NORWAY. PROGRESS REPORT ON CETACEAN RESEARCH, JANUARY 2006 TO DECEMBER 2006, WITH STATISTICAL DATA FOR THE CALENDAR YEAR 2006

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1. SPECIES AND STOCKS STUDIED

Common name	Scientific name	Area/stock(s)	Items referred to
Blue whale	*Balaenoptera musculus*	Northeast Atlantic	3.1.3;3.2;4.1
Bowhead whale	*Balaena mysticetus*	North Atlantic	2.1.1;4.1;4.4
Fin whale	*Balaenoptera physalus*	Northeast Atlantic	2.1.1;2.2;3.1.3;3.2;4.1
Humpback whale	*Megaptera novaeangliae*	North Atlantic	2.1.1; 2.2;3.1.1;3.1.3;4.4
Killer whale	*Orcinus orca*	Northeast Atlantic	2.1.1
Minke whale	*Balaenoptera acutorostrata*	Northeast Atlantic	2.1.1;2.2;3.1.1;3.1.3;3.2;4.1;4.2; 4.4; 6.2
Sperm whale	*Physeter macrocephalus*	Northeast Atlantic	2.1.1; 2.2;3.1.1

2 SIGHTINGS DATA

2.1 Field work

2.1.1 Systematic

During the period 3 July to 6 August 2006 a sighting survey was conducted with two vessels covering the Small Management Area EW, which includes the waters off the Finnmark coast, Lofoten/Vesterålen and the eastern parts of the Norwegian Sea. This was the fifth year of the recent six-year program 2002-2007 to cover the northeast Atlantic to provide a new abundance estimate of minke whales every sixth year as part of the management scheme established for this species. A total of 2,300 nautical miles was surveyed on primary effort and 121 sightings of minke whales were made during this effort. Sightings of other cetacean species include sperm whales (107 primary sightings), Lagenorhynchus dolphins (91 primary sightings), killer whales (47 primary sightings), harbour porpoise (43 primary sightings), fin whales (25 primary sightings) and humpback whales (5 primary sightings). (IMR)

A search for bowhead whales in the Greenland Sea along the ice edge in the Fram Strait between Svalbard and Greenland was conducted during the second half of April using the research vessel “Lance”. A total of 8 observation events included 17-20 bowhead whales. Observations were done along the ice edge in the same general area (80-81° N, 0° E) during a 12 day period. All whales were detected visually from the vessel’s bridge and all observations were made in a relatively small area of the Fram Strait over the continental slope at depths between 1,030 and 2,785 meters. Age and sex of the animals were not determined, but those whales we got close to with small boats for biopsy darting were at least 15 m long.

2.1.2 OPPORTUNISTIC, PLATFORMS OF OPPORTUNITY

In April-June 2006 mapping of whale distributions was conducted during an ecosystem survey in the Norwegian Sea by having dedicated whale observers onboard who collected information following line transect protocols. A similar effort was conducted during the ecosystem surveys in the Barents Sea in August to September 2006. (IMR)

Databases containing incidental observations of marine mammals have been updated. (IMR)

2.2 Analyses/development of techniques
Abundance estimates for fin, sperm and humpback whales based on recent surveys have been provided earlier, however, in 2006 some studies were done on bias in fin whale estimates attributed to g(0) deviating from 1. It was shown that this effect on fin whale estimates based on data from the Norwegian surveys was minor. (IMR)

Data from the ecosystem surveys have also been analysed consecutively. Predators aggregate where prey is available, a process termed the predators' aggregative response. Therefore, systematic spatial concordance between predators and potential prey species is a good indicator of predator-prey interactions. Since 2003 marine mammal observers have participated on ecosystem surveys in the Barents Sea conducted in August-October. In addition to marine mammal distributions, these surveys provide information on ocean climate and distribution of watermasses, and abundance and distribution of zooplankton and fish. From 11-18 species of marine mammals are observed each year, and of these *Lagenorhynchus* dolphins (white-sided and whitebeaked dolphins), common minke whales *Balaenoptera acutorostrata* and humpback whales *Megaptera novaeangliae* are most frequently observed. While *Lagenorhynchus* dolphins and common minke whale occur throughout the Barents Sea and along the Barents Sea shelf edge, humpback whales are predominantly observed along the shelf edge and in the deeper troughs around Bear and Hopen Islands. Preliminary analyses show that *Lagenorhynchus* dolphins mainly overlap with capelin in central and northern Barents Sea, and blue whiting and herring in southern and western Barents Sea. Common minke whale overlap consistently with herring in southern Barents Sea and with capelin in central, northern and eastern Barents Sea. Humpback whales, often occurring in associations with both minke whales and *Lagenorhynchus* dolphins, overlapped consistently with capelin in central Barents Sea, but few occurrences of overlap between humpback whales and pelagic fish along the shelf edge and around Bear Island suggest other prey species than pelagic fish, such as krill, to be important in this area. Hence, our preliminary results suggest that capelin and herring are important prey species for these cetaceans during fall, and that blue whiting, currently increasing in abundance in the Barents Sea, may be an important prey species for *Lagenorhynchus* dolphins but not for the baleen whales. (IMR)

3. MARKING DATA
3.1 Field work

3.1.1 NATURAL MARKING DATA
During the minke whale sighting survey in July – August covering the Small Management Area EW (see 2.1.1) identification photos were collected from humpback, minke, fin and sperm whales. (IMR)

Collection of humpback whale photo IDs continued in 2005, and a total of about 30 individuals were sampled during several effort occasions this year. (IMR)

3.1.2 ARTIFICIAL MARKING DATA
No new information.

3.1.3 TELEMETRY DATA
During the minke whale sighting survey in July – August covering the Small Management Area EW (see 2.1.1) VHF radio tags were put on two minke whales and these were followed for 18 hours over 50 nmi and for 39 hours over 80 nmi, respectively. (IMR)

In August-September field work was conducted off Spitsbergen and Bear Island in the Barents Sea to instrument whales for collecting dive time data and studying their migrational behaviour. At this time of the year, these areas usually have reasonable high densities of minke whales but this turned out to be different in 2006 as only very few minke whales were observed and none were possible to close on for attachment of tags. Off Spitsbergen some blue whales were observed, and one of these was instrumented with a satellite tag. Also two fin whales were approached and tagged, but none of the instruments provided signals. (IMR)

3.2 Analyses/development of techniques
The work with cataloguing identification photos of humpback whales collected on incidental occasions and during our own surveys in Norwegian and adjacent waters is progressing. More recently, we have also collected

identification photos from other species like minke whales, fin whales, blue whales and sperm whales. For the latter two species the usefulness in collecting such data is seen in connection with other established identification catalogues in the North Atlantic. (IMR)

4. TISSUE/BIOLOGICAL SAMPLES COLLECTED

4.1 Biopsy samples

During the minke whale sighting survey covering the Small Management Area EW (see 2.1.1) biopsy samples were collected from 11 minke whales, one fin whale, one humpback whale and three sperm whales. (IMR)

In August-September during field work conducted off Spitsbergen and Bear Island in the Barents Sea biopsies were collected from five fin whales, five humpbacks and three blue whales. (IMR)

Seven biopsies for genetic analyses were collected from bowhead whales observed in the Fram strait in April. Preliminary genetic analyses indicate that several samples were taken from the same whale. (NP, NHM)

4.2 Samples from directed catches

During the traditional whaling season (April-October), body condition data and tissue materials for studies of DNA identity were collected from all minke whales taken by vessels participating in the Norwegian small type whaling. (IMR)

4.3 Samples from stranded animals

No new information reported from 2006

4.4 Analyses/development of techniques

The Norwegian DNA register for minke whales has been further studied to develop and investigate methods to determine stock structure, estimate abundance and eventually other life history parameters. (IMR)

The status of the Norwegian minke whale DNA-register as of February 2007 is given in the table below:

Year	DNA-register[1]	IWC catch statistics[2]	Not landed[3]	Landed[4]	Duplicates[5]	Missing samples[6]	Total missing[7]
1997	488	503	7	496	3	5	8
1998	609	625	11	614	1	4	5
1999	571	591	17	574	2	1	3
2000	470	487	6	481	3	8	11
2001	538	552	11	541	2	1	3
2002	625	634	9	625	0	0	0

[1] Number of unique individuals contained in the DNA-register (not containing duplicates).
[2] Number of individuals caught by Norway, including individuals not landed.
[3] Number of individuals killed, but not taken onboard the vessel.
[4] Number of individuals taken onboard the vessel.
[5] Number of occurrences of (tissue) sample switching on board the vessel as detected by comparison of genetic profiles. The result is that two samples have been returned from one individual, and no sample has been returned for one individual.
[6] Number of individuals for which tissue samples are missing for other reasons than sample switching.
[7] The difference between the columns “Landed” and “DNA-register”.
[8] Genetic analyses not yet completed.
[9] Tissue samples collected, but not yet sent to genetic laboratory.

2003	637	647	9	638	1	0	1
2004	530	544	7	537	7	0	1
2005[8]	-	639	6	633	-	4	-
2006[9]	-	545	7	538	-	2	-

The number of individuals contained in the DNA-register, and the number of individuals missing. For 2005 and 2006 the genetic analyses are not completed, as indicated by the '-' in the table.

Based on statistics collected in connection with the minke whaling, growth of minke whale fetuses and birth periods for minke whales in the North Atlantic have been studied in a master thesis. With a pregnancy period of about 10 months, mating mainly takes place in March-April and calving in January-February. Based on mating time, North Atlantic minke whales seem to group into three geographical clades – one that comprises the North Sea, Iceland, Jan Mayen and Svalbard; one which comprises the Norwegian Sea and the Barents Sea, and one which comprises Canada and Greenland. Mean estimated length at birth falls into two groups – One comprises the Barents and Norwegian Seas and Svalbard, and one comprising the rest. (IMR)

Data on prey partitioning between minke whales and cod in the Barents Sea were published. (IMR)

Data on minke whale predation and competition with other top predators in the Barents Sea have been analysed and submitted for publication. (IMR)

Data on minke whale consumption is being used in multispecies modelling (e.g., GADGET) of the Barents Sea ecosystem. (IMR)

Stomach content samples from minke whales have been analysed using traditional methods where the original biomass and size composition of prey items have been reconstructed based on remaining hard parts in the contents. (IMR, NFH-UIT)

Substantial changes have occurred in the Barents Sea ecosystem over the past 30 years, the most conspicuous being related to the rises and falls of stocks of the two dominant pelagic shoaling fish species: capelin and herring. Based on data from annual studies, effects of these ecological changes on the diet and food consumption of minke whales have been assessed for the whole period 1992-2004. Following a collapse in the capelin stock in 1992/1993, minke whales foraging in the northern Barents Sea apparently switched from a capelin-dominated diet to a diet almost completely comprised of krill. The second half of the 1990s saw a clear improvement of the capelin stock, and the species was again observed on the whale diet in the northern areas in 2000. In the southern area of the Barents Sea, capelin has been observed to be preyed upon by minke whales increasingly after 1995. In this area, also gadoids and, more importantly, krill and herring, are the food items of interest for the whales. The southern region of the Barents Sea includes important nursery areas for the Norwegian spring spawning herring. Good recruitment to this stock gives strong cohorts (e.g., 1991, 1992 and 1998) and large numbers of s adolescent herring (0-3 years old) which serve as the main minke whale prey in the area. Recruitment failure with subsequent weak cohorts (e.g., 1993-1997) seems, however, to reduce the availability of adolescent herring to such an extent that minke whales switch to other prey items such as krill, capelin and, to some extent, gadoid fish. After 1999, sampling was extended to include also areas outside the Barents Sea. The material collected during late May-June 2000-2004 revealed a relatively mixed diet on the population level, whereas on an individual level, each whale had fed upon mainly one species. There were significant differences in diet composition between areas and some differences between years. The importance of krill in the Barents Sea increased with latitude and dominated the Spitsbergen diet. Capelin dominated the diet around Bear Island and contributed considerable to the diet along the coast of northern Norway. In the latter area, herring and haddock were also a large part of the diet. The diet in the Norwegian Sea consisted of mainly mature herring, while the diet in the North Sea was dominated by sand eels and mackerel. The whales were found to feed on a wide range of prey sizes; apparently determined by the availability of different size classes. (IMR, NFH-UIT)

Minke whales are important predators in the Barents Sea ecosystem with a consumption of commercial species that may present an economic problem for the local fishery. In order to estimate this consumption and understand the potential consequences for prey dynamics, it is essential to determine the multi-species functional response of the whales.To parameterise a functional response requires measurements of consumption rates and prey availability. In a localized study

in a selected sub-area of the Barents Sea, undigested whale stomach contents were collected (from the commercial whale hunt) and used to assess the amount of each prey that had been consumed immediately prior to capture. To determine the availability of prey to the whales, standard acoustic surveys were run in the same area within 2 days of the capture of the whales. The spatial distribution of prey was modelled using GAMs. In order to generate a measure of prey availability and the uncertainty in this value, a simple model was assumed for whale movement, and prey abundance was sampled over space according to a gaussian kernel. A multi-species functional response model was then fitted to the consumption and prey availability data using Bayesian methods. Simple simulations, based on the fitted MSFR, indicate that minke whales may deplete local capelin aggregations at small spatial scales. This is the first time that a multi-species functional response has been fitted for a cetacean predator, and the methods outlined here may prove useful for modelling marine mammal-fish interactions in other systems. (IMR)

The past and present status of bowhead whales in the Northeast Atlantic are studied in a project in cooperation between NHM, IMR, NP. Other institutions involved are the Greenland Institute of Natural Resources, Nuuk, Wildlife Conservation Society, New York, and Fisheries and Oceans, Winnipeg. The population structure of bowhead whales during postglacial time is studied by help of dna extracted from ancient (bones and baleen) and tissue from extant individuals. The material making the basis for the investigation is about 300 samples of bone remains found along the coasts of Svalbard and the Norwegian mainland. About 200 of these have been 14C dated are from recent to about 40,000 years old. Up to now we have managed to sequence parts of the mitochondrial DNA control region from about 200 individuals. Only minor differences in haplotype diversity have been found between the Spitsbergen and Bering Sea stocks. The results support previous findings suggesting that the BCB stock retained a large amount of genetic variation despite the severe bottleneck caused by whaling around the turn of the 20th century. The similar haplotypes of the ancient Svalbard samples and the current BCB stock indicate significant migration between stocks.

5. POLLUTION STUDIES

No new studies reported.

6. STATISTICS FOR LARGE CETACEANS

6.1 Corrections to earlier years' statistics for large whales

No corrections made.

6.2 Direct catches for the calendar year 2006

Species	Type of catch	Management Areas					Total catch
Minke whale		EB	EN	ES	EW	CM	
	Small-type whaling	23	31	118	373	0	545

6.3 Anthropogenic mortality of large whales for the calendar year 2006

6.3.1 OBSERVED OR REPORTED SHIP STRIKES

No observations or reports from 2006.

6.3.2 FISHERY BYCATCH OF LARGE WHALES

No large cetaceans were reported bycaught during the observed fishing operations in 2006 in Norwegian shelf and offshore fisheries and in the coastal and inshore fisheries.

7. STATISTICS FOR SMALL CETACEANS

7.1 Corrections to earlier years' statistics for small cetaceans.

No corrections made.

7.2 Direct catches of small cetaceans for the calendar year 2006

No direct catches

7.3 Anthropogenic mortality of small cetaceans for the calendar year 2006

7.3.1 OBSERVED OR REPORTED SHIP STRIKES OF SMALL CETACEANS

No observations or reports from 2006.

7.3.2 FISHERY BYCATCH OF SMALL CETACEANS 2006

Species	No.	Date	Location	Fate	Targeted fish species	Gear	How observed?	Source or contact
Harbour porpoise	1		ICES area Ia	D	Various	GN	F/V	IMR (Arne Bjørge)
Harbour porpoise	134		ICES area $IIia_2$	D	Various	GN	F/V	IMR (Arne Bjørge)
Harbour porpoise	10		ICES area IIIa	D	Various	GN	F/V	IMR (Arne Bjørge)
Harbour porpoise	4		ICES area IVa	D	Various	GN	F/V	IMR (Arne Bjørge)
Comments:								

8. STRANDINGS

Information on strandings has been collected by the Institute of Marine Research, Bergen, Norway.

9. OTHER STUDIES AND ANALYSES

Minke whale catch data for the 2006 season have been computerised and evaluated.

11. PUBLICATIONS

11.1 Published or 'In Press'

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11.2 Unpublished literature

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