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Source: Chelonian Conservation and Biology, 21(1) : 136-140

Published By: Chelonian Research Foundation and Turtle Conservancy

URL: https://doi.org/10.2744/CCB-1514.1

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Chelonian Conservation and Biology, 2022, 21(1): 136–140
doi:10.2744/CCB-1514.1
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Records of Olive Ridley Marine Turtles (*Lepidochelys olivacea* Eschscholtz 1829) in Venezuelan Waters: A Review of Historical Data Sets and Threats

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Abstract. – We assess all the records of olive ridley turtles (*Lepidochelys olivacea*) in an exhaustive review of multiple data sources between 1977 and 2018 in Venezuela. We compiled 35 records of olive ridleys in the country. Our findings confirm the almost year-round presence of this species in Venezuelan waters.

Resumen. – Se evaluaron todos los registros de tortuga guaraguá (*Lepidochelys olivacea)* disponibles a través de una revisión exhaustiva de diversas fuentes, la cual comprendió entre los años 1977 y 2018 para Venezuela. Se compilaron un total de 35 registros de tortuga guaraguá para el país. Las evidencias confirman la presencia casi permanente durante todo el año de la especie en aguas territoriales venezolanas.

Lepidochelys olivacea (Eschscholtz 1829) is the most abundant sea turtle in the world (Pritchard 2007). This species is currently categorized as vulnerable according to the International Union for Conservation of Nature (Abreu-Grobois and Plotkin 2008). *Lepidochelys olivacea* has a unique polymorphic nesting behavior (in mass nesting events "arribadas," or solitary) that occur on only a few nesting locations in the eastern Pacific Ocean and the eastern Indian Ocean (Bernardo and Plotkin 2007). Late colonization of the Atlantic Ocean by this species is evident in its phylogeography and the low number of nesting beaches in the western Atlantic (da Silva et al. 2007; Catry et al. 2009), the Mediterranean Sea (Revuelta et al. 2015), the southwestern Atlantic (González-Paredes et al. 2017), and the Caribbean Sea (Moncada et al. 2000; Moncada and Romero 2015).

In the western Atlantic, *L. olivacea* nesting beaches are located among 3 countries: Suriname, French Guiana, and Brazil (Marcovaldi 1999). In 2010, Wallace et al. (2010) described the presence of olive ridley turtles within the Wider Caribbean Region waters, as previous literature documented (e.g., Cuba and Florida; Moncada et al. 2000; Foley et al. 2003; Moncada and Romero 2015), but these records were considered as extreme and uncommon for the species' home range and distribution. Therefore, in the West Atlantic Regional Management Unit description, Venezuela, as well as other Caribbean countries, was not included as part of the olive ridley's distributional range (Wallace et al. 2010).

In Venezuelan databases, olive ridley turtle presence has been documented (Wildermann and Barrios-Garrido 2012; Barrios-Garrido et al. 2015), being the least common marine turtle in the country (Guada and Sole 2000). Although year-round presence has been documented, critical knowledge gaps remain regarding population structure, distribution, trends, and nesting status. Wildermann et al. (2018) mentioned that identifying developmental habitats of *L. olivacea* is critical and necessary to enable studies on the population and trends of this species. Hence, our study aims to describe the year-round presence of *L. olivacea* within the Venezuelan waters to identify developmental habitats in the country.

Methods. — We examined the official Venezuelan national data set from 1977 to 2018 (Fig. 1), including the stranding network data set (organized by C. Balladares), national museum registers, local nongovernmental organization databases, gray literature, unpublished data, and

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Figure 1. Geographical location of the study area. Marks in the map are showing the localities (states or territories) where *Lepidochelys olivacea* individuals were recorded: (triangle) Zulia state, (square) Falcon state, (pentagon) Carabobo state, (hexagon) Miranda state, (diamond) Anzoátegui state, (up arrow) Sucre state, (four-pointed star) Delta Amacuro state, (six-pointed star) Nueva Esparta state, (circle) Los Testigos Archipelago, and (five-pointed star) La Tortuga Island. Map created using Maptool (2002, SEATURTLE.ORG, Inc, available at http://www.seaturtle.org/maptool).

the Opportune Information Network (in Spanish, Red de Aviso Oportuno) databases (Vernet and Gómez 2007; Barrios-Garrido and Montiel-Villalobos 2016). We identified *L. olivacea* records through morphology characteristics (Pritchard and Mortimer 1999) and photos. Additionally, each account was verified by experts with experience in marine turtles.

We include the information regarding each record found, such as date (month/year), state, location (beach name or village), biometric measurements, presence of flipper tags, and cause of death (if known) (Barrios-Garrido and Montiel-Villalobos 2016; Rojas-Cañizales et al. 2021).

Measurements of curved carapace length (CCL) from complete carapaces were extracted from the databases. CCL measurements were taken using a flexible tape ($\pm$ 0.2 cm) from the nuchal notch to the posteriormost notch (Bolten 1999). We estimated the percent of immature and adult olive ridleys as follows: $\leq$ 62.4 cm CCL for immature (da Silva et al. 2007) and $\geq$ 62.5 cm CCL for adults (Tagliolatto et al. 2020).

Results. — We found 35 records of *L. olivacea* within 12 different states or territories within the Venezuelan waters (Fig. 2). Olive ridley turtles were documented almost year-round throughout the Venezuelan coast (Fig. 3). The majority of the olive ridley encounters (34%, n = 12) were documented in the Zulia state. Twenty-one of these records found included the whole animal or carapace (5 alive and released and 16 records of dead individuals). CCL measurements were taken on 21 olive ridley turtles, and most of them were adults (85.72%, n = 18). Mean CCL was 66.6 cm (SD = 5.96 cm, median = 66.64 cm, range = 53.0–80.0 cm, n = 21).

Of the 35 records, 19 olive ridleys were registered as dead-stranded or bycaught in artisanal longlines or gillnets (Fig. 2) and 5 cases as intentional take for human consumption (turtle meat and other body parts were found in local markets or restaurants; n = 5). Finally, 10 of the animals registered showed no evident cause of death, in most of the cases due to the advance decomposition state of the bodies when found.

Discussion. — The 35 olive ridley turtles were recorded almost year-round in 12 states of Venezuela; most of the encounters (n = 26) were found in 3 states (Zulia, Nueva Esparta, and Sucre), where long-term (minimum 15 yrs) conservation and research programs have been carried out by national universities, local nongovernmental organizations, and government initiatives. Thus, it is likely that this uneven proportion of records is related to the concentrated efforts by environmental groups near these localities (Guada et al. 2002; Vernet and Gómez 2007; Balladares and Cova 2013; Barrios-Garrido and Montiel-Villalobos 2016). It is important to mention that in western Zulia state, olive ridley turtles do not have a local name, and indigenous Wayuú fishers considered the species a "rare green turtle" (Barrios-Garrido et al. 2018). Conversely, in eastern Venezuelan coasts, olive ridley turtles are colloquially named "Maní" or "Guaraguá" in Spanish (Barrios-Garrido et al. 2015).

No records of olive ridleys were documented in 4 states that have marine coastal areas (Monagas, Vargas, Aragua, and Yaracuy); however, we do not discard the presence of this species on these locations, as they present specific environmental conditions, such as sandy grounds that are used by *L. olivacea* to forage over multiple prey benthonic species (Plotkin 2003; Wildermann and Barrios-

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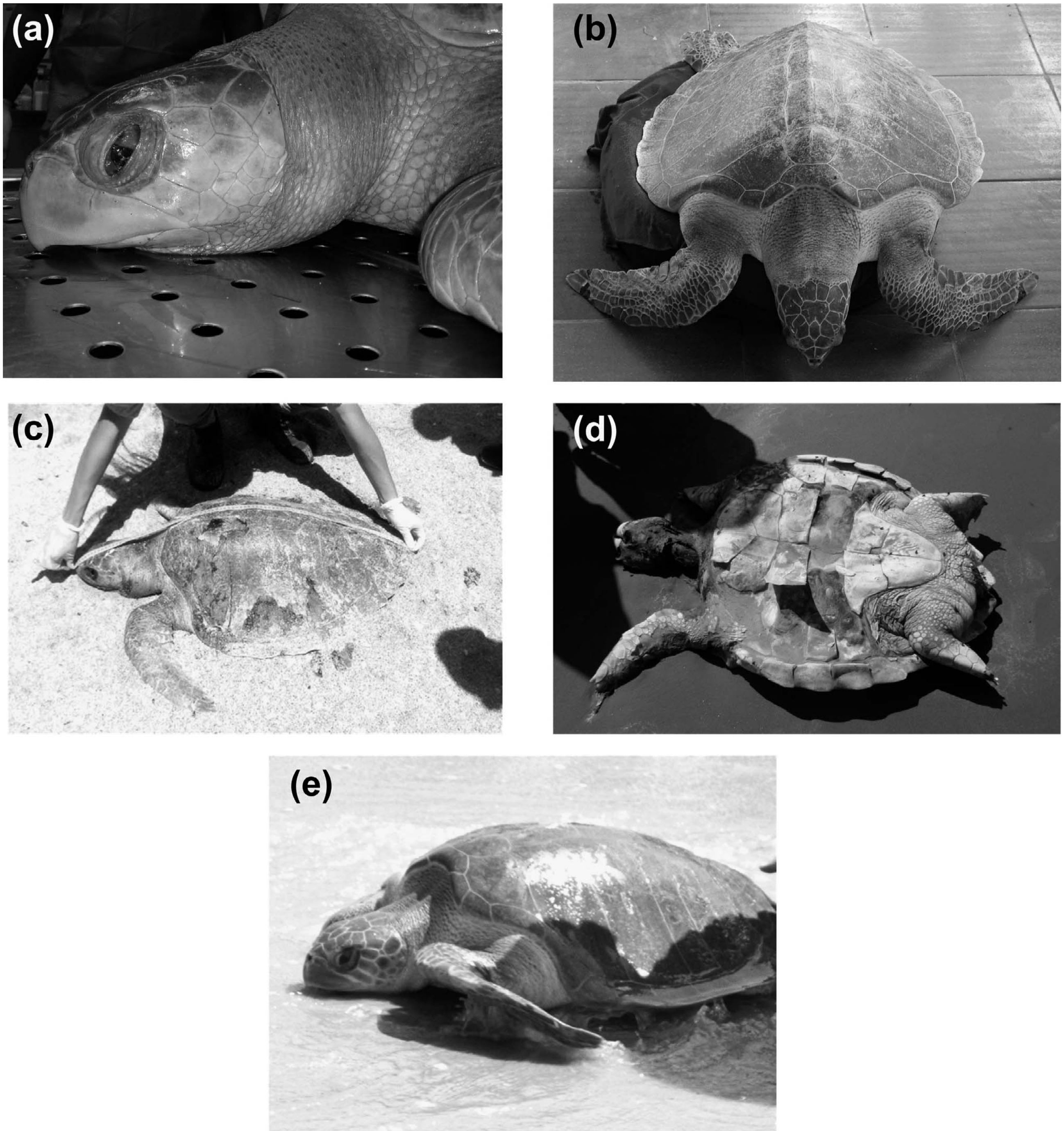

Figure 2. Stranding records evidences of olive ridley turtles in Venezuela. (a) Dead (fresh carcass); (b) individual during its rehabilitation process; (c) stranded animal with marks of fishery interaction; (d) stranded animal in advanced state of decomposition; (e) turtle during reinsertion to the sea. Photos by GTTM-GV personnel (a, b, d, and e) and MPPEA personnel (c).

Garrido 2012; Di Beneditto et al. 2015). Due to the limited data set and the temporal scale of this assessment, it is unclear how the monthly variation of *L. olivacea* observations may vary during the year. Hence, we encourage carrying out extensive field patrols with trained personnel to identify this species and its temporality in future assessments.

Based on CCL measurements taken, most of the encounters were adult (n = 18), suggesting the use of Venezuelan waters by mature olive ridley turtles. However, the lack of further evaluations (such as complete necropsies) of fresh dead animals hindered any additional analysis regarding sexual maturation, sex ratio, and postreproductive migrations of mature *L. olivacea* toward Venezuelan feeding grounds. One record of a postbreeding olive ridley turtle was documented based on a flipper tag recapture identified from a nesting turtle tagged at Eilanti beach (Suriname) while laying eggs and later recaptured in

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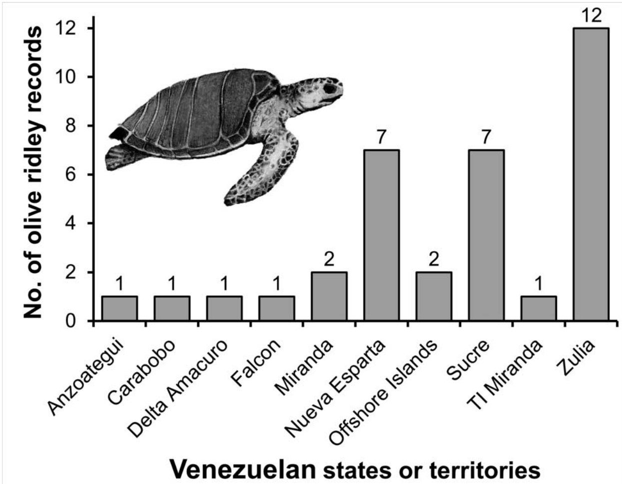

Figure 3. Spatial distribution per states or territories of olive ridley turtles registered in Venezuela ($n = 35$).

the Guajira Peninsula (Zulia state) with no further information but the tag code (Barrios-Garrido et al. 2020a). Hence, adult female olive ridleys in Venezuelan waters are likely using French Guyana and Suriname beaches as nesting habitats (Chambault et al. 2016; Barrios-Garrido et al. 2020a). Further research is needed to verify the connection between Venezuela and neighboring countries with the presence of *L. olivacea* and to elucidate if individuals from Brazilian nesting beaches are also reaching Venezuela's shelf during their postreproductive periods. Such information will be helpful to understand how these animals are using Venezuelan foraging grounds (Santos et al. 2019).

Over half (54%) of the recorded animals showed evidence of interactions with artisanal fisheries (e.g., longline and gillnets). However, Alió et al. (2010) conducted observations of industrial shrimp trawlers in northeastern Venezuela, and no records of *L. olivacea* were identified. In addition, considering that 29% of the animals registered showed no evident cause of death, we recommend that necropsies of fresh bodies be carried out whenever possible to verify the causes of death (Vélez-Rubio et al. 2013; Rojas-Cañizales et al. 2021). Intentional take for human consumption (e.g., for family intake or for sale) was identified as cause of death in 5 cases (14%). Similarly, previous research described intentional take as the main source of mortality for green turtles in the country, especially in the Guajira Peninsula (Barrios-Garrido et al. 2020b; Rojas-Cañizales et al. 2020). However, no evaluations have been carried out to assess *L. olivacea* intentional take.

Acknowledgments. — We would like to thank all the volunteers and technical personnel who helped to document the records compiled on this research and also the fisher communities, which report to environmental entities. This research did not receive any private or national funds. The authors want to thank anonymous reviewers for their comments, edits, and suggestions.

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Received: 21 July 2021

Revised and Accepted: 17 February 2022

Published Online: 13 June 2022

Handling Editor: Jeffrey A. Seminoff

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