

Interactions between herring fishery and killer whales in northern Norway

Tiu Similä

WWF killer whale project, P.O.Box 181, 8465 Straumsjøen, Norway

Abstract

The main prey of killer whales (*Orcinus orca*) occurring in the coastal waters of northern Norway is Norwegian spring-spawning herring (*Clupea harengus*). A long term study (1990-2004) has been conducted in the wintering grounds of herring to study interactions between killer whales and their prey. Killer whales have been studied using behavioural observations, underwater video, high-frequency sonar and satellite-tracking. During daytime herring is present in deep waters (150-300 m) and killer whales can chase schools from this deep layer towards surface (dives down to 312 m recorded). However, the whales prefer to search out small patches of herring, which occur in shallow waters in early morning. Feeding occurs mainly in shallow waters and in areas with underwater seamounts (habitat covering less than 10 % of the study area), which aid the whales in herding their prey. Killer whales are not capable of catching herring unless they have stunned them first with tail slaps. As the herring catch quotas have increased from 70 000 tn in 1990 to 470 000 in 2004, the whales have learned to follow the fishing fleet and feed on herring that falls from the nets when the catch is being pumped in. The herring fishery has thus become a major factor influencing the movement pattern, habitat use and behaviour of killer whales.

Introduction

The main prey of killer whales (*Orcinus orca*) occurring in the coastal waters of northern Norway is Norwegian spring-spawning herring (*Clupea harengus*). A long term study (1990-2004) has been conducted in the wintering grounds of herring to study interactions between killer whales and their prey. To be able to capture herring, the whales need to isolate small schools from the thick "layer" of wintering herring. During daytime herring is present in deep waters (150-300 m). The satellite-linked dive-depth recorders attached to seven killer whales in 2000-2001 revealed that the whales are capable of diving down to at least 312 m and chase herring schools closer to the surface. However, the whales prefer to search out small patches of herring, which occur in shallow waters in early morning. Feeding occurs mainly in shallow waters and in areas with underwater seamounts (habitat covering less than 10 % of the study area), which aid the whales in herding their prey.

The killer whales in the study area live in stable family groups which cooperate in herding herring schools and while feeding. Chasing a herring school from the wintering layer is an elaborate process and it can take up to three hours from the time the whales start herding before they can start feeding on herring. The whales are unable to catch herring without stunning them first with tailslaps, a learned technique which killer whales use in both Icelandic and Norwegian waters in capturing herring.

When the whales have managed to isolate a small school of herring they are able to herd it to the surface and feed using a technique called "carousel feeding" where the whales keep the school pushed towards the surface while feeding. This technique is easily observed and correctly identified in the field by different observers (other feeding behaviours need more skilled observers) and is therefore suitable for behavioural observations conducted from

several platforms. The occurrence of this behaviour decreased during 1995-1999 and it was thought that this was related to the fact that the main herring wintering grounds moved from Tysfjord and Ofotfjord to Vestfjord with less areas with underwater seamounts and other features beneficial for carousel feeding. However, satellite- and VHF-tracking of killer whales in winter 2000-2001 gave the first description of the behaviour of the whales during dusk and at night. The data showed that killer whales were following the herring fleet (which operates mainly during evening and night), feeding around vessels pumping in their catches. Although the tracking data was not sufficient to give a quantitative analysis of the importance of this behaviour, it was considered as a potential factor explaining the decrease in the occurrence of carousel feeding among killer whales in the wintering grounds of herring. The aim of this study was to investigate how herring fishery affects killer whale behaviour by comparing behavioural observation data and herring catches within the study area during October-January 2003-05.

Material and methods

Killer whale behaviour was studied 15.10 – 15.01 in 2003-2005 in the wintering grounds of herring in Tysfjord and Vestfjord in northern Norway. The whales were searched on opportunistic basis within the fjord system from three different vessels; a 12 m steel ketch, a 33 m whale-watching vessel and a 5 m inflatable. When encountered, the behaviour of the whales was observed at 5 minute intervals and the behaviour was divided into travelling, socialising, resting and feeding (carousel-, travel- and subsurface feeding). In this study only observations of carousel feeding (for description see Similä and Ugarte 1993) killer whales were used, since this feeding technique can reliably be identified by different observers. Data on daily catches of herring within the wintering grounds was received from Norwegian Fishermen's Sales Organisation for Pelagic Fish.

Results and discussion

Killer whales were observed for a total of 110 hours in 2003-04 and 132 hours in 2004-05. Carousel feeding was observed throughout October – December in both years (44 feeding encounters in 2003, 81 in 2004). However, the observations of carousel feeding became more frequent as herring catches/day diminished (Fig 1). The large number of carousel feeding observations in 2004-05 is probably explained by the fact that the peak in herring fishery was over earlier than in the previous year. After herring fishery started first of January no carousel feeding was observed neither in 2004 or 2005. The herring starts to migrate out of the fjord system in January and is typically found in greater depths than in October-December, which makes the benefit of following herring vessels even greater for the whales. Few observations (11) were made of killer whales feeding around fishing boats hauling in their catches. However, this was not surprising since majority of fishing took place in dusk and in darkness.

After the collapse in the Norwegian spring-spawning herring stock (in late 1960`s) there was practically no fishery on this stock for two decades. In 1990 the quota was 70 000 tons and in 2004 the quota had increased to 470 000 tons. The decrease in occurrence of carousel feeding recorded in 1995-1999 is probably explained by the substantial increase in herring fishery and killer whales learning to feed on herring falling out of the nets when catch is being pumped in. Killer whales are known to take advantage of long-line fishery and trawlers in other parts of the world. Feeding around herring purse-seiners has been reported from Icelandic waters, where this behaviour was utilized in live capture of killer whales in 1976-1988.

When feeding around herring fishing boats, the whales do not need to go through the elaborate herding behaviour and they do not need to stun their prey. However, the behaviour is risky for the whales, since it is common that several boats operate close to each other and the whales can get caught in a net set in an area where they are feeding on the discards from a fishing boat pumping in its catch. The whales are capable of swimming through the nets and jumps over the corkline have been reported, although rarely. When fishermen observe killer whales inside the net, they usually try to lower down part of the corkline to release the whales and avoid damage to their nets. Reports of killer whales getting entangled and drowning in the nets are rare, however, this kind of information has not been collected systematically. Swimming through the nets can create cuts in the dorsal fin, most commonly in the trailing edge. Analysis of killer whale photo-identification data collected in the wintering grounds in 1991-92 and 2002-03 has revealed a significant increase in net marks in the dorsal fins of the population, which is another indication of an increased interaction between the herring fishing fleet and killer whales.

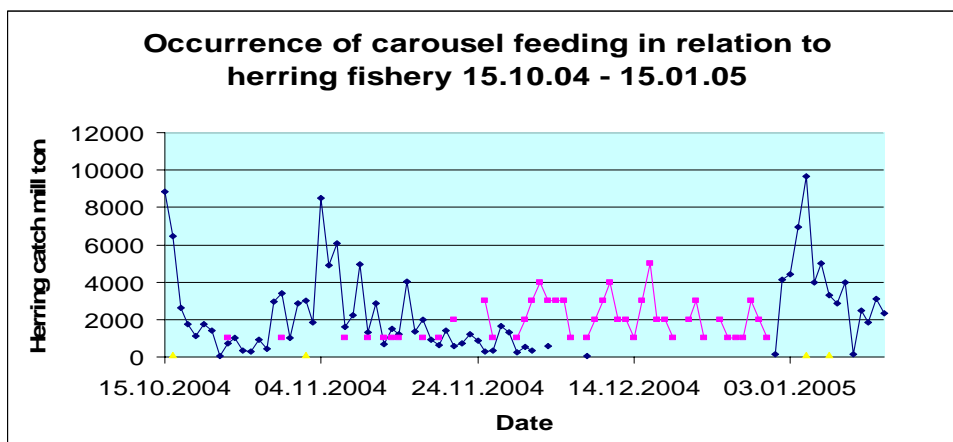
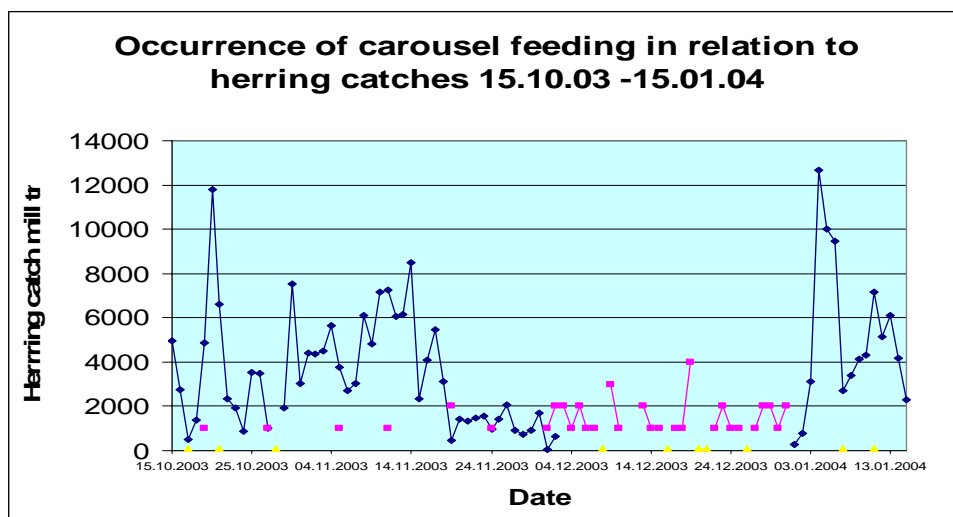


Fig. 1. Observations of carousel feeding killer whales in relation to herring fishery 15.10.03 -15.01.04 and 15.10.04 – 15.01.05

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