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ABSTRACT

PETROLEUM STRUCTURES AND THE DISTRIBUTION OF SEA TURTLES

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PETROLEUM STRUCTURES AND THE DISTRIBUTION OF SEA TURTLES

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INTRODUCTION

More than 4000 platforms are documented in the 1988 U.S. Coast Guard data base offshore of Louisiana. Current regulations require the removal of nonproductive petroleum platforms from federal waters. A common method uses explosives to shear the platform's support structures below the sediment line.

Loggerhead (Caretta caretta) and hawksbill (Eretmochelys imbricata) sea turtles have been reported to frequent hard bottoms and underwater structures (Hopkins and Richardson 1984). In the northern Gulf of Mexico, hawksbills are believed to be uncommon but loggerheads are probably the most common sea turtle (Carr et al. 1982). All sea turtles in the Gulf are protected by the Endangered Species Act. The probability of sea turtles being near platforms, and perhaps injured or killed by the explosions used to remove platforms, has not been reported.

In June 1988, supported by Minerals Management Service's Environmental Studies Program, we begin a 12-month study of the association between sea turtles and platforms offshore of Louisiana. Our study was primarily designed to study whether sea turtles were attracted to platforms. Additionally, our study addressed three other research questions having direct bearing on sea turtle conservation: are sea turtles similarly abundant among different habitats, are sea turtles similarly abundant seasonally, and are any other marine animals reliable indicators of habitats preferred by sea turtles?

METHODS

Five study areas, ranging from about 900 to 1300 km^2, offshore of Louisiana were selected. Areas with varying platform densities, ranging from none to many per unit area, occur in each study area. Sediment types vary among study areas. Water depths range from about 2 to 200 m but, in each study area, water depth is a constant among the differing platform density areas. One study area is east of the Mississippi River and near the Chandeleur Islands. These islands are used by nesting loggerheads. The other four study areas are west of the river, not near any known sea turtle nesting beaches, and range from near shore to about 150 km offshore.

In this paper we have used data from the June through December surveys for density and distribution analyses. Each study area was surveyed 4 or 5 times, depending on random selection, per month. Each survey consisted of a series of systematic transects from a single random starting location in each study area. Systematic transects insured similar coverage of the different platform density areas.

A Twin-Otter aircraft was flown at 229 m altitude and about 204 km/h ground speed. Two observers, one on each side of the aircraft, reported observations to the computer operator. Two types of sea turtles, leatherbacks (Dermochelys coriacea) and chelonids, were easily differentiated. Chelonids were segregated to most probable species or classed as unidentified. The majority of chelonids were either loggerheads or not identified. In addition to sea turtles, similar data was collected for about 40 other types or species of marine animals, 7 types of pollution, and 10 types of human activities. The computer was interfaced with a LORAN-C receiver and automatically recorded the study area, date, time, and location for each data record. Many observer supplied variables described the survey environment and animal behavior. A high resolution video camera, mounted in a open porthole, recorded, the transect tracklines.

Line transect data analysis methods were used to estimate surfaced sea turtle abundance. For this paper we used two methods to study sea turtle association with platforms. We generated 10 repetitions of 100 random points in each study area. Correlations between the distances from each point to the nearest platform and the nearest turtle location were tested with Kendall's measure of rank association and Spearman's measure of rank correlation (Upton and Fingleton 1985). The cumulative probabilities of observed and expected distances from turtle locations to the nearest platforms (Hamill and Wright 1986) were compared. We used radii increasing in 100 m increments to compare observed versus expected numbers of turtles sightings per distance interval. We used the Kolmogorov test statistic (Conover 1980) to test for significant differences between the observed and expected cumulative probability distributions.

Surface sea temperatures have been monitored by two methods. During the summer and early fall a high resolution, precision radiation thermometer was mounted on the aircraft and used to record temperatures at intervals along each transect and whenever a marine animal was sighted. At least twice a month, the NOAA-9, NOAA-10, or NOAA-11 satellites were accessed for sea surface temperatures. Resolution of these images was about 1 km^2. In addition to estimating sea surface temperatures at marine animal locations, these images provided an overall assessment of how sea surface temperatures were changing.

RESULTS

From June through December, a total of 142 sea turtles were sighted. Thirteen were leatherbacks, the other 129 were identified as chelonids. Eight (62%) of the leatherbacks have been observed in one study area west of the river, usually associated with jellyfish. Surfaced chelonids abundance was dissimilar among study areas. Seventy-eight (60%) of the chelonids were observed in the study area offshore of the Chandeleur Islands (Figure 1). In that study area, the average surfaced chelonid density (June through November) was 0.028 turtles/km^2, much greater than the average surfaced chelonid densities for the same time period in the other four study areas (range 0.007 to 0.001 turtles /km^2).

Chelonids offshore of the Chandeleur Islands have shown a significant affinity for the petroleum platform area. Both Kendall's and Spearman's tests found chelonid locations positively correlated with platform ($P < 0.01$). Hamill and Wright's test for dispersion indicated the association became significant in the 900 to 1000 m distance interval ($P < 0.05$), and maximum significance occurred in the 4800 to 4900 m distance interval ($P < 0.001$).

Surfaced chelonids were not associated with platforms in the other study areas (Kendall's and Spearman's tests; $P > 0.20$ for these studies). Results from the tests for dispersion indicated chelonids were somewhat repulsed from the platforms in two of the study areas and randomly dispersed in the other study area. Too few sea turtles have been sighted in the deep water study area to allow significance testing.

Surfaced chelonids in the study area offshore of the Chandeleur Islands have been most abundant in the southern portion, the area where platforms are most abundant. Fourteen percent of the turtles have been within 500 m of a platform, 30% within 1000 m, and 45% within 1500 m. West of the river, 7% of the surfaced turtles have been within 500 m, 14% within 1000 m, and 23% within 1500 m of the nearest platform.

If we assume adult loggerheads spend about 8% of the daylight hours on the surface (Nelson et al. 1987), we can use a factor of 12.5 to calibrate estimated surfaced turtle abundance to total loggerhead sea turtle abundance. If we assume that the chelonids are not territorial, that is, one turtle being near a platform does not affect the probability of another being nearby, and then randomly pick a Chandeleur Island study area platform, the probability of one or more chelonids being within 500 m would be about 0.27, within 1000 m about 0.50, and within 1500 m about 0.65. West of the river, the probability of one or more chelonids being within 500 m of a randomly selected platform would be about 0.04, within 1000 m about 0.08, and within 1500 m about 0.13.

Summer (June through September) sea surface temperatures in the study areas were uniformly 22 to 24 C. In the fall, the surface sea temperatures began to stratify and in February the surface temperatures ranged from about 12 C nearshore to 20 C about 150 to 180 km offshore. Compared to the "summer" abundance and distribution, surfaced sea turtles observed from November through March, were more or less similar in abundance and distribution pattern.

DISCUSSION AND CONCLUSIONS

Offshore of the Chandeleur Islands, the greater abundance of sea turtles, along with either an attraction for platforms or an attraction for the platform area, increases the probability that a chelonid, probably a loggerhead, will be near a platform. West of the river, because chelonids are more uncommon, because they do not appear to be attracted to platforms or platform areas, and because the density of platforms is so great, the probability of a sea turtle being near any randomly selected platform is much less, but not inconsequential.

In temperate areas, loggerhead sea turtles are believed to migrate and brumate as a response to either decreasing water temperatures and/or decreasing photophase periods (Carr et al. 1980, Ogren and McVea 1981, Dodd 1988). We observed surfaced sea turtles during the winter months in study areas where surface sea temperatures were about 14 to 16 C. To what extent the moderate 1988/89 winter weather may have influenced sea turtle behavior is not known.

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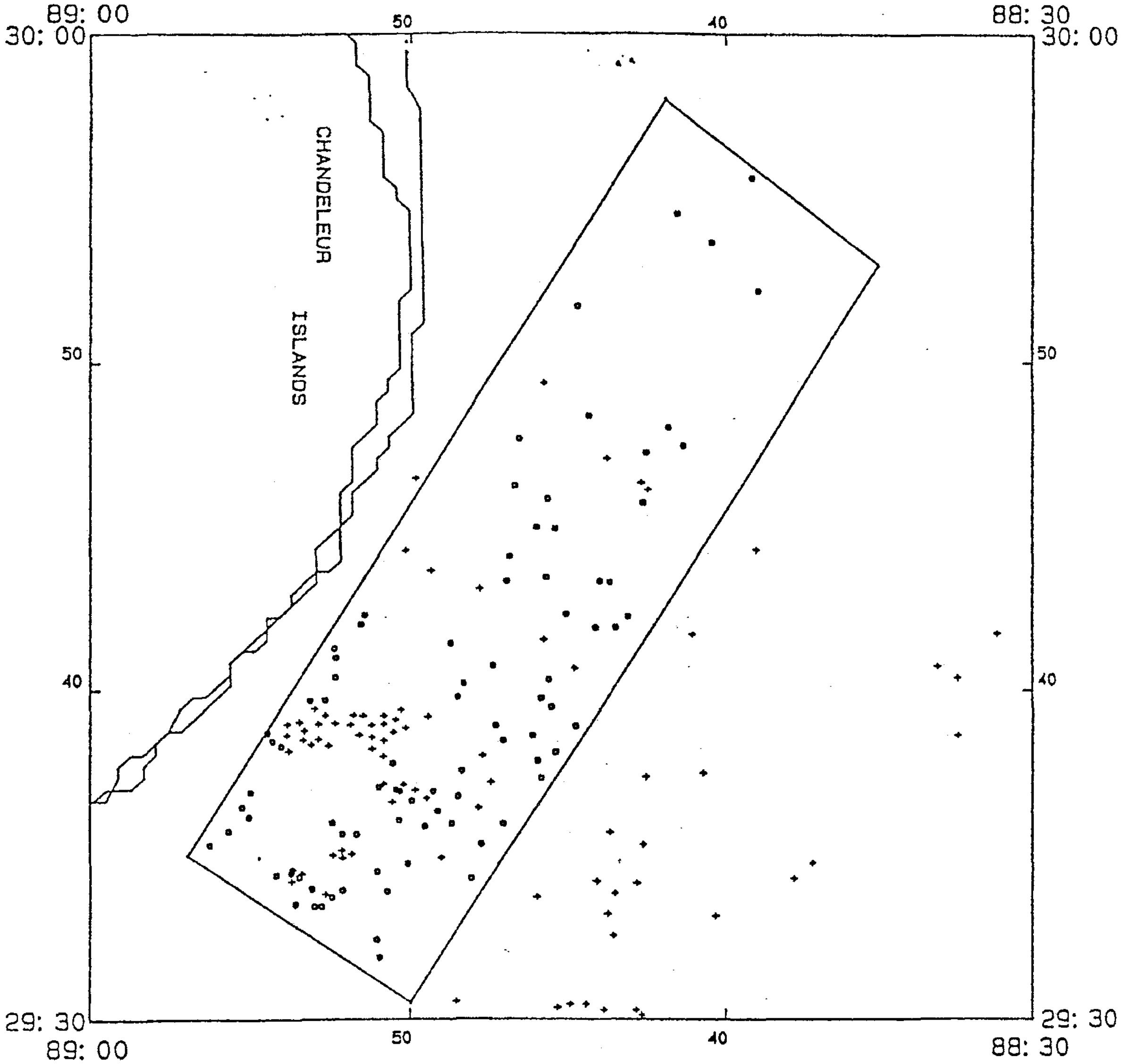

Figure 1. Locations of surfaced Chelonids (circles) observed during the June through February surveys. Platform locations are crosses and the parallelogram delineates the study area.