Short Communication

Killer whale attacking on South American sea lion associated to a fishing vessel: predator and prey tactics

M. Florencia Grandi[1], Rocío Loizaga de Castro[1,2] & Enrique A. Crespo[1,2]

[1] Laboratory of Marine Mammals, CENPAT-CONICET, Blvd. Brown 2915, U9120ACV Puerto Madryn, Chubut, Argentina

[2] National University of Patagonia San Juan Bosco, Blvd. Brown 3051, U9120ACV Puerto Madryn Chubut, Argentina

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 to a trawling fishery. Particularly in Argentina the predatory behaviours of killer whales and anti-predatory behaviours of South American sea lions were described from land-based observations from coast, but predator-prey behaviour of these species is poorly known from open waters. Here we account of a killer whale group attacking on an individual sea lion, of a video recorded from a trawling vessel, along with an interview of the ship captain. This predator-prey behaviour represents an example on the complexity of interactions between marine mammals and fisheries along Patagonia coast.

Keywords: *Orcinus orca; Otaria flavescens*; behaviour; trawling fishery; Patagonia

Orcas atacando a lobo marino común asociados a un barco pesquero: tácticas de predador y 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 común asociados a un barco pesquero de arrastre. Particularmente en Argentina comportamientos predatorios de orcas y el anti-predatorios de lobos marinos comunes fueron descriptos a través de observaciones costeras, pero poco se sabe sobre el comportamiento de estas especies en aguas abiertas. En este trabajo, a partir de un

video grabado sobre 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 común. Este comportamiento predador-presa representa un ejemplo sobre la complejidad de las interacciones entre mamíferos marinos y pesquerías a lo largo de la costa patagónica.

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

Corresponding author: M. Florencia Grandi (grandi@cenpat.edu.ar)

Killer whales, *Orcinus orca* inhabit all oceans of the world and likely represent the most widely distributed marine mammal species (Jefferson *et al.*, 1994). 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). However, their diet and feeding behaviours can be extremely specialized (Barrett-Lennard & Heise 2006).

In the Southwest Atlantic Ocean killer whales have been reported from Brazil to Tierra del Fuego (Secchi & Vaske 1998; Iñíguez 2001; Forney & Wade 2006). From long-term studies in northern Patagonia, Argentina, predatory behaviour of killer whales are well known, preying 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, reported 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 cepedianu*s (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 from coast (López & López 1985; Hoelzel 1991; Vila *et al.*, 2008), but predator-prey behaviour of these species is poorly known from open waters in Argentine sea. 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, or photographs) is often the only and best way to document those interactions. Therefore sightings registered during vessel transits are very useful, due to the vantage point that gives the bow of a large ship, the distance from shore, etc.

Here we report the predator-prey behaviour of killer whales and South American sea lion associated to a trawling fishery. The following is a brief account of a killer whale group attacking on an individual sea lion, of a video recorded from a trawling vessel, along with an interview of the ship captain.

The video was recorded from the posterior deck of a trawling vessel of 34 m length. The target species of the trawling fleet is the Argentine red shrimp, *Pleoticus muelleri* (Crespo *et al.*, 1997). This fleet operates at northern San Jorge Gulf, 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 San Jorge Gulf (Fig. 1) (Reyes *et al.*, 1999), and direct and indirect interactions with fisheries occurred in this area (Crespo *et al.*, 1997, 2007; Dans *et al.*, 2003). However, so far no interaction between killer whales and fisheries was described before.

In order to explain the behaviour of the interaction observed, *Ad libitum* method was used (Mann 1999). The sex/age class of the individual killer whales was determined based on the individual relative size and shape of the dorsal fin. Adult male's dorsal fin is at least twice the size of adult female and has a triangular shape. However, it can be difficult to determine 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 based upon body shape and colour (Crespo & Pedraza 1991), and also established by its relative size regarded to 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 October 2008, a group of three killer whales were sighted by the crew following the trawling vessel close to Quintano Island (45.24ºS; 66.70ºW; Fig. 1, sighting 1). Three days later, a group of 3 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, 12 miles south from the coast of Pan de Azúcar Island (45.10º S; 65.81ºW; Fig. 1, sighting 2). According to the captain's interview, killer whales appeared and the sea lions group split into a cluster of 9 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 (Alejandro Pérez), the male sea lion swam along the fishing vessel, diving to maintain its body between the hull of the stern and the nozzle of the propeller (Fig. 2). Therefore, the sea lion tried to maintain that position to avoid being caught from below by the killer whales because of the strong turbulence generated by the propeller and the moving boat. Two of the killer whales alternately performed movements in figure-eight, 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 its tail fluke or back. Probably, killer whales were trying to take the sea lion breathe away. This killer whale behaviour was persistent for five minutes, and was so aggressive that caught the attention of all the crew and so the captain decided to start video recording.

In the video is 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 whale predation. The killer whale group consisted in 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, 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, to prevent escaping into deeper 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. Keeping its body very close to the hull of the vessel the sea lion ran away from accurate bites, but could not avoid the repeated killer whales struck.

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 just breathing. Then, 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 was kept below the sea lion, the other AF/SAM killer whales 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 was run out of battery.

According to captain's comments killer whale seized the sea lion in its mouth and sink it. The wounded sea lion was swept out by the current of the propeller 15 m behind the vessel. Immediately the male killer whale jumped over 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 are probably more than one of killer whale pods along the coast of Argentina using different foraging tactics.

South American sea lions commonly follow fishing vessels to feed on target species, as well as by-catch species that are discarded (Crespo *et al.*, 1997, 2007; Dans *et al.*, 2003). The shrimp fishery in particular, has the highest levels of discard of Argentine hake, *Merluccius hubbsi* (Crespo *et al.*, 1997, 2007), which is the primary prey for 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 at San Jorge Gulf 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.

Several anti-predatory behaviours of many pinniped species in response to killer whale attacks have been observed, for example, avoid or hide in shallow coastal waters, kelp beds, river mouths, surf zone, among ice floes, or hauling out on shore. Also, sea lions have even 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 the killer whales attacks near the coast (Vila *et al.*, 2008). For example, adults swimming to shallow areas, increase their swimming speed, porpoise along the coast, or haul out of the water for the safety of land (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 new adaptive sea lion behaviour as the existence of this kind of vessel 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 lion stayed

close to the hull of the vessel when killer whales were present associated with the jack mackerel fishery, but they never recorded any direct attack.

It was suggested that killer whales from Chile use the fishery as an indirect source of prey, and that dolphins developed a hunting strategy to benefit from the aggregation of sea lions in open waters, far away from their land refuges (Hückstädt & Antezana 2004). Therefore, the event described here not only support the hypothesis mentioned above also highlight that may occur along the Argentine Sea. Moreover, it represents another example on the complexity of interactions between marine mammals and fisheries in Patagonia.

ACKNOWLEDGEMENTS

The authors would like to thank to Juan Manuel Medina and Juan Angel Allieri who kindly provided the video. Also to Alejandro Pérez for allowing us to use the video and for the extensive interview and all the patience to tell in detail his experience. To Juan Copello and Roberto Bubas helped us with the identification of killer whales. In addition we thanks to Federico Greslebin for the video edition. At the time this manuscript was written, M.F.G. and R.L.C. were supported by a fellowship from National Research Council of Argentina (CONICET).

REFERENCES

Barrett-Lennard, L.G. & K.A. Heise. 2006. The natural history and ecology of killer whales. In: J.A. Estes, R.L. Brownell Jr., D.P. DeMaster, D.F. Doak & T.M. Williams (eds.). Whales, whaling and ocean ecosystems. University of California Press, Berkeley. pp. 163-173.

Crespo, E.A. & S.N. Pedraza. 1991. Estado actual y tendencia de la población de lobos marinos de un pelo (*Otaria flavescens*) en el litoral norpatagónico. Ecol. Austr., 1: 87-95.

Crespo, E.A., S.N. Pedraza, S.L. Dans, M. Koen Alonso, L.M. Reyes, N.A. García, M. Coscarella & A.C.M. Schiavini. 1997. Direct and indirect effects of the highseas fisheries on the marine mammal populations in the northern and central Patagonian coast. J. Northwest. Atl. Fish. Sci., 22: 189-207.

Crespo, E.A., S.L. Dans, M. Koen Alonso & S.N. Pedraza. 2007. Interacciones entre mamíferos marinos y pesquerías. In: J.I. Carreto & C. Bremec (eds.). El mar argentino y sus recursos pesqueros, Tomo 5. El ecosistema marino. INIDEP, Mar del Plata. pp. 151-169.

Dans, S.L., M. Koen Alonso, E.A. Crespo, S.N. Pedraza & N.A. García. 2003. Interactions between marine mammals and high seas fisheries in Patagonia: an integrated approach. In: N. Gales, M. Hindell & R. Kirkwood (eds.). Marine Mammals: Fisheries, Tourism and Managements Issues. CSIRO Publishing, Collingwood. pp. 88-103.

Ford, J.K.B., G.M. Ellis, L.G. Barrett-Lennard, A.B. Morton, R.S. Palm & K. Balcom. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. Can. J. Zool., 76: 1456-1471.

Forney, K.A. & P.R. Wade. 2006. Worldwide distribution and abundance of killer whales. In: J.A. Estes, R.L. Brownell Jr., D.P. DeMaster, D.F. Doak & T.M. Williams (eds.). Whales, whaling and ocean ecosystems. University of California Press, Berkeley. pp. 145-162.

Góngora, M.E., N.D. Bovcon & P.D. Cochia 2009. Ictiofauna capturada incidentalmente en la pesquería de langostino patagónico *Pleoticus muelleri* Bate, 1888. Rev. Biol. Mar. Oceanogr., 44: 583-593.

Guinet, C., L.G. Barrett-Lennard & B. Loyer 2000. Co-ordinated attack behavior and prey sharing by killer whales at crozet archipelago: strategies for feeding on negatively-buoyant prey. Mar. Mamm. Sci., 16: 829-834.

Hatfield, B.B., D. Marks, M.T. Tinker, K. Nolan & J. Peirce. 1998. Attacks on sea otters by killer whales. Mar. Mamm. Sci., 14: 888-894.

Hoelzel, A.R. 1991. Killer whale predation on marine mammals at Punta Norte, Argentina: Food sharing provisioning and foraging strategy. Behav. Ecol. Sociobiol., 29: 197-204.

Hückstädt, L.A. & T. Antezana. 2004. Behaviour of Southern sea lions in presence of killer whales during fishing operations in Central Chile. Sci. Mar., 68: 295-298.

Iñíguez, M.A. 2001. Seasonal distribution of killer whales *(Orcinus orca)* in Northern Patagonia, Argentina. Aquat. Mamm., 27: 154-161.

Jefferson, T.A., P.J. Stacey & R.W. Baird. 1991. A review of killer whale interactions with other marine mammals: Predation to co-existence. Mamm. Rev., 21: 151-180.

Jefferson, T.A., S. Leatherwood & M.A. Webber. 1994. FAO species identification guide. Marine Mammals of the world.

Koen Alonso, M., E.A. Crespo, S.N. Pedraza, N.A. García & M.A. Coscarella. 2000. Food habits of the South American sea lion *Otaria flavescens*, off Patagonia, Argentina. Fish. Bull., 98: 250-263.

López, C.L. & D. López. 1985. Killer whales *(Orcinus orca)* of Patagonia and their behavior of intentional stranding while hunting nearshore. J. Mamm., 66: 181-183.

Mann, J. 1999. Behavioral sampling methods for cetaceans: a review and critique. Mar. Mamm. Sci., 15: 102-122.

Reyes, L., E. Crespo & V. Szapkievich. 1999. Distribution and population size of the southern sea lion (*Otaria flavescens*) central and southern Chubut, Patagonia, Argentina. Mar. Mamm. Sci., 15: 478-493.

Reyes, L.M. & P. García-Borboroglu. 2004. Killer Whale (*Orcinus orca*) Predation on Sharks in Patagonia, Argentina: A First Report. Aquat. Mamm., 30: 376-379.

Secchi, E.R. & T. Vaske. 1998. Killer whale (*Orcinus orca*) sightings and depredation on tuna and swordfish longline catches in southern Brazil. Aquat. Mamm., 24: 117-122.

Thomas, P.O. & S.M. Taber. 1984. Mother-infant interaction and behavioral development in southern right whales, *Eubalaena australis*. Behaviour, 88: 42-60.

Vila, A.R., C. Campagna, M. Iñíguez & V. Falabella. 2008. South American sea lions (*Otaria flavescens*) avoid killer whale (*Orcinus orca*) predation. Aquat. Mamm., 34: 317-330.

Visser, I.N., G. Thomas, T.G. Smith, I.D. Bullock, G.D. Green, O.G.L. Carlsson & S. Imberti. 2008. Antarctic peninsula killer whales (*Orcinus orca*) hunt seals and a penguin on floating ice. Mar. Mamm. Sci., 24: 225-234.

Würsig, B. & M. Würsig. 1980. Behavior and ecology of the dusky dolphin, *Lagenorhynchus obscurus,* in the South Atlantic. Fish. Bull., 77: 871-890.

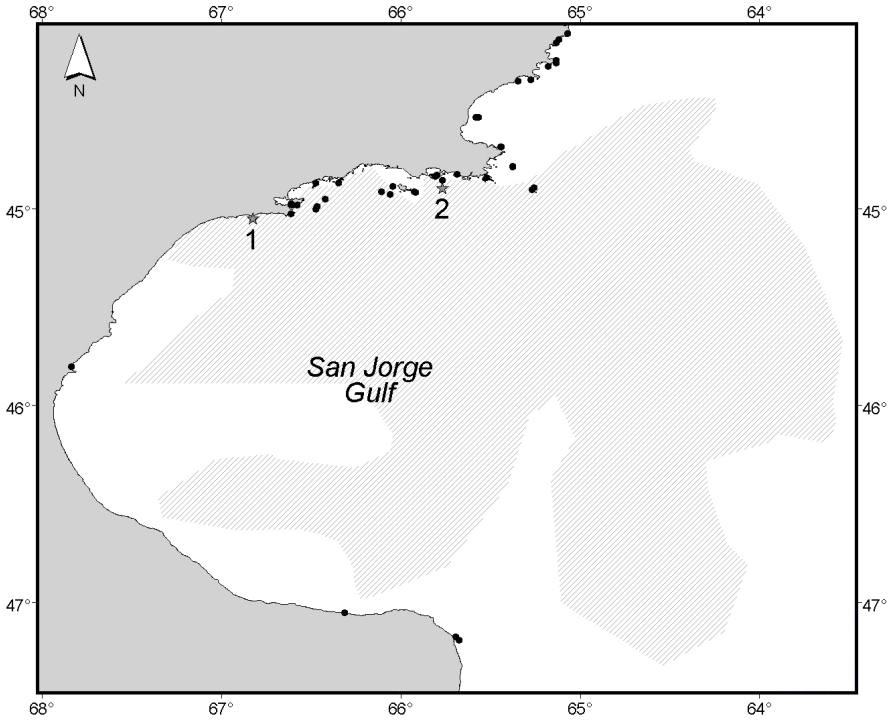

Figure 1. Position of the killer whale sightings (stars) and sea lion colonies (dots) at San Jorge Gulf. The shady area indicates Patagonian shrimp fishing grounds (extracted from Góngora et al., 2009).

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

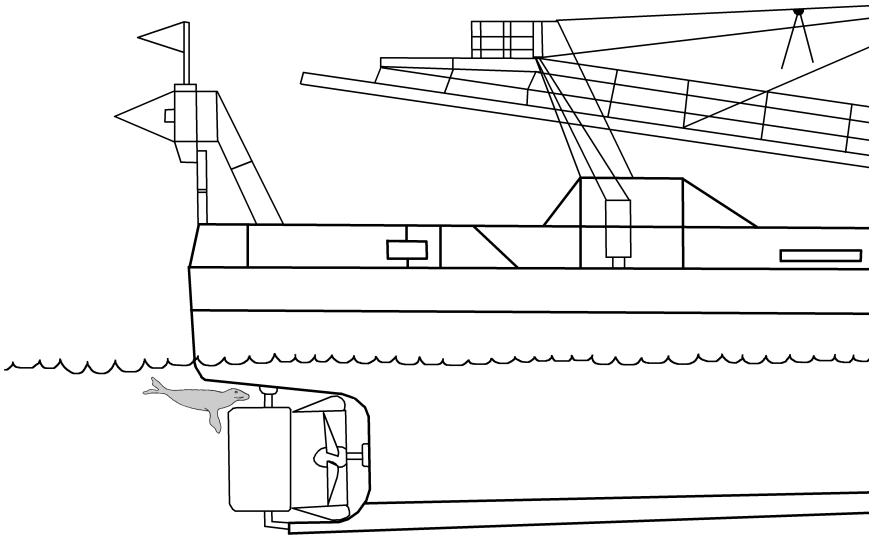

Figure 2. Sketch showing the sea lion swimming position to maintain its body between the hull of the stern and the nozzle of the propeller.

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