

Aquatic mammals from the Mexican Caribbean; a review

Mamíferos acuáticos del Caribe mexicano, una revisión

Carlos Alberto Niño-Torres¹, María del Carmen García-Rivas², Delma Nataly Castelblanco-Martínez³,
Janneth Adriana Padilla-Saldívar⁴, María del Pilar Blanco-Parra³ and Rafael de la Parra-Venegas⁵

¹Universidad de Quintana Roo. División de Ciencias e Ingeniería. Blvd. Bahía s/n esq. Ignacio Comonfort, Col. Del Bosque, Chetumal, Quintana Roo, 77019. México

²Reserva de la Biosfera Tiburón Ballena, Parque Nacional Isla Contoy Puerto Juárez, Quintana Roo., Comisión Nacional de Areas Naturales Protegidas. SEMARNAT. Insurgentes 445, Col. Magisterial, Chetumal, Quintana Roo, 77039. México

³Fundación Internacional para la Naturaleza y la Sostenibilidad (FINS), Calle Larún Manzana 75, Lote 4, Andara, Chetumal, Quintana Roo, 77014, México.

⁴El Colegio de la Frontera Sur. Av. Centenario Km. 5.5, Chetumal, Quintana Roo, 77014. México

⁵Red de Varamientos de Mamíferos Marinos del Caribe Mexicano. Av. Xelha N°1-311, SM 28, Cancún, Quintana Roo, 77500. México
e-mail: carlosalni@gmail.com.

Niño-Torres C. A., M. C. García-Rivas, D. N. Castelblanco-Martínez, J. A. Padilla-Saldívar, M. P. Blanco-Parra and R. de la Parra-Venegas. 2015. Aquatic mammals from the Mexican Caribbean; a review. *Hidrobiológica* 25 (1): 127-138.

ABSTRACT

We present a review of the aquatic mammal species occurring in the Mexican Caribbean. Several published sources were reviewed to find information about aquatic mammals reported for the Mexican Caribbean. Additionally, we consulted 29 national and international collections and museums. Based on documents, collections, direct records and local news, we analyzed 18 confirmed species of aquatic mammals for the study area [*Tursiops truncatus*, *Stenella clymene*, *S. frontalis*, *S. longirostris*, *Steno bredanensis*, *Grampus griseus*, *Globicephala macrorhynchus*, *Peponocephala electra*; *Pseudorca crassidens*, *Orcinus orca*, *Physeter macrocephalus*, *Kogia breviceps*, *K. sima*, *Ziphius cavirostris*, *Mesoplodon europaeus*, *Trichechus manatus manatus*, *Lontra longicaudis annectens* and *Monachus tropicalis* (extinct)]. In order to gather solid baseline information that enhances efficient long-term management, regular and systematic population censuses of the aquatic mammal community are recommended. We recommend the use of the "Mexican Caribbean" area as a separate unit of management and conservation, differently as has been included in the macro region "Gulf of Mexico/Mexican Caribbean".

Key words: Aquatic mammals, Mexican Caribbean, management units.

RESUMEN

Se presenta una revisión de las especies de mamíferos acuáticos para el Caribe Mexicano. Un gran número de fuentes publicadas fueron consultadas para buscar información sobre mamíferos acuáticos reportados para el Caribe Mexicano. Además, se consultaron 29 colecciones y museos nacionales e internacionales. Basados en documentos, colecciones, registros directos y noticias locales, el presente trabajo reporta la presencia de 18 especies de mamíferos acuáticos en el área de estudio [*Tursiops truncatus*, *Stenella clymene*, *S. frontalis*, *S. longirostris*, *Steno bredanensis*, *Grampus griseus*, *Globicephala macrorhynchus*, *Peponocephala electra*; *Pseudorca crassidens*, *Orcinus orca*, *Physeter macrocephalus*, *Kogia breviceps*, *K. sima*, *Ziphius cavirostris*, *Mesoplodon europaeus*, *Trichechus manatus manatus*, *Lontra longicaudis annectens* and *Monachus tropicalis* (extinct)]. Para obtener información de línea de base que permita un manejo eficiente a largo plazo de este recurso, se recomienda realizar censos poblacionales regulares y sistemáticos de la comunidad de mamíferos acuáticos. Se sugiere a la comunidad de mastozoólogos marinos utilizar al "Caribe Mexicano" como una unidad separada de manejo y conservación, a diferencia de cómo es usualmente incluida en la macro-región "Golfo de México/Caribe Mexicano".

Palabras clave: Caribe mexicano, mamíferos acuáticos, unidades de manejo.

INTRODUCTION

The “aquatic mammal” (not a taxonomic term) makes reference to those animals that spend their entire life, or most of their lifespan in aquatic environments. It usually includes three orders: *i.* Cetacea, including Mysticeti (whaleboned cetaceans), and Odontoceti (toothed cetaceans), *ii.* Carnivora, including Otariidae (sea lions), Phocidae (seals), Odobenidae (walrus), Mustelidae (otters), Ursidae (polar bear), and *iii.* Sirenia: manatees and dugongs (Perrin *et al.*, 2009).

Aquatic mammals are consumers at most trophic levels. Because of their large body sizes and abundances, they are considered to have a major influence on the dynamic structure and function of aquatic ecosystems (Bowen, 1997). Among all mammals, aquatic mammals have been intensively exploited for human consumption and trade. The hunt of aquatic mammals was intensive in Mexico during the 18th and 19th century, particularly along the Pacific coast, by Russian, British, and American fleets, that were attracted by their great diversity and abundance (Guerrero Ruíz *et al.*, 2006). Intensive harvesting led to fragmentation in the populations of several species, and eventually led to the extinction of the Caribbean monk seal (*Monachus tropicalis* (Gray, 1850)) (Calambokidis & Barlow, 2004; Guerrero Ruíz *et al.*, 2006; Perrin *et al.*, 2009). In spite of the current Mexican and international laws protecting aquatic mammals, these species still face a number of threats like habitat degradation, pollution, incidental catch, and ship collisions, among many others (Bearzi *et al.*, 2004).

At least 47 species of aquatic mammals have been reported as present in Mexican territory (Torres *et al.*, 1995). Torres *et al.* (1995) proposed four zones for aquatic mammal distribution in Mexican waters (Fig. 1A): I. Pacific coast of Baja California Peninsula, II. Gulf of California, III. Pacific coast (from Nayarit to Guerrero), and IV. Gulf of Mexico (Mexican territory) and Mexican Caribbean. Although some authors have proposed the use of the Mexican Caribbean as a separate area (Fig. 1B) (Salinas & Ladrón de Guevara, 1993; Ceballos *et al.*, 2005), to date, the Torres *et al.* (1995) criteria are probably the most commonly used in Mexican aquatic mammal literature. In the “Gulf of México and Caribbean Sea” region, studies have focused specifically on the Gulf of Mexico (Auriolles-Gamboa, 2009). Consequently, the information about aquatic mammals in the Mexican Caribbean is relatively poor, except for the Antillean manatee (*Trichechus manatus manatus* Linnaeus, 1758) that has received considerable research efforts (see Results and Discussion sections).

Although there are some documents that list aquatic mammal species inhabiting the Mexican Caribbean, most of them lack reliable sources to support occurrence records. The aim of this study was to confirm the current list of aquatic mammal species occurring in the Mexican Caribbean and to amend the list with updates from additional occurrence records.

MATERIAL AND METHODS

Study area. We considered the Mexican Caribbean the area located between Cabo Catoche, in the northern portion of Quintana Roo, Mexico (21° 36' 18" N; 87° 06' 13" W), to the border with Belize (18° 09' 45" N; 87° 48' 50" W), encompassing approximately 865 km of coast line (Fig.

2). This area includes the Mexican Exclusive Economic Zone among the maritime-borders of Mexico, Belize, and Cuba in the Caribbean Sea (Fig. 1B, Zone 5).

Compilation and review. We conducted an exhaustive search for information about the distribution of aquatic mammals in the study area from a variety of sources including peer-reviewed journal articles, databases, books, theses, technical reports (from universities, governments and NGOs) and scientific meeting proceedings. To find documents reporting the presence of aquatic mammals in the study area, we repeatedly searched the article databases Elsevier, Springerlink, Wiley Online Library, Web of Science, Gale CENGAGE, Oxford Journals, BioOne, and Scholar Google for the keywords “Caribbean sea”, “Quintana Roo”, “Mexican Caribbean”, “Caribbean”, “Yucatan”, “marine mammals”, “aquatic mammals”, “dolphin”, “whale”, “otter”, “seal”, and the 47 aquatic mammal scientific names. The databases we searched contain hundreds of documents that match these possible combinations. We conducted a rapid visual excluding procedure by evaluating their titles, keywords, and abstracts. Documents containing “Caribbean sea”, “Quintana Roo”, “Mexican Caribbean”, “Caribbean” or “Yucatan” mixed with other keywords were revised in detail. Additional documents were consulted in local libraries. In order to find records of aquatic mammals deposited in scientific collections, we visited and/or consulted the collections and electronic catalogs reported on Table 1. Finally, we reviewed 302 reports in the “Database of Mexican Mammals” deposited in United States and Canada Collections (López-Wilchis. R. 2003). Additionally, we compiled and sighting data of aquatic mammals from specialists and corroborated local news reports that occurred in the Mexican Caribbean. Confirmed records of the Mexican Caribbean Marine Mammal Stranding Network (Red de Varamientos de Mamíferos Marinos del Caribe Mexicano, RVMCM) were included, as well as direct sightings and/or strandings attended by the authors. Reports or local news of aquatic mammals that could not be confirmed by the authors or other specialists were excluded from the analysis.

The obtained information was classified according to the following eight categories: *I*) organisms deposited in scientific collections or museums, *II*) peer-reviewed papers, *III*) books/book chapters, *IV*) sightings and/or strandings attended *V*) scientific meeting abstracts, *VI*) thesis, *VII*) corroborated government, institutional or NGOs reports, and *VIII*) corroborated local news. Records were then organized in tables and described broadly. The species were only included in the list if at least one confirmed report was found.

RESULTS

We reviewed hundreds of possible references, 19 national and 10 international collections/museums, and 14 scientific meeting proceedings. Additionally, we included data from 25 direct records (15 sightings and 10 strandings). A total of 123 confirmed records were obtained, mainly from peer-reviewed papers, followed by direct records, meeting abstracts, books or book chapters, specimens deposited in collections/museums, government/institutional/ONGs reports, thesis and local news respectively (Table 2).

The highest number of reports was obtained for the Antillean manatee (*Trichechus manatus manatus*), while other species, such as *Or-*

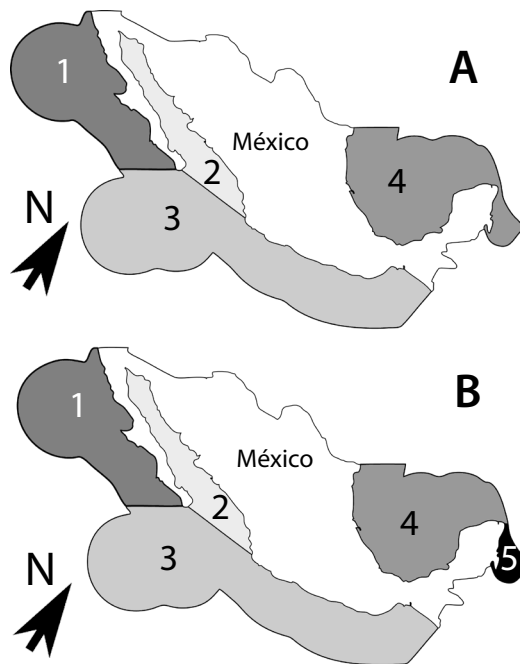


Figure 1. Map of Mexico showing the aquatic mammal zones proposed by A) Torres *et al.* (1995) and B) Ceballos *et al.* (2005). Zones are: 1) the Pacific coast of Baja California Peninsula, 2) the Gulf of California, 3) the Pacific coasts (from Nayarit to Guerrero), 4A) the Gulf of Mexico and Mexican Caribbean, 4B) the Gulf of Mexico, and 5B) the Mexican Caribbean.

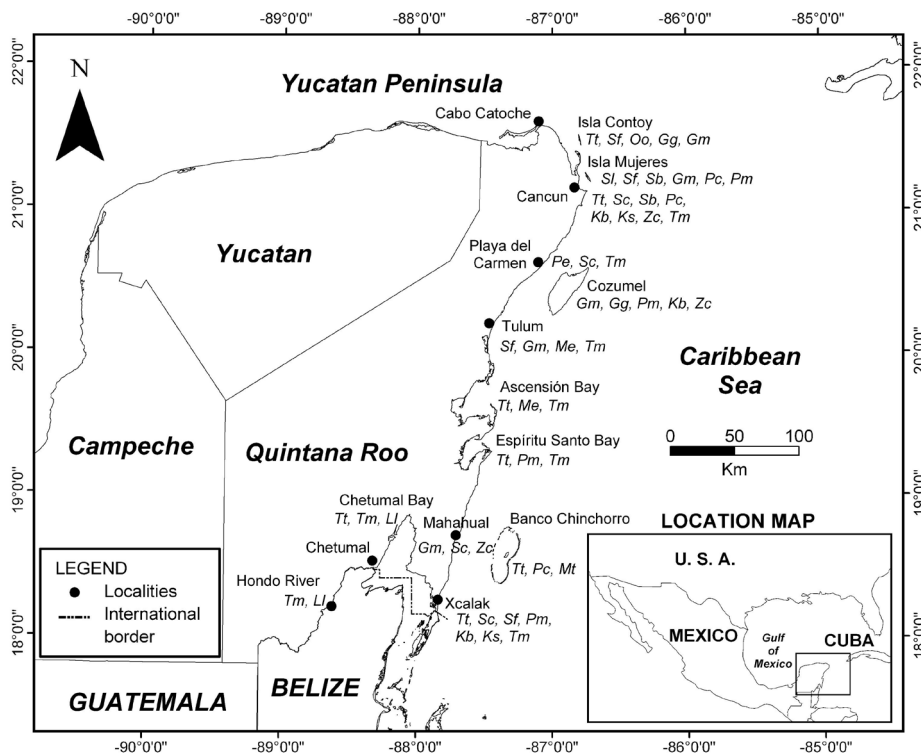


Figure 2. Yucatan Peninsula map showing the study area in the Mexican Caribbean, the coast between Cabo Catoche and Belize. Confirmed species of aquatic mammals in localities of the study area are included as: *Tt*: *Tursiops truncatus*, *Sc*: *Stenella clymene*, *Sf*: *Stenella frontalis*, *Sl*: *Stenella longirostris*, *Sb*: *Steno bredanensis*, *Gg*: *Grampus griseus*, *Gm*: *Globicephala macrorhynchus*, *Pe*: *Peponocephala electra*, *Pc*: *Pseudorca crassidens*, *Oo*: *Orcinus orca*, *Pm*: *Physeter macrocephalus*, *Kb*: *Kogia breviceps*, *Ks*: *Kogia sima*, *Zc*: *Ziphius cavirostris*, *Me*: *Mesoplodon europaeus*, *Tm*: *Trichechus manatus manatus*, *Ll*: *Lontra longicaudis annectens*, *Mt*: *Monachus tropicalis*.

Table 1. Visited and/or consulted scientific collections/Museums.

Collection/Museum	Acronym
Mexican:	
Colección Osteológica de Mamíferos Marinos de la Facultad de Ciencias, UNAM	FCMM
Colección de Mamíferos del Instituto de Investigaciones Biológicas de la Universidad Veracruzana	-
Colección de Mamíferos del Museo de Historia Natural -Alfredo Dugès- Instituto Tecnológico de Chetumal	-
Colección de Mamíferos de El Colegio de la Frontera Sur, Unidad Chetumal	ECO-CH-M
Colección de Mamíferos del Instituto Tecnológico de Huejutla	HMAM
Colección Mastozoológica del Museo de Zoología, Universidad Autónoma de Yucatán	FMVA
Colección Mastozoológica del Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional, Unidad Oaxaca	-
Colección de Vertebrados de la Universidad Autónoma de Tamaulipas	-
Colección Mastozoológica de la Universidad Autónoma de Aguascalientes	-
Colección de Mamíferos de la Universidad Michoacana de San Nicolás de Hidalgo	-
Colección de Mamíferos del Centro de Investigaciones Biológicas del Noroeste	-
Colección Mastozoológica de la Universidad Autónoma de Campeche	-
Colección Zoológica Regional (Mammalia) del Instituto de Historia Natural y Ecología	-
Colección Nacional de Mamíferos del Instituto de Biología, UNAM	-
Colección de Mamíferos de la Universidad Autónoma Metropolitana	-
Colección Osteológica "M. en C. Ticul Álvarez Solórzano" del Instituto Nacional de Antropología e Historia	-
Colección de Vertebrados del Instituto Tecnológico de Estudios Superiores de Monterrey-Guaymas y del Centro de Investigación en Alimentación y Desarrollo, A. C. Unidad Guaymas	-
Museo del Parque Nacional Isla Contoy	-
Foreing:	
European museums BioCase	BIOCASE
The Museum of Vertebrate Zoology at Berkeley	MVZ
Smithsonian Institution National Museum of Natural History	USNM
Vertebrate Museum of Humboldt University	HSU
Museum of Texas Tech University, Natural Science Research Laboratory	NRSL
The Oxford University Museum of Natural History	OUMNH
San Diego Natural History Museum	SDMNH
The Natural History Museum of United Kingdom	NHMK
Florida Museum of Natural History	FLMNH
American Museum of Natural History	AMNH
Swedish Museum of Natural History	SMNH

Table 2. Number of records of aquatic mammal species confirmed in the Mexican Caribbean.

Species	Papers	Direct records	Conference proceedings	Book/Book chapters	Collections/Museums	Reports	Thesis	Local news	TOTAL
<i>Trichechus manatus manatus</i>	12	2	2	6	1	3	3		29
<i>Tursiops truncatus</i>		6	2	1	3	1	1		14
<i>Globicephala macrorhynchus</i>	4		1	3	2				10
<i>Kogia breviceps</i>	4	1	5						10
<i>Physeter macrocephalus</i>		1	3	3	1	1			9
<i>Pseudorca crassidens</i>		3	3		1	1			8
<i>Stenella clymene</i>	3	2	2						7
<i>Lontra longicaudis annectens</i>	1	1		2	1		1		6
<i>Ziphius cavirostris</i>		1		1	2			1	5
<i>Monachus tropicalis</i>	5								5
<i>Kogia sima</i>			1	1		2			4
<i>Stenella frontalis</i>		2	1	1					4
<i>Steno bredanensis</i>		1	1					1	3
<i>Grampus griseus</i>		2							2
<i>Kogia sp.</i>	1								2
<i>Mesoplodon europaeus</i>		1			1			1	2
<i>Orcinus orca</i>		1							1
<i>Peponocephala electra</i>								1	1
<i>Stenella longirostris</i>		1							1
TOTAL	30	25	21	18	12	8	5	4	123

cinus orca Linnaeus, 1758 had only one single confirmed report (Table 2). As we found a high number of manatee references, only the most relevant reports about their presence or mortality were mentioned. Fig. 2 shows the species confirmed in different localities of the study area. Cancún and Xcalak are the localities where the most species have been reported, with eight and seven species respectively. A total of 18 confirmed species (one extinct) in the Mexican Caribbean are listed (Table 2).

Order CARNIVORA

Family MUSTELIDAE Fisher, 1817

***Lontra longicaudis annectens* Major, 1897**

In Quintana Roo (the mainland portion of the Mexican Caribbean), reports on Neotropical otters were not confirmed until last decade (Gallo-Reynoso, 1997). Lately, research has confirmed the presence of the species in the southern part of the state. The Neotropical otter is distributed along the Hondo River and some parts of Chetumal Bay, including creeks flowing into both bodies of water (Morales-Vela & Olivera-Gómez, 1994a; Orozco-Meyer, 1998; Calmé & Sanvicente, 2009). An otter skin from the Hondo River collected in February 1996 is maintained in the mammal collection at ECOSUR (ECO-CH-M). There are no reports of otters in the central and northern regions of the state.

Family PHOCIDAE Gray, 1821

***Monachus tropicalis* (Gray, 1850)**

The Caribbean monk seal was once abundant in the wider Caribbean; however hunting pressures led to its extinction (Villa *et al.*, 1985; Timm *et al.*, 1997; Mignucci-Giannoni & Odell, 2001; Adam & Garcia, 2003; McClenachan & Cooper, 2008). Sightings from the last century in the Mexican Caribbean were reported in Banco Chinchorro in 1957, and ~1977 (Adam & Garcia, 2003). The Smithsonian Institution National Museum of Natural History (USNM) reported five monk seal specimens in their archives collected from the Yucatan Peninsula, unfortunately they do not know the precise location where of collection and it is possible they were found outside of our study area.

Order CETACEA

Family DELPHINIDAE Gray, 1821

***Globicephala macrorhynchus* Gray, 1846**

The short-finned pilot whale is one of the most common species found stranded in the Mexican Caribbean; at least five stranding events have been documented. A stranding involving three animals occurred in 1991 north of Cozumel (Morales-Vela & Olivera-Gómez, 1993). The skulls and the remaining skeletons of these three individuals are stored in the ECO-CH-M mammal collection. The other four events consist of individual stranded animals, two in 1984 in Isla Mujeres and Isla Contoy (Morales-Vela & Olivera-Gómez, 1993; Xacur Maiza *et al.*, 1998), one in September 1989 in Xcacel (16 km north of Tulum) (Navarro *et al.*, 1990), and a young male in April 2009 at Puerto Angel beach (8 km south of Mahahual) (García-Rivas *et al.*, 2010, 2013). Two short-finned pilot whale skulls from the Mexican Caribbean are deposited in the Marine Mammal Osteological Collection from the National University of Mexico (FCMM).

***Grampus griseus* (G. Cuvier, 1812)**

Only two confirmed reports of Risso's dolphins (*Grampus griseus*) have been documented in the Mexican Caribbean. In February 1986, two groups of Risso's dolphins (encompassing ~28 animals) were observed near Isla Blanca, south of Isla Contoy (personal observation RDPV). The second report was obtained in May 2012 when a Risso's dolphin was found dead in Cozumel (attended by author MCGR).

***Orcinus orca* (Linnaeus, 1758)**

The presence of this species in the Mexican Caribbean has been documented only once. On June 25th, 1987, a group of 6 animals was sighted east of Isla Contoy (personal observation RDPV).

***Peponocephala electra* (Gray, 1846)**

In September 2012, a melon-headed whale calf was found stranded alive on a beach near Playa del Carmen. The calf was transported to Delphinus (a local dolphinarium) where medical care was provided. The individual died two days after arrival (corroborated local news, species identified by Raúl Torres). This species seems to be very uncommon in the region; this case represents the first documented report in the Mexican Caribbean.

***Pseudorca crassidens* (Owen, 1846)**

A group of 17 animals was observed on May 21st, 1998 near Banco Chinchorro (García-Rivas, 1999b). On January 25th, 2000, one skeleton was recovered in Cancún (attended by authors MCGR/RDPV) that is now on exhibit in the Museum of Isla Contoy. On June 15th, 2003, a stranded calf was reported in Cancun (García-Rivas, 2003; Delgado Estrella *et al.*, 2004; Lenzi *et al.*, 2004). In August 2012, a group of approximately 85 individuals was spotted 18 km east of Isla Mujeres; the species was sighted in schools of *Tursiops truncatus* Montagu 1821 and *Steno bredanensis* Cuvier, 1823 (personal observation RDPV). In June 2012, a group of 37 individuals was observed near Banco Chinchorro (personal observation MCGR).

***Stenella clymene* (Gray, 1850)**

To date, there are few stranding reports for the short-snout spinner dolphin (*Stenella clymene*) in the Mexican Caribbean. In October 1991, Fertl *et al.* (2003) and De la Parra Venegas (1998) reported one stranding event on a beach near Cancun. In February 2002, a young male was found dead in Puerto Juárez, north of Cancun (Delgado Estrella *et al.*, 2004), and in November 2003 a single animal was found alive in Playa Kantenah (30 km south of Playa del Carmen) (Aguilar-Aguilar *et al.*, 2010). In March 2010, three individuals were observed in a group with 29 Atlantic spotted dolphins in Xcalak (personal observation MCGR). In February 2013, one individual stranded 25 km south of Mahahual (attended by author MCGR). The presence of this species has been also documented in Belize, close to the Mexican border (Jefferson & Curry, 2003).

***Stenella frontalis* (G. Cuvier, 1829)**

Xacur Maiza *et al.*, (1998) reported sightings at north of Isla Contoy (no date available). In 1996, a stranded female was found alive in Tulum and died eight days later (Sánchez-Okruky, 1997). Large groups up to 70 individuals of this species have been reported from 1986 to 2013, from May to September, usually east of Isla Mujeres (personal obser-

vation RDPV). In March 2010, a group of 29 individuals was sighted in Xcalak, in the company of three *Stenella clymene* and one *Tursiops truncatus* (personal observation MCGR).

***Stenella longirostris* (Gray, 1828)**

Groups of up to 15 spinner dolphins (*Stenella longirostris*) have been spotted recently (July and August 2013) in waters around 15 km east and northeast of Isla Mujeres (personal observation RDPV).

***Steno bredanensis* (G. Cuvier in Lesson, 1828)**

Rough-toothed dolphins (*Steno bredanensis*) have been sighted in groups up to 29 individuals east and northeast of Isla Mujeres from 1986 to 2013, often found in mixed groups with *Tursiops truncatus* (personal observation RDPV). In April 2001 a female rough-toothed dolphin was found in Cancun and held for 143 days in a delphinarium before her death. The animal was estimated to be 3.5 years old by tooth analysis (Delgado Estrella *et al.*, 2002). Another alive dolphin was found stranded on August 12th, 2013, in Cancun. It was rehabilitated by the staff of Dolphin Discovery (a local delphinarium) and released one month later (local news, species identified by author RDPV).

***Tursiops truncatus* (Montagu, 1821)**

The bottlenose dolphin (*Tursiops truncatus*) is probably the most common cetacean species inhabiting the Mexican Caribbean (Navarro *et al.*, 1990; De la Parra, 1989). Groups between two and 100 animals have been reported in Ascensión Bay, although smaller groups (two-12 animals) are more often observed (Navarro *et al.*, 1990). Ortega-Ortiz (1996) reported an absolute abundance of 66 dolphins in Ascensión Bay. The presence of *T. truncatus* seems to be permanent in the southern Mexican Caribbean (Zacarias-Araujo, 1992); small groups of *T. truncatus* were frequently observed from 2004 to 2013 in Xcalak and Banco Chinchorro (personal observation MCGR). On January 31st, 1999, one individual stranded in Isla Contoy (García-Rivas, 1999a), the skeleton was recovered and it is on exhibit at the Museum of Isla Contoy. Chetumal Bay is regularly visited by this species (Olivera-Gómez & Olivera-Gómez, 2002), in groups ranging between 6 and 43 individuals (personal observation CANT/DNCM in 2012). Recently, at least three cases of stranded bottlenose dolphins have been attended in Chetumal Bay: a female (185 cm, July 28th, 2010), a male (240 cm, August 18th, 2012), and a female calf (127 cm, June 1st, 2013) (attended by authors CANT/DNCM). Bottlenose dolphin skulls from the study area are stored at the Marine Mammal Osteological Collection of the National University of Mexico (FCMM). The ECO-CH-M mammal collection keeps bones of nine individuals, seven of which were collected in Chetumal Bay, while the rest came from Cancun and Espíritu Santo Bay.

Familia PHYSETERIDAE Gray, 1821

***Physeter macrocephalus* Linnaeus, 1758**

There are at least six confirmed reports of sperm whales in the Mexican Caribbean. Navarro *et al.*, (1990) reported a jaw collected in September 1987 in Espíritu Santo Bay. Additional strandings occurred in Cozumel in 1995, Isla Mujeres in 1996, and in Xcalak in 1998, 2006 (Ortega-Argueta *et al.*, 1998; Xacur Maiza *et al.*, 1998; García-Rivas, 2006) and 2013 (attended by author MCGR). The mammal collection of ECOSUR (ECO-CH-M) stores a jaw and ribs from the individual stranded in 1998 in Xcalak.

Family KOGIIDAE Gill, 1871

***Kogia breviceps* (Blainville, 1838)**

The presence of pygmy sperm whales in the Mexican Caribbean has been well documented from stranding events. Two strandings occurred in June 1996 in Cozumel, two days apart from each other (28th and 30th), (Ortega-Argueta *et al.*, 1998; Cardona-Maldonado & Mignucci-Giannoni, 1999; González Solís *et al.*, 2006). In September 1997, another pygmy sperm whale was found dead near Cancun (De la Parra Venegas, 1998; Ortega-Argueta *et al.*, 1998). A stranded female was reported alive on January 16th, 2003 in Cancun; she died 21 hours after the report (García-Rivas *et al.*, 2003). In October 2008, another dead pygmy sperm whale was found in Xcalak (attended by author MCGR).

***Kogia sima* (Owen, 1866)**

Reports of dwarf sperm whales stranded in the study area consisted of single individuals in December 1996 in Cancun (Sánchez-Okruky, 1997; Xacur Maiza *et al.*, 1998), in April 2011 (García-Rivas, 2011) and on June 14, 2012 in Xcalak (García-Rivas, 2012). One specimen of *Kogia* sp. from the study area is archived by the Smithsonian Institution National Museum of Natural History (USNM), unfortunately, the specimen has not been identified to species level, could be *K. sima* or *K. breviceps*. The specimen was collected in September 1987 south of Quintana Roo. It was also reported by Cardona-Maldonado and Mignucci-Giannoni (1999).

Family ZIPHIDAE Gray, 1850

***Mesoplodon europaeus* (Gervais, 1855)**

On May 4th, 2010, two dead Gervais' beaked whales (a male and a female) were found in Ascensión Bay (attended by author MCGR). Recently, on March 11th, 2013, a Gervais' beaked whale was found stranded in Tulum. It died a few hours later (corroborated local news, species identified by author CANT). The body was transported to Delphinus (a local delphinarium) to preserve some parts of the body.

***Ziphius cavirostris* G. Cuvier, 1823**

In April 2011, a skull and vertebra of a Cuvier's beaked whale were found on the coast, 14 km north of Mahahual (pers. comm. Raúl Díaz-Gamboa and René Calderón-Mandujano). In April 2013, a dead individual was found in Cozumel (corroborated local news, species identified by J. Urbán-R). The Marine Mammal Osteological Collection from the National University of Mexico (FCMM) reported the skull of a Cuvier's beaked whale that was collected in the Mexican Caribbean (Vázquez-Cuevas & Medrano-González, 2006). The USNM also maintains one individual of this species from Quintana Roo.

Order SIRENIA

Family TRICHECHIDAE Gill, 1872

***Trichechus manatus manatus* Linnaeus, 1758**

The Antillean manatee is probably the most common aquatic mammal present in the region; consequently, it has received considerable research effort (Gallo-Reynoso, 1983; Fuentes & Aguayo Lobo, 1989; Morales-Vela & Olivera-Gómez, 1994a, b, c, 1997; Morales-Vela *et al.*, 1996, 2000, 2002, 2003, 2008, 2011; Ortega Argueta, 1997; Morales-Vela & Medrano-González, 1999; Morales-Vela, 2000; Olivera-Gómez, 2002; Olivera-Gómez & Mellink, 2005; Castelblanco-Martínez *et al.*, 2009, 2012, 2013; Landero-Figueroa, 2010; Nourisson *et al.*, 2011).

Although the last systematic population size assessment was conducted in 1994 (Morales-Vela & Olivera-Gómez, 1994c), it is estimated that there are about 200-250 manatees in Quintana Roo (Morales-Vela *et al.*, 2011). The three most important areas of manatee abundance are: a) the coast between Tulum and Playa del Carmen, b) Ascención and Espíritu Santo bays, and c) Chetumal Bay (Morales-Vela & Olivera-Gómez, 1997). Manatees were reported in Cancun in 1998, and in Xcalak where individuals have been observed from 2007 to 2013 (personal observation MCGR). The highest concentration of manatees in the Yucatan Peninsula occurs in Chetumal Bay (Morales-Vela & Padilla-Saldivar, 2009a,b), where stranding data (1990-2010) indicated an average of two or three dead manatees per year (Morales-Vela *et al.*, 2002; Pérez-Flores *et al.*, 2010). The mammal collection ECO-CH-M maintains the bones of 49 individuals, 93% of which came from dead manatees found in Chetumal Bay and Hondo River.

DISCUSSION

Unconfirmed species in the area. Some government reports (INE-SEMARNAP, 1998, 2000) and divulgation documents (Morales Barbosa, 1993; Morales-Vela *et al.*, 2011), mention the presence of the following species in the Mexican Caribbean: *Lagenodelphis hosei* Fraser, 1956, *Delphinus delphis* Linnaeus, 1758, *Stenella attenuata* (Gray, 1846), *Megaptera novaeangliae* (Borowski, 1781), *Feresa attenuata* (Gray, 1874), *Mesoplodon densirostris* (Blainville, 1817), and *Balaenoptera physalus* (Linnaeus, 1758). Unfortunately, these documents do not specify the source of the information. These references were carefully reviewed, but no valid records for the mentioned species were found for the Mexican Caribbean. Consequently, we did not consider these documents as valid references and they were discarded from the analysis.

Additional cetacean species have been reported in the coastal area of the neighboring country of Belize: *S. attenuata* (Jefferson & Lynn, 1994), and *Balaenoptera physalus* (BERDS, 2013). Many marine mammals are known to travel great distances and to have large home ranges. For instance, manatees regularly travel between Belizean and Mexican waters (Castelblanco-Martínez *et al.*, 2013), and cetaceans are expected to do so as well. Therefore, it is very likely that species reported in Belize waters may be found in Mexican waters. Nevertheless, we do not include those species in the list because of the lack of confirmed reports in the study area. Regular systematic population censuses of the aquatic mammal community in the Mexican Caribbean and a rigorous record of stranding and sighting events are needed to confirm and update the species composition of the region, as well as to gather solid baseline information to build efficient long-term management and conservation programs in the region.

Mexican Caribbean as a separate management unit. Despite that the Mexican Caribbean has been already considered as a separate unit in the analysis of the richness and biodiversity of Mexican marine mammals (Salinas & Ladrón de Guevara, 1993), an evaluation of the research frequency in SOMEMMA meetings (Mexican Association of Marine Mastozoology specialists, acronym in Spanish) (Auriolos-Gamboa, 2009) and reviews of marine mammals in the Wider Caribbean (Ward *et al.*, 1999), the zonation of Torres *et al.* (1995) has prevailed in the aquatic mammal literature. Whereas Torres *et al.* (1995) reported 31 species for the macro-region Gulf of Mexico/Mexican Caribbean, in

the present study we confirmed the presence of only 18 species for the Mexican Caribbean area. In order to analyze population trends of aquatic mammals, and enhance the adequate management of these populations, we suggest that the “Mexican Caribbean” be considered as a separate unit from the Gulf of Mexico (Fig. 1B), as previously proposed by Ceballos *et al.* (2005). Our suggestion about the use of this area, is representative only for the Mexican Caribbean; differences between areas 1 and 3 proposed by both authors (Torres *et al.*, 1995; Ceballos *et al.*, 2005) were not evaluated in the present study.

Biogeographically, the Caribbean Sea is defined as a semi-enclosed basin in the western Atlantic Ocean, bounded by the coasts of Central and South America and by the Antilles island chain, representing a major hotspot of marine biodiversity worldwide (Miloslavich *et al.*, 2010). The Mexican Caribbean is classified as part of the “Yucatan Channel” region (Alvera-Azcárate *et al.*, 2009), and has been catalogued as one of the Mexican marine provinces/eco-regions, recognized by the “Mexican National Commission for Knowledge and Use of Biodiversity (CONABIO)” and the Commission for Environmental Cooperation of North America” (Lara-Lara *et al.*, 2008).

Separating the Mexican Caribbean from the Gulf of Mexico has tremendous implications in conservation management plans for the species. For example, for the management of the Antillean manatee, the Mexican government has divided their distribution area into three zones, one of which is “Región 1/Mar Caribe” that includes the Mexican Caribbean and the coastal zone of Yucatan state (SEMARNAT, 2001). Additionally, there are other practical reasons to consider the Mexican Caribbean as a separate unit. For instance, there is evidence of two genetic clusters of manatees in Mexico, one in the Gulf of Mexico and the other in the Caribbean Sea (Nourisson *et al.*, 2011). Similar genetic separation might be present in other species in the region such as *T. truncatus*. Sellas *et al.* (2005) reported strong genetic divergence among bottlenose dolphins in the United States portion of the Gulf of Mexico, indicating this species presents semi-isolated populations. Worldwide, bottlenose dolphins in particular present multiple ecotypes/populations in the same geographic area (Fernández *et al.*, 2011).

ACKNOWLEDGEMENTS

Special thanks to A. Nuñez-Garduño, G. E. Magaña-Cota, M. Briones-Salas, J. P. Gallo-Reynoso, H. A. Garza-Torres, J. C. Santos, J. Ramírez-Pulido, R. de la Riva Hernández, M. Briones-Salas, O. G. Retana, E. Arellano, A. F. Guzmán-Camacho, F. X. González-Cózatl, L. Medrano-González, E. Escobedo-Cabrera, Daniela C. Kalthoff, Phil Unitt, and Chris Conroy for valuable information about the specimens in collections. We also thank V. Hernández, J. López G. and J. Pérez-Flores from the Chetumal Bay and Hondo River Aquatic Mammal Stranding Network, and the staff of the Mexican Caribbean Marine Mammal Stranding Network, for their generous participation during stranding events. Thanks to R. Torres and Delphinus communication-team for information about *P. electra*, and R. Díaz-Gamboa, R. Calderón-Mandujano, G. Poot-López, G. Cárdenas-Hinojosa, J. Urbán-Ramírez and F. Elorriaga-Verplancken for providing data and/or identification of specimens of *Z. cavirostris*, *M. europaeus* and *S. bredanensis*. This manuscript benefited from commentaries of W. McFee, R. Wells, and one anonymous reviewer. Thanks to M. F. Baron and E. A. Ramos for the English revision.

REFERENCES

- ADAM, P. J. & G. G. GARCÍA. 2003. New Information on the Natural History, Distribution, and Skull Size of the Extinct, West Indian Monk Seal, *Monachus tropicalis*. *Marine Mammal Science* 19: 297-317.
- AGUILAR-AGUILAR, R., A. DELGADO-ESTRELLA & R. G. MORENO-NAVARRETE. 2010. New host report for nematodes in a stranded short-snouted spinner dolphin *Stenella clymene* (Cetacea: Delphinidae) from the Mexican Caribbean coast. *Helminthologia* 47: 136-138.
- ALVERA-AZCÁRATE, A., A. BARTH & R. H. WEISBERG. 2009. The Surface Circulation of the Caribbean Sea and the Gulf of Mexico as Inferred from Satellite Altimetry. *Journal of Physical Oceanography* 39: 640-657.
- AMNH (American Museum of Natural History). 2013. American Museum of Natural History. Available online at: <http://entheros.amnh.org/db/emuwebamnh/Query.php>. Downloaded at: 15 September 2013.
- AURIOLAS-GAMBOA, D. 2009. Mamíferos marinos. In: Ramírez Pulido, J. (Ed.). *COSMOS Enciclopedia de las Ciencias y Tecnología de México*. Consejo Nacional de Ciencia y Tecnología, Universidad Autónoma Metropolitana, Instituto de Ciencia y Tecnología del Distrito Federal. pp. 241-262.
- BEARZI, G., D. HOLCER & G. NOTARBARTOLO DI SCIARA. 2004. The role of historical dolphin takes and habitat degradation in shaping the present status of northern Adriatic cetaceans. *Aquatic Conservation: Marine and Freshwater Ecosystems* 14: 363-379.
- BERDS (Biodiversity and Environmental Resource Data System). 2013. Biodiversity and Environmental Resource Data System of Belize. Available at: <http://www.biodiversity.bz/find/species/checklists/>. Downloaded at: 15 September 2013.
- BIOCASE (Biological Collection access Service for Europe). 2013. Biological Collection access Service for Europe. Available online at: search.biocase.org/. Downloaded at: 15 September 2013.
- BOWEN, W. 1997. Role of marine mammals in aquatic ecosystems. *Marine Ecology Progress Series* 158: 267-274.
- CALAMBOKIDIS, J. & J. BARLOW. 2004. Abundance of blue and humpback whales in the Eastern North Pacific estimated by capture-recapture and line-transect methods. *Marine Mammal Science* 20: 63-85.
- CALMÉ, S. & M. SANVICENTE. 2009. Distribución, uso de hábitat y amenazas para la nutria neotropical (*Lontra longicaudis annectens*): un enfoque etnozoológico. In: Espinoza Avalos J., I. Islebe & H. Hernández Arana (Eds.). *El sistema ecológico de la Bahía de Chetumal, costa del Caribe mexicano*. El Colegio de la Frontera Sur. Chetumal, Quintana Roo, México. pp. 124-130.
- CARDONA-MALDONADO, M. A. & A. A. MIGNUCCI-GIANNONI. 1999. Pygmy and dwarf sperm whales in Puerto Rico and the Virgin Islands, with a review of *Kogia* in the Caribbean. *Caribbean Journal of Science* 35: 29-37.
- CASTELBLANCO-MARTÍNEZ, D. N., E. BARBA, J. J. SCHMITTER-SOTO, H. A. HERNÁNDEZ-ARANA, & B. MORALES-VELA. 2012. The trophic role of the endangered Caribbean manatee *Trichechus manatus* in an estuary with low abundance of seagrass. *Estuaries and Coasts* 35: 60-77.
- CASTELBLANCO-MARTÍNEZ, D. N., B. MORALES-VELA, H. A. HERNÁNDEZ-ARANA, & J. PADILLA-SALDÍVAR. 2009. Diet of the manatees (*Trichechus manatus manatus*) in Chetumal Bay, Mexico. *Latin American Journal of Aquatic Mammals* 7: 39-46.
- CASTELBLANCO-MARTÍNEZ, D. N., J. PADILLA-SALDÍVAR, H. A. HERNÁNDEZ-ARANA, D. H. SLONE, J. P. REID, & B. MORALES-VELA. 2013. Movement patterns of Antillean manatees in Chetumal Bay (Mexico) and coastal Belize: A challenge for regional conservation. *Marine Mammal Science* 29: E166-E182.
- CEBALLOS, G., J. ARROYO-CABRALES, R. MEDELLÍN, L. MEDRANO-GONZÁLEZ & O. GISSELE. 2005. Diversidad y Conservación de los Mamíferos Marinos en México. In: Ceballos G. & O. Giselle (Eds.), *Los mamíferos silvestres de México*. México, D.F. FCE- CONABIO. pp. 41-66.
- DE LA PARRA VENEGAS, R. 1989. Notas sobre la observación de Odontocetos al Este de Cancún, Quintana Roo. Proceedings of the XIV Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 25.
- DE LA PARRA VENEGAS, R. 1998. Registros de dos varamientos: *Stenella clymene* y *Kogia breviceps* en la costa de Cancún, Quintana Roo. Proceedings of the XXIII Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 15.
- DELGADO ESTRELLA, A., L. IBARRA, A. ROMERO-TENORIO & A. DE LA TORRE. 2004. Varamiento de una hembra de delfín clymene *Stenella clymene* y una cría de Falsa Orca *Pseudorca crassidens*, en la Costa de Quintana Roo, México. Notas sobre la Biología reproductiva y salud. Proceedings of the XXIX Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 45.
- DELGADO ESTRELLA, A., A. ROMERO-TENORIO, L. IBARRA-VARGAS & R. TORRES-SALCEDO. 2002. Rescate y rehabilitación de una hembra varada de delfín de dientes rugosos, *Steno bredanensis*, varada en la costa de Cancún, Quintana Roo. Proceedings of the XXVII Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 26.
- FERNÁNDEZ, R., S. GARCÍA-TISCAR, M. B. SANTOS, A. LÓPEZ, J. A. MARTÍNEZ-CEDEIRA, J. NEWTON & G. J. PIERCE. 2011. Stable isotope analysis in two sympatric populations of bottlenose dolphins *Tursiops truncatus*: evidence of resource partitioning? *Marine Biology* 158: 1043-1055.
- FERTL, D., T. A. JEFFERSON, I. B. MORENO, A. N. ZERBINI & K. D. MULLIN. 2003. Distribution of the Clymene dolphin *Stenella clymene*. *Mammal Review* 33: 253-271.
- FLMNH (Florida Museum of Natural History). 2013. Florida Museum of Natural History. Available online at: <http://www.flmnh.ufl.edu/collections/databases/>. Downloaded at: 15 September 2013.
- FUENTES, A. & A. AGUAYO LOBO. 1989. La Distribución del Manatí *Trichechus manatus* en el Estado de Quintana Roo. Proceedings of the VI Simposio de Fauna Silvestre. Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México. pp. 464-474.
- GALLO-REYNOSO, J. P. 1983. Notas sobre la distribución del manatí (*Trichechus manatus*) en las costas de Quintana Roo. *Anales del Instituto*

- de Biología, Serie Zoología. Universidad Nacional Autónoma de México 53: 443-448.
- GALLO-REYNOSO, J. P. 1997. Situación y distribución de las nutrias en México, con énfasis en *Lontra longicaudis annectens Major*. *Revista Mexicana de Mastozoología* 2: 10-32.
- GARCÍA-RIVAS, M. DEL C. 1999a. Informe técnico del varamiento de un tursión *Tursiops truncatus* en Isla Contoy. Informe Técnico CONANP, Región Península de Yucatán y Caribe Mexicano, México. Comisión Nacional de Áreas Naturales Protegidas. 1 p.
- GARCÍA-RIVAS, M. DEL C. 1999b. Registro de nado con Orcas falsas *Pseudorca crassidens* en el Caribe Mexicano. Proceedings of the XXIV Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 56.
- GARCÍA-RIVAS, M. DEL C. 2003. Informe técnico del varamiento de una cría hembra de *Pseudorca crassidens* en Cancún. Informe Técnico CONANP, Región Península de Yucatán y Caribe Mexicano México. Comisión Nacional de Áreas Naturales Protegidas. 5 p.
- GARCÍA-RIVAS, M. DEL C. 2006. Informe técnico del varamiento de ejemplar de cachalote *Physeter macrocephalus* en el Parque Nacional Arrecifes de Xcalak. Informe Técnico CONANP, PNAX Región Península de Yucatán y Caribe Mexicano México. Comisión Nacional de Áreas Naturales Protegidas. 2 p.
- GARCÍA-RIVAS, M. DEL C. 2011. Informe técnico del varamiento de ejemplar de cachalote *Kogia simus* en el Parque Nacional Arrecifes de Xcalak. Informe Técnico CONANP, PNAX Región Península de Yucatán y Caribe Mexicano México. Comisión Nacional de Áreas Naturales Protegidas. 2 p.
- GARCÍA-RIVAS, M. DEL C. 2012. Informe técnico del varamiento de ejemplar de cachalote *Kogia simus* en el Parque Nacional Arrecifes de Xcalak. Informe Técnico CONANP, PNAX Región Península de Yucatán y Caribe Mexicano México. Comisión Nacional de Áreas Naturales Protegidas. 2 p.
- GARCÍA-RIVAS, M. DEL C., J. PÉREZ, F. AMEZCUA, F. LEÓN & J. J. SCHMITTER-SOTO. 2010. Varamiento de un macho joven de calderón de aletas cortas, bufeo, o ballena piloto *Globicephala macrorhynchus* en Mahahual, Q Roo. Proceedings of the XXIII Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 29.
- GARCÍA-RIVAS, M. DEL C., R. DE LA PARRA VENEGAS & R. AGUILAR-AGUILAR. 2003. Varamiento de una hembra adulta de cachalote pigmeo *Kogia breviceps* en Cancún Quintana Roo. Proceedings of the XXIV Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 49.
- GARCÍA-RIVAS, M. DEL C., J. J. SCHMITTER-SOTO & J. PÉREZ-FLORES. 2013. Fatal predation of oilfish, *Ruvettus pretiosus* (Gempylidae), by a young short-finned pilot whale, *Globicephala macrorhynchus* (Delphinidae). *Research Journal of the Costa Rican Distance Education University* 5: 1-3.
- GONZÁLEZ SOLÍS, D., V. M. VIDAL-MARTÍNEZ, D. M. ANTOCHIW-ALONSO & A. ORTEGA-ARGUETA. 2006. Anisakid nematodes from stranded pygmy sperm whales, *Kogia breviceps* (Kogiidae), in three localities of the Yucatan Peninsula, Mexico. *The Journal of parasitology* 92: 1120-1122.
- GUERRERO RUÍZ, M., J. URBÁN R. & L. ROJAS BRACHO. 2006. *Las ballenas del Golfo de California. México*. Secretaría de Medio Ambiente y Recursos Naturales: Instituto Nacional de Ecología. 537 p.
- HSU. 2013. Vertebrate Museum of Humboldt University. Available online at: <http://www.humboldt.edu/vmuseum/database.html>. Downloaded at: 15 September 2013
- INE-SEMARNAP (Instituto Nacional de Ecología/Secretaría de Medio Ambiente y Recursos Naturales). 1998. Programa de manejo del Parque Marino Nacional Costa Occidental de Isla Mujeres, Punta Cancún y Punta Nizuc. México, D.F. Instituto Nacional de Ecología. 161 p.
- INE-SEMARNAP (Instituto Nacional de Ecología/Secretaría de Medio Ambiente y Recursos Naturales). 2000. Programa de manejo Parque Nacional Arrecife de Puerto Morelos. México, D.F. Instituto Nacional de Ecología. 224 p.
- JEFFERSON, T. A. & B. E. CURRY. 2003. *Stenella clymene*. Mammalian Species 726: 1-5.
- JEFFERSON, T. A. & S. K. LYNN. 1994. Marine mammal sightings in the Caribbean Sea and Gulf of Mexico, summer 1991. *Caribbean Journal of Science* 30: 83-89.
- LANDERO-FIGUEROA, M. 2010. Distribución potencial del manatí (*Trichechus manatus manatus*) en Bahía de la Ascensión, Quintana Roo. M.Sc Thesis. Instituto Politécnico Nacional. 86 p.
- LARA-LARA, J. R., V. ARENAS FUENTES, C. BAZÁN GUZMÁN, V. DÍAZ CASTAÑEDA, E. E. BRIONES, M. D. L. C. G. ABAD, G. G. CASTRO, G. R. JARERO, R. S. ÁVALOS, L. A. S. GONZÁLEZ, M. TAPIA GARCÍA & J. E. VALDEZ-HOLGUÍN. 2008. Los ecosistemas marinos. In: CONABIO (Comisión Nacional Para el Conocimiento y uso de la Biodiversidad) (Ed.). *Los ecosistemas marinos, en Capital natural de México, vol. I: Conocimiento actual de la biodiversidad*. CONABIO, México, pp. 135-159.
- LENZI, R., M. SÁNCHEZ-O, W. SHELLY, A. CORTÉZ & S. NOVOA. 2004. Primer reporte de varamiento de una cría de orca falsa: un intento de Rehabilitación. Proceedings of the XXIX Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 70.
- LÓPEZ-WILCHIS. R. 2003. Base de datos de los mamíferos de México depositados en colecciones de Estados Unidos y Canadá. Universidad Autónoma Metropolitana-Iztapalapa. Available online at: <http://investigacion.izt.uam.mx/mamiferos/>. Downloaded at: 16 September 2013.
- McCLENACHAN, L. & A. B. COOPER. 2008. Extinction rate, historical population structure and ecological role of the Caribbean monk seal. Proceedings The Royal Society. *Biological sciences* 275: 1351-1358.
- MIGNUCCI-GIANNONI, A. A. & D. K. ODELL. 2001. Tropical and subtropical records of hooded seals (*Cystophora Cristata*) dispel the myth of extant Caribbean monk seals (*Monachus tropicalis*). *Bulletin of Marine Science* 68: 47-58.
- MILOSLAVICH, P., J. M. DÍAZ, E. KLEIN, J. J. ALVARADO, C. DÍAZ, J. GOBIN, E. ESCOBAR-BRIONES, J. J. CRUZ-MOTTA, E. WEIL, J. CORTÉS, A. C. BASTIDAS, R. ROBERTSON, F. ZAPATA, A. MARTÍN, J. CASTILLO, A. KAZANDJIAN & M. ORTIZ. 2010. Marine Biodiversity in the Caribbean: Regional Estimates and Distribution Patterns. *PLoS ONE* 5: e11916.

- MORALES BARBOSA, J. 1993. El mar y sus recursos. *In: Introducción a los Ecosistemas de la Península de Yucatán*. México. Amigos de Sian Ka'an. Quintana Roo. 90 p.
- MORALES-VELA, B. 2000. Distribución, abundancia y uso de hábitat por el manatí en Quintana Roo y Belice, con observaciones sobre su biología en la Bahía de Chetumal, México. Tesis doctoral. Universidad Nacional Autónoma de México, 143 p.
- MORALES-VELA, B. & L. MEDRANO-GONZÁLEZ. 1999. *Variación genética del manatí (Trichechus manatus), en el sureste de México y monitoreo con radio-transmisores en Quintana Roo*. Informe final del proyecto H164. México, D.F. SNIB-CONABIO. 86 p.
- MORALES-VELA, B., D. OLIVERA-GÓMEZ, J. E. REYNOLDS III & G. B. RATHBUN. 2000. Distribution and habitat use by manatees (*Trichechus manatus manatus*) in Belize and Chetumal Bay, Mexico. *Biological Conservation* 95: 67–75.
- MORALES-VELA, B. & L. D. OLIVERA-GÓMEZ. 1993. Varamiento de calderones *Globicephala macrorhynchus* (Cetacea: Delphinidae) en la Isla de Cozumel, Quintana Roo, México. *Anales del Instituto de Biología serie Zoología* 64 177–180.
- MORALES-VELA, B. & L. D. OLIVERA-GÓMEZ. 1994a. Mamíferos acuáticos y su protección en la zona fronteriza México-Belice. *In: Suárez-Morales, E. (Ed.). Estudio integral de la frontera México Belice: recursos naturales*. CIQRO. Chetumal, Quintana Roo, México. Volume 4, pp. 197–211.
- MORALES-VELA, B. & L. D. OLIVERA-GÓMEZ. 1994b. Distribución y abundancia del manatí en la reserva de la biosfera de Sian Ka'an, Quintana Roo, México (1992-1994). Sian Ka'an Serie documentos 2, pp. 55–59.
- MORALES-VELA, B. & L. D. OLIVERA-GÓMEZ. 1994c. Distribución espacial y estimación de la población de los manatíes en la Bahía de Chetumal, Quintana Roo, México. *Revista de investigación científica* 2: 27–52.
- MORALES-VELA, B. & L. D. OLIVERA-GÓMEZ. 1997. Distribución del Manatí (*Trichechus manatus*) en la costa norte y centro-norte del estado de Quintana Roo, México. *Anales del Instituto de Biología serie Zoología, Universidad Nacional Autónoma de México* 68: 153–167.
- MORALES-VELA, B., L. D. OLIVERA-GÓMEZ, & P. RAMÍREZ. 1996. Conservación de los manatíes en la región del Caribe de México y Belice. Informe anual para el Consejo Nacional de Ciencia y Tecnología MM-01. MM-01. Centro de Investigaciones de Quintana Roo. Quintana Roo, México. 131 p.
- MORALES-VELA, B. & J. A. PADILLA-SALDIVAR. 2009a. Demografía, ecología y salud de la población de manatíes (*Trichechus manatus manatus*) en Quintana Roo, y su variación y representación genética en México. Informe Técnico Final. Proyecto SEMARNAT/CONACYT 2002-C01-1128. El Colegio de la Frontera Sur. Chetumal, Quintana Roo, México. 259 p.
- MORALES-VELA, B. & J. A. PADILLA-SALDIVAR. 2009b. Aspectos biológicos de los manatíes en el sur de Quintana Roo. *In: Espinoza-Ávalos J., Islebe G. A., & H. Hernández-Arana (Eds.). El sistema ecológico de la bahía de Chetumal/Corozal: costa occidental del Mar Caribe*. El Colegio de la Frontera Sur. Chetumal, Quintana Roo. pp. 115–123.
- MORALES-VELA, B., J. A. PADILLA-SALDIVAR, & D. M. A. ANTOCHIW. 2011. Mamíferos marinos. *In: Pozo, C., N. Armijo-Canto & S. Calmé (Eds.), Riqueza Biológica de Quintana Roo. Un análisis para su conservación*. El Colegio de la Frontera Sur, Comisión Nacional para el Conocimiento y uso de la Biodiversidad, Gobierno del Estado de Quintana Roo. México, D.F. pp. 223–236.
- MORALES-VELA, B., J. A. PADILLA-SALDIVAR, & M. SANVICENTE-LÓPEZ. 2002. Mortandad de manatíes en la Bahía de Chetumal y riesgos actuales. *In: Rosado-May, F., R. Romero-Mayo & A. De Jesús Navarrete (Eds.), Contribuciones de la ciencia al manejo costero integrado de la Bahía de Chetumal y su área de influencia*. Universidad de Quintana. Chetumal, Quintana Roo, México. pp. 67–72.
- MORALES-VELA, B., J. A. PADILLA-SALDIVAR & A. A. MIGNUCCI-GIANNONI. 2003. Status of the manatee (*Trichechus manatus*) along the northern and western coasts of the Yucatan Peninsula, Mexico. *Caribbean Journal of Science* 39: 42–49.
- MORALES-VELA, B., E. SUÁREZ-MORALES, J. A. PADILLA-SALDIVAR & R. W. HEARD. 2008. The tanaid *Hexapleomera robusta* (Crustacea: Peracarida) from the Caribbean manatee, with comments on other crustacean epibionts. *Journal of the Marine Biological Association of the United Kingdom* 88: 591–596.
- MVZ (Museum of Vertebrate Zoology). 2013. University of California, Berkeley. Available online at: arctos.database.museum/SpecimenSearch.cfm?collection_id=28. Downloaded at: 13 September 2013
- NAVARRO, D., A. JIMENEZ & J. JUÁREZ. 1990. Los mamíferos de Quintana Roo. *In: D. Navarro-López & J.G. Robinson (Eds.). Diversidad Biológica en la Biosfera de Sian ka'an Quintana Roo*, Centro de Investigaciones de Quintana Roo/University of Florida. México. Chetumal, Quintana Roo, México. pp. 371–450.
- NHMUK (Natural History Museum United Kingdom) . 2013. The Natural History museum. Available online at: <http://www.nhm.ac.uk/research-curation/scientific-resources/collections/zoological-collections/zoology-specimen-database/>. Downloaded at: 15 September 2013.
- NOURISSON, C., B. MORALES-VELA, J. A. PADILLA-SALDIVAR, K. P. TUCKER, A. CLARK, L. D. OLIVERA-GÓMEZ, R. BONDE & P. MCGUIRE. 2011. Evidence of two genetic clusters of manatees with low genetic diversity in Mexico and implications for their conservation. *Genetica* 139: 833–842.
- NRSL (Natural Science Research Laboratory). 2013. Museum of Texas Tech University. Available online at: <http://www.nsrll.ttu.edu/search/>. Downloaded at: 15 September 2013.
- OLIVERA-GÓMEZ, L. D. 2002. Asociación entre características del hábitat y la distribución y abundancia del manatí antillano (*Trichechus manatus manatus*) en el norte de la bahía de Chetumal. *In: Rosado-May, F., R. Romero & A. D. J. Navarrete (Eds.). Contribuciones de la ciencia al manejo costero integrado de la bahía de Chetumal y su área de influencia*. Universidad de Quintana Roo, Quintana Roo, México. pp. 61–66.
- OLIVERA-GÓMEZ, L. D. & E. MELLINK BIJTEL. 2005. Distribution of the Antillean manatee (*Trichechus manatus manatus*) as a function of habitat characteristics, in Bahía de Chetumal, Mexico. *Biological Conservation* 121: 127–133.
- OLIVERA-GÓMEZ, L. D. & A. OLIVERA-GÓMEZ. 2002. Ocurrencia del delfín *Tursiops truncatus* en la Bahía de Chetumal, Quintana Roo, México.

- Proceedings of the XXVII Reunión Internacional para el Estudio de los Mamíferos Marinos. p. 57.
- OROZCO-MEYER, A. 1998. Tendencia de la distribución y abundancia de la nutria de río (*Lontra longicaudis annectens* Major, 1897), en la ribera del Río Hondo, Quintana Roo, México. Tesis de licenciatura. Instituto Tecnológico de Chetumal. 36 p.
- ORTEGA ARGUETA, A. 1997. Uso actual de caletas y cenotes por el manatí del Caribe *Trichechus manatus manatus* (Linnaeus, 1758) y el impacto del turismo en Quintana Roo, México. Tesis de maestría. Universidad Veracruzana. 87 p.
- ORTEGA-ARGUETA, A., B. MORALES-VELA & L. D. OLIVERA-GÓMEZ. 1998. Registros recientes de varamientos de Physeteridos (Mammalia: Cetacea) en Quintana Roo, México. Proceedings of the XXIII Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 42.
- ORTEGA-ORTIZ, J. 1996. Abundancia de las toninas (*Tursiops truncatus*) en la Bahía de Ascensión, Quintana Roo, México. Proceedings of the XXI Reunión Internacional para el Estudio de los Mamíferos Marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 6.
- OUMNH. 2013. The Oxford University Museum of Natural History. Available online at: <http://www.oum.ox.ac.uk/database/zoology/mammals.htm>. Downloaded at: 15 September 2013.
- PÉREZ-FLORES, J., B. MORALES-VELA & J. A. PADILLA-SALDIVAR. 2010. Análisis de la mortalidad de manatíes en la Bahía de Chetumal (1990-2010). Proceedings of the XXXII Reunión Internacional para el Estudio de los Mamíferos Marinos: Indicadores de Salud del Ecosistema Marino. p. 109.
- PERRIN, W. F., B. G. WÜRSIG & J. G. M. THEWISSEN. 2009. Encyclopedia of marine mammals. London. Academic. 1473 p.
- SALINAS, M. & P. LADRÓN DE GUEVARA. 1993. Riqueza y diversidad de los mamíferos marinos. *Ciencias* 7: 85–93.
- SÁNCHEZ-OKRUCKY, R. 1997. Atención de mamíferos marinos varados en las costas de Quintana Roo. Proceedings of the XXII Reunión internacional para el estudio de los mamíferos marinos. Sociedad Mexicana para el Estudio de los Mamíferos Marinos. p. 6.
- SEMARNAT. 2001. *Proyecto de conservación, recuperación y manejo del manatí Trichechus manatus en México*. México, D.F. Secretaría del Medio Ambiente y Recursos Naturales. 51 p.
- SDNHM (San Diego Natural History Museum). 2013. San Diego Natural History Museum. Available online at: <http://www.sdnhm.org/science/birds-and-mammals/projects/mammal-atlas/database/>. Downloaded at: 15 September 2013
- TIMM, R. M., R. M. SALAZAR & A. T. PETERSON. 1997. Historical Distribution of the Extinct Tropical Seal, *Monachus tropicalis* (Carnivora: Phocidae). *Conservation Biology* 11: 549–551.
- TORRES, A., C. ESQUIVEL & G. CEBALLOS. 1995. Diversidad y conservación de los mamíferos marinos de México. *Revista Mexicana de Mastozoología* 1: 22–43.
- USNM (United States National Museum). 2013. Smithsonian Institution, National Museum of Natural History. Available online at: <http://collections.mnh.si.edu/search/>. Downloaded at: 15 September 2013
- VÁZQUEZ-CUEVAS, M. & L. MEDRANO-GONZÁLEZ. 2006. Colección osteológica de mamíferos marinos de la facultad de ciencias. In: Espinosa, E. & M. Briones (Eds.). *Colecciones mastozoológicas de México*. Universidad Nacional Autónoma de México/Asociación Mexicana de Mastozoología A.C. México, D.F. pp. 35-40.
- VILLA, B., J. GALLO & B. LEBŒUF. 1985. La foca monje *Monachus tropicalis* (Mammalia: Pinnípedia) definitivamente extinguida en México. *Anales del Instituto de Biología serie Zoológica* 56: 573–588.
- WARD, N., A. MOSCROP & C. CARLSON. 1999. Marine mammals of the wider Caribbean region: *A review of their conservation status*. Proceedings of the Fourth Meeting of the Interim Scientific and Technical Advisory Committee to the Protocol Concerning Specially Protected Areas and Wildlife in the Wider Caribbean Region. 25 p.
- XACUR MAIZA, J. Á., M. C. L. TORRES, E. V. CARLOS, L. DEL C. V. VÉLEZ & L. VILIESID. 1998. *Enciclopedia de Quintana Roo*. México, D.F. Volumes 1-8. Agregar número total de páginas
- ZACARÍAS-ARAUJO, F. 1992. Distribución espacial y temporal de *Tursiops truncatus* en la zona sur del Caribe mexicano, durante los años 1987 y 1988. Tesis de maestría.. Universidad Nacional Autónoma de México. México DF. 131 p.

Recibido: 11 de noviembre de 2013.

Aceptado: 28 de noviembre de 2014.