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Distribution of Bottlenose Dolphins (*Tursiops truncatus*) on the East Coast of Isla Margarita and the Los Frailes Archipelago, Venezuela

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Abstract

There have been few studies on the composition, distribution, and abundance of cetaceans in Venezuelan waters. Opportunistic stranding and sighting data revealed *Tursiops*, *Stenella*, *Delphinus*, and *Balaenoptera edeni* in the waters around Isla Margarita, Coche, Cubagua, and Los Frailes Archipelago. All of these sites are located off the northeast coast of the mainland of Venezuela in an area of coastal upwelling and complex submarine topography. The purpose of this study was to conduct a preliminary assessment of bottlenose dolphins and other cetaceans in this area. Data were gathered from June 1999 through November 2000 using a land-based platform (28 h) and a boat-based platform (26 surveys, totaling 121 h and 699 nmi). Data in relation to sea floor relief were analyzed using GIS software. Complex topographical features, such as depressions and passes located southwest of the study area, appear to limit the range of *Tursiops*. Bottlenose dolphins commonly occur between Punta Ballenas and Los Frailes Archipelago, where movements among those localities evidence a great plasticity in two different environments, likely to be related to prey distribution. No interspecific aggregation was recorded for bottlenose dolphins, as observed in the central coast of the country with *Stenella frontalis* and *Tursiops truncatus*. This study is the first to document cetacean habitat use around Isla Margarita and, with continued effort, will be important not only for documenting Venezuelan cetaceans but also for the assessment of potential impacts of local development, including ecotourism.

Key Words: bottlenose dolphin, *Tursiops truncatus*, submarine topography, sightings, spatial distribution, Isla Margarita

Introduction

Bottlenose dolphin (*Tursiops truncatus*) is commonly reported for the entire Caribbean basin (van Bree, 1975; Debrot et al., 1998; Mignucci, 1998), and is widely distributed throughout the coastline of Venezuela (Evans et al., 1977; Naveira, 1996; Acevedo, 2001; Oviedo & Silva, 2001). *T. truncatus* is perhaps the most widespread, along with *Balaenoptera edeni*, of the more than 22 species reported in territorial waters (Acevedo, 2001). Oviedo & Silva (2001) consider *T. truncatus* to be the dominant dolphin species in Los Frailes Archipelago and the east coast of Isla Margarita.

Two ecotypes are recognized for *T. truncatus*: (1) a coastal form and (2) an offshore form (Hersh & Duffield, 1990; Rossbach & Herzing, 1999). For other delphinid species, such as *Delphinus* spp., those ecotypes are currently accepted as separated species: *D. delphis* and *D. capensis* (Heyning & Perrin, 1994). Coastal forms of bottlenose dolphins develop resident behavior patterns within their ranges, with varied degrees of site fidelity (Würsig & Würsig, 1977, 1979; Würsig & Harris, 1990). Those ranges could well be limited by defined boundaries for resident populations (Wells & Scott, 1999) or extended for open populations (Defran & Weller, 1999; Defran et al., 1999). The bottlenose dolphin is not endangered in Venezuelan waters, although there is no accurate information about the status of the local populations throughout the country, and some might soon be facing extended environmental pressures in areas where human coastal communities are increasing. The purpose of this study was to conduct a preliminary assessment of bottlenose dolphins along the east coast of Isla Margarita and Los Frailes Archipelago.

Materials and Methods

Study Area

The sampled area was divided into two portions. The northeast coast (11° 15' N, 63° 50' W) was comprised of the coastline of the east region of Isla Margarita from Punta Ballenas to El Tirano, including Los Frailes Archipelago. The main environmental feature of this area is the wide influence of coastal upwelling from the mainland (Castellanos, 1997; Llano et al., 1999a; Lorenzoni, 2000). The second sampled portion was the southeast coast (10° 52' N, 64° 03' W) from Punta Ballenas to Punta de Mangle toward the west, within a submarine depression called Las Marites.

Sampling

Observations were accomplished with two methodologies: (1) a land-based sampling from Punta Ballenas Lighthouse at approximately 70 m above sea level, located at the southeast point of Isla Margarita, and (2) boat-based observations were done using a 27-ft motorboat at 10 to 15 knots. Three different kinds of sampling cruises were used: (1) northeast cruise from the coastal town of El Tirano to Los Frailes Archipelago (10 nmi); (2) southeast cruise from Punta Ballenas to Punta de Mangle, about 18.93 nmi at 500 m from the coast; and (3) southeast-northeast cruises from Punta Ballenas toward Los Frailes Archipelago, 13.32 nmi at 500 m from the coast. Observations were achieved using 7 × 50 Tasco binoculars. No photographic records of individuals sighted were taken.

Topographical Analysis

This analysis was undertaken to describe the submarine relief as a percentage of depth in any given section of the study area. A grid of 5 min latitude by 5 min longitude quadrats was established in the study area. The slope index was calculated through the following formula:

$$SI = Zmax - Zmin / ZmaxRA \times 100$$

Zmax is the maximum depth of a specific quadrat; Zmin is the minimum depth, considered 1 m for coastal areas; and ZmaxRA is the maximum depth of the research area. The slope indices were grouped into three classes by a Euclidean distance cluster analysis. A posterior statistical treatment was unnecessary given the explicit character of the data. Mignucci (1998) used a Chi-square for the same analysis with a greater number of quadrats that were not uniformly surveyed. In this research, just nine quadrats were considered and were surveyed continuously.

Results

Sightings of bottlenose dolphins (n = 20) usually were of groups made up of 2 to 16 individuals (group mean size 8.5 ± 4.9). Thirty-five percent (n = 7) of the sightings were female adults with calves. Feeding activity was observed in 20% (n = 4) of the sightings, particularly during all the cliff-based observations, where behaviors related with feeding activity, such as feeding splash (Shane, 1990) and porpoising (Hastie et al., 2004), were recorded.

The distribution range of *Tursiops truncatus* along the east coast of Isla Margarita shows a major occurrence pattern toward the Punta Ballenas–Farallon area, with a sightings' mean depth of 17 m, and Los Frailes Archipelago, where the bathymetry of the sightings range from 9 to 35 m, with a mean of 25 m. The results of the topography analysis through the sloping index, as well as the discrimination of the sighting data by a cluster analysis, allowed the differentiation of three specific topographical zones in the study area: (1) a highly diverse topography HDT (SI > 75%, n = 2 quadrats) west of Farallon, within the Marite's Depression; (2) a medium diverse topography MDT (SI > 43% < 55%, n = 5 quadrats) north of Farallon; and (3) a diverse topography DT (SI > 56% < 74%, n = 2 quadrats), which comprise Los Frailes Archipelago. According to these data, *T. truncatus* favored two of the topographical zones mentioned above—the diverse topography of Los Frailes Archipelago, with 50% (n = 10) of the sightings in this area, and the medium diverse topography north of Farallon, with 45% (n = 9) of the sightings. Five percent (n = 1) of the sightings took place in a quadrat that was not surveyed continuously and, thus, was not considered in the analysis.

Discussion

The trend in sighting distributions of *Tursiops truncatus* in this contribution could be correlated with the topographical characteristics of the area and a complex of oceanographic features, including the strong influence of the upwelling in the northeast coast basin (Castellanos, 1997; Llano et al., 1999a; Lorenzoni, 2000), which directly affect the prey abundance in the sampled area. Similar patterns of prey distribution influenced by submarine landscape have been observed elsewhere with resident populations of bottlenose dolphins (Würsig & Würsig, 1979; Wilson et al., 1997; Defran et al., 1999; Hastie et al., 2004). The influence of topography is also important in the accuracy of the dolphins' sense of prey detection. Topographic relief associated with sound production by fishes could improve the bottlenose dolphins' ability to capture prey, and may similarly amplify the acoustic detection of *Tursiops* (Barco et al., 1999).

There were no mixed species groups of *T. truncatus* in this investigation. All of the sightings were monospecific pods of bottlenose dolphins in contrast with the records reported for the central coast of Venezuela, in Aragua State, where mixed groups of *Stenella frontalis* and *T. truncatus* were sighted (Bolaños et al., 1999; González, 2000). Interspecific association patterns are also influenced by topography and depth. *Tursiops* populations with a neritic range do not associate with other dolphins, while mixed groups are frequently reported in pelagic areas (Scott & Chivers, 1990), with ranges located outside the shelf break and offshore. The fact that all the sighting records for the east coast of Isla Margarita and Los Frailes Archipelago were done within a neritic area, where the shelf break is at 150 km away from the eastern shoreline (Llano et al., 1999a), while the records in Aragua State were from an area where the shelf break is reached at less than 3.7 km from the coast (Llano et al., 1999b), suggests a possible differentiation between these two bottlenose dolphin populations into an offshore group for the central coast dolphins and a coastal group for the ones studied in this investigation.

The lack of sighting records for the highly diverse topography area west from Punta Ballenas (Figure 1) is the most striking evidence of the correlation between topography features and the distribution range of *T. truncatus* in the study area. Similarly, the bottlenose dolphin population in southern California is distributed along 155 km of coastline, with a well-defined southern limit. The submarine relief around the southern limit area is highlighted by two submarine canyons that represent a topographical barrier for the dolphins (Hansen, 1990). In Argentina, there is evidence of bottlenose dolphin usage of topographical features as reference points to establish limits in their movement patterns within their range (Würsig & Würsig, 1979). The submarine topography of an area might be recognized through dolphin's use of the acoustic environment in this habitat (Norris, 1967, and Evans, 1971, as cited in Hansen, 1990). The limits and boundaries in bottlenose dolphin distribution range areas are frequently established by topographic characteristics or abrupt changes in depths (Wells & Scott, 1999). The analysis of the sighting records for the east coast of Isla Margarita in relation with the topographical relief of the study area (Figure 1) suggests that the Marite's and Margarita Depressions in the southwest are two limiting topographic factors in the spatial distribution of *T. truncatus* in the study area. The studied population of bottlenose dolphins in this research could potentially be described as the "coastal ecotype" of the species, based on its movement pattern within its range, its intraspecific association pattern, and the neritic distribution within a well-defined geographic limit; however, more evidence is needed to support this hypothesis, and detailed data on the social structure of the population needs to be studied.

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Figure 1. Map of the eastern end of Margarita Island, Venezuela; depth isobaths are in meters. Filled circles indicate locations of bottlenose dolphin sightings.

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