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Short Note

First Recorded Mass Stranding of the Short-Finned Pilot Whale (*Globicephala macrorhynchus*) on the Caribbean Coast of Nicaragua

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The Caribbean coast of Nicaragua is a remote region in the central-western Caribbean, with numerous large, mangrove-lined lagoons and estuaries that provide shelter and food for a great diversity of wildlife. Offshore, the continental shelf extends more than 160 km from the mainland at Cabo Gracias a Dios and is characterized by vast seagrass meadows, cays, and reefs that host species of ecological and economic importance to coastal communities (Nietschmann, 1972; Lagueux, 1998; Jiménez, 2002; Chang Bennett, 2010).

Although research on marine turtles in Caribbean Nicaragua has been conducted over several decades (Mortimer, 1981; Lagueux, 1998; Campbell, 2003; Lagueux et al., 2003, 2014; Lagueux & Campbell, 2005; LeRoux et al., 2012; Vander Zanden et al., 2013), the occurrence, distribution, abundance, and/or population structure of marine mammals along this coast is not well known. Nevertheless, a few studies have suggested this coast may be an important area for marine mammals. The West Indian manatee (*Trichechus manatus*) inhabits lagoons and coastal waterways along the Nicaragua coast (Jiménez, 2002). Small cetaceans like the tucuxi (*Sotalia fluviatilis*) (Carr & Bonde, 2000; Edwards & Schnell, 2001) and bottlenose dolphin (*Tursiops truncatus*) (Acevedo-Gutiérrez et al., 2005; V. Huertas, pers. obs., 30 May 2006) are also known to inhabit this and adjoining areas; however, additional marine mammal research along this coast has likely been hindered by difficult access to this region and challenging logistics, as well as civil unrest in recent decades.

Short-finned pilot whales (*Globicephala macrorhynchus*) have a circumtropical distribution, occurring from tropical to temperate waters, often inhabiting deep offshore areas (Jefferson et al., 2008; Olson, 2009). Throughout the eastern and southern Caribbean, their occurrence has been well documented (Caldwell & Erdman, 1963; Caldwell & Caldwell, 1971; Mitchell, 1975; Casinos & Bou, 1980; Boisseau et al., 2006; Pardo & Palacios, 2006; Yoshida et al., 2010; Téllez et al., 2014). In the northern Caribbean, between 1986 and 1991, at least 31 *G. macrorhynchus* were involved in two mass strandings in the Yucatán peninsula (Navarro, 1988; Morales Vela & Olivera Gómez, 1993); and additional confirmed sightings have occurred in Puerto Rico and the U.S. and British Virgin Islands (Mignucci-Giannoni, 1998; Téllez et al., 2014), as well as in Jamaica (Téllez et al., 2014). Whitt et al. (2011) provide a comprehensive review of the occurrence of short-finned pilot whale sightings in Cuba. Despite numerous reports of their occurrence in the Caribbean, sightings or strandings of short-finned pilot whales along the Caribbean coast of Central America have not previously been reported.

On 8 March 2011, local residents notified Nicaraguan authorities that they had sighted a group of cetaceans stranded on the beach, just north of the town of El Bluff, Nicaragua (Balladares García & Reyes Buitrago, 2011). This section of coastline is sparsely populated and is characterized by a narrow low-profile beach, backed by dense vegetation dominated by sea grape (*Coccoloba uvifera*), cocoplum (*Chrysobalanus icaco*), coconut palm (*Cocos nucifera*), and several species of mangroves. In the afternoon, staff from the nearby Bluefields regional office of the Nicaraguan Ministerio del Ambiente y los Recursos Naturales (MARENA; Ministry of the Environment and Natural Resources) conducted a trip to the area and estimated the presence of eight cetaceans swimming near the shore; they also encountered

three cetaceans stranded on the beach, two of which were alive and were returned to the water (Balladares García & Reyes Buitrago, 2011). Thus, they estimated having observed approximately 11 animals on 8 March 2011. Species identification of the cetaceans encountered was not described or definitively made by Balladares García & Reyes Buitrago (2011) but only that the characteristics of the animals "greatly agreed" (translated from the Spanish *concuerda grandemente*) with those of false killer whales (*Pseudorca crassidens*); however, the basis for this identification was not provided. Nonetheless, one of the two photographs included in the Balladares García & Reyes Buitrago report shows the anterior portion of an animal with the characteristic bulbous head of a pilot whale, not that of the more conical-shaped head of a false killer whale. Thus, we are confident that these animals, or at least this individual, was misidentified.

On 10 March 2011, the Nicaraguan newspaper, *La Prensa*, reported on the mass stranding of 13 false killer whales near El Bluff (León C., 10 March 2011). The number of animals reported in the newspaper article is most likely an error because the information is inconsistent with that reported by Balladares García & Reyes Buitrago (2011).

On the afternoon of 9 March 2011, officials from MARENA contacted the Wildlife Conservation Society's (WCS) office in Pearl Lagoon, Nicaragua (located approximately 29 km north of the stranding), and requested assistance to survey the area and rescue any additional or restranded cetaceans. Based on these efforts, we present the first report of a mass stranding of short-finned pilot whales in Caribbean Nicaragua.

In the early morning of 10 March 2011, one of us (VH) and a local assistant surveyed False Bluff beach from a 7-m-long fiberglass skiff at a distance of approximately 40 m from shore (Figure 1). For each stranded animal sighted, we went ashore and recorded the GPS coordinates of the location, date, and time of encounter; condition; and sex. For the dead animals, we measured the total body length and pectoral flipper length, from anterior insertion to tip. We obtained straight-line body length measurements with a reel fiberglass tape for each dead individual encountered except for one animal, for which only a curved measurement was taken. Body length was measured from the tip of the upper jaw to the notch between the tail flukes. Animal condition was classified following the criteria described by Pugliares et al. (2007). In addition, we returned the following day, 11 March 2011, to take a complete set of straight-line

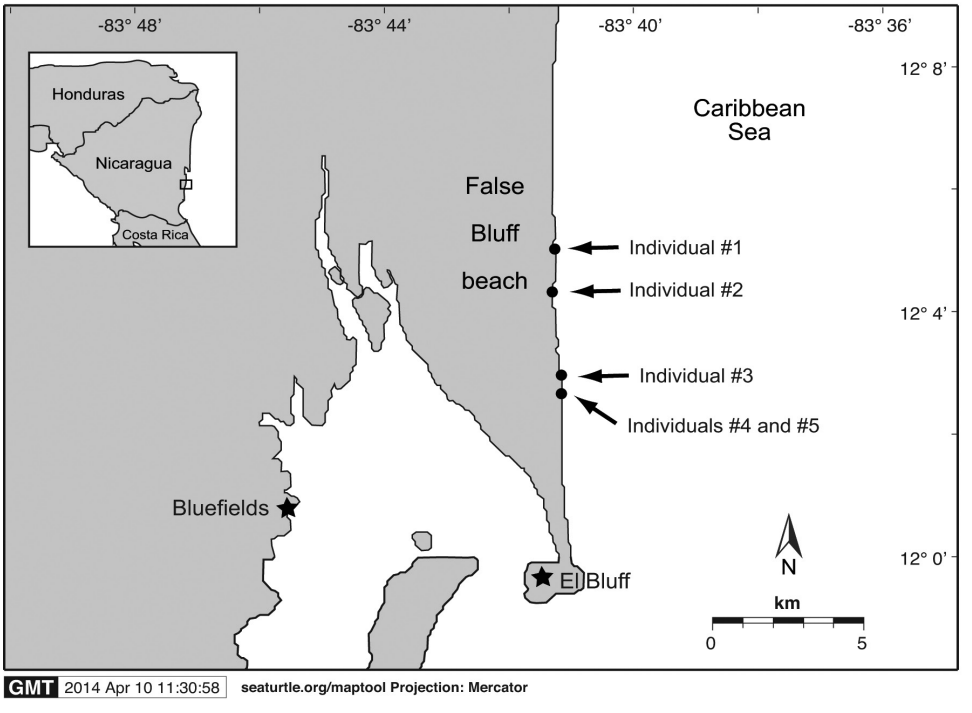

Figure 1. Location of five short-finned pilot whales (*Globicephala macrorhynchus*) stranded on False Bluff beach, Nicaragua, 10 March 2011; baseline map created using *Maptool* (SEATURTLE.ORG, 2002).

Table 1. Short-finned pilot whales (*Globicephala macrorhynchus*) encountered stranded on False Bluff beach, Nicaragua, 10 March 2011; N/A = not available.

Individual	Time found	Location	Condition[1]	Sex	Pectoral flipper length[2] (cm)	Total straight-line body length (cm)	Ratio of pectoral flipper to total body lengths (%)
#1	0750	12° 05' 03" N, 83° 41' 18" W	3 (Moderate decomposition)	Female	52.0	390.0[3]	N/A
#2	0840	12° 04' 33" N, 83° 41' 18" W	2 (Fresh)	Female	58.1	331.1	17.5
#3	1000	12° 03' 00" N, 83° 41' 14" W	1 (Alive)	N/A	N/A	N/A	N/A
#4	1000	12° 02' 50" N, 83° 41' 14" W	3 (Moderate decomposition)	Male	74.5	420.0	17.7
#5	1000	12° 02' 50" N, 83° 41' 14" W	1 (Alive)	Female	N/A	N/A	N/A

[1] Body condition scale is based on Pugliares et al. (2007).

[2] Straight-line measurement is from anterior insertion to tip.

[3] Length is curved, following the dorsal midline, from the tip of the upper jaw to the notch between the tail flukes.

measurements with an aluminum tree-caliper (127-cm maximum opening) or reel fiberglass tape for one recently dead animal, and to dissect the auditory canals to look for the presence of parasites since they have been reported to occur frequently in stranded short-finned pilot whales (see Mignucci-Giannoni et al., 1998).

On 10 March 2011, we surveyed an estimated 35.7 km of beach and nearshore waters between the Pearl Lagoon bar mouth to the north at 12° 21' 05" N, 83° 37' 04" W and stranded individual #5 to the south at 12° 02' 50" N, 83° 41' 14" W. On 11 March 2011, we resurveyed an estimated 32.5 km between the Pearl Lagoon bar mouth and stranded individual #2. During the 10 March survey, we encountered five odontocetes stranded between 5.7 and 9.8 km north of El Bluff (Figure 1). We did not observe any animals swimming in the vicinity of the stranding event. No additional cetaceans were observed during the 11 March survey.

Of the five animals encountered stranded, two were still alive (individuals #3 and #5). VH and an assistant transported individual #3, a small-sized animal encountered close to the surf, with the aid of sheets and towels, back into shallow water. Individual #5, a larger animal, was transported back into the water with the assistance of a group of local residents who had arrived by tractor with trailer from El Bluff. We maintained each animal at the surface until it regained mobility and was able to swim unaided, a period of about 10 to 15 min. Both animals swam perpendicular to the coast, heading offshore until we lost sight of them. The group of local residents reported to one of us (VH) that they had released two animals they had encountered stranded prior to arriving at individuals #4 and #5, but north of El Bluff.

The remaining three animals we encountered stranded were dead. We considered an animal dead when there were obvious signs of decomposition or it did not move or breathe for more than 20 min. We did not observe any obvious external signs of trauma, mutilation, or tags on the three dead cetaceans. Condition of the carcasses encountered was either a "2" (fresh) or a "3" (moderate decomposition) (Table 1). Straight-line total body length ranged from 331.1 to 420.0 cm, and three of the four animals sexed were females (Table 1). The complete set of measurements for individual #2 is provided in Table 2. Dissection of the cranial sinuses of individual #2 revealed the presence of a large number of the nematode *Stenurus* sp.

Animals were identified to species based on morphology, dentition, and geographic location of the stranding event. All animals had a prominent bulbous, blunt head with a barely discernible beak (Figure 2A). The bodies were robust and had a dark coloration (Figure 2B). The dorsal fin was falcate and broad at the base, and was located anterior to the mid-point on the back. The shape of the head and position of the dorsal fin are consistent with that of pilot whales and inconsistent with similar species of odontocetes (Jefferson et al., 2008).

The pectoral flippers of all the animals we encountered were smoothly curved like those of short-finned pilot whales; whereas those of long-finned pilot whales (*Globicephala melas*) are more angled, forming a bend or "elbow" (Jefferson et al., 2008; Olson, 2009) (Figure 2C). Additionally, the ratio of the length of the pectoral

Table 2. Straight-line measurements of *Globicephala macrorhynchus* individual #2, False Bluff beach, Nicaragua, 11 March 2011. %TL = percent of total body length; N/A = not applicable.

Body region	Measurement (cm)	%TL
Tip of snout to fluke notch (total length)	331.1	100.0
Tip of snout to apex of melon	2.3	0.7
Tip of snout to gape of mouth	35.0	10.6
Tip of snout to center of eye	37.4	11.3
Tip of snout to center of blowhole	38.1	11.5
Tip of snout to anterior insertion of pectoral flipper	63.9	19.3
Tip of snout to anterior insertion of dorsal fin	86.1	26.0
Tip of snout to dorsal fin tip	126.6	38.2
Tip of snout to center of genital slit	211.3	63.8
Tip of snout to anus	226.2	68.3
Fluke notch to anus	108.6	32.8
Dorsal fin height	27.9	8.4
Pectoral flipper, anterior length	58.1	17.5
Pectoral flipper, maximum width	16.9	5.1
Fluke width	82.0	24.8
Blubber thickness – dorsal	1.8	N/A
Blubber thickness – lateral	1.4	N/A
Blubber thickness – ventral	1.9	N/A

flipper to total body length for short-finned pilot whales ranges from 15.8 to 18.9%; whereas in *G. melas*, the ratio ranges from 21.9 to 26.2% (Yonekura et al., 1980), although Bloch et al. (1993) reported a small overlap in this ratio for short- and long-finned pilot whales. The pectoral flipper to total body length ratio for individuals #2 and #4 was 17.5 and 17.7%, respectively (Table 1), providing additional support for identification of the animals stranded in Nicaragua as short-finned pilot whales.

Individual #2 had eight teeth per row (Figure 2D); and although the dental count of short- and long-finned pilot whales overlap, with short-finned pilot whales having 7 to 9 teeth per row and long-finned pilot whales having 9 to 12 teeth per row (Olson, 2009), the overlap in tooth count between the two species does not affect the identification of this animal as a short-finned pilot whale.

Pigmentation features in the form of a gray eye blaze and a saddle patch posterior to the dorsal fin can be observed in pilot whales (Bloch et al., 1993); however, we did not detect any of these features on the animals we encountered. Nonetheless, pigmentation patterns can be highly variable, and such features can disappear rapidly in dead animals (Yonekura et al., 1980; Stacey & Baird, 1993).

This stranding in the tropical waters of Nicaragua is well within the 50° N and 40° S limits of the known distribution for *G. macrorhynchus* (Jefferson et al., 2008; Olson, 2009) and well outside the northern and southern range of the antitropical distribution for *G. melas*. Although geographic location is not a definitive argument for species identification, *G. melas* is reported to occur primarily in temperate and subpolar regions (Jefferson et al., 2008; Olson, 2009), far from Nicaragua's coast. Thus, based on our observations of the stranded animals' characteristics and the geographic location of this stranding event, we identified all animals encountered as short-finned pilot whales (Figure 2).

Overall, a minimum of five, and possibly a total of seven short-finned pilot whales were encountered stranded on 10 March 2011 within 9.8 km north of El Bluff. Our maximum count includes the two live individuals that had stranded to the south of individual #5. Individuals #3, #4, and #5 stranded in close proximity to each other (Figure 1; Table 1) and were spotted on the beach by us at the same time. We had just completed the release of individual #3 when the local residents arrived. We lack reliable information about the sex and size of the two individuals released by the locals; and although the description of the animals they provided was consistent with *G. macrorhynchus*, the possibility remains that these animals

Figure 2. Short-finned pilot whales encountered stranded on False Bluff beach, Nicaragua, 10 March 2011: (A) antero-lateral view of individual #1, (B) external appearance of individual #2, (C) antero-lateral view of individual #2 with skin beginning to slough off by the following day (11 March 2011) (note shape of pectoral flipper), and (D) teeth from individual #2 (Photo credit: V. Huertas)

may have been a different species. While we did not observe the two animals reported to us, there was no apparent motivation for the locals to provide false information on their release of two animals, including no request for compensation of any kind, and, therefore, we regard their information as reliable. The possibility that the two animals released by the local residents were the same individuals that we encountered alive (#3 and #5) is highly unlikely due to the timing of both groups of people on the beach and the coastal current. The prevailing southerly coastal current would have made it difficult for the animals released by the local residents to have traveled northward against the current and strand above the swash line prior to our arrival.

To avoid overestimating the number of stranded pilot whales, our total does not include the three stranded animals encountered by MARENA's staff on 8 March 2011. Based on the description of the dead animal reported by Balladares García & Reyes Buitrago (2011), we believe this animal was probably our individual #1. Also, one of the photographs included in this same report shows one of the live animals with a V-shaped scrape on the left side of its head, posterior to the mouth. On 10 March 2011, an identical scrape was also visible on our individual #2; thus, it is highly likely they were the same animal. Nevertheless, it is possible that the remaining individual, which was released by MARENA personnel, was not encountered by us during our survey. If this was the case, then as many as eight short-finned pilot whales could have been involved in this mass stranding event.

Globally, short-finned pilot whales are listed as data deficient by the International Union for Conservation of Nature (IUCN) (Taylor et al., 2011), despite being one of the most common cetaceans comprising mass strandings (Morales Vela & Olivera Gómez, 1993; Jefferson et al., 2008; Olson, 2009; Téllez et al., 2014). Stranding events and, to a lesser extent, the study of live, wild populations in areas where the edge of the continental shelf is close to shore (e.g., Hawaii, USA; the Canary Islands, Spain) (Migura & Meadows, 2002; Aguilar Soto et al., 2008; Sakai et al., 2011) have been the source of most of the knowledge accumulated about pilot whales. The broad shallow profile off the coast of eastern Nicaragua likely deters this species from approaching the coastal shoals where most human activities occur. Nevertheless, several local fishermen identified the pilot whales in our photographs as "blackfish" and reported having seen them previous to this stranding event, although it is possible that some of the previous sightings might have been other dark-colored odontocetes (e.g., false killer whale,

pygmy killer whale [*Feresa attenuata*], or melon-headed whale [*Peponocephala electra*]).

Although mass strandings are likely the result of a sequence of events, several hypotheses have been suggested to explain their occurrence (Ridgway & Dailey, 1972; Morimitsu et al., 1987; Duignan et al., 1995; Kirkwood et al., 1997; Wiley et al., 2001; Degollada et al., 2002; Fernández et al., 2008). Entrapment is unlikely to be the cause of this mass stranding due to the small tidal range and the absence of topographical features along the coast of Nicaragua. Although bycatch of cetaceans (Carr & Bonde, 2000; Edwards & Schnell, 2001) and sea turtles (Lagueux & Campbell, 2005) occurs along this coast, we did not observe conspicuous marks or scars on the three dead stranded animals, suggesting that it was unlikely that these pilot whales had any recent interaction with fisheries.

The nematode *Stenurus* sp. has frequently been reported among a broad range of odontocetes, including *G. macrorhynchus* (Mignucci-Giannoni et al., 1998); however, it is not clear whether this pseudaliid nematode is involved in cetacean strandings or not. Early reports suggest *Stenurus* sp. can cause pathologies to the auditory organs that can likely affect echolocation and the hearing ability of odontocetes (Dailey & Walker, 1978; Delyamure, 1955, as cited in Geraci & St. Aubin, 1987). In the 1980s, however, researchers noted that pathological disorders may not necessarily impair hearing and echolocation (Parry et al., 1983; Geraci & St. Aubin, 1987), and, thus, may not hinder the host's ability to communicate or find prey. In fact, more recent studies have concluded that the presence of *Stenurus minor* (even in large numbers) in both healthy and diseased harbour porpoises (*Phocoena phocoena*) suggested that they were not negatively affected by the parasite (Faulkner et al., 1998; Gibson et al., 1998). Based on the available information, we have insufficient evidence to suggest a hypothesis to explain this mass stranding event in Nicaragua.

Our observations of *G. macrorhynchus* in Caribbean Nicaragua add to the list of marine mammals known to occur in these waters. It is not clear whether short-finned pilot whales occur regularly in Nicaraguan waters; however, the deep-diving habits of these odontocetes (Aguilar Soto et al., 2008; Olson, 2009) and the shallow profile of Caribbean Nicaragua's inshore waters suggest their presence may be only occasional. Further research is needed to evaluate the extent of marine mammal biodiversity and abundance in this region. In particular, systematic surveys of the continental shelf edge off Nicaragua's Caribbean coast are needed to determine if important foraging areas or migratory corridors occur for *G. macrorhynchus* in this region.

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