

Surface and submerging intervals in minke whale, *Balaenoptera acutorostrata*, diving cycles

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Information on surface and diving intervals of minke whales *Balaenoptera acutorostrata* were sampled in the Lofoten-Vesterålen area, Norway. Data from 29 different solitary whales performing a total of 351 diving cycles were collected. The mean time of the diving intervals was $108\text{s} \pm 95\text{s}$ (range 7 - 380 s), and the period spent in surface position $3.4\text{s} \pm 0.3\text{s}$. The whales are visible in surface position in 3.1% of the total time. This information should be considered when designing and/or evaluating results from sighting surveys for estimating minke whale stock sizes.

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INTRODUCTION

Minke whales (*Balaenoptera acutorostrata*) of the northeast Atlantic are believed to consist of a discrete stock (Christensen 1975), and are estimated to 30.000 to 120.000 individuals, based on mark-recapture and catch per unit effort methods (Anon. 1987). The large range reflects the weaknesses in the methods. Ship-borne sighting surveys have been conducted during recent years in order to estimate minke whale densities. The significance of precise information regarding surface time of the whales should be considered in the design of such surveys.

Mean surface times of minke whales have been reported to range from 1.95s (Doi et al. 1982) to $6.2 \pm 4.4\text{s}$ (Joyce 1982). The traditional method when recording surface times is the direct approach *in situ* using a hand stop watch. By recording diving minke whales using a video-camera, and timing the surface intervals during repetitive playbacks of the tapes, we wanted to improve this method and consequently obtain more accurate measurements of the surface intervals. Diving intervals were also included in the present study in order to determine time spent in surface position relative to diving periods.

MATERIAL AND METHODS

Material was collected during scientific whaling in the area of Lofoten—Vesterålen

(68° — 70°N , 13° — 16°E), Norway, from August 1—21 1988. Diving intervals were recorded using a stop watch. A diving interval is defined as the period from which the whale leaves the surface until it first is rediscovered at the surface. A total of 351 diving intervals were collected from 29 different solitary minke whales, exhibiting from 2—49 registered dives per individual. The whales were monitored on a Video-8 recorder in order to measure the surface time of the diving cycles. The surface time was defined as the period from which a part of the whale was first visible above the surface until the last part of the whale disappeared below the surface. All usable surface sequences ($N=37$) from 10 different whales were used in the further calculations. Each surface interval was played-back five times, and the period the whale was visible during each sequence was measured using a stop watch.

RESULTS AND DISCUSSION

The frequency distribution of the 351 minke whale dives (Fig. 1) shows that most dives were relatively short. When the whale prepares for a longer dive it exhibits several short shallow diving cycles. Each of these are registered as a dive interval and this partly explains why short dives dominate in the figure.

The duration of minke whale diving intervals averaged $108\text{s} \pm (\text{SD})95\text{s}$, ranging from

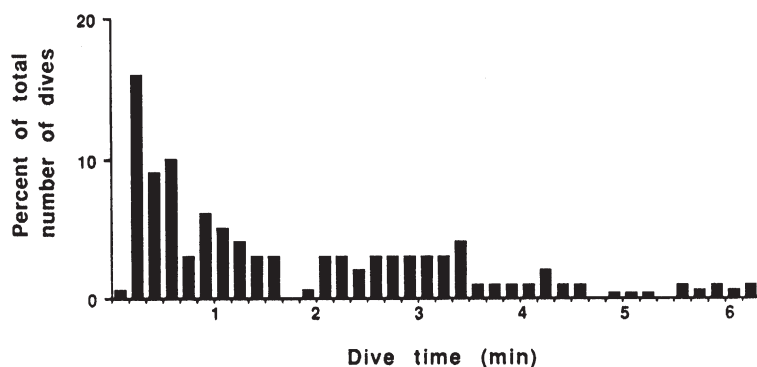


Fig. 1. Frequency distribution of durations of minke whale dives collected in Lofoten — Vesterålen, Norway, August 1988.

7s. to 380s. The mean period a minke whale is visible in surface position, was calculated to be $3.4s \pm (SD)0.3s$. Total submerging time for all registered dives ($n=351$) was 37876s and total surfacing time 1193s. Thus during a period of 39069s the whales are visible in surface position in 1193s, corresponding to 3.1% of the total time.

Generally, the diving patterns of whales appear to vary significantly with time of day, season, geographical area, environmental conditions and number of individuals present (Leatherwood et al. 1982). Our records thus concern solitary minke whales in a summer situation from a restricted area of Norway.

The material was collected when pursuing whales in connection with a scientific whaling programme. The possibility that the whales may try to escape from the vessel and thus possibly display a quite different diving behaviour compared to when left alone must be considered. Our observations indicated, however, that most of the whales were unaffected by the presence of the boat. They where often foraging in schools of herring (*Clupea harengus*) and when followed by the ship they appeared to surface randomly sometimes very close to the boat, totally ignoring the presence of the whaler as described by both Horwood (1981) and Ivashin & Votrogov (1982). If the whales perceived the boat as a threat, they would have had no difficulties in escaping. Some of the whales approached the boat, a seeking behaviour described by several authors (Kasuya & Ichihara 1965, Beamish & Mitchell 1973), and are thus affected by our presence. Also it is important to note that even if the whales behaviour in general is affected by the presence of the whaler, this will not impair the

value of the calculations of diving pattern intervals, since the sighting surveys are performed using boats.

Of a total of 15 whales caught during this field work, we had the opportunity to record the diving pattern of five individuals, four sexually mature males and one immature female. Most of the animals observed probably were males, since they constituted 80% of total catch. The material is not sufficient for an analysis of age-sex differences in diving pattern, but provides information relevant to evaluation of results from sighting surveys.

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