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Research programme on common minke whales (*Balaenoptera acutorostrata*) in Icelandic waters - A progress report May 2009.

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1 INTRODUCTION

In 2003, the Marine Research Institute, in collaboration with a number of other Icelandic research institutions, submitted to the IWC, a proposal for wide ranging research on cetaceans in Icelandic waters (Marine Research Institute 2003). The programme had multiple objectives and involved limited sampling of three species of whales in Icelandic waters under scientific permit, while non-lethal methods were to be used when these were deemed feasible with respect to the objectives of the research. Specific dates for implementation were not set out in the proposal, although it was assumed that the sampling phase could be concluded in two years.

The original plan assumed a catch of a total of 200 common minke whales (*Balaenoptera acutorostrata*), 200 fin whales (*B. physalus*) and 100 sei whales (*B. borealis*) in two years of the programme. In August 2003 Iceland decided to start implementation of the part of the programme concerning common minke whales however with a considerably slower sampling procedure than assumed in the original plan. During the years 2003, 2004, 2005, 2006 and 2007 the numbers of 37, 25, 39, 60 and 39 respectively, common minke whales were caught under a special permit granted by the government of Iceland. Thereby the takes of a total of 200 common minke whales for the study is now completed.

No decision has been taken by Icelandic authorities regarding implementation of the part of the programme concerning fin and sei whales.

The primary objective of the part of the research programme concerning common minke whales is to increase our knowledge on the feeding ecology of minke whales in Icelandic waters by studies on diet composition, energetics, seasonal variation in distribution and abundance, consumption of different prey species and multispecies modelling.

The programme also has the following secondary objectives

- Examination of population structure. (a) Comparison of the genetic structure of common minke whales off Iceland, Norway (including the Jan Mayen area), the Faroes and Greenland. (b) Monitoring the movements of minke whales by satellite telemetry.

- Monitoring and evaluation of the morbidity of potential pathogens.

- Investigate potential temporal changes in biological parameters.

- Analyse contaminant burden and evaluation of the health status of individual whales and populations.

- Evaluate the applicability of non-lethal research methods in studies on feeding, energetics and pollutant burden.

The research programme was thoroughly discussed by the Scientific Committee of the IWC in 2003 and progress was reported to the SC annual meetings in 2004 to 2008 (Víkingsson *et al*.

2004, 2005, 2006, 2007, 2008). The objectives, methodology, total sample size and spatial and seasonal distribution of the sample remain largely unchanged from the original proposal (for details see Marine Research Institute 2003) and the modifications involved primarily reduced rate of sampling.

2 FIELD ACTIVITIES

Except for satellite tracking, the field work of the programme, including biological sampling from the whales taken was completed in September 2007. Reports on progress of the program including narratives for the field seasons 2003 to 2007 sampling and status of different subprojects have been reported annually to the Scientific Committee (Víkingsson *et al.* 2004, 2005, 2006, 2007, 2008).

3 STATUS OF DIFFERENT SUBPROJECTS

Because of the temporal and spatial distribution incorporated in the design of the research program, it was deemed premature for most of the studies to present results before sampling was completed. Samples collected for many of these have already been analysed or are at a final stage of laboratory analyses. For other projects, requiring complex setup for chemical analysis (pollution, genetics) it was considered unfeasible to start the laboratory work until all samples were available. This also applies to analyses conducted outside Iceland requiring complicated and time consuming bureaucratic work associated with export of whale samples. After finishing the sampling in 2007 these studies were initiated and are presently at various analysing stages. The status of different subprojects of the programme is discussed under representative sections below.

3.1 Feeding and energetics

3.1.1 Diet composition

The contents of different stomach compartments were measured and samples taken from all animals sampled in 2007. Species identification of the contents of the forestomach is completed, and further analyses s.a. age determination of fish prey is at a final stage. Compared to the limited previously available data (Sigurjónsson *et* al. 2000), preliminary results from the present study indicates considerable higher proportions of large teleost fish species including cod (*Gadus morhua*) and haddock (*Melanogrammus aeglifinus*), and also somewhat higher incidence of sandeel (Ammodytidae). Conversely, capelin *(Mallotus villosus*) and euphausiids were found in less amounts than in the earlier study. There appears to be considerable geographical variation in the diet within the Icelandic continental shelf area. Pronounced changes in the marine ecosystem around Iceland appear to be reflected in the diet of minke whales during the sampling period. In light of preliminary results on diet composition from the first half of the program, minor changes were made to the geographical distribution of the sampling for increasing sample size in areas with high prey diversity (Table 1).

3.1.2 Energetics

Laboratory analysis on the energy density of muscle, blubber and visceral fat from all animals from 2003, 2004, 2005 and 2006 and liver and kidneys from 25 animals from 2003 and 2004 is finished. A simplified method for estimation energy content was developed and used on part of the sample collection. Laboratory analysis on samples from 2007 are at a final stage.

3.1.3 Constituents of prey species

51 samples of 7 common prey species were prepared and analysed for energy density. Determination of stable isotopes, fatty acids, and organochlorines is completed and analyses of minerals and trace elements are underway.

3.1.4 Stable isotopes

Samples of muscle, skin and blood, (85 samples in total), have been analysed for stable isotopes. Evaluation of results is underway.

3.1.5 Seasonal variations in distribution

A series of aerial surveys were conducted in 2004 and 2005 to estimate seasonal variation in distribution and abundance of common minke whales in Icelandic continental shelf waters (Gunnlaugsson *et al*. 2004, Víkingssson *et al* 2005). As a part of the T-NASS survey in 2007 a mid summer survey was again conducted around Iceland. As the abundance was remarkably low in this survey compared to all previous mid-summer surveys (Pike at al. 2008), the Faxaflói area off south-west Iceland, where the main minke density has been observed in previous surveys, was surveyed again in mid summer 2008. Results are given in SC/61/RMP 11.

3.2 Stock structure

3.2.1 Genetics

Samples of skin and muscle were collected from all sampled minke whales in 2006 for genetic analysis. Iceland is constructing a database of the DNA profile of Icelandic and Norwegian minke whales according to the Norwegian DNA database (Olaisen 1997; Dupuy & Olaisen 2002. IWC 1998). The databases will consist of every legally obtained minke whale in Iceland. The purpose is to establish a control system to detect illegal trades of the meat. The Icelandic DNA database will also be used to study population genetic structure of Icelandic minke whales as has been done for the Norwegian minke whales (Skaug & Oien 2004; Skaug et al. 2002; 2003; Martien, et al. 2003; Andersen 2004). The DNA profile of each individual entered into the databases is composed of microsatellite DNA genotypes (allele sizes), sex chromosome genotypes (for sex determination) and mtDNA sequence data. The genetic analysis has been optimized at Matís-Prokaria genotyping company, Iceland. Laboratory analysis on all samples collected in 2003–2007 for the stock structure component of the minke whale research programme is completed. Today, all samples collected in Icelandic waters from 1981 to 2007 have been genotyped for 16 microsatellite loci and the mtDNA (n= 342 for the microsatellite loci; n= 347 for the mtDNA). In addition samples

collected at feeding grounds in Greenland (n=37), Barents Sea (n=50), Norway coastal region (n=37), Spitsbergen (n=63) and North Sea waters (n=7) were genotyped for geographical comparisons (Pampoulie *et al.* 2008).

3.2.2 Telemetry

During 4.-7. November two common minke whales and two humpback whales were instrumented with a satellite tag by MRI staff in Eyjafjörður, N-Iceland. Data were only received from the two humpback whales. Seven minke whales were tagged in 2004, one of which migrated to waters off the coast of West Africa (Víkingsson and Heide-Jørgensen 2005). The tagging experiments will be continued in 2009.

3.2.3 Other methods

Morphometric data were collected from most of the common minke whales caught in 2003-2007 for comparison with available data from other areas. The potential use of pollutants and other chemical signals for stock delineation is under investigation.

3.3 Parasites and pathology

3.3.1 Hematology and serology

EDTA-blood samples and blood smears were collected and analysed. The EDTA-blood was examined for the following hematological parameters: Hemoglobin, hematocrit (PCV), white blood cell count (WBC). The blood smears were examined under a microscope and a white blood cell differential count was performed. Preliminary results show no hematological abnormalities. However, final interpretation remains to be completed.

3.3.2 Blood and Urinalysis

Serum, plane blood, plasma as well as urine samples were collected for analyses of electrolytes (Na+, K+, Cl-, Mg++, Ca++), creatinine, urea, uric acid, pH, osmolality, protein and other constituents. These measurements will make it possible to study the kidney function of the animals and assess the their rate of food intake (Kjeld and Ólafsson, 2004). Analyses of the samples are underway.

3.3.3 Histology

Tissue samples from major internal organs were fixed in formalin. The samples were processed with routine methods and tissue slides were stained with H.E. and examined under a microscope. Histological examination has shown mild to moderate cholangiohepatitis in liver samples from few animals that were heavily infested with liver flukes. Mild to moderate nephrocalcinosis has been observed in kidney samples from few animals. No apparent pathological changes have been found in other organs.

3.3.4 Microbiology

Bacteriological results of cultures from blood and major organs of animals caught in 2003 were negative with respect to pathogenic bacteria. Therefore a routine bacteriological sampling of all major organs was abandoned in the subsequent years and samples only taken from sites with likely bacterial infections such as wounds or cysts of some kind.

3.3.5 Virology

As a part of veterinary autopsies conducted on a subsample of animals virological studies focused on the intestinal tract, peripheral blood leukocyte cells the spleen and the respiratory tract.

3.3.6 Parasitology

Representative samples of ectoparasites were collected during visual inspection of the surface of all animals. Pictures were taken of skin lesions and representative samples collected for histological analyses. Stomach nematodes were collected from all animals with the diet samples. Endoparasites were systematically collected from all animals in veterinary autopsies. External parasites from all samples have been analysed and analysis of endoparasite samples taken 2003-2007 is ongoing.

3.4 Biological parameters

Gonads from all animals have been analysed for sexual maturity for both sexes and reproductive history for females. Analyses of amino acid racemisation (AAR) in eye lenses will completed in 2010..

For verification of the amino acid racemisation method, eye lenses from 50 Antarctic minke whales (*Balaenoptera bonaerensis*) from the JARPA project are being analysed. The results will be compared to age readings already obtained from ear plug readings for those same animals.

3.5 Environmental contaminants

Of the 95 samples collected in 2003, 2004 and 2005, 25 animals were selected for detailed studies on organic and inorganic contaminants. All tissues samples for trace elements have been processed and analysed. Evaluation of data is ongoing. Five animals from 2003 have been analysed for dibenzo-p-dioxins, dibenzofurans, dioxinlike PCBs and marker PCBs in blubber. In addition measuments have been made of BFR's in blubber and PFOS in liver (both with 3 groups of 5 animals).

For prey species, analyses pf organochlorine concentrations is completed and analysis of trace elements is underway.

Interpretation and diagnostic work on trace elements with reference to biological parameters (age, size, sex, etc), pathology, trophic status, body condition and geographical variation is underway.

4 REFERENCES

Andersen, L.W. 2004. On the possibility of estimating exchange rates between sub-populations of North Atlantic minke whales. Paper SC/56/AWMP4 presented to the IWC Scientific Committee, Sorrento Italy, July 2004. 10pp.

Dupuy, B.M. and Olaisen, B. 2002. Typing procedure for the Norwegian minke whale DNA register. Department of Forensic Medicine, University of Oslo, Norway. 19pp.

Gunnlaugsson, Th., Víkingsson, G.A., and Pike, D.G. 2004. Comparison of sighting rates from NASS and other dedicated cetacean vessel effort around Iceland during 1982 to 2003. NAMMCO SC/12/21 and IWC/SC/56/O5, 33 pp.

International Whaling Commission. 1998. Report of the Scientific Committee. Annex Q. Report of the Working Group on Proposed Specifications for a Norwegian DNA Database Register for Minke Whales. *Rep. int. Whal. Commn.* 48:287-9.

Kjeld, M. and Olafsson, O. 2004. A preliminary report on predicted urine production and food ingestion rate and salt balance of the common minke whale (*Balaenoptera acutorostrata*) off Iceland. IWC SC/56/O11, 11pp.

Marine Research Institute, 2003. A programme for a two year feasibility study on cetaceans in Icelandic waters. Paper SC/55/O2-revised, 63 pp.

Martien, K.K., Chivers, S.J., O'Corry-Crowe, G., Oien, N., Olavarría, C., Rosel,, P.E., Sellas, A.B., Skaug, H.J., Taylor, B.L. and Wells, R.S. 2003. Empirical Validation of Boundary Rank. Paper SC/55/SD10 presented to the IWC Scientific Committee, May-June 2003, Berlin, Germany (unpublished). 3pp.

Olaisen, B. 1997. Proposed specifications for a Norwegian DNA database register for minke whales. Paper SC/49/NA1 presented to the IWC Scientific Committee, September 1997, Bournemouth (unpublished).

Pampoulie, C., Daníelsdottir, A.K. and Víkingsson, G.A. 2008a. Genetic structure of the North Atlantic common minke whale (*Balaenoptera acutorostrata*) at feeding grounds: a microsatellite loci and mtDNA analysis. Paper SC/60/PFI10 presented at the annual meeting of the IWC Scientific Committee, Santiago, Chile, June 2008. 17pp.

Pike, D.G., Gunnlaugsson, Th. and Víkingsson, G.A. 2008a. T-NASS Icelandic aerial survey: survey report and a preliminary abundance estimate for minke whales. Paper SC/60/PFI12 presented at the annual meeting of the IWC Scientific Committee, June 2008. 29pp.

Sigurjónsson, J. Galan, A. And Víkingsson, G.A. 2000. A note on stomach contents of minke whales (Balaenoptera acutorostrata) in Icelandic waters. In: Gísli A. Víkingsson and Finn O.Kapel

(eds): Minke whales, harp and hooded seals: Major predators in the North Atlantic ecosystem. NAMMCO Scientific Publications vol. 2: 82-90.

Skaug, H.J. and Oien, N. 2004. Genetic tagging of males in North Atlantic minke whales through comparison of mother and fetus DNA-profiles. Paper SC/56/SD3 presented to the IWC Scientific Committee, Sorrento Italy, July 2004. 11pp.

Skaug, H.J., Haug, T. and Oien, N. 2002. Paper SC/54/RMP6 presented to the IWC Scientific Committee, May 2002, Shimonoseki, Japan (unpublished). 4pp.

Skaug, H.J., Haug, T. and Oien, N. 2003. Paper SC/55/NAM4 presented to the IWC Scientific Committee, May-June 2003, Berlin, Germany (unpublished). 4pp.

Víkingsson, G.A. and Heide-Jørgensen, M.P. 2005. A note on the movements of minke whales tracked by satellite in Icelandic waters in 2001-2004. (SC/57/O9).

Víkingsson, G.A., Ólafsdóttir, D., Gunnlaugsson, Th., Halldórsson, S.D., Galan, A., Svansson, V., Jörundsson, E., Kjeld, M., Daníelsdóttir, A.K., Gíslason, D., Auðunsson, G.A., Thorgilsson, B. and Stefánsson, M. 2004. Research programme on common minke whales (*Balaenoptera acutorostrata*) in Icelandic waters - A progress report, May 2004 IWC/SC/56/O10, 16 pp.

Víkingsson, G.A., Ólafsdóttir, D., Gunnlaugsson, Th., Halldórsson, S.D., Galan, A., Svansson, V. , Jörundsson, E., Kjeld, M., Daníelsdóttir, A.K., Gíslason, D., Auðunsson, G.A., Þorgilsson, B., Stefánsson, M., Hjartardottir, S., Þórðarson, G. and Pike, D.G. 2005. Research programme on common minke whales (*Balaenoptera acutorostrata*) in Icelandic waters - A progress report, May 2005. IWC/SC/57/O14, 20 pp.

Víkingsson, G.A., Ólafsdóttir, D., Gunnlaugsson, Th., Halldórsson, S.D., Galan, A., Svansson, V. , Jörundsson, E., Kjeld, M., Daníelsdóttir, A.K., Gíslason, D., Auðunsson, G.A., Pálmadóttir, H., Gunnlaugsdóttir, H., Þorgilsson, B., Stefánsson, M., Hjartardottir, S., and Pike, D.G. 2006. Research programme on common minke whales (*Balaenoptera acutorostrata*) in Icelandic waters - A progress report, May 2006. IWC/SC/58/O20, 18 pp.

Víkingsson, G.A., Ólafsdóttir, D., Gunnlaugsson, Th., Halldórsson, S.D., Galan, A., Svansson, V. , Jörundsson, E., Kjeld, M., Daníelsdóttir, A.K., Gíslason, D., Auðunsson, G.A., Pálmadóttir, H., Gunnlaugsdóttir, H., B., Stefánsson, M., Hjartardottir, S., and Pike, D.G. 2007. Research programme on common minke whales (*Balaenoptera acutorostrata*) in Icelandic waters - A progress report, May 2007. IWC/SC/59/O16, 18 pp.

Víkingsson, G.A., Ólafsdóttir, D., Gunnlaugsson, Th., Halldórsson, S.D., Galan, A., Svansson, V. , Kjeld, M., Daníelsdóttir, A.K., Auðunsson, G.A. 2008. Research programme on common minke whales (*Balaenoptera acutorostrata*) in Icelandic waters - A progress report, May 2008. IWC/SC/60/O13, 18 pp

Table 1. Temporal and spatial distribution of the sampled common minke whales in 2003-2007.

	Area*	April	May	June	July	August	Sept-Oct.	Total
2003	Area 1					4	6	10
	Area 2					2	3	5
	Area 3					1		1
	Area 4					2	1	3
	Area 5					1	1	2
	Area 6					3	2	5
	Area 8					1	1	2
	Area 9					3	2	5
	Area 10					2	2	4
	Total 2003		**0**	**0**	**0**	**19**	**18**	**37**
	Area 1			8				8
	Area 2			2	1			3
	Area 3			2				2
	Area 4			1				1
	Area 5							0
	Area 6			1				1
	Area 8				2			2
	Area 9			2	6			8
	Area 10							0
	Total 2004		**0**	**16**	**9**	**0**	**0**	**25**
	Area 1				6	7		13
	Area 2				2	5		7
	Area 3				1	2		3
	Area 4				1			1
	Area 5				2	1		3
	Area 6				2			2
	Area 8							0
	Area 9				6	2		8
	Area 10				1	1		2
	Total 2005		**0**	**0**	**21**	**18**	**0**	**39**
	Area 1			1	6	8		15
	Area 2			1	3	2		6
	Area 3			5	4			9
	Area 4			2	3			5
	Area 5			2	2			4
	Area 6			1	3	4		8
	Area 8							0
	Area 9				4	5		9
	Area 10			2		2		4
	Total 2006		**0**	**14**	**25**	**21**	**0**	**60**
	Area 1		**4**	**1**			**1**	6
	Area 2	**2**	**1**	**2**		**5**		10
	Area 3			**1**				1
	Area 4	**1**		**5**				6
	Area 5			**2**				2
	Area 6		**2**	**6**				8
	Area 8							0
	Area 9		**1**					1
	Area 10			**5**				5
	Total 2007	**3**	**8**	**22**	**0**	**5**	**1**	**39**
	Grand total	**3**	**8**	**52**	**55**	**63**	**19**	**200**

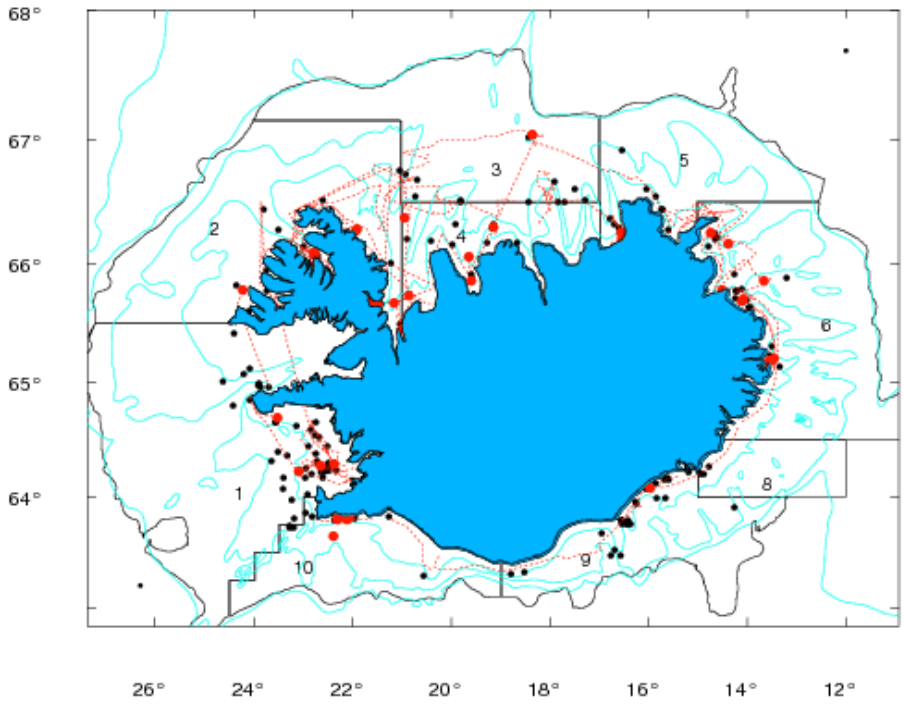

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Figure 1. Catch positions 2007 (large red dots). Catch positions 2003-2006 (small black dots). Track lines on effort 2007 (red lines). Numbered areas represent the area division of Icelandic coastal areas utilized in the programme.