

**Final Project Memorandum  
Southeast Climate Science Center Project**

**1. ADMINISTRATIVE**

**Principal Investigator**

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**Project Title**

Identifying Conservation Objectives for the Gulf Coast Habitats of the Black Skimmer and Gull-billed Tern

**Project Number**

031

**Date of Report**

1 February 2020

**Period of Performance**

September 2016 - September 2019

**Total Cost**

\$56,000

**2. PUBLIC SUMMARY**

Many shorebirds and nearshore waterbirds are of conservation concern across the Gulf of Mexico due to stressors such as human disturbance, predation, and habitat loss and degradation. Conservation and protection of these birds is important for the functioning of healthy ecosystems and for maintaining biodiversity in North America. Consequently, resource managers along the Gulf need decision-aiding tools that can help to answer important conservation questions for different species (e.g., how much area should be targeted by management actions to meet a species' needs). To address this need, project researchers developed statistical models that could help identify habitat conservation objectives and actions for bird species taking into account different Gulf coast conservation scenarios that might occur in response to sea-level rise. The project focused specifically on the Black Skimmer (*Rynchops niger*) and Gull-billed Tern (*Gelochelidon nilotica*), two species designated as U.S. Fish and Wildlife Service Species of Conservation Concern and Gulf Coast Joint Venture Priority Species. These two birds are also representative of a variety of other beach and barrier-island nesting birds whose nesting habitats are threatened by sea-level rise (e.g., Least Tern, Snowy and Wilson's Plover). The statistical models linked each bird's abundance to habitat

characteristics that could be influenced by different management actions. This information could be used to identify conservation objectives under different conservation scenarios.

### **3. TECHNICAL SUMMARY**

Many species of shorebirds and nearshore waterbirds are of conservation concern across the Gulf of Mexico due to a common suite of threats, namely human disturbance, predation, and habitat loss and degradation (e.g., Brown et al. 2001; Dinsmore 2008; Brooks et al. 2014; Molina et al. 2006). Consequently, there is a need for decision-aiding tools that can help managers prioritize Gulf conservation efforts for species, which are representative of broader habitat sustainability. To address this gap, the U.S. Fish and Wildlife Service's Biological Objectives for the Gulf Coast working group (BOGC) defined 16 Biological Planning Units (BPUs) to facilitate the compilation and derivation of population and habitat objectives for target species that are affiliated with the unique ecological setting of the different sub-regions of the Gulf (Tirpak et al. 2017). Black Skimmer (*Rynchops niger*) and Gull-billed Tern (*Gelochelidon nilotica*) are USFWS Species of Conservation Concern and Gulf Coast Joint Venture (GCJV) Priority Species whose breeding colonies often co-occur in unvegetated coastal sites of sand, shell, or gravel substrate (Gochfeld & Burger 1994; Golder et al. 2008; Molina and Erwin 2006; Molina et al. 2010, 2014). Both species are representative of a variety of other beach and bare-ground nesters whose coastal nesting habitats are threatened by sea-level rise (e.g., Gochfeld et al. 1994; Molina and Erwin 2006; Molina et al. 2010, 2014; Maslo et al. 2016). Yet, managers lack estimates for how much area is needed to achieve these species' population objectives (i.e., habitat objectives sensu NEAT 2006). Thus, the purpose of the project was to estimate Black Skimmer and Gull-billed Tern habitat objectives for BPUs with established population objectives. The South Central and Southeast Climate Adaptation Science Centers funded the first objective of this project, which was to develop an influence diagram (i.e., a conceptual model) that hypothesized relationships between the number of nests at a site given habitat characteristics that could be influenced by management actions. In a series of meetings with species experts, we defined the project's spatial extent, determined what is considered a potential breeding site, and developed an influence diagram. The influence diagram was used throughout the remainder of the project to identify data needs and appropriate statistical analyses for developing the Bayesian network model. The Bayesian network model can aid coastal habitat managers by providing decision-support tools that estimate how much more area is needed to achieve Black Skimmer and Gull-billed Tern population objectives and guide selection of specific management actions to achieve those objectives.

Upon publication in a peer-reviewed journal, the data and metadata from this project will be archived on Science Base as a project (i.e., child item) under the BOGC landing page, available via this link: <https://www.sciencebase.gov/catalog/item/58b47870e4b01ccd54fca8d0>

This project was co-funded by the South Central and Southeast Climate Adaptation Science Centers; the Gulf Coast Prairie, Gulf Coastal Plains and Ozarks, and Peninsular Florida Landscape Conservation Cooperatives; U.S. Fish and Wildlife Service; U.S. Geological Survey – Ecosystems Mission Area; Gulf Coast Joint Venture; and the Gulf Vulnerability Assessment.

#### 4. PURPOSE AND OBJECTIVES

The purpose of the project was to develop Bayesian network models of the relationships between each species and its habitat characteristics, including the influence of sea-level rise, and use model outputs to derive habitat objectives for each species under different conservation scenarios. The South Central and Southeast Climate Adaptation Science Center funds were provided to achieve the project's first objective, which is listed below.

1. *Develop an influence diagram, which is a conceptual model (i.e., box and arrow graph) that hypothesizes the key processes influencing the species across the Gulf.* We achieved this objective. However, rather than developing one influence diagram per species, we developed a single 'site-level' influence diagram that addressed the needs of both species. A single influence diagram was developed because species experts believed that both Skimmers and Terns would be influenced by the same habitat characteristics and that Gull-billed Terns influence Black Skimmers.

#### 5. ORGANIZATION AND APPROACH

This work was conducted by a technical team of scientists from the U.S. Geological Survey's Wetland and Aquatic Research Center and a team of species experts identified by the Gulf Coast Joint Venture's Waterbird Working Group. We identified habitat characteristics that may influence Black Skimmer and Gull-billed Tern nest count at a site by searching the available literature and working with species experts (Marcot et al. 2006). We first obtained input from experts in a series of meetings, where we presented hypothesized relationships among habitat characteristics and nest counts in the form of an influence diagram, which was based on a literature review. Influence diagrams represent variables as rounded rectangles (i.e., nodes) and influences as arrows (i.e., links) (Marcot et al. 2006). We then asked the experts to revise the influence diagram (e.g., add or remove nodes or links) based on their knowledge of Black Skimmer and Gull-billed Tern breeding sites across the Gulf.

#### 6. PROJECT RESULTS

The primary results from Objective 1 are summarized below. These text sections come directly from a manuscript that is in preparation (Cronin *in prep*). The publication portion of this cooperator report provides links to additional project results and products.

**Methods from:** Cronin, J.P., Robinski, V.L., Dale, L.L., Tirpak, B.E., and Tirpak, J.M. In prep. Black Skimmer (*Rynchops niger*) and Gull-billed tern (*Gelocheilidon nilotica*) habitat objectives for Gulf Coast Biological Planning Units. For submission to Journal of Wildlife Management.

Study Area: "Species experts defined the study area as all bare ground sites within 200 m of the higher high tide line across the U.S. portion of the Gulf of Mexico. This area includes sites on mainland, natural barrier islands, and dredged spoil islands."

Potential Breeding Site: "Species experts defined a potential breeding site as a contiguous patch of bare ground that shared similar restrictions on human and dog activity."

Influence Diagram: “Species experts identified twenty-nine variables, which they hypothesized to either directly or indirectly influence nest count at a site. These variables included characteristics of the site (i.e., soil texture, topography, and site area), characteristics of the land mass on which the site was located (i.e., maximum elevation, amount of shrub, and land mass area), characteristics of the surrounding landscape (i.e., region, connectivity to the mainland, and distance to human development), the presence of predators (i.e., presence and management of coyotes, racoons, and feral cats), and restrictions on human and dog activity (e.g., limitations on dog access, public access, beach raking, and beach driving). Of these twenty-nine variables, eighteen variables were candidates (i.e., exogenous variables) for model inputs.”

## **7. ANALYSIS AND FINDINGS**

The primary analyses and findings from Objective 1 are summarized below. These text sections come from a manuscript that is in preparation (Cronin *in prep*). The publication portion of this memorandum provides links to additional project results and products.

**Methods from:** Cronin, J.P., Robinski, V.L., Dale, L.L., Tirpak, B.E., and Tirpak, J.M. In prep. Black Skimmer (*Rynchops niger*) and Gull-billed tern (*Gelocheilidon nilotica*) habitat objectives for Gulf Coast Biological Planning Units. For submission to Journal of Wildlife Management.

Study Area: “Species experts defined the study area as all bare ground sites within 200 m of the higher high-water line across the U.S. portion of the Gulf of Mexico. This area includes sites on mainland, natural barrier islands, and dredged spoil islands.”

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## **8. CONCLUSIONS AND RECOMMENDATIONS**

### **Primary Conclusions**

- Our results clearly and explicitly represent hypothesized relationships among key habitat characteristics and Black Skimmer and Gull-billed Tern nest counts at potential breeding sites across the Gulf Coast.

### **Primary Recommendations**

- A Bayesian network model for predicting Black Skimmer and Gull-billed Tern nest counts at a given site could be developed by collating and analyzing datasets, which contain estimates of the variables as represented by the influence diagram.
- Spatially explicit predictions of Black Skimmer and Gull-billed Tern nest counts at sites across the Gulf could be made by collating or processing existing geospatial datasets for eighteen of the influence diagram's exogenous habitat variables and using them as model inputs. These inputs should cover 200 m from the higher high water line.

## **9. MANAGEMENT APPLICATIONS AND PRODUCTS**

To meet the needs of species that are of conservation concern, Gulf restoration programs are increasingly funding managers to implement a variety of Gulf-wide management actions (e.g., depositing material on islands, creating new islands, setting back vegetative succession) to mitigate these stressors (e.g., nest inundation, erosion-induced long-term habitat loss) (e.g., Trembanis et al. 1998; USFWS 2016; Gulf Coast Ecosystem Restoration Council 2015). There is concern that these conservation opportunities lack a coordinated response because the explicit biological objectives that quantify what it means to actually meet species' needs and recover injuries remain undefined (NOAA 2013). Not only is there a general lack of explicit biological objectives for the Gulf region (Gulf Coast Ecosystem Restoration Council 2013), there is uncertainty about the ability of management actions to achieve biological objectives because these stressors often interact and differentially influence species in the environments of different subregions (e.g., Brown et al. 2001; Hunter et al. 2000). To address these information gaps, the influence diagram was used by the BOGC Working Group as a guide for (1) collecting and analyzing the data used to develop a Black Skimmer and Gull-billed Tern Bayesian network model, (2) developing geospatial datasets that were used as model inputs to generate spatially explicit predictions of Black Skimmer and Gull-billed Tern nest counts across the Gulf Coast, and (3) simply communicating the key habitat characteristics thought to influence Black Skimmer and Gull-billed Tern nest counts to stakeholders.

To complete this research, we worked with the (1) USFWS Biological Objectives for the Gulf Coast Working Group and (2) the Gulf Coast Joint Venture's Waterbird Working Group and their partners. We also worked with various partners to share and distribute our findings, including Landscape Conservation Cooperatives (LCC) and the Gulf of Mexico Alliance (GOMA).

### *Manager/Stakeholder Quotes*

"Conservation of Black Skimmers and Gull-billed Terns are priorities for the Gulf Coast Joint Venture partnership. The influence diagram developed through this work is foundational to our collaborative efforts to develop spatially explicit habitat objectives for these species." – Barry Wilson, Gulf Coast Joint Venture Coordinator.

## **10. OUTREACH**

The outreach products included below are separated into the following three categories, (1) Publications; (2) Technical Presentations, and (3) Science Communication. The technical

presentations and science communication categories include webinars, conference presentations, tools cafe presentations, and seminars.

### **Publications**

Cronin, J.P., Robinski, V.L., Dale, L.L., Tirpak, B.E., and Tirpak, J.M. In prep. Black Skimmer (*Rynchops niger*) and Gull-billed Tern (*Gelocheilidon nilotica*) habitat objectives for Gulf Coast Biological Planning Units. For submission to Journal of Wildlife Management.

### **Technical Presentations**

Cronin, J.P., Tirpak, B.E., Dale, L.L., Brink, V., Tirpak, J.M., Vermillion, W.G., and Wilson, B.C., 2019, Quantitative, spatial decision support tools for establishing Brown Pelican, Black Skimmer, and Gull-billed Tern habitat objectives [abs.], Southeast Climate Adaptation Science Center Regional Science Symposium, November 13-15, New Orleans, La., 1 p., <https://secasc.ncsu.edu/se-casc-regional-science-symposium/> [Presented] Approved 9/10/19; IP-111694

Cronin, J.P., Tirpak, B.E., Dale, L.L., Brink, V.L., Tirpak, J.M., Vermillion, W.G., and Wilson, B.C., 2019, Spatially explicit habitat objectives for Brown Pelican, Black Skimmer, and Gull-billed Tern [abs.], Louisiana Association of Professional Biologists and the LA Chapter of The Wildlife Society meeting, August 8-9, 2019, Lafayette, La., 1 p., <https://www.labiologists.org/> [Presented] Approved 7/8/19; IP-109716

Cronin, J.P., Tirpak, B.E., Brink, V.L., Dale, L.L., and Tirpak, J.M., 2018, Strategic habitat conservation for the Gulf of Mexico Coast: using spatially explicit Bayesian networks to derive habitat objectives for Brown Pelican, Black Skimmer, and Gull-billed Tern [abs]: Ecological Society of America Annual Meeting, August 5-10, 2018, New Orleans, La., Abstracts with Program. [Presented] Approved 2/16/18; IP- 095258

Cronin, J.P., Tirpak, B.E., Dale, L.L., Brink, V., and Tirpak, 2017, J. Establishing explicit biological objectives to guide strategic habitat conservation for the Gulf Coast [abs]: GCP & GCPO LCC Project Report. Abstract. [Presented] Approved 7/03/17; IP-085312

Cronin, J.P., Tirpak, B.E., Dale, L.L., Brink, V., and Tirpak, J., 2016, Establishing Biological Objectives to Guide Strategic Habitat Conservation for the Gulf of Mexico Coast [abs]: The 70<sup>th</sup> Annual Conference of the Southeastern Association of Fish and Wildlife Agencies. Abstracts with Program [Presented]. Approved 06/15/2016; IP-076785

### **Science Communication**

Quantitative tools for strategic habitat conservation. Gulf of Mexico Alliance All Hands Meeting: Wildlife and Fisheries Team Meeting. June 13, 2018, Gulf Shores, AL. Remote Video Presentation [Invited]

Strategic habitat conservation for the Gulf of Mexico Coast: quantitative, spatial decision support tools for derive colony nesting bird habitat objectives. Migratory Bird - Joint Venture GIS Webinar. October 10, 2018, Remote Video Presentation [Invited].

Gull-billed tern (*Gelocheilidon nilotica*) and black skimmer (*Rynchops niger*) habitat objectives under alternative restoration scenarios: spatially explicit decision support tools for understanding nest counts on bare ground sites across the Gulf Coast. USGS South-central Climate Science Center Monthly Meeting. June 20, 2018. Remote Video Presentation [Invited]

Strategic habitat conservation for the Gulf of Mexico Coast: spatially explicit decision support tools to understand wildlife-habitat relationships and establish explicit habitat objectives. Gulf of Mexico Alliance All Hands Meeting: Wildlife and Fisheries Team Meeting. February 7, 2018, New Orleans, LA. [Invited] and June 14, 2018, St. Petersburg, FL [Invited]

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