

Study Title	Sea Turtle Movement and Habitat Use in the Northern Gulf of Mexico
Report Title	Discerning behavioral patterns of sea turtles in the Gulf of Mexico to inform management decisions
Report Number(s) (OCS Study)	BOEM 2021-088
Completion Date of Report	February 2022
Number of Pages	77
Award Number(s)	M15PG00032
Sponsoring OCS Region or Office	Gulf of Mexico Region (GOMR)
Applicable Planning Area(s)	Northern Gulf of Mexico, primarily Central Planning Area
Fiscal Year(s) of Study Funding	FY 2016-19
Costs by Fiscal Year	FY 2016: \$250,000; FY 2017: \$300,000; FY 2018: \$250,000
Cumulative Project Cost	\$750,000
Project Manager(s)	Kristen M. Hart
Affiliation of Project Manager(s)	US Geological Survey, Wetland and Aquatic Research Center
Address of Project Manager(s)	3321 College Avenue, Davie, FL 33314 USA
Principal Investigator(s)	Kristen M. Hart and Margaret M. Lamont
Keywords	Sea turtle, Gulf of Mexico, endangered species, relocation trawling, satellite tracking, dive profiles, genetic population structure, isotopes

ABSTRACT: The protection of all sea turtles globally is a high priority, and research projects on these imperiled species are focused on those that are likely to result in improvements in monitoring and management for population recovery. Determining distribution, seasonal movements, vital rates and habitat use for all life-stages of sea turtles has been identified by the US Fish and Wildlife Service (USFWS) and US National Marine Fisheries Service (NMFS) as important for achieving recovery. This study provides information on in-water aggregations of sea turtles in the northern Gulf of Mexico. Data collected includes individual dive profiles, movements, seasonal site fidelity, genetic population structure, and isotopic signatures.

BACKGROUND: US Geological Survey (USGS) and Bureau of Ocean Energy Management (BOEM) collaborated to design a study to collect spatial data and dive information for sea turtles captured in the water in the northern Gulf of Mexico (GOM). Combining turtle movement and dive data with genetic stock analyses, population demographics, and diet studies (via stable isotope analysis) addressed information gaps listed in individual sea turtle species Recovery Plans. Gathering missing or incomplete data on threatened and endangered species in the GOM improves BOEM's ability to make informed management decisions regarding projects conducted on the Outer Continental Shelf (OCS), particularly dredge projects. These data gaps have been identified through the National Environmental Policy Act (NEPA) process and through ESA Section 7 consultations with U.S. Fish and Wildlife Service (USFWS)

and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA NMFS). This USGS-BOEM collaborative project involved USGS investigators with the expertise and permits required from NMFS to collect biological samples, tag turtles, and analyze and interpret the resulting spatial and dive data.

OBJECTIVES: Objectives of this project were to determine the extent of movements and seasonal site fidelity of sea turtles captured and tagged at OCS borrow sites, to characterize dive profiles of sea turtles in sand-dominated areas throughout the year, to identify and assess physical and biological features of specific high-use habitats particularly with respect to BOEM dredging sites, to assess the genetic population structure of captured sea turtles, and to determine the carbon and nitrogen isotopic signatures of sampled sea turtles across multiple tissue types (blood, tissue, carapace).

METHODS: All turtles were captured via trawling. Trawling was conducted at four study sites, approximately 4 miles offshore of Pensacola, Florida; 10 miles offshore of Mississippi near Cat Island, Ship Island, Petit Bois Island Pass, and Dauphin Island; and proximal to Pascagoula, Ship Shoal and Chandeleur Islands offshore of Louisiana. Both relocation trawling permitted in conjunction with dredging operations and USGS directed trawling on the OCS were performed. Relocation trawling involved a contracted trawl vessel capturing and relocating sea turtles in the path of the hopper dredge up to 24 hours a day. In contrast, directed trawling involved a contracted trawler operating 12 hours a day along tracks pre-determined by the USGS research team unrelated to hopper dredge operations. Turtles captured by relocation trawlers were released approximately 8 miles from capture sites, whereas turtles captured by directed trawling were released at their capture sites. For all trawling, tow times were limited to 30 min and were conducted at between 2 and 4 mph. Turtles captured were outfitted with a satellite tag for collecting spatial information and tissue and blood samples were collected for genetic and isotopic analyses.

RESULTS: Over the course of the project, USGS captured and tagged 50 turtles with satellite tags funded by BOEM. USGS also captured 27 additional turtles that were tagged with satellite tags funded by other projects. All turtles were sampled for biological specimens. For the 50 BOEM turtles, 24 were Kemp's ridley, and 26 were loggerhead, the majority of which were adults including 9 males (6 Kemp's ridley, 3 loggerhead). Kemp's ridley turtles ranged in size from 59.5 – 70.5 cm CCL (mean $\pm$ SD = 65.5 $\pm$ 3.6 cm) and were tracked for 76–117 days (mean $\pm$ SD = 100.1 $\pm$ 15.2 d) for a total of 1001 tracking days. Loggerhead turtles ranged in size from 78. –101 cm CCL (mean $\pm$ SD = 88.3 $\pm$ 7.3 cm) and were tracked for 3–192 days (mean $\pm$ SD = 100.8 $\pm$ 56.1 d) for a total of 1612 tracking days. None of the turtles departed the Gulf of Mexico. Dive depth and duration varied by species and time of year. On average, loggerhead dive time was primarily in 15–30 minute bins (46%), whereas Kemp's ridley dive time was primarily in 0–15 minute bin (43%). Loggerhead mean time at the surface (0–2 m) was 16.0% ($\pm$ 9.4 SD) and Kemp's ridley mean time at the surface was 10.0% ($\pm$ 6.0 SD). Genetic analyses revealed a total of seven mitochondrial control region haplotypes identified among the loggerhead turtles sampled and four mitochondrial control region haplotypes for the Kemp's ridleys sampled. Analysis of stable carbon and nitrogen values revealed that mean values from carapace and whole blood were similar, differing from flipper tissue samples which were less depleted in carbon regardless of species or sex. However, nitrogen values were more variable between species and sexes.

CONCLUSIONS: Project goals were met and these included identifying sea turtle dive patterns and habitat use on the OCS, particularly at shoals and other areas where dredging occurred. The extent of seasonal movements could not be evaluated across the year as the majority of satellite tags transmitted for only 4 months, on average. This is an artifact of the northern GOM high fouling rates rather than failure of tagging equipment or tag attachment procedures. During tracking periods high site fidelity to capture locations was observed, with only movements to the south documented for a small proportion of tagged turtles. Future work on anti-fouling sensors may help to lengthen tracking durations, and wintertime

captures and tracking will be necessary to obtain winter movements and dive patterns. This project provides a foundation for longer term capture-mark-recapture work in these study sites, which could feed into future research towards determination of species-specific vital rates and population abundance. The genetic signature of turtles captured at our study sites, which represent mixed-stock foraging grounds, highlighted connections to known nesting beaches, including a rare Cape Verdean link. Isotopic signatures highlighted food web resource use levels, against which changes can be measured in the future should resources available in the study sites change.

STUDY PRODUCT(S):

1. **BOEM study report:** Hart, KM, Lamont, MM. 2020. Discerning behavioral patterns of sea turtles in the Gulf of Mexico to inform management decisions. Davie (FL): US Department of the Interior, Bureau of Ocean Energy Management. 77 p. Contract No.: M15PG00032. Report No.: BOEM 2022-088.
2. **Project Description Sheet:** https://www.usgs.gov/centers/wetland-and-aquatic-research-center-warc/science/sea-turtle-movement-and-habitat-use?qt-science_center_objects=0#qt-science_center_objects
3. **Complete data transfer:** CSV, depth histograms, photo ID files, data sheets, metadata for each of 50 BOEM turtles were uploaded in a Zip file on 12/28/21 for future analyses.

MAP OF STUDY AREA: Figure 1 of report OCS Study BOEM 2021-XXX

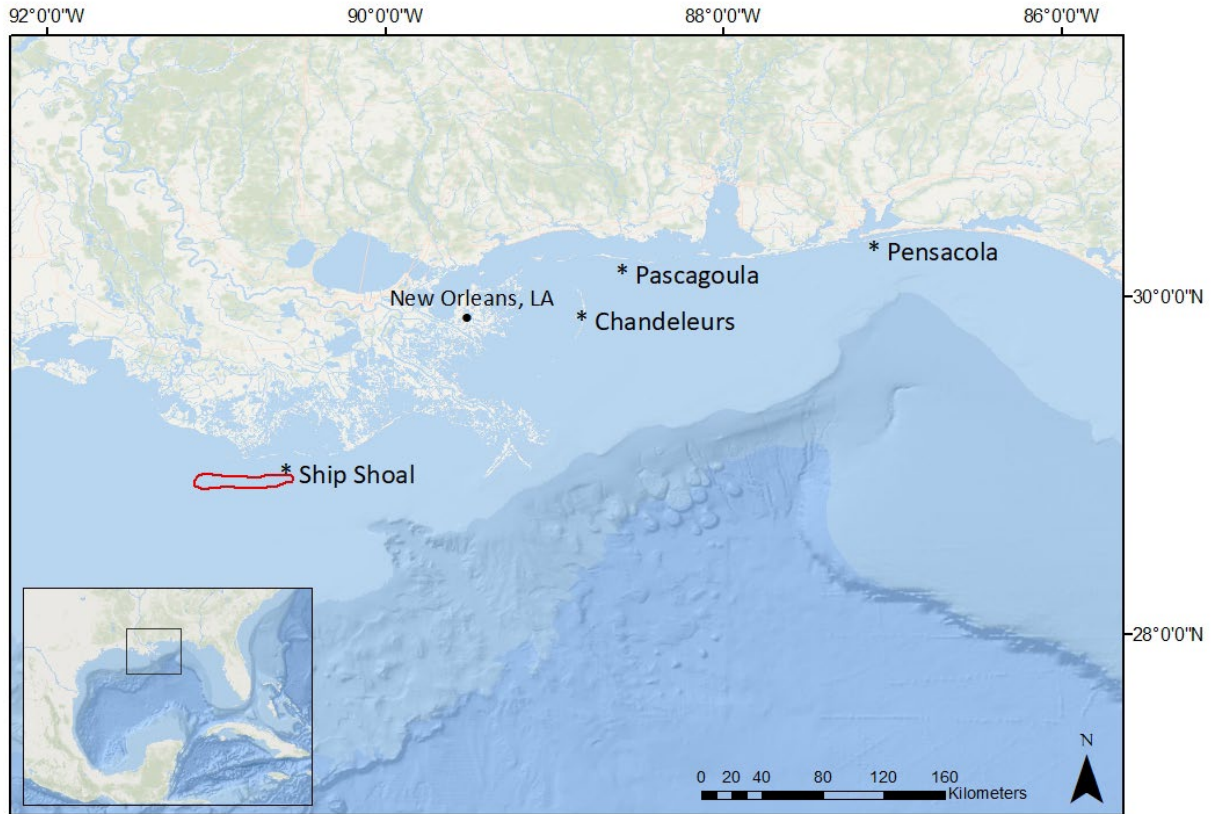


Figure 1. Map of study sites where turtles were sampled as part of ongoing relocation trawling (Pensacola, Ship Shoal and Pascagoula) and USGS directed trawling (Ship Shoal, Chandeurs), Gulf of Mexico, 2016-2019. Ship shoal outlined in red polygon.