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Short Communication

Killer whales attack on South American sea lion associated with a fishing vessel: predator and prey tactics

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ABSTRACT. Interactions between killer whales and sea lions are widely known. This work describes the predator-prey behaviour of killer whales and South American sea lion associated with a trawling fishery. In Argentina the predatory behaviours of killer whales and anti-predatory behaviours of South American sea lions have been described from costal based observations, but predator-prey behaviour of these species is poorly known at open waters. Here we describe a killer whale group attack on an individual sea lion, using a video recorded from a trawling vessel and an interview of the ship captain. This predator-prey behaviour represents an example of the complexity of interactions between marine mammals and fisheries along the Patagonian coast.

Keywords: *Orcinus orca*, *Otaria flavescens*, behaviour, trawling fishery, Patagonia.

Ataque de orcas a un lobo marino sudamericano asociado a un barco pesquero: tácticas del predador y la presa

RESUMEN. Las interacciones entre orcas y lobos marinos son ampliamente conocidas. Este trabajo describe el comportamiento predador-presa entre orcas y un lobo marino sudamericano asociados a un barco pesquero de arrastre. Particularmente en Argentina el comportamiento predatorio de las orcas y el anti-predatorio de los lobos marinos comunes fueron descriptos mediante observaciones costeras, pero se sabe poco sobre el comportamiento de estas especies en aguas abiertas. En este trabajo, a partir de un video grabado desde un barco de pesca arrastrero, junto con la entrevista del capitán del barco, se describe cómo un grupo de orcas ataca a un lobo marino Sudamericano. Este comportamiento predador-presa representa un ejemplo sobre la complejidad de las interacciones entre mamíferos marinos y las pesquerías a lo largo de la costa patagónica.

Palabras clave: *Orcinus orca*, *Otaria flavescens*, comportamiento, pesquería de arrastre, Patagonia.

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Killer whales, *Orcinus orca*, inhabit all oceans of the world and likely represent the most widely distributed marine mammal species (Jefferson *et al.*, 1993). They have long been recognized as top-predators, preying on a wide range of marine animals: baleen whales, sperm whales, dolphins, seals, fishes, squids, sea turtles, sharks, sea otters, and seabirds (Jefferson *et al.*, 1991; Ford *et al.*, 1998; Hatfield *et al.*, 1998; Secchi & Vaske, 1998; Guinet *et al.*, 2000; Reyes & García-Borboroglu, 2004). Despite this, their diet and feeding behaviours can be extremely specialized localy (Barrett-Lennard & Heise, 2006).

In the Southwest Atlantic Ocean killer whales have been reported from Brasil to Tierra del Fuego (Secchi & Vaske, 1998; Iñíguez, 2001; Forney & Wade, 2006). From long-term studies in northern Patagonia, Argentina, predatory behaviours of killer whales are well known, where they prey on South American sea lions, *Otaria flavescens* and southern elephant seals, *Mirounga leonina* (López & López, 1985; Hoelzel, 1991; Iñíguez, 2001). Occasional observations along the Patagonian coast of Argentina showed that killer whales also prey more rarely on dusky dolphins, *Lagenorhynchus obscurus*, southern right whales,

Eubalaena australis, minke whales, *Balaenoptera bonaerensis* and sevengill sharks, *Notorhynchus cepedianus* (Würsig & Würsig, 1980; Thomas & Taber, 1984; Reyes & García-Borboroglu, 2004; E.A. Crespo, *pers. comm.*).

The majority of the predatory behaviours of killer whales and anti-predatory behaviours of South American sea lions from Argentina are known from land-based observations (López & López, 1985; Hoelzel, 1991; Vila *et al.*, 2008), but predator-prey behaviours of these species are poorly known at open waters off Argentina. Since it is difficult to obtain an accurate description of feeding events involving killer whales and sea lions at offshore areas, the availability of any source of information (such as video recordings, photographs, or testimonies) is often the only and the best way to document these interactions. Therefore sightings registered during vessel transits are very useful, due to the vantage point from the bow of a large ship, the long distance from shore, and other factors.

Here we report the predator-prey behaviour of killer whales and a South American sea lion associated with a trawling fishery. The following is a brief account of a killer whale group attack on an individual sea lion, using a video recorded from a trawling vessel along with an interview with the ship captain. He has more than 28 years of experience fishing in southern Patagonia, and from the interview we corroborated that he perfectly knew the species observed and its common behaviours.

The video was recorded from the posterior deck of a 34 m length trawling vessel. The target species of the trawling fleet is the Argentine red shrimp, *Pleoticus muelleri* (Crespo *et al.*, 1997). This fleet operates at northern Golfo San Jorge, Patagonia, Argentina (Fig. 1), and bottom trawling is done during daylight. Several South American sea lion rookeries and haul-out sites are located on the coast of Golfo San Jorge (Fig. 1) (Reyes *et al.*, 1999), and direct and indirect interactions with fisheries occurr in this area (Crespo *et al.*, 1997, 2007; Dans *et al.*, 2003). However, no interactions between killer whales and fisheries have been previously described within Argentine waters.

To explain the behaviour of the interaction observed, an *ad libitum* method was used (Mann, 1999). The sex/age class of the individual killer whales was determined based on the size and shape of the dorsal fin. An adult male's dorsal fin is at least twice the size of an adult female and has a triangular shape. However, it can be difficult to distinguish non-sprouted sub-adult males (*i.e.*, the dorsal fin has not reach the adult height yet) from females, thus animals of medium size were classified as adult female/sub-adult male (AF/SAM) (Visser *et al.*, 2008). The sex/age class of the sea lion was determined by body shape and colour (Crespo & Pedraza, 1991), and also established by its body size relative to the killer whales. Individual killer whales were identified by natural marks based on photo-Id catalogues from long-term observations conducted in northern Patagonia (López & López, 1985; Hoelzel, 1991; Iñíguez, 2001).

On 15 October 2008, a group of three killer whales were sighted by the crew of the trawling vessel. The killer whales were following the ship and were close to Isla Quintano (45.24ºS, 66.70ºW; Fig. 1, sighting 1). Three days later, the same group of killer whales and 10 South American sea lions were seen next to the trawler. The ship was trawling at 3.5-4.0 kts in a fishing area of 67 m depth, 20 km south from the coast of Isla Pan de Azúcar (45.10ºS, 65.81ºW; Fig. 1, sighting 2). According to the captain's interview, killer whales appeared and the sea lion group split into a cluster of nine females and juveniles that went to the stem and the only adult male sea lion went to the stern. According to the crew when killer whales were present the group of sea lions in the stem swam alongside the moving vessel, extremely close to the hull, and maintained there while the attack occurred. Killer whales did not follow any of the females/ juveniles and were interested only in the big sea lion on the stern.

According to the detailed description provided by the captain (Mr. Alejandro Pérez), the male sea lion swam alongside the fishing vessel, diving to maintain its body between the hull of the stern and the nozzle of the propeller (Fig. 2). Probably, the sea lion tried to maintain that position to avoid being caught from below by the killer whales, because there was strong turbulence generated by the propeller and the moving boat. Two of the killer whales alternately performed movements in a figure-eight shape, from one side of the sea lion body to the other side, and each time they passed under the sea lion they beat the sea lion chest or belly with their tail fluke or back. Probably, killer whales were trying to make it difficult for the sea lion to breath. This killer whale behaviour was persistent for five minutes, and was so aggressive that it caught the attention of all the crew and so the captain decided to start video recording.

In the video it was possible to see a group of killer whales attacking a big male sea lion next to the hull of the trawling vessel, and the sea lion's behaviour to avoid killer whales predation. The killer whale group consisted of one adult male and two AF/SAM. First, one of the AF/SAM killer whale rushed perpendicularly towards the sea lion beating against its body,

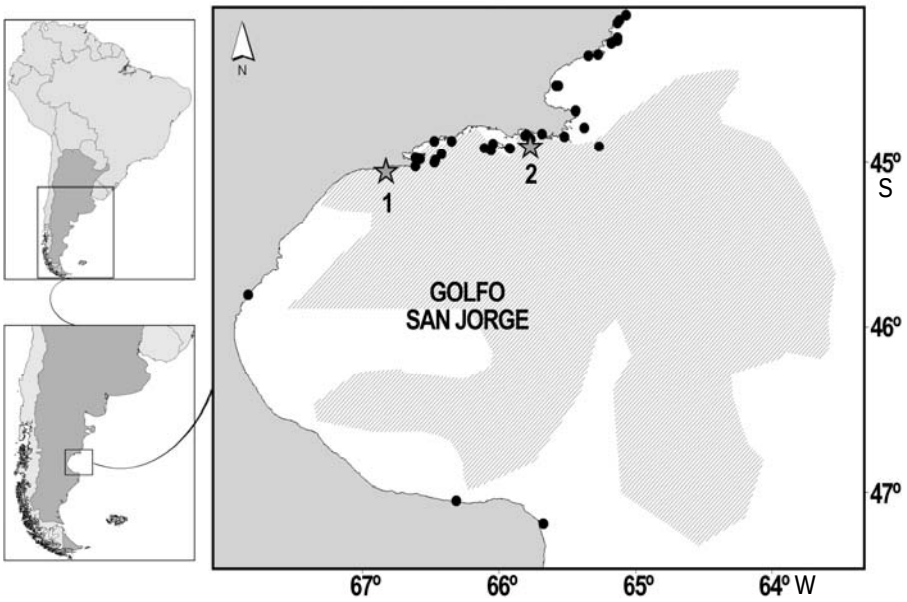

Figure 1. Position of the killer whale sightings (stars) and sea lion colonies (dots) at Golfo San Jorge. The shady area indicates Patagonian shrimp fishing grounds (extracted from Góngora *et al.*, 2009).

Figura 1. Posición de los avistamientos de orcas (estrellas) y de las colonias de lobos marinos (puntos) en el Golfo San Jorge. El área sombreada indica las áreas de operación de la pesquería de langostino patagónico (extraído de Góngora *et al.*, 2009).

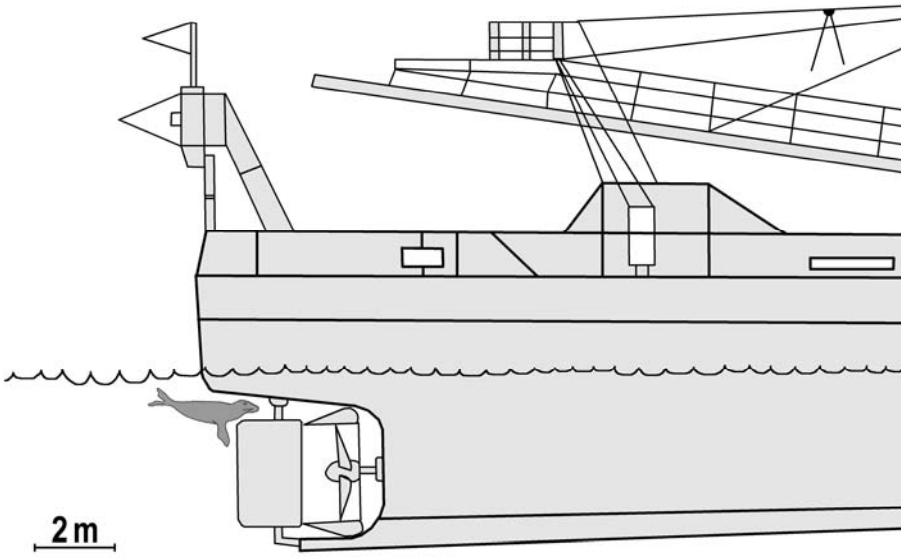

Figure 2. Sketch showing the sea lion swimming position to maintain its body between the hull of the stern and the nozzle of the propeller.

Figura 2. Esquema mostrando la posición adoptada por el lobo marino Sudamericano para mantener su cuerpo entre el casco de popa y la tobera de la hélice del barco.

trying to separate it from the hull of the vessel. Immediately from the opposite side of the sea lion, the other AF/SAM killer whale swam fast and tried to bite the posterior flippers of the sea lion unsuccessfully. During these two attempts the male killer whale was kept below the sea lion, swimming on its side, possibly to prevent the sea lion escape into deep water.

The anti-predatory behaviour of the sea lion was to swim all the time following the moving vessel, struggling to keep more than half of its body just under the stern of the ship and near the turbulence of

the propeller. By keeping its body very close to the hull of the vessel the sea lion could avoid killer whale bites, but it could not avoid the repeated killer whale strikes.

After the first unsuccessful attempt to catch the sea lion, killer whales moved away from the back of the vessel 20-30 m to the side, and just breathed. Then, the killer whales returned to the sea lion attack. One of the AF/SAM killer whales hit the sea lion body again. While the adult male killer whale stayed below the sea lion, the other AF/SAM killer whale rushed from one side of the sea lion and tried to catch the flippers, but failed, then immediately swerved and caught the posterior third of the sea lion body in one bite. Unfortunately the video ended here because the camera had run out of battery.

According to the captain's comments, the AF/SAM killer whale seized the sea lion in its mouth and sank it. The wounded sea lion was then swept out by the current of the propeller 15 m behind the vessel. Immediately the male killer whale catched the sea lion and killed it. There are no records of the pod sharing or not the prey, because the vessel continued trawling leaving the group behind too far to see (A. Pérez, *pers. comm.*).

Killer whales involved in this event did not correspond to any of the individuals residents identified in Península Valdés (J. Copello and R. Bubas, *pers. comm.*). Consequently, there is probably more than one killer whale pod along the coast of Argentina, and different pods may use different foraging tactics (López & López, 1985; Hoelzel, 1991; Iñíguez, 2001; present study).

South American sea lions commonly follow fishing vessels to feed on target species, as well as by-catch species that are discarded from boats (Crespo *et al.*, 1997, 2007; Dans *et al.*, 2003). The shrimp fishery has the highest levels of discard of Argentine hake, *Merluccius hubbsi* (Crespo *et al.*, 1997, 2007), which is the primary prey of the South American sea lions (Koen-Alonso *et al.*, 2000). Killer whales do not feed on shrimp and also fishermen have never seen this species feeding on discarded fish (A. Pérez, *pers. comm.*). However, according to the ship captain (A. Pérez), the presence of killer whales in Golfo San Jorge associated to trawling vessels is quite frequent from September to November in some years. But, after 28 years fishing in this area, he said that this was the first time he saw a sea lion being attacked.

Anti-predatory behaviours of several pinniped species in response to killer whale's attacks have been observed, for example avoiding or hiding in shallow coastal waters, kelp beds, river mouths, surf zone, among ice floes, or hauling out on shore. Also, sea lions have climbed or attempted to climb aboard vessels, buoys, or other floating objects for protection (Jefferson *et al.*, 1991). In particular, adult South American sea lions from Punta Norte (Península Valdés, Argentina) have fully developed a variety of anti-predatory behaviours to killer whales's attacks near the coast (Vila *et al.*, 2008). For example, adults swim to shallow areas, increase their swimming speed, porpoise along the coast, or haul out of the water (Hoelzel, 1991; Vila *et al.*, 2008). The sea lion behaviour strategy described here seems to be an anti-predatory tactic used in open water, using the hull of the vessel as a refuge, and the turbulence of the propeller as an acoustic and visual hiding place from killer whales. This is probably a new adaptive sea lion behaviour, as the existence of this kind of vessels is recent. Additionally, this behaviour deals with a new "object", which can be dangerous (propeller or accidental catches). Hückstädt & Antezana (2004) also described that South American sea lions stayed close to the hull of a vessel when killer whales were present and associated with the jack mackerel fishery, but they never recorded any direct attack.

It has been suggested that killer whales from Chile use the fishery as an indirect source of prey, and that they developed a hunting strategy to benefit from the aggregation of sea lions in open waters, far away from their land refuges (Hückstädt & Antezana, 2004). The event described here supports this hypothesis and provides evidence that this same hunting strategy occurs along the Argentine Sea. Moreover, it represents another example on the complexity of interactions between marine mammals and fisheries in Patagonia.

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