Cue rates for common minke, fin and humpback whales in West Greenland

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ABSTRACT

Field observations of cue rates for common minke whales, fin whales and humpback whales were conducted in July 1996 and May-September 2006. The cue's for minke whale was usually the dorsal ridge breaking the surface. A total of 295 minutes of surfacings of five minke whales ranging from 27 to 106 minutes were observed and the simple mean was 46.1 surfacings per hour (CV=0.11). The cue for fin and humpback whale surfacings was either the head breaking the surface but most often a blow. Twenty-three trials of fin whale groups ranging from 1 to 4 individuals provided 620 minutes of observations. The simple mean of all the trials was 52 blows/hr (CV=0.06), and if only trials >10 min are included the surfacing rate remain unchanged, but if only surfacings >30 min are included the surfacing decreases to 50 blows/hr (CV=0.07, N=8 trials). A total of 860 min (N=39 trials) and 1232 blows from surfacing humpback whales were collected from groups of 1-4 individuals. The simple mean of all trials was 71 blows/hr (CV=0.07). Both the minke, fin and humpback whale cue rate estimates are close to values obtained from other studies, but they are the first that are specific to West Greenland and it is suggested that they should be used for correcting abundance estimates obtained from the aerial cue counting method.

Key words: common minke whale, fin whale, humpback whale, cue rates, West Greenland

INTRODUCTION

Frequent surveys of common minke whales (*Balaenoptera acutorostrata*), fin whales (*Balaena physalus*) and humpback whales (*Megaptera novaeangliae*) in West Greenland is an important part of the scientific background for developing advice on the sustainable utilization of whales in West Greenland. Several types of sighting surveys of cetaceans have been tried in West Greenland. Ship-based surveys were conducted in 1982, 1983 and 2005, aerial line-transect surveys were conducted in 1983-85, aerial cue-counting surveys were conducted in 1987-88, 1993 and 2005, and aerial photographic surveys were attempted in 2002 and 2004. Of the four different types of surveys aerial cue-counting surveys shows the best performance. Aerial surveys has the advantage that large areas can be covered during the relatively short windows with optimal sighting conditions in West Greenland in summer and the cue-counting method (Hiby 1992) has the advantage of utilizing an independent cue rate as a mean to correct for whales that are submerged during the passage of the plane. However, estimates of cue rates for the target species of whales has to be developed based on observations preferable over longer periods at the same time period and area as the survey is covering. Various compromises have of course to be implemented to meet these ideal conditions, but it seems evident that area specific cue rate estimates are necessary because diving patterns of whales varies with behaviour, depth, prey and seasonally (cf. Laidre et al. 2003; Kopelman and Sadove 1995). Thus cue rate estimates from one different area are not necessarily applicable to a survey in a different area.

In order to develop cue rate estimates for minke whale, fin whale and humpback whale that are specific to the West Greenland survey area, field observations of diving patterns of whales were conducted at two sites in West Greenland.

METHODS

A cruise targeting common minke whales was conducted between 9th and 22nd July 1996 in Nuuk fjord, West Greenland, with the research vessel Adolf Jensen and four trained whale observers (Figure 1). Observations were maintained with binoculars (Leitz

7x42). Observations of diving patterns of fin and humpback whales were made between 15th and 27th August 2006 in Disko Bay (Figure 1). Additional observations of humpback whales were made in Nuuk fjord from May to September 2006 (Figure 1). The observations were made from land-based lookout points and from boats with binoculars (Optimic 10x42).

When a whale was located during ship-based observations, the boat was directed towards the area. If the whale was resting in the area the engine was shut down and the whale was followed. If the whale was traveling the engine was kept running and the boat followed the whale at a distance and at slow speed. Data were continuously recorded with time stamps with precision to the nearest second on dictaphones.

RESULTS AND DISCUSSION

Cue's for minke whale surfacings were usually the dorsal ridge breaking the surface, less frequently the surfacing was detected by the dorsal fin or by a blow from the whale. A total of five surfacing sequences of common minke whales ranging between 27 and 106 minutes were obtained in the Nuuk area in 1996 (Table 1). A simple mean of the 5 sequences give 46.1 surfacings per hour (CV=0.11). There is a slight tendency for longer cue rates for longer observation periods and this is probably a result of the increased risk of missed surfacings during longer observation periods and it was therefore decided to use a simple mean rather than a mean weighted by the observation period.

Several studies have addressed surfacing rates for common minke whales in other parts of North Atlantic. Gunnlaugsson (1989) reported an overall average surfacing interval of 52.7s (CV=0.06) from 16 series of visual observations totaling 501 surfacings mostly collected from presumably feeding minke whales in Icelandic water in July and August 1987. From the Norwegian Sea, Joyce et al. (1989) reported a mean rate of 52.4 s/hr (SE= 9.4) from four trials. However, this sample size was augmented by a study by Øien et al. (1990) that gave a time-weighted average of 36.7 s/hr for over 1000 min observations from five vessels in the Norwegian Sea and along the Norwegian coast.

Surfacing rates of whales have also been estimated from VHF radio tracking of instrumented whales and Joyce et al (1990) got an average day time rate of 60.35 s/hr (CV=0.43) from one minke whale in Faxafloi, Iceland. Øien et al. (2003) summarized Norwegian data on surfacings based on VHF tracking of 14 whales in the North Sea, the Norwegian Sea and off Lofoten and the simple mean of all the whales was 48.1 s/hr (SD=9.5).

Visual observations and VHF tracking may not be entirely compatible in estimating surfacing rates. Both methods may miss surfacings but depending on the position of the transmitter on the whale, VHF tracking may also give false positive surfacing indications when the antenna is close to the surface but without the whale actually breaking the surface. Independent of this there seem to be generally good agreement between surfacing estimates derived for a variety of studies in very different parts of the North Atlantic thus it seem reasonable to assume that the surfacing rate is a robust parameter with limited population wide variability.

Witting and Kingsley (2004) used sequences of images of surfacing common minke whales taken during an aerial photographic survey in Faxaflói, Iceland, in 2003 to estimate the average time period during which a surfacing common minke whale can be identified on an image. The author estimated this to be 7.2 seconds (SE=0.07), which is twice as much as estimated from the visual observations in this study (mean=3.5, SE=0.31). The difference is probably due to the fact that an aerial photographic survey includes some time where the whale is submerged but close to the surface in addition to the time it is breaking the surface.

The cues from the fin and humpback whales were a blow and in a few instance the rostrum breaking the surface. Because these whales often traveled in pods of 1 to 4 whales it was not possible to determine blows from the same individuals. Instead it was necessary to determine the pod size and calculate the number of blows per individual as a fraction of the pod size (Table 2 and 3). Data on surfacing from 23 trials of fin whales were collected comprising a total period of 620 minutes and more than 1000 blows. The simple mean of all the trials was 52 blows/hr (CV=0.06), and if only trials >10 min are included the surfacing rate remain unchanged, but if only surfacings >30 min are included the surfacing decreases to 50 blows/hr (CV=0.07) based on only 8 trials. None

of the these values are different from the value 52.4 blows/hr (Hiby 1992) that has been used as the cue rate for fin whales in West Greenland in past aerial cue counting surveys (Larsen 1995). However, the present estimate of the blow rate has an associated estimate of the variance and must therefore be considered a more realistic value for correcting surveys. Data from 39 trials, from 5 to 65 min duration, on surfacing humpback whales (19 trials from Disko Bay and 20 trials from Nuuk fjord) were collected, comprising a total period of 860 min and 1232 blows. The simple mean of all trials was 71 blows/hr (CV=0.07). This value is close to the mean blow rate estimates of 72 blows/hr obtained from humpback whales in Fredericks Sound, Alaska (Dolphin 1986).

Time spent at the surface was determined for 436 fin whale surfacings and had a mean of 4 s (SD=2) with a range from 2 to 11 s and for 479 humpback whale surfacings in Disko Bay and had a mean of 4 s (SD=2) with a range of 1 to 18 s.

The present study provides the first cue rates for common minke, fin whales and humpback whales for West Greenland with associated variances and it is therefore suggested that these estimates are more appropriate for correcting the aerial abundance estimates of these whales in West Greenland (see Heide-Jørgensen in prep.).

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Table 1. Surfacing data from common minke whales from Nuuk, West Greenland, September 1996.

Trial	Duration (min)	Number of surfacings	Cue rate surfacings/whale/hour	Time at surface (sec)		
				mean	min	max
1	107	101	56.92	4.48	2.9	7.4
2	49	26	32.08	3.35	2	4.7
3	50	50	60.67	2.97	2	4.5
4	64	47	44.27	3.93	2.7	5.7
5	27	17	37.62	2.78	1.7	4.6

Table 2. Surfacing data from fin whales from Disko Bay, West Greenland, September 2006

Trial	Duration (min)	Number of blows	Number of whales	Blows/hr	Blows/whale/hr
1	14	21	1	90	90
2	7	9	1	77	77
3	43	80	2	112	56
4	32	78	3	146	49
5	9	14	2	93	47
6	114	246	2	129	65
7	12	11	1	55	55
8	49	155	3	190	63
9	40	142	4	213	53
10	24	79	4	198	49
11	12	10	1	50	50
12	23	40	2	104	52
13	6	4	2	40	20
14	20	46	3	138	46
15	31	27	3	52	17
16	5	13	3	156	52
17	9	31	3	207	69
18	18	41	2	137	68
19	11	17	2	93	46
20	11	17	2	93	46
21	64	100	2	94	47
22	19	28	2	88	44
23	47	64	2	82	41

Table 3. Surfacing data from humpback whales from Disko Bay and Nuuk fjord, West Greenland, May-September 2006.

Trial	Location	Duration (min)	# blows	# whales	Blows/hr	Blows/whale/hr
1	Disko	7	16	1	137	137
2	Disko	24	53	1	133	133
3	Disko	25	43	1	103	103
4	Disko	5	10	1	120	120
5	Disko	8	12	2	90	45
6	Disko	16	18	1	68	68
7	Disko	5	13	1	156	156
8	Disko	7	9	1	77	77
9	Disko	5	13	2	156	78
10	Disko	23	27	1	70	70
11	Disko	12	7	1	35	35
12	Disko	27	36	1	80	80
13	Disko	8	14	2	105	53
14	Disko	6	46	4	460	115
15	Disko	34	83	2	146	73
16	Disko	19	119	3	376	125
17	Disko	11	44	4	240	60
18	Disko	11	42	2	229	115
19	Disko	24	19	1	48	48
20	Nuuk	9	4	1	27	27
21	Nuuk	49	48	1	59	59
22	Nuuk	22	28	1	76	76
23	Nuuk	20	20	1	60	60
24	Nuuk	19	14	2	44	22
25	Nuuk	16	18	1	68	68
26	Nuuk	29	37	2	77	38
27	Nuuk	65	75	1	69	69
28	Nuuk	15	20	1	80	80
29	Nuuk	16	13	1	49	49
30	Nuuk	27	19	1	42	42
31	Nuuk	28	27	1	58	58
32	Nuuk	7	7	1	60	60
33	Nuuk	39	33	1	51	51
34	Nuuk	61	77	2	76	38
35	Nuuk	32	39	1	73	73
36	Nuuk	22	16	1	44	44
37	Nuuk	28	18	1	39	39
38	Nuuk	48	59	1	74	74
39	Nuuk	31	36	1	70	70

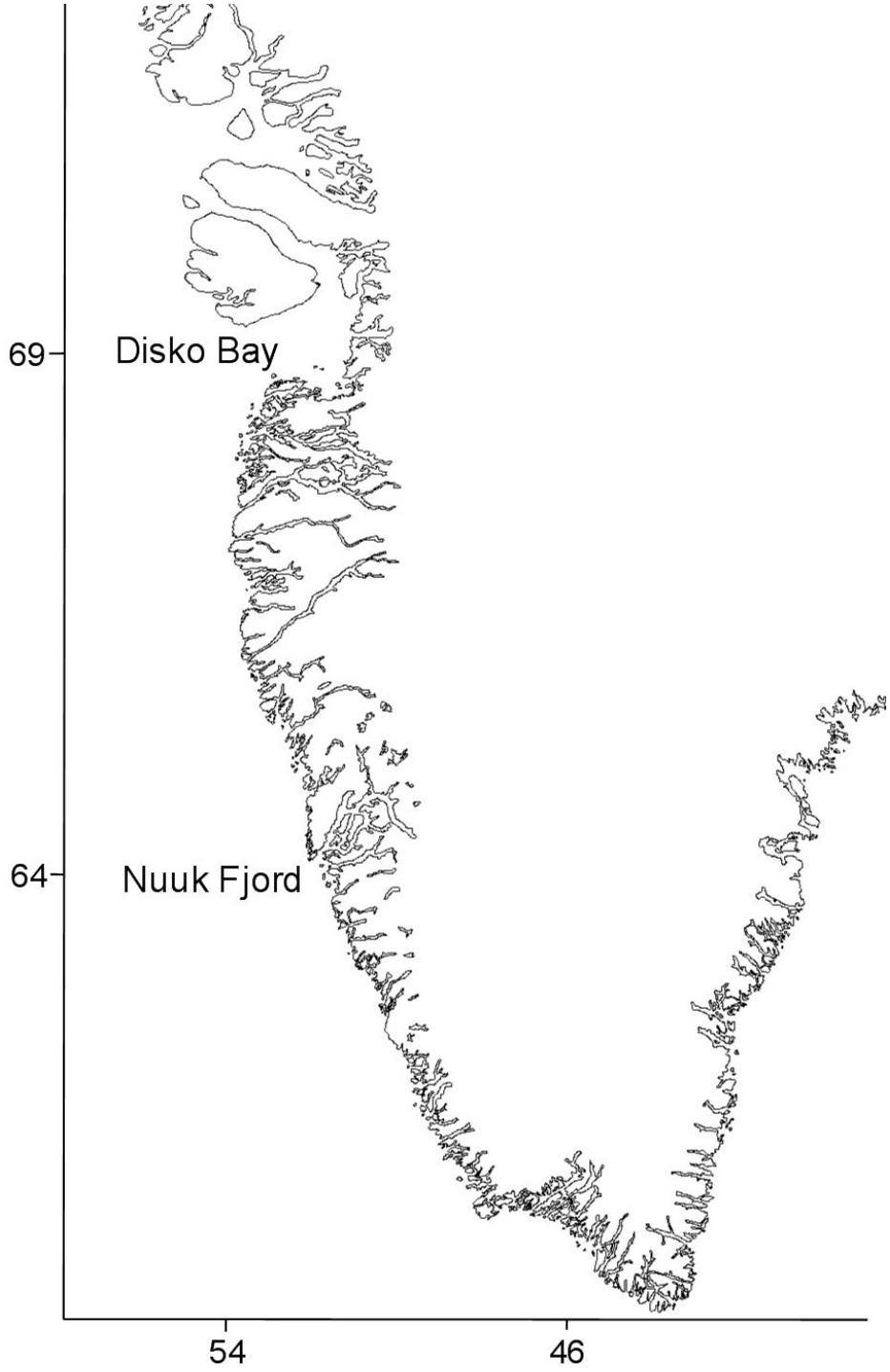

Figure 1. Map of West Greenland.