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The Presence of Long-Beaked Common Dolphins (*Delphinus* spp.) off Central-Western Venezuela

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Abstract

The common dolphin (genus *Delphinus*) is regularly found in regions with upwelling-modified waters. The “Venezuelan stock” of the common dolphin is documented to occur in north-eastern Venezuelan waters, particularly in the “Eastern Upwelling” eco-region.

Records of *Delphinus* for other eco-regions of Venezuela are extremely sparse. Information was compiled from three independent cetacean studies conducted during 2009-2011 in the states of Aragua (Central Coast eco-region), Miranda (Unare-Píritu eco-region) and Zulia (Gulf of Venezuela eco-region), respectively. Fourteen records of *Delphinus* were compiled for this study: 10 sightings (71,5%) off the coast of Aragua State; two (14,3%) off Miranda State; as well as one sighting (7,1%) and one stranding (7,1%) in the Gulf of Venezuela. Records in the states of Miranda and Zulia were related to upwelling-modified waters. We found no evidence of upwelling in waters off Aragua State (71,5% of the records).

Keywords: Common dolphin, *Delphinus*, distribution, Caribbean Sea, Venezuela, coastal upwelling.

Presencia de delfín común de rostro largo (*Delphinus* spp.) al norte y oeste de la costa continental de Venezuela

Resumen

El delfín común (género *Delphinus*) es frecuentemente encontrado en zonas de surgencias. El “Stock Venezolano” del género *Delphinus* está ampliamente documentado para las aguas del nor-orienté de Venezuela, particularmente en la eco-región “Surgencia Oriental”. Registros de esta especie en otras regiones venezolanas son extremadamente escasos. En el presente trabajo se recolectó información proveniente de tres diferentes proyectos de campo efectuados en los estados Aragua (Eco-región Costa Central), Miranda (Eco-región Unare-Píritu) y Zulia (Eco-región Golfo de Venezuela). Se documentaron 14 registros de *Delphinus*: 10 en Aragua (71,5%), dos en Miranda (14,3%), así como un avistamiento (7,1%) y un varamiento (7,1%) en Zulia. Los registros en Miranda y Zulia estuvieron relacionados con zonas de surgencia; sin embargo en el presente estudio no encontramos evidencias de surgencia en la costa de Aragua, donde ocurrió el 71,5% de los avistamientos.

Palabras clave: Delfín común, *Delphinus*, distribución, Mar Caribe Sur, surgencia costera.

INTRODUCTION

The common dolphin (genus *Delphinus*) is known to occur in three general areas in the western Atlantic: 1) off the east coast of Canada and the United States (Western North Atlantic stock); 2) off north-central Venezuela (Venezuelan stock); and 3) southwestern Atlantic (SWA) (Jefferson *et al.* 2009, Tavares *et al.* 2010). For the SWA, Tavares *et al.* (2010) identified two stocks off southern Brazil (Para and Rio de Janeiro states) and one in Argentina (Patagonia region).

As a genus, *Delphinus* appear to prefer upwelling-modified waters in tropical-temperate areas (Jefferson *et al.* 2009). Along the Venezuelan coast, common dolphin distribution seems to mirror the west–east gradient of coastal upwelling, with major concentrations along the “Eastern Upwelling” eco-region in the north-eastern coast, specifically off Araya and Paria Peninsula (Oviedo *et al.* 2010). The Eastern Upwelling eco-region is defined by an extended shelf (over 100 km north) and high level of primary productivity due to seasonal coastal upwelling (Lorenzoni 2000, Miloslavich and Klein 2008) (Figure 1). Rueda-Roa and Muller-Karger (2013, Figure 3) identified 13 upwelling foci distributed all along the Venezuelan coast.

The Venezuelan stock has previously been identified as belonging to the long-beaked common dolphin, *Delphinus capensis* (Bermúdez-Villapol and Boher-Bentti 2003, Ramírez-Carroz and González-Fernández 2004, Bolaños-Jiménez *et al.* 2006) on the basis of external features as described by Heyning and Perrin (1994). More recently, Esteves and Oviedo (2007) reviewed the taxonomy of common dolphins in Venezuela on the basis of morphometric features. These authors found some morphological differences of Venezuelan specimens as compared to other regions of the world and proposed that common dolphins of the Venezuelan stock could be a dwarf morphotype. On the basis of taxonomic uncertainty, Esteves and Oviedo (2007) cautiously treated these populations as a single taxon, *Delphinus* spp.

Up to now, the only confirmed records of common dolphins in areas outside the Eastern Upwelling and Cariaco Trench eco-regions were based in a single stranding in the Gulf of Venezuela (Ramírez-Carroz and González-Fernández 2004) and two sightings off Aragua

State (Cobarrubia and Bolaños-Jiménez 2008). Recent records on the species occurrence in nearby waters of the southern Caribbean: off Aruba (Luksenburg 2013), off the Colombian Guajira (Palacios *et al.* 2012) and Venezuelan waters off southwestern Grenada (Smultea *et al.* 2004, 2013) offer evidence of the presence of common dolphin associated with upwelling modified waters at regional scale.

The distribution, movements and abundance of highly mobile marine species are best studied at large scales but most of the research effort focuses on small areas (Cheney *et al.* 2013). Development of collaborative efforts among research teams working in adjacent areas and integration of multiple data sources are being actively used to better build up a more real picture of the contemporary ranging patterns and abundances of several potential populations of dolphins inhabiting these areas (Cheney *et al.* 2013). In this paper, we integrated data sources from three independent studies to present evidences of the presence of free-ranging common dolphins in central-western Venezuela which confirm the occurrence of the species in regions others than the Eastern Upwelling and Cariaco Trench eco-region.

METHODS

Information was gathered as part of three field projects conducted separately by independent teams in the States of Aragua (Central Coast eco-region), Miranda (Unare-Píritu) and Zulia (Gulf of Venezuela), respectively (see Figure 1).

Description of eco-regions

Miloslavich and Klein (2008) described 13 Venezuelan marine eco-regions: 1) Orinoco delta and Atlantic Front, 2) Eastern Upwelling, 3) Unare-Píritu, 4) Central coast, 5) Golfo Triste, 6) Tocuyo, 7) Paraguaná, 8) Golfete de Coro, 9) Maracaibo Estuary, 10) Gulf of Venezuela, 11) Insular, 12) Oceanic eco-regions and 13) Cariaco Trench. For the interest of this study, we considered five eco-regions (see Figure 1):

Eastern Upwelling. From the east of Peninsula de Paria to Mochima Bay. Characterized by shallow continental shelf with coarse sandy bottoms and rocky shores. High primary and secondary pro-

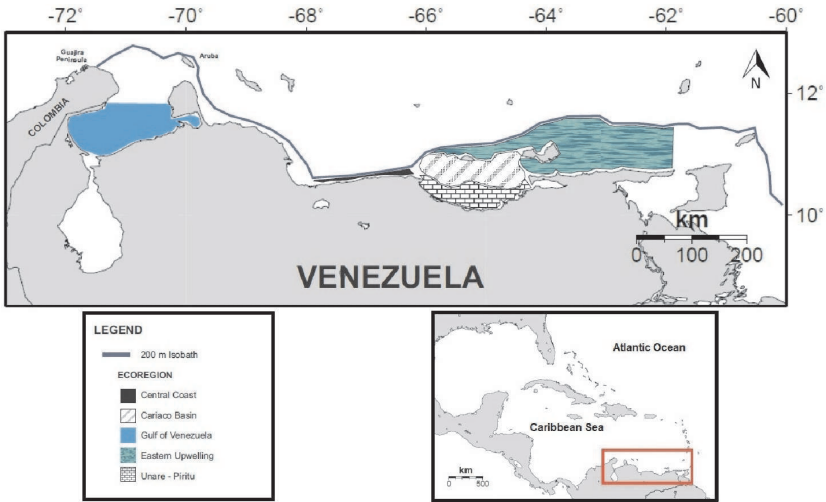


Figure 1. Relative location of the eco-regions mentioned in this study: Gulf of Venezuela, Central Coast, Unare-Píritu, Cariaco Trench and Eastern Upwelling.

duction due to seasonal upwelling fronts. This eco-region the islands of Margarita, Coche, Cubagua, Los Frailes, Los Hermanos and Los Testigos (Miloslavich and Klein 2008). This eco-region includes the following upwelling foci: Don Pedro, Las Galdonas, Carúpano, Manzanillo, Macanao, El Guamache, Golfo de Cariaco and Mochima (Roa-Rueda and Muller-Karger 2013).

Cariaco Trench. It is a depression in the continental shelf, located in front of Barcelona and the Bay of Mochima, states of Anzoátegui and Sucre. This eco-region is anoxic below 250m and is characterized by the existence of chemosynthetic ecosystems. It is a unique system in the world by permanent anoxic characteristics and high surface productivity due to the intense seasonal upwelling (Miloslavich and Klein 2008).

Central Venezuela. As part of the “Central Venezuela” eco-region, the coast of the State of Aragua is characterized by narrow continental margin, rocky shores, coarse sandy beaches and high water transparency (Miloslavich and Klein, 2008). This eco-region does not include an upwelling focus (Rueda-Roa and Muller-Karger 2013).

Unare-Píritu. Shallow coastal lagoons and sandy beaches, high sediment loads from the Unare and Tuy rivers. It is characterized by high secondary production, mostly of crustaceans and bivalves. Upwelling in Cabo Codera is considered unusual in that it can be present when there are no other upwelling fronts (Miloslavich and Klein 2008). This eco-region includes the Unare and Cabo Codera upwelling foci (Rueda-Roa and Muller-Karger 2013).

Gulf of Venezuela. Characterized by a wide continental shelf and shallow bottom (50 m). High primary and secondary production of shrimp due to large upwelling fronts. Bottom communities dominated by detritivorous organisms (Miloslavich and Klein 2008). This eco-region includes the Punta Cardón and Puerto Cumarebo upwelling foci (Rueda-Roa and Muller-Karger 2013).

Field effort

The surveys off the coastal regions of Aragua and Miranda States were designed to obtain baseline information utilizing encounter information and photo-identification data of coastal dolphin populations. However, it is important to consider the following aspects: 1) The surveys for Aragua State are a continuation of the effort reported by Bolaños-Jiménez *et al.* (2007, 2012) and 2) surveys off Miranda State were intended to document oceanic cetaceans in the transition area between the coastal environment off Miranda State (Unare-Píritu eco-region) and the western portion of the Cariaco Trench eco-region. Surveys in the State of Aragua were conducted from January 22-March 3, May 2-July 1, July 23-August 4, and August 25-September 12, 2009 and from August 19 through September 4th, 2011 (Bolaños-Jiménez *et al.* 2012, Castro-Pérez 2009, Sifontes 2013). Surveys in the State of Miranda were conducted between January-July 2011. Based on the latter, surveys differed in routes and frequency; however standard sighting information as well as standard photo-ID data were equally collected and applied in both locations.

Dolphins were identified according to descriptions in Jefferson *et al.* (1994) and Heyning and Perrin (1994). For each sighting, the dolphins were determined to be the common dolphin on the basis of the long snout and the crisscross color pattern that are diagnostic of the genus (Jefferson *et al.* 1994, Heyning and Perrin 1994). The number of dolphins around the boat was estimated every 5-10 min

and the maximum number was recorded at the end of the encounter. Photographs of the dolphins were taken with SLR cameras (Nikon D60 and Canon Rebel Xti EOS400, equipped with 18-55 mm and 70-200 mm lenses). According to standard procedures for photo-ID projects, we attempted to photograph the dorsal fin of every dolphin in each sighting (Bolaños-Jiménez *et al.* 2012). The encounter ended when all of the dolphins had been photographed or the dolphins left the area. The bottom depth at the sighting location was derived from the map of the southern Caribbean from BlueChart Americas 2008 using Mapsource™ (Garmin) software.

For the stranding in the State of Zulia, one of us (MFP) had the opportunity to photograph skeletal remains found on a beach in Cai-mare Chico, Guajira Peninsula (Figure 4). Craniological features and tooth counts were used for species identification. The skull could not be collected.

We generated monthly maps of satellite-measured chlorophyll-a by NASA's MODIS/Aqua sensor for our study area, obtained through NOAA Coastwatch, West Coast Node ([http:// www.coastwatch.noaa.gov/](http://www.coastwatch.noaa.gov/)). We used these maps to determine the intensity and extent of upwelling plumes along the coast of central and western Venezuela during the survey periods.

RESULTS

We recorded 10 sightings (71,4%) off Aragua State, two sightings (14,4%) off Miranda State and one sighting (7,1%) and one stranding (7,1%) in the State of Zulia. All of the sightings were recorded in waters over the continental shelf (Table 1 and Figure 2). Depth ranged between 12-160 m (average 74 ± 48 m, see Table 1).

Nine out of 10 sightings recorded off Aragua between July-November 2009 were of a small group that ranged from 2-6 individuals. Because of the presence of one identifiable dolphins -particularly a presumed mother with her calf- we believe that most of the sightings recorded in Aragua during July-September 2009 were of the same group (Bolaños-Jiménez, pers. obs., Sifontes, pers. obs., Armando Díaz, pers. comm., see Figure 3a). No good quality pictures are available for photo-identification purposes and no attempt has

Table I. Recent records of the common dolphin in central-western Venezuela (States of Aragua, Miranda and Zulia) during 2009-2011.

#	Date	Latitude (N)	Longitude (W)	Depth (m) JL	N	N° calves and juveniles	State of:	Record
1	2008	11,893180	-71,239346	12	3	0	Zulia	Sighting
2	26 March 2009	11,12881700	-71,80742100	NA	1	NA	Zulia	Stranding
3	01 July 2009	10,50111111	-67,75805556	45	60	?	Aragua	Sighting
4	27 July 2009	10,51277778	-67,72611111	71	4	1	Aragua	Sighting
5	04 Aug 2009	10,50194444	-67,77361111	90	4	1	Aragua	Sighting
6	25 Aug 2009	10,52138889	-67,73138889	160	2	1	Aragua	Sighting(*)
7	29 Aug 2009	10,50666667	-67,79250000	145	6	1	Aragua	Sighting
8	07 Sept 2009	10,52166667	-67,67527758	141	4	1	Aragua	Sighting
9	09 Sept 2009	10,51525778	-67,71277778	72	5	1	Aragua	Sighting
10	11 Sept 2009	10,50722222	-67,73777778	68	5	1	Aragua	Sighting
11	13 Nov 2009	10,50277778	-67,74199444	28	5	1	Aragua	Sighting
12	22 July 2011	10,49611111	-65,92083333	58	200	?	Miranda	Sighting
13	23 July 2011	10,41333333	-65,85833333	56	300	?	Miranda	Sighting
14	02 Sept 2011	10,50250000	-67,73277778	15	1	0	Aragua	Sighting(**)

(*): Mixed-species aggregation with approx. 20 Atlantic spotted dolphins (*Stenella frontalis*).

(**): Mixed-species aggregation with approx. 180 Atlantic spotted dolphins (*S. frontalis*).

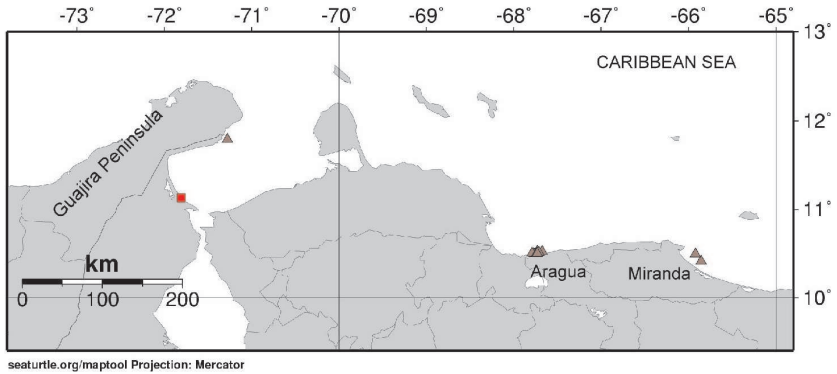


Figure 2. Sighting (brown triangles) and stranding (red square) records of *Delphinus* spp. in central-western Venezuela, 2009-2011. This map was produced by using Maptools, available at www.seaturtle.org/maptool.



Figure 3. Long-beaked common dolphins (*Delphinus* spp.) in the states of Aragua (A and B) and Miranda (C), central Venezuela. Photo credits: Leonardo Sifontes (A), Jaime Bolaños-Jiménez (B) and Lenín Oviedo (C).

been made to start a catalog aimed to target this species in Aragua State, because of scarcity of encounters.

The specimen collected in Caimare Chico, Guajira Península, State of Zulia, corresponded to the body condition Code 5 (skeletal remains) according to the classification of Geraci and Lounsbury (2005). On the basis of the high tooth count (over 45 per series) and the presence of deep palatal grooves (see Figure 4) this specimen was confirmed to be a common dolphin, genus *Delphinus*. This determination was confirmed by specialists (see Acknowledgements).



Figure 4. Skull of a common dolphin stranded in Caimare Chico, State of Zulia, found on 26 March 2006. Photo: María Fernanda Puerto.

DISCUSSION

The common dolphin is regularly found in upwelling-modified waters (Jefferson *et al.* 2009, Oviedo *et al.* 2010). In Venezuela, this species has rarely been seen outside the Eastern Upwelling eco-region (see Cobarrubia and Bolaños-Jiménez 2008) but, recently, a sighting has been confirmed in Venezuelan waters southwestern

from Grenada (Smultea *et al.* 2004, 2013). We found that sightings of common dolphins in the State of Aragua presented in this paper were not related to upwelling-modified waters, but satellite imagery revealed a high level of pigments, probably because of both chlorophyll and colored dissolved organic matter (CDOM)(Klein, pers. comm., 2013). The discontinuity of records presented here might be an artifact of the few sightings included in the study; nevertheless, it provides grounds to speculate on the possibility of: 1) a more continuous presence of *Delphinus* throughout the Venezuelan coast and 2) exploratory movements of dolphins from one upwelling focus to another. Because of the opportunistic nature of the records and the small number of sightings we cannot rule out or confirm any of the alternatives.

The presence of *Delphinus* in the State of Miranda (Unare-Píritu eco-region) was expected, because the area is adjacent to the Eastern Upwelling eco-region and there exists a previously published sighting around Cabo Codera (see Jefferson *et al.* 2009). Our results are in agreement with Cobarrubia and Bolaños-Jiménez (2008), who concluded that—based on the paucity of sightings—the common dolphin was not a regular inhabitant in the State of Aragua. As for the nine sightings recorded in Aragua between July-November 2009. Bolaños-Jiménez *et al.* (2012) speculated that they could be related to the effects of Cabo Codera upwelling. Nevertheless, our review of chlorophyll images did not reveal the occurrence of an upwelling plume during the time of sightings.

Until recently, the occurrence of *Delphinus* in the Gulf of Venezuela was based on the finding of skeletal remains in year 2002 (Ramírez-Carroz and González-Fernández 2004). Our addition of one stranding and one sighting in that region (see Table 1, Figure 2) confirms the occurrence of free-ranging *Delphinus* in waters of the Gulf of Venezuela. Recently, some sightings have been recorded to the east of the Gulf of Venezuela in Aruban waters (Luksenburg 2013, Smultea *et al.* 2004; 2013) and to the west, off the Colombian side of the Guajira Peninsula (Palacios *et al.* 2012). Palacios *et al.* (2012) tentatively proposed the existence of a “Guajiran stock” that would be separated from the “Venezuelan stock” by outflow of warm water from the Lake of Maracaibo and the Gulf of Venezuela (Palacios *et al.* 2012, Figure 1). According to authors, this stock

would inhabit the waters surrounding both the Colombian and Venezuelan sides of the Guajira Peninsula. Palacios *et al.* (2012) also acknowledged that a more or less continuous distribution of common dolphins from northeastern Venezuela to northern Colombia is a possibility that cannot be ruled out until further survey work is conducted. Continued research efforts in the southern Caribbean will further help elucidate the occurrence of *Delphinus* as well as its association with environmental parameters.

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