Evidence of Long Distance Homing in a Displaced Juvenile Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

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Sea turtles accomplish some of the longest migrations observed in nature, and these migrations have been extensively studied (Benson *et al.* 2011; Lohmann & Lohmann 2003; Luschi *et al.* 1998; Nichols *et al.* 2000; Plotkin 2003). Though the navigational mechanisms and orientation cues used by sea turtles during their journeys are not as well understood, various hypotheses have been proposed and tested (wave perception: Lohmann *et al.* 1995; Salmon & Lohmann 1989; olfaction and chemoreception: Endres *et al.* 2009; Grassman *et al.* 1984; Manton *et al.* 1972; vision: Avens & Lohmann 2003; geomagnetism: Lohmann *et al.* 1997, 2004, 2008a, 2008b; Papi *et al.* 2000). Additionally, a combination of cues, such as visual and magnetic cues (Avens & Lohmann 2003) or magnetic field intensity and inclination angle (Lohmann *et al.* 2008b), could influence sea turtle migrations, and different life history stages may use different migratory cues to reach their desired locations (Lohmann *et al.* 2008a).

Juvenile sea turtles of certain species eventually depart from their pelagic habitats for foraging grounds in neritic waters and may display strong site fidelity to these developmental areas (Musick & Limpus 1997). Homing behavior has been documented through genetics in juvenile loggerhead sea turtles (Bowen *et al.* 2004) and experimentally in both juvenile loggerhead and green sea turtles (Avens *et al.* 2003; Avens & Lohmann 2004; Lohmann *et al.* 2004). Avens & Lohmann (2004) physically displaced juvenile loggerhead (42.3-70.4 cm standard straight-line carapace length (SCL)) and green turtles (21.2-44.0 cm SCL) 30-167 km from their foraging grounds and detected significant orientation toward their original capture site. Lohmann *et al.* (2004) exposed juvenile green turtles (29-47 cm SCL) to simulated magnetic fields that were representative of those existing approximately 330 km north or south of the original capture site, and significant orientation toward the original capture site was observed in these turtles.

The present paper details the long distance homing of a displaced juvenile Kemp's ridley sea turtle (*Lepidochelys kempii*), incidentally captured by a fisherman in 2010 and then found stranded and dead in 2012. From 2010 – 2012, an abnormally high number of stranded sea turtles were recorded in the northern Gulf of Mexico, with the largest concentration occurring in the three coastal counties of Mississippi (NOAA 2012a). Only 19 strandings were reported in Mississippi in 2009; however, the number drastically rose to almost 300 in both 2010 and 2011. Although the total declined to less than 200 in 2012, strandings continue to be a serious concern in the northern Gulf of Mexico (NOAA 2012b). Furthermore, immature Kemp's ridley sea turtles constituted over 90% of the overall stranding total in Mississippi. These elevated stranding numbers could be attributed to a number of factors, including increased public awareness, fishery interactions (i.e., decreased turtle excluder device (TED) use in the shrimping fishery), effects of the BP Deepwater Horizon oil spill, or a combination of these and other factors.

In March 2012, a juvenile Kemp's ridley sea turtle (33.3 cm SCL) was found stranded and dead in Waveland, MS, by the Institute for Marine Mammal Studies' (IMMS) stranding team. The author assumed that the stranding location was in the general vicinity of the site of mortality. The stranding location (N 30.26865, W 89.38265) was approximately two kilometers from the Garfield Ladner Pier (N 30.28063°, W 89.36495°), where this turtle was incidentally captured by a recreational fisherman in June 2010 (Fig. 1). After a successful rehabilitation at the IMMS, this turtle along with several others were transported in August 2010 to Sea World Orlando and released in Ten Thousand Islands, FL (N 25.85993°, W 81.58282°). These rehabilitated turtles were not released in Mississippi waters due to the high number of stranded sea turtles appearing on the Mississippi coast. However, it appears that this turtle traveled from its release site in southern Florida to its original foraging grounds in the north-central Gulf of Mexico.

Immature Kemp's ridleys have displayed seasonal site fidelity throughout their range (Morreale & Standora 1998; Renaud & Williams 2005; Schmid 1998; Schmid &Witzell 2006; Seney & Landry 2011). Additionally, Kemp's ridleys in these life history stages have shown fidelity to foraging areas between years (Schmid 1998; Schmid & Witzell 2006). Employing satellite telemetry, Schmid & Witzell (2006) recorded winter migrations of 120 - 296 km in immature Kemp's ridleys inhabiting the eastern Gulf of Mexico, and three of the six tagged turtles returned to their original capture location the following spring, which suggests the existence of homing behavior in these turtles.

The complete path taken by the presently discussed stranded turtle from its release site in Ten Thousand Islands, FL, to its stranding location near Waveland, MS is unknown. The release site was over 1,000 km from the stranding location as measured in Google© Earth, if the turtle followed the coastline on its migration to Mississippi (Fig. 1). Immature Kemp's ridleys have been tracked mainly to near shore waters (Renaud & Williams 2005; Schmid & Witzell 2006); although offshore movements occurred when water temperatures decreased in the fall (Renaud & Williams 2005; Schmid & Witzell 2006). If the turtle followed this general pattern prior to it stranding in Mississippi, then it most likely traveled farther than the estimated 1,000 km. The exact homing mechanism used by this turtle on its migration is also unknown. Sea turtles have demonstrated the capacity to detect magnetic parameters (magnetic inclination angle and field intensity) that might aid in their navigation (Lohmann *et al.* 2008b). And, as previously stated, the importance of visual cues in the navigation of immature sea turtles has been shown (Avens & Lohmann 2003). Thus, this stranded turtle might have exploited multiple navigational signals on its journey back to the north-central Gulf of Mexico, especially if it traveled close to the coastline.

In contrast to homing behavior, the turtle's movements could be explained as general dispersal behavior or random nearshore movements that resulted in it migrating back to Mississippi waters. However, this turtle bypassed several known immature Kemp's ridley foraging grounds (Ten Thousand Islands, FL (Witzell &

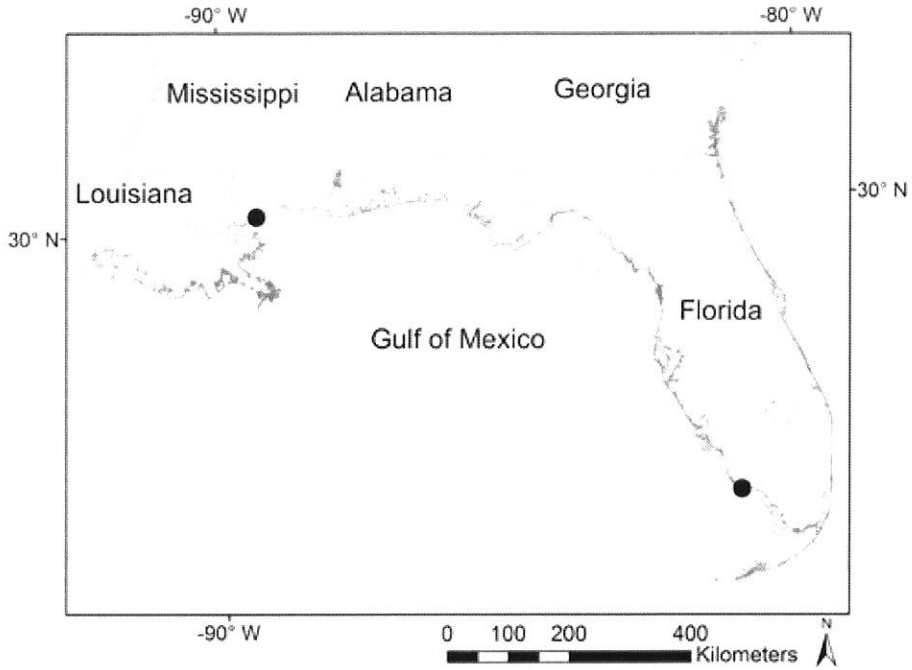

Figure 1. Map showing the locations of the 2010 release of the IMMS rehabilitated turtle in Ten Thousand Islands, FL, and its subsequent 2012 stranding in Waveland, MS.

Schmid 2005), Cedar Key, FL (Schmid 1998), Big Bend area, FL (Barichivich *et al.* 1999), and Big Gulley area, AL (Ogren 1989)) on its return, which would seem improbable if its migration were due to dispersal or nearshore movements. Lyn *et al.* (2012) also detected possible homing behavior in a group of displaced immature Kemp's ridleys whose movements were tracked via satellite telemetry in 2010. The rehabilitated turtles were released in Cedar Key, FL, and several turtles displayed directional movements from their release sites toward their original hooking or stranding sites. The present paper along with the results from Lyn *et al.* (2012) contributes to the growing dataset that suggests Kemp's ridley sea turtles display homing behavior and that the north-central Gulf of Mexico, including the Mississippi Sound, represents a crucial developmental habitat for this Critically Endangered species.

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