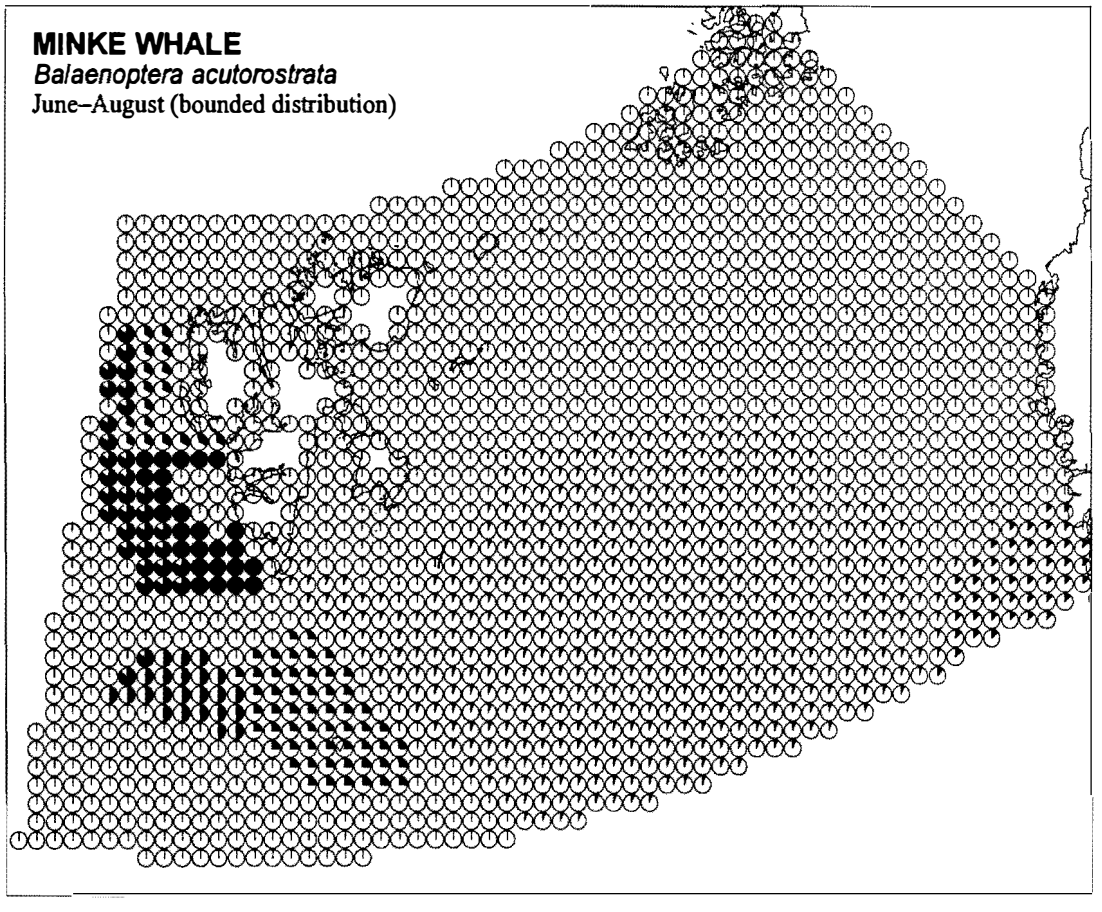
SPECIES	PERIOD	FILE	DATA SOURCES
Minke whale	March–May	mi-0305U.raw	Catches, incidental sightings
	June–August	mi-0608U.raw	Survey, uniform block density
	June–August	mi-0608P.raw	Survey, bounded distribution
	September–February	nil, insufficient information	
Harp seal	March–May	gr-0305P.raw	Incidental sightings and Russian data
	June–August	gr-0608P.raw	
	September–November	gr-0911P.raw	
	December–February	nil	
Humpback whale	May–July	hu-0507U.raw	Sightings survey
	August–October	hu-0810U.raw	Incidental sightings
	November–April	nil – Insufficiently known	
Fin whale	Unspecified – July	fi-U.raw	Sightings survey
Harbour porpoise	Unspecified – July	ni-U.raw	Sightings survey
Lagenorhynchus spp.	Unspecified – July	la-U.raw	Sightings survey

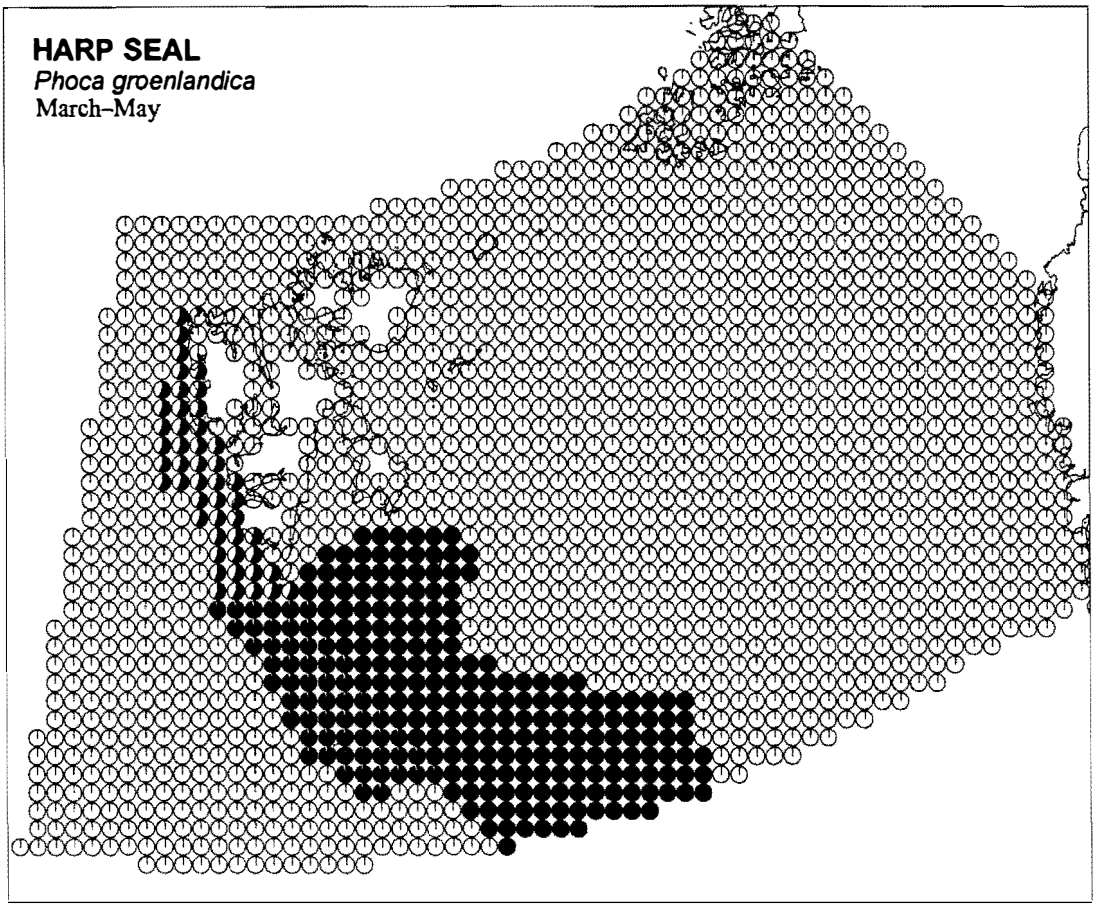
APPENDIX 2 (Distribution maps)

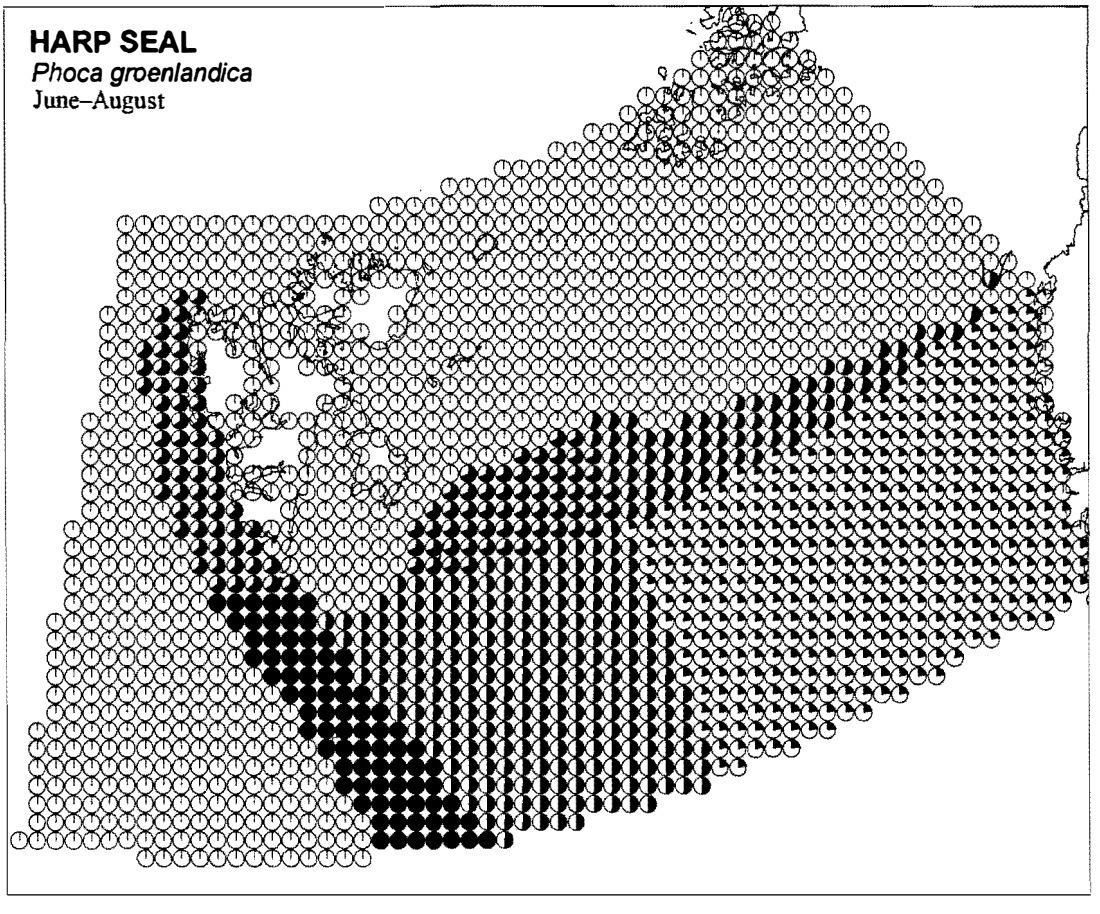


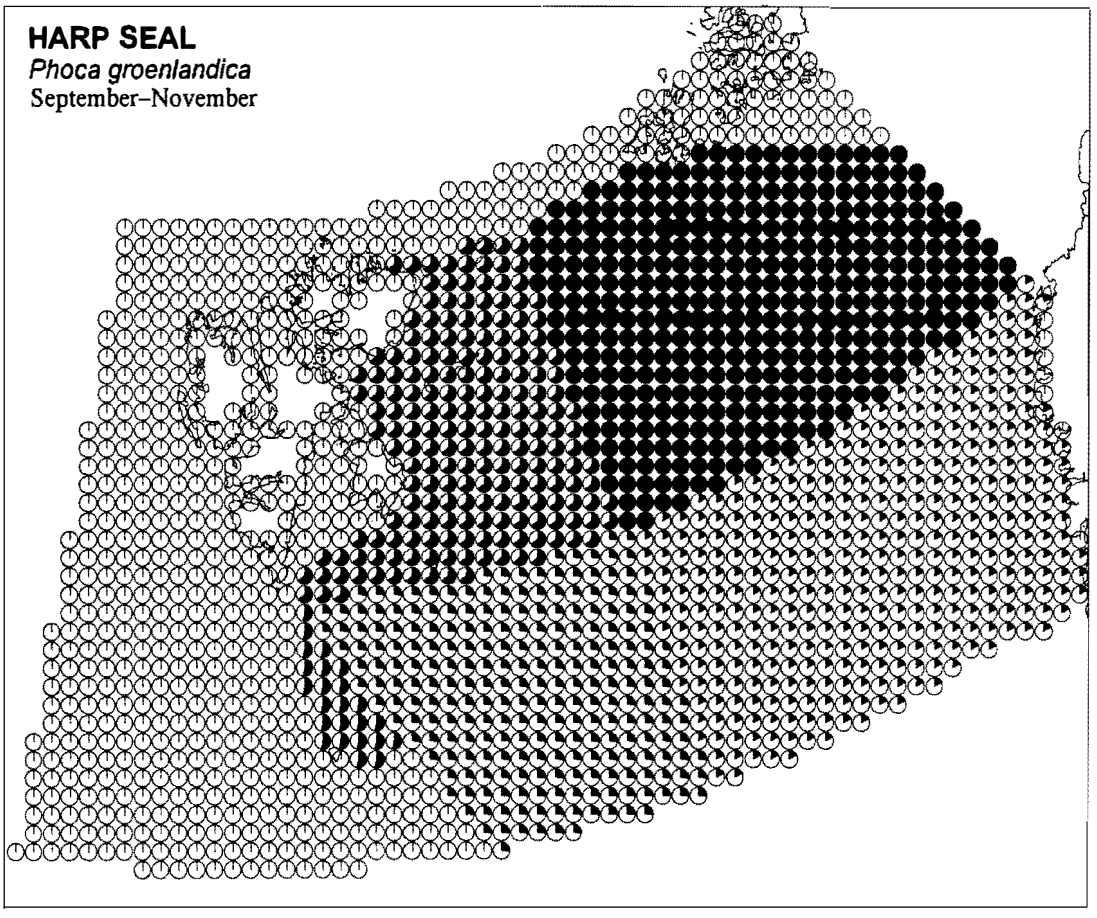


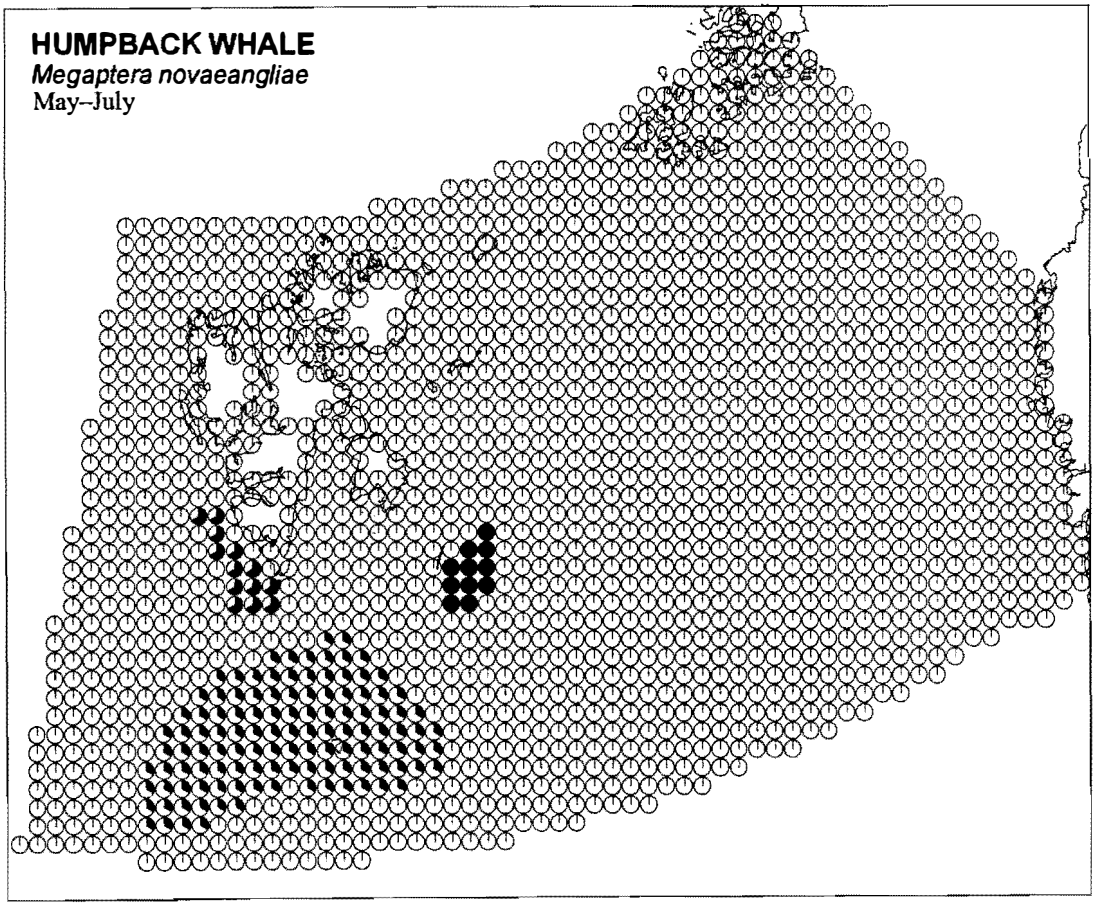

MINKE WHALE
Balaenoptera acutorostrata
June–August (uniform block density)

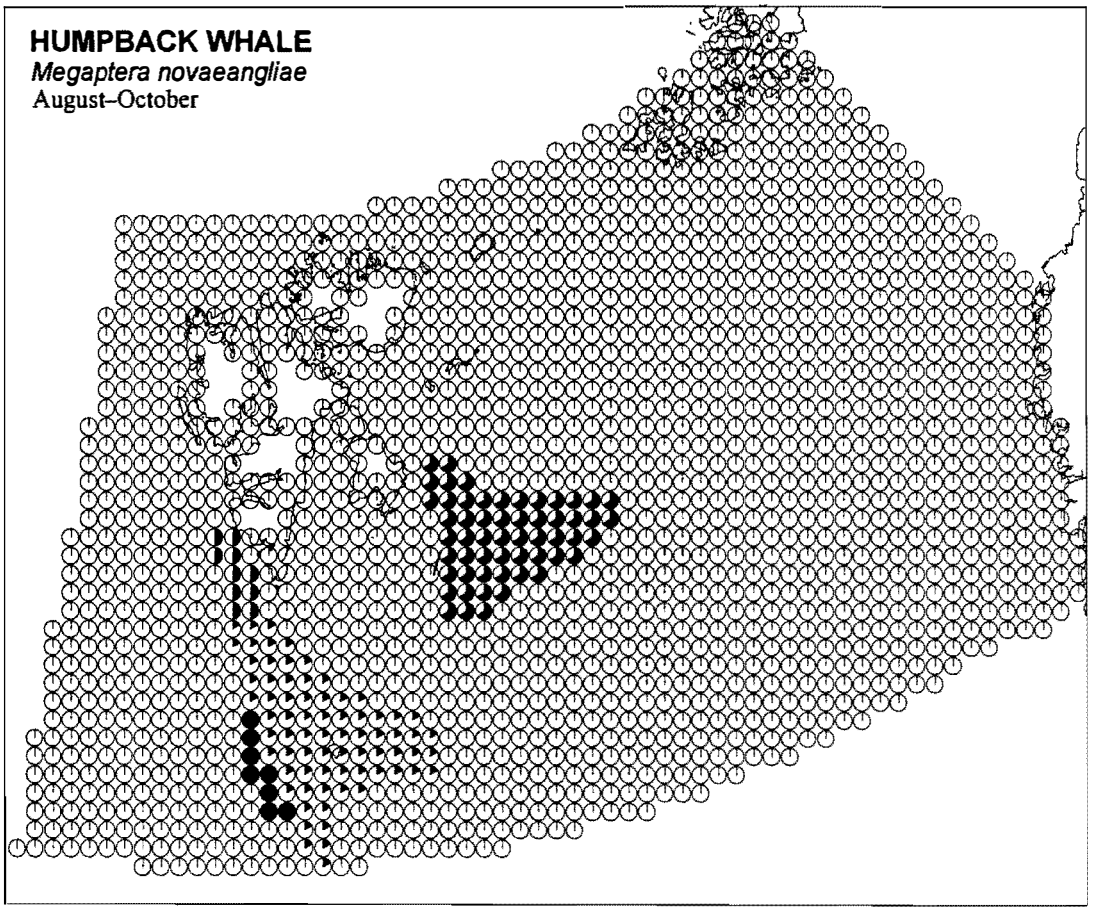

MINKE WHALE
Balaenoptera acutorostrata
June–August (bounded distribution)

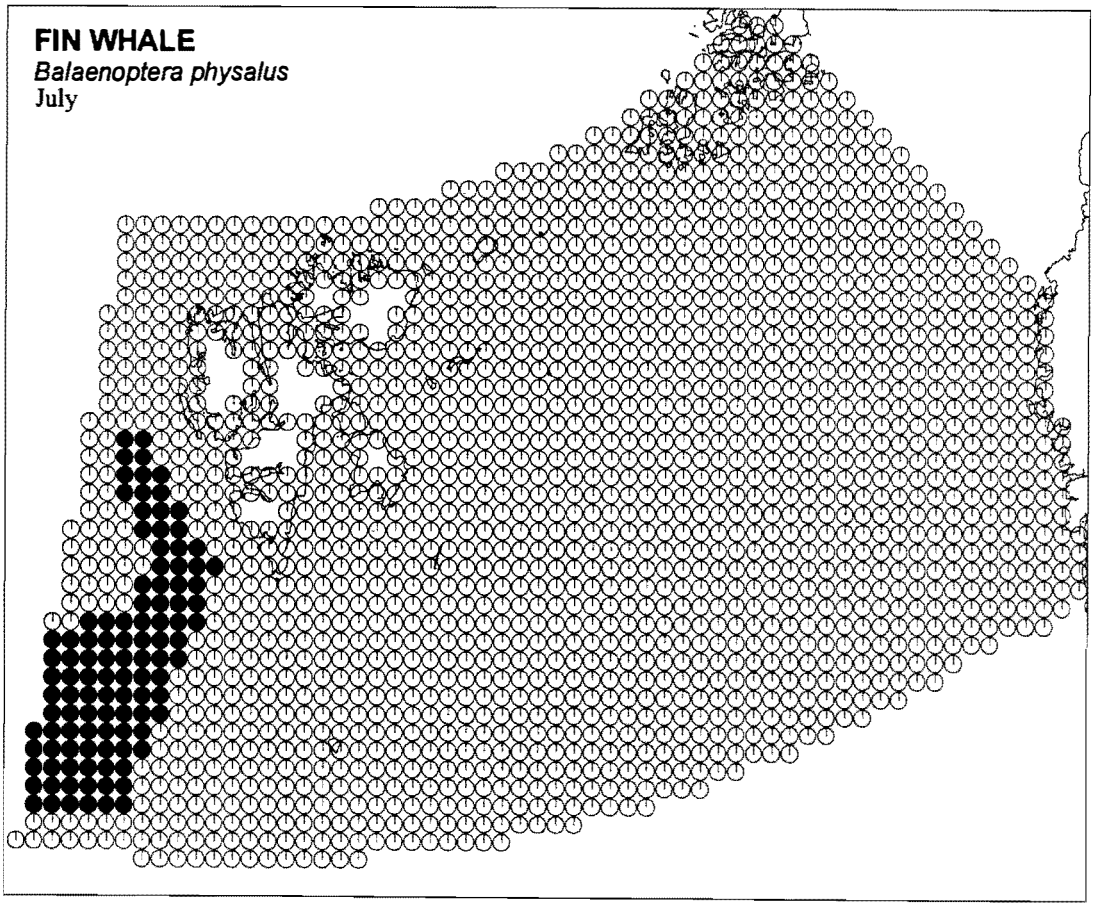

HARP SEAL
Phoca groenlandica
March–May

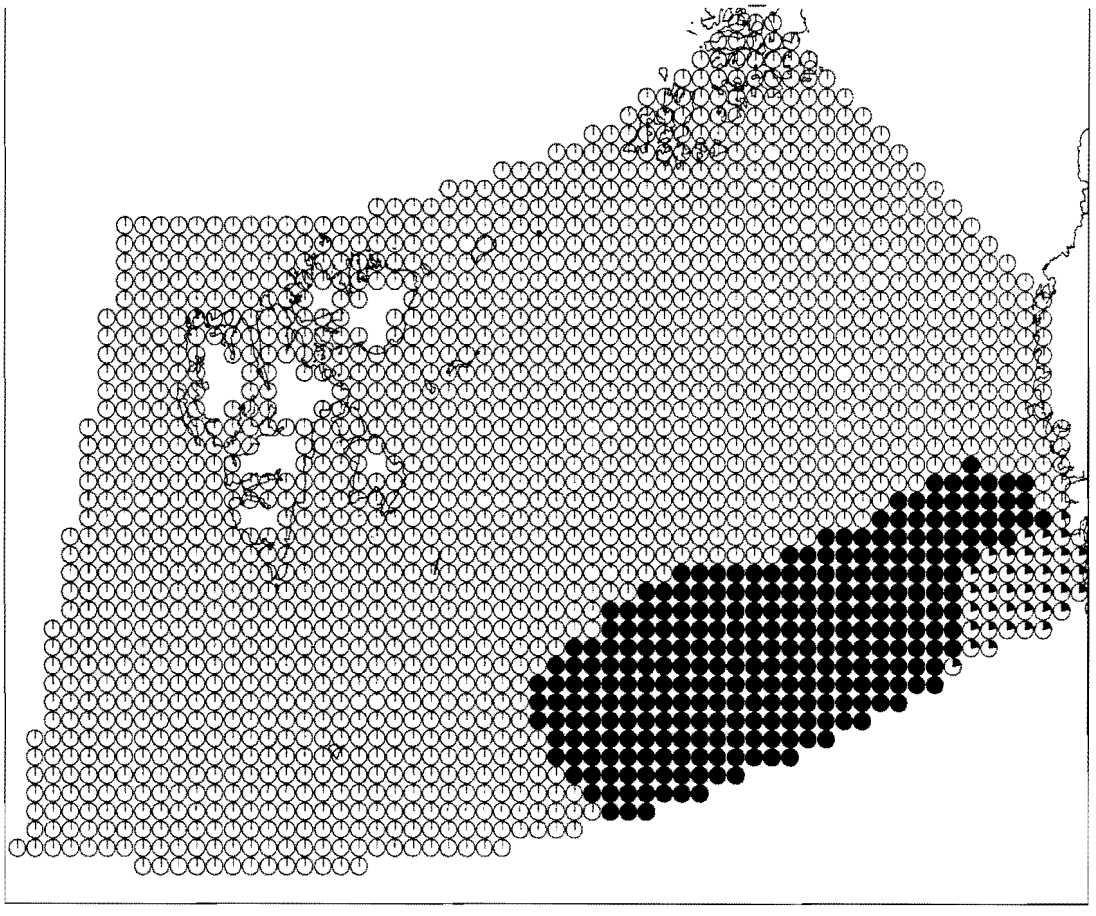

HARP SEAL
Phoca groenlandica
June–August


HARP SEAL
Phoca groenlandica
September–November

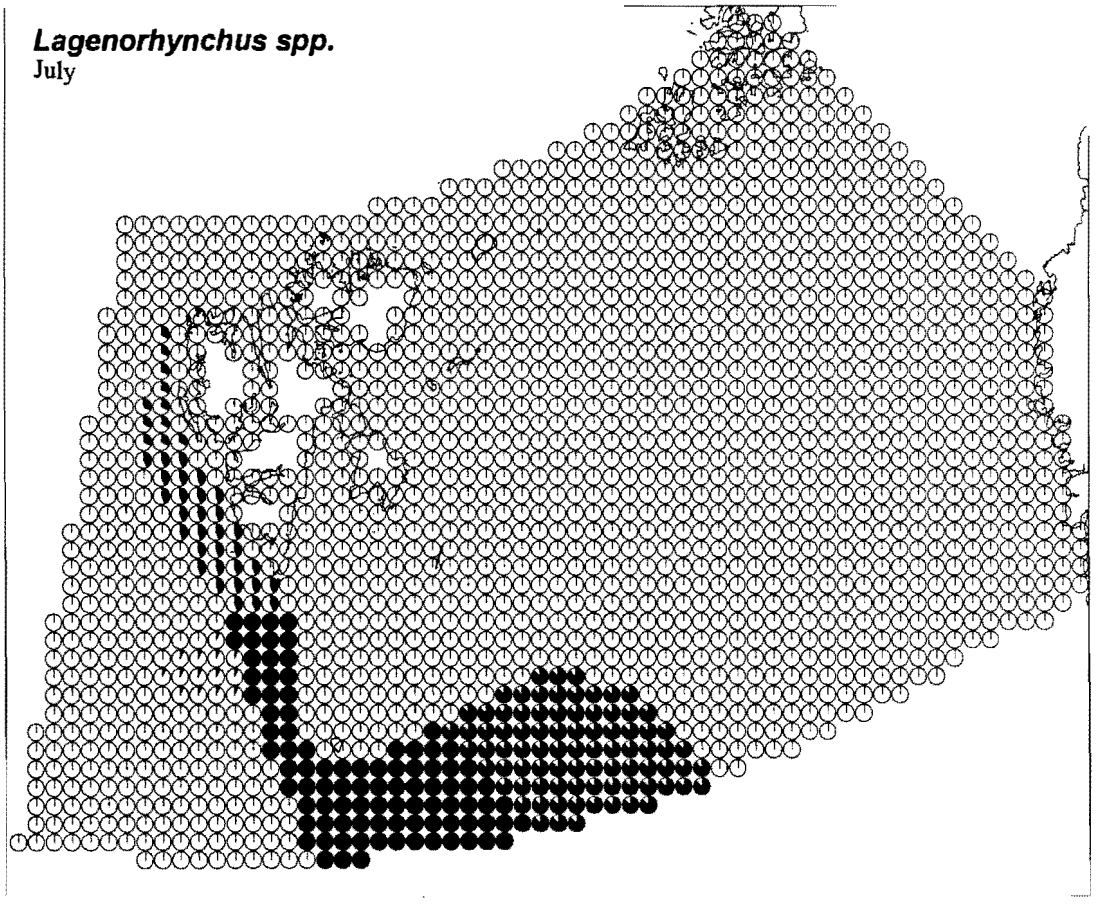

HUMPBACK WHALE
Megaptera novaeangliae
May–July


HUMPBACK WHALE
Megaptera novaeangliae
August–October


FIN WHALE
Balaenoptera physalus
July



Lagenorhynchus spp.
July



SEASONAL DISTRIBUTION OF HARBOUR SEALS, BEARDED SEALS, WHITE WHALES AND POLAR BEARS IN THE BARENTS SEA

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White whales (*Delphinapterus leucas*) at Nordaustlandet – the small grey individuals are young. Photo by Fridtjof Mehlum.

Abstract – The seasonal distribution of harbour seals (*Phoca vitulina*), bearded seals (*Erignathus barbatus*), white whales (*Delphinapterus leucas*) and polar bears (*Ursus maritimus*) in the northern Barents Sea is outlined. Bearded seals, white whales and polar bears are closely connected to ice-filled waters during whole or parts of the year, often with the highest concentrations along the ice edge. The extension of the ice in the Barents Sea varies considerably both during the year and between years, and the distribution of these species varies accordingly. The area with potentially high densities may therefore be very large. The knowledge on population size and distribution in different seasons is relatively poor for several species. The geographical distribution is therefore illustrated with relative density-values.

INTRODUCTION

Information on the geographical distribution of sea mammals in the Barents Sea is crucial in assessing how large proportions of the populations might be affected by an oil spill in this area. The distribution of most of the species occurring in the northern Barents Sea have been reported elsewhere (Jødestøl & Ugland 1993; Jødestøl et al. 1994; Øien & Hartvedt 1995). Four important species were, however, not treated in those reports. These are the harbour seal (*Phoca vitulina*), the bearded seal (*Erignathus barbatus*), the white whale (*Delphinapterus leucas*) and the polar bear (*Ursus maritimus*). The seasonal distribution of these four species is treated here. The general biology of the four species is given elsewhere in this volume (Lydersen & Wiig 1995) and is therefore not repeated here.

DISTRIBUTION MAPS

Relative distribution maps have been made based on general knowledge of the distribution of the species (Appendix 1). Polar bears and white whales are believed to have a relatively high density along the ice edge in the Barents Sea in winter and spring. The extension of the ice edge within a season varies considerably from year to year. The depicted high density areas for these species are given between the minimum and maximum ice edge in the period (after Vinje 1985), and the high density areas are therefore much larger than they can be in a single year.

SPECIES ACCOUNTS

HARBOUR SEAL *Phoca vitulina*

Harbour seals tend to be solitary in the water, but are highly gregarious at haul-out sites. Haul-out sites are normally small rocks or sandy beaches, and these chosen areas are frequently visited, especially at low tides. The species is generally considered to be non-migratory. Longer migrations have, however, been documented (e.g. Wiig & Øien 1988)

Between 500 and 600 animals are found in Svalbard (Prestrud & Gjertz 1990). The population has a very limited geographical distribution and is almost exclusively confined to the western coast of Prins Karls Forland.

New unpublished information (Gjertz, Lydersen & Wiig unpublished), achieved by help of satellite transmitters, has shown that some harbour seals tagged at Prins Karls Forland in autumn have migrated to Bjørnøya in winter, and at least one was seen in the tagging area again the following summer. Most of the tagged animals have been in the tagging area as long as we have followed them into the winter.

We believe that the migratory pattern is dependent on the distribution of ice. Based on this preliminary information we suggest that the general distribution of harbour seals is around Prins Karls Forland with the highest abundance at the west coast. From October to June some specimens might be found down to Bjørnøya. The density in the distribution area on the map is given on a relative scale from 1 to 3.

BEARDED SEAL *Erignathus barbatus*

Bearded seals are normally associated with drifting ice floes, but are also able to maintain breathing holes in fast ice, and in some areas they also haul-out on land. Their general benthic food habits restrict their range to relatively shallow waters (Burns 1981). Bearded seals are thought to move great distances during the year mainly to keep in association with the ice, but in areas where the ice melts such as in the White Sea, they may haul-out on shore. In addition some animals, mainly subadults, may summer in the open seas (Burns 1981). The bearded seals are solitary animals and do not form herds either at sea or when hauled out. Potelov (1975) states that a large part of the population of bearded seals that inhabit the White, southern Kara and Barents Seas during winter, migrate to the northern Barents and Kara Seas during the summer and autumn.

We do not have data that makes it possible to give a good relative density distribution on bearded seals in the assessment area. It seems that their distribution pattern follows the dynamics of the drifting ice and that the density along the ice edge is higher than in open water during the ice season from October to July. In particular it seems as if there is a high density of breeding bearded seals with new-born pups near the ice edge in April–May (see Wiig 1995). In summer and autumn they are found in the fjords and in connection with open drift ice in the Barents Sea.

WHITE WHALE *Delphinapterus leucas*

White whales are highly gregarious and are normally found in pods consisting of a mixture of different age and sex groups or in all male groups. There is a general seasonal movement of schools coming into coastal waters and river estuaries during summer, and to off-shore pack-ice areas and polynyas in winter (Brodie 1989). During the summer-stay in shallow waters, white whales undergo an annual apparently unique process in whales, where they shed their

epidermis in a moult-like manner (St. Aubin et al. 1990). These shallow areas are thus very important habitats for white whales.

The distribution pattern of white whales in the assessment area presented here is based on Gjertz & Wiig (1994).

Some white whales may *winter* along the western coast of Svalbard. Most of the whales are, however, believed to be found in open water and along the ice edge in the Greenland and Barents Seas.

In *spring* the white whales follow the dynamics of the ice. Large schools have been observed in the ice edge zone in the Barents Sea. When the ice breaks up in the western fjords the whales are found here in large schools. It seems that females with calves are found farther north than the rest of the population in early spring.

In the ice free period in *summer* they are most likely to be found in nearshore areas all over Svalbard. They are also found along the coasts of Novaja Zemlja and Zemlja Franca Iosifa. In particular they are found in estuaries near large rivers.

In the *autumn* the white whales leave the fjords and coasts when the ice increases and probably disperse to the east and west along the ice edge. Some probably stay along the ice free west coast of Spitsbergen.

According to Belikov and Boltunov (in prep.) many white whales from the Kara Sea winter in the Barents Sea. The spring migration of white whales from the Barents Sea to the Kara Sea goes through Karskie Vorota strait and north of Cape Zhelaniya in April–May and through Yugorskyi Shar strait in May–June. In summer (July–August) white whales continue to move to the Kara Sea from Matochkin Shar strait. The white whales migrate back to the Barents Sea in autumn through the same straits.

POLAR BEAR *Ursus maritimus*

According to Larsen (1986) the polar bears in the Svalbard area move seasonally with the changing ice conditions in the Barents Sea. As a result the bears tend to move northeast in the summer when the ice retreats and southwest when the sea freezes up again in autumn and winter.

The results of recent studies (Wiig 1993, in press) based on satellite telemetry show that several female bears follow such a seasonal movement. However, a number of them also stay on land after most of the ice in an area has disappeared. In some cases high concentrations of polar bears on an island during summer drifting with the ice far away from shore, have been interpreted as if the bears have been 'trapped' on land (Larsen 1986). This may well be the situation in some extreme cases, but it seems that many bears choose to stay on land for several summers, while others follow the drifting ice. The very different movement pattern found is probably not a result of random variation, but rather a result of individual choice.

This means that when considering possible conflicts between oil exploration activity and polar bears, the bears are not only found in connection with the drifting ice, but many are also found on land during summer. This does not, however, relate to Bjørnøya were few bears are seen during the ice-free period of the year (Larsen 1986).

Larsen (1986) regarded 82°N as the northern border of the distribution of the polar bears at Svalbard. The very few females that have been tracked that far support this. This limit coincides with where the shallow Barents Sea falls off into the deep Arctic Ocean and where the marine productivity and the availability of seals drops (Larsen 1986).

A very high number of migrating polar bears are observed at Hopen each winter. In years when the ice reaches Bjørnøya in winter and spring a large number of bears are also observed there (Larsen 1986). Wiig & Bakken (1990) and Wiig (1995) found indications of a very high concentration of polar bears near the southern ice edge in the Barents Sea during winter and spring. Few of the female bears that have been followed by satellite in the Svalbard area have, however, been tracked south to the ice edge area during winter.

In *winter* and *spring* the lowest concentrations of bears are found along the western coast of Spitsbergen from Isfjorden to the northwestern part of Spitsbergen. In other areas farther east and south the concentrations may vary but are relatively high. The highest concentrations have been found in Hornsund, the Storfjord coast of Spitsbergen, and along the ice edge in the Barents Sea.

In *summer* and *autumn* the bears follow the retreating ice, but many bears might stay along the Storfjord coast of Spitsbergen and at Barentsøya and Edgeøya. In some years with very little ice very high concentrations of bears have also been found on Kong Karls Land.

Important denning areas of polar bears have been located at Kong Karls Land. Many dens are also found along the coast of Nordaustlandet, Barentsøya, Edgeøya, the Storfjord coast of Spitsbergen and in Hornsund.

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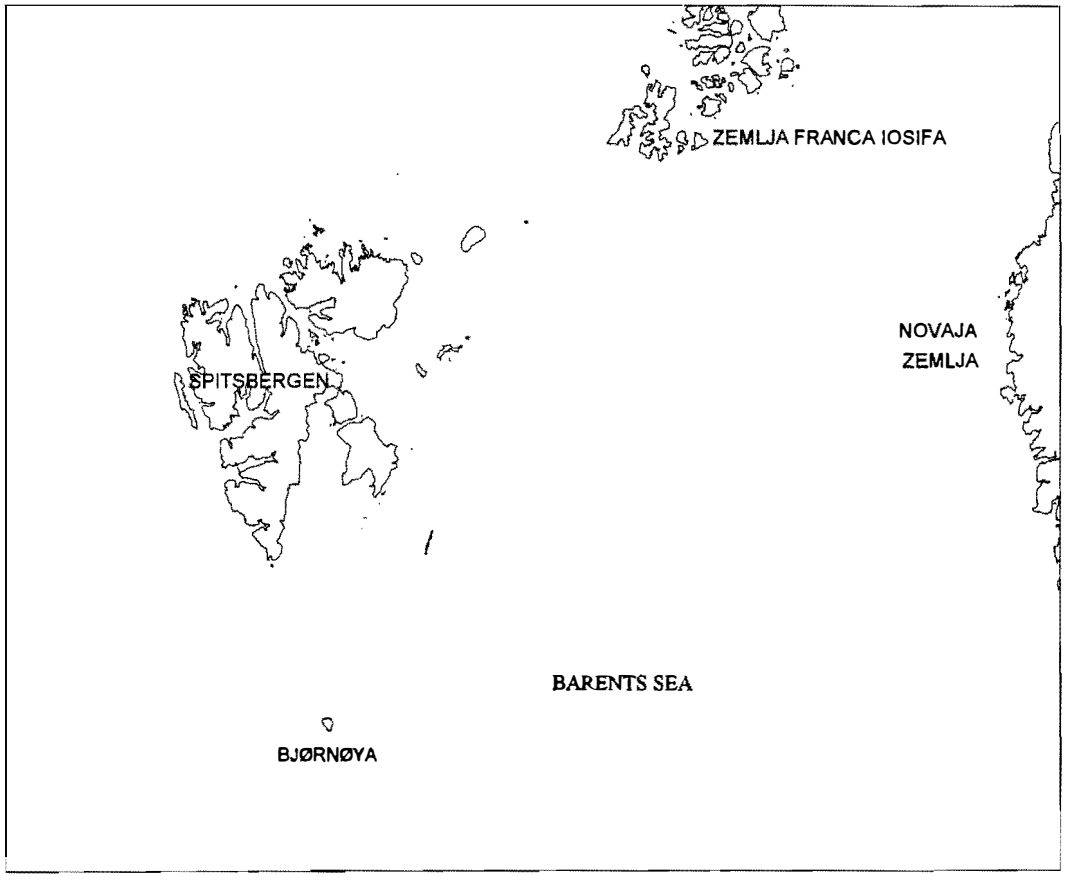
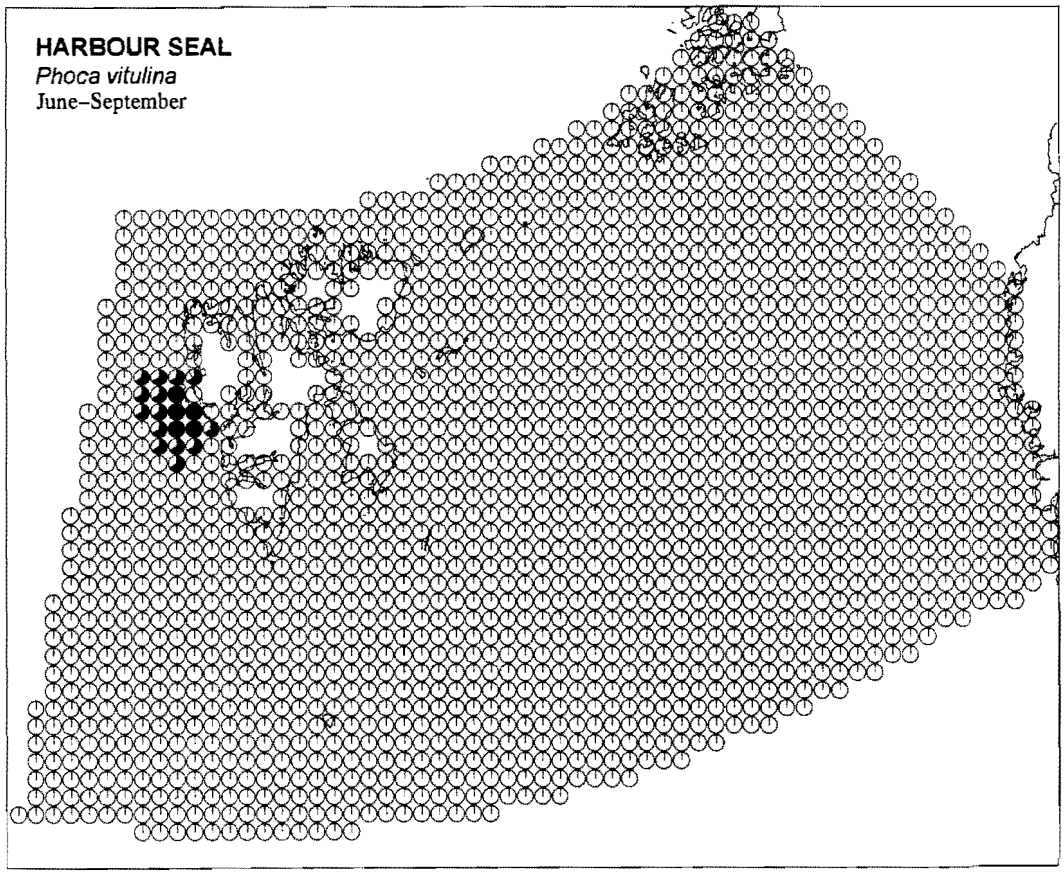
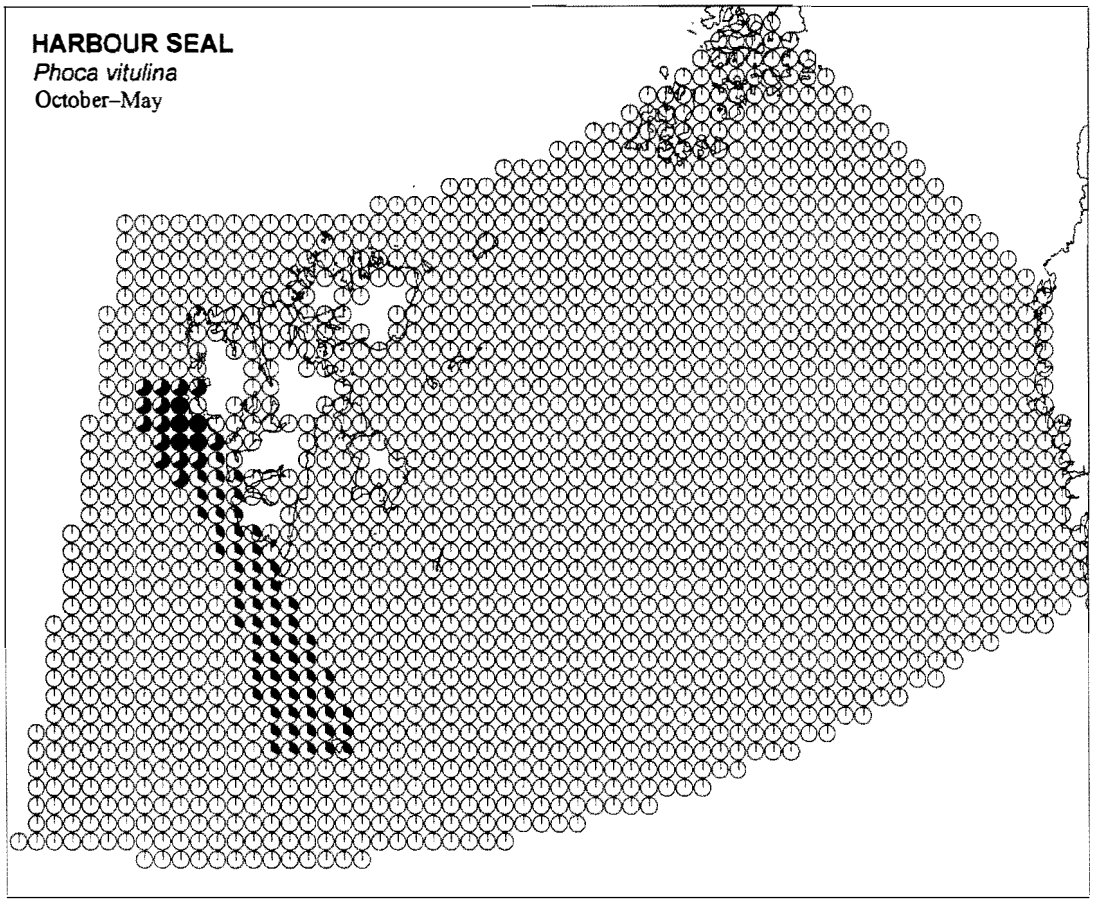
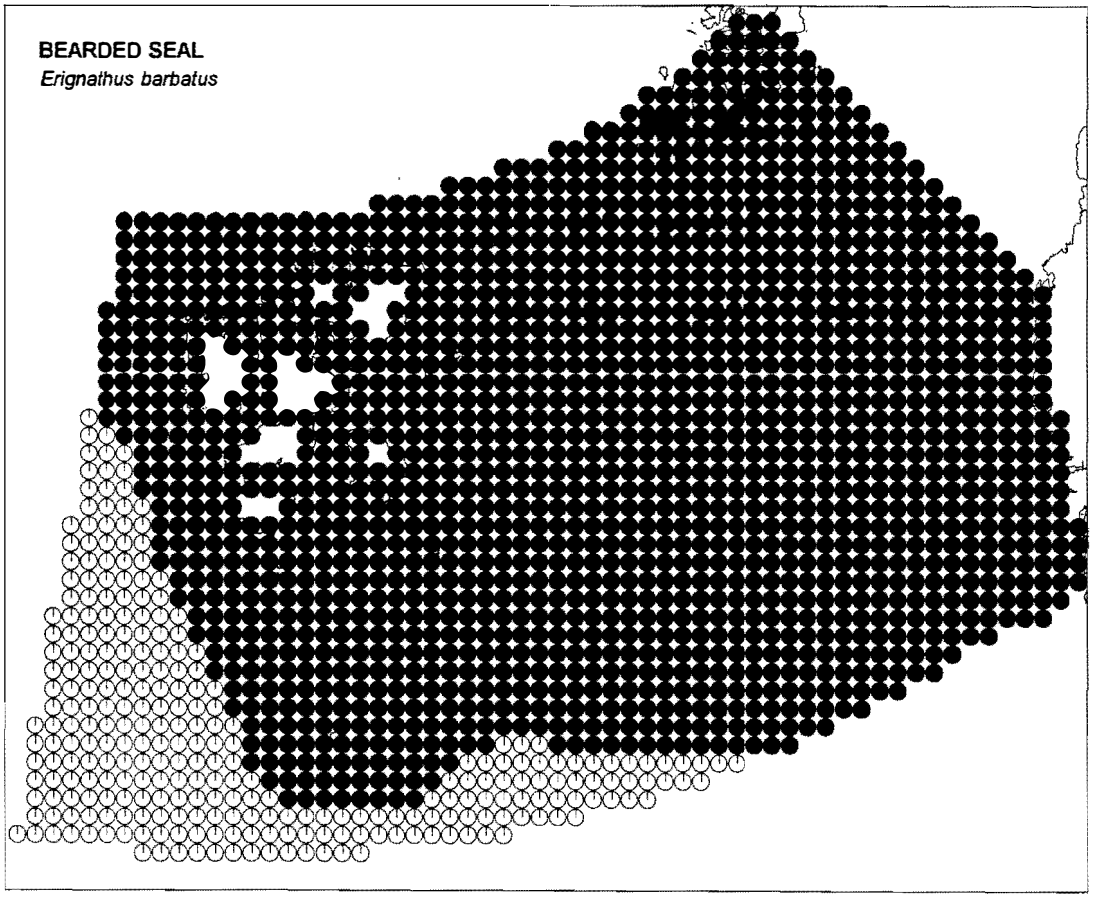
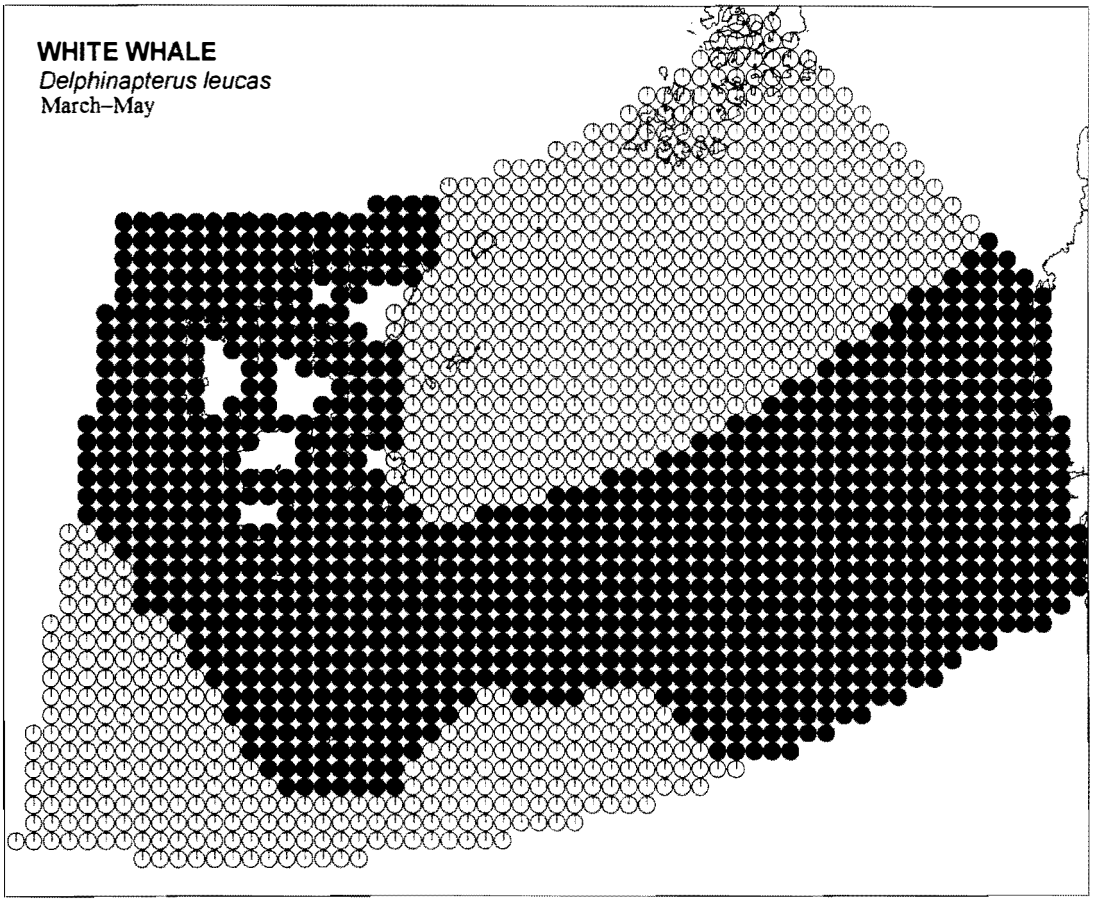
APPENDIX 1 (Distribution maps)

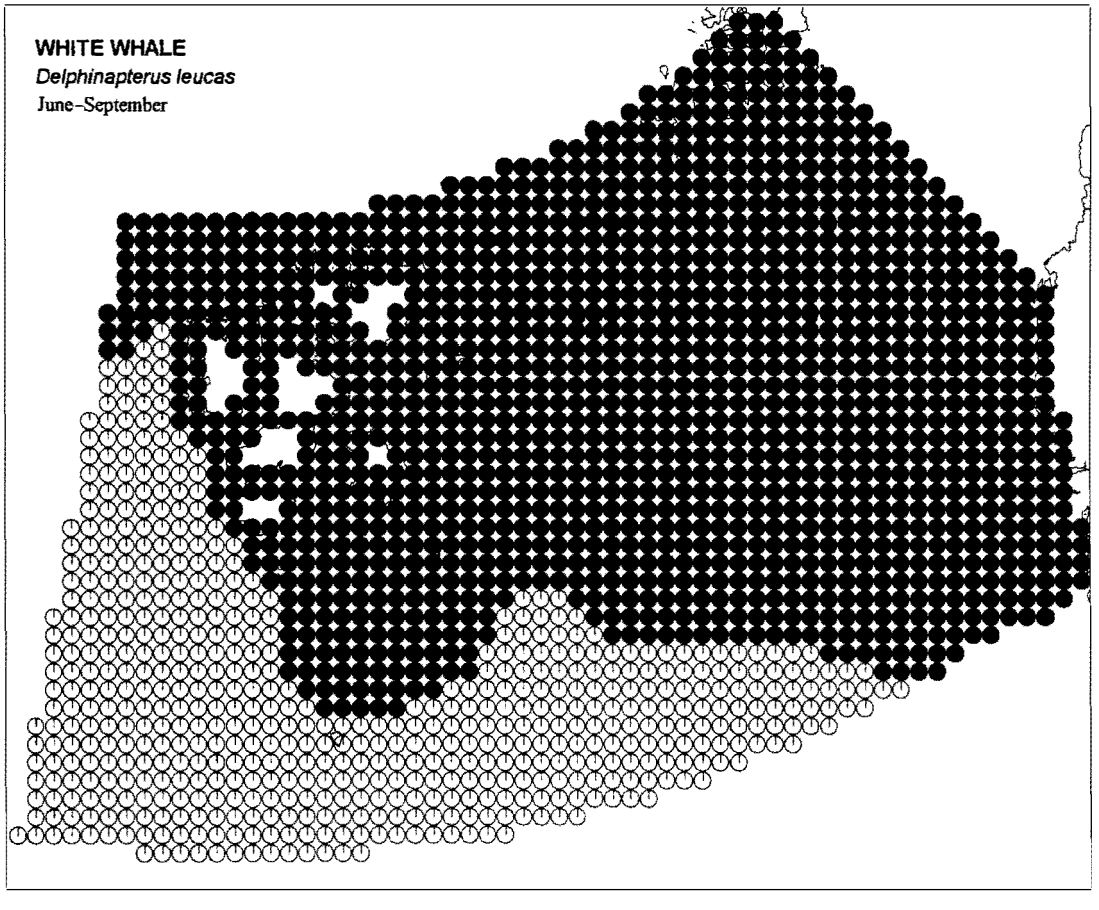


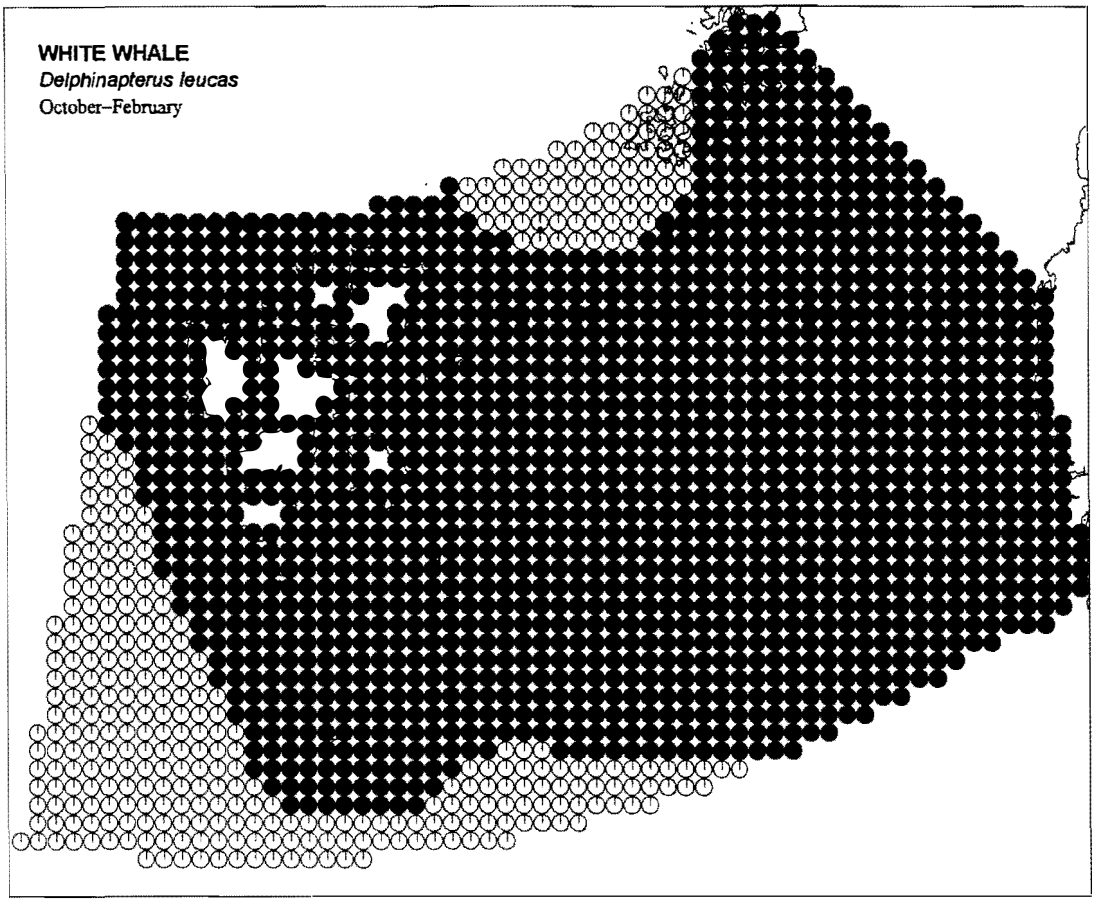


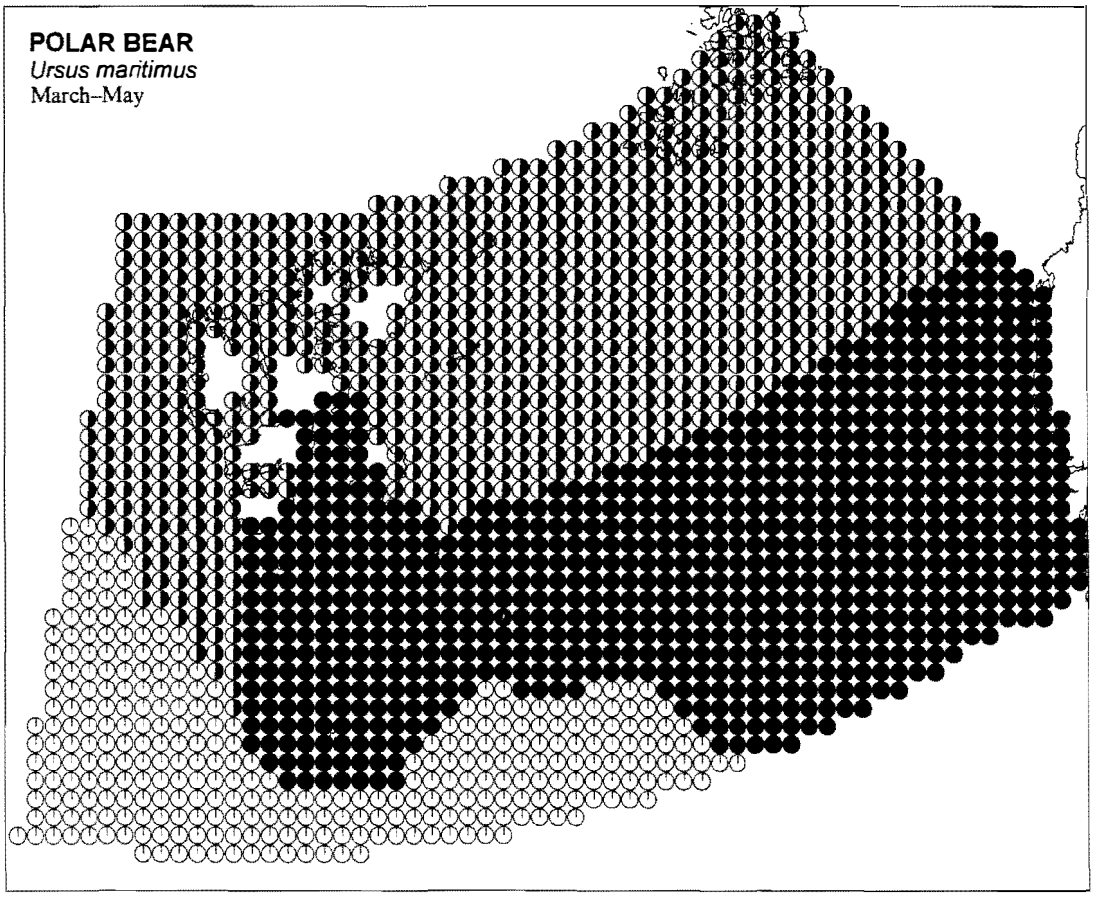

HARBOUR SEAL
Phoca vitulina
October–May


BEARDED SEAL
Erignathus barbatus

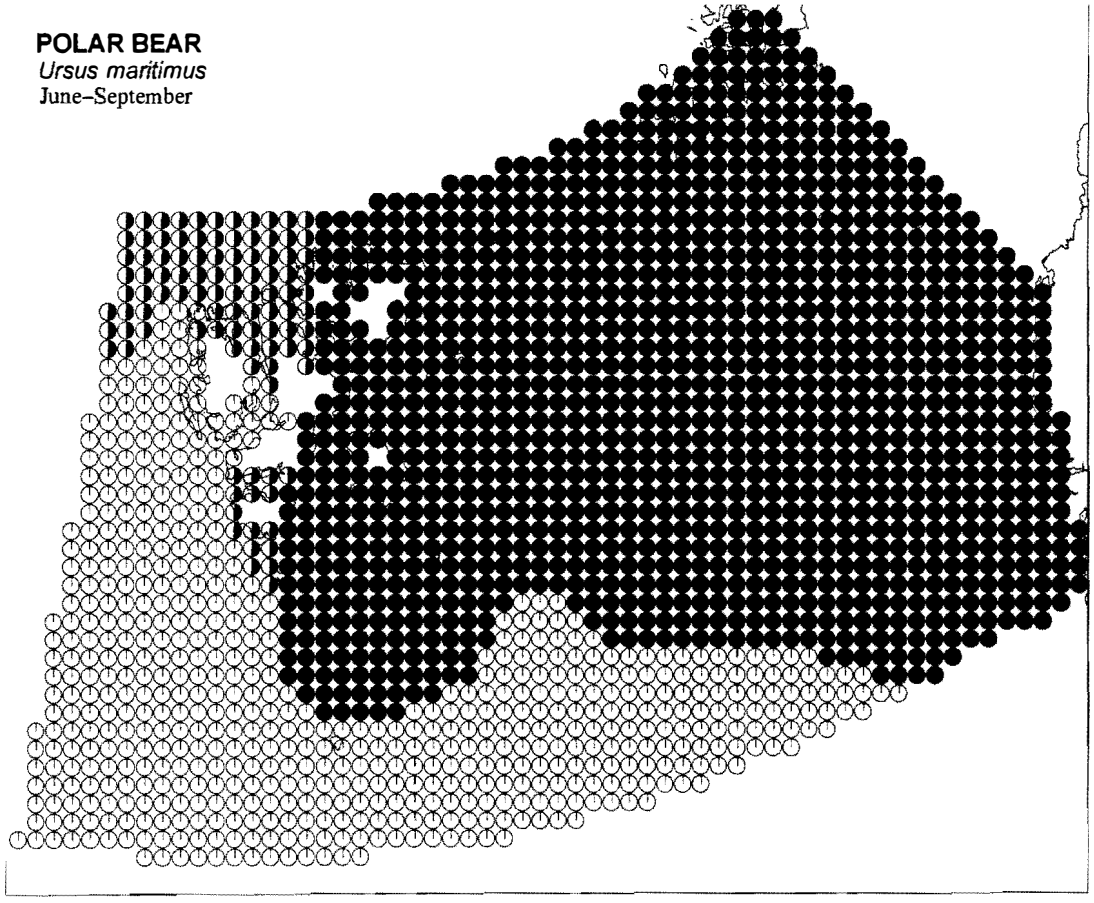

WHITE WHALE
Delphinapterus leucas
March–May


WHITE WHALE
Delphinapterus leucas
June–September

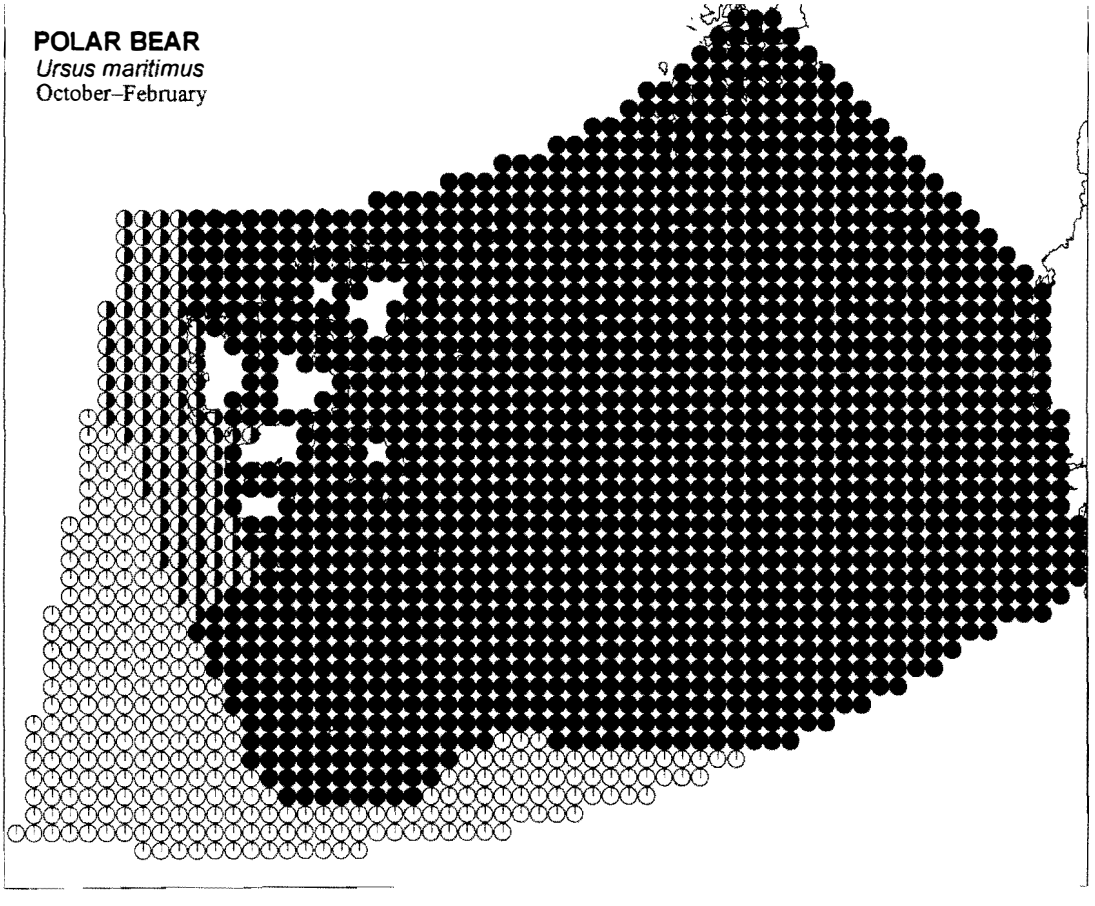

WHITE WHALE
Delphinapterus leucas
October–February

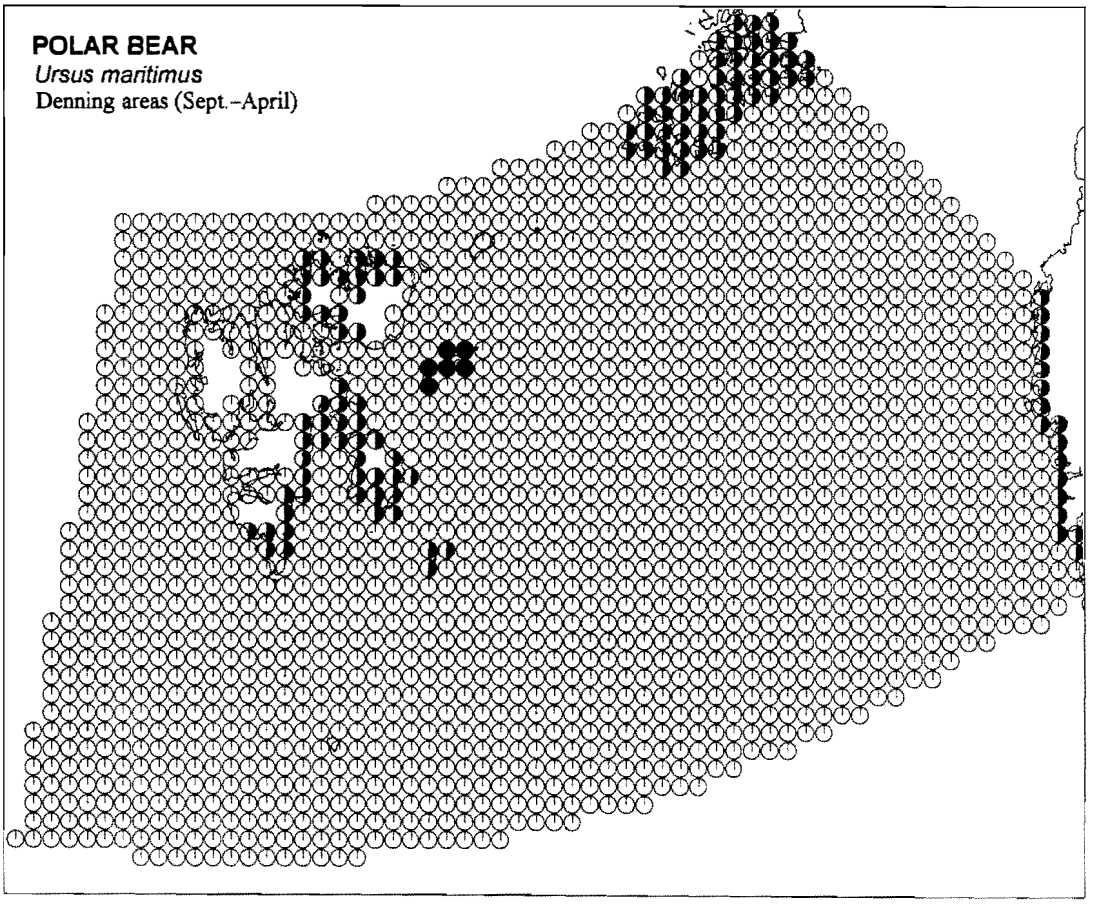

POLAR BEAR
Ursus maritimus
March–May

POLAR BEAR
Ursus maritimus
June–September



POLAR BEAR
Ursus maritimus
October–February




POLAR BEAR
Ursus maritimus
Denning areas (Sept.–April)

APPENDIX

Systematic list of marine mammal species treated or mentioned in this report.

NORWEGIAN	ENGLISH	SCIENTIFIC
Nebbhval	Bottlenose whale	*Hyperoodon ampullatus*
Hvithval	White whale	*Delphinapterus leucas*
Nise	Harbour porpoise	*Phocoena phocoena*
Kvitskjeving	White-sided dolphin	*Lagenorhynchus acutus*
Kvitnos	White-beaked dolphin	*Lagenorhynchus albirostris*
Grønlandshval	Bowhead whale	*Balaena mysticetus*
Vågehval	Minke whale	*Balaenoptera acutorostrata*
Finnhval	Fin whale	*Balaenoptera physalus*
Blåhval	Blue whale	*Balaenoptera musculus*
Knølhval	Humpback whale	*Megaptera novaeangliae*
Isbjørn	Polar bear	*Ursus maritimus*
Hvalross	Walrus	*Odobenus rosmarus*
Steinkobbe	Harbour seal	*Phoca vitulina*
Ringsel	Ringed seal	*Phoca hispida*
Grønlandsel	Harp seal	*Phoca groenlandica*
Storkobbe	Bearded seal	*Erignathus barbatus*