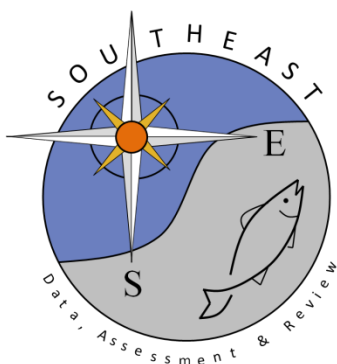


**First Verified Record of the Smooth Hammerhead (*Sphyrna zygaena*) in Coastal Waters of the Northern Gulf of Mexico with a Review of their Occurrence in the Western North Atlantic Ocean**

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## First Verified Record of the Smooth Hammerhead (*Sphyrna zygaena*) in Coastal Waters of the Northern Gulf of Mexico with a Review of their Occurrence in the Western North Atlantic Ocean

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**Abstract** - *Sphyrna zygaena* (Smooth Hammerhead) is considered a wide-ranging hammerhead species, though its distribution throughout its range is not well known. The occurrence of this species in the northern Gulf of Mexico is largely unknown, with only limited unverified records in this region. In September of 2017, a Smooth Hammerhead was collected from Florida coastal waters in the northern Gulf of Mexico, representing a confirmed record of this species in this region. To further understand the range of the Smooth Hammerhead, we reviewed available occurrence data throughout the western North Atlantic Ocean, which suggests this species may occasionally transit into the Gulf of Mexico.

*Introduction.* *Sphyrna zygaena* (L.) (Smooth Hammerhead) is a coastal-pelagic and semi-oceanic hammerhead shark that is distributed worldwide throughout temperate and tropical waters (Ebert et al. 2013). In the western North Atlantic Ocean, the hypothesized range is from Nova Scotia, Canada, to Florida and partly into the Caribbean Sea (Castro 2011, Compagno 1984). While available data suggest this species to be wide ranging, its distribution is not well known due to low encounter rates in scientific studies and a lack of reliable fisheries records (Miller 2016). In Canadian waters, this species is thought to be rare and found only in waters of the Gulf Stream (Fisheries and Oceans Canada 2010). In the Caribbean Sea, its presence has not been confirmed despite this region being noted as a part of its range. Bigelow et al. (1948) believed that the Smooth Hammerhead could account for some historic sighting records in the Caribbean region, but could not confirm the identification of those specimens. A review of available historical checklists by Miller (2016) noted no records from Puerto Rico (Erdman 1987) and the US Virgin Islands (Smith-Vaniz and Jelks 2014). However, Miller (2016) did note catches of Smooth Hammerheads off Venezuela (Tavares 2005), indicating that the species may occasionally venture from central Atlantic waters into the Caribbean Sea.

The Smooth Hammerhead is closely related to other hammerhead shark species found in the western North Atlantic Ocean: *Sphyrna lewini* (Griffith and Smith) (Scalloped Hammerhead), *Sphyrna mokarran* (Rüppell) (Great Hammerhead), and *Sphyrna gilberti* Quattro, Driggers, Grady, Ulrich, & M.A. Roberts (Carolina Hammerhead). All 3 species share similar morphological characteristics and are encountered in coastal and pelagic fisheries in the western North Atlantic Ocean, which could lead to misidentification (Beerkircher et al. 2004, Coelho et al. 2011). The difficulty in discerning species in these fisheries often results in records reported generically as “*Sphyrna*” or “hammerhead”, which limits the understanding of species-specific geographic distributions (Bezerra et al. 2017, Graefe and Ditton 1976, Miller 2016). The potential of misidentification and a general lack of data available on this species have limited our understanding of the distribution and occurrence of the Smooth Hammerhead in the western North Atlantic Ocean.

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According to the most recent descriptions of the distribution of the Smooth Hammerhead, the Gulf of Mexico is not considered a part of their known range (Castro 2011, Ebert et al. 2013). Historically, there have been records of Smooth Hammerheads described as captured off the coast of Texas and Louisiana (Baughman 1950, Baughman and Springer 1950, Bigelow et al. 1948, Reed 1941). Upon review of these historic records, it is not possible to confirm the identification of these specimens. Both Bigelow et al. (1948) and Clark and von Schmidt (1965) advised caution in relying on older records due to many later being identified as Scalloped Hammerheads. Gilbert (1967) quoted a personal communication with Stewart Springer, who stated that he knew of no authentic record of the Smooth Hammerhead in the Gulf of Mexico. Upon review of museum repositories for the specimens referenced in the historical literature, they were either not listed, which could mean they were reclassified as another species, or listed as suspect identification pending review. Therefore, there is uncertainty that these specimens described in the historical literature were Smooth Hammerheads.

A review of long-term scientific survey data also has no records of this species from throughout the northern Gulf of Mexico (W.B. Driggers, NOAA Fisheries, Southeast Fisheries Science Center, Mississippi Laboratories, Pascagoula, MS, pers. comm.; Grace and Henwood 1997; Ingram et al. 2005). However, a review of data from observer programs in pelagic longline and shark-directed bottom longline commercial fisheries did contain some records of this species from the Straits of Florida and into the deep offshore waters of the southern Gulf of Mexico (S. Cushner, Pelagic Observer Program, NOAA Fisheries Southeast Fisheries Science Center, Miami FL, unpubl. data; A.N. Mathers, Riverside Technologies Inc., Panama City, FL, unpubl. data). Herein, we report on the first verified record of a Smooth Hammerhead occurring in coastal waters of the northern Gulf of Mexico (Fig. 1) with a review of records throughout the western North Atlantic Ocean.

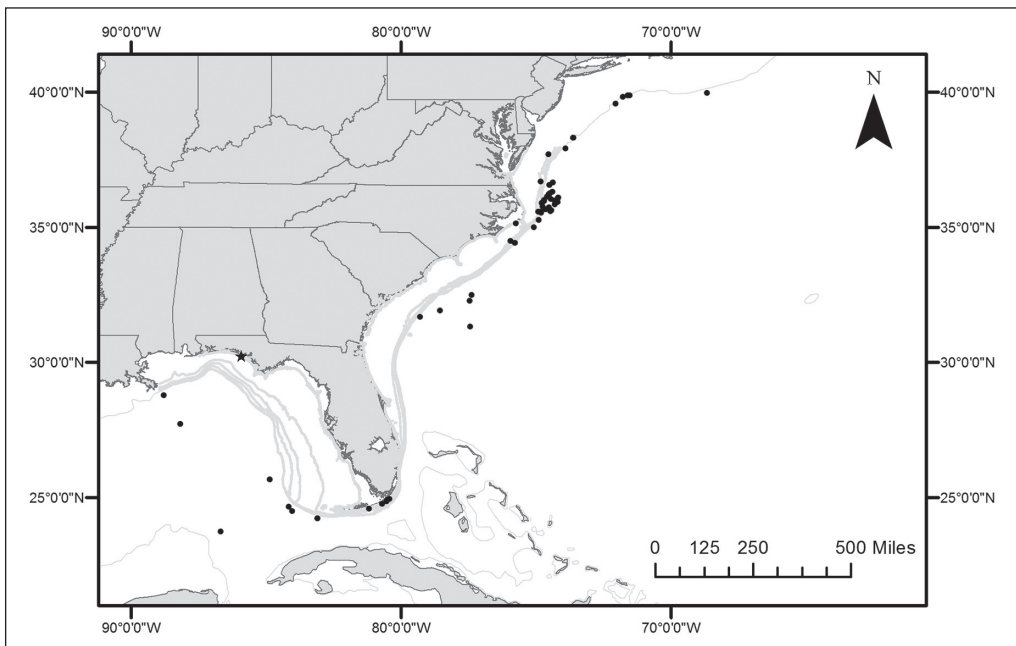


Figure 1. *Sphyrna zygaena* (Smooth Hammerhead) records (black dots) from fishery observer data (pelagic longline and shark bottom longline commercial fisheries) in the western North Atlantic Ocean and the Gulf of Mexico, including the verified record (black star) in the panhandle of Florida.

*Methods and specimen description.* On the morning of 29 September 2017, biologists with NOAA Fisheries Service-Southeast Fisheries Science Center, Panama City Laboratory were contacted about a beached shark near the Beachcomber Beach Resort (30°13.289'N, 085°53.400'W) in Panama City Beach, FL (Fig. 1). Personnel were sent to retrieve the animal, which was identified as a Smooth Hammerhead. Given the rare nature of this species' presence in the Gulf of Mexico, a thorough investigation using taxonomic keys (Castro 2011, Compagno 1984) was performed to confirm its identification. The length over the curve of the body (pre-caudal length [PCL]) was recorded.

The lack of a central indentation on the cephalofoil is indicative of the Smooth Hammerhead (Fig. 2A; Castro 2011, Compagno 1984). Further defining characteristics include a moderately falcate dorsal fin located over the pectoral fin insertion and non-falcate pelvic

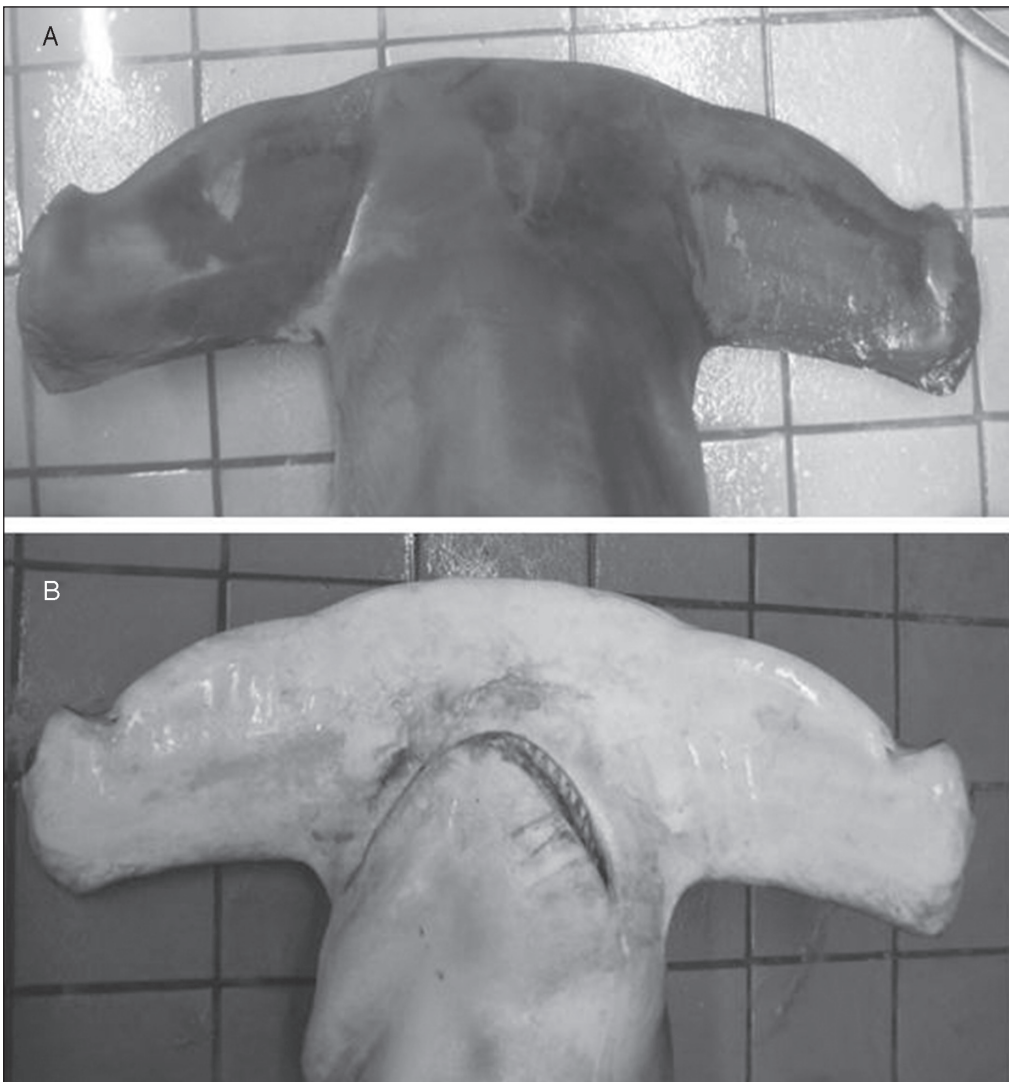


Figure 2. (A) Dorsal view of head showing no medial notch in cephalofoil of a *Sphyrna zygaena* (Smooth Hammerhead) found on the beach in Panama City Beach, FL, on 29 September 2017. (B) Ventral view of head of the same animal.

fins with the anal fin slightly larger than the second dorsal (Castro 2011). This specimen measured 210 cm PCL and was classified as a mature male by the presence of fully rotating and calcified claspers following Clark and von Schmidt (1965).

To provide a better understanding of the Smooth Hammerhead's distribution, we conducted an extensive search of fisheries and scientific survey data and searched the Global Biodiversity Information Facility Database (GBIF) for records associated with museum specimens throughout the western North Atlantic Ocean, including the Gulf of Mexico.

*Results and discussion.* The Smooth Hammerhead collected in Panama City Beach, FL, represents a confirmed record of this species occurring in the coastal areas of the northern Gulf of Mexico. Scientific fishery surveys throughout the northern Gulf of Mexico have reported no captures of Smooth Hammerheads (Bethea et al. 2014; W.B. Driggers, pers. comm.; Drymon et al. 2010; K.L. Smith, Texas Parks and Wildlife, Austin, TX, pers. comm.). However, at-sea observer data from 1996–2018 in the pelagic longline fishery that targets *Xiphias gladius* L. (Swordfish) and *Thunnus* sp. (tuna) contained 8 records of Smooth Hammerheads in deep offshore waters, mostly in the southern Gulf of Mexico (Fig. 1; S. Cushner, unpubl. data). Additionally, a review of data collected by observers from the commercial shark bottom longline fishery since 1994 reported 6 Smooth Hammerhead captures in the Straits of Florida (Fig 1; Hale et al. 2009, 2011; A.N. Mathers, unpubl. data; Morgan and Burgess 2005); however, this area is geographically not considered part of the Gulf of Mexico .

In the southern Gulf of Mexico, Bonfil (1997) reviewed available literature on fisheries in Mexican waters stretching from northern Mexico (near the United States border) to the Yucatan Peninsula, and did not list Smooth Hammerhead as a species encountered in this region. A later survey of the Mexican artisanal fishery does list Smooth Hammerhead as a species landed in the fishery, but there was limited additional information provided, presumably because occurrence was very low (Castillo-Geniz et al. 1998).

In recreational fisheries, while Great Hammerheads and Scalloped Hammerheads are frequently captured, there have been no confirmed records of Smooth Hammerheads caught in the Gulf of Mexico (Graefe and Ditton 1976, Shiffman and Hammerschlag 2014). However, as previously noted, most landings data for hammerhead sharks are not identified to species, which could account for underreporting of occurrence (Bezerra et al. 2017).

Off northern Brazil, Bezerra et al. (2017) reported the first occurrence of the Smooth Hammerhead in the Saint Peter and Saint Paul archipelago. Because this species is commonly encountered in fisheries off southern Brazil, Bezerra et al. (2017) hypothesized that the presence of the specimen they collected in the Saint Peter and Saint Paul archipelago could indicate range expansion due to the close proximity of their previously known area of occurrence. Given that the known range for the Smooth Hammerhead extends through southeastern Florida in the western North Atlantic Ocean, and the Gulf of Mexico can be easily accessed through the Straits of Florida, which connects these 2 ocean basins, there is potential that this species may transit between the 2 regions. The examination of available fishery observer data, in addition to the instance of the confirmed Smooth Hammerhead specimen we have described, supports this possibility (Fig. 1).

In the western North Atlantic Ocean, the Smooth Hammerheads' distribution is not well known (Miller 2016). A review of available records showed that sightings are limited, and available data comes generally from commercial fishery catch data, recreational fishing reports, historical reports, and reports through citizen science organizations like diver groups (Miller 2016, GBIF Secretariat 2017). The majority of these records occurred in the deep offshore waters beyond the continental shelf, and there appears to be a trend of habitat usage that suggests this species tends to occur in offshore pelagic waters along the continental

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shelf (Fig. 1), though we recognize some of this apparent pattern may be directly tied to fishing effort due to the majority of the data coming from observations on commercial fishing vessels. Recently, recreational divers have also reported seeing schools of Smooth Hammerheads near the Nantucket Canyon offshore of Long Island, NY, in late July and August (T. Bacon and S. Genereux, Moore Charitable Foundation, New York, NY, pers. comm.), which coincides with pelagic areas near the continental shelf. The occurrences from observer data in the Gulf of Mexico suggest this species may follow the deep waters of the shelf in this region as well. Given the highly migratory nature of other closely related hammerhead shark species, these reports could suggest that the Smooth Hammerhead migrates along the edge of the continental shelf off the east coast of the United States and into the Gulf of Mexico and occasionally ventures into coastal waters.

While these few records help provide a limited description of the Smooth Hammerhead's range, further data is required to fully understand their occurrence throughout this region. Currently, the Smooth Hammerhead is classified as vulnerable in the International Union for the Conservation of Nature Red List (IUCN 2019), and there is a need of further biological information on the species (Casper et al. 2005; Coelho et al. 2011; Cortes et al. 2010, 2015). Documented encounters such as the one we have described in the northern Gulf of Mexico are important for understanding the complete distribution of this species and will be important for future management and conservation measures.

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