Latin American Journal of Aquatic Mammals

ISSN: 2236-1057 | Vol. 17 No. 1, April 2022

Cetacean sightings in the Caribbean Sea of Guatemala

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Cetaceans are a group of aquatic mammals that include whales and dolphins. Cetaceans play an important ecological role as top predators and ecosystems engineers, helping to maintain the integrity and balance of the ecosystems where they are found (Roman *et al*., 2014; Pace *et al*., 2015; Chami *et al*., 2019). However, cetaceans face various threats around the globe, such as habitat loss and degradation, pollution, food depletion due to overfishing, bycatch, boat collisions, unsustainable tourism practices, industrial disturbances, military operations, and climate change (Reeves *et al*., 2003). The Caribbean Sea of Guatemala is no exception: there are strong fishing pressure, high maritime traffic, pollution from rivers, coastal development, among others (CONAP, 2008). To implement management and conservation measures at local and potentially regional level with a focus on cetaceans and their ecosystems, information on their occurrence, distribution, seasonality, abundance, and conservation status is needed (Furry and Harrison, 2008).

In Guatemala, cetaceans have been studied only in the Pacific Ocean, where 18 species belonging to the Delphinidae, Kogiidae, Physeteridae, Ziiphidae, and Balaenopteridae families have been recorded (Cabrera *et al*., 2014; Quintana-Rizzo *et al*., 2021). In the Caribbean Sea of Guatemala, the study of cetaceans has been very limited or even absent. For example, the presence of "dolphins" is mentioned in a somewhat vague manner in national reports (Arrivillaga, 2004; Villagrán *et al*., 2004).

This note aims to compile and summarize unpublished data obtained from opportunistic sightings of cetaceans at the Caribbean Sea of Guatemala between 2007 and 2020 (Fig. 1). Reports of historical (1900 to 1999) and recent (2000 to 2020) cetacean strandings are also included, thus providing baseline information on the cetacean species that are present in the region.

Sighting data were gathered through several sources, including scientific publications, conference abstract books, theses, specimens deposited in national museums and collections, online databases (*e.g.* GBIF), citizen science platforms (*e.g.* iNaturalist), technical reports, local newscasts, and social media (*e.g.* Facebook). Personal communications were made with independent researchers working in the Caribbean Sea of Guatemala to obtain opportunistic, non-systematic records of cetaceans. Personnel from CONAP (from its acronym in Spanish, National Council of Protected Areas) Northeast Unit was also interviewed to obtain records of cetacean sightings in the region. Finally, sightings made by the authors were also included.

Photographs and/or videos of the sightings were requested to corroborate the reported taxonomic identification, age class estimation, and general behavior (Table 1). When in doubt, experts were consulted to confirm the identification of the species of the genus *Stenella*, since the characteristics of these organisms are not fully appreciated in the photographs. Subsequently, the compiled data was depurated, eliminating duplicate records. In order to visually represent the geographic location of cetacean sightings along the Caribbean Sea of Guatemala, maps were made with the geographic coordinates or the name of the geographical area using ArcMap V10.3 (ESRI, 2018). Because Amatique Bay is a complex estuarine ecosystem that consists of mangrove areas, fresh waters with intertidal influence, seagrass beds, and the adjacent continental platform (Yáñez-Arancibia *et al*.,

Keywords:
Amatique Bay, dolphins, La Graciosa Bay, Punta de Manabique, whales

ARTICLE HISTORY

Manuscript type: Note

Article History
Received: 16 August 2021
Received in revised form: 26 October 2021
Accepted: 26 October 2021
Available online: 8 March 2022

Responsible Editor: Nataly Castelblanco-Martinez

Citation:
Ortiz-Wolford, J.S., Corona-Figueroa, M.F., Machuca Coronado, O.H. and Giró Petersen, A. (2022) Cetacean sightings in the Caribbean Sea of Guatemala. *Latin American Journal of Aquatic Mammals* 17(1): 51-58. https://doi.org/10.5597/lajam00279

Table 1. Description of the taxonomic identification, age class estimation, and behavior of the cetaceans registered for the Caribbean Sea of Guatemala.

Item or category	Description
Taxonomic identification	The identification of the cetacean species was based on external morphological characteristics according to Shirihai and Jarret (2006) in the field guide "Whales, dolphins and other marine mammals of the world." • *T. truncatus*: notably robust body, short and well-defined snout, falcate and high dorsal fin, in a central position, and gray coloration. • *S. frontalis*: presence of spots and faint blaze that meets dark cape just below and in front of the dorsal fin. • *S. attenuata*: dark dorsal cape reaching lower on flanks in front of dorsal fin, presence of spots, and dorsal fin falcate and pointed. • *S. longirostris*: extremely long beak, dorsal fin usually more or less triangular or slightly falcate, and tricolored pattern (dark cape, pale gray sides, and whitish belly). • *G. macrorhynchus*: black color, bulbous head, and falcate dorsal fin with a broad base. • *M. novaeangliae*: flattened and knobble rostrum, hump and dorsal fin shape, and extremely long arm-like flippers.
Age class estimation	• Calf: recognized for being less than 75% the length of an adult and swimming in close association with the alleged mother. • Adult: determined based on the length reported for each species by Shirihai and Jarret (2006).
Behavior	Behaviors were identified according to the descriptions by May-Collado and Morales (2005): • Feeding: subgroups move at different speeds and in different directions in the area. Diving is characterized by the vertical lifting of the peduncle. There could be aerial behaviors, such as tail flicking and jumping. • Traveling: movement of the group in the same direction and constant speed. • Socialization: frequent physical contact, superficial displays (jumping) and games, sexual behaviors and parental care are observed. It also includes interaction with the boat, such as swimming in the bow. • Resting: cetaceans generally keep buoying on the surface or moving slowly in undefined directions in the area.

1999), records that lacked geographic data and those that were associated with this wide region were not represented on the map but remain on the species list.

A total of 39 cetacean records were compiled: two historical records (1904 and 1995) and 37 sightings recorded between 2007 and 2020 (Table 2). Of these, 82% (n = 32) were sightings,

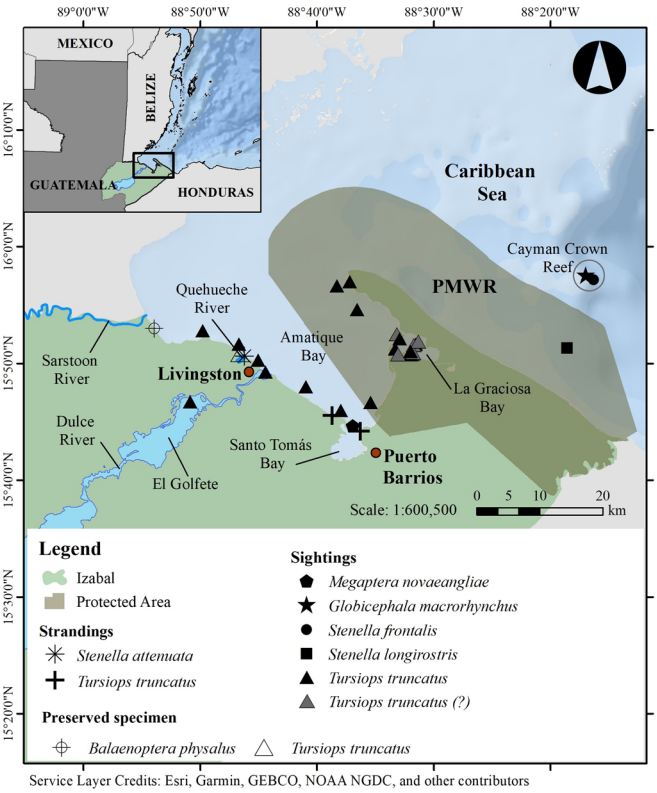

Figure 1. The Caribbean Sea of Guatemala and cetacean records. Borders, main municipalities, rivers, sites of interest, and protected areas are observed (PMWR: Punta de Manabique Wildlife Refuge). (?) Records of *T. truncatus* without photographs for verification.

10% (n = 4) corresponded to strandings, and 8% (n = 3) to specimens stored in museums or collections. All 39 cetacean records correspond to opportunistic sightings reported by the authors (n = 12), institutional records of CONAP (n = 9); personal communications with independent researchers (n = 8), local newscasts/social media post (n = 5), museum specimen (n = 1), online databases (n = 2), citizen science report (n = 1) and a poster presentation (n = 1) (Table 2).

Tursiops truncatus (Montagu, 1821): Bottlenose dolphins were reported on 30 occasions (Table 2) year-round. However, only 73% of the reports included photographs or videos to confirm the species (Fig. 2A). Most of the sightings occurred in La Graciosa Bay (n = 12) and at different areas of Amatique Bay (n = 17), while only one was reported in the Dulce River region (Fig. 1). The group size of the bottlenose dolphins ranged from one to 20 individuals, with calves present in 11 sightings recorded in May, June, July, August, October, and December. Feeding behavior was observed in April, May, July, August, and September in La Graciosa Bay, and in April 2020 in Dulce River (Table 2).

Bottlenose dolphin records also included two strandings. The first one occurred on 14 August 2007, in Puerto Barrios, and involved a dead female calf. According to the necropsy report, it suffered skull and rib contusions along with internal bleeding (Dávila and Ixquiac, 2009). A second stranding occurred on 20 October 2018, in Punta de Palma and involved a newborn with a presumed skull injury (Relato, 2018). However, no necropsy was performed, and the sex of the animal is unknown, as it was returned to the sea by the fishers before the arrival of the corresponding authorities. A final record corresponds to a skull found in March 1995 and deposited in the Texas Cooperative Wildlife Collection (Prestridge, 2021).

Stenella frontalis (Cuvier, 1829): Two sightings of the Atlantic spotted dolphin were reported in August, 2019 (Table 2). The first report was published on social media by a tourism company in Izabal, on 11 August 2019. The sighting occurred in Punta de Manabique Wildlife Refuge (PMWR). The second group of up to

Table 2. Cetaceans sighted and stranded in the Caribbean Sea of Guatemala (1904 and 1995-2020).

No.	Species	Date	Locality	Coordinates	Group size	Calves	Type of record	Photo/ Video	Type of source	Reported by
1	*Tursiops truncatus*	01 Mar 1995	Livingston*	15°50′48″N 88°46′35″W	1	U	Preserved specimen	N	4	Prestridge (2021)
2	*Tursiops truncatus*	15 Jul 2007	Punta de Manabique	15°56′59″N 88°37′13″W	6	U	Sighting	Y	1	AGP
3	*Tursiops truncatus*	14 Aug 2007	Puerto Barrios	15°44′11″N 88°36′17″W	1	Y	Stranding	Y	2	Dávila and Ixquiac (2009)
4	*Tursiops truncatus*	21 Aug 2010	La Graciosa Bay	15°51′2″N 88°31′59″W	2	N	Sighting	Y	1	OHMC
5	*Tursiops truncatus*	08 Dec 2010	La Graciosa Bay	15°51′2″N 88°31′59″W	3	N	Sighting	Y	1	OHMC
6	*Tursiops truncatus*	15 Feb 2011	La Graciosa Bay	15°51′2″N 88°31′59″W	4	N	Sighting	Y	1	OHMC
7	*Tursiops truncatus*	18 May 2015	Punta Gruesa	15°51′38″N 88°31′34″W	6	Y	Sighting	Y	6	CONAP
8	*Globicephala macrorhynchus*	27 May 2015	Corona Caimán	15°57′31″N 88°16′59″W	7	Y	Sighting	Y	1	AGP
9	*Tursiops truncatus*	20 Jul 2015	La Graciosa Bay	15°50′47″N 88°31′52″W	7	Y	Sighting	N	6	CONAP
10	*Tursiops truncatus*	13 Aug 2016	La Graciosa Bay	15°50′43″N 88°31′59″W	17	Y	Sighting	Y	6	CONAP
11	*Tursiops truncatus*	29 Sep 2016	Punta Cocolí	15°52′46″N 88°49′48″W	2	N	Sighting	Y	1	OHMC
12	*Tursiops truncatus*	19 Dec 2016	Livingston	15°50′16″N 88°45′4″W	4	Y	Sighting	Y	1	OHMC
13	Delphinidae	03 Apr 2017	Punta de Manabique	--	1	N	Stranding	N	6	CONAP
14	*Tursiops truncatus*	17 Sep 2017	Dulce River Mouth	15°49′14″N 88°44′26″W	2	U	Sighting	Y	5	Ueda (2021)
15	*Tursiops truncatus*	02 Feb 2018	Siete Altares	15°51′37″N 88°46′42″W	6	U	Sighting	Y	7	G. Gálvez, FUNDAECO, pers. comm., 7 Oct 2020
16	*Tursiops truncatus*	01 Mar 2018	Siete Altares	15°51′39″N 88°46′42″W	6	U	Sighting	Y	7	G. Gálvez, FUNDAECO, pers. comm., 7 Oct 2020
17	*Stenella attenuata*	01 May 2018	Quehueche River	15°50′35″N 88°46′13″W	2	N	Stranding	Y	8	Noti 7 (2018)
18	*Tursiops truncatus*	14 Jun 2018	Amatique Bay	15°46′38″ N 88°35′25″W	1	N	Sighting	Y	1	JSOW
19	*Tursiops truncatus*	15 Jun 2018	La Graciosa Bay	15°51′13″N 88°33′19″W	13	Y	Sighting	Y	1	JSOW
20	*Tursiops truncatus*	18 Jul 2018	Amatique Bay	--	1	N	Sighting	Y	1	JSOW
21	*Tursiops truncatus*	27 Jul 2018	La Graciosa Bay	15°51′33″N 88°31′44″W	18	Y	Sighting	N	6	CONAP
22	*Tursiops truncatus*	14 Aug 2018	La Graciosa Bay	15°50′53″N 88°31′47″W	20	N	Sighting	N	6	CONAP
23	*Tursiops truncatus*	21 Sep 2018	Punta de Palma	15°47′59″ N 88°40′59″W	7	U	Sighting	Y	1	AGP
24	*Tursiops truncatus*	20 Oct 2018	Punta de Palma	15°45′30″N 88°38′42″W	1	Y	Stranding	Y	8	Relato (2018)
25	*Tursiops truncatus*	15 Mar 2019	Punta Gruesa	15°51′51″N 88°31′20″W	1	N	Sighting	N	6	CONAP
26	*Stenella longirostris*	30 Mar 2019	Punta de Manabique	15°51′18″N 88°18′36″W	60-70	U	Sighting	Y	7	H. Araujo, Semillas del Océano, pers.comm., 5 Oct 2020
27	*Tursiops truncatus*	11 Apr 2019	La Graciosa Bay	15°50′45″N 88°33′4″W	24	Y	Sighting	N	6	CONAP
28	*Stenella frontalis*	11 Aug 2019	Punta de Manabique	--	1	N	Sighting	Y	9	GTP Chalets de RioDulce
29	*Stenella frontalis*	22 Aug 2019	Corona Caimán	15°57′9″N 88°16′19″W	9	N	Sighting	Y	1	AGP
30	*Tursiops truncatus*	17 Jan 2020	Punta de Palma	15°45′57″N 88°37′58″W	5	U	Sighting	Y	7	M.R. Paz, Fundación Defensores de la Naturaleza, pers. comm., 7 Oct 2020
31	*Tursiops truncatus*	18 Feb 2020	Estero Lagarto	15°54′36″N 88°36′35″W	4	U	Sighting	N	7	G. Gálvez, FUNDAECO, pers. comm., 7 Oct 2020
32	*Tursiops truncatus*	25 Mar 2020	La Graciosa Bay	15°52′28″N 88°33′11″W	11	Y	Sighting	N	6	CONAP
33	*Tursiops truncatus*	30 Apr 2020	El Golfete, Dulce River	15°10′45″N 88°50′57″W	10	U	Sighting	Y	8	Soy 502 (2020)

No.	Species	Date	Locality	Coordinates	Group size	Calves	Type of record	Photo/ Video	Type of source	Reported by
34	*Tursiops truncatus*	22 May 2020	La Graciosa Bay	15°50'60''N 88°31'60''W	14	U	Sighting	Y	6	CONAP
35	*Tursiops truncatus*	14 Jul 2020	La Graciosa Bay	15°52'6''N 88°32'55''W	16	Y	Sighting	Y	7	A.R. Silva, independent researcher, pers. comm., 6 Oct 2020
36	*Tursiops truncatus*	09 Sep 2020	Punta de Manabique	15°56'38''N 88°38'18''W	10	U	Sighting	Y	7	H. Araujo, Semillas del Océano, pers.comm., 5 Oct 2020
	Mysticeti: Balaenopteridae									
37	*Balaenoptera physalus*	1904	Sarstoon Bar	15°52'58''N 88°53'56''W	1	N	Preserved specimen	N	4	Orrell (2020)
38	*Megaptera novaeangliae*	24 Jan 2016	Amatique Bay - Santo Tomás de Castilla Bay	15°44'38''N 88°36'56''W	1	N	Sighting	Y	8	Canal Antigua (2016), Prensa Libre (2016)
39	*Balaenoptera* sp.	U	Amatique Bay	--	1	N	Preserved specimen	Y	3	Orrell (2020)

*Approximate location according to information from verbatim locality in the label of the specimen. U = Unknown; Y = Yes, N = No. Type of source: 1 = Author sighting, 2 = Poster presentation, 3 = National museum, 4 = Online database, 5 = Citizen science platform, 6 = Institutional record, 7 = Personal communication, 8 = Local newscast, 9 = Social media

10 individuals was sighted on 22 August 2019, near the Cayman Crown Reef. The animals approached a group of divers that were working in the area (AGP, pers. obs.; Fig. 2B).

Stenella attenuata (Gray, 1846): Pantropical spotted dolphins were reported only once, on 1 May 2018 (Table 2). The report corresponds to the live stranding of two adult individuals in the Quehueche River, Livingston, Izabal. The individuals were returned to the sea by local people, and the only evidence is a video that was broadcasted by a local news station (Noti 7, 2018). Information on the sex of the animals and if the release to the sea was successful, or if the individuals stranded again, are unknown (Fig. 2C).

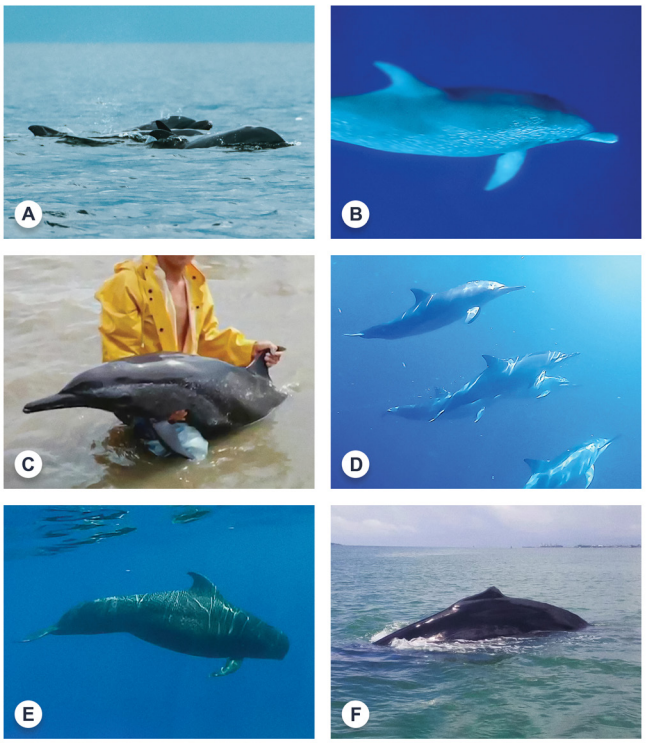

Figure 2. Cetacean species registered in the Caribbean Sea of Guatemala. A) *Tursiops truncatus*, B) *Stenella frontalis*, C) *Stenella attenuata*, D) *Stenella longirostris*, E) *Globicephala macrorhynchus*, F) *Megaptera novaeangliae*. Photo A by A.R. Silva; photos B and E by A. Giró, photos C and F by local news; and photo D by Ecobuceo Petén.

Stenella longirostris (Gray, 1828): Spinner dolphins were reported only once on 30 March 2019 (H. Araujo, Semillas del Océano, pers. comm., 5 Oct 2020). The group size oscillated between 60 and 70 individuals. The sighting occurred in the neritic zone within the PMWR. The group displayed traveling behavior, although some individuals displayed a socializing behavior when approaching and swimming near the bow of the boat (Fig. 2D).

Globicephala macrorhynchus Gray, 1846: Short-finned pilot whales were registered only once, on 27 May 2016 in Cayman Crown Reef (Table 2). The group consisted of eight individuals and at least two calves (APG, pers. obs.; Fig. 2E).

Megaptera novaeangliae (Borowski, 1781): An adult humpback whale was recorded on several occasions in a three-month period in the Caribbean Sea of Guatemala. Its presence was broadcasted by local newscasts on 25 January 2016. To aid the whale in case of a stranding event, CONAP technicians followed up the sightings reported by the local community in the area between January and April 2016 (Table 2). The photographs and videos that report the sighting only show the dorsal fin (Fig. 2F). Due to the lack of photographs of the ventral region of the fluke, the individual was unidentified. The humpback whale was observed in different areas of Amatique Bay, and it entered the Santo Tomás de Castilla Bay (Canal Antigua, 2016; Prensa Libre, 2016), an area with high boat traffic due to the presence of ports. Reports indicated that the whale had a tangled trammel net. Although it was released, the animal stranded on 25 April in Toledo District, Belize (Ramos *et al*., 2016).

Balaenoptera physalus (Linnaeus, 1758): The only record of a fin whale in the Caribbean Sea of Guatemala corresponds to a partial skeleton stored in the mammal collection of the Smithsonian National Museum of Natural History, in Washington. The fin whale skeleton was located in the Sarstoon River, Livingston, Izabal, in 1904 (Orrell, 2020). This specimen, collected ~117 years ago, represents the oldest cetacean ever recorded in the Caribbean Sea of Guatemala.

Unidentified species: An unidentified dolphin stranded in Punta de Manabique on 3 April 2017. Although the stranded event was attended by CONAP (Table 2), there is no photographic evidence of the specimen, and the species remains unidentified. Another unidentified whale skeleton is stored in the Museum of Paleontology and Archeology "Ing. Roberto Woolfolk Saravia" in Zacapa, Guatemala. This whale is thought to have stranded in Amatique Bay. Despite an initial misidentification, based on the arched shape of the upper jaw, it is suggested that the specimen belongs to the Balaenopteridae family, possibly the *Balaenoptera* genus (Table 2).

Concerning the conservation status, all the species mentioned in this study are classified by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species as Least Concern, except for the fin whale, which is classified as Vulnerable (IUCN, 2021). According to the List of Threatened Species of Guatemala (LEA, by its acronym in Spanish) (Diario de Centro América, 2021), all species mentioned in this note are listed in Category 2 (Endangered), except for the fin whale, probably because its distribution is unknown in national waters. Additionally, the dolphin species are found on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), while the two whale species are on Appendix I (UNEP-WCMC, 2021).

This review compiled the presence of at least seven cetacean species in the Caribbean Sea of Guatemala, representing 23% of the 31 species reported for the Caribbean Sea by Ward *et al*. (2001). Overall, all the species of the Delphinidae family reported in this note have a wide distribution range since they can be found in tropical and temperate waters around the world, except for the Atlantic spotted dolphin, which is restricted to the Atlantic Ocean (Jefferson *et al*., 2003; Shirihai and Jarrett, 2006). However, the presence of these species in Guatemala is mainly supported by regional records from neighboring countries (Ward *et al*., 2001).

Most of the confirmed records in this note belonged to bottlenose dolphins. The bottlenose dolphin is reported as the most common cetacean species inhabiting the Mexican Caribbean (Niño-Torres *et al*., 2015) and the best-known marine mammal in Belize (Ramos *et al*., 2016). Bottlenose dolphin is also the most observed species in other countries of the region such as Costa Rica, Panama (May-Collado *et al*., 2018) and Puerto Rico (Rodríguez-Ferrer, 2018). The Atlantic spotted dolphins, pantropical spotted dolphins, spinner dolphins, and short-finned pilot whales are species that have also been reported in neighboring countries such as Belize (Ramos *et al*., 2016) and the Mexican Caribbean (Niño-Torres *et al*., 2015). Contrary to the few records of spinner dolphins and short-finned pilot whales in Guatemala, Magileviciute (2007) reports these species as the most observed in the Island of Utila, Honduras. Considering the proximity between Honduras and Guatemala, it is suggested that the records of these species may be underestimated due to the lack of systematic research in the area, especially in open waters, outside Amatique Bay.

It is still uncertain that the pantropical spotted dolphin inhabits the Caribbean Sea of Guatemala, since the only record is associated with a stranding event. The stranded dolphin was probably weak or sick and was made ashore by the ocean currents. This highlights the need to conduct cetacean research in the Caribbean Sea of Guatemala to answer these and other concerns.

Regarding the baleen whales, while the winter areas of the Atlantic humpback whale population are well documented in the eastern Caribbean (Swartz *et al*., 2003; Whitt *et al*., 2011; Debrot *et al*., 2013; MacKay *et al*., 2016), it is necessary to expand studies in the western Caribbean region. The sighting of the humpback whale, as well as the records of the stranding of two rorquals (*Balaenoptera* spp. and *B. physalus*) on the coasts of the Caribbean Sea of Guatemala, may be an indication that their presence has gone unnoticed and could be underestimated (Ramos *et al*., 2016). Otherwise, the sightings reported here could correspond to disoriented or sick animals that were carried to land by sea currents (Tamayo-Millán *et al*., 2018). However, there are two reports of live rorquals stranding, one in Belize that occurred in 1986 (Ramos *et al*., 2016) and another in northern Quintana Roo, Mexico, in 2018 (García-Rivas *et al*., 2019). Therefore, the rorqual records compiled in this note could add to the evidence of the presence of this species in the Western Caribbean Sea.

The records compiled in this note come from opportunistic sightings as well as secondary and tertiary sources. Currently, while systematic studies focused on cetaceans in the Caribbean Sea of Guatemala are lacking, opportunistic records can contribute to preliminary analyses of the spatial and temporal distribution of cetaceans (Rodríguez-Ferrer *et al*., 2018). The generation of this baseline information is a fundamental step to establish effective actions and strategies for the conservation of these species.

La Graciosa Bay presented the highest number of records, followed by the coastal area, south of Amatique Bay (Fig. 1). La Graciosa Bay could be an important habitat for cetaceans due to its mangrove and seagrass habitats, which may serve as a refuge and breeding grounds for several fish species (Arrivillaga and Baltz, 1999), which in turn could serve as feeding grounds for dolphins (Grigg and Markowitz, 1997; Barros and Wells, 1998; Eierman and Connor, 2014). Considering the presumed association of dolphin presence and high primary productivity near river mouths (Cubero-Pardo, 2007; Valdes-Arellanes *et al*., 2011), the areas near the Sarstoon and Dulce river mouths in Amatique Bay could represent potential feeding areas. However, it should be noted that both areas have a greater chance of detecting cetaceans compared to the open sea. La Graciosa Bay is a protected area that is usually the study area for researchers and an area of frequent monitoring carried out by rangers, and Amatique Bay is an area with urban development, tourism, fishing and navigation activities, and ports.

Stranding records reported here raise two important situations. First, the intention of local people in supporting the attention to stranded animals. Second, the potential threat of vessel collisions with cetaceans, given that two of the stranded common bottlenose dolphins had skull and rib contusions. Both situations reflect the need to carry out environmental education campaigns with the local communities aimed at conserving cetaceans and the marine and coastal ecosystems of this area.

Finally, this note emphasizes the importance of conducting systematic surveys in the future focused on cetaceans in the Caribbean Sea of Guatemala, to solve information gaps on their spatio-temporal distribution, relative abundance, habitat use, ethology, anthropogenic threats, and the consideration of species with potential distribution in Guatemala, like fin whale, in the LEA. The importance of conducting research focused on the reports of cetacean sightings in La Graciosa Bay and river mouths is

also highlighted to evaluate the importance of these areas for dolphins. It is also emphasized that cetacean stranding records are crucial for the knowledge of this group, mainly when they refer to species that are difficult to observe in the field. Therefore, it is necessary to strengthen efforts to attend stranding events in this region. Such efforts are essential to propose strategies aimed at the sustainable management and conservation of the marine ecosystems of the Caribbean Sea of Guatemala.

Acknowledgments

We thank the people who contributed to this communication by providing their opportunistic records of cetaceans from the Caribbean of Guatemala, including S.D. Hernández-Gómez (CONAP), G.A. Gálvez-Argueta, M.R. Paz-Pérez, H. Araujo, F.D. Penados-Saravia, A.R. Silva-Rivera, E. López, J. Martínez and D. Núñez. We also thank the National Council of Protected Areas (CONAP) for allowing the use of the records taken by technicians and park rangers. We are grateful to anonymous colleagues who collaborated in the verification of the species of the genus *Stenella* and for the identification of the specimen from the Zacapa Museum. We thank the authors of the photographs and videos of Figure 2 of this communication; credits go to: A.R. Silva (*T. truncatus*); A. Giró (*G. macrorhynchus* and *S. frontalis*) and Ecobuceo Petén (*S. longirostris*). We are grateful to R. Thigpen, A. Pacay and A.A. Cabrera for reviewing the English language of our manuscript. Finally, we thank the anonymous reviewers for their suggestions, which significantly improved the manuscript.

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