ACCESS NUMBER: BRD 96-0004 and 96-0009

STUDY TITLE: Coastal and Marine Ecosystem Program: Distribution and Abundance of Marine Mammals in the Gulf of Mexico (GulfCet II)

REPORT TITLE: Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance, and Habitat Associations, Volume I: Executive Summary, Volume II: Technical Report, and Volume III: Data Appendix

CONTRACT NUMBER(S): USGS BRD: 1445-CT09-96-0004 and 1445-IA09-96-0009

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREA(S): Western, Central, and Eastern Gulf of Mexico

FISCAL YEAR(S) OF PROJECT FUNDING: 1996; 1997; 1998

COMPLETION DATE OF REPORT: January 2000

COST(S): FY 1996: $934,708 ; FY 1997: $712,401 ; FY 1998: $624,123 ; CUMULATIVE PROJECT COST: $2,271,232

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KEY WORDS: Western Gulf; Central Gulf; Eastern Gulf; cetaceans; whales; dolphins; sea turtles; seabirds; habitats; food habits; physical oceanography; biological oceanography; satellite oceanography; marine ecology; acoustics; currents; distribution and abundance; oil and gas; surveys; zooplankton; micronekton; line transects; anthropogenic impacts; behavior

BACKGROUND: Cetaceans, sea turtles, and seabirds are upper trophic level predators that play an important role in the pelagic marine ecosystem of the Gulf of Mexico. These animals are highly valued, protected by national laws and international agreements; knowledge of their distribution, abundance, and ecology is vital to their protection. The GulfCet II study was conducted to help resolve issues concerning the potential impacts of various deep oil and gas activities on cetaceans, sea turtles and seabirds on the northern Gulf of Mexico, continental slope in waters 100-2,000 m deep. The GulfCet II surveys (1996-1998) complemented and supplemented the spatial and temporal extent of the GulfCet I shipboard and aerial surveys that had been conducted in the north-central and northwestern Gulf from 1992-1994. The U. S. Geological

Survey, Biological Resources Division procured and administered the GulfCet II study based on information needs of the Minerals Management Service

OBJECTIVES: (1) Obtain data on temporal and spatial patterns of distribution and minimum abundance estimates of cetaceans using line-transect and acoustic survey techniques directly comparable to those used in previous (GulfCet I) surveys, including incidental sightings of sea turtles and seabirds; (2) Identify possible associations between cetacean and seabird high-use habitats and the ocean environment, and attempt to explain any relationships of physical and biological variables to cetacean distributions.

DESCRIPTION: It is generally believed that the distribution of cetaceans and seabirds in the Gulf of Mexico is linked, in part, by the availability of their foods. Although the diets of most cetaceans and seabirds in the Gulf are poorly known, it was hypothesized that different hydrographic regimes in the northern Gulf have different levels of potential prey, and furthermore, that these prey might be locally concentrated in nutrient-rich areas. To evaluate these hypotheses, an integrated approach was used to survey cetaceans and seabirds, characterize associated hydrographic and bathymetric features, and measure the biomass of co-occurring zooplankton and micronekton. The study area encompassed over 400,000 km². The region was characterized hydrographically using data from expendable bathythermographs (XBTs), conductivity-temperature-depth (CTD) stations, nutrient and chlorophyll measurements, collected during four cruises and from tandem remote sensing of sea surface height using the TOPEX/POSEIDON and ERS-2 satellite altimeters. The distribution and abundance of potential cetacean foods were measured via nighttime net tows using a Multiple Opening/Closing Net and Environmental Sampling System (MOCNESS) and an Isaacs-Kidd Midwater Trawl. The numbers of cephalopod (squid) paralarvae and myctophids (an abundant family of midwater fishes) collected in the nets were used to estimate relative prey availability. Continuous measurements of zooplankton and micronekton biomass were made using an Acoustic Doppler Current Profiler (ADCP), whereby the acoustic backscattering strength of the ADCP signals were calibrated by regression analysis from the biomass obtained from the net tows. Line transect methods from shipboard and aerial surveys were used to make abundance estimates of cetaceans and seabirds. Cetacean distribution was also evaluated by recording species-specific vocalizations and simultaneous anthropogenic sounds (ambient noise) as detected by a towed hydrophone array.

SIGNIFICANT CONCLUSIONS: The Mississippi River outflow and two major circulation features dominate an oceanographically complex, dynamic Gulf of Mexico and strongly influence the associated biotic communities. The Loop Current, connecting the Yucatan and Florida Currents, governs the circulation of the eastern Gulf. In the central and western Gulf, a warm-water anticyclonic eddy with associated cold-water cyclones, are the primary features. High levels of nutrients (nitrate) and chlorophyll were associated with the Mississippi River plume, shelf edge upwelling (during early summer months), and the cold-water cyclones. The trawls and bioacoustic surveys showed that the cyclones had locally higher stocks of zooplankton and

micronekton. Cephalopod paralarvae and myctophid abundances were relatively higher in the cyclone and confluence areas relative to areas with anticyclonic circulation, suggesting that such areas may afford enhanced foraging for cetaceans. Indeed, cetaceans in general were concentrated along the continental slope in areas of cyclonic circulation and where chlorophyll and zooplankton biomass were elevated. Cetaceans were less frequently observed over water deeper than 2,000 m and in anticyclones. Sperm whales were sighted most frequently in the area off the mouth of the Mississippi River along the 1000 m isobath and showed an affiliation with the edges of cyclonic and anticyclonic eddies. Photo-identified sperm whales showed intra- and inter-year site fidelity to the Mississippi Canyon, suggesting that this area is important habitat for this endangered species. The mouth of the Mississippi River also had relatively large number of certain seabirds, including the pomarine jaeger and black tern. The highest diversity of seabirds was found in areas of cyclonic circulation. Recordings from the hydrophone array included “sightings” of 11 species of cetaceans, including sperm whale. Based on the acoustic records, no significant difference in cetacean sighting frequency was found for areas of relatively low, medium, and high anthropogenic underwater noise levels, which included signals from seismic exploration activities.

STUDY RESULTS: The oceanic cetacean community in the Gulf of Mexico was composed of at least 19 species. The most numerous species were pantropical spotted dolphin (46,625 individuals), spinner dolphin (11,251), and Clymene dolphin (10,093) comprising about 50%, 12%, and 11%, respectively, of the estimated total cetacean abundance (94,182 individuals) in the study area. Those three species were followed in order of abundance by bottlenose dolphin (5,618), striped dolphin (4,858), melon-headed whale (3965), Atlantic spotted dolphin (3,213), Risso’s dolphin (3,040) and short-finned pilot whale 1,471), rough-toothed dolphin (852), false killer whale (817), dwarf/pygmy sperm whale (733), sperm whale (530), pygmy killer whale (518), killer whale (277), Cuiver’s beaked whale (159), Fraser’s dolphin (127), and Bryde’s whale (35). On a regional basis, fewer cetaceans were sighted in the western Gulf relative to the central and eastern Gulf. The cetaceans of the continental shelf and shelf-edge were almost exclusively bottlenose dolphin and Atlantic spotted dolphin. Clymene dolphin, pantropical spotted dolphin, spinner dolphin, and striped dolphin occurred more often over the lower slope and deepwater regions in areas of cyclonic or confluence circulation. Squid-eaters, including dwarf and pygmy sperm whale, false killer whale, melon-headed whale, pilot whale, pygmy killer whale, Risso’s dolphin, rough-toothed dolphin, and Cuvier’s beaked whale, occurred most frequently along the upper slope in areas outside of anticyclones. Loggerhead, Kemp’s ridley, and leatherback sea turtles were sighted throughout the study area but were most numerous during winter months and over shelf waters. Seabirds also varied seasonally. Two of the most commonly identified seabird species, laughing gull and royal tern, are year-round residents in the Gulf, while pomarine jaeger, the third most commonly identified species is a winter migrant. During mid-summer, black tern was the most abundant species followed by band-rumped storm petrel (summer migrant pelagic), frigatebird (permanent resident), Audubon’s shearwater (summer migrant pelagic), and sooty tern (summer resident).

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STUDY PRODUCT(S): Davis, R.W., W.E. Evans, B. Würsig, eds. 2000. Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume I: Executive Summary. U.S. Department of the Interior, U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0005 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-002, 40 pp.

Davis, R.W., W.E. Evans, B. Würsig, eds. 2000. Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume II: Technical Report. U.S. Department of the Interior, U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-003, 363 pp.

Davis, R.W., W.E. Evans, B. Würsig, eds. 2000. Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume III: Data Appendix. U.S. Department of the Interior, U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2000-004, 229 pp.

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