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First documentation of long-distance travel by a Florida manatee to the Mexican Caribbean

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West Indian manatees (*Trichechus manatus*) are separated into two allopatric subspecies: the Florida manatee (*T. m. latirostris*) and the Antillean manatee (*T. m. manatus*). In the winter of 2020–2021, an adult manatee was sighted off the coast of Cancun, Quintana Roo, Mexico, in areas where Antillean manatees are not typically seen. The individual had distinct watercraft scars on its body, which were matched using photo-identification to a known male Florida manatee (PE424) that had been repeatedly photographed in Florida since 1998. This is the first record of a Florida manatee visiting the Mexican Caribbean. Previous reports of individuals from this subspecies in Cuba, combined with genetic evidence, suggest some level of connectivity among geographically separated manatee populations.

KEY WORDS: *Trichechus manatus latirostris*, West Indian manatee, photo-identification, citizen monitoring, Quintana Roo.

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INTRODUCTION

There are two subspecies of the West Indian manatee *Trichechus manatus* (Sirenia Trichechidae): the Florida manatee (*T. m. latirostris*) and the Antillean manatee (*T. m. manatus*) (Domning & Hayek 1986). The species is considered vulnerable by the IUCN (Deutsch et al. 2008) due to the persistence of a wide array of threats, mostly of human origin. West Indian manatees are distributed in an extensive area, and therefore, international cooperation is highly desired in order to accomplish conservation and management goals. The range of the Florida manatee is primarily the Florida Peninsula, with sightings extending as far north as Massachusetts and as far west as Texas during non-winter months, while the Antillean manatee has an extended and patchy distribution from the Gulf coast of Mexico to northeastern Brazil, including the Caribbean coasts of Central and South America and the Greater Antillean islands of the Caribbean (Self-Sullivan & Mignucci-Giannoni 2008). The Florida and Antillean subspecies are distinguished by craniometric characteristics (Domning & Hayek 1986) and body shape (Johnson 2019), and there are many ecological differences between the populations, which lead to differences in behavior, habitat use, and migratory patterns.

Manatees require at least periodic access to freshwater for drinking (Ortiz et al. 1999) and feed upon riparian vegetation or seagrass beds in coastal areas; therefore, they are primarily found in relatively shallow areas close to the coast or live in fully freshwater environments. Manatees are highly susceptible to cold stress and death when water temperatures drop below 20 °C (Hardy et al. 2019). Florida manatees occupy subtropical areas and seek out warmer than ambient waters in winter months due to thermo-regulatory needs (Irvine 1983) and are known to migrate to warm-water refugia located along peninsular Florida in response to changing water temperatures (Deutsch et al. 2003). Some Florida manatees exhibit long-distance migration patterns, with median maximum range of 631 km (min–max = 586–2,360 km) (Deutsch et al. 2003). Antillean manatees, on the other hand, inhabit tropical areas in which water temperature is far above the tolerance limit at which manatees experience cold stress (Castelblanco-Martínez et al. 2013). Also, seasonal variation in primary productivity tends to be less pronounced in tropical latitudes (Lee et al. 2007). Strong currents and deep channels of the Straits of Florida, combined with lack of suitable habitats for the species in the northern Gulf of Mexico could have resulted in the geographical separation of the subspecies (Domning & Hayek 1986). Here, we present the first direct evidence of a Florida manatee traveling a long distance to the Mexican Caribbean within the range of the Antillean manatee.

METHODS

The Quintana Roo Marine Mammal Stranding Network (RVMMQROO) was created in 2015 by the Mexican environmental agency Procuraduría Federal de Medio Ambiente (PROFEPA), with the aim of providing timely and proper management of stranded marine mammals in the state of Quintana Roo. The members of the network are environmental agencies, non-governmental organizations, and academic and research groups. On 25 November 2020, the RVMMQROO was notified of the presence of an adult manatee in the north portion of the state, in an area where manatees are not typically seen. The network began closely monitoring this individual through direct observations and citizen collaboration.

Manatee colleagues from Belize, Cuba, and the United States were consulted to determine the origin of this manatee. In the United States, the photographs and videos of the animal were compared to documented individuals within the Manatee Individual Photo-identification System (MIPS) (Beck & Clark 2012). The MIPS is a cooperative effort of three main partners in the United States: the U.S. Geological Survey (USGS), the Florida Fish and Wildlife Conservation Commission (FWC), and Mote Marine Laboratory (MML) (Rood et al. 2012). The system uses the photo-documentation of scars, mutilations, or other marks to identify individual Florida manatees (Beck & Clark 2012), and currently contains information for more than 5,000 individually identifiable manatees (unpublished MIPS data, FWC/MML/USGS). MIPS is a searchable sightings and life history database whereby newly acquired images of uniquely featured individuals are compared to individuals previously cataloged based on strict criteria (Beck & Reid 1995). Cataloged MIPS individuals' features are assigned unique codes, according to feature type, location, size, number and color. Feature codes are manually entered into a search page and the return results display representative images of cataloged individuals with matching codes, allowing the searcher to compare new images with existing ones. All potential matches are second verified by experienced MIPS staff. Photo-identification of Florida manatees has been occurring since the late 1960s (Hartman 1979; Beck & Reid 1995).

RESULTS AND DISCUSSION

Through photographs and videos obtained in Mexico, the manatee was matched to PE424, a male that was photo-documented for the first time in February 1998 by the USGS at the Florida Power & Light Company's (FPL) Port Everglades Power Plant, in Fort Lauderdale, Florida (Fig. 1). This manatee was not known to have been previously rescued or captured for health assessment or tagging purposes in Florida. It had been successfully monitored through photo-identification methods with sightings on the east coast of Florida spanning 14 years, with the last sighting in the USA recorded in Fort Pierce, Florida on 19 March 2012 (Table 1, Fig. 2) (Castelblanco-Martínez et al. 2021).

Several preliminary observations suggested that this manatee was not native to the Mexican Caribbean. The behavior of the individual was more consistent with some Florida manatees. Whereas manatees in the Caribbean are typically shy and cryptic (Castelblanco-Martínez et al. 2009; Alvarez-Alemán et al. 2016), this manatee remained close to boats and humans. The animal was also observed appearing to search for water on the marina docks and drinking from water hoses, a behavior often observed in Florida manatees (Reep & Bonde 2006). Furthermore, physical characteristics of the manatee distinguished it from other animals in the area. The manatee in question seemed to be more robust than Antillean manatees and bore a fully healed and conspicuous white, spine-shaped scar on the right dorsal trunk, and several parallel, healed cuts on its tail. Both the trunk and tail markings were indicative of sub-lethal injuries caused during encounters with watercraft, as commonly observed in Florida (Bassett et al. 2020). Although accidents with high-speed vessels are common in Belize (Castelblanco-Martínez et al. 2018), they are not a major threat to manatees in the Mexican Caribbean, with only one documented case of a manatee killed by a boat in the last 20 years (Castelblanco-Martínez et al. 2020). These preliminary observations were important clues suggesting this individual was not native to the Caribbean coasts of Mexico.

Including the 2020–2021 records, the sighting history of PE424 currently spans 23 years. In Mexico, the manatee was sighted in the coastal portion of the city of Cancun (21°10′43″N, 86°48′22″W) on 25 November 2020. It stayed in this area for

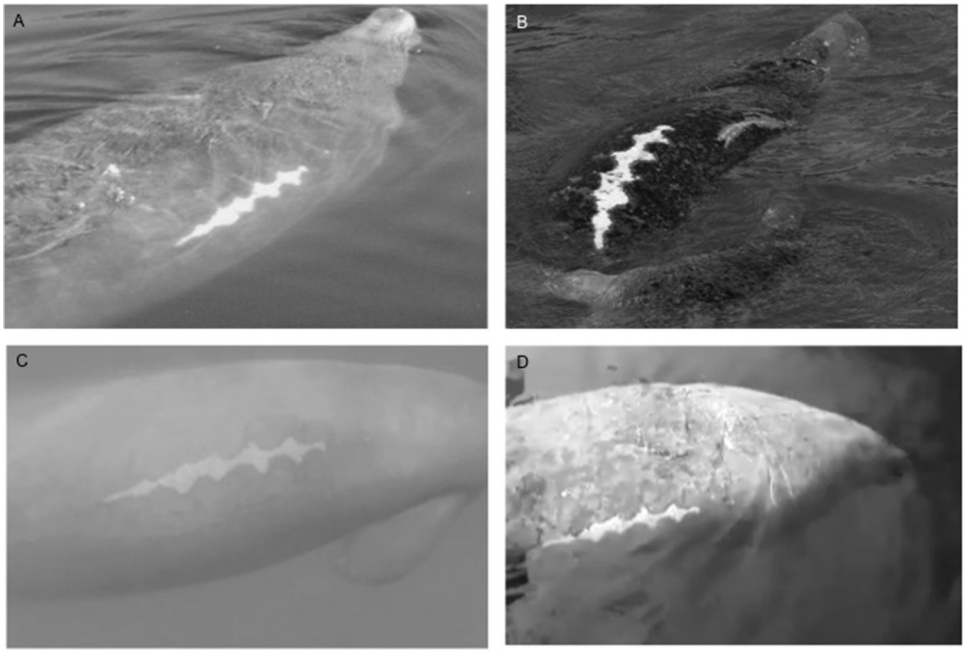

Fig. 1. — A male Florida manatee (*Trichechus manatus latirostris*), PE424, first photo-documented in the United States and recently in Mexico: (A) PE424 at Florida Power and Light, Lauderdale Plant, Fort Lauderdale, Florida, USA (8 March 2010) (photo credit: Kit Curtin, USGS); (B) PE424 at Harbor Branch Oceanographic Institute, Fort Pierce, Florida, USA (19 March 2012) (photo credit: Harbor Branch Oceanographic Institute); (C) PE424 at Puerto Juárez, Quintana Roo, Mexico (6 December 2020) (Photo credit: José Ancona, Delphinus); (D) PE424 at Isla Mujeres, Quintana Roo, Mexico (4 January 2021) (photo credit: Unknown citizen from Isla Mujeres).

approximately 2 weeks, and then moved 9.3 km North to Playa Mujeres, where it was observed on 10 and 17 December 2020. Then, the individual crossed 6.7 km of open water to Isla Mujeres where it was sighted for approximately 1 month beginning 23 December 2020. The seafloor around Isla Mujeres is relatively flat and shallow (0.5–9 m) and is rich in macroalgae and seagrasses (mainly *Thalassia testudinum*) (Mendoza-González et al. 2007).

One week after its arrival at Isla Mujeres, the manatee showed abnormal breathing behavior and poor body condition upon visual assessment. This raised concerns about its ability to find appropriate sources of food and freshwater, and furthermore, to be capable of long-distance travel back to Florida. This also suggests that the animal was not familiar with the main sources of freshwater in the area and may be naïve to the area. The animal was captured in Isla Mujeres on 26 January 2021 by members of the RVMMQROO, and radio-tagged and released in the same island on 2 February 2021. The biomedical health assessment did not reveal any illness or poor body condition (R. Sánchez-Ockrucky, Dolphin Discovery, written communication, 2021). After release, the individual came back to the mainland, southern Cancun (Location 16, Fig. 2). The locations where the individual were reported are within a

Table 1.

Historical locations of PE424 obtained by photo-identification methods.

Sighting number	Date	Locality	Country	Sighting agency
1	10 February 1998	FPL Port Everglades Power Plant, Fort Lauderdale, Florida	USA	USGS
2	9 January 2002	FPL Port Everglades Power Plant, Fort Lauderdale, Florida	USA	USGS
3	10 September 2008	Sebastian Inlet State Park, Melbourne Beach, Florida	USA	FWC
4	8 March 2010	FPL Lauderdale Plant, Fort Lauderdale, Florida	USA	USGS
5	19 March 2012	Harbor Branch Oceanographic Institute, Fort Pierce, Florida	USA	USGS
6	25 November 2020	Puerto Juarez, Cancun, Quintana Roo	MEX	RVMMQROO
7	2 December 2020	Punta Sam, Cancun, Quintana Roo	MEX	RVMMQROO
8	6 December 2020	Puerto Juarez, Cancun, Quintana Roo	MEX	RVMMQROO
9	8 December 2020	Puerto Juarez, Cancún, Quintana Roo	MEX	RVMMQROO
10	10 December 2020	Playa Mujeres, Cancun, Quintana Roo	MEX	RVMMQROO
11	17 December 2020	Playa Mujeres, Cancun, Quintana Roo	MEX	RVMMQROO
12	23 December 2020	Isla Mujeres, Quintana Roo	MEX	RVMMQROO
13	4 January 2021	Isla Mujeres, Quintana Roo	MEX	RVMMQROO
14	26 January 2021	Isla Mujeres, Quintana Roo*	MEX	RVMMQROO
15	2 February 2021	Isla Mujeres, Quintana Roo**	MEX	RVMMQROO
16	11 February 2021	Bohorquez Lagoon, Cancún, Quintana Roo	MEX	RVMMQROO

*Capture. **Release.

highly touristic area with several nautical activities such as scenic tours, sailing, yachting and diving (Perera-Valderrama et al. 2017).

The manatee was sighted between the coasts of Cancun and Isla Mujeres, a zone that includes a few transient Antillean manatees, but in general is not considered an area of high use by the subspecies (Morales-Vela & Olivera-Gómez 1997; Morales-Vela et al. 2003). Antillean manatees consistently use sheltered habitats of the major coastal lagoons and estuaries of southern Quintana Roo, specifically Chetumal Bay, Espiritu Santo Bay, Ascención Bay and Yalahau Lagoon, representing the hotspots of abundance for the species in the state (Morales-Vela et al. 2000). Insular areas of Quintana Roo such as Banco Chinchorro, Isla Mujeres, Cozumel and Isla Contoy are not traditionally used by Antillean manatees likely due to the lack of permanent or abundant sources of freshwater.

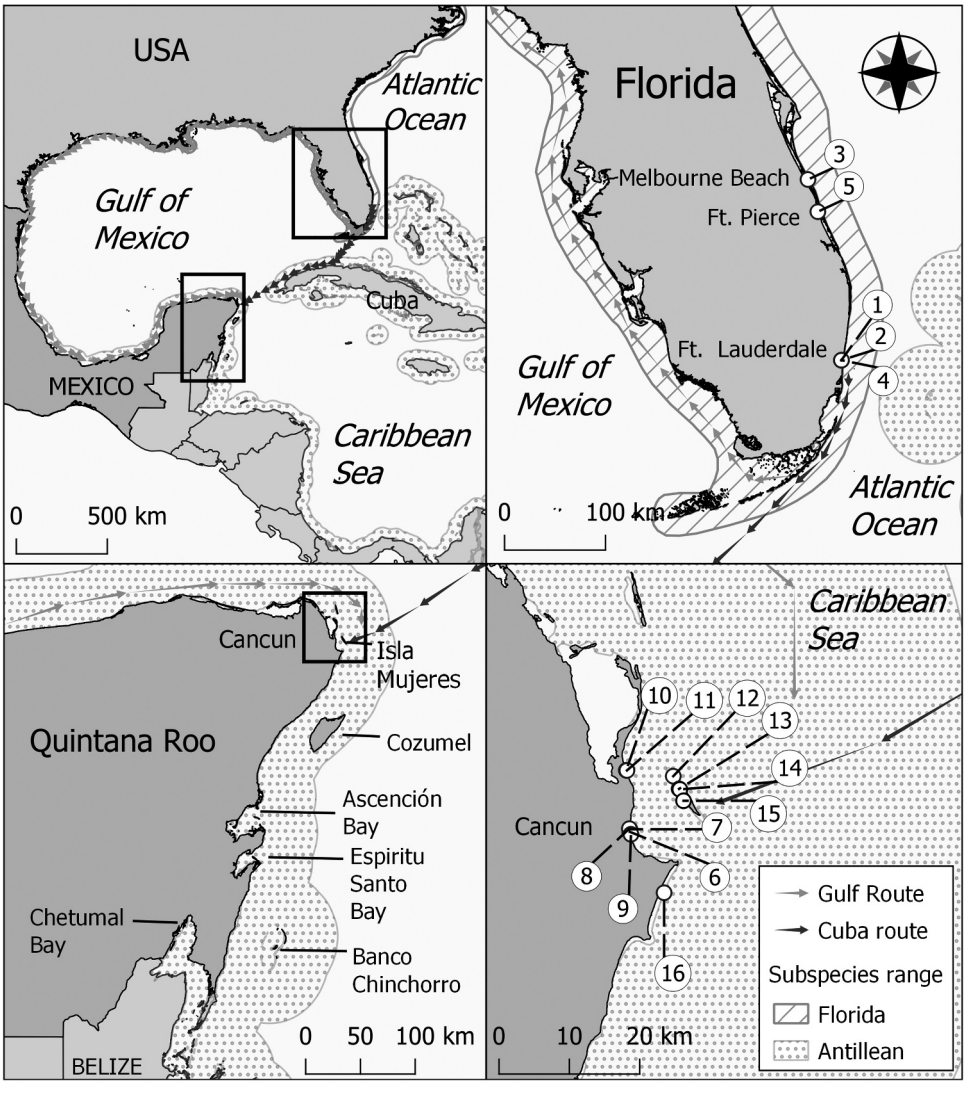

Fig. 2. — Locations of the manatee PE424 are indicated in circles. The numbers correspond to sighting number in Table 1; capture = location 14, release = location 15. Two possible routes (Gulf of Mexico or Cuba) for this manatee are displayed.

Here, we present the first evidence of a long-distance movement by a manatee from Florida to the Mexican Caribbean (minimum distance of 900 km following a direct offshore route). Outside of Florida, individuals of the Florida subspecies have been reported to venture as far north as Falmouth, Massachusetts (Deutsch et al. 2003; Beck 2006; Cummings et al. 2014) and along the Gulf of Mexico, as far west as Texas (Fertl et al. 2005). Moreover, seven manatees have been documented through photo-identification in the continental United States and then subsequently at

islands in the Caribbean (Cuba) or the North Atlantic Ocean (Bahamas) (Rood et al. 2020). Those Florida manatees reported in Cuba between 2007–2017 were identified as mother/calf pairs: (1) in 2007 a pair was sighted using a power plant canal in north Havana, Cuba (Alvarez-Alemán et al. 2010), and (2) in 2017 another mother-calf pair was photographed in a river from Havana city (Alvarez-Alemán et al. 2018). Previous telemetry tracking studies indicate that seasonal migration of Florida manatee occurs usually between winter and warm-season areas, which are separated by a median distance of 280 km (Deutsch et al. 2003). Also, the same authors reported that long-distance movements of Florida manatees (migrations over 400 km up to 2,300 km) were less frequent, with only 12% of the tagged individuals showing this movement pattern. Nonetheless, the mentioned research was conducted over 20 years ago and an updated analysis might be necessary to explore migration variations in response to changes in population density, habitat suitability and availability, and climate change.

The path that this individual (PE424) traveled to arrive in Mexico is unknown. Manatee sighting locations were input to Google Earth Pro to measure the approximate minimum travel distances undertaken by the manatee along two possible routes. Previous reports of Florida manatees observed in Cuba suggest that this animal could have traveled from the Peninsula of Florida to Cuba directly crossing the Strait of Florida and the Florida Current (Cuba route, Fig. 2). It could have remained in Cuba for a period of time before continuing its way toward the west and southwest to the Yucatan Peninsula, covering approximately 1,000 km of travel. The longest plausible route is the shoreline of the Gulf of Mexico through the USA and Mexico (Gulf route, Fig. 2), a travel distance of ~ 5,000 km in length. This presumes the animal remained largely in shallow coastal waters and traveled the short paths along both routes. However, it is also possible that it traveled some of its journey through offshore waters and that it did not take a direct route from Florida to Mexico, stopping in other locations or traveling in other directions.

The movement of a manatee from Florida to the northernmost part of the Mesoamerican Reef System (Gress et al. 2019) raises interesting questions regarding the potential demographic implications of such migrations. Although this case study is the first report of a Florida manatee observed in the Mexican Caribbean, a previous microsatellite DNA marker study found that four manatees from Chetumal Bay (southern Quintana Roo) shared a high percentage (between 59% and 76%) of remote ancestry with the Florida population (Nourisson et al. 2011). Likewise, a study of mtDNA in manatees suggests historical links between Florida and Cuba (Hernández-Martínez et al. 2013), and the Florida haplotype (A01) is present in manatees from the north coast of Puerto Rico and the Dominican Republic (Hunter et al. 2012). Nourisson et al. (2011) proposed that the genetic diversity along the Caribbean may have been influenced recently by migration from the growing manatee population in Florida. The Florida haplotype (A01), however, is absent in Belize (Hunter et al. 2010; Nourisson et al. 2011), supporting the idea that historical barriers have limited the dispersal of Florida manatees to other areas of the Greater Antilles or the Caribbean (Vianna et al. 2006).

The West Indian manatee is considered a vulnerable species, although the risk scenario is different among its subspecies (Deutsch et al. 2008). According to the IUCN, Antillean manatees are endangered (Self-Sullivan & Mignucci-Giannoni 2008), based on declining populations due to entanglement, boat collisions, poaching and habitat loss (Castelblanco-Martínez et al. 2012). Despite the increase in numbers of the Florida subspecies over the last 25 years (Fish and Wildlife Service 2017),

threats to manatee population still persist (Runge et al. 2017), and include watercraft collisions, harmful algal blooms, and warm-water habitat loss. Effective conservation of both subspecies of West Indian manatees benefits from close collaboration on an international scale to better understand manatee population dynamics. The documentation of this case of long-distance movement of a Florida manatee and previously reported cases (i.e. Alvarez-Alemán et al. 2010, 2018; Rood et al. 2020), were only possible due to data collected through long-term photo-identification efforts with Florida manatees (Beck & Reid 1995; unpublished MIPS data, FWC/MML/USGS), and through long-term research and conservation efforts in the Caribbean countries where this species is present (e.g., Mexico, Puerto Rico, and Cuba). This photo-identification monitoring effort has provided information about movements, habitat selection, site fidelity, and population dynamics of the Florida manatee (e.g. Reid et al. 1991; Kendall et al. 2004; Langtimm et al. 2004; Rood et al. 2020). The presence of the RVMMQROO at the north of Quintana Roo, in addition to productive communication among scientists, citizens and Mexican authorities were crucial to detect and monitor the manatee reported here.

In the future, the implementation of a regional photo-identification project in the Caribbean would be a low-cost, long-term strategy that could be useful to monitor manatee movements within Caribbean regions and to document any exchange of individuals from different populations. The incorporation of aerial drones as part of the protocols to collect high-resolution pictures of manatees (Landeo-Yauri et al. 2020) may help facilitate this goal.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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ETHICAL STANDARD

The study was non-invasive and complies with Mexican Law.

AUTHOR CONTRIBUTION

D.N. Castelblanco-Martínez, R. Torres, A. Alvarez-Alemán, and A.A. Mignucci-Giannoni monitored the individual through citizen science. A.L. Teague, S.L. Barton, and K.A. Rood photo-identified the individual. D.N. Castelblanco-Martínez took the lead in writing the manuscript. E. A. Ramos and D.N. Castelblanco-Martínez prepared maps and graphical material. All authors provided critical feedback during data interpretation and substantively revised the manuscript.

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