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RESEARCH NOTE

Incidental capture of the short-beaked common dolphin (*Delphinus delphis*) in the industrial purse seine fishery in northern Chile

Captura incidental del delfín común (*Delphinus delphis*) en la pesquería industrial de cerco, norte de Chile

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Abstract.- Incidental capture of marine mammals during fishing activities is a worldwide concern given the potentially drastic effects this can have on marine mammal populations. To assess the interaction between marine mammals and industrial fishery, an onboard observer monitored 8 purse seine fishing trips in northern Chile. He reported the incidental capture of 58 short-beaked common dolphins, 3 of which died, and one South American sea lion, which also died. The mortality rate of dolphins was 0.15 dolphins/haul and 0.3 dolphins/fishing trip, whereas for sea lions the mortality rate was 0.05 sea lions/haul and 0.125 sea lions/fishing trip. This study recorded for the first time the incidental capture of common dolphins in industrial fishery in Chile, and emphasizes the need to implement a specific monitoring plan to estimate bycatch rates of marine mammals.

Key words: Marine mammals, bycatch, purse seine, anchovy

INTRODUCTION

Incidental capture occurs in almost all fisheries around the world and is one of the main causes of the decrease in populations of top predators, which are particularly affected due to their low reproductive rate (Perrin *et al*. 1994, Chilvers 2008, Watkins *et al*. 2008, Mannocci *et al*. 2012). Marine mammals are no exception; the deaths of tens of thousands of small cetaceans and pinnipeds (seals, sea lions and walrus) have been documented as a result of getting trapped in fishing nets (Hall *et al*. 2000, Bertozzi & Zerbini 2002, Read *et al*. 2006, Prado *et al*. 2013). In Chile, although there is evidence on this kind of interaction in industrial and artisanal fishing for both cetaceans (Goodall *et al*. 1988, Pérez-Alvarez *et al*. 2015) and pinnipeds (Hückstädt & Antezana 2003, Reyes *et al*. 2013), to our knowledge no studies have examined its impacts on local populations of these groups.

The Chilean coast (FAO Fisheries Zone N° 78) is one of the most productive fishing zones in the world, with an annual landing of about 1.5 million t in 2013 (SERNAPESCA 2013). From this total, 64% is captured by the industrial fishing fleet. The main species extracted by industrial fishing include the Peruvian anchovy (*Engraulis ringens*), Chilean jack mackerel (*Trachurus murphyi*), and to a lesser degree, the Araucarian herring (*Strangomera bentincki*) (SERNAPESCA 2013). In 2013, a total of 592,000 t of anchovy were extracted, mainly in the most northern zone of the country (Regions XV, I and II), by an operative industrial purse seine fishing fleet of 158 boats (SERNAPESCA 2013), averaging 34 m of length (range between 22 and 44 m) and 400 m^3 hold capacity (range between 140 and 670 m^3) (González *et al*. 2015). This fishing fleet operates year-round, with the exception of extraction bans during the recruitment (January to March) and reproductive periods (August and September) (Yañez *et al*. 2008).

Such a large number of fishing boats along with an increase in fish capture technology (*i.e.*, more effective fishing gears and high-tech ecosounders/fish-finders), lead to an increased probability of interaction with -and incidental capture of- marine mammals (Harwood & Croxall 1988, Bjørge *et al*. 2002). Due to the general lack of knowledge on the magnitude of these captures, it is highly necessary to assess the different types of interactions between fisheries and marine mammals (Fertl & Leatherwood 1997, Read *et al*. 2006), as well as to understand the possible effects of these interactions on the species of marine mammals involved (Reyes *et al*. 2013).

The short-beaked common dolphin *Delphinus delphis* (Linnaeus, 1758), hereafter referred as common dolphin, is a small oceanic cetacean that is widely distributed in the tropical and temperate waters of the Atlantic and Pacific Oceans (Jefferson *et al*. 2008). In Chile, it is found from Arica (18º28'S) to Puerto Montt (40º47'S) (Aguayo-Lobo *et al*. 1998). Most of the sightings of this species are recorded off northern and

central Chile, with a relative abundance index from 0.76 to 193.04 animals day^{-1} (Aguayo-Lobo *et al.* 1998). According to these authors, this species should be abundant along the Chilean coast. No information is available on the incidental capture of this species in Chile. However, in Mexico and Central America common dolphins were the cetacean with the third greatest mortality due to incidental capture, after *Stenella attenuata* and *S. longirostris* (Smith 1983, Perrin *et al.* 1994). In Peru and Ecuador, this is the cetacean species that presents the most negative interactions with the artisanal gillnet fishery (Félix & Samaniego 1994).

This study reports incidental captures of common dolphins in fishing activities off the Chilean coast for the first time, and particularly on mortalities caused by the industrial purse seine fishery in the north.

Materials and methods

This study was conducted from 26 January to 5 February 2010. During this period we monitored a total of 8 fishing trips and 19 hauls in 4 zones of the north coast of Chile: Arica, Iquique, Tocopilla and Mejillones (Table 1, Fig. 1). All fishing trips took place on board a 44 m long industrial purse seiner, fishing for anchovy, with a storage capacity of 550 t and 13 crew members. The net used was made of black braided thread, with a mesh size of 5/8", 828 m long and 130 m high.

For all trips an onboard observer recorded the interaction of marine mammals with fishing activities, compiling information on (1) geographical location of the fishing zones, (2) species of marine mammals present, (3) number of individuals, (4) observation of the behavior of the animals, (5) observation of the behavior of the fishermen when marine mammals were captured, and (6) the result of the interaction.

The mortality rate was estimated as the total number of dolphins or sea lions that were hauled out dead relative to the total number of hauls (N= 8) or fishing trips (N= 19). The number of healthy, injured and dead animals was counted onboard and also corroborated by video recording.

Results and discussion

The largest number of trips and fishing hauls were off Arica, and in decreasing order in the coastal areas of Iquique, Tocopilla and Mejillones (Table 1, Fig. 1). All hauls were performed at dawn or in the early hours of the morning. Hauls took an average of 90 min each; 2 to 4 hauls were performed per fishing trip before returning to port (Table 1).

A total of 58 common dolphins were captured; all individuals were captured only in one of the hauls performed in the Arica sector (Table 1). Of the 58 dolphins trapped in the net, 44 escaped without observable harm (75.9%), 11 escaped with physical lesions (19.0%) and 3 were hauled out dead (6.1%). The 11 animals with lesions were those individuals that escaped with evident trouble swimming and with notorious wounds in their faces. We do not know if they recovered or died.

A four-step brief sequence of this event is presented in Figure 2. While the net was being hauled in, the dolphins followed the school of anchovies, suddenly finding themselves surrounded by the net with no chance of escape (Figs. 2a, b). The fishermen tried to save the animals by lowering and raising the net; a maneuver that proved to be quite effective allowing the majority of the dolphin group to escape. Nevertheless, the fishing operation continued and 3 dolphins became trapped in the cod end along with the fish and died (Figs. 2c, d).

Table 1. Information of the incidental capture of marine mammals in the purse-seine fishery in northern Chile during summer 2010 / Información de la captura incidental de mamíferos marinos en la flota pesquera industrial del norte de Chile durante el verano de 2010

Port	N° trips	N° hauls	N° hauls with common dolphin bycatch	*Delphinus delphis*		*Otaria flavescens*	
				Captured	Dead	Captured	Dead
Arica	4	8	1	58	3	1	1
Iquique	2	6	0	0	0	0	0
Tocopilla	1	3	0	0	0	0	0
Mejillones	1	2	0	0	0	0	0
TOTAL	8	19	1	58	3	1	1

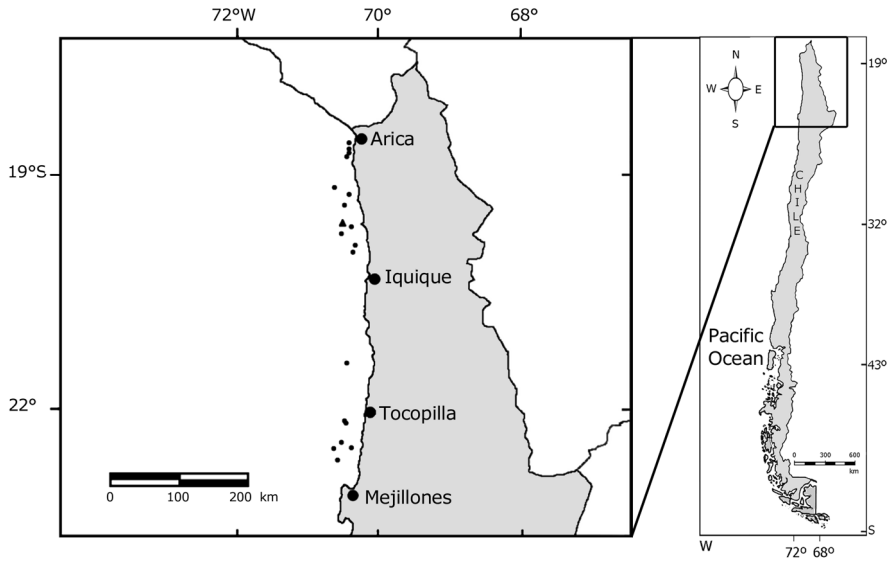

Figure 1. Study area and geographic location of the fishing areas /Área de estudio y ubicación geográfica de las zonas de pesca

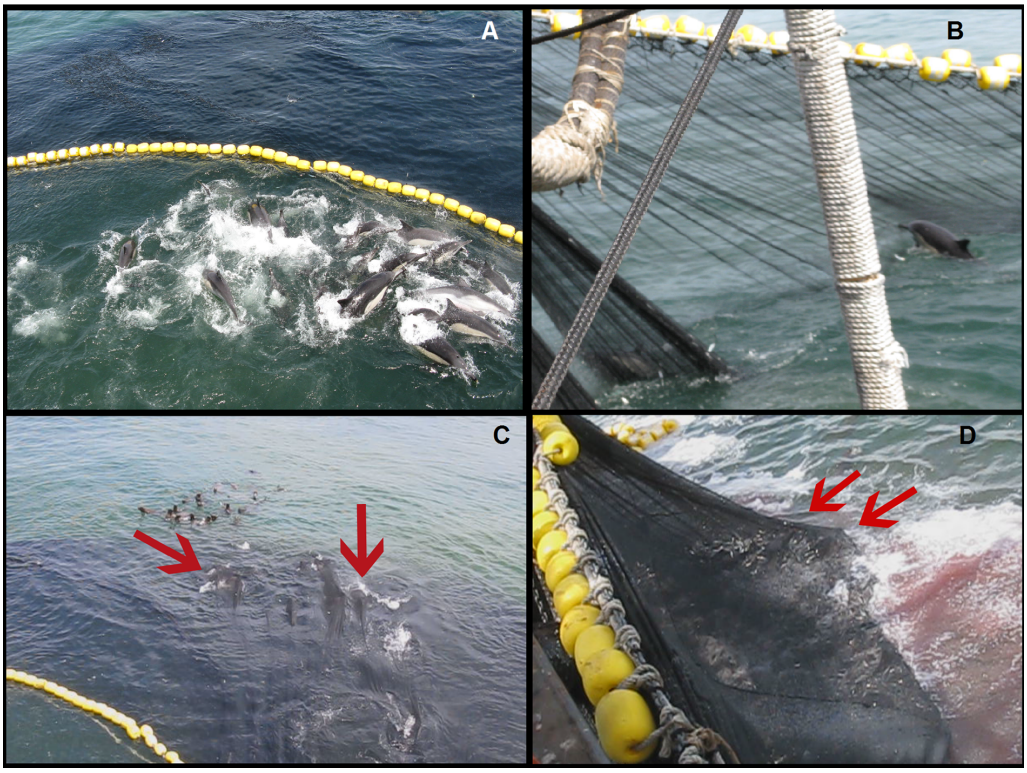

Figure 2. Sequence showing short-beaked common dolphins being caught in purse-seine nets off Arica. (a) animals trapped in the net, (b) animals trapped in folds of net, (c) animals trying to breathe through the net, (d) individuals trapped in the cod of net; in this figure it is possible to see blood in the water. Red arrows indicate the location of the dolphins inside the net / Secuencia de eventos de la captura de delfines comunes en redes de pesca de la zona de Arica. (a) animales atrapados en el cerco, (b) animales atrapados en el paño de la red, (c) animales intentando respirar a través de la red, (d) animales atrapados en el cono de la red; en esta figura es posible ver sangre en el agua. Las flechas rojas indican la ubicación de los delfines dentro de la red

The dolphins that died were those that were lifted by the folds of the net in the turn, passing through the power block. The dead animals were thrown into the ocean. According to the fishermen this was not an isolated incident; occasionally this and other species of small cetaceans become trapped.

In addition, in another fishing operation, also performed in the Arica area, we observed the incidental capture and death of one South American sea lion (*Otaria flavescens*). In this case, again, the animal was lifted in a fold of the net and died when passing through the power block. This incident was not directly observed; the fishermen noticed the animal already dead and dealt with the corpse of the sea lion as they did with the dead dolphins (*i.e.*, throwing them over board). What was observed in this particular event is in line with the report of Arata & Hucke-Gaete (2005), reporting that the sea lions were trapped in the net and killed when passing through the hydraulic system as the net was hauled out onto the fishing boat.

The mortality rate of dolphins was 0.16 dolphins/haul and 0.38 dolphins/fishing trip. The latter rate is greater than that estimated by Van Waerebeck *et al.* (1997) for this same species in Ecuador (0.0064 dolphins/fishing trip), but similar to that estimated by Félix *et al.* (2007) (0.286 dolphins/fishing trip) in Ecuador. For the South American sea lion, the mortality rate was 0.05 sea lions/haul and 0.125 sea lions/fishing trip. These results are similar to those reported by Hückstädt & Antezana (2003) (0.06 sea lions/haul) in purse seine fishing for Chilean jack mackerel, but lower than that reported for bottom-trawling (1.2 sea lions trawl^{-1}) in south-central Chile (Reyes *et al.* 2013).

To our knowledge, this is the first report of incidental capture, damage and mortality of common dolphins in Chile. Other studies performed in the south-central and southern zones of Chile have reported the capture of individuals of Commerson's dolphin (*Cephalorhynchus commersonii*), Chilean dolphin (*C. eutropia*), bottlenose dolphin (*Tursiops truncatus*) and Burmeister's porpoise (*Phocoena spinipinnis*) (Goodall *et al*. 1988, Pérez-Alvarez *et al*. 2015). The species with the highest bycatch frequency off the coasts of Ecuador and Peru are the dusky dolphin (*Lagenorhynchus obscurus*), bottlenose dolphin, common dolphin and Burmeister's porpoise (Van Waerebeek *et al*. 1997, Reyes 2009, Mangel *et al.* 2010). For pinnipeds in Chile, the only species that has been recorded in individual capture events is the South American sea lion (Hückstädt & Antezana 2003, Arata & Hucke-Gaete 2005, Reyes *et al*. 2013).

It is noteworthy that the fishermen dumped the dead animals overboard in the open ocean. This is probably done in an attempt to stay out of trouble because the capture of marine mammals is prohibited in Chile by Ministerial Decree 179/2008 (SUBPESCA 2008) and by the ban on extraction of the South American sea lion (Ministerial Decree 31/2016), making it difficult to quantify incidental mortality events. It is expected that with the recently passed new Fisheries Law there will be a substantial improvement in the collection of relevant data on this potentially important marine mammals-fisheries conflict off the Chilean coast. The new law enforces the recording of incidental capture of marine birds, reptiles and mammals, along with the onboard presence of the trained scientific observers from the Instituto de Fomento Pesquero (IFOP).

The events here reported indicate that the fishing nets used by the industrial purse seine fleet in Chile may represent a significant threat for small cetaceans, as previously reported for other marine mammal species in Chile. Based on the results of this study, we recommend that long-term studies should be performed over a wider geographic area, covering a larger part of the fishing fleet and possibly different fishing seasons, in order to provide a clearer picture of the current situation and, if necessary, identify the most adequate solutions in order to ensure the health of dolphin populations in Chilean waters.

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