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Photoidentification of individual killer whales, *Orcinus orca*, off the coast of Norway, 1983-1986

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ABSTRACT

Photoidentification of individual killer whales has been conducted since 1983 in two study areas off Norway, one in Lofoten, northern Norway, and one in Møre, southwestern Norway. Thus far, 26 individuals have been identified. Based on associations among individuals, six whales have been preliminarily assigned to one pod (field estimates of pod size ranged from 7 to 10 whales), nine to a second pod (field estimates 7-12 whales) and six to a third pod (field estimate 10-15 whales). The remaining five whales have not been assigned to any pod, even provisionally. Comparison between years and areas has resulted in the following matches: five individuals of two pods photographed in Lofoten in September 1983 were again photographed in Lofoten in September-October 1986. One of these whales was also photoidentified in the same area in December 1984. One individual photographed in Lofoten in the autumn of 1985 was photographed in the same area in the autumn of 1986. Two individuals of one pod photoidentified in southern Møre in April 1984 were photographed in Lofoten in the autumn of 1985, representing the first documented movement of identified killer whales between these two areas, about 700 km apart. Comparison of photographs of these 26 known killer whales from Norway with photographs of 143 killer whales photoidentified in coastal waters off eastern Iceland, 1981-1986, has not resulted in any matches.

INTRODUCTION

Killer whales occur along the entire Norwegian coast, but areas of main concentration are the southern west coast, Møre, Lofoten and Finnmark. Killer whales have been observed in Norwegian coastal waters throughout the year (Jonsgård and Lyshoel 1970; Christensen 1982; Øien 1988 - this volume; Christensen 1988 - this volume). Between 1938 and 1981, 2,435 killer whales were taken by Norwegian whalers, an average of about 55 per year (Øien 1988 - this volume); the majority were taken in Norwegian coastal waters (Christensen, 1982; Øien 1988 - this volume: Table 2).

In 1981, noting that existing information was inadequate for stock assessment and in light of the history of exploitation, the Scien-

tific Committee of the International Whaling Commission (IWC) recommended that the killer whale stock(s) occurring in Norwegian coastal waters be unclassified, and that a zero catch limit be applied (IWC 1982). In 1982, the Norwegian government voluntarily placed a ban on the taking of killer whales by Norwegian whalers. This ban is still in effect.

The Scientific Committee also recommended that population assessments be carried out and that photographic and acoustic techniques developed and successfully applied in studies of killer whale populations in the northeastern Pacific Ocean be the first method-of-choice. Photoidentification of individuals has been used in population studies of killer whales off British Columbia since 1973 (e.g. Bigg 1982; Bigg *et al.* 1987), off

Washington State since 1976 (Balcomb *et al.* 1982; Bigg *et al.* 1987), off southern Alaska since 1976 (Leatherwood *et al.* 1984; Ellis *et al.* in press) and off Iceland since 1981 (Lyrholm *et al.* 1987; Sigurjónsson *et al.* 1988 – this volume).

From 1983 through 1985, pilot studies to photoidentify and acoustically record killer whales in Norwegian coastal waters were carried out in Lofoten and off Møre (Lyrholm 1984, 1985). The work continued with increased effort in 1986. This paper summarizes progress made in photoidentification from 1983 through 1986 as part of an on-going long term study of the population biology, social organization and acoustic behaviour of killer whales in Norwegian coastal waters.

METHODS

Data collection

The study areas are located in the Lofoten archipelago in northern Norway and in Møre in the southwest (Fig. 1). The waters were searched for killer whales from landbased lookout points or from boats. The boats did not search along randomized transects, but rather went to areas where the likelihood of encountering killer whales was thought to be greatest, based on previous experience and information from local residents. Radiocontact with fishermen sometimes aided in finding whales.

Whenever killer whales were seen and weather permitted, they were approached by a small boat, counted and photographed from the left side, using standardized photographic techniques (Bigg *et al.* 1986): photographs were taken with 35 mm SLR cameras with 300 mm telelenses and 400 ASA black-and-white film exposed at 1600 ASA. Shutter speed was maintained at 1/1000 second or faster.

Effort level was lower in 1983 and 1985 (two weeks of field work in each year) than in 1984 and 1986 (17 days and five weeks of field work, respectively). Many of the photographs from 1983 and 1985 were provided by people other than the principal research team and were taken incidental to other activities, often

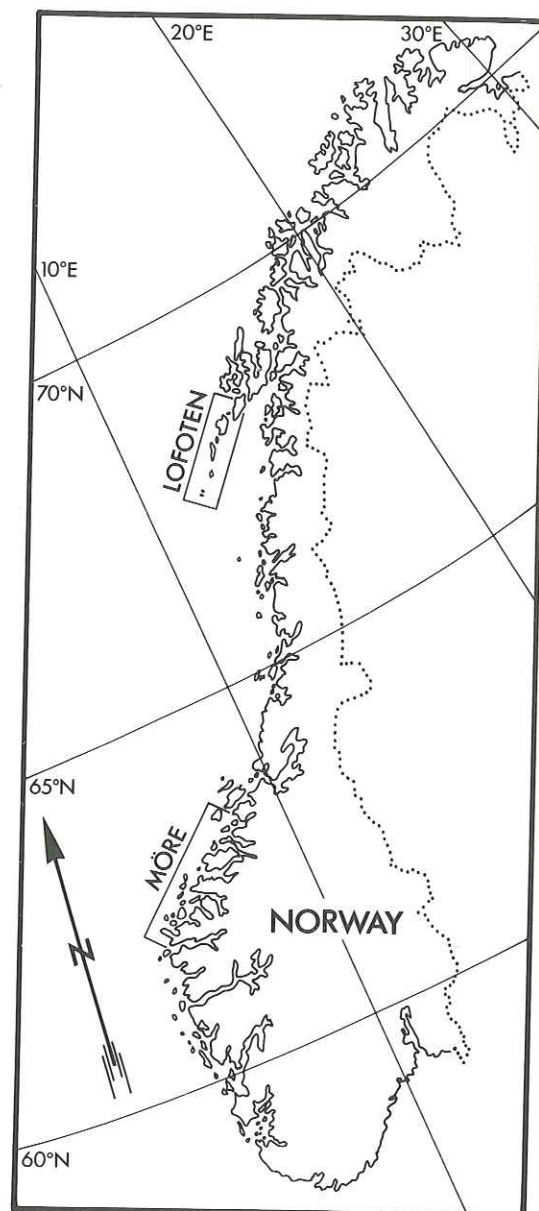


Fig. 1. Norway with the study areas indicated.

without following standardized procedures. Furthermore, photographs from 1983 were accompanied with little information on date, precise locations of whale encounters and separations of social groupings. In April 1984,

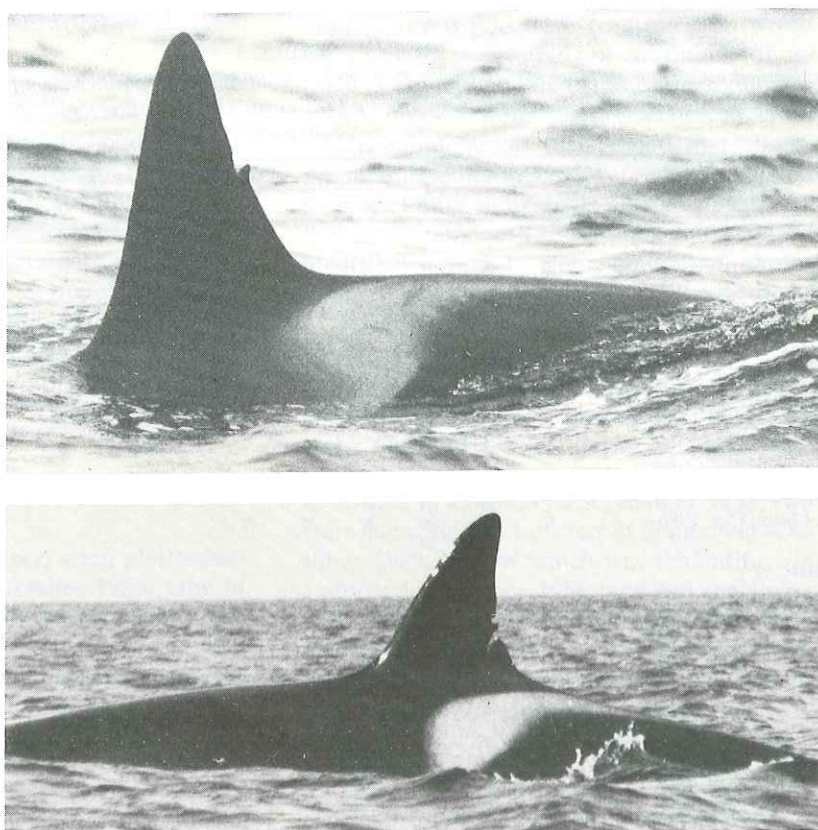


Fig. 2. Examples of a killer whales photoidentified off Norway showing identification characteristics.

systematic photoidentification was carried out in Møre, about 700 kilometres south of Lofoten (Lyrholm 1984, 1985). Photographs from the autumns of 1983 and 1985 are from the same study area in Lofoten as those from the autumn of 1986.

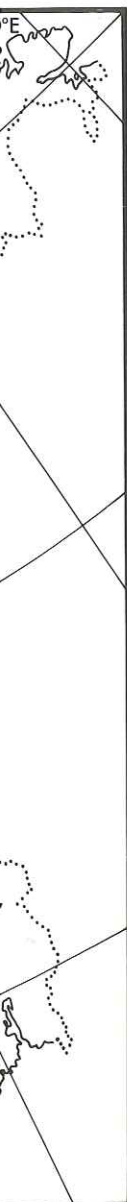
Data analysis

Individual whales were identified by examining the photographic negatives under a dissection microscope. Whenever possible, identified animals were provisionally assigned to pods based on associations with other photoidentified individuals. Pods were indicated by a letter code (N for Norway, followed by A, B, etc., unique to each pod), and individuals within pods were sequentially given identity numbers. Thus, NA-1 indicates whale number one in NA pod, NB-1 whale number one in NB pod, etc.. Some whales could not be as-

signed to particular pods, even provisionally, owing to insufficient data on associations with other individuals. These whales were assigned identity numbers only and were included in a "miscellaneous" category.

A 12.7 × 17.8 cm print was made of the best photograph of each identified whale and placed into a working catalogue against which further identifications were checked. The identified individuals were provisionally assigned to broad age/sex classes as: adult males; females and subadult males; or juveniles and calves. As outlined in Bigg (1982), adult males can be distinguished from all other age/sex classes by their tall dorsal fin. Finer resolution of the other ages and sexes can only be made through long term observation of the same identified individuals or observation of the genitals.

Identification photographs from the Norwe-



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TABLE 1
 Identified individual killer whales 1983–86. X: positive identification. 0: positive identification but feature permitting identification of uncertain long-term validity. +) Lien *et al.* (1988). Misc.*) Miscellaneous animals not assigned to pods.

Area and year	Animal Identification Number													
	1	2	3	4	5	6	7	8	9	13	14	24	25	26
<i>NA pod</i>														
Møre April 1984	X	X	0	X	0	0								
Lofoten Sept. 1985	X	X												
<i>NB pod</i>														
Lofoten Sept. 1983						X	X	X						
Lofoten Sept.–Oct. 1986	0	0	X	0	X	X	X	X	0					
<i>NC pod</i>														
Lofoten Sept. 1983			X	X										
Lofoten Dec. 1984 +)				X										
Lofoten Oct. 1986	0	0	X	X	X	0								
<i>Misc.*)</i>														
Lofoten Sept. 1983														
Lofoten Sept.–Oct. 1985														X
Lofoten Sept.–Oct. 1986										X	0	X	X	

gian sample were compared between areas and years and with photographs of killer whales collected in the Lofoten study area in December 1984 by Lien *et al.* (1988 – this volume). They were also compared with photographs of 143 individual killer whales identified off Iceland, 1981–1986 (Lyrholm *et al.* 1987; Sigurjónsson *et al.* 1988 – this volume).

RESULTS AND DISCUSSION

Twenty-six individual killer whales were identified from various combinations of the following characteristics: shape and size of the dorsal fin, pigmentation and scarring in the post-dorsal-fin saddle patch, nicks and tears in the dorsal fin and body scars (Fig 2). Eleven of these 26 whales did not have extensive nicks and tears in the dorsal fin (which are permanent injuries (Bigg 1982)) but were identified on the basis of subtle characteristics, mainly scars in the saddle patch and on the body. In killer whales, some such scars become permanent while others heal and disappear (Bigg 1982). It is difficult to determine

from a photograph which scars will remain and which will not. Thus, some of these subtle characteristics may not permit long-term identification of the eleven individuals, although they permitted them to be positively distinguished in the present sample.

Twenty-one of the twenty-six identified individuals were provisionally assigned to the pods shown in Table 1 and discussed below.

NA pod

Whales assigned to this pod were first photographed in repeated encounters in southern Møre in April 1984. Six individuals were photographically identified. Field estimates of pod size ranged from 7 to 10. Two of the six whales catalogued were reidentified in one encounter in Lofoten in the autumn of 1985, where they were travelling together and with several unidentified whales. This represents the first documented movement of killer whales between Møre and Lofoten, about 700 km apart. Comparable ranges of movement, about 650 km, have been noted for one pod travelling between Prince William Sound and

Southeast Alaska (Leatherwood *et al.* 1984; Ellis *et al.* in press).

NB pod

Three whales assigned to this pod were encountered and photographed in Lofoten in September 1983. They were reidentified in repeated encounters in Lofoten in September–October 1986. Six additional whales first photoidentified during September/October 1986 were assigned to this pod. Thus, nine whales have been catalogued in the NB pod. The maximum number photoidentified in any one encounter was five whales. Field estimates in encounters with this pod ranged from 7 to 12.

NC pod

Two members of this pod were photoidentified in Lofoten in September 1983. One of them was reidentified in photographs from Lofoten in December 1984 (Lien *et al.* 1988 – this volume) and both were reidentified in one encounter in Lofoten in October 1986, when four more individuals were added to the catalogue, bringing the total to six whales. Ten to 15 killer whales were estimated to be present.

Some animals were assigned to pods based on their associations in only one or a few encounters. These pod designations should be regarded as preliminary. Adequate determination of the patterns of association in killer whales may require many repeated encounters with identified individuals over several years. In British Columbia and Washington State, associations between certain individual killer whales (i.e. within pods) have been consistent since studies began there in 1973 (Bigg *et al.* 1987). It is not known whether the associations that have led to the pod designations in Norway represent similar long term bonds. It could be argued that the term "pod" should be reserved for groups that are known to be cohesive over many years, but it is used here since it is a generally accepted term for groups of killer whales.

Within the short study period in 1986 (five weeks), some of the associations among indi-

viduals in NB pod were confirmed in two to six encounters spanning a maximum of 25 days. Two individuals of NC pod found together in 1983 were also associated in 1986, and two individuals of NA pod first photographed together in 1984 were also associated in 1985. Other individuals present in the earlier encounters with these pods could not be identified owing to poor quality of photographs.

Miscellaneous Animals

Five photoidentified whales could not be assigned to any pod, even provisionally; they were included in the "miscellaneous" category, pending further data. One was photoidentified in Lofoten in September 1983; two were identified in Lofoten in September–October 1985, one of which was reidentified in Lofoten in October 1986; and the remaining two were photographed in Lofoten in September–October 1986.

In summary, 26 individual killer whales have been photoidentified to date in two study areas off Norway. Of these, eleven which were positively identified were recognized on the basis of characteristics for which long term persistence is uncertain. The matches between years and areas demonstrate repeated use of Lofoten by the same individuals in different years (in the autumn/winter) and some movement between Möre and Lofoten.

Christensen (1988 – this volume) and Øien (1988 – this volume) suggest that seasonal movements of killer whales occur between Lofoten and Möre and that at least some of the whales follow the migration of the Norwegianspring-spawning herring, which in recent years have moved between Lofoten in the autumn and Möre in the spring (Röttingen 1987). The matches of two killer whales first photographed in Möre in April 1984 and subsequently reidentified in Lofoten in September–October 1985 support this hypothesis, although more data are needed to allow conclusions on the regularity and extent of such movements.

To date, no matches have been found between the 26 individual killer whales photo-

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identified off Norway and the 143 individuals photoidentified off Iceland (Lyrholm *et al.* 1987; Sigurjónsson *et al.* 1988 – this volume). Neither is there overlap in the call repertoires thus far recorded from whales in these two areas (Moore *et al.* 1988 – this volume). Thus, movements between Norway and Iceland, suggested by Jonsgård and Lyshoel (1970), cannot be confirmed by the present data.

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