Herpetological Conservation and Biology 11(1):244–252.
Submitted: 5 August 2013; Accepted: 25 March 2016; Published: 30 April 2016.

STRANDINGS OF LEATHERBACK TURTLES (*DERMOCHELYS CORIACEA*) ALONG THE WESTERN AND SOUTHERN COAST OF THE GULF OF VENEZUELA

***HÉCTOR BARRIOS-GARRIDO* [1,2,3,5] *AND MARÍA G. MONTIEL-VILLALOBOS* [3,4]**

[1]*College of Marine and Environmental Sciences, Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University, Townsville, Queensland 4811, Australia*
[2]*Laboratorio de Ecología General, Centro de Modelado Científico (CMC), Facultad Experimental de Ciencias, La Universidad del Zulia, Apartado 526, Maracaibo 4001, Venezuela*
[3]*Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV), Urb. Villa Venecia, Calle 40B #15A-41, Maracaibo 4001, Venezuela*
[4]*Laboratorio de Ecología y Genética de Poblaciones, Centro de Ecología, Instituto Venezolano de Investigaciones Científicas (IVIC), Apartado 20632, Caracas 1020-A, Venezuela*
[5]*Corresponding author, e-mail: hector.barriosgarrido@my.jcu.edu.au*

Abstract.—**Leatherback Turtle (*Dermochelys coriacea*) strandings in the Gulf of Venezuela (GV) were evaluated to estimate: (1) the area of most frequent strandings; (2) the period of greatest strandings; and (3) the number of strandings that exhibit evidence of human interaction. We gathered data from three sources: (1) scientific patrols; (2) Opportune Information Network (in Spanish Red de Aviso Oportuno – RAO); and (3) contact with local non-governmental organization. At each stranding site, we collected information about the location, date, specimen condition, and, when possible, the midline curved carapace length (CCL) and curved carapace width (CCW). We categorized the cause of strandings as either interaction with human activities or an unknown cause. We recorded 57 Leatherback Turtle strandings along the GV coast during 2001–2007. The mean CCL was 126.2 cm ± 16.5 (range 86–168 cm, n = 47) and the mean CCW was 99.1cm ± 12.6 (range 83–109 cm, n = 47). Strandings were mainly distributed along the North and South coast (49% and 46%, respectively), and were mostly concentrated between February and March (51%). Over half (55%) of the strandings showed signs of interaction with human activities. Establishing a relationship between fisheries and strandings in the GV remains difficult. Although the stranding number reported is low when compared to other localities, our results represent a minimum estimate of mortality. A management plan is crucial for mitigating possible impacts of artisanal fisheries in the region.**

Key Words.—artisanal gillnet fishing; by-catch; boat strike; intentional fishing; management plan; RAO network

INTRODUCTION

The Leatherback Turtle (*Dermochelys coriacea*) is listed as Vulnerable in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Wallace, B.P., M. Tiwari, and M. Girondot. 2013. *Dermochelys coriacea*. The IUCN Red List of Threatened Species. Version 2014.3. Available at www.iucnredlist.org. [Accessed 14 March 2015]), mainly due to egg poaching on nesting beaches (Chacón et al. 1996; Lagueux and Campbell 2005; Tomillo et al. 2008), bycatch from longline fisheries (Lewison et al. 2004; Lewison and Crowder 2007; Lewison et al. 2015) and drift-netting (Barata et al. 2004; Lee Lum 2006). In Venezuela, the Gulf of Venezuela (GV) is one of the most important feeding grounds for Leatherback, Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*), and Olive Ridley (*Lepidochelys olivacea*) turtles (Rondón Medicci et al. 2010; Barrios-Garrido 2015). Despite this, information about Leatherback Turtle distribution in the GV is scarce (Guada and Solé 2000). Some evidence of nesting in the Gulf has been found, such as a necropsied female Leatherback Turtle with eggs in her oviduct, and more recently, five Leatherback Turtle nests were identified in Irramacira, Castilletes (Espinoza-Rodríguez et al. 2013).

The vast majority of information about Leatherback Turtles in the GV has been derived from stranding data within the past 20 y (Acuña and Toledo 1994). Several anthropogenic threats to the species have been identified, such as the traditional use of meat, leather, and oil (Barrios-Garrido and Montiel-Villalobos 2006a, 2008), and habitat degradation (Rondón Medicci et al. 2010; Barrios-Garrido 2015). Artisanal fishing, particularly gillnets that overlap with foraging sites (Montiel-Villalobos et al. 2008), and commercial fisheries have been linked to Leatherback Turtle strandings in the GV (Pirela et al. 2008), but neither has been systematically examined. In this study, we specifically aimed to estimate: (1) the area of the most frequent strandings; (2) the period of greatest strandings; and (3) the number of strandings that exhibit evidence of human interaction.

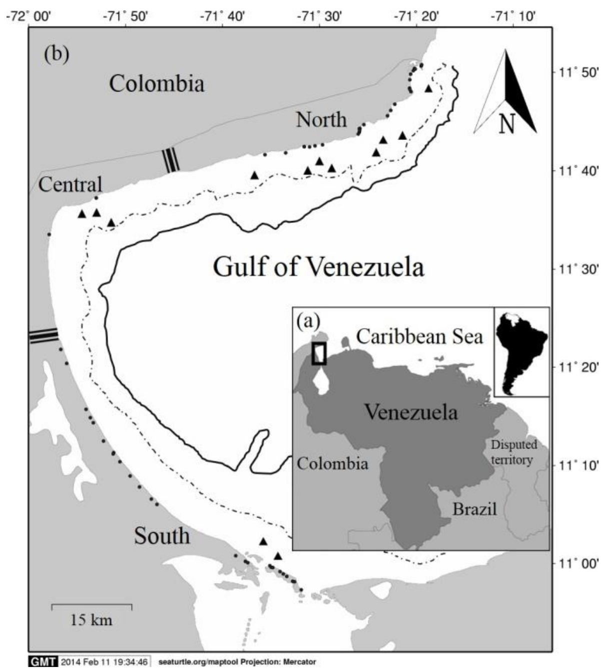

FIGURE 1. (a) Geographical location of the study area (dark rectangle) of strandings of Leatherback Turtle (*Dermochelys coriacea*) within Venezuela, showing its relative position within South America. (b) Detail of the central and western coast of the GV, showing the study area. Triple lines demark areas: North, Central, and South. Lines indicate depths of 10 m (dashed) and 15 m (continuous), black triangles indicate areas containing year-round artisanal fishing nets, and circles indicate areas where stranded Leatherback Turtles were found. Map produced using SEATURTLE.ORG Maptool (2002. SEATURTLE.ORG, Inc. Available at http://www.seaturtle.org/maptool/).

MATERIALS AND METHODS

Study site.—The Gulf of Venezuela (GV) is located in the north-western region of Venezuela (Fig. 1a). This area is the most important foraging ground for the five marine turtle species in the country (Guada and Solé 2000). The GV serves as a migratory corridor and a foraging site (Barrios 2003; Montiel-Villalobos 2012; Barrios-Garrido 2015), and there are three recorded nesting beaches along the coastline within Zulia state (Barrios-Garrido and Montiel-Villalobos 2006b; Espinoza-Rodríguez et al. 2013). Our study covers about 160 km stretch of coastline along the north-western and southern GV (11°36´27.5´´N; 71°53´48.7´´W) in the Zulia State region, among the municipalities of Almirante Padilla and Guajira (Guajira Peninsula). The Almirante Padilla municipality has more tourist activity than Guajira municipality due to proximity to Maracaibo City, the capital of Zulia State.

We defined a stranding as an event in which a marine turtle, dead or alive, was found on the beach as a result of either natural causes or human impacts such as fishery activities (Vélez-Rubio et al. 2013; Lopes-Souza et al. 2015). We recorded stranding events in the region during the study period (2001–2007) using three sampling methods (Table 1; Lopes-Souza et al. 2015): (1) scientific patrols, in which a biologist with expertise on marine turtles surveyed for stranded turtles every 1–3 mo from August 2001 to June 2004 and once monthly from July 2005 to September 2007, using a 4×4 vehicle or by foot; (2) surveys conducted by Opportune Information Network (in Spanish, Red de Aviso Oportuno, RAO), in which trained community members searched for stranded turtles every 2–4 weeks by foot from January 2005 to January 2007 (Vernet and Gomez 2007); and (3) surveys by the Marine Turtle Working Group in the Gulf of Venezuela (in Spanish, Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela, GTTM-GV), a non-governmental organization, which carried out surveys opportunistically in the southern region of the GV at least once every 2 mo (Vélez-Rubio et al. 2013; Lopes-Souza et al. 2015). We used a 4×4 vehicle for patrols whenever possible; for areas without roads, islands, and beaches with cliffs, we entered the site on foot. We considered each visit to a site a patrol (Vélez-Rubio et al. 2013; Lopes-Souza et al. 2015).

To evaluate the geographical distribution of the strandings, we used the categorization proposed by Montiel-Villalobos and Barrios-Garrido (2008) to differentiate areas (Fig. 1b): North, from Castilletes (11°50’54.0’’N; 71°19’26.3’’W) to Cojoro Creek (11°37’54.9’’N; 71°50’44.8’’W); Central, from Cojoro Creek to Caño Sagua (11°22’57.6’’N; 71°56’56.2’’W); and South, from Paraguaipoa Beach (11°22’29.6’’N, 71°56’43.7’’W) to Quisiro Beach (10°58’38.2’’N; 71°15’57.7’’W; SEATURTLE.ORG 2002. Maptool. SEATURTLE.ORG, Inc. Available at http://www.seaturtle.org/maptool/. [Accessed 11 February 2014]). Although the artisanal fishing effort changes throughout the year (Montiel-Villalobos 2012), we created a map displaying only locations of the permanent, year-round artisanal fishing nets in our study region.

At each stranding site, we recorded the location using a handheld GPS and evaluated if the turtle had been butchered. We categorized the state of the carcasses following Meager and Limpus (2012) and Vélez-Rubio et al. (2013) as: 0 (alive); 1 (alive, but subsequently died); 2 (dead, carcass fresh); 3 (dead, carcass fair; decomposing but internal organs intact); 4 (dead, carcass poor; advanced decomposition state); 5 (dead, mummified carcass with skin holding bones together); 6 (dead, disarticulated bones. When possible, we measured the midline curved carapace length (CCL) and the curved carapace width (CCW) using flexible tape (± 0.2 cm) from the nuchal notch (anterior edge of the carapace at the midline) to the posterior tip of the caudal peduncle (Bolten 1999), and the widest distance across the carapace from opposing sides of the lateral ridge

TABLE 1. Sampling survey of stranded Leatherback Turtles (Dermochelys coriacea) in the Gulf of Venezuela (2001–2007).

Sampling method	Personnel involved	Transportation	Sampling effort	Area evaluated
Scientific patrols	Biologists with expertise on marine turtles (authors)	Vehicle 4×4 On foot	Once every 1–3 mo (1 August 2001 to 30 June 2004)	All
	Biologists with expertise on marine turtles (authors)	Vehicle 4×4 On foot	Once monthly (1 July 2005 to 15 September 2007)	All
RAO Network[1]	Trained community members	On foot	Once every 2–4 weeks (15 January 2005 to 15 December 2007)	All
Contact with GTTM-GV[2]	Community members and general public (students, fishermen, others)	On foot	Once every 2–3 mo (January 2001 to December 2007)	South

[1]Red de Aviso Oportuno; Vernet and Gómez, 2007.
[2]NGO Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela.

(Steyermark et al. 1996). We took these measurements only in animals between categories 0 to 4. We also categorized the life stage of the animals as either juveniles (< 145cm) or adults (≥ 145cm) based on their CCL (Eckert 2002; Stewart et al. 2007). We determined if turtles had flipper tags but did not scan for passive integrated transponder (PIT) tags because we did not have access to a scanner.

We categorized carcasses following the protocol proposed by Koch et al. (2006), where the apparent cause of stranding was catalogued as either an interaction with human activities (including signs of fishery interaction) or an unknown cause (no sign of fishery interaction). We inferred interaction with human activities if the carcass was entangled in fishing gear or had fresh evidence of injuries consistent with fishing gear interaction around neck and/or flippers (gillnet fishing, hooks, longlines, fishing lines, and other fishing gear; Fig 2a), for carcasses that had been harvested and exhibited evident knife marks (Fig 2b), for carcasses that showed evidence of poaching or vessel strikes (fishing boats or tankers; Fig 2c, 2d, 2e), or for living animals that were found tied to an artisanal fishing boat or anchored with a fishing buoy awaiting to be butchered. When we found animals in an artisanal port, we carried out informal interviews with residents to investigate when the animal washed ashore (dead or alive) or was captured. Due to logistical constraints, we transported and necropsied only one fresh carcass to the University of Zulia (Faculty of Veterinary Sciences). The rest of the necropsies were carried out in situ, and with permission of the community members.

Although the consumptive use of marine turtle is illegal in Venezuela, due to the strong magical beliefs and traditions towards these animals in this region, we were required to obtain permission from the clan leader to carry out necropsies (Barrios-Garrido and Montiel-Villalobos 2006a; Barrios-Garrido 2015). If there was no sign of fishery interaction or other obvious cause of death, or if the carcass was in an advanced stage of decomposition, we categorized the cause of death as unknown. Histopathology studies were not carried out due to the absence of resources and because of the logistical constraints with tissue collection and storage.

RESULTS

Between 2001 and 2007, 57 Leatherback Turtle strandings were recorded within our study region. One animal was found alive (category 0) and another was found fresh dead (category 2); the rest were found in an advanced state of decomposition (categories 3 to 5). Flipper tags were not found on any of the specimens. The mean (± SD) CCL was 126.2 cm ± 19.5 (range 86–168 cm, n = 47; Fig. 3), and the mean CCW was 99.1cm ± 12.6 (range, 83–109 cm, n = 47). Based on the measured CCL, we concluded that 82.9% of the stranded animals were juveniles (sexually immature). The two areas with the most frequent stranding events in the GV were along the North Coast (49%, n = 28) and the South Coast (46%, n = 26). Sporadic strandings were also reported along the Central Coast (5%, n = 3; Fig. 1b).

We documented the presence of permanent artisanal fishing nets, which operate year-round throughout the study region (Fig. 1b). Nets were most abundant in the northern area; only three permanent nets were located in the central area and only two permanent nets were observed in the southern area (Montiel-Villalobos 2012). The nets mainly targeted shark, rays, and lobsters; however, due to their mesh size and the area where the nets are set, they also capture marine turtles (Green Turtle, Hawksbill Turtle, Loggerhead Turtle, and Leatherback Turtle), dolphins (mainly Guiana Dolphin, *Sotalia guianensis*), and rarely Antillean Manatees (*Trichechus manatus*). The time from February to March contained the greatest number of stranding events (n = 29, 51% of reported strandings), followed by August to September (n = 24, 42% of reported strandings) and across the remaining months (n = 4, 7% of reported strandings; Fig. 4). We categorized the

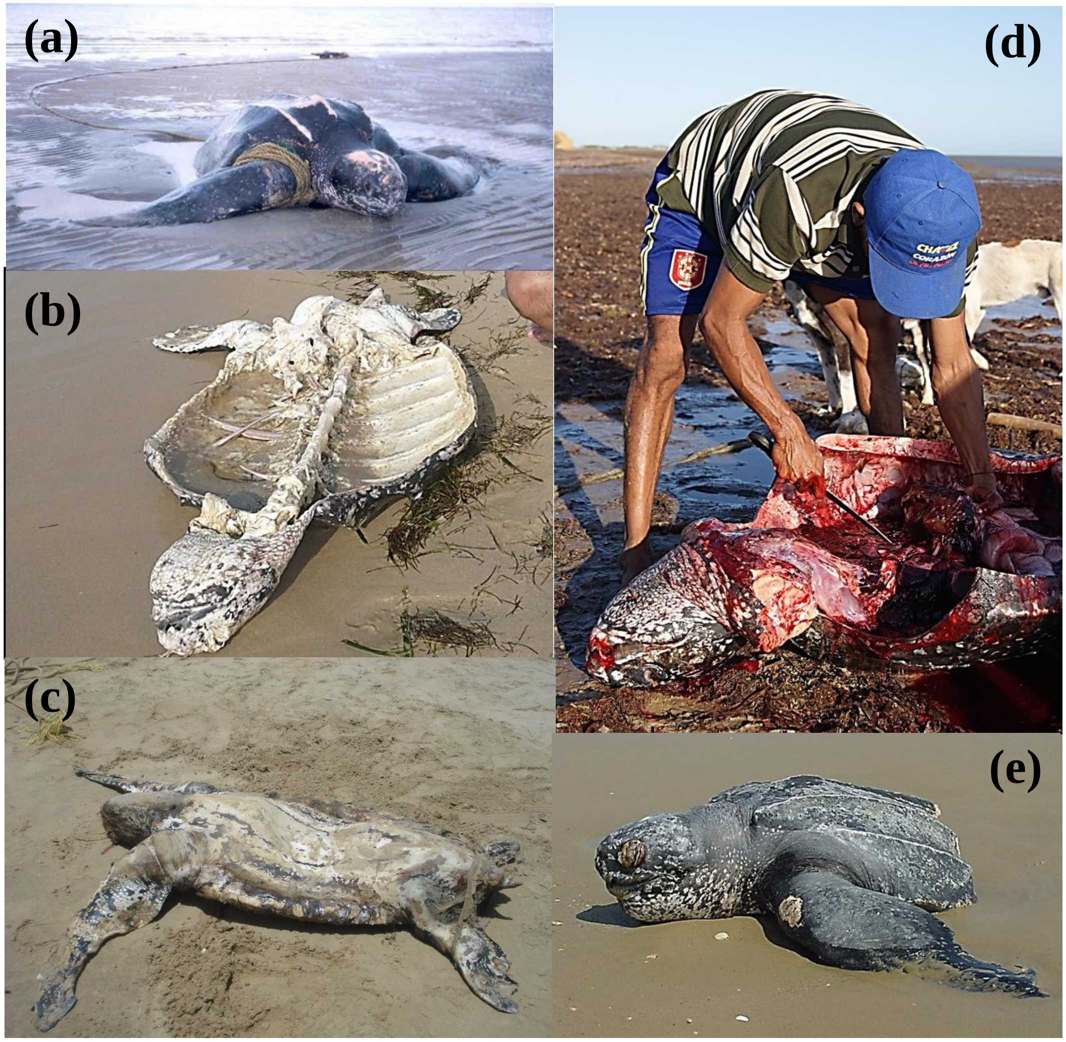

FIGURE 2. Stranded Leatherback Turtles (*Dermochelys coriacea*) in the Gulf of Venezuela with evidence of interaction with human impacts. (a) Fishing gear (Photographed by Alexander Acuña), (b) Harvested Leatherback Turtle (Photographed by Libicni Rivero), (c) Leatherback Turtle with a mark of rope-net in front right flipper: see rope in the top left corner (Photographed by Nínive Espinoza-Rodríguez),(d) Butchering Leatherback Turtle (Photographed by Héctor Barrios-Garrido), and (e) Boat strike (Photographed by Héctor Barrios-Garrido).

majority of the strandings as due to interaction with human activities (n = 32, 55% of reported strandings).

DISCUSSION

More than 80% of the Leatherback Turtles that stranded in the GV between 2001 and 2007 were sexually immature, based on curved carapace length (Eckert 2002; Stewart et al. 2007). Several authors have described how removal of large juveniles (or new adults) from the population negatively impacts future populations of marine turtle species (Heppell et al. 2003; James et al. 2005), particularly as this portion of the population offers the greatest potential for recovery of depleted rookeries. The lack of information regarding the population size and demographic characteristics of Leatherback Turtles using the GV and nesting beaches close to the GV (Colombian Guajira, Paraguana Peninsula-Venezuela) impedes our understanding of how strandings in the GV could be affecting the status of this species in the Southern Caribbean (Rondón Medicci et al. 2010; Borrero Avellaneda 2013).

The northern and southern areas of the GV comprised more than 95% of the recorded strandings (Fig 1b). Due to prevailing marine currents, some coastal areas are more susceptible to receiving greater numbers of strandings than others, causing this uneven distribution (Epperly et al. 1996; Barata et al. 2004; Koch et al. 2013). A map of the marine currents proposed by Zeigler (1964) indicates the clear presence of currents

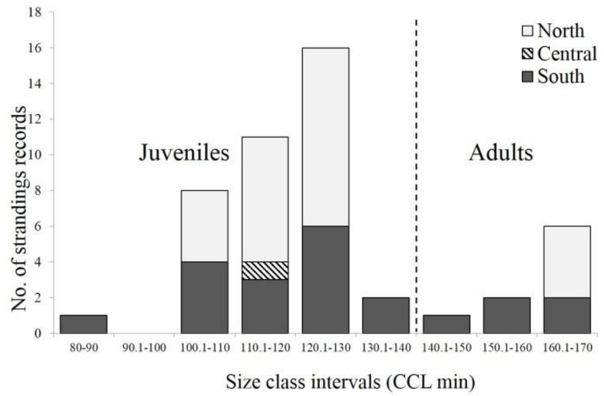

FIGURE 3. Size class intervals of stranded Leatherback Turtles (*Dermochelys coriacea*) in the Gulf of Venezuela (n = 57). Dashed line represents the minimum size reported for adult females, within the Atlantic populations (Eckert 2002; Stewart et al. 2007).

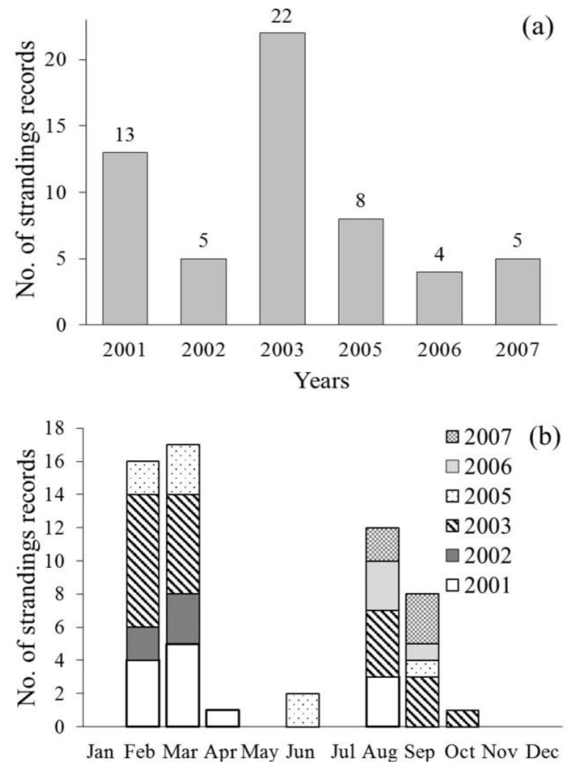

FIGURE 4. Temporal distribution of the Leatherback Turtles (*Dermochelys coriacea*) strandings (n = 57): (a) Annual, (b) Monthly.

that converge in both the Northern and Southern GV. This may be the main cause for the large concentration of strandings events in these areas of our study region. Although the area of the stranding is not necessarily the location where the animal died (Koch et al. 2013), it is an important factor to consider as it may provide information about the possible cause of stranding of the animal, particularly in light of regional fishing activities. Given the concentration of strandings in the Northern and Southern regions, we suggest that inter-agency assessments of strandings of marine megafauna and fishing activities should focus on these areas of the GV. These assessments will be a first step towards creating management and conservation plans in the GV.

Although we provide evidence of a higher level of year-round fishing effort in the Northern area, a large number of strandings were recorded in the Southern area as well. This may be related to two factors: offshore movable fisheries in the southern region of the GV and a higher level of public engagement and awareness. Offshore fishing boats (e.g., artisanal Bongo boats, which use long nylon gillnets up to 1,000 m length) are not evident from the coast line, so they are not reflected in our maps. Although individual fishing trips for artisanal vessels last for five to seven days offshore, they are considered a non-industrial fishery. Further research on target species, fishing areas, and by-catch impacts (manatees, sharks, marine birds, marine turtles, and cetaceans) for offshore artisanal fisheries are warranted. Another cause for the high number of reported strandings in the Southern GV may be the contribution of data from other organizations (e.g., researchers from universities and other non-governmental organizations) as well as the general public that use of the southern part of the GV, especially Zapara Island, San Carlos Peninsula (Almirante Padilla municipality), and Caimare Chico beach (Guajira municipality). There is a greater likelihood that a stranded turtle will be sighted at these highly populated tourist destinations.

Examination of the compiled dataset reflected a seasonal pattern of strandings, and this pattern generally coincided with the periods preceding and following the Leatherback Turtle nesting season (April to July) on the east coast of Venezuela at Margarita Island and the Paria Peninsula (Hernández et al. 2004, 2007; Rondón Médicci et al. 2010). Annual variation in monthly stranding records may reflect variation in fishing effort and tourism activity. Although an increase in strandings occurred concurrently with the nesting season, size data for stranded turtles was heavily skewed towards juvenile Leatherback Turtles. Juvenile Leatherback Turtles using the GV may migrate at similar times and by similar routes as the adult turtles. James et al. (2005) reported that juvenile and adult Leatherback Turtles broadly share a migratory pathway southward from Canadian waters and into the Southern Caribbean during the fall and winter. Further research is necessary to understand the observed pattern of strandings, particularly with regards to how juvenile and adult Leatherback Turtles are using the water of the GV and why juveniles appear to be more vulnerable to stranding compared with adults.

Our results show that 55% of the stranded carcasses exhibited evidence of interaction with human activities.

Of particular concern is the evidence of interactions with artisanal nearshore and offshore fisheries (Dugarte-Contreras 2012; Montiel-Villalobos 2012; Wildermann et al. 2012). The artisanal gillnet fishery has been reported by other authors as an important cause of diminution of female nesting Leatherback Turtles in Caribbean rookeries (Troëng et al. 2004; Lee Lum 2006; Lewison et al. 2015). However, the actual effect of gillnet fisheries on Leatherback Turtle populations are poorly understood. Our limited knowledge about the fisheries that operate in the GV impedes calculations on the true impact on target and bycatch species that use this marine ecosystem.

The first two confirmed deaths of Leatherback Turtles by entanglement in artisanal gillnet fishing during our study were reported in September 2007 (Montiel-Villalobos et al. 2008). Other fishing gears that affect Leatherback Turtles in the GV include the artisanal longline and shrimp trawl fisheries (Barrios-Garrido et al. 2003). Although industrial shrimp trawling was prohibited in 2009 (Bolivarian Republic of Venezuela 2009), recently introduced artisanal trawling could be impacting this species (Wildermann et al. 2012). Artisanal trawling is forbidden by Venezuelan laws, but it has been reported throughout the GV in places such as Zapara Island, San Carlos Peninsula, Punta de Palmas, and Kazuzain (Dugarte-Contreras 2012; Wildermann et al. 2012).

Establishing a relationship between fisheries and Leatherback Turtle strandings in the GV remains difficult. Recorded strandings of Leatherback Turtles due to human interaction are low in the GV when compared with strandings due to artisanal fisheries in other areas (Brazil, USA, and Peru; Barata et al. 2004; Murphy et al. 2006; Alfaro-Shigueto et al. 2007, 2010, 2011); however, this number likely represents a minimum estimate of mortality because the exact proportion of dead animals that actually strand on beaches is unknown (Epperly et al. 1996; Barata et al. 2004; Koch et al. 2013). Furthermore, our results may be an underestimate of mortality due to the period of time between samplings, as the carcasses may dry out and get buried through natural processes, be eaten by vultures and pigs, and/or be dragged to the dunes and eaten by dogs (observed frequently in the area by the authors).

Boat strikes were also recorded in this study. The use of the navigation channel connecting the Maracaibo Lake and the GV by oil tankers (Severeyn et al. 2003) may be one of the reasons of these findings. Further evidence needs to be evaluated to determine the impact of the boat traffic in the area.

Our research provides the first documentation of Leatherback Turtle strandings in the GV, an important foraging and breeding area for this species. We strongly encourage future research to assess Leatherback Turtle mortality due specifically to artisanal gillnets and other artisanal fishing gear. Incorporation of necropsies and collection of histological and genetic samples whenever possible would provide a better perspective about the probable cause of death, as well as origin of the stranded animal. Continuation of this research is necessary in order to improve our understanding of the overall impacts of artisanal fishing on Leatherback Turtle populations, and create a conservation management plan to mitigate the possible impacts of artisanal fisheries in the region (Lewison et al. 2015).

*Acknowledgments.—*We are particularly grateful to the fishermen of Castillete, Tapuri, Porshoure, Parashiou, Zapara Island, and San Bernardo Peninsula for their trust and assistance. We thank all the volunteers and people who activated the RAO-Zulia (Red de Aviso Oportuno, Zulia state). We would like to thank in particular Jordano Palmar, Segundo Palmar (Paraguaipoa), Martín Oquendo (Castilletes), Francisco "Piñita" Rodríguez, Tibisay Rodríguez (Zapara Island), José Luis González, Abraham González (Porshoure), Lerminth Torres (NGO-Mangle), Helímenes Perozo (MPPAmb-Costa Oriental del Lago) and Neiro Flores (San Bernardo). We are appreciative of Natalie Wildermann and Nínive Espinoza-Rodríguez for logistical support in the field, and for their comments. We thank Chloe Nash (Wesleyan University), and Elizabeth Tynan (JCU) for their help in improving the English of this manuscript, also Michael Coyne (MAPTOOL – seaturtle.org). This research was authorized by Venezuela´s Environmental Ministry (Ministerio del Poder Popular para el Ambiente) via scientific hunting licenses 1224 and 828. James Cook University (through the International Postgraduate Research Scholarship, IPRS) supports Hector Barrios-Garrido's Ph.D. candidature.

LITERATURE CITED

Acuña, A.J., and J.R. Toledo. 1994. Rare records of *Dermochelys* in the Gulf of Venezuela. Marine Turtle Newsletter 64:10.

Alfaro-Shigueto, J., P.H. Dutton, M.F. Van Bressem, and J. Mangel. 2007. Interactions between Leatherback Turtles and Peruvian artisanal fisheries. Chelonian Conservation and Biology 6:129–134.

Alfaro-Shigueto, J., J.C. Mangel, F. Bernedo, P.H. Dutton, J.A. Seminoff, and B.J. Godley. 2011. Small-scale fisheries of Peru: a major sink for marine turtles in the Pacific. Journal of Applied Ecology 48:1432–1440.

Alfaro-Shigueto, J., J.C. Mangel, M. Pajuelo, P.H. Dutton, J.A. Seminoff, and B.J. Godley. 2010. Where small can have a large impact: Structure and characterization of small-scale fisheries in Peru. Fisheries Research 106:8–17.

Barata, P.C.R., E.H.S.M. Lima, M. Borges-Martins, J.T. Scalfoni, C. Bellini, and S. Siciliano. 2004. Records of the Leatherback Sea Turtle (*Dermochelys coriacea*) on the Brazilian coast, 1969–2001. Journal of the Marine Biological Association of the United Kingdom 84:1233–1240.

Barrios-Garrido, H. 2015. Las tortugas marinas en el Golfo de Venezuela: Análisis de los datos poblacionales históricos, ecológicos y de conservación. Promotion Dissertation to Associate Professor. Facultad Experimental de Ciencias, La Universidad del Zulia (LUZ). Maracaibo, Venezuela. 110 p.

Barrios-Garrido, H., and M.G. Montiel-Villalobos. 2006a. The sea turtle in magical-religious beliefs of the Wayuu indigenous people: Venezuela. Pp. 189–190 *In* Proceedings of the Twenty-Third Annual Symposium on Sea Turtle Biology and Conservation. Pilcher, N.J. (Ed.). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Technical Memmorandum NMFS-SEFSC-536, Miami, Florida, USA.

Barrios-Garrido, H., and M.G. Montiel-Villalobos. 2006b. First record of nesting activities of the sea turtle in the Gulf of Venezuela: not just for food. Pp. 256 *In* Book of Abstracts of the Twenty-Sixth Annual Symposium on Sea Turtle Biology and Conservation. Frick, M., A. Panagopoulou, A.F. Rees, and K. Williams (Compilers). International Sea Turtle Society, Athens, Greece.

Barrios-Garrido, H., and M.G. Montiel-Villalobos. 2008. Impacts in the conservation of the marine turtles on the part of fishing communities Wayuu in the Gulf of Venezuela. Pp. 72–73. *In* Proceedings of the Twenty-Seventh Annual Symposium on Sea Turtle Biology and Conservation. Rees, A., M. Frick, A. Panagopoulou, and K. Williams. (Compilers). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Technical Memmorandum NMFS-SEFSC-569, Miami, Florida, USA.

Barrios-Garrido, H., M.D. Marchena, A. Medina, K. Mejía, A. Nava, and J.A. Rincón. 2003. Descriptive analysis of the fishing arts that affect the marine turtles in the Gulf of Venezuela. Pp. 156 *In* Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. Seminoff, J. (Compiler). U.S. Department of Commerce, National Oceanic and Atmospheric Administration NOAA Technical Memmorandum NMFS-SEFSC-503, Miami, Florida, USA.

Barrios, H. 2003. Análisis de la diversidad filogenética de la tortuga verde (*Chelonia mydas*) en el Golfo de Venezuela. Bachelor Degree Dissertation, Universidad del Zulia, Maracaibo, Zulia, Venezuela. 65 p.

Bolivarian Republic of Venezuela. 2009. Ley de Pesca y Acuicultura. Official Gazette No. 5877. Expediente número AA50-T-2008-0397. Caracas, Venezuela. 12p.

Bolten, A.B. 1999. Techniques for measuring sea turtles. Pp. 1–5 *In* Research and Management Techniques for the Conservation of Sea Turtles. Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly. (Eds.). IUCN/SSC Marine Turtle Specialist Group, Washington, D.C., USA.

Borrero Avellaneda, W.J., E.A. Patiño, M.L. Guerra, and W.A. Gouriyu. 2013. New evidence of nesting *Dermochelys coriacea* (Tortuga Achepa) at Iporoimao-Utareo Beaches, Guajira, Colombia. Marine Turtle Newsletter 137:13–14.

Chacón, D., W. McLarney, C. Ampie, and B. Venegas. 1996. Reproduction and conservation of the Leatherback Turtle *Dermochelys coriacea* (Testudines: Dermochelyidae) in Gandoca, Costa Rica. Revista de Biología Tropical 44:853–860.

Dugarte-Contreras, F.N. 2012. Aspectos biológico-pesqueros de la Carpetica (*Diapterus rhombeus*) en la Bahía del Tablazo, por parte de la flota pesquera de la Isla Zapara. Bachelor Degree Dissertation, Universidad del Zulia, Maracaibo, Zulia, Venezuela. 57 p.

Eckert, S.A. 2002. Distribution of juvenile Leatherback Sea Turtle *Dermochelys coriacea* sightings. Marine Ecology Progress Series 230:289–293.

Epperly, S.P., J. Braun, A.J. Chester, F.A. Cross, J.V. Merriner, P.A. Tester, and J.H. Churchill. 1996. Beach strandings as an indicator of at-sea mortality of sea turtles. Bulletin of Marine Science 59:289–297.

Espinoza-Rodríguez, N., P. Vernet, L. Morán, N. Wildermann, and H. Barrios-Garrido. 2013. Primer reporte de la actividad de anidación de tortugas marinas en la costa Nor-Occidental del Golfo de Venezuela. Boletín del Centro de Investigaciones Biológicas 47:86–95.

Guada, H.J., and G. Solé. 2000. WIDECAST Plan de Acción para la Recuperación de las Tortugas Marinas de Venezuela. United Nations Environment Programme, Caribbean Environment Programme, Kingston, Jamaica.

Heppell, S., L. Crowder, D. Crouse, S. Epperly, and N.B. Frazer. 2003. Population models for Atlantic Loggerheads: past, present, and future. Pp. 255–273 *In* Loggerhead Sea Turtles. Bolten, A.B., and B. Witherington (Eds.). Smithsonian Institution Press, Washington, D.C., USA.

Hernández, R., J. Buitrago, and H. Guada. 2004. Leatherback Sea Turtle: *Dermochelys coriacea* (Vandelli, 1761) (Reptilia: Dermochelyidae) nesting activity assessment in Playa Parguito, Margarita Island. Memoria de la Fundación La Salle de Ciencias Naturales 64:79–89.

Hernández, R., J. Buitrago, H. Guada, H. Hernández-Hamon, and M. Llano. 2007. Nesting distribution and hatching success of the Leatherback Turtle, *Dermochelys coriacea*, in relation to human pressures at Playa Parguito, Margarita Island, Venezuela. Chelonian Conservation and Biology 6:79–86.

James, M. C., C.A. Ottensmeyer, and R.A. Myers. 2005. Identification of high-use habitat and threats to Leatherback Sea Turtles in northern waters: new directions for conservation. Ecology Letters 8:195–201.

Koch, V., W.J. Nichols, H. Peckham, and V. de la Toba. 2006. Estimates of sea turtle mortality from poaching and bycatch in Bahia Magdalena, Baja California Sur, Mexico. Biological Conservation 128:327–334.

Koch, V., H. Peckham, A. Mancini, and T. Eguchi. 2013. Estimating at-sea mortality of marine turtles from stranding frequencies and drifter experiments. PloS ONE, 8(2):1–10. http://dx.doi.org/10.1371/journal.pone.0056776

Lagueux, C.J., and C.L. Campbell. 2005. Marine turtle nesting and conservation needs on the south-east coast of Nicaragua. Oryx 39:398–405.

Lee Lum, L. 2006. Assessment of incidental sea turtle catch in the artisanal gillnet fishery in Trinidad and Tobago, West Indies. Applied Herpetology 3:357–368.

Lewison, R.L., and L.B. Crowder. 2007. Putting longline bycatch of sea turtles into perspective. Conservation Biology 21:79–86.

Lewison, R.L., S.A. Freeman, and L.B. Crowder. 2004. Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on Loggerhead and Leatherback Sea Turtles. Ecology Letters 7:221–231.

Lewison, R.L., B.P. Wallace, and S.M. Maxwell. 2015. Impacts of Fisheries on the Leatherback Turtle. Pp. 196–207 *In* The Leatherback Turtle: Biology and Conservation. Spotila, J.R., and P. Santidrián Tomillo. (Eds). Johns Hopkins University Press, Baltimore, Maryland, USA.

Lopes-Souza, A., A. Schiavetti, and M.R. Álvarez. 2015. Analysis of marine turtle strandings (Reptilia: Testudine) occurring on coast of Bahia State, Brazil. Latin American Journal of Aquatic Research 43:675–683.

Meager, J.J., and C.J. Limpus. 2012. Marine wildlife stranding and mortality database annual report 2011. III. Marine Turtle. Conservation Technical and Data Report 2012:1–46.

Montiel-Villalobos, M.G. 2012. Efecto de la extracción artesanal de la tortuga verde, *Chelonia mydas*, en el Golfo de Venezuela: Conexiones entre hábitats de alimentación y anidación reveladas por ADN mitocondrial. PhD Dissertation, Centro de Estudios Avanzados, Instituto Venezolano de Investigaciones Científicas (IVIC), Altos del Pipe, Miranda, Venezuela. 140 p.

Montiel-Villalobos, M.G., and H. Barrios-Garrido. 2008. Geographic distribution of the sea turtles in the Gulf of Venezuela. Pp. 141 *In* Proceedings of the Twenty-Fourth Annual Symposium on Sea Turtle Biology and Conservation. Mast, R.B., B.J. Hutchinson, and A.H. Hutchinson. (Compilers). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Technical Memmorandum NMFS-SEFSC-567, Miami, Florida, USA.

Montiel-Villalobos, M.G., H. Barrios-Garrido, and K. Rodríguez-Clark. 2008. Incidental artisanal by-catch of Green Turtles in the Gulf of Venezuela: identifying its impact and priorities areas for mitigation efforts. Pp. 98–99. *In* Proceedings of the Twenty-Seventh Annual Symposium on Sea Turtle Biology and Conservation. Rees, A., M. Frick, A. Panagopoulou, and K. Williams. (Compilers). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Technical Memmorandum NMFS-SEFSC-569, Miami, Florida, USA.

Murphy, T.M., S.R. Murphy, D.B. Griffin, and C.P. Hope. 2006. Recent occurrence, spatial distribution, and temporal variability of Leatherback Turtles (*Dermochelys coriacea*) in nearshore waters of South Carolina, USA. Chelonian Conservation and Biology 5:216–224.

Pirela, D., J. Rojas, J. Bolaños-Jiménez, R. Márquez, F. Troncone, J. Hernández, and F. Mujica. 2008. Estudio Preliminar de las Interacciones entre la Actividad Pesquera, Cetáceos y Tortugas Marinas en el Golfo de Venezuela. Informe Técnico (pp. 47): Instituto para la Conservación y Control de la Cuenca del Lago de Maracaibo (ICLAM). Ministerio del Poder Popular para el Ambiente (MPPA), Maracaibo, Venezuela.

Rondón Médicci, M., J. Buitrago, and H.J. Guada. 2010. Biología reproductiva de la tortuga cardón (*Dermochelys coriacea*) en playas de la Península de Paria, Venezuela, durante las temporadas de anidación 2000–2006. Interciencia 35:263–270.

Severeyn, H., J. Delgado, A. Godoy, and Y. García de Severeyn. 2003. Efecto del derrame de petróleo del buque Nissos Amorgos sobre la fauna macro invertebrada bentónica del Golfo de Venezuela: cinco años después. Ecotropicos 16:83–90.

Stewart, K., C. Johnson, and M. Godfrey. 2007. The minimum size of Leatherback at reproductive maturity, with a review of sizes for nesting females from the Indian, Atlantic and Pacific Ocean basins. Herpetological Journal 17:123–128.

Steyermark, A.C., K. Williams, J.R. Spotila, F.V. Paladino, D.C. Rostal, S.J. Morreale, J. Stephen, M.T. Koberg, and R. Arauz-Vargas. 1996. Nesting

Leatherback Turtles at Las Baulas National Park, Costa Rica. Anidamiento de las tortugas baula en el Parque Nacional Marino Las Baulas, Costa Rica. Chelonian Conservation and Biology 2:173–183.

Tomillo, P.S., V.S. Saba, R. Piedra, F.V. Paladino, and J.R. Spotila. 2008. Effects of illegal harvest of eggs on the population decline of Leatherback Turtles in Las Baulas Marine National Park, Costa Rica. Conservation Biology 22:1216–1224.

Troëng, S., D. Chacón, and B. Dick. 2004. Possible decline in Leatherback Turtle *Dermochelys coriacea* nesting along the coast of Caribbean Central America. Oryx 38:395–403.

Vélez-Rubio, G.M., A. Estrades, A. Fallabrino, and J. Tomás. 2013. Marine turtle threats in Uruguayan waters: insights from 12 years of stranding data. Marine Biology 160:2797–2811.

Vernet, P.D., and A.J. Gómez. 2007. Red de aviso oportuno: estrategia para la conservación de las tortugas marinas en la Isla de Margarita, Venezuela. Memoria de la Fundación La Salle de Ciencias Naturales 167:101–110.

Wildermann, N., G. Delgado-Ortega, J. Reverol, L. Montiel, J. Palmar, and H. Barrios-Garrido. 2012. Artisanal trawling and sea turtle by-catch in the Venezuelan Mid-Guajira. Pp. 300. *In* Proceedings of the Thirty-First Annual Symposium on Sea Turtle Biology and Conservation. Jones, T.T., and B.P. Wallace (Compilers). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Technical Memmorandum NMFS-SEFSC-631, Miami, Florida, USA.

Zeigler, J. M. 1964. The hydrography and sediments of the Gulf of Venezuela. Limnology and Oceanography 9:397–411.

HÉCTOR BARRIOS-GARRIDO is a Biologist (2003) from the University of Zulia, Maracaibo, Venezuela. He received his Masters degree in Aquatic Ecology from the same institution (2006). In 2007 he was Runner Up for the Archie Carr Award, in the Best Conservation Paper category. Since 2008 he has been a member of the Marine Turtle Specialist Group (MTSG-IUCN) and is the President-founder (in 1997) of the Venezuelan NGO Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV). Hector is an Associate Professor at the University of Zulia, where he coordinates courses such as General Ecology, Conservation Biology, Sea Turtle Biology, and Ecology. He has vast experience in community-based conservation, especially among indigenous people. Currently, Hector is a Ph.D. Candidate at James Cook University (JCU) in Townsville, Australia. (Photographed by Dr. Mark Hamann).

MARIA GABRIELA MONTIEL-VILLALOBOS is a Biologist (2003) at the University of Zulia, Maracaibo, Venezuela. She received her Ph.D. in Biology with a major in Ecology in 2012 from the Instituto Venezolano de Investigaciones Científicas (IVIC). Dr. Montiel-Villalobos is a founding member of the Venezuelan NGO Grupo de Trabajo en Tortugas Marinas del Golfo de Venezuela (GTTM-GV). Maria Gabriela has worked during the past 10 y in several research projects related to marine turtle conservation in Venezuela, and previously has accumulated experience by engaging in national and international research relevant to the conservation of marine turtles, as well as other endangered species such as manatee and dolphins. During her Ph.D. research, she developed new methods for identifying critical marine turtle habitats in Venezuela, combining genetic and ecological data. (Photographed by MSc. Héctor Barrios-Garrido).