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Aggressive Behavior of Short-Finned Pilot Whales Towards Sperm Whales in the Gulf of California: Insight into Food Competition

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Short-finned pilot whales (*Globicephala macrorhynchus*) inhabit tropical, subtropical, and warm temperate waters of the world, generally offshore, where they feed mainly on squid (Jefferson et al., 2008; Olson, 2009). Along with five other delphinids, the pygmy killer whale (*Feresa attenuata*), the melon-headed whale (*Peponocephala electra*), the false killer whale (*Pseudorca crassidens*), the killer whale (*Orcinus orca*), and the long-finned pilot whale (*Globicephala melas*), they form a group colloquially called "blackfish," which preys on other cetaceans, either commonly or occasionally (Carwardine, 2002; Weller, 2009). Sperm whales (*Physeter macrocephalus*), the largest odontocete, are characterized as deep, long divers and teutophagous in offshore waters (Whitehead, 2003). Herein, we describe an observation of short-finned pilot whale aggressive behavior towards sperm whales during a cetacean survey in the southern Gulf of California.

On the morning of 28 January 2005, sperm whales and bottlenose dolphins (*Tursiops truncatus*) were detected using an omnidirectional hydrophone, approximately a mile from our boat. At 0930 h (at 25° 02.32' N, 110° 45.30' W during the survey), a group of 13 female and juvenile sperm whales associated with offshore bottlenose dolphins was travelling north; our research vessel was focal following the sperm whales to photograph individual flukes and to sample sloughed skin or collect biopsies. Until 1252 h (at 25° 14.69' N, 110° 54.22' W), the sperm whales continued travelling north as a group with unsynchronized dives of ~35 min, spending 8 min at surface intervals (Figure 1). At 1308 h (at 25° 14.90' N, 110° 54.33' W), the sperm whales changed their vocalizations from usual clicks to codas and creaks, and began making shallow dives of ~24 min until all individuals gathered at the surface. At 1346 h (at 25° 17.054' N, 110° 53.20' W), a group of ~30 short-finned pilot whales, composed mainly of females, with some males, juveniles, and calves, was sighted heading towards the sperm whales. At 1403 h, the pilot whales arrived at the sperm whale group and began chasing sperm whales and displaying excited behavior (e.g., fast swimming, porpoising, breaching; Figure 2). At that time, the sperm whales remained closely together, performing very shallow dives of ~5 min and spending little time at the surface. The interaction became aggressive when a pilot whale made physical contact with the caudal fin of a sperm whale, which caused the sperm whale to immediately hit the water surface with its fluke, defecate, and then submerge. Although we could not see what caused the sperm whale to react, we believe the pilot whale might have bit the sperm whale fluke. After this, the sperm whales displayed lobtailing, sidefluking, fast swimming, porpoising, and defecating behaviors until, at 1413 h, they synchronized deep dives while showing their flukes. At 1418 h (at 25° 17.85' N, 110° 52.66' W), the pilot whales continued displaying fast swimming and breaching with no sperm whales observed at the surface. At that time, we collected some skin/blubber biopsies from the pilot whales until they all submerged, after which we lost sight of them. At 1534 h (at 25° 30.07' N, 110° 55.52' W), the sperm whales were resighted about 6.5 km away from the boat heading northeast, while the pilot whales were observed approximately 3.2 km behind them, following the same course.

Before the interaction, biopsy and sloughed skin samples had been collected from two different sperm whale individuals. Biopsies were taken from the pilot whales after the interaction. In addition, phytoplankton samples were collected using a 64 µ mesh size net for 5 min at 1 kt speed. These samples were analyzed to determine the carbon and nitrogen stable isotope ratios to estimate the trophic level and

Figure 1. Female and immature sperm whale (*Physeter macrocephalus*) group in the Gulf of California before the interaction with short-finned pilot whales (*Globicephala macrorhynchus*) (*Photo credit:* Raúl E. Díaz-Gamboa, CICIMAR)

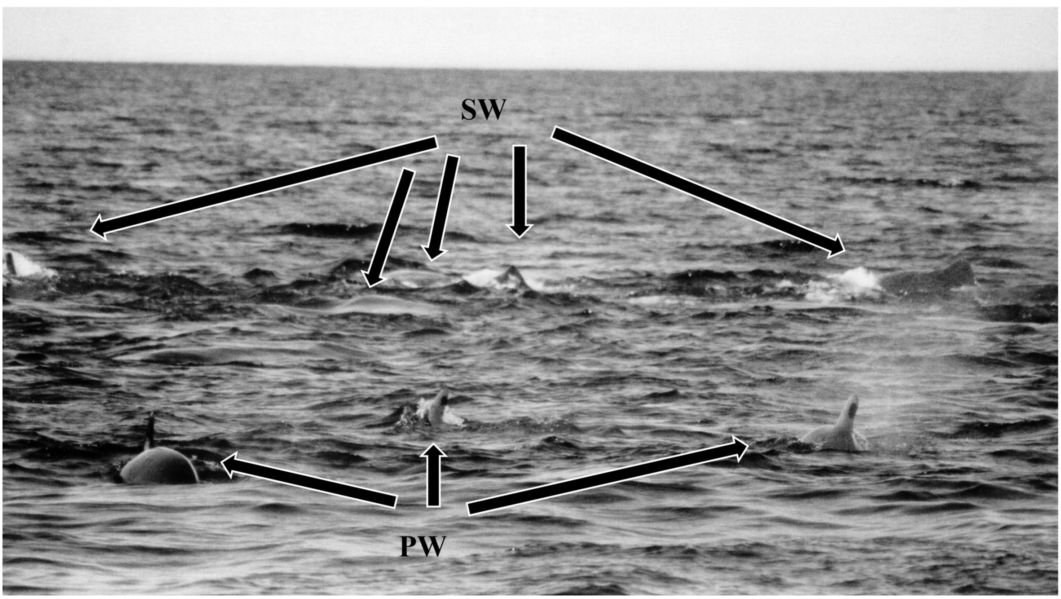

Figure 2. Pilot whales (PW) chasing the sperm whales (SW) (*Photo credit:* Raúl E. Díaz-Gamboa, CICIMAR)

the average diet of both species in the area (Díaz-Gamboa et al., 2018). Trophic level was estimated using the following (Hobson & Welch, 1992):

$$TL = 1 + (D_m - D_n) / 2.82‰$$

where *TL* is the trophic level of the cetacean; *1* the trophic level of phytoplankton; D_m the $\delta^{15}N$ of the cetacean; D_n the $\delta^{15}N$ of the phytoplankton; and *2.82‰* is the estimated value of $\delta^{15}N$ enrichment between cetacean skin and the prey consumed (Borrell et al., 2012; Gimenez et al., 2016).

Pilot whales and sperm whales had similar carbon and nitrogen stable isotope ratios, indicating that both fed in the same isotopic region and at a similar trophic level; therefore, it is possible they

Table 1. Stable isotope ratios of phytoplankton, pilot whales, sperm whales, and potential prey in the Gulf of California (mean ± SD in ‰) and trophic level

Species	*n*	$\delta^{13}C$	$\delta^{15}N$	Trophic level
Phytoplankton	20	-21.20 ± 1.00	11.70 ± 1.20	1.00
Pilot whales (*Globicephala macrorhynchus*)	4	-15.17 ± 0.20	19.44 ± 0.18	3.70
Sperm whales (*Physeter macrocephalus*)	2	-15.09 ± 0.03	20.23 ± 0.51	4.03
Jumbo squid* (*Dosidicus gigas*)	15	-17.05 ± 0.81	16.74 ± 0.89	2.79

*Values from Díaz-Gamboa et al. (2018)

focused on the same prey (Table 1). The jumbo squid (*Dosidicus gigas*) has been reported as the main prey of female and immature sperm whales in the Gulf of California (Ruiz-Cooley et al., 2004; Díaz-Gamboa et al., 2018). Both our results and those of Díaz-Gamboa et al. (2018) agree that the potential primary prey of sperm whales and pilot whales was the jumbo squid (Table 1). Although the number of sperm whale samples is low, the isotopic values agree with those reported by Díaz-Gamboa et al. (2018).

Pilot whales have been observed behaving aggressively towards other cetaceans such as humpback whales (*Megaptera novaeangliae*), common dolphins (*Delphinus delphis*), and *Stenella* sp. dolphins (Ciano & Jørgensen, 2000; Olson, 2009). In addition, agonistic interactions between short-finned pilot whales and sperm whales have been reported in the Gulf of Mexico and South Pacific and were serious enough to provoke the sperm whales into a marguerite formation response (Weller et al., 1996). In this instance, the defensive response of the marguerite formation was not observed possibly due to the absence of calves.

Besides killer whales, there are few records of other blackfish attacking cetaceans in the wild; only records of false killer whale, pygmy killer whale, and pilot whale attacks have been described (Weller, 2009). That said, the killer whale and false killer whale are the only species reported to predate on sperm whales (Palacios & Mate, 1996). Some sperm whale behaviors (e.g., lobtailing, sidefluking, fast swimming, porpoising, defecating) displayed in this observation have been reported during aggressive interactions with these cetaceans (Herman & Travolga, 1980; Palacios & Mate, 1996; Weller et al., 1996). Therefore, the response behavior of these sperm whales may have been due to previous interactions with other blackfish, and it is not unreasonable that they felt threatened by the pilot whales.

Even considering there was visible physical contact between one pilot whale and one sperm whale, it is unlikely that this interaction was for predation purposes. Although social play by the pilot whales cannot be discounted, the trophic results suggest that both species fed on jumbo squid and, therefore, compete for the same resource in the Gulf of California. Our hypothesis to describe this interaction is that this aggressive interaction by pilot whales was harassment to a possible competitor, either by competitive exclusion or by food robbery.

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