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Distribution of the Antillean manatee (*Trichechus manatus manatus*) as a function of habitat characteristics, in Bahía de Chetumal, Mexico

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Abstract

The Antillean manatee *Trichechus manatus manatus* is considered endangered because of its reduced numbers, poor knowledge about its population status, and human modification of rivers, estuaries and coastal areas which it inhabits. Previous studies identified some elements of the habitat of manatees in the Caribbean, but few have explored quantitatively their relationship with their use by manatees, specially at a local scale. We explored the correlations between several habitat characteristics and the use of small spatial units by manatees in Bahía de Chetumal. Distance to freshwater sources, vegetation cover, depth, slope, salinity and shelter were sampled concurrently during 17 manatee aerial surveys, between November of 1998 and April of 2000. All variables, except shelter, were correlated with the occurrence of manatees. The distance to freshwater and depth contributed the most to multivariate Poisson and Logistic regression models and should be considered first in developing habitat models and conservation strategies for this species.
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Keywords: Antillean manatee; Habitat variables; Mexico; Bahía de Chetumal

1. Introduction

The Antillean manatee *Trichechus manatus manatus* is a subspecies of the West Indian manatee that, because intensive hunting from the 16th century to the early 20th century, has strongly reduced populations (Lefebvre et al., 2001). Low scale subsistence hunting is still practiced in Mexico; but, currently, the main conservation threat in this country is the continuous change and degradation of the riverine and coastal habitats used by this species. Healthy populations of manatees in Mexico are confined to relatively isolated regions, but increasing human development pressure is a major reason of concern threatening these animals.

The characterization of manatee habitat at regional and local scales is a priority research issue for international, regional and local conservation plans for this species (USFWS, 2001; UNEP, 1995). Some habitat characteristics like the presence of freshwater sources, warm water, abundance of aquatic plants, water shallowness, shelter from wind and surf, and presence of travel corridors between areas with different characteristics, are considered important components of the general habitat of the manatees (Hartman, 1979; Powell and Rathbun, 1984; Packard and Wetterqvist, 1986; Rathbun et al., 1990; Provancha and Hall, 1991; Lefebvre et al., 2000), but few studies have been directed at quantifying their importance at smaller spatial scales.

In the Mexican Caribbean coasts, manatees are concentrated mostly in Bahía de Chetumal, which has been designated as a manatee natural protected area (Peridico Oficial del Gobierno del Estado de Quintana Roo, 1999). This bay along with the adjacent coast of Belize is considered one of the main areas of distribution of this

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species in the Caribbean Sea (O'Shea and Salisbury, 1991; Morales-Vela et al., 2000).

Bahía de Chetumal had been poorly studied, although recently some studies have begun to address its biological, physical and chemical features (Morales-Vela et al., 1996). Axis-Arroyo et al. (1998) conducted a small-scale study to explore the relationships between some habitat characteristics and the distribution of manatees in this area, but it covered a small geographic regions and data on manatee distribution was obtained opportunistically from multiple sources, limiting its interpretability.

The main goal of the study we report upon here was to examine the correlation between the occurrence of manatees and several habitat characteristics, at a local scale. We covered a large area in Northern Bahía de Chetumal, and obtained concurrent data about manatee distribution and habitat characteristics.

2. Methods

2.1. Manatee data

We used a CESSNA-182 airplane to conduct 17 aerial surveys for manatees in the Northern section of Bahía de Chetumal (Olivera-Gómez and Mellink, 2002). Three flights were conducted in November 1998, four in May–June 1999, five in August–September 1999, and five in April–May 2000. For each flight, we flew for about one hour over the survey area (about 1.25 h of total flight time), at an altitude of 150 m and an average speed of 180 km h^{-1}, following a series of transects parallel to the coast along the West and East sides of Northern Bahía de Chetumal (Fig. 1). The survey crew consisted of a pilot and one observer in the front, and two observers in the rear seats. Each observer scanned a 400 m wide zone, the inner proximal edge determined by the limit of the observer's vision below the aircraft and the outer edge by a mark on the aircraft window, adjusted for the height of each observer. All sightings as well as the flight path were recorded with a global position system device (GPS, Garmin II plus).

2.2. Habitat characteristics

The transects covered in the aerial surveys were divided in 309 study units of 0.5 km large and 0.4 km wide (Fig. 2). Within each unit we determined *depth*, *slope of the bottom*, *cover by aquatic rooted macrophytes*, *distance to freshwater sources*, *shelter from wind and surf*, and *salinity*. These data were entered into a Geographical Information System (GIS; TNT-Lite 6.01, Microimages Inc.).

The *distance to main freshwater sources* (see Fig. 2) and *shelter from wind and surf* were calculated directly over digitized charts of the study area. We defined three

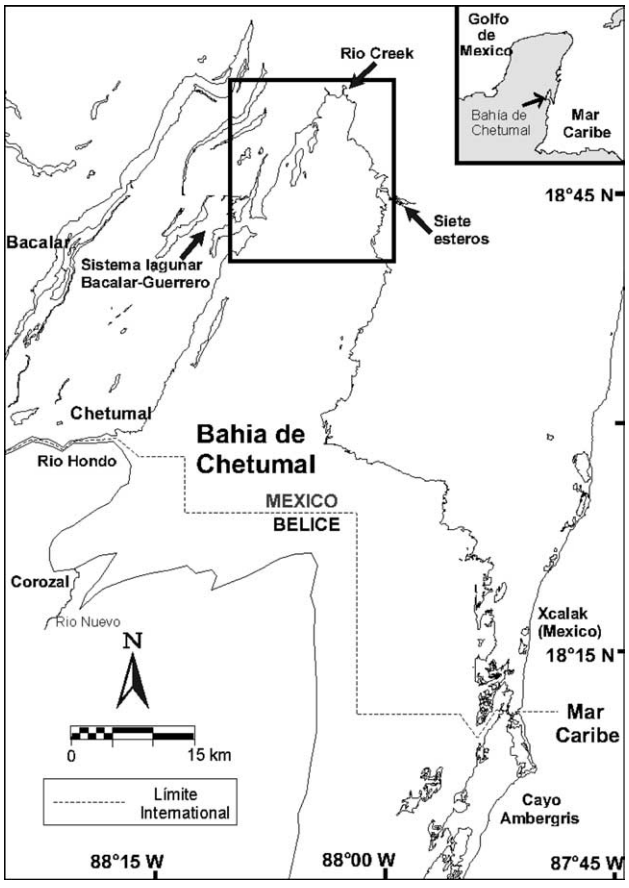

Fig. 1. Bahía de Chetumal, located in the Southeastern base of the Yucatán peninsula shared by Mexico and Belize.

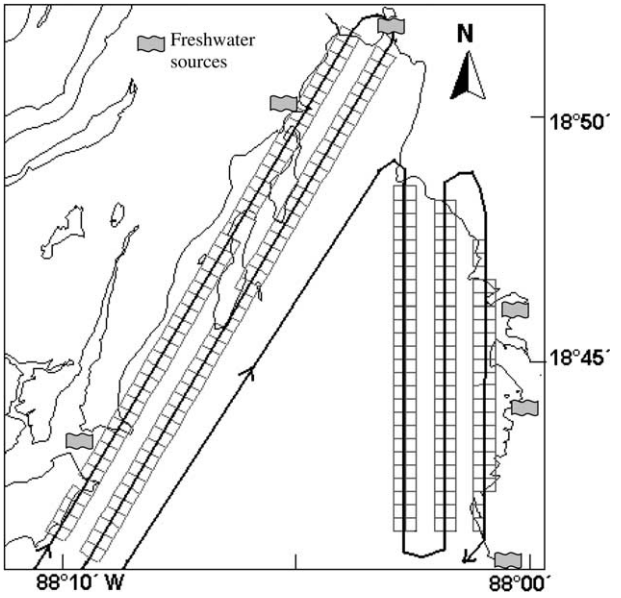

Fig. 2. Locations of 309 units to study the correlation between environmental characteristics and habitat use by manatees in the Northern section of Bahía de Chetumal along a flight path, and location of the main freshwater sources in this section of the bay 1998–2000.

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