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Stranding reports of the Antillean manatee in the middle Magdalena Basin, Colombia 2011 to 2023

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Abstract

The aim of this study was to conduct an analysis of reported events concerning Antillean manatee (*Trichechus manatus manatus*) strandings in the middle Magdalena Basin region of Colombia from January 2011 to December 2023. To achieve this, a literature search was conducted in newspapers, news broadcasts, as well as gray and published reports, complemented by interviews and workshops with various governmental and non-governmental organizations. This search resulted in reliable information regarding past experiences involving stranded manatees over the years. Cases attended to by the environmental authority and its partners were also considered. Forty-four stranding events were recorded, with 34 deaths and 10 live manatees. Of the cases discovered, 79.5% of the reported cases were addressed. This effort highlighted the current lack of an official database that would provide firsthand knowledge of Antillean manatee stranding events in Colombia, thereby hindering timely and appropriate territorial management during response to the challenges faced by this species in the region. Furthermore, it underscores the need to implement a standardized response pathway for manatee cases, following appropriate protocols, and promoting the coordination of stakeholders within the regional stranding network in the middle Magdalena Basin. This approach, in addition to supporting the capacity building of communities, institutions, and organizations for improving response knowledge, conservation, and manatee recovery, is of paramount importance for the long-term sustainability of manatee populations in the region.

Keywords:
aquatic mammal, Colombia, emergencies, freshwater population, mortality, *Trichechus manatus manatus*

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Introduction

The Antillean manatee (*Trichechus manatus manatus*), a subspecies of the West Indian manatee (*Trichechus manatus*), is an herbivorous aquatic mammal species that inhabits coastal, estuarine, and freshwater areas of Colombia (Trujillo et al., 2006). One of the main areas associated with this species in the country is the Magdalena River, where the distribution of manatees extends from Puerto Berrío (Antioquia) to its mouth at Bocas de Ceniza and the Canal del Dique (Montoya et al., 2001; Debrot et al., 2023). This species is classified as Endangered both at the global and national levels (Self-Sullivan & Mignucci-Giannoni, 2008; MADS, 2024).

Strandings involving aquatic mammals such as manatees are unfavorable situations due to anthropogenic or natural conditions (Galves et al., 2023). These can include orphaned calves, sick or injured individuals, entangled, stranded, beached, trapped, and/or deceased manatees (SEMARNAT, 2020). In the middle Magdalena Basin, the presence of the West Indian manatee is recognized in the departments of Santander, Antioquia, Bolívar, and Cesar, playing a crucial ecological and social role. As such, each emergency case is of special relevance for the region.

Due to seasonal fluctuations in water levels (floods/droughts) in the Magdalena River and its tributaries, combined with anthropogenic alterations (changes in water flow, embankments, etc.), manatees that inhabit these areas are exposed to situations that can endanger their survival. These sporadic situations are stranding events, in which the manatees are found on the shore of a body of water, whether alive, dead, or in a condition that makes their return to the aquatic environment impossible (Geraci & Lounsbury, 2005; Moore et al., 2018). In recent years, there has been an increase in complaints made about these events by the local community of the middle Magdalena Basin through the media and social networks. Despite this, no institution has kept rigorous and systematic records, so it is necessary to collect existing information to raise awareness on the issue and generate alerts and calls for attention about the health of the ecosystems (MADS, 2024). For the documentation of these events, a comprehensive examination of each one must be conducted, recording the location, exact time, circumstances, encounter history, weather conditions, individual assessment, samples collected, photographic records, and other relevant details (Bonde et al., 2012).

Therefore, this study aims to analyze reports of Antillean manatee strandings in the middle Magdalena Basin during the period 2011 through 2023. Data on manatees in specific registered categories and/or attended to by different local responders were collected to visualize the problem in the region and contribute to the necessary measures for managing potential future events.

Material and Methods

From 2011 through 2023, stranding events of live and dead manatees were documented in the middle part of the Magdalena River basin, covering the departments of Santander, Antioquia, south of Cesar, and south of Bolívar. Reports of these events were categorized as orphaned calves, sick, injured, and/or entangled individuals, those injured by collisions with boats, live stranded, and deceased. In the case of dead individuals, necropsies were performed, and samples were taken for toxicological studies, however the advanced state of decomposition prevented us from concluding a causality of death. Samples of gastric content and feces were obtained for toxicological studies, which were sent to the Colombian Forensic Veterinary Medicine laboratory, located at the Remington University Corporation, where qualitative toxicological methods were implemented (presence/absence) using thin layer chromatography for the detection of carbamates, pyrethrins, and pyrethroids, due to the intensity of agricultural activities in the region.

Fourteen workshops were held with different regional and local stakeholders, government institutions, and non-governmental organizations that provided data related to their experiences with manatee assisted responses.

Additionally, a review of associated documents was carried out that included press archives, web records, news articles, scientific papers, and graduate degree theses, as well as individual consultations with people and other entities. Finally, an updated database of all the stranding events reported to date was consolidated. Information on each case was collected, whenever possible, including date, location, whether it was a live or dead stranding, condition of the animal, age range, sex, and total length. Age ranges were estimated based on straight line total length: neonates were defined as 140 cm or less, calves between 141 and 175 cm, juveniles ranged from 176 to 225 cm, and manatees 226 cm or longer were classified as adults (Mignucci-Giannoni et al., 2000; Castelblanco-Martínez et al., 2021). Strandings were classified according to the number of animals: when it involved a single manatee, it was called a single stranding; when it involved two or more manatees, it was called a mass stranding; when no data were available, it was called undetermined (Geracy & Lounsbury, 2005). Data from the date for each report were correlated with national information on the status of the El Niño-Southern Oscillation (ENSO) (IDEAM, 2023). This information was made available in the middle Magdalena Manatee Stranding Network, a management strategy adopted by local and regional environmental authorities, local communities, some NGOs, and a private company. The data were entered and tabulated using descriptive statistics in Microsoft Excel to analyze the information, its location was mapped and analyzed with densities, and subsequently projected using ArcGIS Pro.

Results

A total of 44 Antillean manatee stranding events was recorded between January 2011 and December 2023. Ninety-one percent of these events were reported by communities, governmental or non-governmental institutions present in the territory, indicating direct attention and/or knowledge of the cases; nine percent were registered based on bibliographic references from previous years (Aguilar & Castelblanco, 2014; Arévalo-González et al., 2014; Villamizar, 2015); digital media searches did not contribute any additional records beyond what was provided by the institutions. The years with the highest number of cases were 2023 with 20.5% (n = 9) of the events, followed by 2020 and 2022 with 15.9% (n = 7 each), 2014 and 2016 with 11.4% (n = 5 each), and 2011, 2015, 2018, and 2019 with 4.5% (n = 2 each); finally, 2013 with 2.3% (n = 1).

The responses occurred in all four departments studied, with Santander showing the highest number of events at 50% (n = 22), distributed in the municipalities of Barrancabermeja, Cimitarra, Puerto Parra, Sabana de Torres, and Puerto Wilches. Antioquia followed with 18.2% (n = 8) in the municipality of Yondó, Bolívar in the municipality of Simití with 18.2% (n = 8), and finally Cesar with 13.6% (n = 6) in Aguachica and San Martín (Fig. 1). Regarding

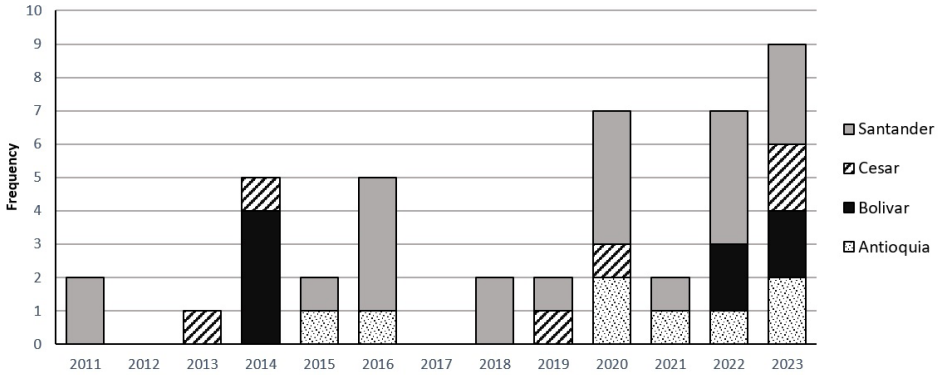

Figure 1. Frequency of manatee (*Trichechus manatus manatus*) stranding events in the middle Magdalena Basin by socio political division (states) from 2011 through 2023.

specific location, Ciénaga de Paredes (Paredes Swamp), located between the municipalities of Puerto Wilches and Sabana de Torres (Santander, Fig. 2.2) stood out with eight records (18.2%). Of the total number of responses, 82.5% were attended, of which 72.7% with the support of primary responders, while only 9.1% by local communities only, either directly (disentanglement) or indirectly (monitoring, assisted feeding, etc.). When relating the number of registered reports to ENSO of each date, it was found that 38.6% (n = 17) of the events occurred during La Niña, whilst 47.7% (n = 21) during El Niño events.

During this analysis, 11.4% of the cases (n = 5) were classified as mass strandings. It is worth noting that all of these events occurred during the low water season and were related to "empozamientos" or pondings (which occur when manatees cannot access deep enough water to travel to other destinations). These events are common during El Niño periods resulting in buildup of high sedimentation levels in the Magdalena River basin during the dry season (Aguilar & Castelblanco-Martínez, 2020). The highest number of stranded manatees was recorded in 2020 at the Complejo Cenagoso El Totumo (Antioquia), with 36 live manatees documented. The second highest was registered in 2011 in Ciénaga de Paredes, with 12 live manatees; two more cases occurred in the same water body, but the number of affected manatees could not be determined.

Of the 44 reports, we were able to obtain the sex of 25 individuals, where 56% were females and 44% males. It was possible to determine the total length of 33 individuals involved in strandings, where 48.5% were adults, 24.2% juveniles, 18.2% calf and 9.1% neonates. Out of the 44 events, 27.3% involved live strandings (n = 12). None of the live cases required rehabilitation; three manatees (6.8%) were accidentally trapped and two animals (4.5%) were intentionally trapped with fishing nets by locals who later released them; five cases (11.4%) were mass strandings, and two manatees (one found sick and the other an orphan baby) died before receiving medical attention.

Community reports of dead manatees accounted for 70.5% of the records (n = 31), but the final total number of deaths was determined to be 77.3% of the cases (n = 34), while 41.2% underwent postmortem examination. Of the total number of dead manatees, 38.2% (n = 13) were in advanced state of decomposition, 38.2% were in moderate decomposition, and 11.8% were in early state of decomposition. In 73.5% of the carcasses, the cause of death could not be determined. However, with the information provided for each case and the results of the necropsies, the cause of death was determined in 26.5% of the cases. Deaths of dependent calves, accidentally trapped, and injured accounts were recorded in 5.9% of the dead manatee cases (n = 2 each), while natural death, crushing, and collisions with boats accounted for 2.9% each. Qualitative toxicological studies were carried out using thin layer chromatography in 6.8% (n = 2) of the manatees, detecting the presence of pyrethrins in one adult female, and carbamates and organophosphates in a second individual. These chemical compounds had never been reported in manatees in Colombian waters.

Discussion

The Ciénaga de Paredes is the location with the highest number of manatee records, where several emergency responses have been reported in years prior to this study, many of them related mainly to low water levels in summer (Caicedo-Herrera et al., 2005; Castelblanco et al., 2005). In this study, that locality had the same number of cases during high water and low water conditions; the year-round occurrence of responses without a predominant period highlights the need to maintain an active alert response throughout the year, as manatee strandings can happen in the middle Magdalena River basin regardless of the season. On the other hand, El Totumo Complex, which has the largest registered number of stranded manatees, is a wetland strongly fragmented by the creation of roads, which affected hydrological dynamics and has resulted in fluctuating depth of the wetlands (Caballero et al., 2001), making them more likely to result in pondings.

It is worth noting that, according to data provided by institutions, in the four ponding cases monitoring and assisted feeding were conducted by fishermen until the arrival of the rains. Similarly, an event was reported in 2019 in San Martin (Cesar) - the only one with direct intervention - where three female manatees and one male calf were assisted and relocated to ensure their survival (Corpocesar, 2019, pers. comm.). This emphasizes the urgency of aligning species conservation strategies with climate change adaptation and mitigation efforts (SEMARNAT, 2020). The incidence of strandings documented in this study during years with the presence of the El Niño event can directly influence the increase in cases of manatee mortality in fluctuating systems such as the rivers and swamps of Colombia (Marsh et al., 2017).

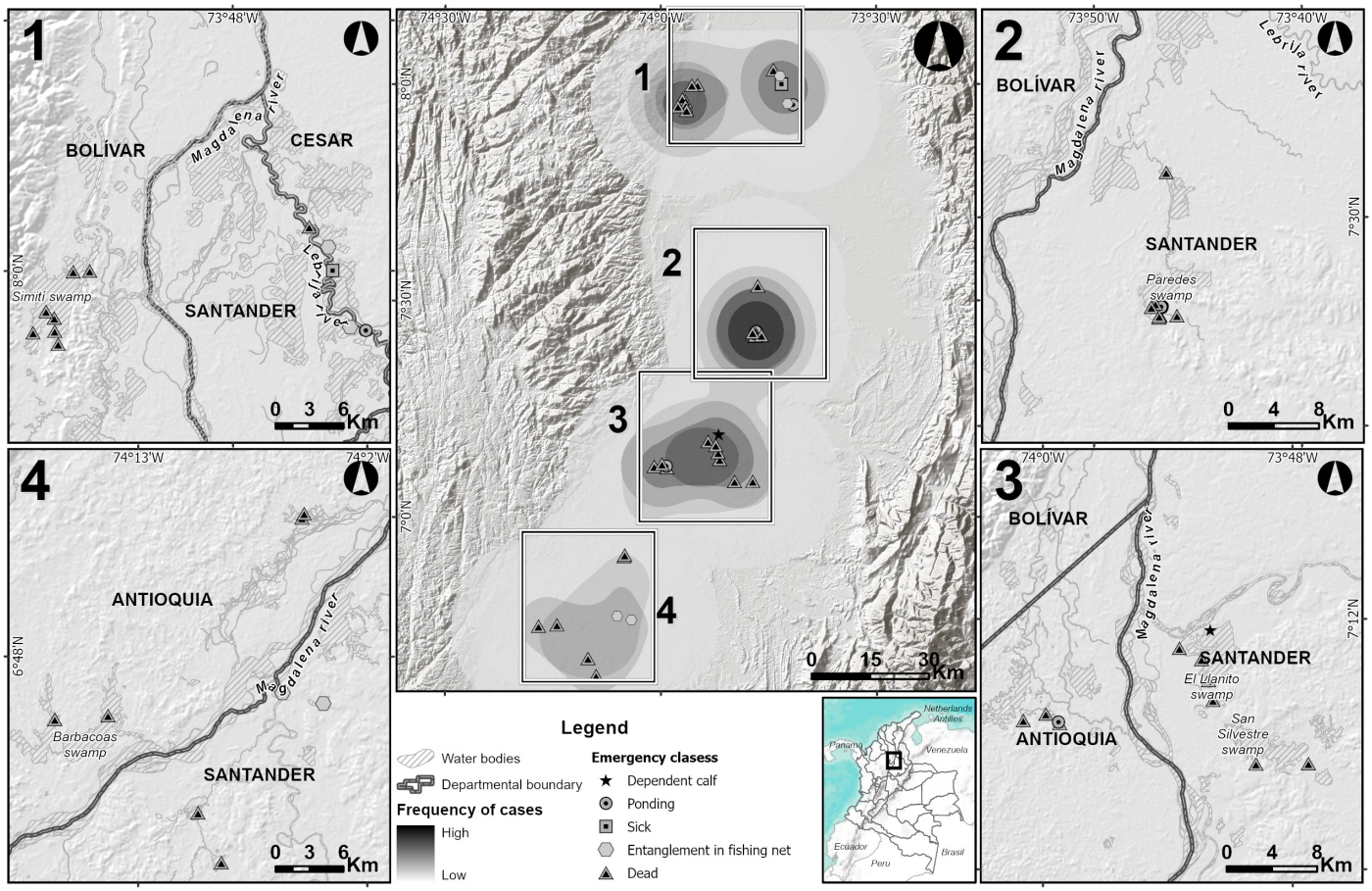

Figure 2. Location of manatee (*Trichechus manatus manatus*) emergency events from 2011 through 2023 in the middle Magdalena River basin, Colombia.

The intensity of extreme meteorological phenomena associated with climate change may generate behavioral changes and negative impacts reflected in a decrease in food supply, reduced fertility, decreased population size and genetic diversity, and make adaptive capacity in the face of thermal stress impossible (Edwards, 2013; Deutsch et al., 2022). These climatic disturbances may impair the manatee's immunological and adaptive responses (Marsh et al., 2022). The data presented in this study underscore the importance of trained personnel performing necropsies, since a postmortem manatee may become a valuable source of scientific and biological information. It is essential to consider that a necropsy not only implies the external and internal examination of a manatee, but also the potential for subsequent laboratory analysis of tissues that may assist in determining the cause of death and inferring information about the state of the ecosystem's health (Bonde et al., 2012).

Regarding the live manatee events, 81.8% had a positive outcome, as the water levels eventually rose and allowed the trapped animals to exit the situation corresponding to ponding cases, or the community released the trapped individuals. In two cases (18.0% of the live records; n = 18), the manatees died after being located. In one event, the calf died before receiving necessary attention while the rescue team was en route, but a necropsy was performed. In another case, the manatee in distress was injured and in an advanced state of pregnancy, and unfortunately died along with the fetus despite technical assistance. The fishing nets are elements used to capture manatees in the region and there were two animals intentionally trapped with fishing nets recorded. This indicates that hunting still occurs in the area despite the conservation efforts involving environmental education, participatory community monitoring, and application of anti-harassment laws. Moreover, it is necessary to continue reinforcing the conservation action and making fishers aware of the laws that protect manatees The establishment of the Manatee Stranding Network in the middle Magdalena Basin provides an opportunity to engage additional key regional actors that can further promote conservation projects. It is necessary to involve private companies to minimize the effect that the poor development of some productive activities can cause, such as agriculture, farming, fishing, water-borne transport, and mining.

Sex and age category

A finding that draws attention in the results from this study is the high incidence of dead females compared to males; these data coincide with what was discovered in historical mortality events in countries such as Cuba (Álvarez-Alemán et al., 2021), Colombia (Montoya-Ospina et al., 2001), and Belize (Castelblanco-Martínez et al., 2018). This phenomenon is discouraging due to the crucial role that females play in the survival of the species (Álvarez-Alemán et al., 2021).

The non-determination of sex and age class is mainly associated with the ignorance of the community and institutions that attended the stranding events. This information is similar to that reported for Antillean manatees from Colombia (Montoya-Ospina et al., 2001) and Puerto Rico (Mignucci-Giannoni et al., 2000) in rescue events and mortality. The high degree of decomposition, high

Table 1. Manatee (*Trichechus manatus manatus*) stranding events in middle Magdalena Basin between 2011 and 2023

ID Record	Date	Department	Location	Geographic coordinates	Attended	Stranding by number of individuals	Status
1	2011	Santander	Ciénaga de Paredes	07°25'20" N 73°46'50" W	Yes	Single	Dead
2	2011	Santander	Río Carare	06°46'16" N 74°06'34" W	Yes	Single	Non-intentionally trapped
3	2013	Cesar	Rio Lebrija	08°02'49" N 73°44'20" W	No	Single	Dead
4	2014	Bolívar	Boquete de Cargadero	07°57'48" N 73°56'36" W	Yes	Single	Dead
5	2014	Cesar	Ciénaga Muzanda	08°00'51" N 73°43'12" W	Yes	Single	Sick
6	2014	Bolívar	Ciénaga El Piñal	07°58'1" N 73°57' W	Yes	Single	Dead
7	2014	Bolívar	Ciénaga El Piñal	07°57'10" N 73°56'35" W	Yes	Single	Dead
8	2014	Bolívar	Ciénaga El Piñal	07°56'33" N 73°56'25" W	Yes	Single	Dead
9	2015	Antioquia	Ciénaga de Barbacoas	06°45'03" N 74°17'00" W	No	Single	Dead
10	2015	Santander	Ciénaga de Paredes	07°25'43" N 73°46'43" W	Yes	Undetermined	Pondings
11	2016	Santander	Ciénaga de Paredes	07°25'40" N 73°46'44" W	Yes	Undetermined	Pondings
12	2016	Santander	Ciénaga de San Silvestre	07°05'36" N 73°49'46" W	Yes	Single	Dead
13	2016	Antioquia	Complejo Cenagoso El Totumo	07°07'02" N 73°59'12" W	No	Undetermined	Dead
14	2016	Santander	Ciénaga de San Silvestre	07°05'57" N 73°47'15" W	Yes	Single	Dead
15	2016	Santander	Caño San Silvestre	07°10'39" N 73°53'27" W	Yes	Single	Dead
16	2018	Santander	Ciénaga El Llanito	07°08'59" N 73°51'50" W	Yes	Single	Dead
17	2018	Santander	Ciénaga El Llanito	07°11'28" N 73°51'57" W	Yes	Single	Orphan calf
18	2019	Santander	Ciénaga La San Juana	06°38'11" N 74°09'11" W	No	Single	Dead
19	2019	Cesar	Ciénaga La Olla	07°57'08" N 73°41'36" W	Yes	Mass	Pondings
20	2020	Santander	Ciénaga de Paredes	07°25'42" N 73°46'46" W	Yes	Mass	Pondings
21	2020	Antioquia	Complejo Cenagoso El Totumo	07°07'13" N 73°59'15" W	Yes	Mass	Pondings
22	2020	Santander	Ciénaga de Paredes	07°25'54" N 73°47'03" W	Yes	Single	Dead
23	2020	Santander	Ciénaga de Paredes	07°25'13" N 73°46'53" W	Yes	Single	Dead
24	2020	Antioquia	Ciénaga de Barbacoas	06°45'14" N 74°14'27" W	No	Single	Dead
25	2020	Santander	Ciénaga de Paredes	07°25'18" N 73°46'52" W	Yes	Single	Dead
26	2020	Cesar	Ciénaga Muzanda	08°01'08 "N 73°43'24" W	Yes	Single	Non-intentionally trapped
27	2021	Santander	Ciénaga La Duda	06°40'34" N 74°10'08" W	Yes	Single	Dead
28	2021	Antioquia	Ciénaga de Sardinata	06°54'42" N 74°05'38" W	No	Single	Dead
29	2022	Santander	Quebrada La Gómez	07°25'20" N 73°46'1" W	Yes	Single	Dead
30	2022	Santander	Caño Parirí	07°32'12" N 73°46'31" W	Yes	Single	Dead
31	2022	Bolívar	Ciénaga de Simití	08°00'43" N 73°54'54" W	Yes	Single	Dead
32	2022	Antioquia	Ciénaga Suarez	07°07'11" N 74°00'57" W	Yes	Single	Dead
33	2022	Santander	Ciénaga de Paredes	07°25'44" N 73°47'15" W	Yes	Single	Dead
34	2022	Santander	Ciénaga El Llanito	07°09'06" N 73°52'03" W	Yes	Single	Dead
35	2022	Bolívar	Ciénaga de Simití	08°00'31" N 73°55'41" W	Yes	Single	Dead
36	2023	Cesar	Ciénaga de Cochoviejo	07°57'18" N 73°42'21" W	No	Single	Non-intentionally trapped
37	2023	Santander	Caño San Silvestre	07°10'07" N 73°52'23" W	Yes	Single	Dead
38	2023	Antioquia	Caño Negro	07°07'30" N 73°59'52" W	Yes	Single	Dead
39	2023	Santander	Ciénaga El Clavo	06°45'45" N 74°04'37" W	Yes	Single	Intentionally trapped
40	2023	Bolívar	Ciénaga de Simití	07°57'06" N 73°57'37" W	Yes	Single	Dead
41	2023	Cesar	Ciénaga de Chocoviejo	07°57'44" N 73°42'53" W	No	Single	Intentionally trapped
42	2023	Santander	Caño Rosario	07°07'19" N 73°52'41" W	Yes	Single	Dead
43	2023	Bolívar	Ciénaga de Simití	07°57'6" N 73°57'37" W	Yes	Single	Dead
44	2023	Antioquia	Ciénaga de Sardinata	06°54'54" N 74° 05'32" W	No	Single	Dead

ambient temperatures, and the lack of materials that would allow documenting morphometric measurements could also have played a vital role in the determination of both the sex and the age category at time of recovery. Because of this, it is essential to have pertinent and available stranding response kits prior to responding to such situations.

The incidence by age category in stranded manatees from Colombia was higher in adult and juvenile animals than calves.

This information differs from that reported in the same species throughout countries such as Cuba (Álvarez-Alemán et al., 2021), Belize and Mexico (Castelblanco-Martínez et al., 2018), Brazil (Balensiefer et al., 2017), Colombia (Montoya-Ospina et al., 2001), and Puerto Rico (Mignucci-Giannoni et al., 2000), where the highest incidence is represented by calves and juveniles. The fact that the mortality events in Colombia are associated with adult manatees could generate a disadvantage for the population that is distributed in the Magdalena River basin because those are individuals of reproductive age, and without their contribution the population could be decreasing, resulting in a bottleneck and loss of genetic variability (Luna et al., 2021).

The high decomposition rate of the carcasses in this study made it difficult to determine the causes of death in many of the cases. This finding has been similarly reported in Cuban manatees (Álvarez-Alemán et al., 2021). The rapid decomposition of the corpses is associated with factors such as high ambient temperatures (Caruso, 2016), remote areas with difficult access, and late reporting of stranding or mortality events by reporting sources.

Hunting represented a low proportion mortality of manatees in middle Magdalena Basin during this study compared with reported by Montoya-Ospina and colleagues in 2001 for the same area. However, new mortality events associated with anthropogenic causes had not been described in Colombian territory, such as collisions with boats. Similarly, it is observed that around the Magdalena River, at a historical level, group stranding events have occurred throughout the different regions that are part of the manatee's distribution area (Montoya-Ospina et al., 2001).

Manatee toxicology findings

Presence of pyrethrins was detected using qualitative methods in two cases of adult female manatees. To date, there are no reference values or detection information for insecticides such as pyrethrins in manatees. However, their presence in these manatees demonstrates the need to initiate studies focused on detecting the possible sources of acquisition of chemical compounds, the levels present in the manatee population, and how pyrethrins could affect the survivorship of these manatees within the habitat and their distribution area.

There are few reports of pyrethrins in aquatic mammals; the only information available is from striped dolphin (*Stenella coeruleoalba*) in Spain (Aznar-Alemany et al., 2017), Franciscana dolphin (*Pontoporia blainvillei*) (Alonso et al., 2012), and Guiana dolphin (*Sotalia guianensis*) (Alonso et al., 2015) in Brazil. In the latter species, quantitative techniques have shown that pyrethrins tend to bioaccumulate throughout the life of the animals (Alonso et al., 2012); it has recently been shown in Guiana and Franciscana dolphins that there is a toxic heritability of these toxins at the transplacental level (Alonso et al., 2015). It would be interesting to evaluate if this compound behaves similarly in manatees and if its presence varies in different age categories. In other species of aquatic organisms, it has been documented that the presence of pyrethrins, such as cypermethrin, is detrimental to aquatic life even at low concentrations, which is why it is essential to monitor their levels in the environment and in organisms (Gowland et al., 2002; Friberg-Jensen et al., 2003).

In a preliminary qualitative analysis, the presence of pesticides such as organophosphates, carbamates, and pyrethroids was detected. However, there are no references for said compounds in manatees, except from Florida where it was present in 55.8% of a population of 105 individuals in a time period of 2009-2019 (O'Shea et al., 2018; De María et al., 2021). However, toxicological studies carried out in Brazil showed that the activity of the enzyme butyrylcholinesterase (BChE) in manatees could suggest the presence of carbamate and organophosphate toxicity mechanisms at the blood level (Anzolin et al., 2012).

It is presumed that the possible sources of availability of these chemical compounds in the different stranding areas are associated with the presence of agro-industrial activities, such as the planting of the African palm (*Elaeis guineensis*) and run-off from livestock, which discharge water with fertilizers and insecticides directly or indirectly to the water bodies where manatees inhabit (Aguilera et al., 2011; Anzolin et al., 2012; Mojica-Figueroa et al., 2014). Manatees can become exposed to these chemical compounds by ingesting water or consuming aquatic plants that absorb or fix contaminants, such as the water hyacinth (*Pontederia crassipes*). The presence of contaminants and chemical substances in aquatic plants, such as water hyacinth commonly eaten by manatees, may represent a threat to the health of the species in its immune and reproductive functions (Belanger & Wittnich, 2008).

In the future, more detailed studies addressing these aspects of quantitative toxicology in stranded and rescued manatees shall allow establishing reference values for these compounds. It is essential to evaluate the presence of pyrethrins, carbamates, and organophosphates due to the proximity of the water bodies to agro-industrial systems in middle Magdalena Basin. Currently, the toxicology literature addresses the study of other compounds but not those found in this study. In the same way, the detection of pesticides and insecticides available in the water can not only affect the health of manatees, but also give insight into the quality of the environment. However, it can also affect the maintenance of the ecosystem for humans under the unified concept (Buttke, 2011).

Conclusions

This type of analysis regarding the possible causes of strandings of Antillean manatees in the middle Magdalena Basin is crucial for filling information gaps about the species in the area, raising awareness among communities and institutions about its significance and degree of threat both globally and regionally, and thus focusing on the generation of conservation programs for the species. Understanding the dynamics of manatee stranding events not only helps generate historical information about past cases, but also aids in identifying the main causes associated with such incidents, consequently enabling the development of mechanisms and environmental policies to reduce the frequency of these events.

This research unveiled that most organizations lacked awareness of the details to consider when registering a manatee stranding. This highlights the need to train all stakeholders

responsible for conserving this species for proper attention and subsequent documentation. Moreover, training local communities, who often manage the registration and data collection, is essential. Emphasizing the need to create and implement standardized protocols for stranding response, followed by community and institutional training, would strengthen collaborative efforts with communities residing near the species' natural habitats. The localities with the largest number of records coincide with places that have carried out environmental education processes and educational projects, which may influence communities and provide them an opportunity to report these events to the appropriate institutions. It has been demonstrated that a stranding event alert system should be maintained throughout the year, regardless of the season when Antillean manatee strandings occur in the middle Magdalena Basin. In this regard, it is essential to align conservation plans with strategies for documenting the impact of climate change resulting in appropriate adaptation and mitigation.

Colombia does not have data to correlate deaths with reproductive periods, since medical, biological, and ecological information on populations restricted to freshwater ecosystems is scarce. The data presented allow us to emphasize the importance of performing necropsies by trained personnel, while a postmortem individual becomes an important source of scientific and biological information. To achieve this, it is necessary to examine in detail as much information as possible, to determine the cause of death, and it also allows inference about the health of the ecosystem in general.

The attention given to these events by the stranding network facilitates a more detailed, structured, and collaborative analysis of each occurrence. This, in turn, contributes to raising awareness among communities and institutions about the importance of manatees and the level of threats they face at a regional and global level. Additionally, it directs efforts toward the development of long-term conservation programs for manatees, with the aim of reducing the frequency of future events involving the species and providing proper justification for the protection of its critical habitat (Mignucci-Giannoni et al., 2000; Bonde et al., 2012; Balensiefer et al., 2017; Galves et al., 2023).

We recommend the maintenance of adequate law enforcement, removal of gillnets from areas currently used by manatees, the establishment of additional protected areas for the species, and expanded and regulated boat speed zones in areas where high boat traffic and manatees are present. Implementation of boating regulations, such as no-wake zones within areas of high manatee presence, as well as regulation of tourism boating activities, should be implemented to reduce the threats to the species (Martin et al., 2015; FWC, 2016; Hostetler et al., 2018; Galves et al., 2023).

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