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Killer Whales (*Orcinus orca*) Chasing Gray Whales (*Eschrichtius robustus*) in the Northern Bering Sea

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ABSTRACT. Sixteen killer whales (*Orcinus orca*) were observed for 90 minues as they approached and then chased gray whales (*Eschrichtius robustus*) in the Bering Sea north of St. Lawrence Island, Alaska. The killer whales swam in four discrete lines that blew synchronously as they approached an area in which gray whales were feeding. Once in the gray whales' feeding area, the killer whales broke into small groups and dispersed. The gray whales, which had been dispersed while feeding, formed groups of three to six and swam away from the killer whales, except for one individual. That whale was pursued by four killer whales swimming nearly abreast in a loose crescent formation with about 300 m between individuals. Although a sonobuoy was deployed throughout the observation period, no sounds were recorded from either species. The absence of whale sounds raises questions about how the whales detected one another and communicated between nearby conspecifics.

Key words: killer whale (*Orcinus orca*), gray whale (*Eschrichtius robustus*), Bering Sea, predator/prey, acoustics

RÉSUMÉ. Seize épaulards (*Orcinus orca*) ont été observés pendant 90 minutes en train d'approcher et ensuite de chasser des baleines grises de Californie (*Eschrichtius robustus*) dans la mer de Béring au nord de l'île St. Lawrence, en Alaska. A l'approche de l'aire d'alimentation des baleines grises, les épaulards nageaient en quatre lignes discrétes soufflant leurs colonnes d'eau de façon synchronisée. Une fois arrivés, les épaulards se divisèrent en petits groupes et s'èparpillèrent. Les baleines grises, dispersées lors de la prise de nourriture, formèrent des groupes de trois à six animaux et s'éloignèrent à la nage des épaulards, sauf un seul individu. Celui-ci fut poursuivi par quatre épaulards nageant presque côte à côte dans une formation peu serrée en forme de croissant laissant quelque 300 m entre les individus. Bien qu'une radio-balise acoustique eut été déployée durant la durée entière de la période d'observation, aucun son n'a été enregistré de la part des deux espèces. L'absence des sons de baleines laisse à découvrir comment les baleines pouvaient se repérer les unes les autres et communiquer avec les individus de leur propre espèce.

Mots clés: épaulard (*Orcinus orca*), baleine grise de Californie (*Eschrichtius robustus*), mer de Béring, prédateur/proie, acoustique

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INTRODUCTION

On 20 May 1981, during systematic aerial surveys for marine mammals, 16 killer whales (*Orcinus orca*) were seen approaching and then chasing feeding gray whales (*Eschrichtius robustus*) in the northern Bering Sea. Though killer whales previously have been observed to chase and to attack gray whales (Scammon, 1874:90; Burrage, 1964; Morejohn, 1968; Baldridge, 1972), we report here the first observations in arctic waters during which there was simultaneous monitoring of underwater sounds.

The strategies used by killer whales for attacking mysticetes and other marine mammals were reviewed by Martinez and Klinghammer (1970), and by Mitchell and Reeves (1982). This report compares behaviors seen in this instance with those previously witnessed in similar circumstances.

METHODS

We made our observations during the course of a systematic aerial survey for marine mammals in the northern Bering Sea conducted under the auspices of the Minerals Management Service (MMS). The aircraft used was a specially modified Grumman Turbo Goose (N 780) equipped with twin turbine engines and operated by the Office of Aircraft Services, Department of Interior, Anchorage, Alaska. It was equipped with a Global Navigation System (GNS), with 0.37 km·h^{-1} precision, providing a continuous readout of latitude and longitude. Altitude varied between 61 and 305 m, and speeds ranged from 222 to 296 km·h^{-1}.

A sonobuoy (type AN/SSQ 41A; frequency response 10 Hz to 5 kHz ± 2 dB) was dropped in 36 m deep water at 63°53.4′N, 167°30.2′W near both killer and gray whales to monitor underwater sounds. Sounds received at the sonobuoy were transmitted to an onboard VHF broadband receiver. Underwater sounds and voice commentary were recorded simultaneously at 7.5 ips (19.05 cm·s^{-1}) on a dual channel NAGRA IV-SJ recorder with a frequency response of 20 Hz to 15 kHz ± 2 dB. The response of the overall system was 20 Hz to 5kHz ± 2 dB.

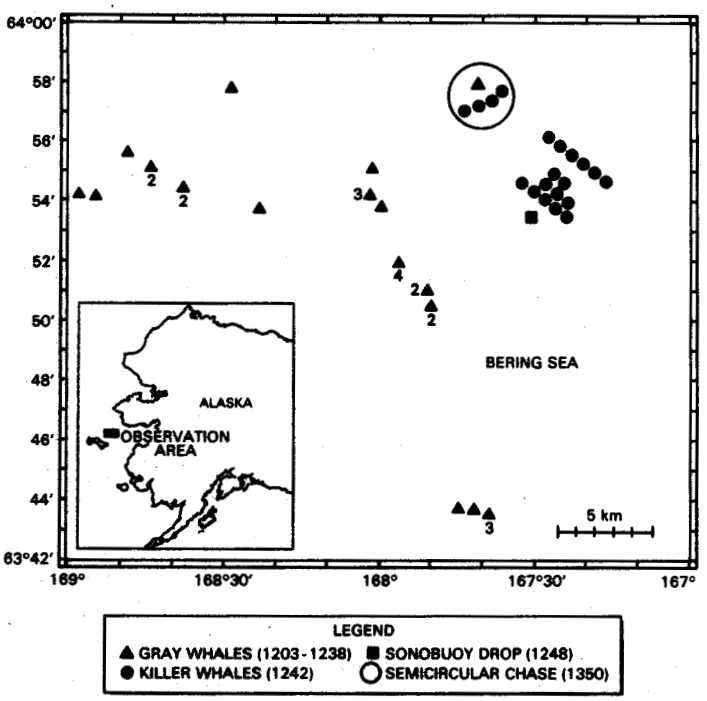

FIG. 1. Relative positions of killer whales and gray whales during 90-minute observation.

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OBSERVATIONS

At 1242 h on 20 May 1981, we observed 16 killer whales swimming toward an area where 27 gray whales had been seen in the course of a systematic survey (Fig. 1). The gray whales were dispersed over a 950-km area about 60 km NE of St. Lawrence Island, and were presumably feeding as indicated by mud streaming from their mouths as they surfaced. The killer whales approached the gray whales in two discrete groups separated by about 1 km. The first group of ten whales swam abreast in three separate lines: one line of five whales in the lead, followed at about 10 m by three whales that were trailed at 20 m by an adult-calf pair. A large male, marked by a reddish-amber saddle blaze behind a dorsal fin approximately 2 m high, swam on the outside position of the first line of five whales. We observed that the whales in this group blew synchronously (Fig. 2): the first five whales blew together, followed about seven seconds later by the second three, which were followed about five seconds later by the trailing pair. We observed this in detail during two complete sequences. The six whales of the second group swam abreast in a single line, and they also surfaced and blew synchronously as they approached the gray whales. A male, somewhat smaller than the one in the first group, held the outside position in the second group's line.

The killer whales maintained this line formation from 1242 h to 1303 h, as they swam toward the gray whales. At 1303 h, as the aircraft flew at 152 m over the front line of five killer whales, the whales broke their formation and criss-crossed over one another. Aircraft noise may have caused this behavioral change. Between 1303 h and 1350 h, the killer whales swam as independent pairs or individuals within about 1-3 km of the gray whales; surfacing and breathing was no longer synchronous. The adult and calf remained together throughout our observation. By 1346 h, the gray whales, which had been dispersed and feeding, had formed compact groups of three to six individuals and were slowly swimming away from the area. At 1350 h, we sighted four killer whales, including the large male with the reddish-amber saddle blaze, swimming nearly abreast in a crescent formation chasing a lone gray whale (Fig. 1). The killer whales were spaced approximately 300 m apart and were about 500 m behind the fleeing gray whale. We continued our observations until 1412 h at which point we had to leave the area because the aircraft was low on fuel.

No waterborne sounds were recorded from the gray or killer whales over the 90-minute observation period, though they remained within 20 km of our sonobuoy. However, we could hear distinct bearded seal (*Erignathus barbatus*) calls and water noise which confirmed that the sound recording gear was working. Killer whales and gray whales produce sounds

FIG. 2. Front line of five killer whales showing synchronous blow. Note large male on left.

within the frequency range of our recording system at reported source levels of 160 dB, and 138 - 152 dB re 1 μPa at 1 m, respectively (Fish *et al.*, 1976). At 20 km, the estimated level of such sounds at the hydrophone, assuming cylindrical spreading loss (L = SL -10 log r: (L) level at hydrophone, (SL) source level, (r) 20 m), would be 117 dB and about 102 dB re 1 μPa, respectively. These levels are well within the sensitivity limits of the sound recording equipment. Because our recording gear had an upper limit of 5 kHz, the presence of higher frequency sounds cannot be ruled out.

Our observations can be summarized as follows:

The killer whales approached and then entered the gray whale feeding area, swimming abreast in lines of two to five. Within each line, the whales surfaced and blew synchronously. Once they were within 3 km of the gray whales, the killer whales separated, except for the adult-calf pair and a group of four (including the largest male). The four, swimming abreast in a loose, crescent formation with about 300 m between each individual, pursued a lone gray whale. The other gray whales, which had been dispersed and feeding over a broad area, formed tight groups of three to six individuals and swam slowly from the area. They swam in different directions, but always away from the killer whales. No waterborne sounds were recorded from either species.

DISCUSSION

There is increasing evidence that killer whales prey on healthy baleen whales, and may be responsible for a significant amount of natural mortality (Michell and Reeves, 1982). Rice and Wolman (1979) noted from whaling records that 18% of the gray whales taken at a California whaling station bore rake and bite marks which were attributed to killer whales. On 18 July 1980, hunters from Gambell, St. Lawrence Island, watched 10-12 killer whales attack and kill a gray whales approximately 18 km NE of Gambell. The killer whales ate about 1/4 of the gray whale, mostly around the head and tongue (Braham *et al.*, 1981). A film documenting a 5.5-hr killer whale attack on a blue whale (*Balaenoptera musculus*) (Tarpy, 1979) is perhaps the best such predation sequence recorded thus far.

Although we did not witness an actual attack by the killer whales, we did observe behavior previously noted in similar encounters. The killer whales' line formations, synchronized blows, and absence of physical attack on the gray whales are similar to behavior patterns observed by Burrage (1964) off southern California. The crescent-shaped formation of the four killer whales in pursuit of a lone gray is similar to a description of "five to seven" killer whales seen chasing, but not attacking, sea lions (Martinez and Klinghammer, 1970). The synchronized approach and the crescent-shaped formation assumed by the killer whales during the chase indicates strong cooperative hunting behavior in this species. By synchronizing their breathing patterns, several whales may give the impression of a smaller group (i.e., the first group of ten whales may have appeared as three, and the second group of six whales as one) and thereby forestall the escape response of the prey species. The crescent formation may also serve a herding function allowing the predator to direct prey movement while fatiguing the prey animals.

The reddish-amber saddle blaze on the large male killer whale aided positive re-identification of this individual throughout our observation. The notation of such distinguishing color variants may lead to a more formalized description of coloration patterns in arctic killer whales when combined with other observations or photographs. Geographic variation in the shape of color patterns on killer whales has been documented for six localities in the Atlantic, Pacific, and Antarctic basins (Evans *et al.*, 1981).

The slow swimming and tight grouping by the gray whales we observed may provide protection similar to that of fish schooling. The predator must choose a moving group, then separate out an individual for efficient attack. Grouping behavior by prey thus makes a successful attack by the predators more difficult. Our observations contrast with reports by Kellogg (1940) and Tomilin (1975) that gray whales remain completely motionless when preyed upon by killer whales.

The tight grouping response of the gray whales has some similarities to the behavior described by Cummings *et al.* (1972) for two right whales (*Eubalaena glacialis*) that moved closer together when under attack by five killer whales. Those whales remained in place while thrashing the water with their flukes and flippers, in contrast to the fleeing response we observed.

Sound is transmitted very efficiently in water. A commonly held hypothesis is that sounds are used by whales for communication (e.g. Thompson *et al.*, 1979). A variety of sounds has been recorded from both killer whales (e.g. Schevill and Watkins, 1966; Dahlheim and Awbrey, 1982) and gray whales (e.g., Fish *et al.*, 1974; Moore and Ljungblad, 1983), yet no sounds were recorded during this incident. Both species may have remained silent to avoid calling attention to themselves. Cummings and Thompson (1971) reported that gray whales flee from the playback of recorded killer whale sounds, and Cummings *et al.* (1972) recorded no underwater sounds from either killer whales or right whales during an attack that they witnessed. All this leaves unanswered the following questions:

- How did the killer whales detect and locate gray whales?
- How did the gray whales detect the killer whales?
- How did the gray whales communicate with each other in order to form their groups and swim away?

Though sounds above 5 kHz cannot be ruled out, it appears the whales may not rely on sound cues to coordinate movements. More such interactions need to be recorded visually and acoustically, utilizing ultrasonic range recording systems, in order to clarify the cues responsible for the coordinated movements observed in both species.

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