History and conservation status of the Antillean manatee *Trichechus manatus manatus* in Hispaniola

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SUPPLEMENTARY MATERIAL 1 Documentary archive search

The search for documentary archives (i.e., written, tabulated, mapped or photographic records) of manatees in Hispaniola included published and unpublished literature written in English, French and Spanish. It included rare book collections, documents not widely distributed and difficult to access (e.g., bulletins from national museums, national archaeology magazine articles, technical reports of local institutes), and personal communications with local experts in the Dominican Republic and Haiti. The documentary archives were grouped into three time periods: the pre-Columbian era 1250 BCE-1491 CE; 1492-1899 CE; and 1900-2013 CE.

The pre-Columbian era included archaeological studies (conducted in the 20th or the 21st century) in which manatee bones or bone objects were found, derived from aboriginal cultures present in Hispaniola before the arrival of Columbus in 1492. From a detailed account of archaeological explorations in the Antilles by Veloz Maggiolo (1972), an initial list of studies conducted in Hispaniola was compiled. The list was complemented with archaeological work cited by Krieger (1931), Rainey (1941), and Lefebvre et al. (2001). Additionally, volumes 1 to 5 (dating from 1971 to 1972) of the Revista Dominicana de Arqueología y Antropología (Dominican Magazine of Archaeology and Anthropology), and numbers 1 to 41 (dating from 1972 to 2007) of the Boletín del Museo del Hombre Dominicano (Bulletin of the Museum of the Dominican Man) were searched.

The 1492-1899 period included the works of chroniclers, voyagers, missionaries and settlers, during the conquest, colonization and independence of the West Indies. An initial list of documents was compiled from the references cited in Peña Linares (1981) and Durand (1983) that mentioned manatees in Hispaniola. The list was complemented with the references cited by Krieger (1930, 1931), Veloz Maggiolo (1972), Cassá (1974), and Lefevbre et al. (2001). These historical documents were searched through Duke University Libraries, the David M. Rubenstein Rare Book and Manuscript Library, the library of the Museo del Hombre Dominicano (Museum of the Dominican Man) and the following digital libraries: Internet Archive (https://archive.org/), Hathi Trust Digital Library (https://www.hathitrust.org/) and Gallica (http://gallica.bnf.fr/).

The most recent time period included any documentary archive from 1900 to 2013 that mentioned manatees in Hispaniola. Published and unpublished documents on dedicated and non-dedicated manatee studies were searched. The sources cited by Lefevbre et al. (2001), and the regional management plans for the West Indian manatee (UNEP, 1995, 2010) were reviewed. The libraries of the Centro de Investigaciones de Biología Marina (Marine Biology Research Centre) of the Universidad Autónoma de Santo Domingo (Autonomous University of Santo Domingo), the Fundación Dominicana de Estudios Marinos (Dominican Foundation of Marine Studies), the Acuario Nacional (National Aquarium) and The Nature Conservancy in the Dominican Republic were visited to collect: (a) the most recent dedicated manatee studies; (b) manatee sighting and stranding records kept by the Red Dominicana de Varamientos (Dominican Stranding Network) and the Centro de Rescate y de Rehabilitación de Especies Acuáticas (Aquatic Species Rescue and Rehabilitation Centre); (c) documents from projects that included coastal surveys where manatees were sighted. For unpublished work, local experts such as José A. Ottenwalder (a former manatee researcher in the Dominican Republic and Haiti), marine biologists from the abovementioned institutes, and staff from the Ministerio de Medio Ambiente y Recursos Naturales (Ministry of the Environment and Natural Resources) were consulted. In addition, manatee sighting sheets were collected from 2006 to 2013 from Dominican commercial pilots, divers and biologists who volunteered to contribute to this research with opportunistic sightings. For the most updated information from Haiti, the director of the NGO Fondation pour la Protection de la Biodiversité Marine (FoProBiM) (Foundation for the Protection of Marine Biodiversity), Jean Wiener, and the director of the Haiti Ocean Project, Jaime Aquino, were consulted.

For documentary archives available in digital format, Spanish, French or English variations of the words manatee, seacow, cow, bones, ivory, Hispaniola, Santo Domingo and Haiti were used to search automatically for relevant information. Otherwise, documents were fully searched to select only those referring explicitly to manatees in Hispaniola. Qualitative or quantitative estimates of manatee abundance and mortality were extracted, as well as indications of population trend, descriptions of hunting methods and uses, and lists of threats to the species and its habitat. For dedicated manatee studies, information on the survey method, survey effort and geographic extent of the study was also extracted.

Description of the documentary archives reviewed

Approximately one-third (32%) of the 152 documentary archives reviewed were historical documents predating the 1900s, consisting mainly of books and journal articles (Supplementary Table 1). The historical photographic records in Supplementary Table 1 depict carved manatee bones from a pre-Columbian archaeological site, and unworked bones from a 1720-1723 ship wreck collected during ongoing research by the Anglo Danish Maritime Archaeological Team in Monte Cristi province (ADMAT, 2015), on the northwest coast of the Dominican Republic.

SUPPLEMENTARY TABLE 1 Type and quantity of documentary archives from different time periods included in the review on Antillean manatees in Hispaniola.

Documentary archive type	1250 BCE-1491 CE	1492-1899 CE	1900-2013 CE	Total
Book	10	18	4	32
Book chapter			4	4
Journal article	16	2	9	27
Newsletter article			2	2
Newspaper article			3	3
Photograph / video	1	1	13	15
Scientific poster / abstract			5	5
Technical report			25	25
Unpublished personal communication			33	33
Unpublished report / raw data			6	6
Total	27	21	104	152

Documents from 1900 onward represented 68% of the documentary archives, but most were personal communications (e.g., telegraphs, letters and electronic mails reporting manatee sightings), technical reports of limited distribution and photographs or videos.

Most (72%) of the 116 documentary archives that provided manatee sighting records for the database described in Supplementary Material 2 were recent (Supplementary Table 2). However, 33 of the 48 historical documents (<1900s) reviewed provided manatee sighting records for the database. The remaining documents provided only general information about manatees.

SUPPLEMENTARY TABLE 2 Time period and number of documentary archives that provided only general information about manatees in Hispaniola versus manatee sighting records, n (%).

Time Period	General information	Manatee sighting records
1250 BCE-1491 CE	6 (17)	21 (18)
1492-1899 CE	9 (25)	12 (10)
1900-2013 CE	21 (58)	83 (72)
Total	36	116

SUPPLEMENTARY MATERIAL 2 Manatee sightings database and record mapping

A Microsoft Excel database of manatee sighting records in Hispaniola was created where each row represents a sighting record and each column is an attribute of the sighting. The novelty of the database is that records are scored based on time, location, evidence and overall reliability criteria as described in Supplementary Table 3.

SUPPLEMENTARY TABLE 3 Time, location, evidence and overall reliability score descriptions for manatee sighting records in Hispaniola.

Score	Description
	Time Reliability
0	An estimated time frame not obtained from the observer
5	A date stated by an interviewee occurring more than one year before an interview
10	A date stated by an interviewee occurring within a year of an interview
15	Dates formally documented by observers
	Location reliability
0	An estimated location from historical records (<1900), or sightings that could not be placed into a single coastal segment (Supplementary Fig. 2)
5	A stated place name
10	Hard copy maps
15	Digital maps
20	Geographic coordinates
	Evidence reliability
0	Historical records (<1900) and an unknown number of observers
5	Recent records (>1900) with at least one observer
10	Recent records and an observer knowledgeable about manatees or surveying for manatees
15	Recent records and two or more knowledgeable observers
20	Recent records with physical evidence such as images or bones
	Overall reliability
0-55	Time reliability + Location reliability + Evidence reliability

To avoid duplicates, a single database record was created for carved manatee bone objects and manatee sightings described in multiple documentary archives. To map sightings lacking geographic coordinates, a digital coastline of Hispaniola was used to locate the place name of the town or the coastal feature mentioned in the documentary archive. Sighting coordinates were then created at approximately 500 m from the coastline of the referenced town or coastal feature. Archaeological finds and manatee strandings were mapped on land. Hard copy maps were geo-referenced to obtain manatee sighting coordinates. Maps were created in ArcGIS 10.3.1 and projected in WGS84 UTM Zone 19 N for the Dominican Republic and Zone 18 N for Haiti.

Description of the database records

Of 889 manatee sighting records in the database, pre-Columbian records (1250 BCE-1491 CE) accounted for 3%, the 1492-1899 CE period accounted for only 1% and the 1900-2013 CE period accounted for the vast majority (96%). Pre-Columbian records were obtained from archaeological sites where manatee bones or bone objects were found. Manatee bones collected from archaeological sites show signs of cuts and fractures, evidence that carcasses were butchered to extract and transport the meat back to the aboriginal settlements while most of the heavy skeleton was left behind (Veloz Maggiolo, 1976). Another possible reason for the paucity of archaeological material is related to the social structure of the Taíno, the most advanced aboriginal culture at the time of arrival of the Europeans to Hispaniola. Ceremonial objects made of manatee bone were richly carved and detailed, and likely belonged to few individuals in positions of power in the community. Furthermore, archaeological looting is ubiquitous (Pagán Perdomo, 2000), and one can expect that such beautifully carved objects have been targeted frequently. Writers from the 1492-1899 CE period provided valuable general information about manatees; however, they rarely noted the time and location of the sightings.

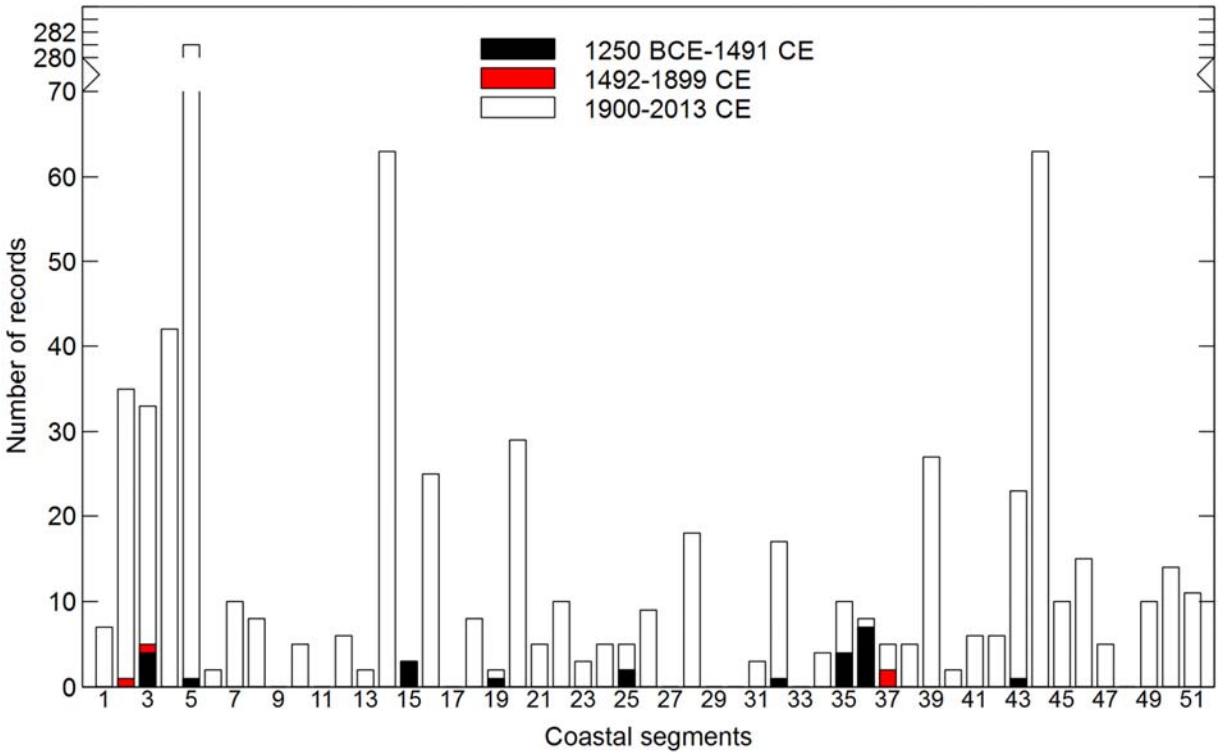
In the most recent period, a large proportion (92%) of records were from three decades: the 2000s (when most of the dedicated manatee studies were conducted) contributed 51%; the 1990s with 27%; and the 1970s with 14%. In the Dominican Republic, the coastal segments with the most sighting records were: segment 5 with 34% (due to the multiple manatee studies conducted in Caño Estero Hondo), segments 43-47 with 15% of the records, and segments 1-4 with 13% (Supplementary Fig. 1). Eight of the 51 coastal segments lacked records for any time period, but those segments were dispersed and surrounded by others that supported manatee sightings and should not be assumed unsuitable for the species without further study.

In general, database records scored high in time reliability but low in location and evidence reliability because most sightings lacked geographic coordinates and were opportunistic (i.e., recorded by observers not surveying for manatees) (Supplementary Table 4). Nevertheless, 42% of the records scored 30 or higher in overall reliability, and could be considered of high quality.

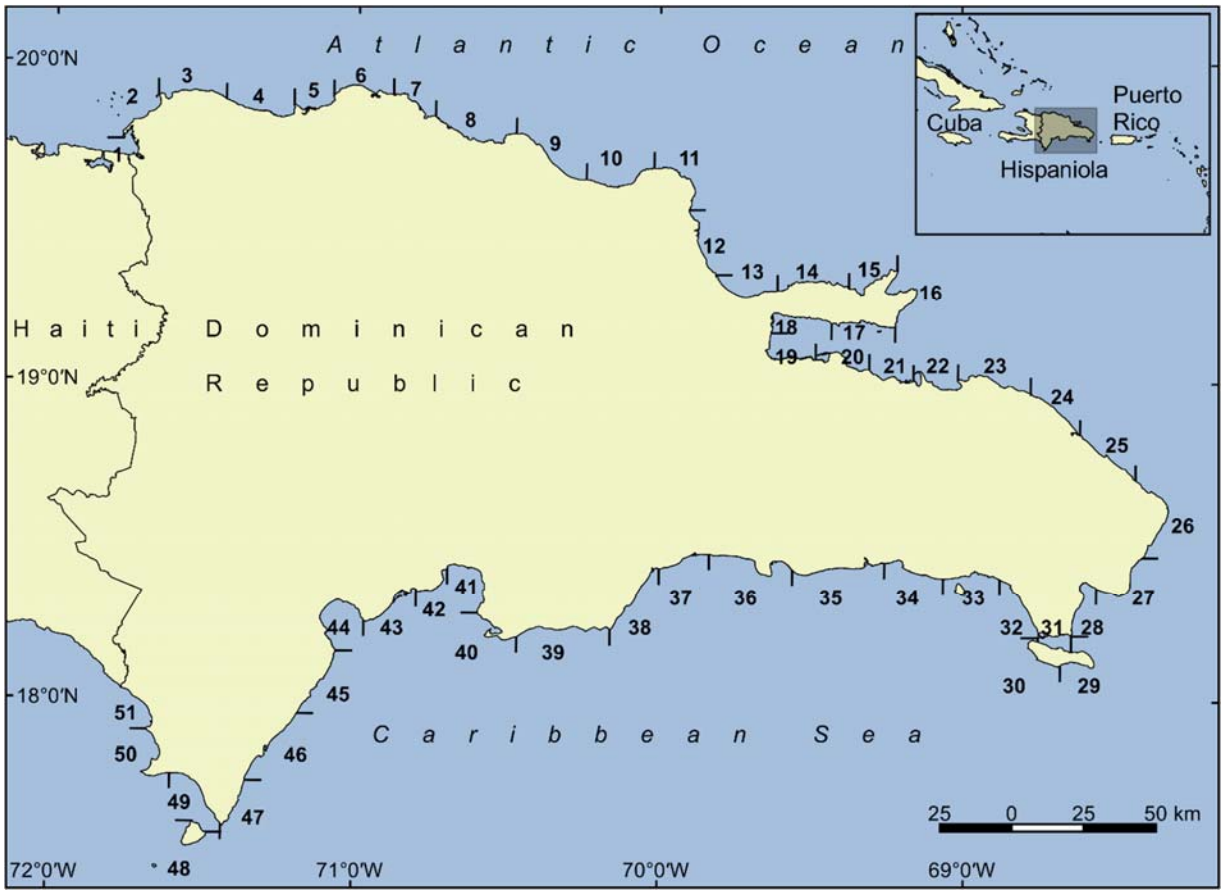
SUPPLEMENTARY TABLE 4 Time, location, evidence and overall reliability score of the Hispaniola manatee sighting database records, n (%).

Score	Time	Location	Evidence	Overall
0	38 (4)	5 (1)	9 (1)	
5	186 (21)	597 (67)	468 (53)	9 (1)
10	292 (33)	124 (14)	67 (8)	1 (0)
15	373 (42)	23 (3)	219 (25)	160 (18)
20		140 (16)	126 (14)	285 (32)
25				56 (6)
30				70 (8)
35				12 (1)
40				135 (15)
45				21 (2)
50				98 (11)
55				42 (5)
Total	889	889	889	889

SUPPLEMENTARY MATERIAL 3 Distribution of manatee sighting records in the Dominican Republic



SUPPLEMENTARY FIG. 1 Number of manatee sighting records per coastal segment of the Dominican Republic (Supplementary Fig. 2). The large number of records (281) in segment 5 is due to multiple dedicated manatee studies conducted in the Caño Estero Hondo lagoon area.



SUPPLEMENTARY FIG. 2 Coastal segments of approximately 30 km in the Dominican Republic, following Belitsky & Belitsky (1978).

SUPPLEMENTARY MATERIAL 4 Manatee hunting methods and uses in Hispaniola

Manatees in Hispaniola have been hunted through history with a variety of methods (Supplementary Table 5). One remarkable method that persisted at least until the colonization of the West Indies was the use of remoras *Echeneis naucrates* and *E. neucratoides*. Chroniclers like de Anglería described remora fishing for large fishes and sea turtles (MacNutt, 1912); other authors included manatees (Cobo, 1892; Fernández de Oviedo y Valdés, 1992). The method involved taming young remoras, which would attach to a target species. After spotting a desired prey from their canoes, the fishers released the trained remoras tethered with a line. When the remoras attached to a larger fish, turtle or manatee, the fishers pulled on the line to retrieve their catch.

SUPPLEMENTARY TABLE 5 Manatee hunting methods in Hispaniola.

Hunting method	1250 BCE-1491 CE	1492-1899 CE	1900-2013 CE	Freq. [1]
Bow and arrow	x			1
Remora	x	x		3
Spear	x		x	3
Net	x	x	x	17
Harpoon		x	x	10
Rifle		x	x	4
Beach seine			x	5
Diving spear gun			x	2
Gill net			x	3
Trap			x	1

[1]Indicates how many times a particular method was mentioned from the total number of documentary archives that described manatee hunting (n=23).

Gudger (1919) traced back references about the “living fish-hook” in Madagascar and the West Indies. Remora fishing has been reported in Africa, Asia, Australia, South America and the West Indies (De Sola, 1932). De Sola (1932) witnessed remora fishing for sea turtles in Cuba in the early 20th century. Remoras are commonly found associated with manatees in the Caribbean (Williams et al., 2003), and the aboriginal peoples of Hispaniola may have been able to capture manatee calves with this ingenious method.

The use of metal harpoons started with the arrival of the Europeans. The harpoon was thrown from boats or canoes: a rope was attached to the harpoon on one end, while the other end carried a cork or piece of wood as a float (Fernández de Oviedo y Valdés, 1992). Once harpooned, the loss of blood and the effort of the escape would fatigue the animal, while the fishers followed the float. Animals were recovered and brought to the beach using the rope.

Nets were used to capture small manatees, but adults were frequently caught from land, while grazing along sea and river shorelines (de Herrera y Tordesillas, 1726; de Charlevoix, 1731; López de Gómara, 1991). Descourtilz (1809) also mentioned how manatees were caught by using nets in their grazing areas, or by shooting with a rifle from a canoe. But harpooning was the most common capture method. Regardless of the capture method used, early authors noted that manatee cows and calves did not separate, so if one was caught, the other usually suffered the same fate (du Tertre, 1667; Oexmelin, 1774). In recent (>1900s) documentary archives, specific types of nets were mentioned as manatee capture methods, such as beach seines and gill nets (Supplementary Table 5); diving harpoons and traps were eventually added.

Manatee meat has been consumed throughout history in Hispaniola (Supplementary Table 6). In the 1492-1899 CE period, several authors praised manatee meat for its various flavors of beef, tuna and pork, and it was especially appreciated during Lent because it was considered fish (Durand, 1983). In the Dominican Republic, Ottenwalder (1995) reported an increase in manatee hunting during Lent, when meat is traditionally substituted with fish. However, manatee meat was not always popular. When the missionary Cobo ate manatee meat in Hispaniola (circa 1596), it was perceived as a coarse meal and many people did not want to eat it because, if they had suffered from syphilis, they believed the illness would return (Cobo, 1892). Centuries later, Sánchez Valverde (1947) repeated this belief. Other reasons not to eat the meat were related to the noble character of manatees: Moreau de Saint-Méry (1798) wrote that the animal's sensitivity and the affection it showed for its calves prevented some people from eating it.

There is no evidence of commercial exploitation of manatees in Hispaniola. From 1500-1800 the island's major exports switched from gold to sugar, leather, livestock, ginger, cocoa, tobacco and wood (Cassá, 1978). During that period, manatee meat may have been imported from South America to Hispaniola as it was to other Caribbean islands. For example, du Tertre (1667) stated that several ships loaded with manatee meat from the continent (South America) and neighbouring islands were brought every year to Saint Kitts (St. Christophe), Guadeloupe,

Martinique and other nearby islands. Lefebvre et al. (2001), also mentioned commercial exploitation of manatees in South America for export to the West Indies during the 17-19th centuries.

Manatee oil was used for cooking, lighting and medicine starting in the 1492-1899 CE period (Supplementary Table 6). In more recent times, manatee oil has been used as an aphrodisiac and for beauty purposes (Ottenwalder & León, 1999). In the 1492-1899 CE period, manatee skin was used to fabricate shoe soles, belts and other leather products (de Herrera y Tordesillas, 1726; de Charlevoix, 1731; Cobo, 1892; López de Gómara, 1991; Fernández de Oviedo y Valdés, 1992). In the most recent time period, leather straps for paddle handles (Domínguez Tejo, 2007), machete sheaths and whips were added (Ottenwalder & León, 1999). The skin is also used for food (similar to pork rinds) and as bait for lobster traps (Ottenwalder & León, 1999).

SUPPLEMENTARY TABLE 6 Uses of manatees in Hispaniola through time.

Body part	Use	1250 BCE-1491 CE	1492-1899 CE	1900-2013 CE	Freq. [1]
Meat	Food	x	x	x	51
	Bait			x	1
Oil/ fat	Cooking		x	x	8
	Lighting (lamp fuel)		x	x	4
	Marinating manatee skin		x		2
	Medicinal		x	x	5
	Aphrodisiac			x	1
	Beauty			x	1
Skin	Belts		x	x	3
	Shoe soles		x	x	7
	Other leather products		x		4
	Bait for lobster trap			x	1
	Food			x	1
	Leather straps			x	3
	Machete sheath			x	1
	Whips			x	1
Bones	Amulets or idols	x			5

	Ceremonial objects (vomiting spatula, bowl, spoon, inhaler)	x			28
	Ear adornments	x			2
	Utensils (adze or hoe, anvil, arrow and spear head, bone pick, sculpting or polishing instrument)	x			9
	Pestle	x		x	3
	Medicinal (earbones)		x		7
	Aphrodisiac			x	1
	Carved ornaments			x	2
	Handcrafts (button, machete and gun handle, necklace, other)			x	5
	Medicinal (ribs)			x	5
	Sold to scientists			x	1
	Witchcraft			x	1
Other	Recreational			x	3
	Selling desiccated animals			x	1

[1]Indicates how many times a particular use was mentioned from the total number of documentary archives that described uses of manatees (n=63).

The Taíno, the most advanced aboriginal culture in Hispaniola at the time of arrival of the Europeans, had many uses for manatee bones, especially for ceremonial purposes. One of their religious rituals, the Cohoba, required purging and inhaling powdered hallucinogenic plants. Ceremonial manatee bone objects included vomiting spatulas or swallowing sticks: long implements carved from manatee ribs used to induce vomit. They also carved bowls and small spoons to hold the powdered substances, and Y shaped tubes to inhale them. Other objects included small amulets or idols and ear adornments. Examples of these objects are found in the archaeological literature (Fewkes, 1907; Krieger, 1929, 1930; Herrera Fritot & Youmans, 1946; Mañón Arredondo et al., 1971; Baztan Rodrigo, 1972; Veloz Maggiolo, 1972; Cassá, 1974; García Arévalo & Chanlatte Baik, 1976; Veloz Maggiolo, 1976; García Arévalo, 1983; Scott, 1985; Morbán Laucer, 1988; Soto-Ricart & Rodríguez, 1989; Veloz Maggiolo, 1991, 1993). Manatee bones were also converted to utensils such as adzes, hoes or bone picks (Krieger, 1929, 1930, 1931; Rainey, 1941; Rouse, 1941). These customs disappeared when the aboriginal population was decimated

under Spanish rule. By 1533, the original human population had been reduced to approximately 600 in Hispaniola (Krieger, 1930) and their culture died out.

From 1492-1899 CE, manatee ear bones were used for treating: renal and urinary lithiasis (de Herrera y Tordesillas, 1726; de Charlevoix, 1731; Cobo, 1892; López de Gómara, 1991; Fernández de Oviedo y Valdés, 1992); urinary tract infections (Cobo, 1892), colics (de Charlevoix, 1731) and "diseases of the head" like epilepsy and vertigo (Oexmelin, 1774).

Manatee bones are still currently used for handcrafts and for medicinal purposes in the Dominican Republic. The latter requires pulverizing the rib bones and drinking the powder in a beverage to cure or treat: menses (Ottenwalder & León, 1999), asthma (Ottenwalder, 1995; Ottenwalder & León, 1999; Domínguez Tejo, 2007), arthritis, rheumatism, diverse body aches, epilepsy, cancer and syphilis (Ottenwalder & León, 1999). Bones are also used as an aphrodisiac, a contraceptive and a guard against the evil eye (Ottenwalder & León, 1999).

It is possible that some of these medicinal uses originated earlier in other areas of the Caribbean or South America and slowly percolated into Hispaniola. For example, while describing manatees in Martinique, Labat (1724) mentioned that ribs were used for haemorrhages and the fluxes and losses of blood. It is also possible that some earlier beliefs were transformed with time. For example, the current use of manatee ribs to cure epilepsy could have derived from the earlier use of manatee ear bones for the same purpose (Oexmelin, 1774). The use of manatee ribs to cure syphilis could be related to the previous belief that manatee meat made the illness resurface (Cobo, 1892).

SUPPLEMENTARY MATERIAL 5 Current threats to manatees in Hispaniola

SUPPLEMENTARY TABLE 7 Current threats to manatees and their habitat in Hispaniola.

Threat	Freq. [1]
Illegal hunting	24
Entanglement in fishing gear	17
Boat strikes/disturbance	11
Contamination	9
Habitat degradation/destruction	7
Lack of law enforcement	4
Shark predation	4
Noise	3
Commerce in bones and oil	2
Hurricanes	1
Lack of freshwater	1
Outdated laws	1
Poverty	1
Sedimentation	1

[1]Indicates how many times a particular threat was mentioned from the total number of documentary archives listing threats to manatees (n=29).

Legislation protecting manatees and their habitat in Hispaniola

The Dominican Republic has ratified or acceded to more international agreements that protect manatees and their habitat compared with Haiti (Supplementary Table 8). The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), promotes the conservation and wise use of wetlands. The convention is relevant to manatee conservation because wetlands are broadly defined to include freshwater habitats, estuaries, and coastal areas. Of the four currently listed Ramsar sites in the Dominican Republic, the Humedales de Jaragua site includes important manatee habitat on the southwest coast.

The International Convention for the Prevention of Pollution from Ships (MARPOL) and the United Nations Convention on Law of the Sea (UNCLOS) protect manatee habitat by controlling pollution in the marine environment. The Dominican Republic has ratified both conventions, Haiti has only ratified the latter.

SUPPLEMENTARY TABLE 8 Participation of the Dominican Republic and Haiti in international treaties relevant to the conservation of manatees and their habitat.

International treaties and agreements	Dominican Republic	Haiti
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), 1971	Accession	Non-Party
Convention for the Prevention of Pollution from Ships (MARPOL), 1973	Contracting State	Non-Party
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973	Accession	Non-Party
Convention on the Conservation of Migratory Species of Wild Animals (CMS), 1979	Ratification	Non-Party
United Nations Convention on Law of the Sea (UNCLOS), 1982	Ratification	Ratification
Protocol Concerning Specially Protected Areas and Wildlife (SPAW Protocol), 1990	Ratification	Non-Party
Convention on Biological Diversity (CBD), 1992	Ratification	Ratification

The West Indian manatee is categorized as Endangered in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The species is also listed in Annex II of the Protocol Concerning Specially Protected Areas and Wildlife (SPAW Protocol). The Dominican Republic ratified both of these international agreements and prohibited the taking, possession or killing, and the commercial trade of manatees, their parts or products.

Parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS) are obliged to provide strict protection to threatened species listed in Appendix I. The West Indian manatee is listed in the Appendix, but only populations restricted to Honduras and Panama are currently included. However, transboundary movement of manatees has been confirmed in other countries and the CMS could include more West Indian manatee populations in the future. Transboundary movement of manatees likely occurs between the Dominican Republic and Haiti, therefore it would be beneficial for Haiti to become party to the CMS.

The Convention on Biological Diversity (CBD) promotes the conservation and sustainable use of biological diversity. As contracting parties, the Dominican Republic and Haiti should promote the recovery of threatened species and develop or maintain legislation for their protection. However, without the ratification of CITES or the SPAW Protocol, and without national legislation specifically designating manatees as a threatened species, they are not officially protected in Haiti.

In contrast, manatees have been protected by national legislation in the Dominican Republic since 1938 (Supplementary Table 9). In 2000, the General Law of the Environment and Natural Resources (Law No. 64-00) offered total protection to manatees in harmony with the international conventions ratified by the Dominican government. It also integrated Decree No. 233-96 as part of the law, protecting all marine mammals in Dominican jurisdictional waters, inside or outside protected areas.

In 2004, Law No. 307-04 presented a setback for manatee protection because marine mammal exploitation was left to the discretion of the Consejo Dominicano de Pesca y Acuicultura (CODOPESCA). This law contradicts the General Law of the Environment and Natural Resources, as it attempts to regulate a prohibited activity. But to date, no exploitation of manatees has been authorized by CODOPESCA. More recently, the Dominican Republic listed the manatee as a Critically Endangered species in the national Red List of species in danger of extinction, threatened or protected (Resolution No. 16/2011) (Ministerio de Medio Ambiente y Recursos Naturales, 2011).

SUPPLEMENTARY TABLE 9 National legislation relevant to manatee protection in the Dominican Republic.

Year	Legislation	Importance
1938	Law No. 1518	Prohibited following, wounding, capturing and killing manatees and introducing manatee remains in all the waters of the country.
1962	Law No. 5914	Maintained the same prohibitions as the previous law.
1987	Decree No. 289-87	Assigned the protection of manatees in the coasts and territorial waters of the country to the Marina de Guerra Dominicana and the Dirección Nacional de Parques.

1996	Decree No. 233-96	Prohibited the hunting and any type of harassment of marine mammal species in all Dominican jurisdictional waters outside of the Marine Mammal Sanctuary of the Dominican Republic.
1999	Decree No. 136-99	Created the National Commission for the Protection of Marine Mammals to formulate protection measures and actions.
2000	Law No. 64-00	Prohibited the hunting, fishing, capture, harassment, mistreatment, killing, traffic, import, export, commerce, the manufacture or elaboration of handcrafts, exhibition and illegal possession of species declared threatened by the Dominican government or other country, in agreement with the international treaties subscribed by the Dominican government.
2004	Law No. 307-04	Created the Consejo Dominicano de Pesca y Acuicultura (CODOPESCA) to manage fisheries and/or the extraction of the biotic resources of the country. Prohibited the unauthorized exploitation of all the biological aquatic resources, as well as those that have legal protection in the Dominican Republic or by virtue of international treaties signed by the country.
2011	Resolution No. 16/2011	Established a national Red List, categorizing manatees as Critically Endangered. Prohibited the hunting, fishing, capture, harassment, mistreatment, killing, traffic, import, export, commerce, manufacture or elaboration of handcrafts and/or illegal possession of listed species.

In Haiti, a 1978 fisheries decree (Décret réglementant l'exercice du droit de pêche en Haiti, 1978) prohibited the use of harpoons for fishing. If strictly implemented, this legal instrument could help protect manatees.

Other national legislation protects manatee habitat in the Dominican Republic and Haiti mainly through the creation of protected areas (Supplementary Table 10). The Dominican Republic's system of protected areas was established in 1974 and has been expanded multiple times. By 2008, the system included 38 coastal marine protected areas encompassing approximately 56,000 Km^2 according to the 2004 sectorial law on protected areas (Law No. 2002-04).

Law No. 2002-04 had both positive and negative impacts on manatee protection. It extended the limits of the Marine Mammal Sanctuary of the Dominican Republic on the northeast coast. It also created the Marine Mammal Sanctuary Estero Hondo on the northwest coast, primarily to protect manatees in the Caño Estero Hondo lagoon (Fig. 1). Both sanctuaries were classified as strictly protected areas. However, the extent of the protected area around Caño Estero Hondo decreased because the total area of Monte Cristi National Park was reduced. Other coastal marine protected areas were also reduced. Furthermore, this law did not integrate the Decree No. 233-96 that protected marine mammals in all Dominican jurisdictional waters. The national system of protected areas was expanded again through a decree in 2009 (Decree No. 571-09), which created two marine sanctuaries, the Santuario Marino Arrecifes del Sureste and the Santuario Marino Arrecifes del Suroeste, that include suitable manatee habitat on the southeast and southwest coasts, respectively.

Following the ecosystem services assessment and the proposed sites by the local NGO Fondation pour la Protection de la Biodiversité Marine (FoProBiM) (Wiener, 2013), the Haitian government recently created two protected areas that enclose extensive coastal areas recognized as optimal manatee habitat by Rathbun et al. (1985): one in the southwest coast in 2013 (Arrêté déclarant l'Aire Protégée de Ressources Naturelles Gérées de Port-Salut/Aquin, 2013), and one in the northeast coast in 2014 (Arrêté déclarant l'Aire Protégée de Ressources Naturelles Gérées des Trois Baies, 2014) (Supplementary Table 10).

SUPPLEMENTARY TABLE 10 National legislation relevant to the protection of manatee habitat in Hispaniola.

Year	Legislation	Importance
Dominican Republic		
1974	Law No. 67	Created a system of protected areas and prohibited hunting or capturing wild animals or extracting their products or remains.
1996	Decree No. 233-96	Created the Marine Mammal Sanctuary of the Dominican Republic by amplifying the limits of a former offshore humpback whale sanctuary, including coastal areas important for manatees on the northeast coast.
1999	Decree No. 136-99	Established the limits of the sanctuary created by the previous decree.

2000	Law No. 64-00	Established the national system of protected areas.
2004	Law No. 202-04	Extended the limits of the Marine Mammal Sanctuary of the Dominican Republic. Created the Marine Mammal Sanctuary Estero Hondo, primarily for manatees. Reduced the area of some existing coastal marine protected areas important for manatees, like Monte Cristi National Park.
2009	Decree No. 571-09	Created two marine sanctuaries that include manatee habitat on the southeast and southwest coasts of the country: Santuario Marino Arrecifes del Sureste, and Santuario Marino Arrecifes del Suroeste.
Haiti		
2013	Arrêté déclarant l' "Aire Protégée de Ressources Naturelles Gérées de Port-Salut/Aquin"	Created an extensive and primarily marine protected area on the southwest coast of Haiti.
2014	Arrêté déclarant l' "Aire Protégée de Ressources Naturelles Gérées des Trois Baies"	Created an extensive and primarily marine protected area on the northeast coast of Haiti.

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