

Short Note

Recent Accidental Entanglements of Humpback Whales (*Megaptera novaeangliae*) in the Colombian Pacific

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Accidental entanglement, incidental catch, or bycatch of marine mammals in fishing gear is a critical problem (Reeves et al., 2013; Brownell et al., 2019) and is currently the threat that affects the largest number of marine mammal species worldwide (101 species; Avila et al., 2018). Currently, an estimated 650,000 marine mammals die annually due to bycatch in fishing nets and other types of fishing gear in both coastal and offshore fisheries—from artisanal to commercial fisheries in national and international waters, to those in developed and developing countries, to those in both urban and isolated rural areas (Read et al., 2006; Tulloch et al., 2020). Furthermore, marine mammal collisions with gear or incidental entanglements also cause damage and economic losses to fishermen and the fishing industry due to damaged or lost gear, down-time for repairs, and loss of catch (Basran & Rasmussen, 2021).

Bycatch in gillnets is the top source of marine mammal deaths due to entanglement (Read et al., 2006; Dawson et al., 2013; Reeves et al., 2013; Brownell et al., 2019), but there are also losses due to other fishing gear such as longlines, purse seines, trawl nets, and pots/traps (Food and Agriculture Organization [FAO], 2018; Hamilton & Baker, 2019). Several cetacean species, such as vaquita (*Phocoena sinus*), Atlantic humpback dolphin (*Sousa teuszii*), and North Atlantic right whale (*Eubalaena glacialis*), are at risk of extinction due mainly to bycatch in fishing nets (Van Waerebeek et al., 2004; Kenney, 2018; Jaramillo-Legorreta et al., 2019; International Union for Conservation of Nature [IUCN], 2021). Other species, such as the humpback whale (*Megaptera novaeangliae*), are significantly affected and, in recent years,

incidental entanglement cases have increased worldwide (Cooke, 2018).

The humpback whale is a cosmopolitan and migratory cetacean that annually inhabits the waters of the Colombian Pacific between May and December to reproduce, give birth, and raise its calves (Avila et al., 2020). Colombian humpback whales belong to the Stock G population, which feeds in summer off southern Chile and the Antarctic Peninsula and reproduces in winter in tropical waters off Peru, Ecuador, Colombia, Panama, and Costa Rica (Stone et al., 1990; Acevedo et al., 2017). Currently, a population of approximately 12,000 individuals has been estimated for the Stock G population (Félix et al., 2021). However, despite its population recovery (after being almost extinct in the 1960s due to commercial whaling), the humpback whale is the species with the largest habitat range at risk worldwide based on currently documented threats (Avila et al., 2018). Moreover, particularly in Colombia, humpback whales are currently one of the most affected species in terms of the greatest diversity of threats faced (Avila & Giraldo, 2022). Threats mainly include collisions with boats, disturbances by tourist boats, pollution, and incidental entanglement (Capella et al., 2001, 2007; Avila et al., 2013, 2015, 2017, 2018, 2021).

In the present study, we collected information on both dead and live specimens of entangled humpback whales from 2016 to 2021 in the Colombian Pacific. Data were taken opportunistically during visits and stays in the area, and through information provided by the local community, divers, and fishermen. We confirmed 14 entangled humpback whales: four calves and 10

adults (Table 1; Figure 1a-f). Twelve entangled animals were alive, and of them, three were successfully untangled. Two entangled animals were found dead (Table 1)—one of them was used as bait in a fish aggregating device (FAD) (Case EnMa_06-2019; Figure 1e), an element used to optimize fishing operations (Isaza-Toro et al., 2021). Most of the entanglements (50.0%) were recorded in Uramba Bahía Málaga National Park (“Uramba”), followed by Chocó waters and Gorgona Natural Park (21.4% for each one), and oceanic Colombian waters (7.1%) (Table 1; Figure 1a-f).

The effects of incidental entanglements depend on the body area involved and the type of fishing gear. In the Colombian Pacific, there have been reports of entanglements on the tail fin, dorsal side, dorsal fin, head, and mouth (Capella et al., 2001). In the present study, we also found diversity in body area involved, which included the dorsal side and the dorsal, pectoral, and tail fins. The most common point of attachment included the tail (57.1%). If the fishing gear is removed in the short term, the injuries are likely to heal, but marks may remain. For example, on 24 October 2017, an adult humpback whale was observed in Bahía Solano, Chocó, with its dorsal fin lacerated, possibly a result of having dragged a fishing net or rope (Figure 2a). Furthermore, in Uramba, one adult was observed on 25 August 2019 with a lacerated peduncle (Figure 2b), an adult on 4 October 2020 was observed with an injury in its dorsal fin (Figure 2c), and another adult was observed on 29 September 2021 with a scar at the base of its dorsal fin (Figure 2d). These wounds could possibly have been due to having dragged a rope or a net. If the rope or net cannot be removed in the short term, it may cause lacerations that over time obstruct blood flow or lead to the amputation of limbs (e.g., Urbán et al., 2004; Botero-Acosta et al., 2019; Minton et al., 2022/in press). Thus, the individual humpback whale observed between 14 and 16 July 2021 (Figure 1f) with gear that could not be removed from it showed deep lesions on the peduncle that could cause amputation of the tail fin in the near future. The situation for an animal would likely be critical if entanglement involved the head and mouth as it could limit foraging activity and feeding. Capella et al. (2001) already reported this situation for entangled calves in the Colombian Pacific.

Most humpback entanglement cases reported in the present study involved surface gillnet gear, specifically trammel nets (64.3%). These are one of the main types of fishing gear used by both artisanal and semi-industrial fishing vessels in the Colombian Pacific (Puentes et al., 2014; Figure 2e & f). Surface gillnets also represent the greatest

risk for humpback whales in other breeding areas of South America such as in Ecuador (Alava et al., 2012; Rosero, 2019), Peru (García-Godos et al., 2013), and Brazil (Ott et al., 2016). In Colombian waters, several cases of humpback whales entangled in gillnets and longlines, though rarely in purse seine gear, have been previously reported (Avila & Giraldo, 2022). No cases of humpback whales in purse seine fisheries were recorded in this study; however, one of the authors (EA) observed that in cases where a humpback whale was nearby to the purse seine set site, the set was stopped until the animal moved away. EA also observed cases where humpback whales were allowed to exit at the bottom of the purse seine; once the whale had exited, the process of closing and retrieving the net was initiated. Artisanal fishermen from the Colombian Pacific (e.g., Bahía Solano, Uramba) mentioned to us that on several occasions when humpback whales have become entangled in their nets, they released them; however, in most cases, the fishermen did not do it to avoid a whale breach, tail slap, or fin slap (M. Pretel, pers. comm., 19 September 2021; A. Caisamo, pers. comm., 16 September 2021). Fishermen also affirmed that when humpback whales become entangled, they usually lost their fishing gear, and, as a consequence, the arrival of humpback whales in these areas has become a mandatory ban for fishermen (Fundación Squalus, 2008). In the Guapi-PNN Gorgona route, the economic impact for artisanal fishermen in 2008-2009 due to loss or damage to their fishing gear because of interaction with marine mammals was estimated at \$7,700 USD for the whole community (Flórez-González & Capella, 2010). On the other hand, the practice of using marine mammals as bait in a FAD, as reported in the present study (i.e., whale calf of 29 November 2019; Figure 1e), had already been previously reported in Ecuador (Castro et al., 2020).

Although the records of bycatch events presented in this study were from the Colombian Pacific, we cannot assume that these entanglement events occurred here. Humpback whales could have been entangled elsewhere along their travel route and simply been observed locally. Nor can we confirm that the entanglement events occurred while nets were being actively fished or as a result of interaction with “ghost nets.” Ghost nets are fishing gear that have been abandoned, lost, or discarded (ALDFG) by fishermen and that drift lost in the sea, entangling a variety of animals, including marine mammals (Gunn et al., 2010). As a migratory species, the humpback whale crosses international borders of several countries. Capella et al. (2001, 2007) confirmed that between 1986 and 2006, approximately 1.9% of the humpback whale population off Colombia was affected by fishing interactions (mainly in Uramba), with an

Table 1. Recent accidental entanglements of humpback whales (*Megaptera novaeangliae*) in the Colombian Pacific. The “Fishing gear type” was classified according to the fishing gear classification of the International Whaling Commission (<https://iwc.int>). “Body area involved” means the humpback whale body site where the net or rope was attached.

Case	Date	Age class	Status	Location	Fishing gear type	Body area involved	Comments
EnMa_01-2016	July 2016	Adult	Alive	Gorgona Natural Park (ca. Planchón, 2° 57' 42" N, 78° 10' 16" W), Cauca	Gillnets and entangling gear – Trammel nets	Dorsal side and pectoral fins	Solitary adult; the whale was partially untangled by the Gorgona National Park staff (Figure 1a).
EnMa_02-2016	August 2016	Adult	Alive	Uramba (3° 58' 12" N, 77° 19' 12" W), Valle del Cauca	Gillnets and entangling gear – Trammel nets	Dorsal side and tail	The entangled animal was accompanied by an adult. It was not untangled.
EnMa_01-2017	November 2017	Adult	Alive	Gulf of Tribugá off Urría, Chocó	Gillnets and entangling gear – Trammel nets	Dorsal side and tail	Animal was untangled by the Urría National Natural Park staff.
EnMa_01-2018	July 2018	Adult	Alive	Gorgona Natural Park (Montañas, 02° 57' 34" N, 78° 12' 42" W), Cauca	Gillnets and entangling gear – Trammel nets	Dorsal side, pectoral fins, tail	Solitary adult; it was not tracked.
EnMa_01-2019	2 August 2019	Adult	Alive	Uramba (3° 58' 12" N, 77° 19' 12" W), Valle del Cauca	Gillnets and entangling gear – Trammel nets	Dorsal side	Animal was alone and it was not tracked.
EnMa_02-2019	8 August 2019	Adult	Alive	Gorgona Natural Park (El Hormo, 03° 00' 07" N, 78° 09' 59" W), Cauca	Hooks and line – Drifting longline	Pectoral fin	Mother–calf pair of which the mother was entangled and dragged about 15 buoys. It was not possible to free it despite scuba divers' efforts (Figure 1b).
EnMa_03-2019	18 August 2019	Calf	Alive	Uramba (3° 58' 12" N, 77° 19' 12" W), Valle del Cauca	Gillnets and entangling gear – Trammel nets	Dorsal fin	The calf was with its mother, but no follow-up was made to release the calf from the net (Figure 1c).
EnMa_04-2019	September 2019	Adult	Alive	Uramba (3° 58' 12" N, 77° 19' 12" W), Valle del Cauca	Gillnets and entangling gear – Trammel nets	Head and pectoral fins	Solitary adult; it was successfully untangled by the community.
EnMa_05-2019	4 October 2019	Calf	Dead, moderate state of decomposition	Punta Arditá Beach in Juradó (7° 08' 41" N, 77° 48' 51" W), Chocó	Hooks and line – Drifting longline	Tail	Whale was found stranded in the beach; the entanglement appeared to be the cause of its death (Figure 1d).
EnMa_06-2019	29 November 2019	Calf	Dead, advanced state of decomposition	Oceanic waters of Colombia to the southwest (2° 32' N, 83° 12' W)	Hooks and line – Drifting longline	Tail	It was found floating dead (Figure 1e).
ICA_EnMa_01-2021	14 & 16 July 2021	Adult	Alive	Uramba (3° 53' 3" N, 77° 26' 38" W), Valle del Cauca	Gillnets and entangling gear – Trammel nets	Tail	On 14 July, it was observed alone; and on 16 July, it was observed accompanied by four adults. The animal dragged two buoys. It was not possible to free it despite Uramba staff, Colombian Navy, and ICA efforts (Figure 1f).
EnMa_02-2021	Between 9 & 13 August 2021	Adult	Alive	Gulf of Tribugá off Jurubirá (5° 50' 37" N, 77° 16' 58" W), Chocó	Gillnets and entangling gear – Trammel nets	Tail	Solitary adult; it was not untangled.
EnMa_03-2021	12 August 2021	Adult	Alive	Uramba (3° 58' 12" N, 77° 19' 12" W), Valle del Cauca	Gear not known – Fishing net	Tail	The calf was with its mother and an escort. It was not possible to untangle it.
EnMa_04-2021	From 13 to 17 August 2021	Calf	Alive	Uramba (3° 58' 12" N, 77° 19' 12" W), Valle del Cauca	Gear not known – Rope	Pectoral fin	

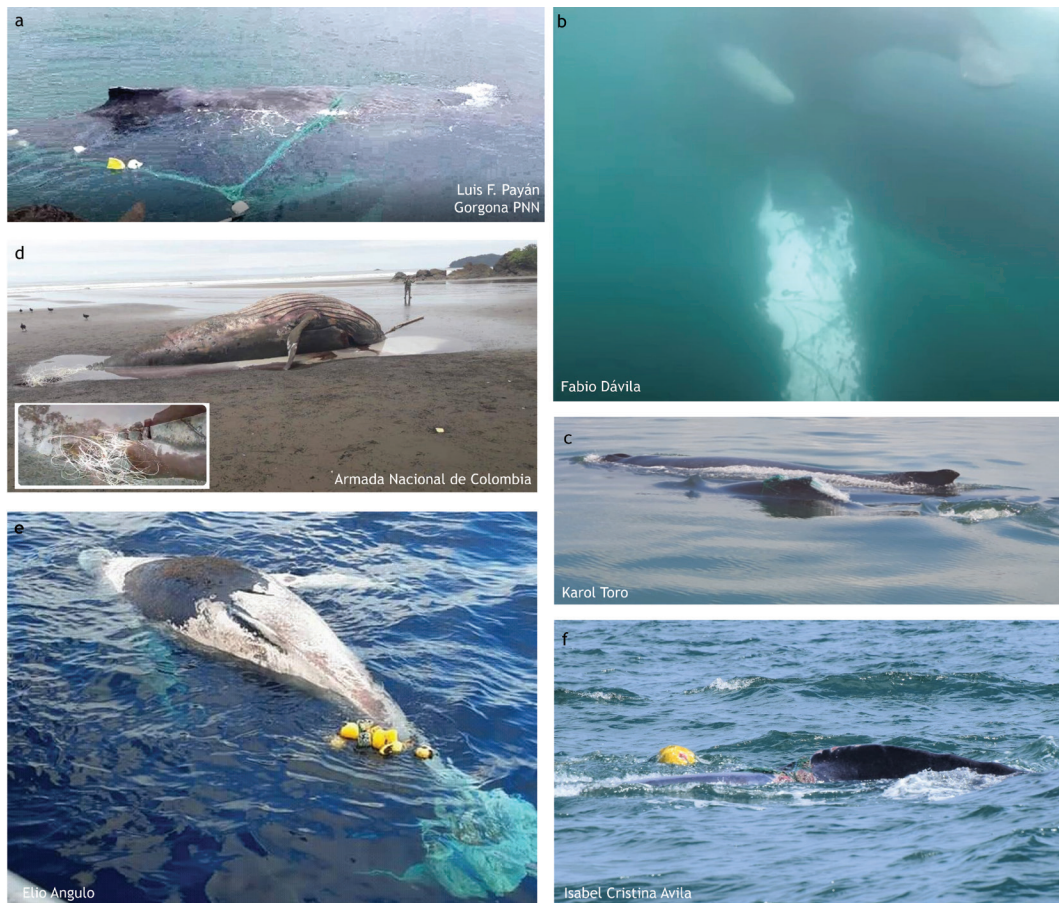


Figure 1. Some cases of incidental entanglement of humpback whales (*Megaptera novaeangliae*) recorded in the Colombian Pacific between 2016 and 2021: (a) Solitary adult with its dorsal side and pectoral fins tangled in a trammel net (July 2016; *Photo*: Luis Fernando Payán, Gorgona National Park); (b) mother–calf pair in Gorgona, Cauca, of which the mother had its dorsal fin tangled in a drifting longline (8 August 2019; *Photo*: Fabio Dávila); (c) mother–calf pair in Uramba, Valle del Cauca, of which the calf had its dorsal fin tangled in a surface gillnet (18 August 2019; *Photo*: Karol Toro); (d) calf in a moderate state of decomposition stranded at Punta Ardita, Chocó, whose tail was entangled in a fishing net, apparently a longline (zoom of the net in the lower left box; 4 October 2019; photo courtesy of Colombian National Navy [<https://www.eltiempo.com/colombia/otras-ciudades/muere-cria-de-ballena-que-quedo-atrapada-en-malla-plastica-en-choco-420006>]); (e) calf in an advanced state of decomposition whose tail was entangled in a drifting longline in oceanic waters of Colombia to the southwest (29 November 2019; *Photo*: Elio Angulo); and (f) adult with its tail entangled in a surface gillnet in Uramba, Valle del Cauca (14 to 16 July 2021; *Photo*: Isabel C. Avila).

average of 2.3 entanglements per year from 1996 to 2006. Our results show a rate of entanglement of 3.3 per year between 2019 and 2021, which indicates that bycatch of humpback whales in the Colombian Pacific has increased. We also found that 28.6% of the cases involved calves.

The current entanglement rate is likely higher than what we recorded in this study as our data were collected opportunistically and not all humpback whales that tangled may have been observed or reported. Increasing efforts to gather data from

entangled whales in Colombia would improve our understanding of the issue and could lead to insights into potential preventive measures as well as offer insight into conservation actions. In addition, this study highlights the importance of the participation of the local community and environmental authorities as a primary source of information. To reduce the entanglement threat, it is recommended to move towards fishery management that considers the regulation of fishing gear in relation to the migratory patterns of humpback whales (e.g., limiting



Figure 2. (a-d) Some cases of humpback whales with scars or marks probably caused by incidental entanglement in the Colombian Pacific: (a) Adult with lacerated dorsal fin, a possible result of having been entangled or carrying a rope on its back (Bahía Solano, Chocó; 24 October 2017; *Photo*: Blink Films); (b) adult with a lacerated dorsal peduncle, possibly because of having been entangled (Uramba; 25 August 2019; *Photo*: Isabel C. Avila); (c) adult with an injured dorsal fin probably due to having dragged a rope or mesh on its dorsal fin (Uramba; 4 October 2020; *Photo*: Isabel C. Avila); (d) adult with a scar at the base of its dorsal fin probably due to having dragged a rope or mesh (Uramba; 29 September 2021; *Photo*: Simón Pineda); (e) adult humpback whale swimming near an artisanal fishing boat at Uramba (17 October 2021; *Photo*: Isabel C. Avila); and (f) adult humpback whale swimming and a semi-industrial fishing vessel close by at Uramba (9 October 2021; *Photo*: Isabel C. Avila).

fishing activity to the months when the whales are not present or to the places where they do not occur). Moreover, the damaged fishing nets should not be disposed into the sea. The implementation of technical methods to mitigate humpback whale entanglements should be evaluated—for example, deterring whales from fishing nets using pingers (acoustic alarms) and light-emitting diodes or using weakened gear (e.g., thinner net twine, narrower gauge longline hooks) to facilitate the whale's disentangling itself (Nelms et al., 2021). Continued monitoring of this humpback whale population is needed. It is important to identify if there are overlapping areas between Colombian fisheries and local whale distribution or travel routes. This information would facilitate improvement of fisheries' management, control, and vigilance over the Marine

Protected Areas, and would support the reduction of negative impacts on whales. In addition, it is necessary to establish an efficient national registry of whale entanglement data, disseminate it, and contribute publications to the Bycatch Management Information System (BMIS; <https://www.bmis-bycatch.org>). Finally, it is important to put into practice a national protocol for immediate attention to deal with cases of entangled marine mammals. All these measures should be in concordance with the Global Whale Entanglement Response Network (GWERN; <https://iwc.int/entanglement>) and the Bycatch Mitigation Initiative (BMI) endorsed by the International Whaling Commission (IWC; <https://iwc.int/bycatch>). GWERN and BMI's aims are to develop, assess, and promote effective bycatch prevention and mitigation measures worldwide.

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