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First Record of Loggerhead Sea Turtles (*Caretta caretta*) in the Southern Gulf of California, Sinaloa, Mexico

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Abstract. – **Loggerhead turtles (*Caretta caretta*) are characterized by their transoceanic migratory patterns in the North Pacific Ocean, as individuals of this species originating from nesting beaches in Japan are known to forage along the Baja California Peninsula (BCP), Mexico. The nearshore waters of BCP serve as important foraging habitat for growth and development; however, the implementation of appropriate management strategies has been hindered by the paucity of data on the biology and distribution of the species, particularly for juveniles during their developmental migrations. We report for the first time the occurrence and distribution of loggerhead turtles in Sinaloa, Mexico, in the southernmost portion of the Gulf of California.**

Loggerhead turtles (*Caretta caretta*) are among the most highly migratory sea turtle species in the world. In the Pacific, most loggerheads carry out an extensive developmental migration, traveling from nesting areas in the western Pacific to far-away developmental and foraging habitats in the eastern and central portions of this ocean basin (Limpus and Couper 1994, Bowen 1995). In the North Pacific, loggerheads nest in Japan and, upon hatching, young loggerheads move eastward into the central North Pacific, where they grow and develop. Some individuals travel even farther, arriving in marine habitats of the eastern Pacific, near the Baja California Peninsula (BCP), Mexico (Ramirez Cruz et al. 1991; Peckham et al. 2008).

Loggerhead turtles are known to aggregate at high densities along the Pacific coast of the BCP (Peckham et al. 2007), and this area is recognized as an important developmental and foraging habitat for the species due to its extensive coastal upwelling and high productivity (Ramírez-Cruz et al. 1991; Nichols 2002; Seminoff et al. 2004). Loggerheads along the BCP experience high mortality linked to coastal fisheries, and loggerhead monitoring and conservation programs in Pacific Mexico have thus far focused on this foraging population. However, loggerheads are also known to occur in other areas of the eastern Pacific. For example, Allen et al. (2013) reported loggerheads along the coast of southern California, in the United States, during warm-water El Niño periods. Seminoff et al. (2004) documented year-round presence of loggerheads in Bahia de los Angeles in the central Gulf of California. Nevertheless, loggerhead distribution and demography of loggerhead turtles in the eastern Pacific remain poorly understood.

The Gulf of California is one of the most productive and diverse marine nurseries in the world's oceans, and is home to over 800 species of fish and 2000 invertebrates and numerous vertebrates. This semienclosed sea is recognized as an important developmental and foraging habitat for several sea turtle species, and it is likely that the region is also host to large numbers of loggerhead turtles. However, aside from the study by Seminoff et al. (2004), few data are available.

Knowledge of regional size-class distributions of sea turtles can help determine the importance of different marine habitats for various life stages and can provide insights into the geographic variability in life history patterns (Bjorndal et al. 2000; Seminoff et al. 2004). Improving this knowledge is essential for the development of effective population models that will support managing their recovery (Crouse et al. 1987; Ehrhart and Ogren 2000).

Here we report the first accounts of loggerhead turtles in the southern portion of the Gulf of California, in coastal waters of the state of Sinaloa, Mexico. Our results expand the range of loggerhead turtles in the eastern Pacific Ocean and demonstrate the southern portion of the Gulf of California is an important area for this endangered species.

Methods. — Between May and June 2012, we developed a participatory research program with La Reforma shark fishermen who agreed to report turtle sightings during their offshore fishing efforts in the region. La Reforma, Sinaloa, Mexico, is a coastal community with a population of 6743 whose primary economic activity is fishing (Fig. 1). This cooperative program was designed to build capacity and train fishers to record basic data: sea turtle size, sex, and species. During routine permitted shark fishing trips from 6–8-m open-hull skiffs, known locally as *pangas*, fishers used entanglement nets (1000×50 m, mesh size = 25 cm stretched, 24 hrs/d) to catch a variety of shark species. Fishing efforts occurred in the offshore area between the Navachiste lagoon system

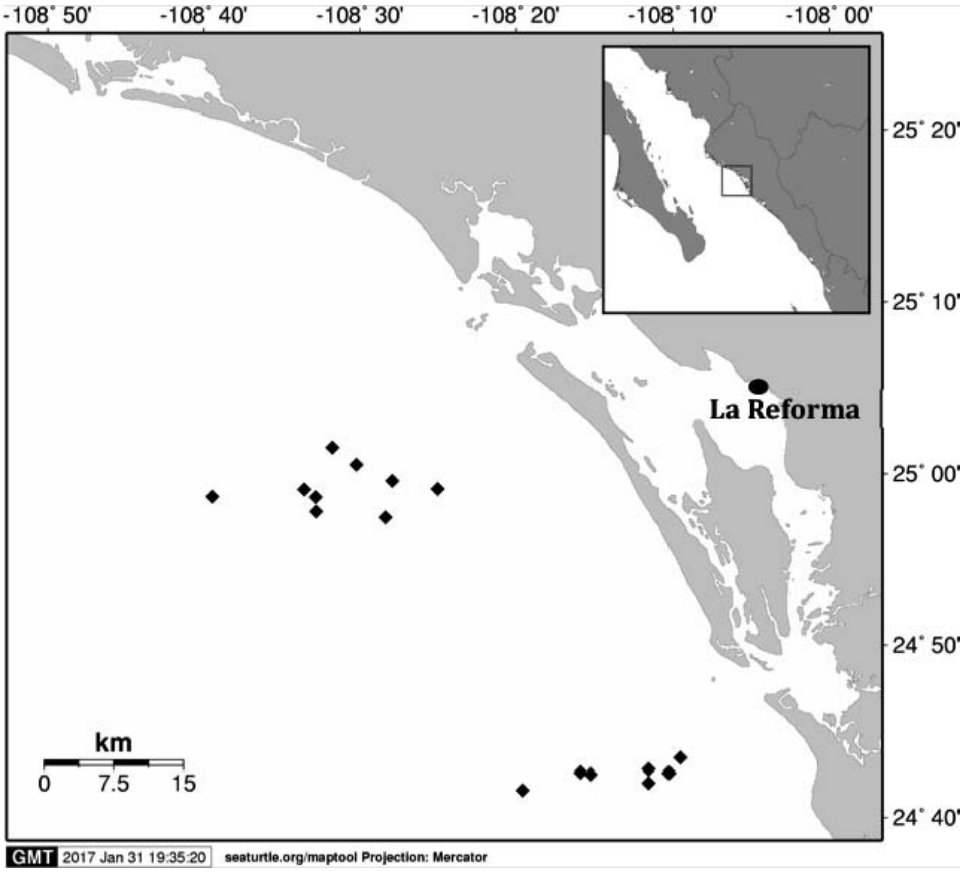

Figure 1. Coast of La Reforma community, Sinaloa, Gulf of California, Mexico. Black diamonds represent capture locations of loggerhead turtles. Map by SEATURTLE.ORG Maptool, 2002. http://www.seaturtle.org/maptool.

and the Santa Maria–La Reforma lagoon system near the municipalities of Guasave and Angostura in northern Sinaloa (Fig. 1). All turtles that were incidentally captured during these efforts were removed unharmed immediately upon capture and pulled aboard for examination, measurements, and flipper tagging.

To compare our data with previous studies, we calculated catch per unit effort (CPUE) adjusting for a net length of 100 m for 24 hrs. The straight carapace length (SCL) in centimeters (mean ± SE) of each turtle was recorded (Bolten 1999). Prior to release, each turtle was tagged with Inconel tags (Style 681, National Band and Tag

Table 1. Capture date, straight carapace length (SCL), and capture coordinates for loggerhead turtles (*Caretta caretta*) from Sinaloa, Gulf of California, Mexico.

No.	Capture date	SCL (cm)	Coordinates (lat, long)
1	1 May 2012	59.41	24°60′520″N, 108°30′220″W
2	2 May 2012	65.14	24°43′430″N, 108°09′543″W
3	4 May 2012	69.20	24°35′999″N, 108°17′733″W
4	4 May 2012	50.41	24°41′567″N, 108°10′231″W
5	7 May 2012	56.99	24°41′585″N, 108°19′562″W
6	12 May 2012	67.02	25°00′520″N, 108°30′220″W
7	12 May 2012	53.07	24°59′065″N, 108°33′588″W
8	12 May 2012	62.30	24°57′464″N, 108°28′342″W
9	16 May 2012	64.23	25°01′517″N, 108°31′770″W
10	18 May 2012	68.13	24°58′638″N, 108°32′825″W
11	20 May 2012	52.22	24°57′792″N, 108°32′799″W
12	2 Jun 2012	61.11	24°42′613″N, 108°15′858″W
13	5 Jun 2012	51.40	24°36′971″N, 108°16′857″W
14	5 Jun 2012	70.46	24°42′491″N, 108°15′203″W
15	8 Jun 2012	67.60	24°42′796″N, 108°11′488″W
16	9 Jun 2012	58.54	24°42′796″N, 108°11′488″W
17	20 Jun 2012	59.41	24°59′102″N, 108°25′026″W
18	22 Jun 2012	65.14	24°58′661″N, 108°39′452″W

Table 2. Comparison of size (mean ± SE) data for loggerhead turtles (*Caretta caretta*) from the Gulf of California and Pacific coast of Baja California (BCP).

n	SCL (cm)[a]	Range	Area	Author
18	61.8 ± 6.7	49.6–69.6	Gulf of California	This study
15	61.9 ± 2.1	43.5–92.7	Gulf of California	Seminoff et al. 2004
40	66.9 ± 6.7	55.3–85.1	BCP	Peckham et al. 2011[b]
180	58.5 ± 11.1	26.6–83.4	BCP	Nichols 2002
39	46.9 ± 1.3	32.0–58.0	BCP	Ramírez-Cruz et al. 1991
2	59.2 ± 4.8	32.9–85.6	BCP	Resendiz et al. 1998

[a] SCL = straight carapace length.
[b] Peckham et al. (2011) reported values in curved carapace length (CCL); these were converted to SCL using the following formula: SCL = (0.932 × CCL) + 0.369 (Peckham et al. 2008).

Company, Newport, KY) in the rear flipper. All turtles were released near their initial capture site within 1 hr.

Results and Discussion. — A total of 18 loggerhead turtles with a mean SCL of 61.8 ± 6.7 cm (range, 49.6–69.6 cm SCL) were captured during 15 fishing trips along the Sinaloa coastline (lat 24°43′430″N, long 108°25′026″W; Fig. 1). CPUE was 0.24 turtles each 24 hrs. All turtles were classified as subadults based on size (Seminoff et al. 2004). Capture date, SCL, and capture locations are presented in Table 1.

Previously, 4 sea turtle species were reported in the state of Sinaloa, including olive ridley (*Lepidochelys olivacea*), green (a.k.a. black) (*Chelonia mydas agassizii*), hawksbill (*Eretmochelys imbricata*), and leatherback (*Dermochelys coriacea*) (Lemus and López 2002). To our knowledge, this is the first report of the presence and distribution of loggerhead turtles in Sinaloa.

The observed capture rates of loggerhead turtles in Sinaloa coast were surprisingly high for a species considered to be endangered (Convention of International Trade in Endangered Species of Wild Fauna and Flora [CITES] 2015). Whereas Seminoff et al. (2004) reported a loggerhead CPUE of 0.014 turtles/24 hrs in Bahia de los Angeles, the loggerhead CPUE in our study was 0.24 turtles/24 hrs, with a total of 18 turtles captured during 15 fishing days in May and June 2012. Although the capture rates are considerably lower than those documented on the Baja Californian Pacific coast loggerhead hotspot (Ramírez-Cruz 1991; Peckham et al. 2007), the observed capture rate in this study suggests a high abundance of loggerhead turtles in our study area.

Previously, the occurrence of juvenile and subadult loggerheads has been reported along the Pacific coast of BCP (Ramírez-Cruz et al. 1991; Resendiz et al. 1998; Nichols 2002). Loggerhead turtles from northern Sinaloa, Mexico, were also classified as juveniles and subadults, further confirming that adult loggerheads are rarely present in the eastern Pacific (Bowen 1995). Our study area in Sinaloa is considered to be a neritic zone with high levels of primary productivity and abundant marine wildlife (Ruelas-Inzunza et al. 2008). Presumably, the semienclosed ecosystem within the Gulf of California, coupled with characteristics distinct from those found in other foraging areas (Storelli et al. 2008; Ley-Quiñónez et al. 2013), provide ideal conditions that create a developmental habitat for juvenile and subadult loggerheads in the region.

Loggerheads in the Gulf of California are within the size range of individuals studied along the Pacific coast of the BCP. Whereas Seminoff et al. (2004) reported a mean SCL of 61.9 ± 2.1 cm, Gardner and Nichols (2001) found a mean size of 58.5 ± 11.1 cm SCL among stranded loggerheads along the Pacific coast of the BCP, and Peckham et al. (2011) reported a mean curved carapace length that is equivalent to 66.9 ± 6.7 cm SCL (Table 2). The loggerheads we encountered in Sinaloa (Table 2) are consistent with the sizes reported by Seminoff et al. (2004), suggesting a uniform size distribution among loggerhead foraging populations in the Gulf of California.

This report confirms the presence of loggerhead turtles in the Gulf of California within an area of high fishing activity. This area has been previously identified as an area with high risk for sea turtle bycatch and direct take (Aguilar-Gonzalez et al. 2014; Parra-Gaxiola 2012). Indeed, the fact that so many loggerheads were captured incidentally during shark-fishing efforts underscores the potential for problematic levels of bycatch in the coastal fisheries of Sinaloa.

Increased monitoring and tracking is needed to define loggerhead distribution and abundance within the Gulf of California. Social studies are also urgently needed to assess and mitigate environmental effects and human impacts including bycatch in coastal fisheries of the area. We recommend that the Gulf of California should be included as a target area for efforts to protect the loggerhead turtle.

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