

STUDY TITLE: Gulf of Mexico and South Atlantic OCS Study on the Distribution and Abundance of Endangered and Vulnerable Mammals, Birds, and Turtles, FY 1980

REPORT TITLE: Effects of Petroleum on the Development and Survival of Marine Turtle Embryos

CONTRACT NUMBERS: BLM: MU0-21; MMS: 14-12-0001-29096

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREA: Western Gulf of Mexico

FISCAL YEAR OF PROJECT FUNDING: 1980

COMPLETION DATE OF REPORT: June 1982

COST: FY 1980:\$494,870

CUMULATIVE PROJECT COST: \$494,870

PROJECT MANAGER: C. Keller

AFFILIATION: U.S. Fish and Wildlife Service

ADDRESS: 1010 Gause Boulevard, Slidell, Louisiana 70458

PRINCIPAL INVESTIGATORS¹: T. Fritts and M. McGehee

KEY WORDS: Western Gulf; Mexico; endangered species; turtles; Kemp's ridley turtle; Lepidochelys; loggerhead turtle; Caretta; acute; chronic; toxicity; toxicity test; oil spill; nesting; mortality; Gulf of Mexico Region

BACKGROUND: The effects of petroleum and petroleum products on the development and survival of marine turtle embryos are unknown. In light of declining marine turtle populations coupled with increasing levels of oil and gas development activity in coastal areas, information was needed to define the potential effects of oil on various life stages of marine turtles. This study was designed to determine the effects of oil on the development and survival of turtle embryos.

OBJECTIVES: (1) To determine the effects of oil on marine turtle eggs and hatchlings relative to oil concentration, aging of oil, and time of contamination through a series of both field and laboratory experiments.

DESCRIPTION: Field observations on the effects of oil on turtle hatchlings following the IXTOC oil spill in 1979. Observations were conducted at Rancho Nuevo, Tamaulipas, Mexico, along a stretch on beach which represents a major nesting area for Kemp's ridley turtle (Lepidochelys kempii). Data on the nature and abundance of oil on this beach were obtained in May, June, and August 1980.

In June 1980, nine clutches of eggs were collected from nesting turtles and divided into two subgroups consisting of between 42 and 56 eggs. One subgroup was subsequently incubated in sand previously collected from the beach where natural nests were found (i.e., oil contaminated sands). The second subgroup was incubated in relatively clean sand. Plastic trash cans, styrofoam boxes, and plastic buckets were used to incubate the eggs. In addition, the incubation success of these various containers was also evaluated. Incubation sites were identical to those utilized during previous turtle conservation projects in the U.S. and Mexico.

Eggs of loggerhead turtles (Caretta caretta) were used in the laboratory phase of this study. Ninety eggs were subjected to various treatments to determine the effects of time and quantity of exposure from oil. Treatments included a control; oil added to sand after 42 days incubation; oil added after 28 days incubation; and exposure in light, medium, and heavy dosages of oil.

Data collected in the experiments included survival, mortality, and unhatched eggs; the number of unhatched eggs with embryos; the number of unhatched eggs with embryos near full term; and numbers of unhatched eggs with embryos 21 to 60 mm in length and 1 to 20 mm in length.

SIGNIFICANT CONCLUSIONS: The most extreme effect of petroleum noted was a significant decrease in survival to hatching in those laboratory tests where oil was poured on top of the incubation sand during the last half and last quarter of the incubation period. Minimum incubation times were not affected by oil exposure but hatchling incubation time may have been. Hatchling scutellation was also affected by the oil treatment, with medium and heavy dosage eggs having more vertebrals and fewer marginals than controls. Oiled sand taken from the beach at Rancho Nuevo failed to produce measurable effects in survival and morphology. The concentration of hydrocarbons in the sand was consistent with visual observations made at Rancho Nuevo. Highest oil concentrations were recorded on the mid-beach, with lowest concentrations occurring on the dune crest. Contamination within these zones was not uniform. From a management standpoint, turtle nesting beaches may not be as vulnerable to petroleum damage as might be expected. The most drastic effects of a one-time spill are probably short-lived and would only threaten a single year's reproductive effort.

STUDY RESULTS: The extent of visible petroleum was variable at the spill contaminated beach at Rancho Nuevo. Oil distributions ranged from clumps of oil confined to a narrow zone above the high tide mark to scattered petroleum throughout the forebeach and onto the face of the dune. Prior to Hurricane Allen, the mean number

of oil clumps was 48.0 on the mid-beach; 56.4 at the seaward base of the foredune; and 2.4 at the crest of the foredune. After the storm, oil was redistributed and deposited on the tops of dunes. Oil resuspended from submerged sediments was also deposited by subsequent tidal action. Concentrations of oil in the sand at Rancho Nuevo ranged from 4 to 1,282 mg/kg on the mid-beach; 4 to 3,192 mg/kg at the base of the foredune; and 6 mg/kg on the dune crest.

No significant differences were noted in a comparison of hatching success between clean and oiled sands. Mean hatching success for all subgroups incubated in clean sands from the affected beach was 64.8%, as compared to 67.7% hatching success for eggs incubated in oiled sands. Most of the variation in the numbers of hatchlings released could be attributed to differences in clutches rather than to experimental treatment. Hatching success was highest in buckets (85.1%) compared to that for cans (50.1%) and styrofoam boxes (64.9%). Mean incubation times were 49.8 days for dune sand and 50.0 days for beach sand. Overall, the effects of dune (clean) sand and beach (oiled) sand did not appear to be significantly different.

In laboratory experiments, the minimum incubation time was not affected by the oil treatment whereas mean incubation times were significantly affected by the oil. Lightly oiled samples had shorter incubation times than controls (52.3 versus 53.3 days) while medium or heavy dose contamination resulted in longer (53.9) incubation times. Treatments with oil at the initiation of development did not affect numbers of dead hatchlings, unhatched eggs, eggs with embryos, or the size of embryos.

Hatchling morphology was affected by the amount of oil to which developing turtles were exposed. Hatchling weight, length, and width were all affected in exposed turtles. Differences in scutellation relative to the amount of oil were also evident. Exposed hatchlings had significantly more vertebral scutes than control turtles.

The time during the incubation period at which the turtle eggs were exposed to oil had a significant effect on various parameters. Eggs which were exposed to oil after 42 days incubation required a longer time to incubate than controls. The numbers of surviving hatchlings were higher in control and full-time oil subsamples than in hatchlings exposed after 28 and 42 days incubation. Numbers of unhatched eggs were significantly higher in the 28 and 42 day exposed eggs than in the controls. Significant differences between the control and treated eggs were measured in unhatched eggs with dead embryos in different development stages. Scutellation of the carapace was also affected by oil treatment.

STUDY PRODUCT: Fritts, T. H. and M. A. McGehee. 1982. Effects of Petroleum on the Development and Survival of Marine Turtle Embryos. A final report by the U.S. Fish and Wildlife Service for the U.S. Department of the Interior, Minerals Management Service Gulf of Mexico OCS Office, New Orleans, LA. NTIS No. PB82-263773. FWS/OBS-82/37. Contract No. 14-12-0001-29096. vii + 41 pp.

¹P.I.'s affiliation may be different than that listed for Project Managers.