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Tough life: the case of a young coastal common bottlenose dolphin repeatedly entangled

Fernando Félix[†,‡,*], Óscar Vásconez[§], Ruby Centeno[¶] and Juan Romero[§]

[†]Pontificia Universidad Católica del Ecuador (PUCE). Av. 12 de octubre 1076, Quito Ecuador
[‡]Museo de Ballenas. Av. Enríquez Gallo entre calles 47 y 50, Salinas, Ecuador
[§]Refugio de Vida Silvestre Manglares el Morro (REVISEM). Recinto Puerto el Morro, Barrio Cruz del Puerto, Guayaquil, Ecuador
[¶]Time for English and Spanish. Av. Circunvalación 906, Guayaquil, Ecuador
*Corresponding author: fefelix90@hotmail.com

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The interaction with fishing gear and direct takes for some populations/species are major conservation issues for marine mammals around the world. Both pinnipeds and cetaceans may become entangled in gillnets and, to a lesser extent, in longlines and other types of gear during their lifetime (Perrin *et al.*, 1994; Read *et al.*, 2006; Reeves *et al.*, 2013; Werner *et al.*, 2015). In some cases, bycatch is a major cause of population decrease or the major obstacle for the recovery of threatened populations (Lewison *et al.*, 2004; Read *et al.*, 2006; Reeves *et al.*, 2013). Coastal small cetaceans are particularly vulnerable to fishing gear and other anthropogenic activities because populations are small, usually live within restrained home ranges and their distribution overlaps with small scale fishing operations (*e.g.* Parsons and Jefferson, 2000; Nery *et al.*, 2008; Slooten *et al.*, 2013; Félix *et al.*, 2017*a*).

When the interaction with fishing gear is not lethal, some sequels may persist in the animals for the rest of their lives in the form of mutilated appendages or visible scars (*e.g.* Van Waerebeek *et al.*, 2007; Bechdel *et al.*, 2009; Félix *et al.*, 2017*b*). However, linking body scars with fishing interactions is not always possible as scarring could also be produced by natural causes such as predation (Corkeron *et al.*, 1987; Wilkinson *et al.*, 2017), aggressive social interactions between conspecifics (Robinson, 2013) and vessel or propeller strikes (Van Waerebeek *et al.*, 2007). For instance, natural marks have been used as a major research technique in photo-ID studies of small cetaceans for a long time (Würsig and Würsig, 1977; Félix, 1994). The scarring rate has been used also as a proxy of the risk level by anthropogenic activities in some cetacean populations and may provide important information regarding sources and interaction frequency (Robbins and Matilla, 2001; Félix *et al.*, 2017*b*). Despite of the high resilience shown by cetaceans, survivors likely suffer great stress, infections and increased vulnerability to predators after the interaction and therefore this is an issue of concern that deserves attention.

Longlines are considered as second-level threat for cetaceans compared to gillnets, but in areas of high fishing effort interactions may be considerable and cause serious injuries and significant mortality (Gilman *et al.*, 2006; Garrison, 2007). Interactions with longlines occur by entanglement, hooking, or both, due to a depredation behavior on struggling hooked fish developed by marine mammals (Garrison, 2007; Werner *et al.*, 2015). Around 60 species of marine mammals are reported to be associated to longline fisheries, but it is still a poorly understood issue and the impact on natural populations is largely unknown (Gilman *et al.*, 2006; Werner *et al.*, 2015). Economic and social consequences due to damage of fishing gear or loss of valuable catch may result from the interaction of marine mammals with fisheries and may predispose fishers negatively (Lavigne, 2003; Gilman *et al.*, 2006).

The common bottlenose dolphin (*Tursiops truncatus*) is a conspicuous top predator of the inner estuary in the Gulf of Guayaquil in Ecuador (Félix, 1994). This coastal population has one of the highest prevalence of body scars in the world and increased over the past 25 years from 2 to 13.2% (Félix *et al.*, 2017*a*). Here we present the case of a young bottlenose dolphin repeatedly entangled that developed scars as consequence of these events. The case was initially described by Félix *et al.* (2017*b*) and here we provide a follow up, given that the animal survived the first entanglement and six months later was involved in another similar case. The individual was first photo-identified on 30 April 2016 and assigned the ID code ES136. It belongs to a bottlenose dolphin resident community of around 25 animals. Until 21 April 2018 the animal was recorded 11 more times allowing us to follow the healing process.

First case

On 21 January 2017, during boat monitoring as part of a long-term study of the coastal bottlenose dolphin in the inner estuary of the Gulf of Guayaquil, Ecuador (see Félix *et al.*, 2017) (02°37'S, 80°15'W), a young solitary animal towing gear at El Morro Channel was found and photographed (Fig. 1). The entangled animal had nine turns of green polypropylene ropes of 4-5 mm in diameter with large hooks of about 5-cm length around its body (Fig. 2). Ropes constricted the base of the dorsal fin, the lower lumbar region and the caudal peduncle. A fish hook was hooked in the anterior edge of the dorsal fin about half of the fin's height, and the tip penetrated into the subdermal tissue on the right side of the fin. Other hooks were visible mainly on the right side of the animal, one hook was free behind the dorsal fin and others were hooking ropes. Ropes cut the skin at the anterior insertion of the dorsal fin producing several lacerations and bleeding wounds. Similar incisive wounds were also noticed at the insertion of the left fluke. Dolphin movement was compromised due to the ropes around the tailstock with obvious difficulty when trying to raise the tail for a longer dive. Seven strands of ropes of unknown length were towed by the dolphin from the rear, but flukes were not compromised at all.

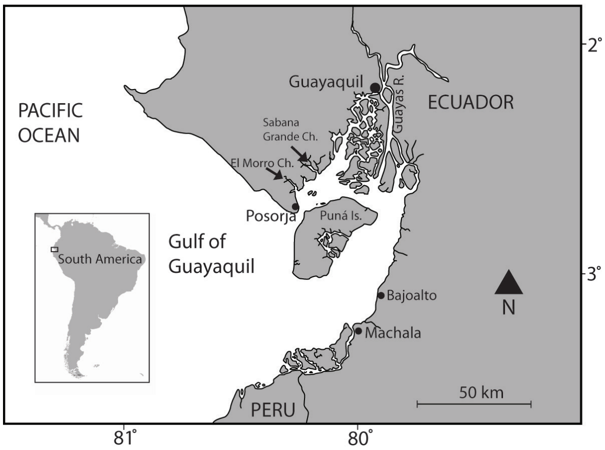

Figure 1. The study area in the inner estuary of the Gulf of Guayaquil. Arrows indicate channels where individual ES136 was recorded in the events here referred.

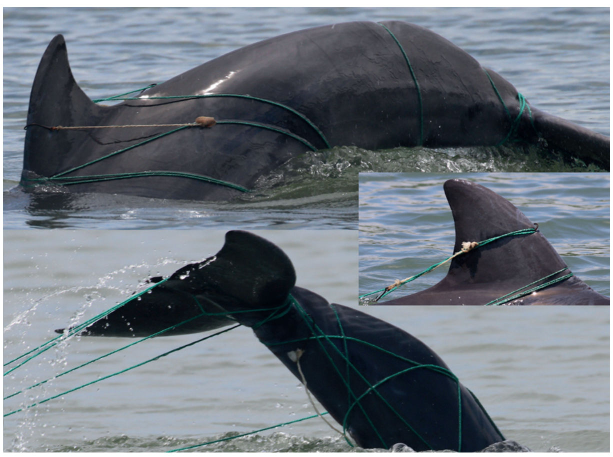

Figure 2. First entanglement of animal ES136 on 21 January 2017. Polypropylene ropes of 4-5 mm with hooks grabbed the animal in different parts of the body.

Several attempts to take the animal and remove the gear were unsuccessful in the hour that lasted the observation as the animal moved away every time the boat approached. At one moment when the animal was near the shore it seemed the gear got hooked in mangrove roots, as jerky movements were observed. After that, the animal had lost part of the gear as thereinafter five ropes were seen being towed, two less than at the beginning. We left the animal alone that day expecting to get a better chance on the next days, assuming it would tire and slow down. However, the animal was not seen again until two months later (25 March and then 8 April 2017), when it was photographed again but on this occasion without gear. Evidently, the animal could rid itself from the gear. Scars on the base of the dorsal fin and a small depression at mid height where the hook had been attached were visible (Fig. 5B).

Second case

On 1 July 2017, ES136 was observed again, this time at Sabana Grande Channel, about 15 km northeast of El Morro Channel, where it was first seen entangled on 21 January. On this occasion, the animal showed numerous linear wounds in process of healing, those being more visible in the lumbar and caudal areas and dorsal fin surface (Fig. 3). Wounds were deeper than those usually observed previously in these dolphins, with irregular edges of a type of laceration as produced by something sharp. Wounds were distributed along the body without a defined pattern, and their length estimated between 10 and 40 cm. In some parts, wounds were more superficial than in others, giving the injuries

Figure 3. Wounds on dorsal fin and dorsum found on animal ES136 on 1 July 2017. Note the necrotic tissue around fluke tips.

Figure 4. Wider white scars on the right surface of the dorsal fin of ES136 (15 July 2017).

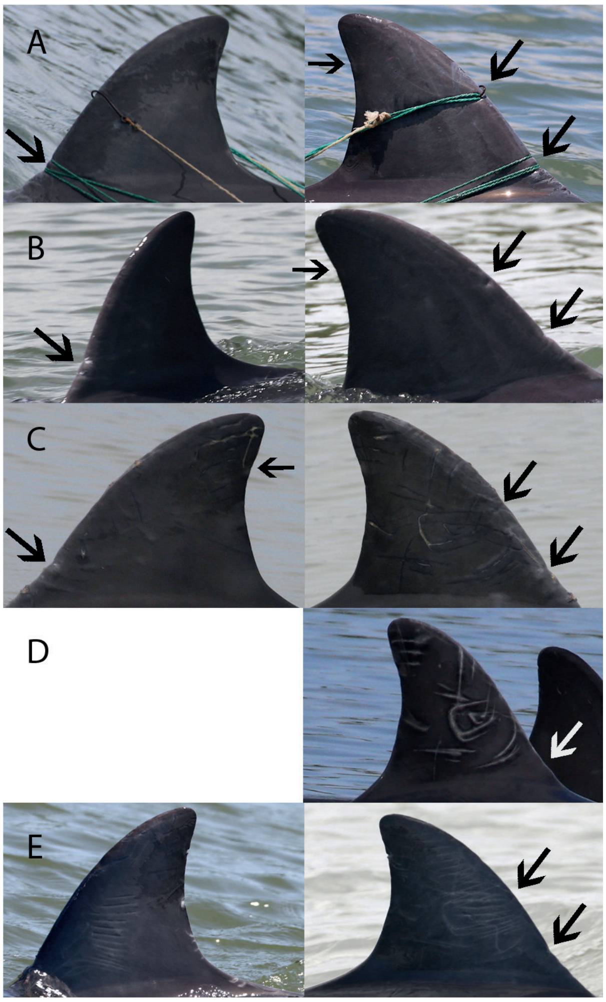

Figure 5. Dorsal fin of animal ES136 (both sides) in different moments: A) 21 January 2017, B) 15 March 2017, C) 1 July 2017, D) 15 July 2017 and E) 10 March 2018 (right) and 21 April 2018 (left). Arrows show the scars left by the longline in January 2017 in the fore border of dorsal fin. Arrows also show a small nick in the rear border of the dorsal fin used for identification of the animal before developing a larger one in March 2018 and another nick by mid rear border in April 2018 (E).

a discontinuous appearance with small protuberances. Additionally, the animal showed skin peeled back in the tail with healing granulation cream-colored tissue and necrotic tissue around the tips, which suggest the wounds dated several days or few weeks. It is presumed the animal became entangled for a second time in fishing gear, but in this case the tail got the worse part. However, during the observation period no remains of fishing gear were observed as in the first case. We presumed the animal managed again to get rid of the gear by itself.

Two weeks later (15 July 2017), ES136 was seen again at Sabana Grande Channel. New photographs showed the wounds were healing (Fig. 4). On the right dorsal fin surface, wounds were covered with new epidermal tissue and little or no inflammation. Scars looked as wide white stripes. The wounds on the rest of the body, observed this time only on the anterior flanks, also looked thicker and maintaining the irregular pattern with small bulges, but with smoother edges covered with epidermal tissue.

On 21 April 2018, new photographs were taken of different parts of the body of ES136 during a period of social interaction, allowing the evaluation of the type of scars left by previous entanglements in the dorsal fin, peduncle and tail (Figs 5, 6 and 7). Several depressions remained in the dorsal fin base as well as in the peduncle that coincide where ropes

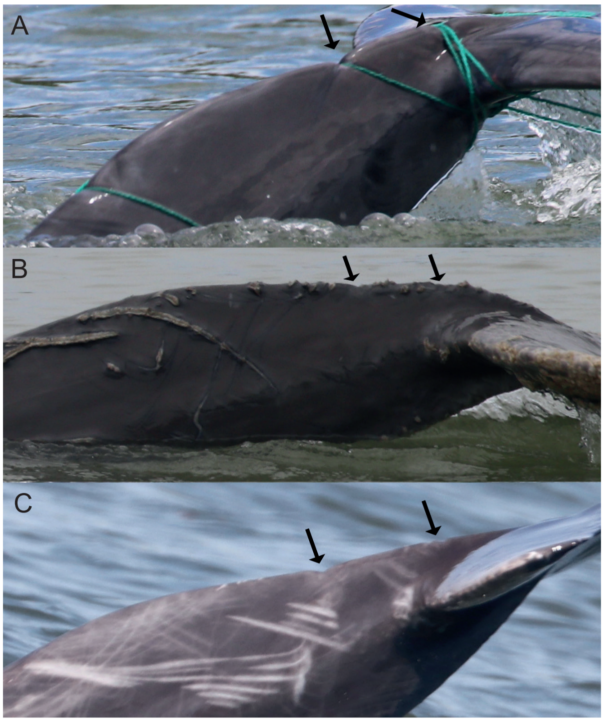

Figure 6. Scars in the peduncle of ES136 in three different moments: A) during the entanglement in a longline on 21 January 2017; B) laceration wounds found on 1 July 2017, and C) healed scars in the form of small depressions where ropes constrained the animal in the first entanglement remained on 21 April 2017 after 15 months. Scars are partially hidden by wounds found in July 2017, photograph B.

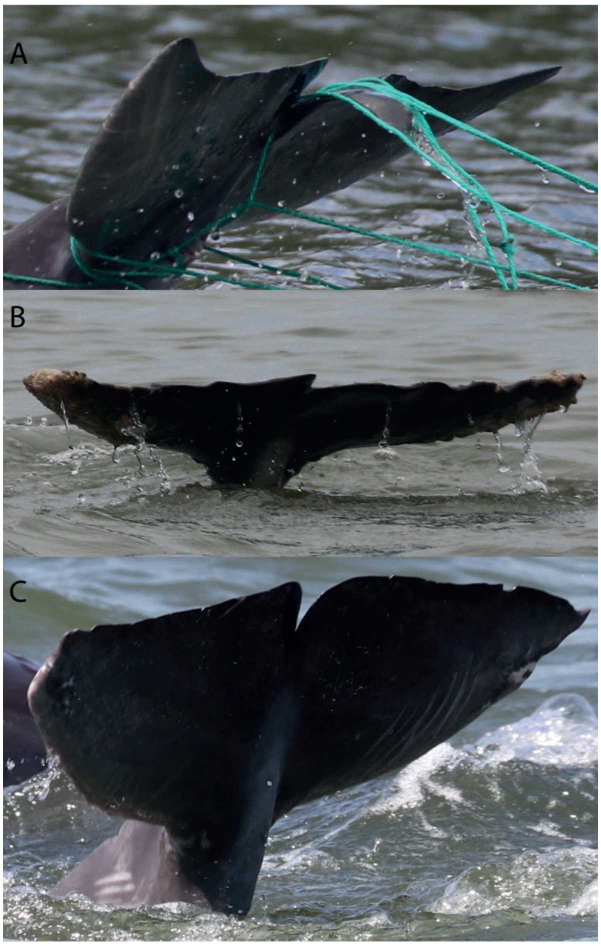

Figure 7. Scars in the tail of ES136 in three different moments: A) when it became entangled in longline ropes in 21 January 2017; B) necrotic tissue around the missing tips on 1 July 2017; and C) mutilated tips healed on 21 April 2018.

grabbed the dolphin in January 2017 (see Fig. 2). There were still some white linear scars on the right surface of the dorsal fin 10 months after the July 2017 event, although the large and numerous stripe wounds had healed, leaving no signs in the body except in the dorsal fin. Finally, wounds in the tail also looked healed, but tips were mutilated.

The case reported here is consequence of the intensive small-scale fishing effort in the inner estuary of the Gulf of Guayaquil (see Herrera *et al.*, 2013). Bottlenose dolphin communities inhabiting the inner estuary have experienced a population decrease of around 50% between 1990 and 2016, presumably due to interactions with fisheries and boat collisions (Félix *et al.*, 2017*a*, *b*). This dolphin population has high rates of scars in the form of longitudinal cuts in the dorsal and lumbar parts, mutilated appendages and series of small depressions (sewed edges) in the peduncle and behind the dorsal fin (Félix *et al.*, 2017*b*). Here we confirm that some of those types of scars are in fact produced by fishing gear.

This is the first documented case of a dolphin entangled in longline in this part of Ecuador, a fishing gear rather uncommonly used within the inner estuary. The gear may have one kilometer or more in length and hundreds of hooks, and is used for large catfish (Family Siluridae). It is possible that ES136 and other dolphins are getting used to depredate on hooked fish, as recorded in other fisheries with species such as sperm whales *Physeter macrocephalus*, killer whales *Orcinus orca*, pilot whales *Globicephala* spp. and Risso's dolphins *Grampus griseus*[1] (Ashford *et al.*, 1996; Garrison, 2007). Although depredation on hooked fish does not seem to be an extended practice in bottlenose dolphins from the inner estuary by now, such behavior appears to be an easily learned process as odontocetes develop familiarity with sounds of boats and gear (Gilman *et al.*, 2006; Werner *et al.*, 2015). Depredation behavior on fish entangled in gillnets by bottlenose dolphins has been reported to be more frequent than previously thought (Reichmont *et al.*, 2018) but not observed directly in the Gulf of Guayaquil.

It was not possible to establish with certainty the type of fishing gear in which ES136 was entangled in the second case (July 2017), when overcoming what appeared to be a severe infection caused by necrotic connective tissue in the tail. Mutilated fin tips in cetaceans are usually caused by nylon monofilament lines and gillnets (Slooten *et al.*, 2013; Félix *et al.*, 2017*b*). The resilience and capability of healing severe wounds is remarkable in this case and is concordant with similar cases reported elsewhere in small cetaceans (*e.g.* Corkeron *et al.*, 1987; Bloom and Jager, 1994; Orams and Deakin, 1997; Elwen and Leeney, 2010; Zasloff, 2011; Bossley and Woolfall, 2014).

How ES136 managed to get rid of the gear by itself in both cases is unclear. It is possible that the animal used mangrove roots to grab the gear, as it occurred - apparently unintentionally - in the first case. This would also explain the cryptic irregular pattern of stripe wounds observed in the second case, which could have been caused by sharp plates of oyster and cirriped shells attached to mangrove roots. We ruled out such stripe wounds were caused by fishing gear because of their irregular pattern, nor boat propeller could cause such wounds because propeller cuts are clean, deeper and in form of parallel slices (*e.g.* Elwen and Leeney, 2010; Byard *et al.*, 2012; Dwyer *et al.*, 2014). We also ruled out predation by sharks as an explanation because those scars are usually deeper with semicircular form (*e.g.* Corkeron *et al.*, 1987; Orams and Deakin, 1997; Wilkinson *et al.*, 2017).

Several mitigation measures have been proposed to address the interaction of cetaceans with fisheries in this population, including closing the access to areas of high concentration of dolphins, deterrent devices, changing fishing gear and

[1]Hucke-Gaete, R., Moreno, C. and Arata, J. (2002) Operational interactions between marine mammals and the Patagonian toothfish (*Dissostichus eleginoides*) fishery of southern Chile. Pages 10-2 *in* Donoghue, M., Reeves, R. and Stone, G. (Eds) New England Aquarium Forum Series Report 03-1. *Report of the Workshop on Interactions Between Cetaceans and Longline Fisheries*, Apia, Samoa, November 2002. New England Aquarium Press, Boston.

methods, among others (Félix *et al.*, 2017*a*, *b*). Developing methods to reduce the interaction with fishing gear is urgent due to the precarious conservation status of the bottlenose dolphin population in the inner Gulf of Guayaquil. Environment and fishing authorities are encouraged to work together with fishers to define effective conservation strategies for this population.

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