GULF COAST JOINT VENTURE

PRIORITY WATERFOWL SCIENCE NEEDS

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Gulf Coast Joint Venture

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INTRODUCTION

The Gulf Coast Joint Venture (GCJV) is a regionally-based bird habitat conservation partnership of state, federal, and non-governmental organizations spanning the coastal portions of Alabama, Mississippi, Louisiana, and Texas (Figure 1). The mission of the GCJV is to advance the conservation of important bird habitats within the GCJV region through biological planning, science-based conservation actions, assumption-driven research, and focused monitoring and evaluation of the planning and implementation process (Figure 2). This document presents a contemporary listing of the highest priority science needs for testing critical assumptions, addressing data gaps, evaluating effectiveness of conservation actions, and assessing future challenges to waterfowl habitat conservation in the GCJV region.

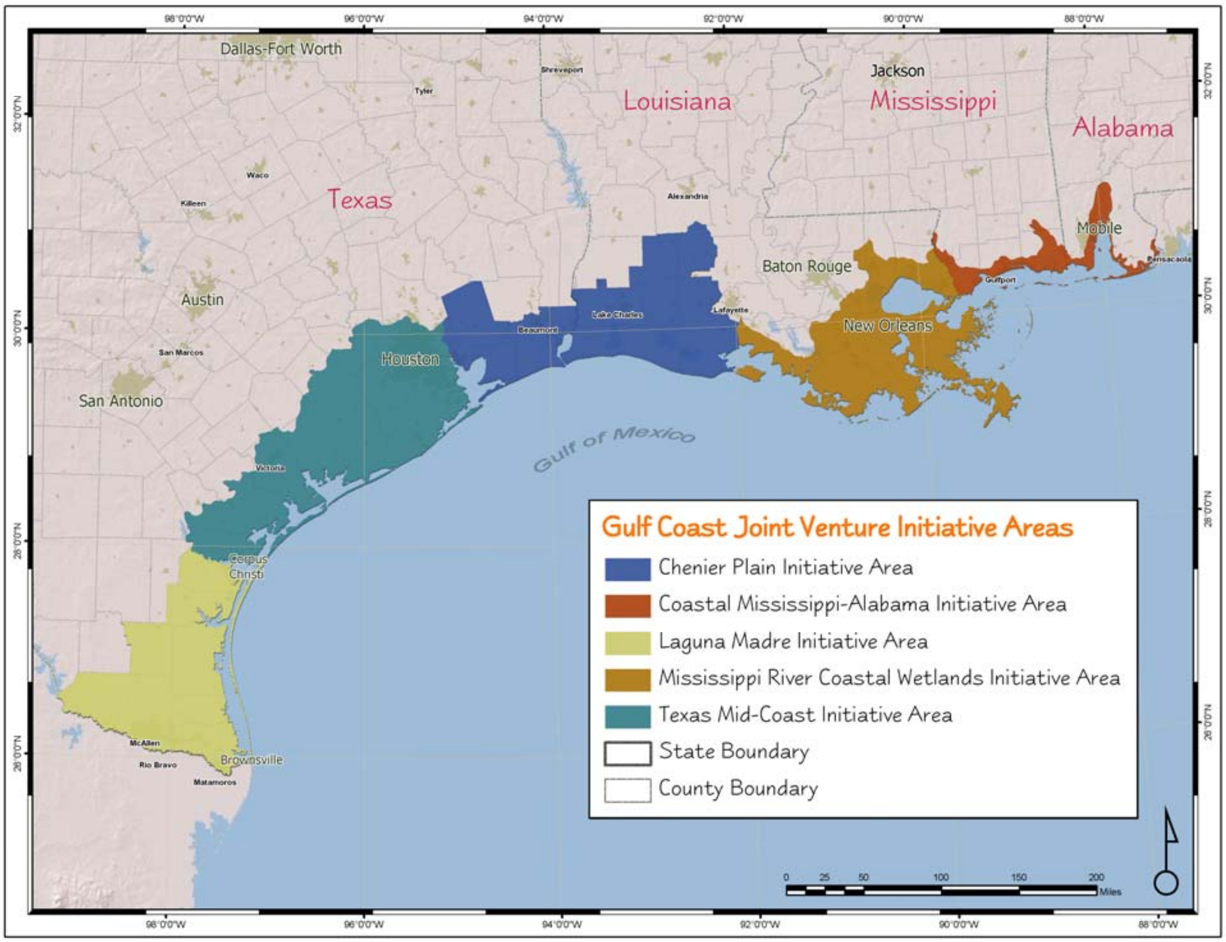

Figure 1. The Gulf Coast Joint Venture region and Initiative Areas within which habitat objectives and conservation actions are tailored to address priority bird habitat conservation needs.

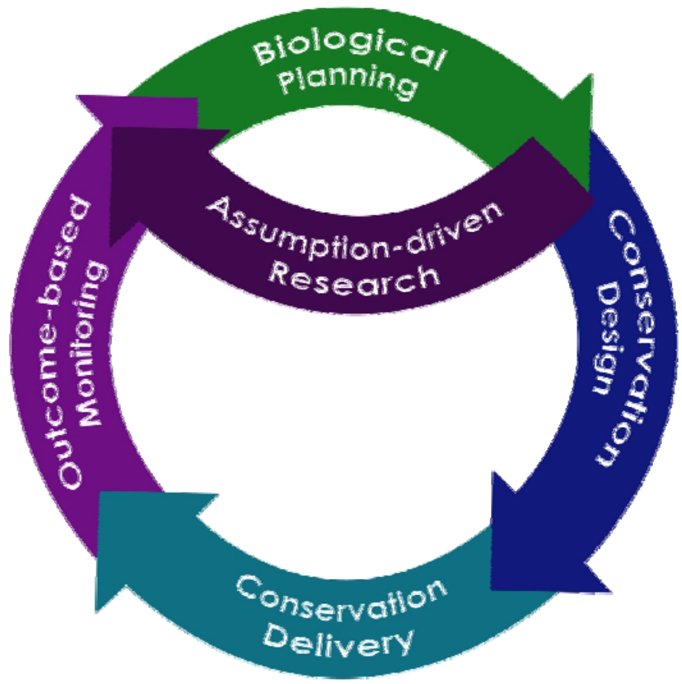

Figure 2. Diagram of the Strategic Habitat Conservation process used by the Gulf Coast Joint Venture to establish, implement, and iteratively refine habitat objectives and conservation actions for priority bird species.

Conservation actions and accomplishments of the GCJV are framed around the needs of priority species identified within each of four bird guilds – waterfowl, waterbirds, landbirds, and shorebirds. For each priority species, the GCJV uses biological models to articulate linkages among population objectives, ecological limiting factors, key habitats, and quantitative habitat objectives. Although developed using the best available science, biological models are often characterized by substantial data uncertainties and untested assumptions. The GCJV promotes targeted research and monitoring to fill critical data gaps, test model assumptions, evaluate impacts of conservation actions on bird populations, and iteratively refine population and habitat objectives for priority species. Four guild-specific technical working groups within the GCJV Monitoring, Evaluation, and Research Team (MERT) are responsible for helping to select priority species, develop and review biological models, and identify priority science needs for refining the biological foundations of population-based habitat objectives and conservation actions.

Significant progress has been made in reducing biological uncertainties associated with waterfowl conservation planning in the GCJV region. Advancements have been informed and guided chiefly by the initial list of GCJV priority evaluation needs presented by Wilson (2003). Of the 14 priorities identified by Wilson (2003), five have been comprehensively addressed and five have been partially addressed through scientific research conducted or supported by the GCJV (Appendix). Although these accomplishments enabled significant refinements to waterfowl habitat conservation objectives and strategies, the GCJV continues to face substantial data gaps, questions about the effectiveness of conservation strategies, and uncertainties about impacts of land-use and environmental changes on waterfowl habitats in the GCJV region. This document was developed to communicate and describe the updated list of priority science needs upon which further refinements to waterfowl habitat conservation in the GCJV will depend.

Science needs herein are listed in decreasing order of relative priority, as determined by the GCJV Waterfowl Working Group (WfWG) through extensive discussions about the uncertainties characterizing each issue and the degree to which GCJV habitat objectives and conservation strategies might be impacted by the availability of new, scientific information. Although these science needs are presented as discrete issues, strong linkages and relationships exist among many of them. Thus, opportunities to address multiple needs or objectives through a single research project should be sought and encouraged. Efficiencies in the expenditure of scientific resources to address priority science needs may also be gained through collaborative endeavors among multiple scientists or research institutions; these too should be encouraged.

This document provides for each science need a concise description of the problem statement, a list of important considerations that should be addressed in formulating a study, key study objectives, the geographic scope to which the issue applies, and a list of minimally expected deliverables. The research consideration section is intended to provide guidance on the development of research plans or study designs, as it highlights studies that have partially addressed a science need, suggests potentially valuable research methodologies, and/or identifies response variables or covariates that should be considered for measurement. However, the information presented for each science need should not be considered exhaustive; individuals interested in addressing any of these needs are strongly encouraged to contact the GCJV Coordinator or Biological Team Leader for additional guidance regarding research needs, objectives, deliverables, and other important considerations.

The overarching purposes of this document are to 1) demonstrate that the GCJV recognizes critical assumptions and data gaps underlying its conservation planning, 2) influence the priorities of researchers and funding entities wishing to address waterfowl-related questions with direct application to GCJV activities, and 3) guide the science investments of the GCJV office and partnership. This document does not present a comprehensive list of science needs for improving the efficiency and effectiveness of waterfowl habitat conservation in the GCJV region. Rather, it is intended to outline the highest priority needs expected to exist over the next 5 years having direct feedback into GCJV activities. Recognizing that scientific research needs exist within a dynamic conservation environment, the potential exists for emerging issues to demand a reassessment of GCJV science priorities over shorter time frames. If this occurs, the GCJV will seek guidance from its WfWG on whether and how to supplement or reprioritize these science needs.

Literature Cited

Wilson, B.C. 2003. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Evaluation plan. North American Waterfowl Management Plan, Albuquerque, NM. 48 pp.

PRIORITIZED LIST OF WATERFOWL SCIENCE NEEDS

1. Estimation of waterfowl foraging values of coastal marsh types in the GCJV region

Problem Statement

Coastal marsh is a priority waterfowl habitat in 4 of 5 GCJV initiative areas. Reliable data on the distribution, type, and abundance of waterfowl foods within coastal marsh systems is necessary for calculating population-based habitat objectives, quantifying the ability of extant landscapes to support target waterfowl populations, and formulating strategic conservation plans for coastal marsh. Coastal marsh may be broadly classified among 4 types based on salinity (fresh, intermediate, brackish, saline; Chabreck and Nyman 2005), and because salinity influences vegetative communities, the abundance and diversity of plant-based waterfowl foods differ among marsh types (Cramer et al. 2011).

Winslow (2003) estimated biomass of seeds and SAV within coastal freshwater ponds in Louisiana and Texas, thus filling an important gap in our understanding of waterfowl foraging values of coastal systems. However, Winslow (2003) did not assess waterfowl foods in intermediate, brackish, and saline marsh types. Some waterfowl species rely heavily on estuarine marsh types; thus, food resources within them must be considered when calculating landscape carrying capacities. In the absence of empirical data, the GCJV used expert opinion and data on relative waterfowl abundance among marsh types as proxies for calculating relative foraging values for estuarine marsh types. Specifically, the GCJV assumed waterfowl foraging values of intermediate, brackish, and saline marsh types were equal to 100%, 50%, and 10%, respectively, of that for fresh marsh. Empirical estimates of waterfowl food abundance in estuarine marsh types are needed to improve the reliability of quantitative habitat objectives and estimates of waterfowl carrying capacity for Gulf Coast marshes. These data will also inform projections of the future capacity of Gulf Coast marshes to support wintering waterfowl under alternative scenarios of landscape and climate change.

Additionally, the temporal and spatial dynamics of waterfowl food abundance within coastal systems, and the factors affecting it, are poorly understood. Efforts to measure impacts of waterfowl herbivory and environmental factors (e.g., water chemistry, seed bank composition, hydrology, etc.) on the temporal and spatial variation in food abundance (e.g., seeds, SAV, below-ground tubers, aquatic invertebrates) are needed to ensure estimates of landscape carrying capacity appropriately reflect natural system dynamics.

Research Considerations

Although waterfowl food abundance in fresh marsh was described by Winslow (2003), these data provided a rather limited assessment of their spatial and temporal variation. In consideration of the profound importance of coastal marsh types to wintering waterfowl and the likely greater importance of fresh marsh, additional data on waterfowl food abundance in fresh marsh ponds are needed to corroborate or refine estimates of Winslow (2003) and enhance our understanding of the interannual dynamics of food production within them. Thus, future studies should incorporate designs that enable sampling and quantification of waterfowl foods across all marsh types simultaneously.

Data on waterfowl food abundance in coastal marsh should be collected using study designs and sampling protocols that yield unbiased estimates of species-specific biomass and foraging values among marsh types while also enabling application to habitat databases used by the GCJV for estimating landscape carrying capacity (e.g., National Wetlands Inventory database). Initial sampling should coincide as nearly as possible with the end of the vegetative growing season and the onset of major waterfowl migrations in the early fall. All standing and fallen seeds and above- and below-ground plant parts of known waterfowl foods should be sampled to a substrate depth of at least 10cm (Jemison and Chabreck 1962) and included in the estimate of available forage. Additional sampling periods will be required to quantify food depletion rates, and these should be conducted on at least a subset of the original sample sites. At minimum, a second sample period at the end of the major waterfowl wintering period should be included, with additional consideration given to the use of exclosures for measuring herbivory as a mechanism for food depletion (e.g., Hartke et al. 2009).

Key Objectives

a. Estimate species composition and biomass of waterfowl foods (seeds, SAV, below-ground tubers, aquatic invertebrates) in fresh, intermediate, brackish, and saline marsh types during fall-winter in the GCJV region
b. Quantify the temporal dynamics of composition and abundance of waterfowl foods during fall-winter in fresh, intermediate, brackish, and saline marshes in the GCJV region
c. Identify the relative role of different mechanisms affecting temporal and spatial dynamics of waterfowl foods during fall-winter in fresh, intermediate, brackish, and saline marshes in the GCJV region
d. Use data from Objectives a. and b. and published estimates of true metabolizable energy (TME) to calculate total dietary energy density (kcal/ha) for waterfowl in coastal marsh types in the GCJV region

Geographic Scope of Work (GCJV Initiative Areas):

Coastal Mississippi and Alabama, Mississippi River Coastal Wetlands, Chenier Plain, Texas Mid-Coast

Deliverables

a. Comprehensive report documenting methods, analyses, results, conclusions, and relevant recommendations
b. Table(s) depicting species-specific biomass and TME values for waterfowl foods (seeds, SAV, aquatic invertebrates) by marsh type, sample period (September/October or February/March), and relevant geographic regions
c. Estimates of total dietary energy density (kcal/ha) for waterfowl by marsh type, sample period, and geographic region
d. Graph(s), tables, and statistics describing waterfowl food depletion throughout fall-winter in marsh types within the GCJV region

Literature Cited

Chabreck, R. H., and J. A. Nyman. 2005. Managing coastal wetlands for wildlife. Pages 839 – 860 *in* C. E. Braun, editor. Techniques for wildlife investigations and management. The Wildlife Society, Bethesda, Maryland, USA.

Cramer, D. M., P. M. Castelli, T. Yerkes, and C. K. Williams. 2011. Food resource availability for American black ducks wintering in southern New Jersey. Journal of Wildlife Management 76:214-219.

Hartke, K. M., K. H. Kriegel, G. M. Nelson, and M. T. Merendino. 2009. Abundance of wigeongrass during winter and use by herbivorous waterbirds in a Texas coastal marsh. Wetlands 29:288-293.

Jemison, E. S., and R. H. Chabreck. 1962. The availability of waterfowl foods in coastal marsh impoundments in Louisiana. Transactions of the North American Wildlife Conference 27:288-300.

Winslow, C. J. 2003. Estimation of waterfowl food abundance in coastal freshwater marshes of Louisiana and Texas. Thesis, Louisiana State University, Baton Rouge, LA, USA.

2. Delineation and mapping of marsh types along the Texas coast

Problem Statement

The GCJV identifies 4 priority habitat types for waterfowl within its planning region – forested wetlands, coastal marsh, seagrass beds, and inland palustrine wetlands. Of these, coastal marsh has the greatest spatial extent and importance to waterfowl, occurring as a conservation priority in 4 of 5 initiative areas and expected to provide 57% of the total dietary energy required to support GCJV winter waterfowl population objectives. Coastal marsh may be broadly classified among 4 types based on salinity (fresh, intermediate, brackish, saline; Chabreck and Nyman 2005), and because salinity influences vegetative communities, the abundance and diversity of plant-based waterfowl foods differ among marsh types (Cramer et al. 2011). Within coastal Louisiana, the GCJV uses geospatial data on the extent and distribution of marsh types and estimates of waterfowl food abundance in each marsh type to calculate the capacity of the existing coastal landscape to support wintering waterfowl. Comparing these estimates to energy demands of the GCJV's target waterfowl population enables determination of whether extant marsh is sufficient to support GCJV waterfowl population objectives.

Aerial surveys for identifying and mapping fresh, intermediate, brackish, and saline marsh types in Louisiana have been conducted with consistent methodologies every 7-10 years since 1968 (Sasser et al. 2007). However, geospatial data of this type for Texas are lacking, and methodologies for its collection in a repeatable and efficient manner have not been developed. It is unknown whether methods used for Louisiana would be appropriate and/or efficient for use in Texas. Development and implementation of a repeatable method to delineate fresh, intermediate, brackish, and saline marsh types on the Texas coast are needed to improve the reliability of GCJV habitat objectives and estimates of waterfowl foraging capacity for Texas coastal marshes.

Research Considerations

A collaborative research project was initiated in July 2010 by the GCJV and Texas A&M University – Kingsville to develop and evaluate methods for delineating marsh types on the Texas coast. Coastal marsh has a more limited spatial extent in Texas than Louisiana, resulting in transitions between salinity zones occurring over shorter distances in Texas. Consequently, sampling protocols employed by Sasser et al. (2007) for delineating marsh types in Louisiana may require modification to ensure they are appropriate for discriminating among narrower salinity zones transitions in Texas. Additionally, classification of remotely-sensed, multi-spectral imagery is being explored for its potential utility in mapping marsh types in Texas.

Additional details of this research and an update on the status of this science need may be obtained by contacting the GCJV office.

Key Objectives

a. Develop a repeatable methodology to delineate fresh, intermediate, brackish, and saline marsh types on the Texas coast
b. Implement the methodology developed in Objective a.
c. Create a geospatial database depicting marsh types on the Texas coast

Geographic Scope of Work (GCJV Initiative Areas):
Texas Chenier Plain and Texas Mid-Coast

Deliverables

a. Comprehensive report documenting methods, analyses, results, conclusions, and relevant recommendations for delineating and mapping marsh types on the Texas coast
b. Geospatial database depicting fresh, intermediate, brackish, and saline marsh types on the Texas coast

Literature Cited

Chabreck, R. H., and J. A. Nyman. 2005. Managing coastal wetlands for wildlife. Pages 839 – 860 *in* C. E. Braun, editor. Techniques for wildlife investigations and management. The Wildlife Society, Bethesda, Maryland, USA.

Cramer, D. M., P. M. Castelli, T. Yerkes, and C. K. Williams. 2011. Food resource availability for American black ducks wintering in southern New Jersey. Journal of Wildlife Management 76:214-219.

Sasser, C. E., J. M. Visser, E. Mouton, J. Linscombe, and S. B. Hartley. 2007. Vegetation types in coastal Louisiana in 2007. U.S. Geological Survey open-file report 2008-1224, 1 sheet, scale 1:550,000.

3. Waste rice and natural seed abundance in rice production systems of the Gulf Coast prairies

Problem Statement

Harvested and idle rice fields in the Western Gulf Coast provide valuable foraging habitat for waterfowl during winter and migration (Hobaugh et al. 1989, Eadie et al. 2008, Esslinger and Wilson 2001). Contemporary and precise estimates of waste rice and natural seed abundance in harvested and idle rice fields are essential for calculating reliable conservation objectives for this important waterfowl habitat and ensuring efficient use of limited conservation resources. Michot and Norling (US Geological Survey, unpublished data) quantified seed and invertebrate biomass estimates in active and idle rice fields in Louisiana and Texas during winter 2002-03. However, their results warrant further corroboration as they were derived from a 1-year study which prevented examination of interannual variability in abundance of waste rice and natural seeds. A multi-year study is necessary to better understand interannual variation in waterfowl food resources within Gulf Coast ricelands. Furthermore, given the rapid pace with which rice cultivation practices have changed, it is unknown whether data collected by Michot and Norling remain relevant to current conditions and practices. Contemporary data is needed to examine potential influences of changing agricultural practices on waterfowl food abundance within Gulf Coast ricelands (see Science Need No. 9).

Preliminary results from recent GCJV analyses suggest the capacity of coastal marshes to support wintering waterfowl is significantly below that needed to sustain target waterfowl population objectives. Because myriad factors are responsible for coastal marsh loss and these factors are expected to continue or accelerate in the future, the GCJV will be significantly challenged to offset coastal marsh foraging habitat deficits. Consequently, wintering waterfowl within the GCJV region may become increasingly reliant on inland, agricultural habitats. Precise and accurate estimates of waterfowl food resources in Gulf Coast ricelands are essential for calculating reliable habitat objectives and informing long-term conservation planning efforts.

Research Considerations

Because waterfowl depend on habitats within the GCJV region over protracted time periods during fall and winter, the GCJV established quantitative waterfowl habitat objectives for 2 temporal planning periods. The early period spans 16 August – 31 October, while the late period spans 1 November – 15 March. These periods were selected to ensure habitat needs of early and late migrants were acknowledged and adequately addressed, as well as because they roughly coincide with timing of the harvest of first and second crop rice and resulting availability of waterfowl food resources within agricultural-based habitats. Consequently, estimates of waterfowl food resources in active and idle rice fields should be estimated for the early and late planning periods.

A pilot research project was initiated in June 2010 by the GCJV and Mississippi State University to collect preliminary data for informing study design and sampling considerations for a large-scale, multi-year study to comprehensively address this need. Details of this research and an update on the status of this science need may be obtained by contacting the GCJV office.

Key Objectives

a. Estimate and compare species composition and biomass of waste rice and natural seeds during autumn-winter between active and idle rice fields and among geographic regions and time periods of importance to waterfowl conservation planning in the GCJV region
b. Use data from Objective a. and published estimates of true metabolizable energy (TME) to calculate total dietary energy density (kcal/ha) for waterfowl in active and idle rice fields of the GCJV region, among relevant geographic regions and time periods

Geographic Scope of Work (GCJV Initiative Areas):

Chenier Plain and Texas Mid-Coast

Deliverables

a. Comprehensive report documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables depicting species-specific biomass estimates and TME values for waste rice and natural seeds commonly consumed by waterfowl and detected in sampled rice fields, summarized by field type (e.g., active rice, idle rice, ratoon rice, etc.), geographic region, and temporal period
c. Estimates of total dietary energy density (kcal/ha) for waterfowl from waste rice and natural seeds detected in sampled rice fields, summarized by field type (e.g., active rice, idle rice, ratoon rice, etc.), geographic region, and temporal period

Literature Cited

Eadie, J. M., C. S. Elphick, K. J. Reinecke, and M. R. Miller. 2008. Wildlife values of North American ricelands. Pages 7-90 *in* S. W. Manley, editor. Conservation in ricelands of North America. The Rice Foundation, Stuttgart, Arkansas, USA.

Esslinger, C. G., and B. C. Wilson. 2001. North American waterfowl management plan, Gulf Coast Joint Venture: Chenier Plain Initiative. North American Waterfowl Management Plan, Albuquerque, New Mexico, USA. 28 pp. + appendix.

Hobaugh, W. C., C. D. Stutzenbaker, and E. L. Flickinger. 1989. The rice prairies. Pages 367 – 384 *in* L. M. Smith, R. L. Pederson, and R. M. Kaminski, editors. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University, Lubbock, Texas, USA.

4. Ecology and conservation of Western Gulf Coast mottled ducks

Problem Statement

The Western Gulf Coast (WGC) is home to approximately 90% of the worldwide population of mottled ducks, and because they are nonmigratory, mottled ducks must satisfy the entirety of their annual cycle needs from habitats existing within this small geographic range. No long-term, range-wide survey currently exists for estimating visibility-corrected population estimates or indices for WGC mottled ducks. Among data presently available, assessments of population trajectory vary from stable to steeply declining depending on data source and range of years from which inference is drawn. However, the collective weight of evidence suggests a long-term (1971–2009) steep decline of mottled duck abundance in Texas, a stable trend in Louisiana, and a long-term stable to slightly declining trend for the entire WGC population (Bielefeld et al. 2010). Priority habitats for WGC mottled ducks include coastal marshes, active and idle rice fields, native prairie and active pasturelands, and inland palustrine wetlands, all of which are threatened by land-use and environmental changes. Conversion and degradation of critical habitats is believed to be a contributing factor to declines in the WGC mottled duck population, yet specific factors limiting their population growth and the potential for conservation actions to offset them remain poorly understood.

Wilson (2007) used published literature and expert opinion to develop the GCJV Mottled Duck Conservation Plan as a means of providing objective and informed guidance on priority habitat management and conservation strategies for WGC mottled ducks. Wilson (2007) explicitly acknowledged the uncertainties on which many recommendations were based and advocated for rigorous scientific investigations to evaluate the effectiveness of habitat conservation strategies and test biological hypotheses upon which recommendations were based. Several recent studies have significantly advanced our understanding of mottled duck habitat use, movements, seasonal and annual survival, and molt site fidelity. However, further research is needed to elucidate determinants of breeding propensity; quantify relationships between landscape characteristics and productivity measures (e.g., nest success, brood and duckling survival, renesting probability); identify primary mortality agents for mottled ducks during different periods of the annual cycle; and determine the effectiveness of wetland and grassland habitat conservation strategies at positively impacting key mottled duck vital rates. Additionally, the degree to which hybridization with feral mallards exists as a threat to the genetic integrity of WGC mottled ducks remains uncertain.

Research Considerations

The GCJV's highest priority science needs related to habitat conservation for WGC mottled ducks will be guided by recommendations of Wilson (2007) and the Waterfowl Working Group. Priorities will be influenced heavily also by consideration of the advances in our understanding of mottled duck ecology that have been made possible by several recent investigations, including the following, among others:

1. Finger (2002)
    - Estimated nest success, brood survival, adult female survival during breeding and brood rearing, and documented causes of nest failure of mottled ducks on the Texas Mid-Coast

2. Durham and Afton (2003, 2006)
   - Described nesting biology, quantified nest-site selection, and estimate nesting success of mottled ducks nesting in agricultural lands (pastures, idle rice fields) of southwest Louisiana.

3. Rigby (2008)
   - Quantified breeding propensity, breeding season habitat use, brood and duckling survival and recruitment, brood habitat use, and breeding season female survival on the Upper Texas Coast

4. Davis (*Dissertation in development*)
   - Estimated breeding season habitat use and seasonal movements of female mottled ducks in Louisiana and Texas

5. Wehland (*Dissertation in development*)
   - Estimated seasonal and annual survival, post-breeding habitat use, and molt site fidelity of female mottled ducks in Louisiana and Texas

Key Objectives

a. Estimate means and variances for priority vital rates for WGC mottled ducks and identify environmental factors responsible for variation in vital rate estimates
b. Quantify relationships between habitat characteristics and WGC mottled duck vital rates
c. Estimate cause-specific mortality for WGC mottled ducks during different periods of the annual cycle, to include considerations for estimating mortality of mottled duck ducklings
d. Evaluate effectiveness of wetland and grassland conservation strategies at impacting WGC mottled duck vital rates
e. Establish baseline data on hybridization rates of WGC mottled ducks with feral mallards and develop a field key for rapid identification of hybrids if deemed necessary
f. Others as informed by insights from Wilson (2007) and the Waterfowl Working Group

Geographic Scope of Work (GCJV Initiative Areas):

Because mottled ducks occur across the GCJV region, science needs are relevant to all initiative areas. However, priority should be given to work conducted in the Mississippi River Coastal Wetlands, Chenier Plain, Texas Mid-Coast, and Laguna Madre, as these areas support the vast majority of WGC mottled ducks.

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations

Literature Cited

Bielefeld, R. R., M. G. Brasher, T. E. Moorman and P. N. Gray. 2010. Mottled Duck (Anas fulvigula), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/081

Durham, R. S., and A. D. Afton. 2003. Nest-site selection and success of mottled ducks on agricultural lands in southwest Louisiana. Wildlife Society Bulletin 31:433-442.

Durham, R. S., and A. D. Afton. 2006. Breeding biology of mottled ducks on agricultural lands in southwestern Louisiana. Southeastern Naturalist 5:311-316.

Finger, R. S. 2002. Reproductive ecology of mottled ducks in mid-coastal Texas. Thesis, Texas A&M University – Kingsville, Kingsville, TX, USA.

Rigby, E. A. 2008. Recruitment of mottled ducks (*Anas fulvigula*) on the upper Texas Gulf Coast. Thesis, Texas Tech University, Lubbock, TX, USA.

Wilson, B. C. 2007. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mottled Duck Conservation Plan. North American Waterfowl Management Plan, Albuquerque, NM. 27pp. +appendices.

5. Nocturnal, diurnal and seasonal habitat use of waterfowl in the GCJV region

Problem Statement

The GCJV uses bioenergetics models to translate population objectives into habitat-specific energy demands and acreage-based conservation objectives. These calculations require species-specific information on relative use of priority waterfowl habitats, as these data are assumed to represent the relative contribution of each habitat type to satisfying winter energy demands of target waterfowl populations. Empirical data on relative habitat use are available for some species, yet for others these values are based on assumptions informed largely by expert opinion. Moreover, some estimates of relative habitat use are almost exclusively based on daytime observations. Previous research has documented differential habitat use between diurnal and nocturnal time periods and among winter periods for some waterfowl species in the GCJV region (Cox and Afton 1997). Failure to account for these differences may yield biased estimates of relative habitat use and overstate the importance of habitats used during diurnal periods. Objective assessments of habitat use by species, including seasonal and diel differences, are needed to improve the accuracy of GCJV habitat objectives and ensure conservation strategies are targeting foraging habitats of greatest importance to wintering waterfowl.

Additionally, site-specific habitat characteristics (e.g., vegetation density, wetland size) and the spatial configuration or landscape context of habitats (e.g., degree of isolation from other foraging habitats, surrounding land use) may influence the relative quality of waterfowl habitats (Paracuellos et al. 2004, Raeside et al. 2007). Knowledge of these factors and their impacts on habitat quality is needed to help inform strategic delivery of habitat conservation programs.

Research Considerations

Advancements in radiotelemetry have enabled efficient and effective monitoring of habitat use and movements of waterfowl species throughout the diel period. Several recent radiotelemetry studies have provided empirical estimates of nocturnal, diurnal, and seasonal habitat use for selected duck species wintering in the GCJV region. Priority for future studies should be given to those targeting species and initiative areas for which empirical data is lacking and having the greatest potential impact on GCJV habitat objectives. Studies providing contemporary information relevant to this science need and their general conclusions are as follows:

1. Cox and Afton (1997,1998)
    - Nocturnal habitat use of northern pintails in southwestern Louisiana differed markedly from diurnal use, as birds shifted predictably from daytime roost sites to nocturnal foraging sites.

2. Link et al. (2011[a,b])
    - Female mallards in southwestern Louisiana used areas closed to hunting at higher rates during diurnal than nocturnal periods, even during time periods when hunting season was closed, suggesting that mallards respond to common daytime disturbances such as hunting, agricultural activities, and bird watching.
    - Freshwater marsh was used extensively during both diurnal and nocturnal time periods.

- Female mallards moved relatively short distances during all diel periods, suggesting they were able to meet daily energy requirements within a relatively small geographic area.

3. Gray (2010)
    - Unlike mallards and pintails, female gadwalls in southwestern Louisiana did not show evidence of habitat use differences between nocturnal and diurnal time periods, with areas closed to hunting used at similar rates between diurnal and nocturnal periods.
    - Gadwalls preferred intermediate and fresh marsh over brackish and saline marsh and agricultural-based habitats.

4. Anderson (2008)
    - Female pintails in the Texas Mid-Coast demonstrated high proportional use (>90%) of palustrine wetlands (i.e., ricelands) during nocturnal and diurnal time periods.
    - Diurnal and nocturnal use of hunted lands increased following close of the duck season.

5. Davis (*Dissertation in development*)
    - Three-year, radiotelemetry study of female mottled duck habitat use and movements in Louisiana and Texas initiated in 2007. Results will provide empirical data on mottled duck habitat use across the GCJV region throughout the annual cycle.

Other priority waterfowl science needs may also benefit from radiotelemetry studies of habitat use patterns for selected waterfowl species. Specifically, opportunities likely exist to help address science needs related to understanding the role of sanctuary in habitat conservation for wintering waterfowl (Science Need No. 10), foraging patterns and habitat use interactions between ducks and geese (Science Need No. 18), potential value of crawfish aquaculture to wintering waterfowl (Science Need No. 17), and impacts of wind energy development on waterfowl use of priority habitats (Science Need No. 15). Strong consideration should be given to study designs that would enable addressing multiple priority science needs.

Key Objectives

a. Estimate proportional use of habitats by selected waterfowl species during diurnal and nocturnal periods in winter within selected geographies of the GCJV region
b. Estimate use of habitats in relation to spatial availability of sanctuary and variation in temporal occurrence of acute disturbance (i.e., in relation to opening and closing of hunting seasons)

Geographic Scope of Work (GCJV Initiative Areas):

All initiative areas, but priority given to those with greatest contribution to GCJV habitat objectives (e.g., Mississippi River Coastal Wetlands, Chenier Plain, Texas Mid-Coast)

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables, graphs, maps, and/or statistical test results that depict habitat use during diurnal and nocturnal periods and in relation to relevant time periods during winter (e.g., hunting season dates) for individual species within the GCJV
c. Tables, graphs, maps, and/or statistical test results that depict duck habitat use relative to areas of known sanctuary

Literature Cited

Anderson, J. T. 2008. Survival, habitat use, and movements of female northern pintails wintering along the Texas Coast. Thesis, Texas A&M University – Kingsville, Kingsville, TX, USA.

Cox, R. R., and A. D. Afton. 1997. Use of habitats by female northern pintails wintering in southwest Louisiana. Journal of Wildlife Management 61:435-443.

Cox, R. R., Jr., and A. D. Afton. 1998. Evening flights of female northern pintails from a major roost site. Condor 98:810-819.

Gray, J. M. 2010. Habitat use, movements, and spring migration chronology and corridors of female gadwalls that winter along the Louisiana Gulf Coast. Thesis, Louisiana State University, Baton Rouge, LA, USA.

Link, P. T., A. D. Afton, R. R. Cox Jr., and B. E. Davis. 2011[a]. Daily movements of female mallards wintering in southwestern Louisiana. Waterbirds 34:422-428.

Link, P. T., A. D. Afton, R. R. Cox Jr., and B. E. Davis. 2011[b]. Use of habitats by female mallards wintering in southwestern Louisiana. Waterbirds 34:429-438.

Paracuellos, M., and J. L. Telleria. 2004. Factors affecting the distribution of a waterbird community: the role of habitat configuration and bird abundance. Waterbirds 27:446-453.

Raeside, A. A., S. A. Petrie, and T. D. Nudds. 2007. Waterfowl abundance and diversity in relation to season, wetland characteristics and land-use in semi-arid South Africa. African Zoology 42:80-90.

6. Estimating abundance and dietary energy content of waterfowl foods in palustrine wetlands within the Laguna Madre Initiative Area

Problem Statement

Palustrine wetlands are a GCJV priority waterfowl habitat in the Laguna Madre Initiative Area (LMIA), yet empirical data on the abundance and diversity of waterfowl food resources within them is not available. Presently, habitat objectives for palustrine wetlands in the LMIA are calculated based on the assumption that waterfowl foraging resources in them are equal to those documented in idle rice fields within the GCJV region. Vegetation communities in idle rice fields are dominated by annual grasses and sedges (Durham and Afton 2003), and these plant forms are also present in palustrine wetlands of the LMIA. However, differences in climate, hydroperiod, soils, and seed banks between south Texas and Gulf Coast ricelands have potential to produce substantially different plant communities and waterfowl foraging values in these habitat types. Empirical data on the abundance and composition of waterfowl foods (seeds, submersed aquatic vegetation [SAV], and aquatic invertebrates) in palustrine wetlands of the LMIA are needed to improve the reliability of GCJV objectives for this important habitat for wintering waterfowl.

Research Considerations

A collaborative research project was initiated in July 2010 by the GCJV and Texas A&M University – Kingsville to address this need. Details of this research and an update on the status of this science need may be obtained by contacting the GCJV office.

Key Objectives

a. Quantify abundance and composition of waterfowl foods (i.e., seeds, SAV, and aquatic invertebrates) in palustrine wetlands of the LMIA
b. Use data from Objective a. and published estimates of true metabolizable energy (TME) to calculate total dietary energy density (kcal/ha) for waterfowl in palustrine wetlands of the LMIA

Geographic Scope of Work (GCJV Initiative Areas):

Laguna Madre

Deliverables

a. Comprehensive report documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables depicting species-specific biomass and TME values for seeds, SAV, and invertebrates commonly consumed by waterfowl and detected in palustrine wetlands in the LMIA
c. Estimates of total dietary energy density (kcal/ha) from waterfowl foods detected in palustrine wetlands of the LMIA

Literature Cited

Durham, R. S., and A. D. Afton. 2003. Nest-site selection and success of mottled ducks on agricultural lands in southwest Louisiana. Wildlife Society Bulletin 31:433-442.

7. Spatially-explicit decision support tool to guide habitat conservation for Western Gulf Coast mottled ducks

Problem Statement

Mottled ducks are year-round residents of coastal marshes and prairies in the Western Gulf Coast (WGC), a focal species for the U.S. Fish and Wildlife Service, and a priority species in the Texas and Louisiana Comprehensive Wildlife Conservation Plans. Available population survey data suggest the WGC mottled duck population has experienced a long-term steep decline in Texas, is stable or slightly increasing in Louisiana, and is stable to declining across the entire WGC range. Conversion and degradation of important wetland and upland habitats are believed largely responsible for historical declines in mottled duck abundance; hence, conservation and management of upland and wetland habitats for mottled ducks is a priority concern for the GCJV. The GCJV Mottled Duck Conservation Plan (Wilson 2007) recommends conservation actions to address key limiting factors for the WGC mottled duck population. Although this represents an important step in becoming more strategic with limited financial and logistical resources, maximizing the biological return from conservation investments depends further on appropriate spatial placement of conservation actions on the targeted landscape.

Research Considerations

Decisions on where and how to implement a suite of conservation actions may be influenced differentially by biological objectives, landscape conditions, and available resources. Hence, this effort will entail development of a decision support tool (DST) that generates unique recommendations and spatial priorities depending upon specific conservation actions of interest (e.g., restoration, enhancement, and protection), with model outcomes potentially differing based on biological objectives being targeted (e.g., brood survival vs. nest success).

A series of geospatial databases (e.g., Coastal Change Analysis Program, National Wetlands Inventory, Texas Vegetation Classification Project) and/or remotely sensed imagery will be examined, and potentially combined, to identify priority grasslands and palustrine and estuarine wetlands on the GCJV landscape. Desired habitat characteristics articulated in the GCJV Mottled Duck Conservation Plan will inform development of species-habitat models for WGC mottled ducks that reflect current scientific understanding of limiting factors for mottled ducks and priority conservation actions to impact them. Species-habitat models will be combined with geospatial databases within a GIS environment to generate spatial priorities for mottled duck habitat conservation actions across the WGC landscape. An important aspect of this project will be convening a series of workshops to request input from GCJV partners on objectives for a mottled duck habitat conservation DST, seek assistance with development of species-habitat models for mottled ducks, enable review of preliminary and final model outputs, and disseminate end products to GCJV partners for their use and implementation.

Key Objectives

a. Develop decision support tool to provide science-based guidance for on-the-ground delivery of conservation actions that affect restoration, enhancement, and protection of coastal marshes, inland wetlands, and grasslands to positively impact key vital rates for WGC mottled ducks

Geographic Scope of Work (GCJV Initiative Areas):

All initiative areas, but priority given to Mississippi River Coastal Wetlands, Chenier Plain, Texas Mid-Coast, and Laguna Madre

Deliverables

a. Series of maps, tables, presentations, and supporting documentation identifying and describing priority areas for habitat conservation activities to benefit WGC mottled ducks
b. Comprehensive report describing stakeholder input, model development, model results, and their application across the GCJV landscape
c. Time and resources permitting, development of an interactive computer-based application should be considered to enable site-specific planning by conservation delivery partners

Literature Cited

Wilson, B. C. 2007. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mottled Duck Conservation Plan. North American Waterfowl Management Plan, Albuquerque, NM. 27pp. +appendices.

8. Movements, habitat use, and foraging ecology of scaup wintering in offshore and inshore waters of the Western Gulf Coast

Problem Statement

Continental scaup populations have declined significantly since 1978, and the 2011 breeding population estimate was 20% below the North American Waterfowl Management Plan objective (US Fish and Wildlife Service 2011). Reasons for the decline are poorly understood, but several non-exclusive and potentially cross-seasonal factors have been suggested, including problems with contaminants, female survival, and recruitment (Austin et. al. 2000). Louisiana and Texas are considered two of the most important states for wintering scaup. On average, these states are responsible for 91% and 97% of the scaup counted on mid-winter surveys in the Mississippi and Central flyways, respectively (Afton & Anderson 2001). Moreover, GCJV population objectives for scaup are greater than those for any other waterfowl species, despite these objectives excluding birds occurring in offshore waters of the GCJV region. Identifying effective conservation strategies to benefit wintering scaup remains a priority for the GCJV, yet remains a challenge because of an incomplete understanding of scaup movements, habitat use, foraging ecology, and how or whether these differ between scaup inhabiting inshore vs. offshore waters of the GCJV region.

Although Kinney (2004) advanced our understanding of abundance and distribution of wintering scaup in bays and offshore waters of Louisiana, this information is still needed for other areas of the GCJV region (Science Need No. 11). Indeed, Kinney (2004) documented significant numbers of scaup in offshore waters, potentially accounting for 50-86% of all scaup wintering in Louisiana. Yet even with this information, our ability to develop reliable conservation strategies for wintering scaup remains hindered by 1) a lack of understanding about movements and degree of interchange between scaup in offshore and inshore waters, 2) uncertainty about scaup foraging ecology in offshore and inshore waters, 3) a poor understanding of scaup habitat use and how it may be affected by habitat characteristics and environmental factors, and 4) uncertainty about the potential for coastal restoration strategies to positively impact resource needs of wintering scaup. Scientific research efforts are needed to address these uncertainties and enable development of meaningful habitat conservation recommendations to benefit wintering scaup in the GCJV region.

Research Considerations

Documenting movements and interchange of scaup between inshore and offshore areas is likely most easily and reliable tested through a study of individually marked birds. Because of the difficulty and expense of tracking radiomarked birds in vast expanses of coastal bays and offshore waters, satellite telemetry methods would likely be required to effectively address this question. Efforts to understand habitat use and foraging ecology of scaup in offshore waters should consider potential synergies with efforts to quantify scaup distribution and abundance (Science Need No. 11), as scaup distributions could be compared to data on food resource distribution (if known or estimated) or the active extent of the Gulf hypoxic zone, thereby elucidating relationships with environmental variables. For example, the size and distribution of the zone of deoxygenated water may have profound impacts on sessile benthic fauna such as clams, which are a primary food source of scaup in offshore areas (Bowman 1973).

Food habits and resource availability studies will also be needed to quantify differences in scaup diets between offshore and inshore areas and identify preferred food items. Upon documenting scaup foraging preferences, additional studies or literature syntheses may be needed to understand the potential for restoration strategies to impact preferred food resources and increase habitat suitability for scaup.

Key Objectives

a. Estimate habitat use and movements of scaup within and between inshore and offshore waters of the GCJV region
b. Quantify diet composition of scaup collected in inshore and offshore waters of the GCJV region
c. Assess effects of habitat characteristics (e.g., salinity, food densities) and environmental factors (e.g., hypoxia) on habitat use and suitability of inshore and offshore waters for wintering scaup in the GCJV region
d. Examine the potential for coastal restoration strategies to impact resource needs of wintering scaup in the GCJV region

Geographic Scope of Work (GCJV Initiative Areas):

All initiative areas

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables, graphs, maps, and/or statistical test results that depict the likelihood of individual scaup using both inshore and offshore habitats, and the factors affecting such potential habitat transition(s)
c. Tables, graphs, maps, and/or statistical test results that depict the occurrence of scaup relative to habitat features and environmental factors (e.g., clam beds, hypoxic zone)
d. Tables, graphs, maps, and/or statistical test results of scaup food resources and foraging ecology in offshore and inshore waters
e. Report offering recommendations on conservation strategies likely to benefit scaup habitats in the GCJV region

Literature Cited

Afton, A. D. and M. G. Anderson. 2001. Declining scaup populations: a retrospective analysis of long-term population and harvest data. Journal of Wildlife Management 65:781-796.

Austin, J. E., A. D. Afton, M. G. Anderson, R. G. Clark, C. M. Custer, J. S. Lawrence, J. B. Pollard, and J. K. Ringelman. 2000. Declining scaup populations: issues, hypotheses, and research needs. Wildlife Society Bulletin 28:254-263.

Bowman, P.E. 1973. Food habits of the lesser scaup (*Aythya affinis*) in Lake Ponchartrain. Thesis, Southeastern Louisiana University, Hammond, LA, USA.

Kinney, S. D. 2004. Estimating the population of greater and lesser scaup during winter in off-shore Louisiana. Thesis, Louisiana State University, Baton Rouge, LA, USA.

U.S. Fish and Wildlife Service. 2011. Waterfowl population status, 2011. U.S. Department of the Interior, Washington, D.C. USA.

9. Effects of water resource allocation, changing cultivation practices, and urban growth pressures on rice agriculture and associated waterfowl habitats on the Gulf Coast

Problem Statement

Ricelands provide important foraging habitat for wintering waterfowl in North America (Eadie et al. 2008). Across the GCJV region, active and idle rice fields are expected to satisfy 35% of the total dietary energy demands of target waterfowl populations and 52% of the dietary energy demands for waterfowl within the two initiative areas where rice is grown. However, rice production has experienced significant declines on the Gulf Coast in recent decades. During the late 1970s, approximately 1 million acres of rice was grown annually in the coastal parishes and counties of Louisiana and Texas. Since that time, planted rice has declined by nearly 60%, with 425,000 acres planted in these same areas during 2010. Even more concerning, planted rice in Texas dipped to 150,000 acres twice in the past 5 years, and four of the lowest totals for Texas since 1968 occurred in that same period. Development pressures, high production costs, reduction of commodity supports, and competition for a limited water supply have all contributed to this decline.

Agricultural irrigation accounts for 40% of the total consumption of freshwater in the US. Previously considered abundant within much of the GCJV region, water for agricultural purposes is now viewed as a limited resource, primarily due to rising competition and periodic droughts. This view has been exacerbated by observed and projected human population growth, increased municipal and industrial demands for reliable water, and projections of potentially more severe and frequent drought as a result of global climate change. Because rice agriculture is one of the largest consumers of available freshwater in the GCJV region, increased scrutiny and regulation of water usage by rice producers is occurring. Tighter restrictions on availability of water for rice production have been instituted within major irrigation districts in Texas, and concerns about potential depletion of groundwater aquifers are intensifying in other areas of the GCJV. Thus, the sustainability of rice agriculture and the habitat it provides to wintering and breeding waterfowl is becoming increasingly uncertain.

Large investments in research and development of water-efficient rice varieties (e.g., herbicide resistant, high-yielding single crop) and dominant cultivation practices (e.g., dry-seeding, underground irrigation, laser-leveled fields) have occurred in recent years. Although such advancements may enable rice producers to more effectively cope with limited water supplies and increase the likelihood of a sustainable rice industry, their implications for the quality or abundance of habitat for wintering and breeding waterfowl is unknown. Moreover, cultivation of “seed rice” (i.e., rice produced for seed stock) has become increasingly prevalent on the Texas coast in recent years. The abundance and availability of waterfowl food resources within seed rice fields is unknown, although it is believed to be substantially less than that available in conventional rice fields.

There is a great need to examine how farm policies (legislation), water resource allocation plans, human demographics (population growth), changing agricultural practices, and other market drivers may affect rice agriculture and the habitat base it provides to waterfowl. Understanding these issues will likely benefit efforts to promote a sustainable rice industry while maintaining traditional habitat values to waterfowl and waterbirds within the GCJV region. Most importantly, this information is critical for anticipating likely future conditions and abundance of waterfowl habitat in the GCJV region and proactively developing habitat conservation programs that are compatible with future agricultural practices and water use policies.

Research Considerations

Considerable work has already occurred within major irrigation districts of Texas to examine the potential effects of changing water use policies and rice cultivation practices on winter waterfowl habitat (Bio-West Inc. 2007, LCRA-SAWS Water Project 2009). Projections of human population growth, water resource demands, water supplies, and land use changes are also available for the GCJV region (Lower Colorado Regional Water Planning Group 2010, Texas Water Development Board 2012). Thus, initial work on this issue should entail a comprehensive synthesis of existing reports, water use plans, proposed regulations, projections of population growth, and documented shifts in rice cultivation practices to identify the most critical data gaps for effectively understanding and describing this complex issue.

Key Objectives

a. Summarize rice agriculture statistics by individual irrigation district or aquifer region within the GCJV and assess relative risk of water limitations for each irrigation district or aquifer region
b. Model effects of reduced water availability, changes in cultivation practices, farm policies, and land-use changes on rice production and associated waterfowl food resources
c. Identify alternative future scenarios of rice production within the GCJV based on models developed in Objective b. and use bioenergetic models to estimate changes in the capacity of future landscapes to support wintering waterfowl relative to 1) current landscape conditions and 2) needs of target population objectives.

Geographic Scope of Work (GCJV Initiative Areas):

Chenier Plain and Texas Mid-Coast

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations regarding projected impacts on waterfowl habitat in rice agriculture systems of the GCJV region

Literature Cited

Bio-West, Incorporated. 2007. Assessment and potential impact/benefit of LSWP on waterfowl: agricultural management strategies related to waterfowl. Technical memorandum, prepared for Lower Colorado River Authority and San Antonio Water System. 47pp.

LCRA-SAWS Water Project. 2009. 2008 Project Viability Assessment. 180pp. www.lcra.org/portal/page/portal/library/media/public/docs/lswp/pva/2008/2008_LSWP_PVA.pdf

Lower Colorado Regional Water Planning Group. 2010. 2011 Region K Water Plan for the Lower Colorado Regional Water Planning Group. Prepared for Texas Water Development Board.

Eadie, J. M., C. S. Elphick, K. J. Reinecke, and M. R. Miller. 2008. Wildlife values of North American ricelands. Pages 7-90 *in* S. W. Manley, editor. Conservation in ricelands of North America. The Rice Foundation, Stuttgart, Arkansas, USA.

Texas Water Development Board. 2012. Water for Texas, 2012 State Water Plan. Austin, TX, USA. 314 pp. http://www.twdb.state.tx.us/publications/state_water_plan/2012/2012_SWP.pdf

10. Importance of distributed sanctuary in habitat conservation for wintering waterfowl and implications for food limitation

Problem Statement

Bioenergetic models for estimating waterfowl habitat objectives in the GCJV assume all foraging habitats are available. However, empirical evidence suggests disturbance activities may affect the ability of waterfowl to access habitats, potentially rendering them functionally unavailable (Cox and Afton 1997). A better understanding of relationships between disturbance and waterfowl use of habitats, as well as the possible role of strategically distributed sanctuary in facilitating access to foraging habitats during periods of lighter disturbance (e.g., nocturnal periods), is needed to evaluate assumptions of GCJV bioenergetics models and ensure habitat conservation programs adequately address resource needs of wintering waterfowl.

Several forms of human disturbance with potential to limit waterfowl access to foraging habitats are common within the GCJV region. These include airboat activity (e.g. 3-d seismic operations), hunting, crawfish harvesting, recreational boat activity, farm operations, and other recreational activities. The phenomenon of diurnal roosting and evening flights to nocturnal foraging sites has been well-documented for pintails in southwest Louisiana (Cox and Afton 1997, Randall et al. 2011). This is widely considered a behavioral adaptation to avoid heavy diurnal disturbances and exploit high quality foraging habitats during nocturnal periods when disturbance is lighter. Additionally, Cox and Afton (1998) documented greater evening flight distances of pintails in southwest Louisiana as winter progressed, which was consistent with refuging theory that predicts preferential foraging and earlier food depletion on areas nearest sanctuaries.

Link et al. (2011[a,b]) reported female mallards in southwest Louisiana used areas closed to hunting at higher rates during diurnal than nocturnal periods, suggesting this species also may adjust foraging behaviors in response to diurnal disturbances. In contrast, Gray (2010) did not document similar nocturnal foraging patterns for gadwalls in southwest Louisiana. This phenomenon remains untested for other common duck species and areas within the GCJV region. Largely in response to observations of Cox and Afton (1997, 1998), GCJV partners developed the Waterfowl Rest Area Program to provide strategically distributed sanctuary within the agricultural landscape of southwest Louisiana to enable waterfowl to access high quality foraging habitats with reduced flight-related energetic costs. Distributed sanctuary programs may theoretically benefit wintering waterfowl through multiple mechanistic pathways, including reduced energetic expenditure, less time spent foraging, increased time available for detection and avoidance of predators, or reduced waterfowl densities and lower probabilities of disease outbreaks. However, the effectiveness of and need for distributed sanctuary programs within southwest Louisiana or other areas of the GCJV region remain untested. A quantitative understanding of the benefits of sanctuary in winter waterfowl habitat conservation is essential for ensuring GCJV habitat conservation strategies are biological reliable.

Understanding waterfowl habitat use and foraging patterns in relation to disturbance and sanctuary is also important when evaluating more fundamental assumptions underlying habitat conservation planning for wintering waterfowl. Habitat conservation for wintering waterfowl is currently based on the assumption that availability of fall and winter foraging habitat may constrain survival or recruitment of waterfowl. Such constraints may not exist when wintering waterfowl populations are low and/or when abundant, timely rainfall provides plentiful foraging habitats. Fall population size, weather-induced migration, weather-related winter habitat availability, and habitat conditions in other migration and wintering areas may interact to produce varying degrees of habitat limitation on the Gulf Coast. When foraging habitat is limiting, we expect foods to be largely depleted across broad spatial scales, at least to densities below which foraging is not energetically profitable. One potentially confounding variable in studying food depletion is disturbance. Even if foraging habitat is limited, food depletion may not occur at a given site if the frequency, duration, or severity of disturbance are sufficient to prohibit waterfowl access to food resources. Thus, the impacts of disturbance and sanctuary on accessibility of foraging habitats must be considered when evaluating the food limitation hypothesis.

Research Considerations

A waterfowl food depletion study that a priori incorporates disturbance or sanctuary would offer a strong test of refuging theory, and could be particularly informative about the role and appropriate distribution of sanctuary for wintering waterfowl. One possible study design would test for differences in waterfowl food depletion among numerous paired study sites across the entire GCJV, with pairs allocated to each initiative area (i.e., strata) in sufficient numbers to elucidate regional differences among initiative areas. Each pair would consist of a hunted and non-hunted section of otherwise similar habitat in proximity to each other, and sampling at each site would occur both with and without waterfowl exclosures. Sampling of the habitat for waterfowl foods should occur, at minimum, before most waterfowl arrive and again at the end of the waterfowl wintering period. Care would have to be taken to assure similar habitat type and quality within each pair, and a standard definition of disturbance should be applied (e.g., at least one hunt per week). Such a study should be conducted over multiple years to accommodate different winter population sizes and distributions of waterfowl.

Other appropriate study designs include experimental manipulation of disturbance so treatments could be randomly applied, experimental placement of known quantities of waterfowl foods, rigorous quantification of different degrees of disturbance, or a design in which 3 or more levels of disturbance are incorporated a priori. If experimental manipulations of disturbance are not possible, automatic recording units may provide an opportunity to objectively quantify frequency and intensity of disturbance at study sites or across larger scales if systematically deployed. Behavioral observations to test for differences in activity budgets may also be a useful component of potential studies.

Opportunities should be sought to integrate research on this issue with a rigorous evaluation of the Waterfowl Rest Area Program, including examination of factors affecting performance of individual sites enrolled in the program (e.g., size of enrolled tract, date of flooding, surrounding land use, etc.). Efforts to address these research objectives may also help address, or benefit from efforts to address, research objectives identified in Science Needs No. 5 (Habitat use of waterfowl) and No. 17 (Crawfish aquaculture as waterfowl habitat).

Key Objectives

a. Specific objectives may vary depending on study design, but generalized objectives include estimating waterfowl use or food deletion rates in relation to disturbance frequency and severity, proximity to sanctuary, and other habitat or landscape features that may influence availability and quality of sampled foraging habitats
b. Quantify relationships between waterfowl use and food depletion rates and indices of disturbance or sanctuary

Geographic Scope of Work (GCJV Initiative Areas):

Chenier Plain and Texas Mid-Coast

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations
b. Probability values from statistical procedures that test for overall and regional differences in waterfowl food depletion among disturbance treatments
c. Others as determined through consultation with GCJV staff

Literature Cited

Anderson, J. T. 2008. Survival, habitat use, and movements of female northern pintails wintering along the Texas Coast. Thesis, Texas A&M University – Kingsville, Kingsville, TX, USA.

Cox, R. R., and A. D. Afton. 1997. Use of habitats by female northern pintails wintering in southwest Louisiana. Journal of Wildlife Management 61:435-443.

Cox, R. R., Jr., and A. D. Afton. 1998. Evening flights of female northern pintails from a major roost site. Condor 98:810-819.

Gray, J. M. 2010. Habitat use, movements, and spring migration chronology and corridors of female gadwalls that winter along the Louisiana Gulf Coast. Thesis, Louisiana State University, Baton Rouge, LA, USA.

Link, P. T., A. D. Afton, R. R. Cox Jr., and B. E. Davis. 2011[a]. Daily movements of female mallards wintering in southwestern Louisiana. Waterbirds 34:422-428.

Link, P. T., A. D. Afton, R. R. Cox Jr., and B. E. Davis. 2011[b]. Use of habitats by female mallards wintering in southwestern Louisiana. Waterbirds 34:429-438.

Randall, L.A., R. H. Diehl, B. C. Wilson, W. C. Barrow., Jr., and C. W. Jeske. 2011. Potential use of weather radar to study movements of wintering waterfowl. Journal of Wildlife Management 75:1324–1329.

11. Abundance and distribution of scaup in offshore waters of the Western Gulf Coast

Problem Statement

Unreliable or non-existent estimates of scaup abundance in offshore waters of the GCJV region limits the ability of the GCJV partnership to appropriately account for their needs in conservation plans. Continental population levels of scaup are well below the North American Waterfowl Management Plan objective, and their status is a concern to waterfowl managers. Reasons for the decline are poorly understood, but several non-exclusive and potentially cross-seasonal factors have been suggested, including problems with contaminants, female survival, and recruitment (Austin et. al. 2000). Louisiana and Texas are 2 of the most important states for wintering scaup (Afton & Anderson 2001), and scaup lead GCJV waterfowl population objectives over all other species, despite the fact that these objectives exclude offshore populations.

GCJV population and habitat objectives do not explicitly account for the abundance or dietary needs of scaup in offshore waters. This is due to 1) a lack of understanding about the degree of interchange of scaup between offshore and inshore habitats, 2) a lack of survey information to provide reliable numbers of offshore scaup, 3) a lack of information about the effects of inland habitat management on offshore scaup, and 4) a paucity of information regarding direct management activities that might benefit offshore scaup and their habitats. To the extent that conservation strategies can impact scaup habitat in offshore and inshore waters, knowledge of the abundance of scaup in offshore waters is necessary to establish meaningful habitat objectives for this species.

Research Considerations

A pilot survey to enumerate wintering scaup in offshore waters of Louisiana was implemented during winters 2000 - 2002, the results of which were summarized by Kinney (2004). This survey included portions of bays and marine waters up to 5 miles offshore not covered by the coordinated midwinter survey. Approximately 2,000 miles of random aerial survey transects, stratified by 16 units, resulted in a 5.4% sampling intensity. Results of this survey documented large numbers of scaup in previously unsurveyed areas of Louisiana, with annual estimates ranging from 469,730 to 808,222. Large flocks of scaup in offshore areas of Mississippi were observed by some of the survey participants, but not included in this survey. Lesser numbers were observed in offshore waters of the Texas Chenier Plain during an informal survey timed to coincide with the effort in Louisiana. Additionally, large concentrations of scaup are frequently encountered in offshore waters adjacent to the Texas Mid-Coast and Laguna Madre Initiative Areas during the annual winter redhead survey (F. Roetker, US Fish and Wildlife Service, personal communication). Expansion of a well-designed and coordinated survey to the offshore waters and bays of Texas, Mississippi, and Alabama is needed to comprehensively enumerate winter scaup populations throughout the GCJV.

Consultation with GCJV partners will be needed to develop consistent definitions of survey area, survey methodologies, analytical procedures, survey frequency, and other logistics. Responsibility for analyzing, summarizing, and archiving data, as well as distributing associated reports, will also need to be clarified. Although it may not be financially feasible to implement the survey(s) on a long-term, annual basis, strong consideration should be given to implementing the survey(s) annually for at least the initial 3-4 years. Results from these years may be used to refine survey areas and/or methodologies. GCJV staff have participated in formative discussions with representatives of the Sea Duck Joint Venture (SDJV) on shared interests in developing and implementing aerial surveys to enumerate sea ducks in Gulf Coast waters. Opportunities to partner with the SDJV on surveys of offshore scaup in the GCJV region should be explored and pursued where possible.

Results from Kinney (2004) and anecdotal evidence from aerial survey participants suggest that abundance and distribution of scaup in offshore waters varies widely among and within years. Although a pilot survey has already been developed and implemented for Louisiana, this survey should be repeated concurrent with those for Texas, Mississippi, and Alabama to enable a comprehensive estimate and better understanding of scaup abundance and distribution in offshore waters across the GCJV region.

Key Objectives

a. Develop aerial survey methodology for estimating with acceptable precision (e.g., CV <15%) the abundance of wintering scaup in offshore waters of Texas, Mississippi, and Alabama
b. Implement aerial surveys concurrently across the GCJV region to estimate abundance of wintering scaup in offshore waters

Geographic Scope of Work (GCJV Initiative Areas):

Survey development: Coastal Mississippi and Alabama, Texas Chenier Plain, Texas Mid-Coast, and Laguna Madre
Survey implementation: All initiative areas

Deliverables

a. Comprehensive report documenting methods, analyses, results, conclusions, and relevant recommendations
b. Statistically valid estimates of scaup abundance for at least 3 consecutive years in offshore waters of the GCJV region
c. Archives of data summaries, analyses, methodologies, and maps associated with scaup estimates

Literature Cited

Afton, A. D. and M. G. Anderson. 2001. Declining scaup populations: a retrospective analysis of long-term population and harvest data. Journal of Wildlife Management 65:781-796.

Austin, J. E., A. D. Afton, M. G. Anderson, R. G. Clark, C. M. Custer, J. S. Lawrence, J. B. Pollard, and J. K. Ringelman. 2000. Declining scaup populations: issues, hypotheses, and research needs. Wildlife Society Bulletin 28:254-263.

Kinney, S. D. 2004. Estimating the population of greater and lesser scaup during winter in off-shore Louisiana. Thesis, Louisiana State University, Baton Rouge, LA, USA.

12. Effects of coastal marsh restoration on sustainability of GCJV waterfowl habitats

Problem Statement

Coastal marshes are dynamic systems in their natural state, yet many have been highly altered and degraded due to a variety of man-induced factors. This creates a difficult scenario for managers wishing to restore a degraded system, especially considering that degradation factors may operate at vastly different scales, ranging from site-specific (e.g., oil and gas extraction canals), to continental (e.g., altered hydrology of the Mississippi River), and global (e.g., eustatic sea level rise).

A variety of marsh restoration techniques are identified in GCJV Initiative Area plans, yet the sustainability of some has been questioned (Cahoon 1994, Nyman & Chabreck 1995, Reed & Foote 1997), primarily because of concerns about the low probability under some management scenarios of marsh elevation keeping pace with subsidence and/or sea level rise. Conversely, documented accretion rates of some managed marshes appear to be at sustainable levels (Foret 1997). Because of conflicting information and the importance of this issue for designing and conserving sustainable landscapes, the long-term benefits and sustainability of restoration techniques deserves closer examination. Factors that explain differences between the above conflicting findings in structurally managed marshes are of particular interest. These differences could reveal management regimes that are most appropriate for long-term conservation.

Research Considerations

Significant work has been conducted to evaluate waterbird and fisheries benefits of constructed marsh terraces, a common restoration strategy designed to improve conditions for growth of submersed aquatic vegetation (SAV) within open water areas of coastal marsh systems (Caldwell 2003, Cannaday 2006, LaPeyre et al. 2007, O'Connell and Nyman 2010). Although these studies documented measurable benefits to waterbirds and fisheries, they did not address questions about the longer-term implications of this practice to coastal marsh sustainability and incremental gains in waterfowl foraging capacity. Definitively answering these questions may require innovative study designs or sustained efforts over multiple years to measure system response and identify covariates that help determine long-term success (e.g., hydrology, geomorphology, terrace configuration and dimensions). Moreover, there exists a wide variety of conservation objectives for which constructed marsh terraces may be applicable, but for which they have yet to be comprehensively evaluated for either their short- or long-term benefits. Examples include reducing erosion of marsh edge, facilitation of marsh creation, enhancing waterfowl food production, and providing habitat for breeding waterfowl (e.g., nesting habitat for mottled ducks). Future opportunities to measure benefits of constructed marsh terraces should be explored, but careful consideration of management objectives and appropriate study designs (e.g., Before-After/Control-Impact; Stewart-Oaten et al. [1986]) to address them will be essential.

Additional restoration strategies that merit investigation for their ability to provide many of these same benefits and promote coastal sustainability include freshwater diversions, sediment diversions, structural marsh management, and salinity control.

Key Objectives

a. Quantify near- and long-term benefits of marsh restoration strategies to foraging and breeding waterfowl within the GCJV region
b. Assess contributions of restoration strategies to coastal marsh sustainability, potentially including a combination of empirical-based studies and coastal change simulation models
c. Develop guidance for best restoration and management practice

Geographic Scope of Work (GCJV Initiative Areas):

All initiative areas

Deliverables

a. Comprehensive report documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables, graphs, and/or statistical test results that compare parameters of long-term marsh health (vegetation, elevation, nutrients, etc.) among different replicated management treatments
c. Map(s) of study sites, documentation of site-specific management objectives, site-specific management practices actually attempted, and success of such attempts over the course of the study

Literature Cited

Cahoon, D. R. 1994. Recent accretion in two managed marsh impoundments in coastal Louisiana. Ecological Applications 4:166-176.

Caldwell, A. B. 2003. Do terraces and coconut mats affect seeds and submerged aquatic vegetation at Sabine National Wildlife Refuge? Thesis, Louisiana State University, Baton Rouge, LA, USA.

Cannaday, C. D. 2006. Effects of terraces on submerged aquatic vegetation in shallow marsh ponds in coastal southwest Louisiana. Thesis, Louisiana State University, Baton Rouge, LA, USA.

Foret, J. D. 1997. Accretion, sedimentation, and nutrient accumulation rates as influenced by manipulations in marsh hydrology in the chenier plain, Louisiana. Thesis, University of Southwest Louisiana, Lafayette, LA, USA.

La Peyre, M. K., B. Gossman, and J. A. Nyman. 2007. Assessing functional equivalency of nekton habitat in enhanced habitats: comparison of terraced and unterraced marsh ponds. Estuaries and Coasts 30:526-536.

Nyman, J. A. and R. H. Chabreck. 1995. Fire n coastal marshes: history and recent concerns. Pages 134-141 *in* S.I. Cerulean and R.T. Engstrom, eds. Fire in wetlands: a management perspective. Proceedings of the Tall Timbers Fire Ecology Conference, No. 19. Tall Timbers Research Station, Tallahassee, FL.

O'Connell, J. L., and J. A. Nyman. 2010. Marsh terraces in coastal Louisiana increase marsh edge and densities of waterbirds. Wetlands 30:125-135.

Reed, D. J. and A. L. Foote. 1997. Effect of hydrologic management on marsh surface sediment deposition in coastal Louisiana. Estuaries 20:301-311.

Stewart-Oaten, A, W. W. Murdoch, and K. R. Parker. 1986. Environmental impact assessment: "pseudoreplication" in time? Ecology 67:929-940.

13. Potential impacts of climate change on carrying capacity of GCJV waterfowl habitats and implications for long-term conservation planning

Problem Statement

Understanding potential effects of sea level rise and other products of climate change on the capacity of the Gulf Coast landscape to support breeding and wintering waterfowl populations is essential for long-term conservation planning and development of potential climate adaptation strategies (Glick et al. 2011). Combining spatial models of foraging habitat availability with simulations of sea-level rise will be useful as a first step in understanding potential consequences of relative sea-level rise. Climate and ecological community models of greater sophistication will be needed to more fully understand potential impacts of climate change on the capacity of and need for the Gulf Coast landscape to support waterfowl populations (Mcleod et al. 2010). Relevant considerations will include shifts in vegetation composition and their value in providing food resources for waterfowl, inland migration of coastal wetlands, changes in agricultural or other land-use practices, and continental shifts in waterfowl distributions.

Research Considerations

Modeling efforts designed to inform the 2012 Louisiana Master Plan (Coastal Protection and Restoration Authority of Louisiana 2012) offer opportunities to generate more reliable scenarios of the impacts of climate change (i.e., sea level rise) on Gulf Coast marshes and other waterfowl habitats in Louisiana. In addition, a pilot study is underway using alternative scenarios of projected sea level rise to quantify and describe likely impacts on habitat carrying capacity for Whooping Cranes and other waterbirds in the Texas Mid-Coast region. These efforts and other case-studies will provide important insights on what are likely to be the most efficient and meaningful approaches to quantifying climate change impacts on waterfowl habitats, interpreting them in the context of waterfowl carrying capacity, and formulating recommendations on how to adapt conservation planning to account for projected impacts (e.g., Shaughnessy et al. 2012).

Considerable uncertainty exists around individual projections of climate change impact. Thus, coefficients of confidence, metrics representing relative belief in an event occurring, should be assigned to alternative scenarios to enable appropriate weighting of competing results. Additionally, results from all scenarios should be analyzed to estimate spatially-explicit probabilities of impact for waterfowl habitats and regions across the GCJV landscape (e.g., regions projected to be negatively impacted under all scenarios would be assigned a probability of impact equal to 100%).

Climate change will affect habitats of other priority bird species of the GCJV. Thus, modeling efforts should seek to estimate impacts on multiple priority bird species simultaneously, thereby increasing the overall efficiency of GCJV science investments. Moreover, opportunities for collaboration with Landscape Conservation Cooperatives and Climate Science Centers that share interests in this need should be actively pursued.

Key Objectives

a. Develop projections of abundance and distribution of key waterfowl and other priority bird habitats under alternative scenarios of climate change (e.g., sea level rise), including graphical and quantitative depictions of habitat shifts

b. Assign coefficients of confidence to alternative scenarios of climate change impacts and combine results to generate spatially explicit probabilities of impact to waterfowl and other priority bird habitats on the GCJV landscape
c. Use GCJV bioenergetic models to estimate capacity of projected, future landscapes to support wintering waterfowl populations

Geographic Scope of Work (GCJV Initiative Areas):
All initiative areas

Deliverables
a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables, figures, and maps depicting habitat shifts under alternative scenarios of climate change
c. Tables depicting quantitative estimates of landscape carrying capacity for wintering waterfowl and other priority bird species under alternative scenarios of climate change with comparisons to existing GCJV population and habitat objectives
d. Recommendations for adapting conservation plans and strategies in response to projected impacts

Literature Cited
Coastal Protection and Restoration Authority of Louisiana. 2012. Louisiana's Comprehensive Master Plan for a Sustainable Coast. Coastal Protection and Restoration Authority of Louisiana. Baton Rouge, LA, USA.

Glick, P., B. A. Stein, and N. A. Edelson, editors. 2011. Scanning the conservation horizon: a guide to climate change vulnerability assessment. National Wildlife Federation, Washington, D.C., USA.

Mcleod, E., B. Poulter, J. Hinkel, E. Reyes, and R. Salm. 2010. Sea-level rise impact models and environmental conservation: a review of models and their application. Ocean & Coastal Management 53:507-517.

Shaughnessy, F. J., W. Gilkerson, J. M. Black, D. H. Ward, and M. J. Petrie. (*In Print*). Predicted eelgrass response to sea level rise and its availability to foraging black brant in Pacific coast estuaries.

14. Winter site fidelity and breeding ground affiliation of GCJV duck species

Problem Statement

GCJV population objectives are based on the assumption that 1970s winter duck distributions are appropriate and attainable. Relative distributions (i.e., percentages) of birds counted in midwinter surveys were used to apportion continental objectives into flyways and further into initiative areas. However, winter site fidelity has potential implications to current and future winter distributions of ducks regardless of regional habitat conditions and may influence the likelihood of observing future duck abundances in line with GCJV population objectives. Similarly, an understanding of breeding ground origins of ducks wintering in the GCJV is necessary to interpret changes in winter population distributions and to inform studies of cross-seasonal effects of winter waterfowl habitat conservation. Depending on the degree of winter site fidelity exhibited by ducks, habitat conditions within certain breeding regions may be important determinants of GCJV wintering populations.

Hestbeck (1993) examined winter bandings and subsequent recovery distributions of pintails and found that birds from coastal areas, including the Gulf Coast, exhibited higher winter fidelity than pintails in other regions. If true for other species, winter habitat conservation could substantially influence our ability to attain GCJV population objectives. Conversely, populations exhibiting high winter site fidelity to the Gulf Coast may suffer disproportionately from the effects of current habitat deficits or potential future habitat declines within the GCJV region (e.g., continued decline of rice agriculture and degradation of coastal marsh).

Additionally, the extent to which habitat in excess of objectives (i.e., habitat “surpluses”) within one initiative area may help offset, or should be recognized as helping to offset, habitat deficiencies in other initiative areas has not been thoroughly explored. Although this issue bears social and political considerations beyond what may be suggested by ecological principles, scientific investigations into winter site fidelity are needed to enable well-informed discussions of the merits and consequences of alternative conservation planning philosophies.

Research Considerations

Winter site fidelity could potentially be assessed from winter bandings and recoveries, both within and outside the GCJV, but such analyses should be species-specific. Assessments of temporal changes in origins of wintering waterfowl in the GCJV region should be explored. If winter site fidelity to the GCJV has been high, then historical breeding origins of winter duck populations, and subsequent changes in more recent years, could be informative regarding changing distributions of wintering ducks. Decade-specific harvest derivation analyses would elucidate changes to breeding origins of GCJV winter populations. Analysis by GCJV initiative area, although likely challenging to achieve with sufficient precision, would be particularly valuable for considering impacts of shifting waterfowl distributions on initiative area population objectives.

The advent of satellite telemetry techniques may offer additional opportunities to achieve finer-scaled descriptions of winter site fidelity for individual species (e.g., Gray 2010), although achieving sample sizes sufficient to provide reliable knowledge may be cost prohibitive, at least in the near term.

Key Objectives

a. Estimate species-specific winter site fidelity to the GCJV region and initiative areas within it
b. Identify breeding regions having greatest connections to GCJV winter waterfowl habitats, by species, as informed by harvest derivation statistics
c. Assess linkages between waterfowl wintering in the GCJV region and specific breeding areas and examine potential correlations between population changes between these areas over time

Geographic Scope of Work (GCJV Initiative Areas):

All initiative areas

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables, graphs, maps, and/or statistical test results that depict species-specific winter site fidelity to the GCJV, relative to other wintering areas
c. Tables, graphs, maps, and/or statistical test results that depict harvest derivations regions of various GCJV duck species, by decade and initiative area
d. Tables, graphs, maps, and/or statistical test results that depict specific breeding survey strata that are most closely affiliated with various GCJV duck species, by decade, and by initiative area

Literature Cited

Gray, J. M. 2010. Habitat use, movements, and spring migration chronology and corridors of female gadwalls that winter along the Louisiana Gulf Coast. Thesis, Louisiana State University, Baton Rouge, LA, USA.

Hestbeck, J. D. 1993. Overwinter distribution of northern pintail populations in North America. Journal of Wildlife Management 57:582-589.

15. Potential effects of wind energy development on waterfowl behavior and habitats in the Laguna Madre Initiative Area

Problem Statement

Wind energy has emerged as a key player in worldwide quests for alternative and renewable energy sources. Wind power potential within the GCJV region is greatest in offshore and near shore areas of the Laguna Madre Initiative Area (LMIA) (U.S. Department of Energy, National Renewable Energy Laboratory; http://www.nrel.gov/gis/wind.html), and this area has experienced tremendous growth of wind energy development in recent years. The LMIA may annually winter up to 1.2 million ducks and 45,000 geese within its bays, estuaries, and inland wetlands (Esslinger and Wilson 2002). This area is the primary wintering ground for over 80% of the continental redhead population and winters nearly 175,000 northern pintails and over 450,000 lesser scaup, two species whose population remain below NAWMP goals. Reliable information about impacts of wind energy facilities on waterfowl behavior and use of priority habitats is lacking. Potential impacts to local waterfowl populations range from direct mortality caused by collisions with wind turbines to reductions in physiological condition caused by myriad factors influencing the ability to acquire and maintain sufficient nutritional reserves throughout winter. Although direct mortality is an important consideration when examining the impacts of wind energy facilities on waterfowl population dynamics, the GCJV will focus on scientific investigations into direct and indirect effects on waterfowl behavior, waterfowl habitat quality, waterfowl use of priority habitats, and their implications to functional carrying capacities of waterfowl habitats in the LMIA (e.g., if waterfowl avoid habitats in proximity to wind energy facilities, then such habitats would effectively be rendered unavailable).

Significant infrastructure investments (e.g., roads, transmission lines) and routine maintenance activities are also needed to support wind energy facilities, all of which produce varying levels of acute or chronic disturbance. Moreover, construction of wind energy facilities and associated infrastructure has potential to impact physical characteristics or chemistry of nearby palustrine wetlands, some of which may be important determinants of waterfowl use (Ballard et al. 2010). Quantifying these impacts and developing recommendations (e.g., best management practices) on how to minimize them may be important for preserving the quality of wetland habitats for waterfowl in the LMIA.

Research Considerations

Redheads in the LMIA rely heavily on inland palustrine wetlands for dietary freshwater after foraging on shoalgrass rhizomes in the hypersaline Laguna Madre (Adair et al. 1996, Michot et al. 2006). Ballard et al. (2010) used aerial surveys to quantify redhead use of inland palustrine wetlands within the LMIA during 2000 – 2003, which was prior to the rapid development of wind energy facilities in this region. These surveys should be repeated to document contemporary distributions of redheads and their use of inland palustrine wetlands. Anlayses should examine potential influences of wind energy facilities and associated infrastructure (e.g., roads, disturbance) on changes in spatial use patterns of wintering redheads.

Investigations should also examine direct and indirect impacts of wind energy facilities and associated infrastructure on habitat quality and changes in behavior and nutritional ecology of wintering waterfowl in proximity to wind energy facilities. Impacts on wetland abundance may be examined by generating contemporary estimates of seasonal surface water availability and comparing these to estimates derived from time periods prior to wind energy development in the LMIA. Potential study designs to examine impacts on waterfowl behavior and nutritional ecology may require collection and comparison of data from sites proximal to and distant from wind energy facilities.

Key Objectives

a. Quantify effects of wind energy facilities on waterfowl habitat use, behavior, and nutritional ecology in the LMIA
b. Quantify direct and indirect effects of wind energy facilities and associated infrastructure on waterfowl habitats in the LMIA, and determine the implications for landscape carrying capacity for wintering waterfowl
c. Develop recommendations for minimizing potential impacts of wind energy facilities on waterfowl and their habitats in the LMIA

Scope of Work (Initiative Area):

Laguna Madre

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations for conservation actions or future research

Literature Cited

Adair, S. E., J. L. Moore, and W. H. Kiel Jr. 1996. Winter diving duck use of coastal ponds: an analysis of alternative hypotheses. Journal of Wildlife Management 60:83-93.

Ballard, B. M., J. D. James, R. L. Bingham, M. J. Petrie, and B. C. Wilson. 2010. Coastal pond use by redheads wintering in the Laguna Madre, Texas. Wetlands 30:669-674.

Esslinger, C. G., and B. C. Wilson. 2002. North American waterfowl management plan, Gulf Coast Joint Venture: Laguna Madre Initiative. North American Waterfowl Management Plan, Albuquerque, New Mexico, USA. 28 pp. + appendix.

Michot, T. C., M. C. Woodin, S. E. Adair, and E. B. Moser. 2006. Diurnal time-activity budgets of redheads (*Aythya americana*) wintering in seagrass beds and coastal ponds in Louisiana and Texas. Hydrobiologia 567:113-128.

16. Science in support of inter-regional, national, or continental waterfowl conservation planning

Problem Statement

Many science needs associated with delivery of the North American Waterfowl Management Plan (NAWMP) transcend JV boundaries, yet are relevant for biologically meaningful planning within individual JVs. Recent examples include the following, among others:

1. Consideration of competing philosophies for apportioning NAWMP goals to regional levels
2. Evaluating daily ration models and alternative model frameworks for estimating regional-scale habitat objectives for wintering and migrating waterfowl
3. Measuring net changes in landscape carrying capacity and its impacts on continental populations
4. Developing annual cycle models and demographic-based objectives to enable scientifically-informed resource allocation decisions
5. Exploring research and monitoring opportunities to measure effects of winter habitat conservation of waterfowl vital rates
6. Investigating potential effects of climate change on continental waterfowl distributions and implications for JV planning
7. Accounting for spatio-temporal variation in waterfowl distribution and abundance in JV habitat objectives

Effectively addressing these and many other large-scale science needs to ensure their relevance across planning regions requires diverse partnerships, potentially large financial investments, and scientific expertise that often exceed the capacities of individual JVs. The NAWMP Science Support Team (NSST) and other science-related partnerships (e.g., Pintail Action Group [PAG], Scaup Action Team [SAT]) have assumed primary responsibility for helping to advance many of these issues. However, these groups will invariably require input from JV science staff and technical working groups as well as financial support from conservation partnerships to significantly advance these issues.

GCJV staff have been heavily engaged in efforts of the NSST, PAG, and SAT; these investments should continue, but opportunities for the GCJV to become financial partners in addressing inter-regional science issues relevant to conservation planning within the GCJV should be strongly considered. In some cases, refining the biological foundations of planning efforts and philosophies at continental levels may influence GCJV objectives to greater degrees than issues being addressed at local levels (e.g., obtaining a better understanding of climate-induced distributional changes in waterfowl populations).

Research Considerations

Primary consideration should be given to the priorities of the NSST Work Plan (http://www.fws.gov/birdhabitat/NAWMP/NSST/files/NSST2011_15WorkPlan.pdf), recommendations of the 2012 NAWMP Revision, and annual cycle modeling efforts of the PAG (Mattsson et al. 2012) and SAT.

Key Objectives

Primary objectives to be supported with resources of the GCJV will be dictated by objectives of individual science needs and their relevance to conservation planning in the GCJV

Scope of Work (Initiative Area):

All initiative areas

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations for conservation actions or future research

Literature Cited

Mattsson, B. J., M. C. Runge, J. H. Devries, G. S. Boomer, J. M. Eadie, D. A. Haukos, J. P. Fleskes, D. N. Koons, W. E. Thogmartin, and R. G. Clark. 2012. A modeling framework for integrated harvest and habitat management of North American waterfowl: case-study of northern pintail metapopulation dynamics. Ecological Modelling 225:146-158.

17. Compatibility of crawfish aquaculture as foraging, breeding, or sanctuary habitat for waterfowl in the GCJV region

Problem Statement

Crawfish production fields are abundant in southwest Louisiana and their physical features and inundation patterns are consistent with management practices to provide foraging habitat for wintering waterfowl. Use of crawfish fields by wading birds and waterfowl has been well documented (Huner et al. 2002), yet the extent to which crawfish fields are exploited for potential seed and invertebrate food resources is poorly understood (Martin 1985). Chabreck and Takagi (1985) documented diet composition of lesser scaup foraging in crawfish fields and Nassar et al. (1988) reported significant waterfowl use of experimental crawfish impoundments during November and December after which observed use declined significantly. However, the value of crawfish fields as waterfowl foraging habitat remains unclear, as anecdotal observations and contemporary studies of waterfowl habitat use in southwest Louisiana (Link et al. 2011) suggest duck use of crawfish fields during winter varies widely. Additionally, the GCJV has identified a potential need for a distributed sanctuary program to enhance availability of waterfowl food resources across the landscape (Science Need No. 10). Questions have emerged about the compatibility of crawfish production and harvesting with this program, either as applied to acreage enrolled in the program or on fields adjacent to enrolled sanctuary sites. No data is presently available with which to rigorously evaluate these questions.

Normal practices of maintaining water on crawfish fields into late-spring or summer and the presence of emergent vegetation within them produce conditions seemingly offering suitable habitat for breeding waterbirds and waterfowl. Rice fields along the Gulf Coast provide important breeding habitat for waterbirds and waterfowl (Hohman et al. 1994, Durham and Afton 2006, Pierluissi et al. 2010), yet the extent to which active crawfish fields are used as nesting, loafing, or brood-rearing habitats by waterbirds and waterfowl has not been precisely quantified (but see Martin 1985, Nassar et al. 1988, Huner et al. 2002).

Various factors may influence waterfowl use of crawfish fields, including flooding depth, extent of disturbance associated with harvesting operations, food abundance, and presence of crawfish traps that may serve as visual avoidance stimuli. Scientific research into waterfowl use of crawfish fields during winter and breeding periods is needed to better understand existing and potential benefits of crawfish production systems as foraging, breeding, and sanctuary habitat for waterfowl along the Gulf Coast. Moreover, reliable knowledge of factors affecting waterfowl use of crawfish fields is needed to help evaluate and potentially refine recommended practices for incentive-based conservation programs targeting working wetlands (i.e., rice and crawfish production systems) within the GCJV region (e.g., Migratory Bird Habitat Initiative, Working Wetlands Initiative).

Research Considerations

Measurements of waterfowl use must include observations during nocturnal and diurnal time periods, as waterfowl may avoid crawfish fields during diurnal periods when disturbance is greatest (Nassar et al. 1988). Crawfish aquaculture occurs across a variety of field rotation regimes (e.g., rice-crawfish-rice, rice-crawfish-soybean, rice-crawfish-fallow, permanent crawfish pond); thus, research should examine potential benefits of the most common rotation regimes. Because crawfish fields are also potentially valuable foraging habitat for priority waterbirds of the GCJV, investigations into waterfowl use of crawfish fields should also measure use by and benefits to waterbirds.

Concern exists among crawfish producers about the impacts of foraging waterbirds on crawfish harvests, although previous investigations have documented only minor impacts to crawfish yields (Martin and Hamilton 1985). Nevertheless, studies of waterfowl and waterbird use should incorporate experimental designs that enable robust conclusions of the impacts of foraging waterbirds on crawfish yields, especially if practices to encourage waterfowl and waterbird use of crawfish fields are to be adopted by crawfish producers.

Efforts to address these research objectives may also help address, or benefit from efforts to address, research objectives identified in Science Needs No. 5 (Habitat use of waterfowl) and No. 10 (Role of sanctuary in winter waterfowl habitat conservation).

Key Objectives

a. Estimate food abundance, use, and foraging behaviors of waterfowl and waterbirds within crawfish production systems during time periods relevant to conservation planning in the GCJV region
b. Quantify impacts of water depth, disturbance, vegetation density, food abundance, visual avoidance stimuli, and other factors on waterfowl and waterbird use of crawfish systems
c. Estimate impacts of waterfowl and waterbird foraging of commercial crawfish yields

Geographic Scope of Work (GCJV Initiative Areas):

Chenier Plain

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables, graphs, and/or statistical test results that depict waterfowl and waterbird use of crawfish production systems and factors affecting it, both diurnally and nocturnally
c. Tables, graphs, and/or statistical test results that depict waterfowl and waterbird foraging values for various crawfish production systems
d. Tables, graphs, and/or statistical test results for impacts of waterbird and waterfowl foraging on commercial crawfish yields
e. Summary of best management practices to benefit waterfowl and waterbird energetics and use within crawfish production systems

Literature Cited

Chabreck, R. H., and T. Takagi. 1985. Foods of lesser scaup in crayfish impoundments in Louisiana. Proceedings of Annual Conference of Southeastern Association of Fish and Wildlife Agencies 39:465-470.

Durham, R. S., and A. D. Afton. 2006. Breeding biology of mottled ducks on agricultural lands in southwestern Louisiana. Southeastern Naturalist 5:311-316.

Hohman, W. L., J. L. Moore, T. M. Stark, G. A. Weisbrich, and R. A. Coon. 1994. Breeding waterbird use of Louisiana rice fields in relation to planting practices. Proceedings of Annual Conference of Southeastern Association of Fish and Wildlife Agencies. 48:31-37.

Huner, J. V., C. W. Jeske, and W. Norling. 2002. Managing agricultural wetlands for waterbirds in the coastal regions of Louisiana, USA. Waterbirds 25:66-78.

Link, P. T., A. D. Afton, R. R. Cox Jr., and B. E. Davis. 2011. Use of habitats by female mallards wintering in southwestern Louisiana. Waterbirds 34:429-438.

Martin, R. P. 1985. Ecology of foraging wading birds at crayfish ponds and the impact of bird predation on commercial crayfish harvest. Thesis. Louisiana State University, Baton Rouge, Louisiana. 121 pp.

Martin, R. P. and R. B. Hamilton. 1985. Wading bird predation in crawfish ponds. Louisiana Agriculture 28:3-5.

Nassar, J. R., R. H. Chabreck, and D. C. Hayden. 1988. Experimental plantings for management of crayfish and waterfowl. Pages 427 – 439 *in* M. W. Weller, editor. Waterfowl in winter. University of Minnesota Press, Minneapolis, MN, USA.

Pierluissi, S., S. L. King, and M. D. Kaller. 2010. Waterbird nest density and nest survival in rice fields of southwestern Louisiana. Waterbirds 33: 323-330.

18. Foraging ecology, interspecific interactions, and potential resource competition between ducks and geese

Problem Statement

The extent and consequences of interspecific interactions and competition for food resources between ducks and geese within the GCJV region are poorly understood. Specifically, a need exists to quantify foraging ecology (e.g., diet composition, foraging thresholds, and characteristics of preferred foraging habitats) and interspecific interactions between ducks and geese to examine overlaps in resource needs and potential competition for limited resources. Resource competition and differences in foraging ecology between ducks and geese have potential to significantly affect estimates of waterfowl habitat objectives for the GCJV, yet limited data is available with which to address these issues in existing biological models.

Energetic models from which GCJV habitat objectives are calculated currently assume that geese and ducks compete for food resources in agricultural areas. This assumption is based on knowledge that ducks and geese both use flooded agricultural fields and have at least one common food source in waste rice (Dillon 1957, Hobaugh 1985). However, agricultural fields also contain seeds of annual grasses and sedges that are preferred by ducks (Davis et. al. 1960, Harmon et. al. 1960) but whose consumption by geese is less certain. There is potential for ducks and geese to differentially exploit food resources within agricultural-based habitats, thereby minimizing niche overlap and competition for food resources.

Large numbers and body sizes of geese translate into substantial energetic demands that significantly influence habitat objectives of the GCJV. Additionally, assumptions about the extent to which geese compete for and deplete food resources consumed by ducks have important implications to habitat objectives needed to support duck populations. It is currently assumed that geese forage in wet and dry fields in proportion to their availability, and that geese foraging in dry fields do not discriminate between different types of seeds. Thus, dry-field foraging by geese would reduce the value of those fields for ducks when subsequently flooded. Current models also assume identical foraging thresholds for ducks and geese; whether foraging thresholds differ between ducks and geese, and in which direction they differ, remains untested despite its importance for reliable estimates of energetic carrying capacity of waterfowl habitats.

Hobaugh (1984, 1985) documented for wintering geese dietary transitions from waste rice in the fall to sprouting green vegetation in late winter. This transition may be due to changing physiological needs, depletion of waste rice that coincides with the availability of green vegetation (Hobaugh 1984), or both. A better understanding of the timing and explanation for this transition, including the thresholds at which geese cease foraging on seeds, is needed. For instance, if geese and ducks compete for seeds only until January, then a seasonal component to competition should be included in bioenergetic models. Similarly, if the seed density threshold above which geese forage on seeds is higher than that for ducks, then ducks and geese should not compete for seeds at levels below the threshold for geese. Such an adjustment would also need to be incorporated into GCJV bioenergetic models.

In addition to direct competition for food resources, additional factors may potentially render habitats less valuable for ducks if geese negatively affect ducks through agonistic interactions. The degree to which these interactions affect habitat use need to be examined as well as how geese may alternatively improve food resources for ducks by opening dense stands of vegetation through grubbing. Scientific investigations describing community ecology of wintering waterfowl in agricultural habitats on the Gulf Coast are needed to evaluate and potentially refine the biological reliability of GCJV bioenergetics models.

Research Considerations

Investigation(s) of this issue would likely involve behavioral observations, waterfowl food sampling, habitat measurements, and bird collections for esophageal analyses from sites where ducks and geese coexist, as well as sites where each occurs exclusively. Site-specific (e.g., vegetation density, wetland/field size, water depth, food abundance) and landscape characteristics (e.g., degree of isolation, surrounding land-use) of foraging habitats should be measured to identify potential features associated with differential habitat use between ducks and geese. A preliminary approach may include quantifying abundance and distribution of waterfowl on agricultural fields to identify potential resource partitioning between them and determine if the abundance of ducks is inversely related to the abundance of geese. Studies should also include a temporal component to capture changes in foraging ecology and interspecific interactions through the fall and winter periods.

Efforts to address these research objectives may also help address, or benefit from efforts to address, research objectives identified in Science Needs No. 3 (Waste rice and natural seeds in ricelands) and No. 4 (Habitat use of waterfowl).

Key Objectives

a. Document interspecific interactions between ducks and geese in agricultural habitats of the GCJV region
b. Quantify diurnal and nocturnal abundance, time activity budgets, and foraging behaviors of ducks and geese on agricultural habitats in relation to proximity, activity, and abundance of heterospecifics
c. Examine influence of site-specific and landscape characteristics on duck and goose use of agricultural habitats
d. Estimate and compare seed density foraging thresholds for ducks and geese in agricultural habitats of the GCJV region
e. Quantify temporal dynamics of interspecific interactions and foraging ecology of ducks and geese in agricultural habitats and investigate associated causal mechanisms

Geographic Scope of Work (GCJV Initiative Areas):

Chenier Plain and Texas Mid-Coast

Deliverables

a. Comprehensive report(s) documenting methods, analyses, results, conclusions, and relevant recommendations
b. Tables, graphs, and/or statistical test results that depict use versus availability (and temporal variation) of food items for various duck and goose species foraging at same

sites, for habitat types of the GCJV where ducks and geese coexist, and where each occurs exclusively

c. Tables, graphs, and/or statistical test results for estimating seed density thresholds for ducks and geese
d. Tables, graphs, and/or statistical test results that depict the probability of agonistic or exclusive behaviors (and any temporal variation) among various duck and goose species coexisting in GCJV habitats

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APPENDIX

Wilson (2003) presented an initial list of priority science needs for refining waterfowl habitat conservation in the GCJV. Following its development, considerable progress was made in using contemporary research to address several of the highest priority issues. Below is a list of those issues that were addressed in their entirety and brief descriptions of the associated scientific investigations. All other science issues described by Wilson (2003) that were either only partly addressed by contemporary research or not yet addressed were retained in the updated GCJV Waterfowl Science Needs document.

1. Seasonal water on rice prairies and coastal sand plains

   Gulf Coast Joint Venture staff used Landsat TM imagery and spectral classification analyses to quantify the availability of seasonal, palustrine wetlands during the early and late planning periods in the Laguna Madre, Texas Mid-Coast, and Chenier Plain Initiative Areas during representative years of below average, average, and above average precipitation. These data enabled objective comparisons of habitat availability to habitat objectives and helped identify relative priorities for waterfowl habitat conservation during the early and late planning periods within each initiative area examined.

2. Availability of duck habitat within NWI classifications

   Gulf Coast Joint Venture staff used probability-based sampling and a series of GIS and remote sensing analyses to quantify the ratio of "marsh ponds" to vegetation within each National Wetland Inventory classification believed to represent potential waterfowl foraging habitat within Gulf Coastal marshes. These results were combined with empirical data on waterfowl foraging values of fresh marsh (Winslow 2003), reasoned assumptions about relative foraging values of estuarine marsh types, and area estimates for selected NWI classifications to calculate waterfowl foraging capacities of extant landscapes in the GCJV region. These analyses were conducted separately for each initiative area and enabled further refinement of relative conservation priorities for waterfowl habitats.

3. Mottled duck population status and trends

   An operational survey to generate visibility-corrected estimates of mottled duck breeding population size in the Western Gulf Coast was developed and implemented through collaborative efforts among the Louisiana Department of Wildlife and Fisheries, Texas Parks and Wildlife Department, US Fish and Wildlife Service Division of Migratory Bird Management, and GCJV staff (USFWS Division of Migratory Bird Management 2011). The survey has been conducted annually since 2008, but population estimates from 2008 are of limited value because of significant changes in survey methodology that occurred between 2008 and 2009. Although survey methodologies have remained relatively consistent since 2009, survey partners continue to explore additional refinements that may improve survey efficiency or increase precision of population estimates (Fleming and Otto 2010).

4. Habitat use of redheads relative to dietary freshwater

   James (2006) and Ballard et al. (2010) studied redhead nutritional ecology and use of shoalgrass resources in the Laguna Madre of Texas. These studies documented spatial patterns of redhead foraging on seagrass beds in the Laguna Madre and use of adjacent inland, freshwater ponds. Moreover, this research identified important determinants of redhead use of seagrass beds and freshwater ponds and enabled development of a spatially-explicit decision support tool for enhancing, protecting, or creating priority freshwater ponds in the Laguna Madre Initiative Area.

5. Breeding grounds affiliation of snow geese

   Rapid growth and overabundance of mid-continent Snow and Ross's goose populations and their resulting negative impacts on Arctic ecosystems led to unprecedented liberalization of snow goose hunting regulations during the late-1990s (Alisauskas et al. 2011). Wintering waterfowl survey data from the late-1970s to 2001 revealed apparent, long-term declines of white geese in coastal marshes of the Western Gulf Coast concurrent with pronounced increases of white geese in adjacent agricultural regions. Alisauskas (1998) documented differences in morphometrics between snow geese wintering in coastal marshes and those in Gulf Coast rice-prairies. Thus, concern emerged regarding whether snow geese using GCJV coastal marshes were derived from breeding populations different from those associated with increasing populations of wintering snow geese in agricultural regions. If true, population reduction efforts that fail to consider potentially different trajectories of snow goose breeding populations and their affiliations with wintering regions may have unintended consequences on local abundance of wintering snow geese.

   Jonsson (2005) conducted a neck-banding study of snow geese in southwestern Louisiana to estimate the probability of interchange between flocks occurring in coastal marshes and adjacent rice-prairies. Jonsson (2005) also measured morphometrics of snow geese wintering in coastal marshes and rice-prairies to determine if structural characteristics of snow geese were important determinants of flock-mixing in southwest Louisiana and to help elucidate whether snow geese in this region were derived from different populations. Jonsson (2005) documented frequent movements of snow geese between coastal marshes and rice-prairies and, like Alisauskas (1998), documented differences in morphometrics between snow geese collected in coastal marshes and rice-prairies. Snow geese in coastal marshes had larger overall body size, thicker bills and skulls, and large gape lengths and bill nares than those in rice-prairies. Jonsson (2005) concluded that his results were consistent with Alisauskas' (1998) Habitat Selection Hypothesis, which states snow geese sample coastal marsh and rice-prairie habitats and select habitats that best suits their bill size, and did not support the hypothesis that snow geese in southwest Louisiana were derived from distinct populations.

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