BOEM ENVIRONMENTAL STUDIES PROGRAM: ONGOING STUDIES

BOEM OCS Region: Gulf of Mexico

Title: Eastern Brown Pelicans: dispersal, seasonal movements, and monitoring of PAHs and other contaminants in the northern Gulf of Mexico (GM-12-03)

Planning Area: Gulfwide

Total Cost: $1,200,000 **Period of Performance:** FY 2011-2015

Conducting Organization: USGS, South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University, Clemson, SC

BOEM Contact: Dave Moran

Description:

Background: The exploration and development of oil and gas resources in the Gulf of Mexico (GOM), as well as potential renewable energy and alternate use projects, will require BOEM to produce information for a variety of NEPA-related decision documents, as well as compliance with Endangered Species Act (ESA), the Migratory Bird Treaty Act (MBTA), and the MOU. The eastern brown pelican was recently delisted on 17 November 2009 (74 FR 59443 59472). Even though the brown pelican was delisted, all coastal states in the Gulf of Mexico except Alabama consider it as a state Species of Conservation Concern. The eastern brown pelican was one of the most heavily impacted avian species due to oiling from the *Deepwater Horizon* (DWH) event and remains one of the iconic symbols for the state of Louisiana and the GOM.

This study will focus on obtaining information about colony-specific population parameters for brown pelicans across the northern GOM from relatively moderately (Western Planning Area, WPA), heavily (Central Planning Area, CPA), and lesser (Eastern Planning Area, EPA) anthropogenically “impacted” areas. More specifically, this study will provide important information on seasonal and annual movements (e.g., home range size, dispersal, fidelity) of brown pelicans relative to sex-age class and colony, and possibly to include relevant demographic information (e.g., seasonal and annual adult and subadult survival, nest success, # fledged young/nest) among colonies and across Planning Areas. Colony-specific movements and population parameter data for the eastern brown pelican would be invaluable in assessing potential effects of industry activities (and potential spills) on individuals associated with various breeding colonies. Presently, there is some information to suggest that there is among-colony variation in some metrics of reproductive success, but it isn’t clear why such spatial variation is present. Additional data will be collected on levels of polycyclic aromatic hydrocarbons (PAHs) and other ecotoxicological markers of contaminants relative to sex, age, and colony (Seiser et al. 2000, Trust et al. 2000, Alonso-Alvarez et al. 2007a, Esler et al. 2002, Esler et al. 2010, Velando et al. 2010). Relative to the DWH event, it is unclear whether the loss of certain sex-age classes or individuals from certain breeding 'colonies' will influence the duration of time to recovery to pre-spill levels, and what the impacts of the spill had on the long-term viability of this population in the GOM. As of 12 May 2011, 826 brown pelicans had been collected as part of monitoring efforts related to the DWH event. Of the 826 birds collected, 339 were visibly oiled (41% oiling rate); 152 visibly-oiled birds were dead (USFWS 2010). Presently, it is unknown how this level of mortality is distributed among colonies and how this level of mortality might influence population dynamics of eastern brown pelicans breeding in the northern Gulf of Mexico. Given their behavior, habitat use, foraging behavior, and life-history strategy, it appears this species is particularly sensitive to oiling events (Shields 2002). The following study objectives have been identified as information needs by BOEM science staff. All objectives will be considered for feasibility, but only a smaller subset may ultimately be achieved via this IA due to funding constraints, logistical issues, colony access issues, permitting requirements, the value of addressing broad scale ecological questions versus region-specific priorities, and the trade-offs between anticipated costs associated with each objective versus achieving the most information gain given the budget. All objectives identified herein are considered relevant and important to avian ecologists working with brown pelicans.

<u>Objectives</u>:

Study objectives are to:

1. To describe the dispersal, seasonal and annual movements, seasonal home range, and site fidelity of marked adult (or fledgling) brown pelicans among nesting colonies from the Gulf coast of Texas to the northwestern Gulf coast of Florida. Researchers will preferentially capture and mark 10-20 (with satellite or GPS transmitters) adult female brown pelicans/colony along the coast. Although females are the preferred sex for the focus of this study, females cannot be identified easily in the field by size or color, and therefore other techniques may be necessary. If these techniques prove inefficient or inaccurate, we may need to determine sex post-capture and include sex as a covariate during data analysis. We will preferentially deploy satellite transmitters ($\leq$ 3% of body mass) on adults (all captured birds also will be measured and banded) Use of satellite or GPS transmitters will provide data on large spatial scale movements as well as size and location of home ranges during both the breeding and nonbreeding seasons. Data may be compared with those obtained by the PI on brown pelicans satellite tagged in the northern Gulf and along the SE coast of the US during 2010-2011.

2a. To assess body condition and health using standard morphological assessments (i.e. mass, culmen and tarsus length), avian blood chemistry profiles (Jodice and Eggert 2010), an examination of endo- and ectoparasite loads (Eggert and Jodice 2008, Eggert et al. 2010), and levels of contaminants that may show general exposure (Mallory et al. 2010) as well as indications of oiling (PAHs; Fritcher et al. 2002, Perez et al. 2008) in adult brown pelicans and nestlings/immatures. Distribution of sampling effort will encompass a similar geographical range as for the first objective, but may include more intensive sampling in areas that were considered heavily oiled (in Louisiana). Spatial sampling strategy, number of samples collected, and type of samples (e.g., blood, feathers, tissues and/or organs) will be determined at a later date and through feasibility determinations with contacts with the USFWS and states during the permitting process.

2b. To identify what portion of brown pelican contaminant loads are derived from different prey sources and foraging areas. This will allow for inferences to be made regarding the sources of contaminant exposure (i.e. food web or other sources of environmental exposure). Potential prey items will be collected at each site and stable carbon and nitrogen isotopic analyses will be conducted on both predator (i.e. pelican) and prey tissue samples in order to determine to what extent contamination comes from coastal versus pelagic prey, each of which has varying $\delta^{13}C$ and $\delta^{15}N$ values. Proximate composition and energy density of prey also may be measured. These data will also be used to better explore objective 1 by providing a direct link between foraging habits, seasonal movement patterns, habitat use, diet and source of contaminant loads.

3. To capture and mark adult (or nestling) brown pelicans with VHF transmitters to document seasonal and annual home range size or identify major foraging and roosting areas in the nearshore environment. VHF transmitters will require substantial flight time to obtain locations off-colony and therefore require substantial resources (personnel, funding) to obtain a sufficient quality and quantity of relocations. VHF transmitters may therefore best be used to address specific questions that require detailed observations of individuals (e.g. obtaining detailed foraging tracks simultaneously with time-activity budgets). To further address, colony-specific and age-specific survival, researchers may also mark a sample of nestling brown pelicans (~500/yr x 3yrs) with USFWS aluminum leg-bands and colored leg-bands; also to obtain information on juvenile dispersal, movements, and fidelity. If banding is conducted, it will be coordinated with any ongoing state, federal, or other banding efforts.

4. To document among-colony differences in important population demographic parameters including, but not limited to nest success, daily nest survival, # young fledged/nest/colony, prey delivery rates, nest attendance, behavior, and stage-specific survival (estimates by colony). Such data are needed for brown pelicans throughout their breeding range but require intensive research efforts within colonies. Early discussions with the PI indicate the cost of this objective alone represents 85-90% of the overall budget allocation if these data were collected at the spatial scale considered herein (6 – 8 colonies across the 3 Planning Areas). Furthermore, early discussions with state and federal agency personnel suggest that access and logistical constraints may limit the scope and scale of this specific objective, and that similar efforts may be initiated by some research teams in 2012.

Appropriate federal, state, and university permits will be obtained prior to implementation of fieldwork for the capturing, handling, and marking of birds, but also for conducting oil and contaminants assessment. In addition, permission to access all federal and state owned lands will be obtained by the appropriate agencies prior to any fieldwork in these areas. This study will be designed to compliment, not repeat, any directed studies currently or previously being conducted under the Natural Resource Damage Assessment (NRDA) associated with the DWH event (n.b. the PI identified herein is a Co-PI on NRDA efforts involving brown pelicans and therefore is very familiar with recent and ongoing efforts).

Eastern Brown Pelican Movements, Dispersal, Site Fidelity, and Foraging Areas

This study will focus on eastern brown pelicans in the northern Gulf of Mexico including each of the Planning Areas from roughly Corpus Christi, Texas to Cedar Key, Florida. Sampling will be targeted for 2 sites in coastal Texas, 4 sites in coastal Louisiana, 1 site (Gaillard Island, Mobile Bay) in Alabama, and 1-2 sites in northwest coastal Florida although additional or alternative sites may be added if project logistics so warrant. The study will address information gaps relative to brown pelicans in the GOM and provide baseline ecological information. Data to be collected may include but not be limited to daily, seasonal and annual movements and home range size; post-breeding dispersal patterns and locations; fidelity to breeding and wintering sites; and seasonal and annual survival (≤ 4 years). In particular, limited information is known regarding foraging behavior for this species and the general ecology of the immature component of eastern brown pelicans in the northern GOM.

Researchers will preferentially deploy satellite transmitters but also may deploy VHF (very high frequency) transmitters (each ≤ 3% of body mass) to address questions related to Objective 1 and 3. Preference will be given to adult females from known nests where nest fates can be determined, although, as stated previously, sex may need to be determined post-deployment and included as a covariate during analysis. Capture techniques will depend on permitted activities (e.g. access to colonies) and will draw upon successful techniques used to capture birds for the *Deepwater Horizon* NRDA. At this point, the allocation of transmitters among sex-age classes is flexible since we are also interested in obtaining information about the subadult component of eastern brown pelicans in the northern GOM. Also, the number of each transmitter type and allocation of transmitters among nesting colonies has not yet been determined. It would be prudent that transmitters be allocated proportionally among sites in Texas, Louisiana, and Florida (# of sites in each state to be determined) to determine if there is mixing of birds among Planning Areas during either the breeding or nonbreeding seasons.

One of the primary benefits of using satellite transmitters is that the location data are transmitted remotely and data are then provided to the customer via Service ARGOS (ARGOS 1996) with locations defined in various location (i.e., accuracy) classes, e.g., 3, 2, 1, 0, A, B, C (Britten et al. 1999, Hays et al. 2001, Soutullo et al. 2007). This data acquisition process reduces the level of time spent in the field (labor costs) collecting location data and does not necessitate the need to access often remote areas or to fly over expansive areas to search for tagged birds as would occur when using VHF transmitters. One of the biggest differences between transmitter types is the scale or resolution of the data collected versus the cost/transmitter (Lindberg and Walker 2007). VHF transmitters tend to be used when the spatial scale of the questions needs to be resolved at much finer scale (on the order of meters or tens of meters) and their overall cost of purchase is roughly 10% of most satellite transmitters. Conversely, satellite transmitters tend to be used to address large spatial scale questions due to the relative imprecision of location fixes (≥100m) (Britten et al. 1999). In many studies to date, the cost associated with satellite transmitters has resulted in a limited number of marked individuals with limited power to detect differences among sex-age classes, habitats, experimental versus control areas, etc., and limited inference to the population as a whole (Lindberg and Malecki 2007). More recent advances including GPS, NANO, and solar technology associated with these larger package transmitters has increased both the precision of individual fixes (±20m with GPS; Soutullo et al. 2007) and also improvements in the battery-life resulting in increased transmitter longevity (Robinson et al. 2010). The PI has experience using VHF and satellite-transmitters on brown pelicans in the GOM and South Atlantic Planning Areas as part of the Deepwater Horizon NRDA efforts.

Both transmitter types may be employed to generate estimates of seasonal and annual home range sizes and differences in home range size relative to colony, sex, and age (Wood et al. 2000, Horn and Garton 2006). Furthermore, satellite transmitters also can provide critical data on post-breeding dispersal patterns when pelicans that breed in the northern GOM may winter throughout the entire rim of the GOM and even spend time in pelagic waters (Eggert et al. 2011) while VHF transmitters can provide fine-scale temporal and spatial data on core use areas, foraging locations, site fidelity, colony attendance patterns during the breeding season, and foraging tracks paired with time-activity budgets (Kendall and Nichols 2004). Both transmitter types can be used to assess colony attendance, albeit at different spatial and temporal scales. When these telemetry data are paired with visual observations of nests, important baseline measures of adult and chick behavior (e.g. attendance, feeding rates) can be obtained and then used as a measure of change following a natural or anthropogenic disturbance (e.g. Sachs and Jodice 2009).

Seasonal and annual survival estimates may also be estimated via telemetry and/or using a combination of telemetry and live encounters of color-banded pelicans. If this analysis is conducted, multi-state, open population capture-mark-recapture models will be used to estimate annual survival (Φ) and recapture (*p*) (White and Burnham 1999, Murray 2006, White et al. 2006). Models will be fit in program MARK via the Rmark interface. If both males and females are captured, separate survival probabilities may be estimated. Seasonal, annual, and period-specific survival also may be estimated (e.g. 4yr study w/ 3 field seasons could provide 3 annual survival estimates). Because survival may be a function of year, colony, state/Planning Area, status of oiling in study area (e.g. some metric using the coastal oiling data from SCAT surveys, PAH level, EROD activity, etc.), body mass or body condition index (Lebreton et al. 1992, Kendall et al. 2009), these parameters may be considered as covariates in survival analyses. Ideally all birds will be of the same sex and age-class (e.g. adult females w/ transmitters) and all will be captured during the same life-history state (i.e., incubation or prefledging). Therefore, our ability to undertake survival analyses and the exact parameterization of these models will be dependent on permitted activities and capture success.

Eastern Brown Pelicans: Body Condition, Health, Foraging Habits, and Contaminant Exposure

In addition to standard morphological measurements (mass, tarsus and culmen length) needed to assess body condition, we will collect tissue samples (e.g. blood, liver tissue, eggs) from live adult and/or nestling brown pelicans preferably from known colonies (n = 7-10) as means to assess exposure to oil and other contaminants including organochlorines and heavy metals. Prey items will also be collected and analyzed for contaminants, stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotopes. Proximate composition and energy density also may be determined. These data will allow us to better understand the foraging ecology of pelicans and identify the source of contamination obtained via their diet.

Parameters and contaminants of interest will include, but not be limited to PAHs, PCBs, heavy metals, and dioxins which may be obtained through the diet (e.g., consumption of contaminated fish), through ingestion of water during preening or feeding, through direct ingestion of contaminants from the feathers during the preening process, through simple inhalation, or through dermal absorption. Various biomarkers (e.g., PAHs, Heinz bodies, Cytochrome P450- CYP1A and EROD activity; Trust et al. 2000) of petroleum pollution will be quantified in blood. Standard hematology, prevalence and identification of endo- and ectoparasites, incidence of Heinz bodies in red blood cells, and a clinical chemistry panel (plasma enzymes and electrolytes) also may be assessed. These parameters can provide an overall assessment of health as well as exposure to specific contaminants, and can also be obtained within days of collection. Baseline measures for many of these variables exist for young-of-year pelicans from South Carolina and Georgia (Jodice and Eggert 2010).

Specific methodologies, handling techniques, and lab methodologies exist for the aforementioned parameters (see Trust et al. 2000, Fritcher et al. 2002, Perez et al. 2008, Velando et al. 2010). Sampling techniques (e.g. blood collection [volume as a proportion of body mass] liver biopsies (0.5g), or egg collection) are contingent upon obtaining appropriate federal and state permits. Avian veterinarians would be required to conduct liver biopsies on live, sedated birds. Many of these techniques were employed on pelicans by the PI during recent NRDA efforts and knowledge gained regarding handling and sampling techniques during those field projects will be applied here.

Allocation of samples among colonies and sex-age classes has not yet been determined, but should follow the approach used for capturing and marking to reduce disturbance to individual colonies and nests within colonies. To account for spatial variation in contaminant burdens among nesting colonies of eastern brown pelicans within the northern Gulf of Mexico, samples should be obtained from birds from roughly Corpus Christi, Texas in the west to Cedar Key, Florida in the east. Multiple samples should be obtained within each colony across years to account for any temporal variation in contaminant burdens. To ensure independence and to describe a greater amount of potential variation in contaminant burdens among individuals and nests, respectively, only adults (preferably the female), nestling (either sex), or egg will be collected associated with a nest during the incubation period. Samples may also be collected outside of the breeding season in order to better ascertain the precise timing of contaminant exposure.

<u>Products</u>: The primary objective of this IA is to collect and analyze data to provide BOEM with information on eastern brown pelican dispersal, movements, and contaminant levels across their range in the northern GOM. The SCCFWRU will provide quarterly letter reports that address progress and problems for each of the study objectives noted in the goals and objectives above beginning in October 2013. Due to the delays in award in 2012, fieldwork will begin during the spring 2013 nesting season. Periodic updates will be provided as requested.

Importance to BOEM: This Interagency Agreement is being established to provide information used in environmental impact statements and environmental assessments under Outer Continental Shelf Lands Act (OCSLA), 43 U.S.C. 1345, SEC. 20 (Environmental Studies), NEPA, Oil Spill Risk Analysis (OSRA), the Endangered Species Act (ESA) of 1973 (16 USC 1531-1543), Executive Order 13186 (66 FR 3853, January 17, 2001) and the Memorandum of Understanding between MMS and the USFWS, and BOEM Environmental Studies Program to conduct research involving acquisition and analysis of migratory bird and other environmental data. Results from this study could assist in assessment of spills given knowledge of eastern brown pelican movements among Planning Areas and colony-specific productivity estimates (see below). In addition, the information provided from this research may provide insights into why certain colonies tend to more productive compared to others, which colonies tend to be the most productive and where these colonies are located within the northern Gulf of Mexico. This information would be important if the agency were to decide to implement potential mitigation measures leading to creation of artificial nesting islands (e.g., Gaillard Island, Mobile Bay, AL).

Current Status: ongoing

Final Report Due: December 2016

Publications: None

Affiliated WWW Sites: None

Revised date: September 2012

ESPIS **ESPIS** - All ***completed*** ESP Studies:
Full Text, Online, Right Now!
Environmental **S**tudies **P**rogram **I**nformation **S**ystem