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STUDY TITLE: Potential Spatial and Temporal Vulnerability of Pelagic Fish Assemblages in the Gulf of Mexico to Surface Oil Spills Associated with Deepwater Petroleum Development

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CONTRACT NUMBER: 14-35-0001-30660-19962

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREAS: Eastern Gulf of Mexico, Central Gulf of Mexico, Western Gulf of Mexico

FISCAL YEARS OF PROJECT FUNDING: 1998

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COSTS: FY: 1998: $59,056

PROJECT MANAGER: M.C. Benfield

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KEY WORDS: pelagic fishes, adults, larval stages, Gulf of Mexico Region, spatial distributions, tuna, *Thunnus albacares*, *Thunnus thynnus*, *Thunnus atlanticus*, marlin, *Makaira nigricans*, *Tetrapturus albidus*, wahoo, *Acanthocybium solanderi,* dolphinfish, *Coryphaena hippurus*, blue runner, *Caranx crysos*, ocean sunfish, *Mola mola*, flying fish, *Cypselurus furcatus*, *Cypselurus melanurus*, *Sargassum*, sargassumfish, *Histrio histrio*, filefish, *Monocanthus hispidus*, tripletails, *Lobotes surinamensis*

BACKGROUND: As petroleum exploration expands into, and beyond the waters of the OCS, the potential exists, via accidental spills, to adversely impact pelagic recreational and commercial fisheries. Surface petroleum spills in pelagic waters of the OCS will primarily impact those species of fishes and crustaceans that inhabit the epipelagic zone of the open ocean. Members of this group include several species that command a high monetary and socio-economic value, as well as ecologically important or indicator species. Spills in the surface waters are also likely to impact floating *Sargassum* communities, which contain a diverse and often unique faunal assemblage of fishes and invertebrates and which also serve as important nursery habitats for many fishes. Relatively little is known about the susceptibility of pelagic fishes from the Gulf of Mexico OCS to petrochemical spills. The magnitude of any impact will depend upon the spatial and temporal scale of the incident as well as the chemical properties of the spilled material. The spatial scale (location, depth and extent) of the spill combined with the temporal scale (timing and duration) will combine to determine the species and life history stages that are likely to be present in the impacted area. Unfortunately, information on the spatial and temporal distributions of pelagic fish stocks in the OCS is not readily available and is generally scattered throughout the peer-reviewed and non-peer-reviewed technical literature and databases.

OBJECTIVES: This study was undertaken to synthesize what is known about the spatio-temporal distribution patterns of selected pelagic fish species. We have attempted to provide an estimate of what life history stages of these target species are likely to be present within the OCS waters on a seasonal (monthly) basis.

DESCRIPTION: We delineated a study region of the north central Gulf of Mexico that includes waters above the 200-2000 m isobaths south to 26 ºN latitude. The study area was divided into four zones: western zone (96.4 ºW–92.0 ºW, 26.0 ºN–28.0 ºN), central zone (92.0 ºW–88.0 ºW, 26 ºN–28 ºN), eastern zone (88 ºW–84.3 ºW, 26.0 ºN–28.0 ºN), and a triangular northern zone with a base from 90.7 ºW-84.3 ºW at 28 ºN, and an apex at 87 ºW, 30 ºN (Fig. 1). The western, central and eastern zones correspond broadly to the MMS western, central and eastern planning areas. Species selected for study were: bluefin tuna (*Thunnus thynnus*), yellowfin tuna (*T. albacares*), blackfin tuna (*T. atlanticus*), blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), wahoo (*Acanthocybium solanderi*), dolphinfish (*Coryphaena hippurus*), two species of flyingfishes: *Cypselurus melanurus* and *C. furcatus*, blue runner (*Caranx crysos*), Ocean sunfish (*Mola mola*), and *Sargassum* community fauna**:** sargassumfish (*Histrio histrio*), planehead filefish (*Monocanthus hispidus*), tripletails (*Lobotes surinamensis*).

In addition to a comprehensive literature search of the available peer-reviewed literature, gray literature (Table 1), and Internet websites, this report drew heavily on two datasets: the National Marine Fisheries Service (NMFS) long-line database and the Southeast Area Monitoring and Assessment Program (SEAMAP) ichthyoplankton surveys. Reported observations were sorted by month into a 10' longitude by 10' latitude grid (approximately 100 nautical miles^2 or 343 km^2). The potential presence of a particular stage in any of the cells within the grid was ranked according to three categories: confirmed, reasonable inference, and unreported. Confirmed presence was assigned when a physical sample of the relevant stage of a particular taxon had been reported as being present within a cell. Reasonable inference was assigned to any cells within which, there was no confirmed presence, providing the cells were located within a radius of two cell distances (for adults) or one cell distance (for larvae/juveniles) of a cell with a confirmed presence. Reasonable inference was also assigned to any cells that were bounded by four or more cells also designated with the reasonable inference category. Finally, any regions within the study area that were completely surrounded by cells designated as confirmed or reasonable inference were also assigned reasonable inference. Finally, all cells that did not fall into the confirmed or reasonable were assigned an unreported category.

SIGNIFICANT CONCLUSIONS: For each species, we have summarized the available distributional data on a monthly basis and have attempted to predict the distributions of larvae, adults, and juveniles (when possible) within the study region. Companion software in the form of Microsoft Excel spreadsheets allow the user to query the data to obtain probable distributions within specific locations defined by their longitude and latitude. It is clear that for many taxa, substantial gaps exist in our understanding of their spatial and temporal distributions. Prediction of the distributions of larvae and juveniles is particularly problematic due to the limited amount of spatially explicit data available for these life history stages. Estimation of vertical distributions was also problematic for most stages and taxa.

STUDY RESULTS: Distributional data are predicted for each month for adults and larvae/juveniles where possible. An example of these results is provided for yellowfin tuna. Comparable predictions are provided in the report, but are not summarized here, for the other taxa in the study.

Adult yellowfin tuna are likely present throughout the majority of the study area during all months of the year. During winter, the majority of confirmed landings were in the western and western halves of the central and northern zones. By April, yellowfin expand their distribution in the northern zone towards the northeast and this movement pattern continues through May and June. During April there is also an apparent movement into waters deeper than 200 m in the southeastern edge of the northern zone and the northeastern edge of the eastern zone. In summer, adults are present throughout most of the three zones and during fall and early winter, the epicenter of confirmed records shifts back to the western and central zones. The SEAMAP dataset contains extremely limited numbers of confirmed yellowfin larvae that were only present during May and June. Predictions of larval distributions based on this dataset are restricted to these two monthsand do not provide much utility for estimating larval distributions. Limited data suggest that most spawning occurs near the Mississippi River plume frontal region with larval and juvenile yellowfin tuna present seaward and downstream (southwest) of the plume along the 200 m. In the absence of juvenile distributional data, it is likely that their distributions overlap with the larvae.

STUDY PRODUCTS: Benfield, M.C. and R.F. Shaw. 2005. Potential spatial and temporal vulnerability of pelagic fish assemblages in the Gulf of Mexico to surface oil spills associated with deepwater petroleum development. Prepared by the Department of Oceanography and Coastal Sciences, Coastal Fisheries Institute, Louisiana State University. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-012. Xv+158 pp.

Companion Microsoft Excel Spreadsheets: Data for each taxon and stage is provided in a Microsoft Excel spreadsheet separate worksheets for each taxon and life history state. A series of files are provided for each month of the year. There is one set for adults and a second set for larvae/juveniles. Within each file there are worksheets for each species containing latitude and longitude coordinates and a matrix of cells containing distributional data are encoded with values of 2 (confirmed), 1 (reasonable inference), or 0 (unreported). The cells corresponding to the study area are colored yellow. Within each monthly Excel spreadsheet for either larvae/juveniles or adults there is a worksheet called Distribution Calculator that provides a means of querying the data. Individual worksheets for each taxon are accessible via tabs at the bottom of the spreadsheet page. The Distribution Calculator worksheet allows the user to enter the western and southern coordinates of the location to be queried. The calculator will query each taxon for the month in question and return the predicted distribution of adults or larvae/juveniles of each taxon at the location of interest.

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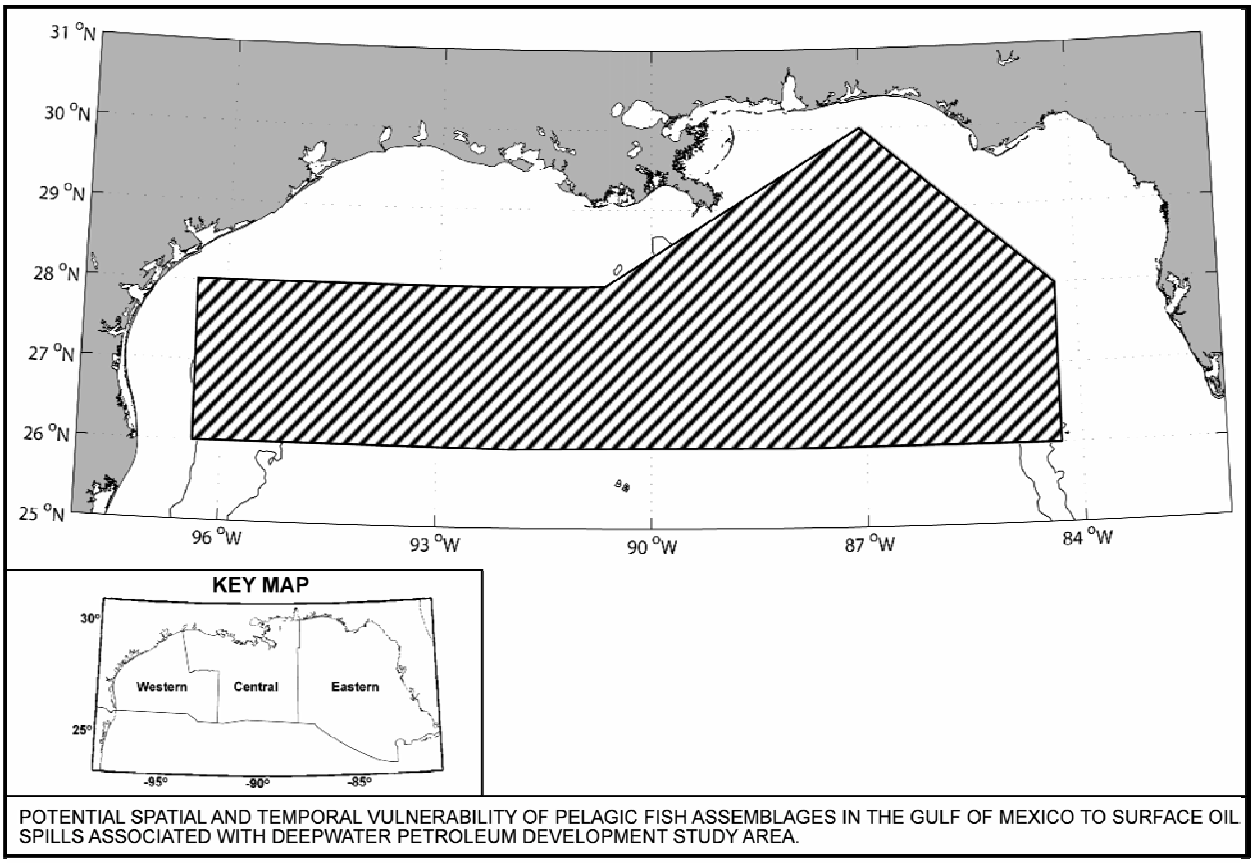

POTENTIAL SPATIAL AND TEMPORAL VULNERABILITY OF PELAGIC FISH ASSEMBLAGES IN THE GULF OF MEXICO TO SURFACE OIL SPILLS ASSOCIATED WITH DEEPWATER PETROLEUM DEVELOPMENT STUDY AREA.