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Summary of available data on northeastern Atlantic minke whale surfacing rates

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ABSTRACT

We provide a summary of the surfacing rate experiments made on minke whales by means of VHF radio tagging in connection with the Norwegian whale survey programme. In total, dive time data have now been collected from 20 minke whales from the North Sea, Norwegian Sea, Svalbard and the south-eastern Barents Sea. Each whale has been observed over time periods varying from 2 to 120 hours. Large variation in blow rates has been observed, both within and between individuals. The range of blow rates between individuals is 29-72 blows/whale/hour, which is also of the same magnitude as the variation within individuals. In 2008 a minke whale was VHF tagged in Varangerfjord, south-eastern Barents Sea. The mean blow rate for this whale was 37.6 blows/whale/hour excluding data collected in conditions with Beaufort > 4. The mean intersurfacing interval of 20 minke whales radio-tagged in Norwegian waters is 77.35 s, corresponding to a blow rate of 48.85 blows/whale/hour. Excluding data collected in weather conditions above Beaufort 4 (where such information is available) have only marginal impact on the mean blow rate.

MINKE WHALES, RADIO-TAGGING, DIVING, SURFACING RATE, NORTHEAST ATLANTIC

INTRODUCTION

The methods used in Schweder et al. (1997) and Skaug et al. (2004) depend on availability of data on surfacing rates and patterns of minke whales. In 1991 the *Ad Hoc Working Group on g(0)* discussed the use of dive time data for abundance estimation (IWC, 1992) and expressed a preference for such data as collected from radio tracking experiments. While the group recognized that dive sequences from VHF tracking could include surfacings that would not normally be visible to an observer and thus result in a positive bias in estimates of g(0), this was preferred to visually derived dive time data which, on the other hand, could involve problems with missed surfacings, combining surfacings from two or more whales and selection bias due to the short time period over which visual data usually are collected.

The Norwegian survey program to collect data for abundance estimates of minke whales at regular intervals has been provided by annual partial surveys, which over six-year periods cover the relevant management areas in the Northeast Atlantic. The intention to collect dive time data has been an integral part of the surveys. By means of VHF tracking, surfacing data have been recorded from several geographical areas, and individual whales have been followed over time periods lasting from 2 to 120 hours.

In 2008 one new VHF data set was obtained, the collection of which is described in this paper. In total, 20 dive time series of varying lengths have now been collected. Of these, 12 series have been collected over the period 2001-2008.

METHODS

For the VHF tagging, we use radio-tags built waterproof, with a frequency-range between 142,00 mHz and 143,00 mHz, and with a power supply of two units of 3.2 V lithium batteries. The total weight of these units is approximately 120 grams each. The attachment of tags is through an anchor-attachment to the blubber layer. All arrows are pre-creamed with an anti-bacterial substance, basimysin. The radio units were applied with the launching system ARTS (Arial rocket transmission system, Heide-Jørgensen *et al.* 2001).

The tracking equipment was a combined solution of ATS (Applications Technology Satellites) instruments, and a line transect PC-GPS unit for downloading of signals. The ATS device included a receiver (R2100), a direction finder (Direction indicating display) and an antenna (Yagia antennas), while the PC-GPS unit was a special designed kit developed during the Norwegian line transect survey program.

VHF TAGGING IN 2008

During the period 1 to 21 September 2008 instrumentation, biopsy sampling and photo ID work were conducted from the vessel *Måøybuen*, operating in the waters off the Norwegian coast from the North Sea to the Russian border in the southeast Barents Sea. Generally, very few whales were seen south of Vestfjorden (Lofoten). Observations were of killer whales, white-beaked and white-sided dolphins and a few minke whales. Conditions for tracking whales within the Vestfjord were deteriorating and two minke whales spotted there were lost quite quickly. Better conditions were found north of Lofoten (Andfjorden) and besides a group of killer whales, a minke whale observed there was followed

for several hours but was not approachable for fastening the VHF tag. Photos taken during the chasing showed that the whale probably had been injured by a fishing net, having visible wounds at the back. Due to few whales seen and bad weather forecasts, we then decided to transit to Varangerfjord, south-eastern Barents Sea. Within Varangerfjord we spotted about 10 minke whales and some harbour porpoises.

On 11 September at about 7 pm, a minke whale was finally instrumented with a VHF tag at position 69°51'N, 30°37'E (Figure 1). The whale was followed for about 7 hours (until 02:32 12 September) when it crossed over the border to the Russian EEZ and thus could not be followed by *Måøybuen*. However, in the afternoon on 12 September contact was again made with the whale and it was now followed until the morning of 14 September when it again crossed the Russian border. During this period we also tried to put a satellite tag on it, without success. Late in the evening on 15 September we got in contact with the whale once again and followed it until 16 September 12:47. Thus the whale was followed over a five-day period, however, with surfacing behaviour recorded for a total of about 60 hours and only when it stayed in Norwegian waters. The tracks of *Måøybuen* as it followed the whale, which will be a proxy for the whale's movement pattern, are shown in Fig. 2. There is no information available on possible prey items in the area. Within the searched area, about 15 minke whales were seen in total, as well as a group of five killer whales and some harbour porpoises.

During the survey with *Måøybuen*, biopsy samples were collected from two minke whales and one white-beaked dolphin, and identification photos were collected from 5 minke whales and one white-sided dolphin.

For comparison with surfacing series presented earlier (Øien et al. 2007, 2008), dive time frequencies of this whale are shown in Figure 3, a plot of the individual dive times in Fig. 4, and mean dive times over half-hour intervals throughout the tracking periods in Fig. 5.

SUMMARY

Sampling locations are shown in Fig. 1 for all the 20 minke whales VHF tagged in connection with the Norwegian marine mammal program, and estimates of dive times and blow rates are given in Table 1 for each whale and totals. The blow rate on an individual basis varies from 29 to 72 blows/whale/hour with a mean for all data of about 49 blows/whale/hour. As discussed on earlier occasions (Øien et al. 2007), this estimate is in accordance with what has been found in similar VHF experiments as well as from visual dive time experiments, but especially the longer series we have collected demonstrate that the variation in blow rates seen on an individual basis is at least as large as that recorded as means between individuals. As seen, the estimated diving parameters of the minke whale tagged in 2008 fall within the range of those collected earlier.

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Table 1

Mean intersurfacing intervals and blow rates for the VHF radio tracking data collected in connection with the program for abundance estimation of Northeast Atlantic minke whales. The mid part of the ID number indicates the year of collection of the data. Also shown are estimates based on all data collected. *Small Management Area* locations for the VHF experiments are given in the last column (*SMA*).

ID	*Intersurfacing interval, s*	*SE of mean*	*Min*	*Max*	*Blows/whale/hour*	*SMA*
mi-1989-01	83.47	9.64	10	404	43.32	EW
mi-1989-02	72.46	2.54	7	505	49.70	EW
mi-1991-01	69.60	7.92	7	403	51.86	EW
mi-1991-02	84.72	3.67	7	394	42.54	EW
mi-1991-03	89.25	5.37	5	550	40.41	EW
mi-1991-04	76.55	9.81	10	340	47.34	EW
mi-1992-01	55.24	3.39	6	230	65.31	ES
mi-1992-02	81.54	2.09	7	463	44.17	ES
mi-2001-01	66.85	5.5	4	385	53.93	EW
mi-2001-02, all data	99.21	2.09	4	480	36.30	EW
mi-2001-02, Beau ≤ 4	*99.28*	*2.32*	*4*	*480*	*36.27*	*EW*
mi-2002-01	59.43	4.58	9	262	60.70	EN
mi-2002-02, all data	73,10	1.85	4	502	49.26	EW
mi-2002-02, Beau ≤ 4	*74.02*	*2.60*	*4*	*479*	*49.26*	*EW*
mi-2002-03	124.27	3.64	4	534	28.98	EW
mi-2002-03, Beau ≤ 4	*107.5*	*9.86*	*9*	*410*	*33.60*	*EW*
mi-2003-01	59.52	2.10	4	398	60.51	ES
mi-2004-01	77.10	7.51	5	335	46.86	EW
mi-2004-02	88.38	5.14	8	572	40.78	EW
mi-2006-01	50.28	1.75	6	372	71.63	EW
mi-2006-02, all data	82.02	2.13	4	602	43.91	EW
mi-2006-02, Beau ≤ 4	*88.12*	*2.69*	*4*	*560*	*40.87*	*EW*
mi-2007-01, all data	58.03	0.76	4	537	62.04	ES
mi-2007-01, Beau ≤ 4	*65.28*	*1.36*	*4*	*537*	*55.16*	*ES*
mi-2008-01, all data	95.93	2.92	4	865	37.54	EB
mi-2008-01, Beau ≤ 4	95.72	2.93	4	727	37.62	EB
All data	**77.35**				**48.85**	**N=20**
Beau ≤ 4	**77.22**				**48.56**	**N=20**

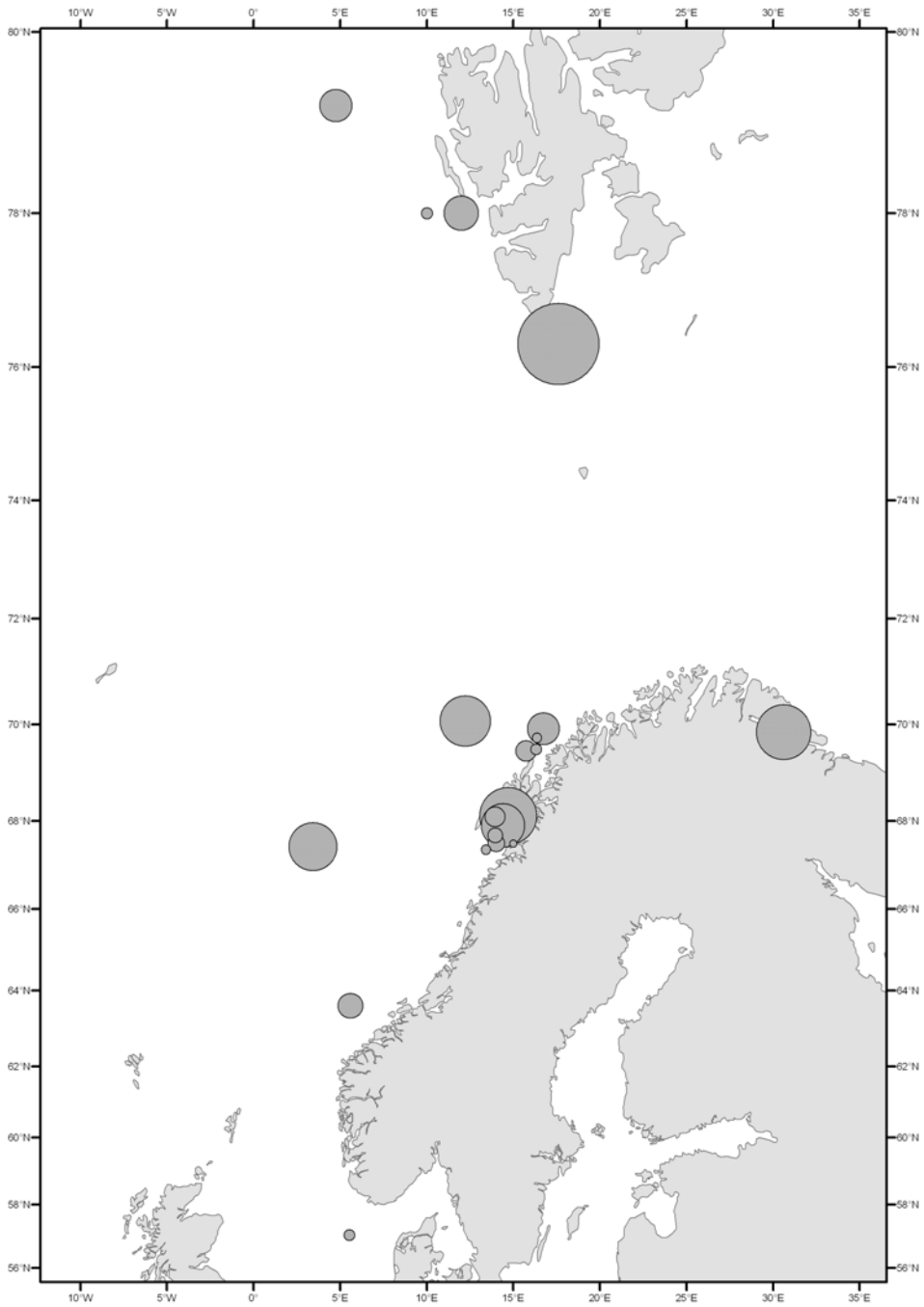

Figure 1. Sampling locations for the twenty minke whales listed in Table 1. The areas of the disks are proportional to the number of hours with dive time data collected on each location. The 2008 experiment was at the easternmost location (approximately 70°N, 31°E) in Varangerfjord.

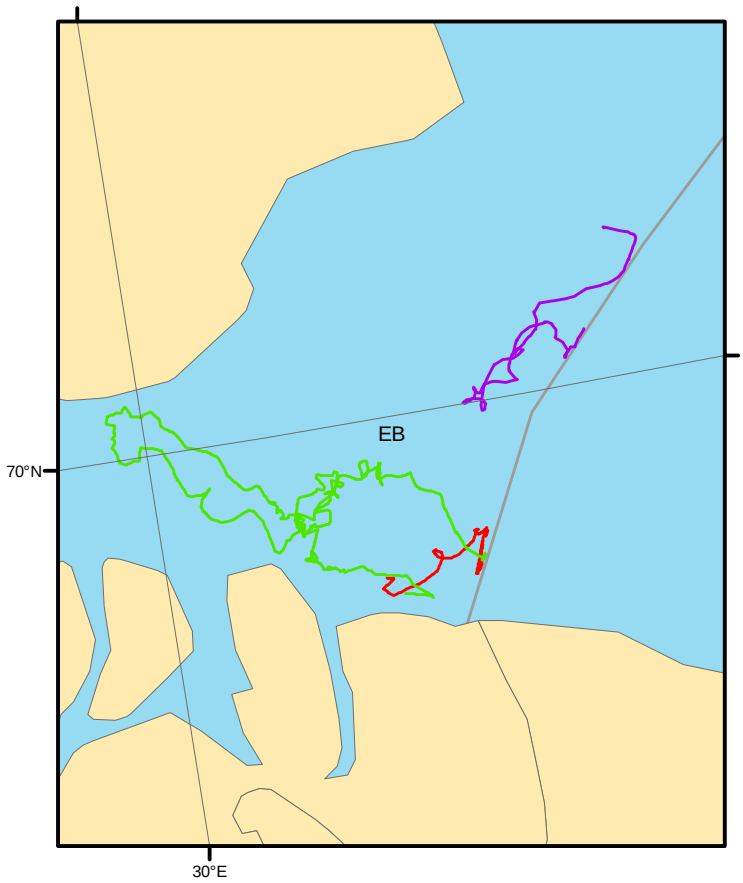

Figure 2. The track of the vessel *Måøybuen* as it followed the VHF tagged minke whale in Varangerfjord over a five-day period from 11 September 2008, 19:12 to 16 September 2008, 12:47. The whale track was broken into three parts because the whale crossed the Russian border (to the right of the brown line) several times. The red track was from 11 to 12 September (7 hours), the green track from 12 to 14 September (39 hours) and the violet track 15-16 September (14 hours).

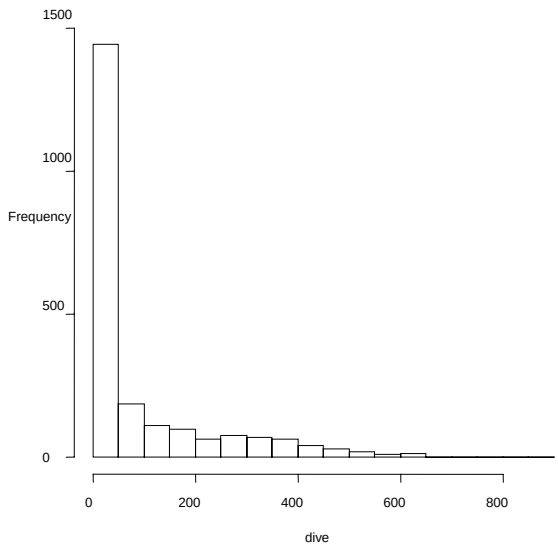

Figure 3. Frequency distribution of dive times (minutes).

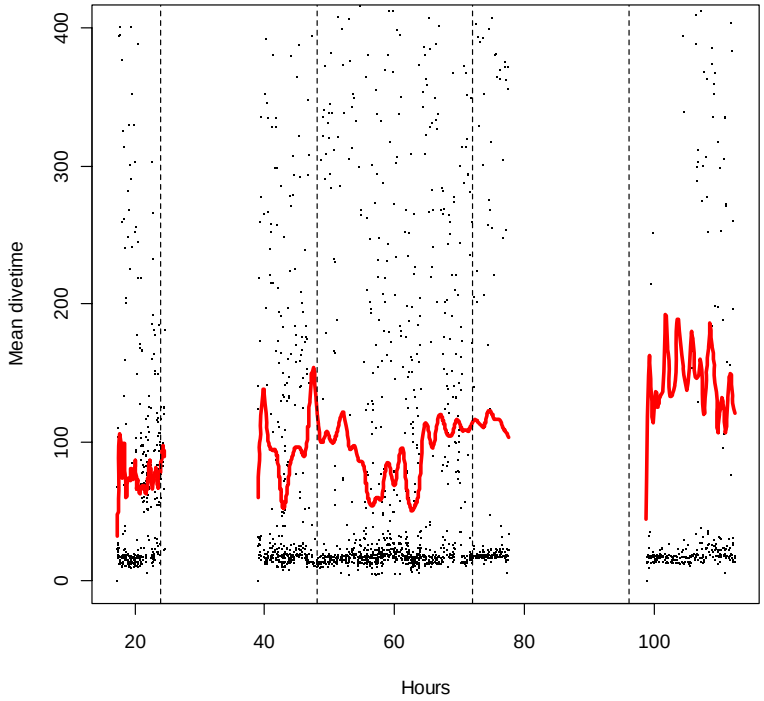

Figure 4. Plot of individual dives as recorded over the total period. The red line is a smoothed spline of the dive times.

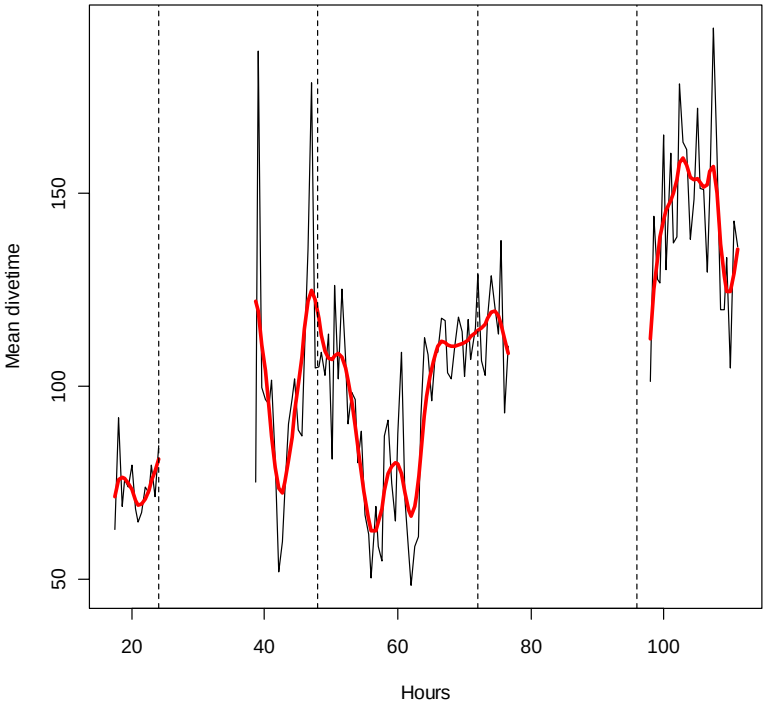

Figure 5. Mean dive times estimated over half-hour intervals; the red line is a smoothed spline.