ORIGINAL RESEARCH

Updated take estimates of marine turtles in the Guajira Peninsula, Venezuela

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ABSTRACT. The Guajira Peninsula is one of the most important foraging grounds areas for marine turtles in Venezuela. There, five species converging: the green turtle, hawksbill, loggerhead, leatherback, and olive ridley. The Wayuú indigenous people are inhabits of the Guajira Peninsula. They have a close relationship with these animals, and for generations, they have used these species as subsistence resources. Marine turtle take has always occurred in this area and has historically been high; it is still happening now, but the current extent is unknown. For that reason, we aimed to assess and update the estimate for marine turtles take in the Guajira Peninsula. We conducted 25 field surveys between February and March 2022 by visiting 15 locations to seek for alive turtles and remains on landing sites. We recorded the species, date, location of each encounter, and curve carapace length (CCL) measurements. Additionally, 15 semi-structured interviews were conducted with members of the Wayuú community. During field surveys, an estimated 81 marine turtles were identified. The most affected species were green turtles (91.3%, n = 74), followed by hawksbills (3.7%, n = 3), loggerheads (3.7%, n = 3), and leatherbacks (1.2%, n = 1). The majority of green turtles were subadults, with an average CCL size of 64.7 ± 16.5 cm (82.2%, n = 52). Interviewees mentioned that marine turtles were caught for cultural practices, consumption, ancient medicine, and commerce. Further monitoring activities are needed to understand the take level and its implications for marine turtle populations in the Caribbean Basin.

Key words: Artisanal fishery, green turtle, Gulf of Venezuela, Illegal Unregulated and Unreported (IUU), aquatic bushmeat.

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Estimaciones actualizadas de capturas de tortugas marinas en la Península de la Guajira, Venezuela

RESUMEN. La Península de la Guajira es una de las áreas de alimentación más importantes para las tortugas marinas en Venezuela. Allí convergen cinco especies de tortugas marinas: la tortuga verde, carey, caguama, cardón y golfina. En esta zona habita el pueblo indígena Wayuú. Ellos tienen una estrecha relación con las tortugas marinas y, durante generaciones, han utilizado estos animales como recursos de subsistencia. En la Península de la Guajira, la captura de tortugas marinas siempre ha ocurrido y ha sido históricamente alta; hoy en día, continúa, pero su magnitud es desconocida. Nuestro objetivo fue evaluar y actualizar la estimación de la captura de tortugas marinas en la Península de la

Guajira. Realizamos 25 salidas de campo entre febrero y marzo de 2022, visitando 15 localidades para buscar tortugas vivas o restos en los sitios de desembarque. Registramos la fecha, ubicación de cada hallazgo y tomamos mediciones biométricas del largo de la curva del caparazón (LCC). Además, se realizaron 15 entrevistas semiestructuradas con miembros de la comunidad Wayuú. Durante los estudios de campo, se identificaron aproximadamente 81 tortugas marinas. Las especies más afectadas fueron las tortugas verdes (91,3%, n = 74), seguidamente con carey (3,7%, n = 3), las caguamas (3,7%, n = 3) y cardón (1,2%, n = 1). La mayoría de las tortugas verdes fueron subadultas, con un LCC promedio de 64,7, 7 ± 16,5 cm (82,2%, n = 52). Se necesitan más actividades de monitoreo en la Península de la Guajira para comprender el nivel de captura y sus implicaciones para las poblaciones de tortugas marinas en la Cuenca del Caribe.

Palabras clave: Pesca artesanal, tortuga verde, Golfo de Venezuela, Ilegal No Reglamentado y No Declarado (INDNR), carne de animales silvestres acuáticos.

INTRODUCTION

Marine turtles are migratory species with a large distribution in tropical and subtropical oceans worldwide (Musick 2002). In Venezuela, five species of marine turtles are present at nesting beaches and feeding grounds: the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*) and olive ridley turtle (*Lepidochelys olivacea*) (Guada and Solé 2000; Barrios-Garrido et al. 2015; Buitrago et al. 2015a, 2015b; Guada et al. 2015; Rondón-Médicci et al. 2015). The Gulf of Venezuela is known as one of the most important foraging grounds for marine turtles in Venezuela and the Caribbean Sea (Guada and Solé 2000; Barrios-Garrido and Montiel Villalobos 2016; Barrios-Garrido et al. 2020a, Rojas-Cañizales et al. 2021), with abundant food resources for the optimal development of these species (Espinoza-Rodríguez et al. 2021).

This area encompasses the Guajira Peninsula, a territory shared between Colombia and Venezuela (Barrios-Garrido et al. 2019), which is an ancestral land of the Wayuú indigenous people (Barrios-Garrido et al. 2018). For the Wayuú people, marine turtles are considered the most important species in their culture (Barrios-Garrido et al. 2018b), a gift from an ancestral God 'Maleiwa'. They are used as food, medicine, and spiritual resource (Rueda-Almonacid et al. 1992; Barrios-Garrido et al. 2019). Although the Wayuú people have traditionally used marine turtles, this use may vary according to the necessities of people (Barrios-Garrido et al. 2017). Nowadays, the Wayuús are changing their traditional practices, such as the inclusion of commercial use of marine turtle products into a formerly trade-based local indigenous economy (Barrios-Garrido et al. 2017). One of the main sources of income for the Wayuú people is artisanal fishery. However, the problem with these fisheries arises when the target species, such as marine turtles, are threatened by local extirpation. Despite international and national restrictions, the trade of marine turtle products continues in populous areas of the Guajira Peninsula. The price of items varies depending on the turtle's size, species, location, season, and destination (Barrios-Garrido et al. 2017, 2020a; Rojas-Cañizales et al. 2020).

The trade of marine turtles is prohibited in Venezuela. However, the Venezuelan Organic Law of Indigenous Communities and People (in Spanish: Ley Orgánica de Pueblos y Comunidades Indígenas), the Wayuú people grants the right to use, manage, and conserve the environment and natural resources within ancestral territories in accordance with traditional customs (Venezuela 2005). Unfortunately, marine turtles are increasingly taken for commercial purposes and not for subsistence uses. This illegal take and trade of marine turtles is an increasingly problem around the world, from the take of animals and eggs on nesting beaches to capturing animals at sea (Awadh et al. 2017; Senko et al. 2022). Illegal taking of threatened species at unsustainable levels impairs the species' capabil-

ity for recovery and incorporate new recruits for their populations (Berry 2013; FAO 2020; Frey 2022; Marsh et al. 2022). The last assessment in the Venezuelan Guajira in 2013 indicated that at least 3,600 marine turtles were illegally taken annually (Barrios-Garrido et al. 2020a; Rojas-Cañizales et al. 2020). Since then, the trends in illegal marine turtle take in the region remained unknown. Given the lack of data over the last decade, it is crucial to investigate and assess the current levels of illegal marine turtle take on the Guajira Peninsula (Barrios-Garrido 2018a). This assessment also helps to reveal the unquantified pressure that marine turtles face, which could significantly impact their populations across the Caribbean basin.

MATERIALS AND METHODS

Study area

The Venezuelan Guajira is located in the northwestern region of Zulia state (Figure 1). It borders Colombia and comprises 88 km along the western shore of the Gulf of Venezuela and is divided into the Upper, Middle, and Low Guajira (Barrios-Garrido and Montiel-Villalobos 2016; Barrios-Garrido et al. 2020b, Rojas-Cañizales et al. 2020). The climate in the area is arid and semi-arid with an average sea surface temperature of 28 °C (Zeigler 1964; Medina and Barboza 2003). The annual precipitation is 1,000 mm, and the region experiences high evaporation rates due to strong insolation. As a consequence of the arid conditions, the predominant vegetation is mainly xerophilic in the absence of salt water and halophilic near the coasts of the Gulf of Venezuela (Medina and Barboza 2003).

Data collection

A total of 25 surveys were conducted between February and March 2022 across 15 locations (landing sites) within the Guajira Peninsula (Table 1). The date, location, and GPS coordinates for each site were recorded. Each landing site within a locality was searched for evidence of marine turtle, including remains such as carapaces, plastrons, and skulls, as well as live turtles, noting the presence of any available tags (Barrios-Garrido and Montiel-Villalobos 2016; Barrios-Garrido et al. 2020b; Rojas-Cañizales et al. 2020). Marine turtles were identified to the species level following the protocol proposed by Pritchard and Mortimer (1999). Measurements of the curved carapace length (CCL) and plastron length (PL) were taken with a flexible 150 ± 0.2 cm tape measure (Bolten 1999). To prevent repetitive sampling, all carapaces/plastrons were painted with black spray paint on the first anterior left lateral scute (Rojas-Cañizales et al. 2020). We estimated the size of juvenile, subadult, and adult turtles based on the CCL measurements for green turtles (juvenile ≤ 51.9 cm, subadult 52-90.9 cm, and adult ≥ 91 cm) (Godfrey and Cluse 2006; Witherington et al. 2006; Stringell et al. 2013), hawksbills (juvenile ≤ 55.9 cm, subadult 56-76.9 cm, and adult ≥ 77 cm) (Robinson et al. 2021; Godfrey and Cluse 2006), and loggerheads (juvenile ≤ 50.9 cm, subadult 51-77.8 cm, and adult ≥ 78 cm) (Godfrey and Cluse 2006; Bovery and Wyneken 2013).

In addition, between February and March 2022, 15 semi-structured interviews (open-ended) were conducted with experienced fishers and locals who acted as key informants. Key informants were Wayuú members who have used, consumed or have traditions regarding sea turtles. All participants were selected by target and snowball sampling (Newing 2010). Interviews were focused on three main subjects: (a) traditional use (i.e. non-commercial use of marine turtle products), (b) trade and consumption (i.e. level of take, trade routes, and price of marine turtle products), and (c) anecdotal information about turtle take (Tambiah 1999; Barrios-Garrido et al. 2017; Mejías-Balsalobre et al. 2021). Interviews were conducted individually in Spanish or Wayuúnaikii, with previous oral consent and guaranteed anonymity regarding personal information (Álvarez-Varas et al. 2020).

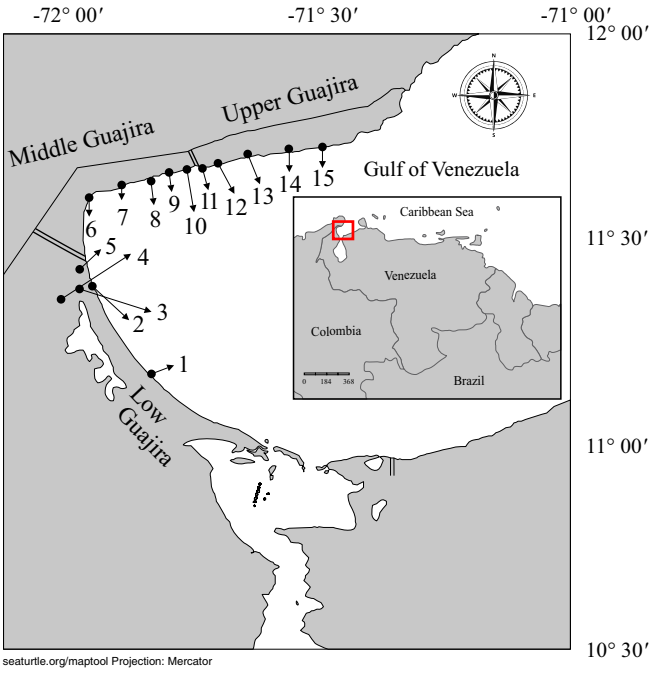

Figure 1. Locations visited during field surveys in the Upper, Middle, and Lower Guajira regions of Venezuela, during February and March 2022.

Table 1. Name and complementary data relative to 15 localities visited during the study period in the three main areas of the Guajira Peninsula, during February and March 2022.

Locality	Figure 1 number	Coordinates	Number of visits	Region
Caimare Chico	1	11.1494-71.8283	1	Low
Caño Sagua	2	11.3503-71.9495	2	Low
Paraguaipoa	3	11.3502-71.9657	2	Low
Laguna del Pájaro	4	11.3865-71.9808	1	Low
Alitain	5	11.3292-72.0276	1	Low
San Francisco	6	11.6003-71.9501	2	Middle
Kazuzain	7	11.6041-71.9198	3	Middle
Uyalcira	8	11.6043-71.9169	1	Middle
Cauchito	9	11.6064-71.9073	1	Middle
Poitchia	10	11.6248-71.8699	1	Middle
Cojoro	11	11.6339-71.8405	2	Middle
Parashiou	12	11.6661-71.7056	1	Upper
Cusia	13	11.6869-71.6311	3	Upper
Porshoure	14	11.6947-71.5727	3	Upper
Irramacira	15	11.6978-71.5574	1	Upper

RESULTS

From February to March 2022, a total of 81 marine turtles were documented on the Venezuelan Guajira Peninsula (Figure 2), with an estimated take rate of 13.5 individuals per week. Among the specimens observed, six were green turtles (7.4%; n = 6) and three were loggerhead turtles (3.7%; n = 3), all of which were recorded alive. Of these, five individuals were taken for consumption, while two greens and two loggerheads were released. Notably, one of the released green turtles showed signs of fibropapillomatosis disease. The majority of individuals taken were green turtles (91.3%; n = 74), followed by loggerheads (3.7%; n = 3), hawksbills (3.7%; n = 3), and a single leatherback turtle (1.2%; n = 1). The highest number of turtles taken were recorded in the Middle Guajira in the localities of Uyalcira (33.3%; n = 27), followed by Porshoure (12.3%; n = 10) and Kazuzain (9.9%; n = 8).

Figure 2. Marine turtle observations from the Guajira Peninsula: marine turtle skull (A), humerus bone (B), dead juvenile green turtle (C), turtle carapaces and plastrons (D), green turtle carapaces (E), flipper tags (F), and green turtle found alive (G).

The mean CCL for green turtles was 64.8 ± 15.7 cm (range 25.5-96.5 cm; n = 62) (Figure 3), while the mean PL was 47.57 ± 11.1 cm (n = 48). The majority of green turtles were subadults (82.2%; n = 51) and its CCL was 70.3 ± 10.9 cm. The mean CCL for loggerhead turtles was 67 ± 0.9 cm (range 66.0-67.5 cm; n = 2), and for hawksbill turtles it was 59 ± 3.3 cm (range 55.5-61.8 cm; n = 3). All loggerheads and hawksbills found were subadults. Additionally, five tags from green turtles taken in the Guajira Peninsula were recorded (Figure 4), two of which were from the same turtle. Among the tagged turtles, one was tagged in Bermuda in 1999, two in Bonaire in 1999 and another in 2015, and the last one was tagged in the Gulf of Venezuela in 2017 at Caño Sagua (Low Guajira) (Figure 4).

All interviewees came from diverse backgrounds related to turtle take in the area. All were members of indigenous families (n = 15), and some of them were turtle hunters (n = 4). They mentioned that marine turtle take has always occurred in the Guajira Peninsula. Our respondents (n = 15) affirmed that capture rate during the sampling months (February and March) is low but increases between July and September (n = 11). They also indicated that the best month for captures is August, due to the high aggregation of turtles around feeding areas. In addition, interviewees affirmed (n = 15) that during the COVID-19 lockdown marine turtles became an important food resource, leading to an increase in their consumption. According to our interviewees, the green turtle is a commonly captured and consumed species, with its flavor considered a delicacy (n = 15). They also catch hawksbills, loggerheads, and leatherbacks, though they do not prefer their taste and flavor as much (n = 15).

Most of our respondents (n = 9) stated that they only take larger sizes turtles (> 50 cm), as smaller animals are not ideal targets. Larger turtles are more expensive when sold. Smaller turtles, on the other hand, are either consumed by families or sold to other families as food. Additionally, respondents mentioned that they consume marine turtles even with visible fibropapilloma diseases. Marine turtles are prepared on the grill or in stews, commonly served with rice, arepa, yucca, or plantains, and eaten for breakfast, lunch, or dinner. One respondent mentioned that eggs are taken when marine turtle nests are found. Finally, some fishermen

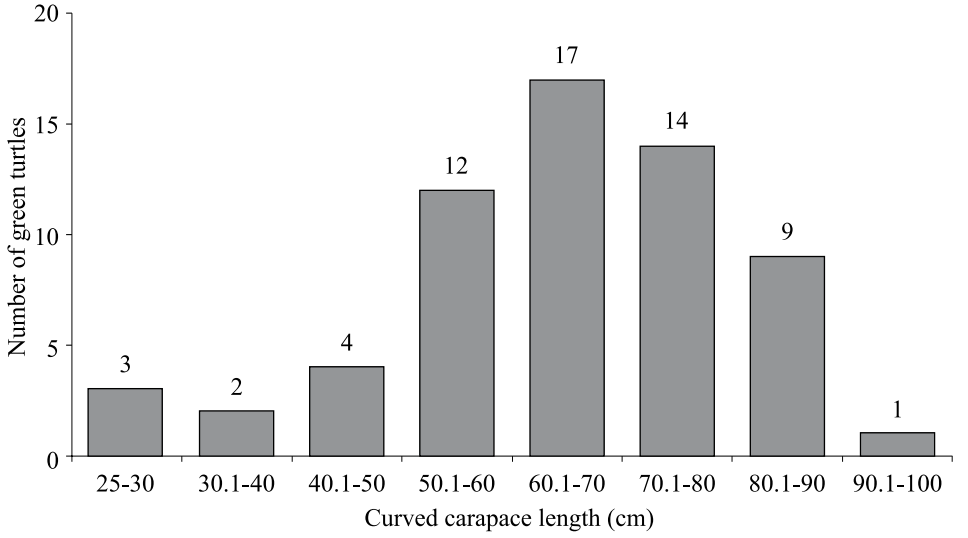

Figure 3. Distribution of curved carapace lengths of green turtles found at landing sites within the Guajira Peninsula during February and March 2022.

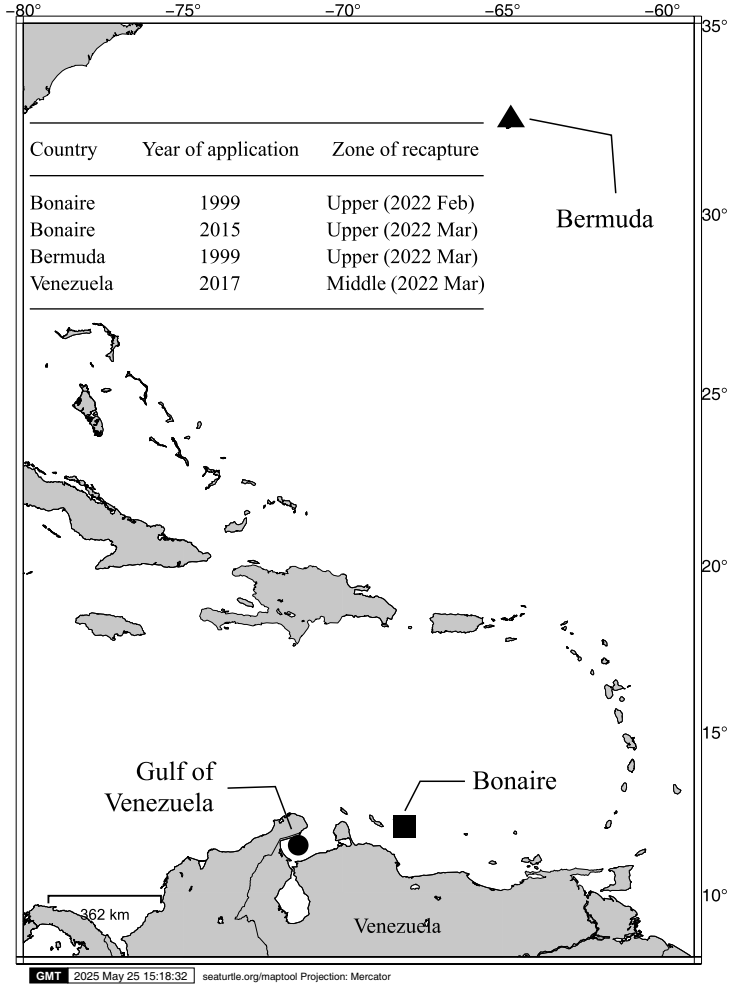

Figure 4. Countries of origin and year for flipper tags applied to green turtles recaptured in the Venezuelan portion of the Guajira Peninsula (source: www.seaturtle.org).

stated that marine turtles are their primary target, while others mentioned that they are caught accidentally. The main fishery targets were painted mackerels (*Scomberomorus regalis*), with sharks and stingrays occasionally caught. Two interviewees reported that marine turtles can be sold at the Paraguaipoa market and various landing sites, with the most common being Caño Sagua, Kazuzain and Porshoure. However, three respondents stated that marine turtle products continue to be illegally traded between Venezuela and other countries, mainly Colombia and Panama.

DISCUSSION

Marine turtles continue to be taken for consumption and trade on the Guajira Peninsula. Our results estimate that at least 13.5 marine turtles are taken each week, which means a rough estimate of 702 marine turtles annually. This estimation represents: 1) off-season capture rates, as our surveys were conducted outside the nesting season, and 2) a minimum figure, as they do not account for

entire turtles that may be sold alive, butchered and cooked, burned, or hidden within houses or landing sites (Rojas-Cañizales et al. 2022). Marine turtles take occurs year-round on the Guajira Peninsula. However, interviewees reported that capture rates peak between July and September, with August being the most active month, coinciding with the rainy season in the Gulf of Venezuela. This finding aligns with a previous study conducted by Rojas-Cañizales et al. (2021) in Middle Guajira in 2013, where 92.2% (n = 154) of turtles captured during a year-long sampling period were green turtles. Although the sampling period was conducted during the off-season, green turtles remain the most affected species. Notably, this period overlaps with the nesting season of green turtles in the Caribbean, explaining the increased capture rates during this period compared to the off-season (Barrios-Garrido et al. 2020a; Rojas-Cañizales et al. 2021; Restrepo et al. 2023). The present study encompasses the Low, Middle and Upper regions of Guajira, with green turtles accounting for 91.3% (n = 74) of encounters. Despite nearly a decade between studies, results are remarkably consistent, highlighting that green turtles represent more than ninety percent of capture cases. This pattern is consistent with earlier researches from 2005, which identified subadult green turtles as the most frequently captured by artisanal fisheries (Barrios-Garrido et al. 2020a; Rojas-Cañizales et al. 2020). This prevalence is attributed not only to their abundance in the area but also to their cultural significance, as they are the preferred species among the Wayuú people (Barrios-Garrido et al. 2018).

During the Covid-19 lockdown, significant marine turtle conservation efforts were reported in various countries, including Malaysia, Costa Rica, Mexico, and parts of Venezuela (Uzair-Rusli et al. 2020; New England Aquarium 2021; Quesada et al. 2021). However, no conservation initiatives were documented in the Guajira Peninsula. Residents of Venezuelan Guajira indicated that marine turtles became a critical food source during the lockdown due to limited availability of other resources. In the Venezuelan Guajira, marine turtles are exploited for both local consumption and illegal trade. The highest capture rates in this study were recorded in Middle Guajira (i.e. Uyalcira and Kazuzain), consistent with findings by Rojas-Cañizales et al. (2021). The proximity of these areas to a main commercial road near the Colombian border facilitates transportation and trade. Larger turtles, which command higher prices, are likely sold alive, particularly in Middle and Upper Guajira (Rojas-Cañizales et al. 2020). Some inhabitants commercialize marine turtle products in Venezuela, Colombia, or Panama for higher profit on the illicit market, particularly in Colombian pesos (Barrios-Garrido et al. 2017). This currency is preferred over the Venezuelan bolivar, which has been heavily devalued due to hyperinflation. Interviewees reported prices for subadult turtles ranging from USD 21 to 79, with pricing dependent on size and seller criteria.

During field surveys, marine turtle tags from other Caribbean locations, such as Bonaire and Bermuda, were documented. This confirms the role of the Gulf of Venezuela as a migratory corridor and feeding ground in the Caribbean Sea (Barrios-Garrido et al. 2020b). These turtles likely use the Gulf of Venezuela due to ontogenetic movement between developmental foraging areas or as part of a final migration to adult foraging range (Barrios-Garrido et al. 2020b). This fact opens a window to better understand the connectivity between the various regions, which is crucial for holistic population management.

Some inhabitants showed interest in marine turtle conservation during our fieldwork, even releasing four turtles during the study. To reduce marine turtles take and consumption in the Guajira Peninsula, collaborative conservation efforts are needed. The GTTM-GV (Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela) should lead efforts with NGOs, government agencies, associations, and collages with a focus on Wayuú community participation. This inclusive approach can foster community engagement, ecological balance and a more responsible society (Kennett et

al. 2004). Community-led initiatives have demonstrated significant progress, with behavioral shifts reducing turtle consumption and encouraging sustainable practices (USAID 2014; Da Silva et al. 2016; Garcia 2020). To ensure effective conservation, multi-level commissions should implement measures such as four-month closed season, during green and hawksbill turtles nesting season (from July to October), annual catch quotas, regulated trade, capture size restrictions, the establishment of a finite number of taking locations to minimize the impact of taking, and environmental education campaigns to generate a more responsible society towards its food, and to spiritual and recreational use (Mendoza-Lewis et al. 2021). Such strategies could include awareness campaigns about the status of marine turtle populations, education regarding the ecological importance of healthy turtle populations, and collaborative conservation management such as nesting beach monitoring, demographic data collection, and poaching patrols (Troëng and Rankin 2005; CIT 2006; Campbell 2010; USAID 2014).

However, non-management-related challenges such as food scarcity, inadequate public services, and limited transportation, must also be addressed to reduce the demand for illegal or unsustainable marine turtle products. Both management and socioeconomic plans are essential to tackle key issues, including the reliance on marine turtles for subsistence and the need for alternative income sources. Non-management-related plans seek efforts to mitigate some of the socio-economic problems, 1) create social programs with government support for food aid 2) educational workshops about alternatives to generate incomes with other occupations, which can be much more profitable than marine turtle trade and favorable to decrease or avoid marine turtle take and trade. Addressing both management and socio-economic challenges is essential for conserving marine turtles in the Venezuelan Guajira and achieving long-term sustainability (Oravetz, 2000; Barrios-Garrido et al. 2020a).

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Author contributions

Royner Carrasquero-Labarca: methodology; investigation; data curation; review, writing-original draft; visualization; funding acquisition. Matthew Ware: investigation; data curation; writing-review and editing. Jordano Palmar: methodology; investigation; data curation; review. Daniela Rojas-Canizales: original research concept and design; validation; formal analysis; data curation; supervision; writing-review and editing. Héctor Barrios-Garrido: original research concept and design; validation; formal analysis; data curation; supervision; writing-review and editing; project administration; resources; funding acquisition.

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