

Habitat Management for Migratory and Breeding Birds at the Cat Island Restoration Project
Grant Project #: GL-00E00712 CAP_2_2014

Quality Assurance Project Plan and Work Plan

Habitat Management for Migratory and Breeding Birds at the Cat Island Restoration Project

Prepared for:

Wisconsin DNR Office of the Great Lakes
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Grant No./Project Identifier: GL-00E00712 CAP_2_2014

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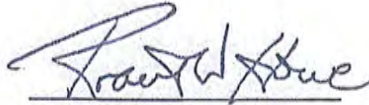
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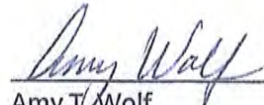
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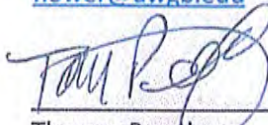
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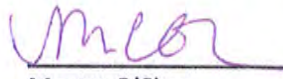
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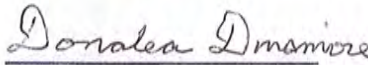
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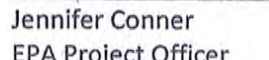
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Abstract/Summary

As a group, shorebirds (small to medium-sized, mostly wading birds in the order Charadriiformes) are threatened globally by loss of habitat, invasive species, and climate change. These ongoing threats and the already imperiled status of many species make shorebirds a critical group for research and conservation. The vast majority of shorebird studies in North America have been conducted on the ocean coasts, and most of the interior studies have focused on the Great Basin and Great Plains. Few studies of shorebirds have been conducted in the Laurentian Great Lakes, even though millions of shorebirds migrate through this region every spring and fall. Indeed, the total length of shoreline (17,549 km) of the Great Lakes rivals that of either coast. Because of its large size and extensive and dynamic shorelines, the embayment of Green Bay is a potentially critical refuge for migrating shorebirds in the interior of North America. Lower Green Bay in particular is known by birdwatchers as an important staging area for migratory shorebirds, but no study has systematically documented numbers and distributions of migratory shorebirds in this region. In 2013, preliminary surveys by Thomas Prestby (University of Wisconsin-Green Bay graduate student) identified 30 shorebird species and four tern species using lower Green Bay, a remarkable diversity that exceeded even the most optimistic predictions. All of the shorebird species were detected at observation points on the newly constructed wave barrier for the Cat Island Restoration Project, an ambitious project aimed at establishing a series of barrier islands extending nearly 3 km from the west shore of the Bay to the commercial shipping channel. This study will document species-specific preferences for substrate type and other important microhabitat attributes at the Cat Island site. We also will document species interactions, including potential impacts of Ring-billed Gulls (*Larus delawarensis*), Herring Gulls (*Larus argentatus*), American White Pelicans (*Pelecanus erythrorhynchos*), Double-crested Cormorants (*Phalacrocorax auritus*), and humans on shorebird/tern habitat and feeding behavior. This information will help inform the development of an effective conservation management plan for the Cat Island project and other undeveloped shorelines of lower Green Bay. The occurrence of such high shorebird and waterbird diversity clearly will attract birdwatchers, leading to recreational opportunities that will need to be strategically managed. Results from our work will provide critical data for building a long-term management, recovery, and monitoring plan for shorebirds in the Lower Green Bay and Fox River Area of Concern.

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Background

Project Organization

Field work at the Cat Island restoration site will be conducted primarily by University of Wisconsin-Green Bay graduate student Thomas Prestby, under the guidance of Dr. Robert Howe and Dr. Amy Wolf, who are faculty members in the Environmental Science and Policy Graduate Program at the UW-Green Bay. During the peak migration period, Prestby will occasionally be assisted by Nicholas Walton, a UW-Green Bay graduate student who has participated in numerous professional field research projects sponsored by the U.S. Forest Service, U.S. Environmental Protection Agency (EPA), and Wisconsin Department of Natural Resources (WDNR). Data analysis and data management will be overseen by the PIs in collaboration with Cofrin Center for Biodiversity Data Specialist, Erin Giese. Quality Assurance (QA), including oversight of data entry and management, will be overseen primarily by Giese and Howe (her supervisor). Howe will be responsible for submitting reports and communicating with the WDNR. Megan O'Shea, Coordinator of the Lower Green Bay and Fox River Area of Concern (AOC) will be the primary WDNR contact, while Donalea Dinsmore, Great Lakes Quality Assurance Coordinator for the WDNR, will be responsible for the QAPP approval and WDNR grant reporting and communication with U.S. EPA-Great Lakes National Program Office staff (Jennifer Conner).

Results of the project will be the basis for Prestby's Master's thesis at UW-Green Bay. Both Wolf and Howe are members of the thesis committee, in addition to WDNR colonial bird ecologist, Sumner Matteson. The PIs (Howe, Wolf, and Prestby) and Giese will continue to participate in planning discussions with the Lower Green Bay and Fox River Area of Concern (AOC) Biota and Habitat Committee, Cat Island Advisory Committee, and biologists from the WDNR and U.S. Fish and Wildlife Service. The ultimate goal of this project is to help guide informed decisions about management of the Cat Island Restoration Project.

Project Team Background

Dr. Robert Howe is the Herbert Fisk Johnson Professor of Natural Sciences and founding Director of the Cofrin Center for Biodiversity (CCB) at the UW-Green Bay. He has been a faculty member in UW-Green Bay's Department of Natural and Applied Sciences since 1984, where he has taught a wide variety of courses, including Introduction to Environmental Science, Ornithology, Mammalogy, and Environmental Data Analysis. In addition to administrative responsibilities with the CCB, he maintains an active research program involving bird population dynamics, northern forest ecosystems, and the ecology and conservation of Great Lakes coastal wetlands. Dr. Howe is author or co-author of more than 70 scientific publications, including *The Atlas of the Breeding Birds of Wisconsin* and papers in the international journals *Ecology*, *Evolution*, *Biological Conservation*, *Conservation Biology*, and *Journal of Wildlife Management*. He has published a number of recent papers on coastal wetlands and ecological indicators, an area relevant to discussions about habitat restoration at Cat Island. Howe obtained his Bachelor's degree in

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Biology at the University of Notre Dame and his Master's and PhD from the University of Wisconsin-Madison.

Dr. Amy Wolf is an Associate Professor of Biology and Environmental Science at UW-Green Bay, where she is currently chair of the Biology Department. Her current research interests include forest ecology, plant-insect interactions, bird ecology, native pollinators, and conservation biology. She is the author (with Dr. John Ascher of the American Museum of Natural History) of the *Bees of Wisconsin* and has authored or co-authored over 40 other peer-reviewed articles on conservation genetics, insect conservation, bird ecology, and forest dynamics. Her students at UW-Green Bay are working on projects ranging from forest understory wildflowers to migratory bats. At UW-Green Bay she currently teaches Conservation Biology, Principles of Ecology, and Seminar in Ecology and Evolution. She is the principal investigator (along with Howe and UW-Green Bay botanist Gary Fewless) of the Wabikon Forest Dynamics Plot Project, part of an international network of >50 research sites coordinated by the Smithsonian Institution's Center for Tropical Forest Science. Wolf received her Bachelor's and Master's degrees from the UW-Green Bay and her PhD from the University of California-Davis.

Thomas Prestby is a graduate student in the Master's Program in Environmental Science and Policy at UW-Green Bay. He received his Bachelor's degree from UW-Madison and subsequently worked as a bird research technician for the WDNR and as a migratory bird researcher at the Whitefish Point Bird Observatory in Upper Michigan. He has enjoyed bird watching as a hobby since he was a young child, and as a young professional his projects include breeding bird surveys in northern Wisconsin forests, marsh bird surveys in wetlands throughout the state, Wisconsin boreal bird surveys including trapping and telemetry with Spruce Grouse (*Falciennis canadensis*), grassland bird nest searching, and grassland bird habitat mapping. He is a member of the Wisconsin Society for Ornithology Records Committee and a Wisconsin editor for eBird, a worldwide innovative online system for cataloging bird observations. Tom is widely recognized as one of Wisconsin's most skilled field ornithologists.

Figure 1 highlights this project's roles and responsibilities and interrelationships.

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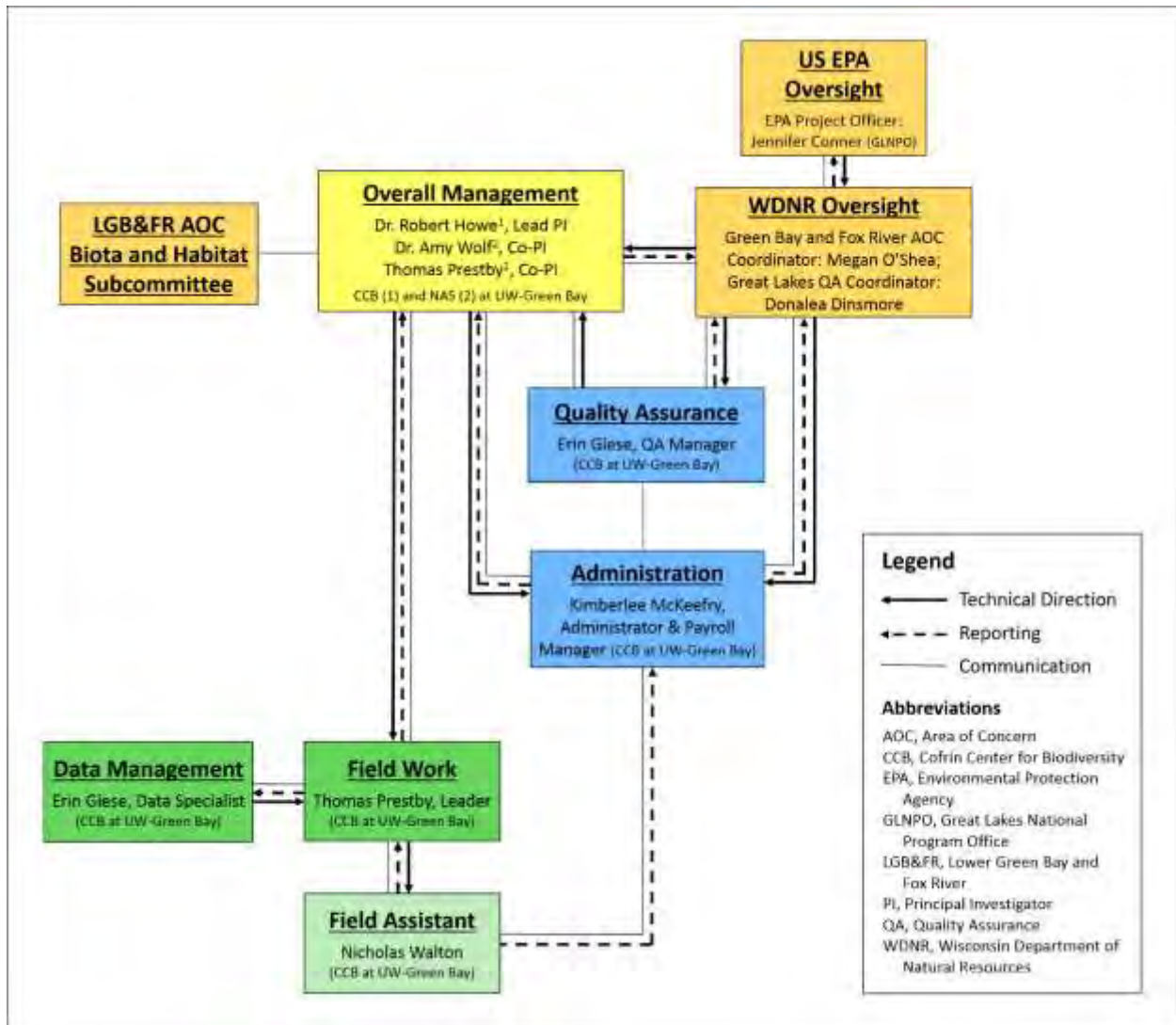


Figure 1. Organizational chart for the project showing job roles and relationships and lines of technical direction, reporting, and communication.

Roles and Responsibilities:

Dr. Robert W. Howe:

- Lead Principal Investigator
- Responsible for writing and editing reports and implementing project budget
- Primary UW-Green Bay contact with the WDNR and the Green Bay and Fox River AOC Coordinator, Megan O'Shea

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- Will partner with Dr. Amy Wolf and Thomas Prestby on development of methods and field schedule
- Will collaborate with Wolf and Prestby on data analysis and writing of manuscripts

Dr. Amy T. Wolf

- Co-Principal Investigator and faculty advisor
- Will partner with Howe and Prestby on development of methods and field schedule
- Will collaborate with Howe and Prestby on data analysis and writing and editing of manuscripts and reports

Thomas Prestby

- Co-Principal Investigator
- Will conduct field surveys and implement initial data management protocol
- Will partner with Howe and Wolf on development of methods and field schedule
- Will collaborate with Howe and Wolf on data analysis and writing and editing of manuscripts, including primary responsibility for writing Master's thesis at UW-Green Bay

Erin Giese, Biodiversity Research Specialist (Cofrin Center for Biodiversity, UW-Green Bay)

- Data Specialist and Quality Assurance Manager
- Will ensure that appropriate metadata and quality control standards are applied to project data management
- Will assist PIs with organizing and archiving data during all phases of the project
- Will oversee student assistants who will contribute to the double data entry process

Kimberlee McKeefry, Program Associate (Cofrin Center for Biodiversity, UW-Green Bay)

- Administrative and Payroll Manager
- Will oversee payroll and assist Prestby with expense reporting

Problem Statement

The multi-million dollar Cat Island Restoration Project in lower Green Bay represents one of the most ambitious habitat restoration projects in the entire Great Lakes. When finished, three artificial barrier islands will enhance 567 ha of wetland/aquatic habitat in the delta of Duck Creek,

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a major tributary draining an increasingly urbanized landscape. The Cat Island system will be formed over decades with dredge materials from the Green Bay navigation channel, re-establishing islands that were important features of the lower Green Bay ecosystem until they disappeared in the 1970s.

Field surveys during 2013 have documented a remarkable capacity for this system to attract and support migratory shorebirds, terns, gulls, herons, egrets, and even winter migrants. Guided by the 2013 Upper Mississippi Valley/Great Lakes regional shorebird conservation plan, Thomas Prestby conducted standardized shorebird and tern surveys at 10 sites in lower Green Bay, Wisconsin from April to November 2013. By far the most productive site was the Cat Island Restoration Foundation, where Prestby observed four tern species and 30 shorebird species, including the endangered Piping Plover (*Charadrius melodus*) and other species listed as “high peril” or “continental concern” such as the Red Knot (*Calidris canutus*).

Project Description

This project will consist of field surveys at the Cat Island Restoration Project and other coastal habitats within the Lower Green Bay and Fox River Area of Concern (LGB&FR AOC) during summer and fall 2014 (Figures 2 and 3). Results from these surveys will be combined with data from 2013 and spring 2014 to document the use of coastal habitats in the LGB&FR AOC by migratory shorebirds and to provide long-term recommendations for habitat management at the Cat Island Restoration Project. Specifically, we will address the following questions:

- 1) Which migratory shorebird species use the Cat Island Restoration Project, how abundant are different species, and how do these abundances vary during spring and fall migration periods?
- 2) What specific habitat features (water depth, substrate type, and shoreline topography) are most important for migratory and breeding shorebirds and colonial waterbirds, such as terns, in lower Green Bay?
- 3) How do waterbird species (including gulls, cormorants, and pelicans) interact at the Cat Island facility and nearby shoals and islands?
- 4) How does the presence of humans affect bird activities at the Cat Island facility?

Information from the proposed monitoring project will help document the Cat Island Restoration Project’s contribution to the delisting of several beneficial use impairments (BUIs) in the LGB&FR AOC, including: 1) degradation of fish and wildlife populations and 2) loss of fish and wildlife habitat. The 2012 Remedial Action Plan Update for the LGB&FR AOC lists the Cat Island Restoration Project as a “key project” for addressing the loss of fish and wildlife habitat BUI. The proposed monitoring effort will help assess the success of this ambitious restoration initiative.

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Shorebirds will be sampled using unlimited-distance counts from georeferenced shoreline locations where significant areas of potential habitat are visible. Counts at four specific points on the Cat Island causeway will be conducted three times per week. Locations of target species will be mapped in order to document critical areas of bird use and potential effects of human disturbance. Surveys will start when ice and snow melt exposes potential shorebird habitat (sand, rock, or mud), usually near 20 April and will continue through 10 June for spring migration. Fall migration counts will begin in early July and will end in mid-November. These dates correspond with typical shorebird arrival and departure dates in central Wisconsin (Robbins 1991, eBird 2012). Even if no target birds are present at a site, observers will remain at each point count for a minimum of 20 minutes.

All shorebirds, terns, and nesting waterbirds observed from the survey points will be recorded, along with distance and direction from the observer. Any arrival or departure by individuals or groups will be noted to the minute. Flyovers will be recorded though they will not be included in all analyses unless they had been clearly disturbed from feeding or resting areas by the observer. Terns flying but actively feeding are an exception and will be counted and included in analyses. A high quality spotting scope (30x power or greater) will be used in all cases to help identify species.

Habitat and microhabitat variables will be evaluated during each survey. Bird locations will be classified as rock,, sand, dry mud, wet mud, mud-water film (1-2 cm), shallow water (2-8 cm), deep water (> 8 cm), shells, and algae (Skagen and Knopf 1994). Water depth will be estimated by evaluating how much of the bird's legs are under water compared to average leg length for that species. Panoramic habitat photographs will be taken during each site visit to monitor changes in water level, exposed substrate, and vegetation. Relevant cover types will be digitized into a GIS layer for subsequent analysis.

Data will be analyzed with a mixed effects generalized linear model using both categorical and continuous predictor variables, with sampling location as a random effect. The goal of this analysis will be to identify site attributes that are important for feeding, nesting, and resting by migratory shorebirds in Green Bay and to describe temporal variation in the abundance of migrants. Landscape habitat variables will be evaluated using GIS and will be incorporated into statistical models. The data analysis will help guide the management plan for the Cat Island Restoration Project by identifying important habitat features and describing species interactions that affect use of these habitats. Comparisons of data in 2013 and 2014 will illustrate how birds use the structure in comparison to construction activities, which decreased dramatically in 2014. We will collaborate with the Cat Island Advisory Committee and local agencies, such as the WDNR and USFWS, to develop cost-effective strategies for monitoring, managing, and enhancing conditions for nesting and migratory waterbirds, including shorebirds.

Quality Control

Data Quality Objectives

The primary data quality objectives (DQO) for this study will be to provide accurate information about the diversity of birds using the Cat Island Restoration Project site and to quantify details about the spatial and temporal distribution of priority species, including migratory shorebirds, terns, and colonial waterbirds. We also hope to gain insights about species interactions that will be relevant to informed long-term management of the restoration site. Correct identification of rare species will be critical for documenting current conservation issues and future ecological restoration opportunities.

The study design calls for frequent visits to spatially explicit sampling stations, providing a repeatable body of field data and enabling us to construct statistical models to evaluate the importance of environmental variables like substrate type, time of year, and geographic location. Prestby has used the sampling protocol for more than one year and is familiar with its requirements and recording details. We strive for high sampling validity and observer safety, therefore surveys will not be conducted in high winds and rain, especially lightning. If questions pertaining to weather or episodes of high water arise, Prestby will consult with the other PIs to make appropriate decisions about whether or not to sample birds.

The co-PIs will be responsible for the quality assurance/quality control (QA/QC) aspects of the study, with training, oversight, and assistance from the Cofrin Center for Biodiversity's Data Specialist, Erin Giese. Co-PIs will conduct periodic QA checks on the data acquisition and recording process. Howe has overseen QA/QC personnel and has been involved with numerous QA/QC discussions for bird-amphibian field teams in the U.S. Environmental Protection Agency-funded Great Lakes Environmental Indicators-I (GLEI-I) project and ongoing Great Lakes Coastal Wetland Monitoring Project (coordinated by Central Michigan University).

Activities to be performed during this project include 1) site selection, 2) collection of field data and supporting habitat measurements, 3) photo-documentation of rare species, 4) data processing and data entry, 5) data QC, and 6) reporting to the WDNR AOC Coordinator and WDNR Office of the Great Lakes (Monitoring Coordinator). The DQO for data entry is 100% accuracy of data copied from field forms into the database. Although not a part of our AOC proposal, we also will collect remote photographs using trail cameras (from a separate funding source) to help assess the behavior of shorebirds and other species in the absence of humans and to provide a basis for further quantifying species interactions, especially the effects of abundant species like gulls and cormorants on foraging or resting activities of shorebirds and terns.

Results from this project will be organized into a permanent database with metadata describing methods, units of measurement, description of field equipment like GPS receivers and weather gauges, and a key to abbreviations used in the database. Data will be organized in Microsoft Excel

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or Access and available at request. Data analysis will include a predictive model that helps identify habitat and locality features associated with occurrences of different bird species. DQOs focus primarily on proper collection, handling, and QC of data, although clear documentation of the analytical methods will be a secondary objective.

The scope of this project is mainly on the Cat Island Restoration Project along the west shore of lower Green Bay. We also will incorporate information from other sites in the lower Bay in order to provide a meaningful context for assessing the significance of observations at the Cat Island Restoration Project site.

Table 1. Summary of project tasks and a timeline of major activities.

Tasks	2014						2015				
	July	Aug	Sep	Oct	Nov	Dec-Mar	Apr	May	Jun	Jul	Aug.-Oct.
Funding received	X										
PI meeting	X				X						
Sampling design	X										
Field surveys	X	X	X	X	X		X	X	X		
Data entry					X	X				X	X
Mid-season QA/QC evaluations			X					X			
Data quality control						X				X	X
Interim reports						X		X			X
Final report										X	X

Special Training Requirements

Prestby, Walton, and other field observers will be trained and certified before sampling begins. Giese will oversee record-keeping, archiving, and data auditing procedures based on Cofrin Center for Biodiversity (CCB) data management policies. All observers will be certified as a Level 3 observer with the [Birder Certification Online](#) website, which requires a high proficiency in both visual and auditory identification.

Criteria for certification:

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- Survey plot locations (demonstrate proficiency)
- Basic navigational skills
 - How to use a compass (e.g., navigation, bearing)
 - How to use a standard, hand held GPS unit (details below)
 - How to read and navigate with a map (e.g., topographic map, atlas, satellite imagery)
- Understanding processes of transferring data to CCB Data Management Center
- Handling of non-911 emergency situations with a pre-established phone contact list
- Visual identification (95% of tested bird images, including difficult views, immature plumages). This test will concentrate on species likely to be seen rather than heard.
- Proper completion of field data sheets (demonstrate proficiency)

Site Selection and GPS Use: All sampling locations will be georeferenced with hand held GPS receivers (Garmin GPS Map 62s). In addition to standard sampling localities (Figure 2), other observations will be documented explicitly or marked on a map of the study area with reference to established landmarks. Field observers will have received training in proper GPS procedures, including equipment use and data entry. Because the habitat of the area is always changing, sampling locations may be added if new shorebird habitat emerges or dropped if shorebird habitat is consistently no longer available.

Record Keeping, Data Custody, and Data Entry: Erin Giese will conduct training on record keeping, sample chain of custody, data custody, and entry of data into the data management system. This portion of the training will also include data error checking protocols. Metadata training and more complete data QC training have been completed by Giese on other U.S. EPA-funded projects and will be shared with Prestby and others involved with data management for this project.

Documentation and Records

We will create a specialized database (in Microsoft Excel and Microsoft Access 2013) dedicated to this project that will be stored on a UW-Green Bay computer network and backed up additionally on an external hard drive. The database will be available to the WDNR and U.S. Fish and Wildlife Service (USFWS). A review of sampling and data collection QC will take place at the start of the project and at the time of data entry. Like the U.S. EPA-funded Great Lakes Coastal Wetland Monitoring Project, data will be entered by two different people. Experience and

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research have shown that double entering data is one of the most accurate methods for data entry, when compared to single entered data approaches (Scott et al. 2008) and other methods (Paulsen et al. 2012). Giese has developed her own system for comparing double entered data using Microsoft Excel. She and others have successfully used this system for many datasets and will teach Prestby how to use this same system for this project. After comparing the double entered data, Prestby will run a series of data checks (e.g., check for empty cells; check for abnormal observations). QC records and reports will be maintained with the appropriate datasets, archived, and provided to the QC manager (Giese) and PIs (Howe, Wolf, and Prestby). Data will be input into the database as quickly as possible after the field season ends. The database will be accompanied by metadata for each data type, including study design, site selection, and reason for rejection of sites that cannot be sampled. We anticipate that this database and accompanying metadata will require less than 100 GB of electronic storage space.

The quarterly report to the Lower Green Bay and Fox River AOC Coordinator will describe all activities of the previous three months, including QC reports and audit results, and brief data summaries. Data will be provided in the form of a Microsoft Access database, Microsoft Excel worksheets, or separate .csv tables as requested. WDNR and USFWS biologists will have access to all data, including raw data.

Records from field observations also will be archived as hardcopies and electronic scans at the Cofrin Center for Biodiversity (CCB) Data Management Center in Mary Ann Cofrin Hall at the UW-Green Bay. Data also will be stored as electronic spreadsheets following the data entry procedure. Copies of formal reports and supporting materials (including QC audit reports) will be archived at the CCB and identified with technical document coding for future retrieval. Sample sheets completed on-site during field sampling and all field sheets, logs, chain of custody documents, and sample materials will be retained by the CCB for a minimum of three years, or made available after that time period.

Deliverables list:

- Quarterly reports to the AOC Coordinator (including QC reports and QC audit reports)
- Bird observation database stored and backed up on UW-Green Bay computer network and provided in appropriate form (Microsoft Access, Microsoft Excel, or .csv) to Wisconsin DNR
- GIS files and maps of site locations and sampling points
- Final report to AOC Coordinator, including data summary, interpretations, and recommendations for long-term bird conservation strategies
- Final QA/QC report including all difficulties encountered and their solutions

DATA ACQUISITION

Site Selection and Project Design

Our broader study of shorebirds in lower Green Bay involves the Brown and Kewaunee County portion of the lower Green Bay. During 2013 and spring 2014, we used aerial photographs from 2010 or later and field groundtruthing to identify potential shoreline habitats in this region (Figure 2). We subsequently selected 18 points (nine on the east shore and nine on the west shore) at ten sites (five on the east shore and five on the west shore) based on public access or granted permission and historical records and availability of potential shorebird habitat (Table 2). Sites represent several habitat types including coastal estuaries (near river mouths), sheltered bays, and high energy shorelines with rock or sand beach. Counts were conducted at permanent georeferenced points where views of the shoreline are maximal and access is obtainable.



Figure 2. Shorebird sampling points (n = 18; Table 2) along lower Green Bay coastline. Birds were sampled twice per week in 2013 and spring 2014.

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Table 2. Points surveyed beginning April 2013. Points are surveyed twice per week except CAT01, CAT02, CAT03, CAT04 which were increased to three times per week beginning July 2013.

Point Name	Shore	Latitude	Longitude
DYC01	East	44.64301	-87.76382
NIC01	East	44.59909	-87.88048
NIC02	East	44.53695	-87.92767
PCOM01	East	44.62012	-87.85531
RRIV01	East	44.66801	-87.74770
SAB01	East	44.58333	-87.90150
SAB02	East	44.58118	-87.90827
SAB03	East	44.57699	-87.91301
SAB04	East	44.57698	-87.90275
CAT01	West	44.57695	-88.01782
CAT02	West	44.56586	-88.00539
CAT03	West	44.56357	-87.99987
CAT04	West	44.55888	-87.99626
LIT01	West	44.66952	-87.99871
LOT01	West	44.61989	-88.01243
SENS01	West	44.64038	-88.00980
SENS02	West	44.63526	-88.00939
SENS03	West	44.63074	-88.00951

The four southwestern-most survey points are located on the Cat Island Restoration Project (Figures 2 and 3). This was an active construction site in 2013, therefore access was sometimes limited and birds were occasionally disturbed by construction crews and vehicles. These four points are placed where shorebird foraging habitat is exposed at least occasionally (Figure 3).

Although the focus of this investigation is the Cat Island Restoration Project, separately funded previous surveys at the other points (Table 2) will provide a context for assessing the importance of the Cat Island complex for migratory shorebirds, terns, and other waterbirds. Trail cameras were placed at two of the points in summer of 2014 in another separately funded project to provide more data on habitat usage, reactions to disturbance including people, and interactions between species.

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Figure 3. Cat Island wave barrier bird sampling points, which will be surveyed three times per week until 15 November 2014 and April-June 2015.

Sampling Methods

Shorebirds will be sampled using a series of unlimited-distance counts from a georeferenced shoreline location where a significant area of potential habitat is visible. We have already conducted counts at each location approximately twice per week during spring and fall migration periods in 2013 and during spring and early summer 2014. Spring surveys began 21 April 2013, when ice and snow melt exposed potential shorebird habitat (exposed sand, rock, or mud); regular sampling persisted through 7 June 2013. Fall migration counts in 2013 began 8 July and ended 18 October. During spring 2014, approximately the same schedule has been followed (with funding from other sources) and will continue to be followed during the fall.

Early in the fall 2013 field season, it became apparent that the Cat Island site in the southwest corner of the Bay was much more productive for shorebirds than the other sites. Therefore, we increased surveys of those points to three times per week and extended the survey period of that site until 15 November. Also, water levels increased on the Bay in summer 2013, taking away exposed substrate that was seen during ground-truthing in early May at several sites. These sites were surveyed only once per week. In 2014 and spring 2015, we will continue to survey the Cat Island site three times per week and if any new shorebird habitat becomes available, we will set up a sampling point at the best vantage point and survey three times per week.

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Site visits are scheduled randomly within each week to reduce biases associated with surveying in a predictable order (Andrei et al. 2008). Because of active construction at Cat Island, timing of surveys was not always random during 2013. Because there will be less construction in 2014 and 2015, we will once again be able to randomize the timing of site visits and the order in which points are surveyed. Even if no target birds are originally seen at a site, observers will remain at each point count for a minimum of 20 minutes.

All shorebirds and terns (Figure 4) observed from a survey point will be recorded, along with distance and direction from the observer. Birds are usually in relatively small groups in open areas and relatively close to the observer, making counting or estimating numbers for all individuals reasonable. Any arrival or departure by individuals or groups will be noted to the minute. Flybys (i.e., flying birds that are not actively hunting or using habitat in the vicinity of the sampling point) will be recorded; however, these birds will not be included in the analysis unless they were clearly disturbed from feeding or resting areas by the observer. Terns flying but actively feeding are an exception and will be counted and included in the analyses. A high quality spotting scope (30x power or greater) will be used in all cases to help identify species. Digital photographs will be taken whenever possible of rare or endangered species, such as Piping Plover, and species that are outside their normal geographic and phenologic range. These photographs will be stored digitally with the rest of the raw and final data.

Almost all surveys have been and will continue to be conducted by the same observer (Prestby) to reduce observer bias. The rest will be conducted by Nicholas Walton, who is an expert in shorebird identification and will be trained on the survey protocol in the field by Prestby.

Temperature, barometric pressure, wind speed, and wind direction will be recorded at each point using a Kestrel 3500 Pocket Weather Meter. Sky conditions will be measured using estimation of percent cloud cover. Surveys will not be conducted in extreme wind or heavy rain because these conditions likely affect bird distribution and behavior. No surveys will be conducted in imminent lightning for safety purposes.

Habitat and microhabitat will be described during each survey. However, since seiche conditions and fluctuating water levels are common in Green Bay, microhabitat of each bird or flock is noted specifically. Substrate categories are rock, sand, dry mud, wet mud, mud-water film (1-2 cm), shallow water (2-8 cm) and deep water (> 8 cm), shells, and algae (Skagen and Knopf 1994). In cases where birds are standing in water, depth will be estimated by evaluating how much of the bird's legs are under water compared to average leg length for that species, which is listed on the back of the field data sheet (Figure 4). Observers will estimate percent water cover, sand cover, rock cover, mud cover, and vegetation cover at the site as in Danufsky and Colwell (2003). Panoramic photographs will be taken of habitat at each visit of each site to monitor changes in exposed substrate and vegetation. Photographs will be stored and organized as part of the final database. Files will be named by date and point name to benefit organization and storage. A

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digital rangefinder will be used when necessary to refine the boundaries of important habitats like exposed mud or shallow aquatic vegetation zones.

Sample Handling and Custody

Data will be recorded on standardized paper field forms (Figure 4). As soon as possible after a field survey, the completed forms will be audited by Prestby where he will search for abnormal observations, illegible hand writing, and unclear or missing information. Should any of these issues occur, he will flag the observation so it is marked in the database and analyzed accordingly. If information is missing from the data sheet but can be estimated through another source (e.g., missing weather can be estimated using archived NOAA weather data), he will fill in the information as accurately and clearly as he can; otherwise, information will be recorded permanently as missing. Auditing data sheets on a regular basis furthermore allows Prestby to ensure that data are being collected as outlined in the protocols and sampling design and to address issues early in the project. Once a data sheet has been audited, Prestby will create back-up copies of the data by scanning the data sheets and making photocopies. Original data sheets will be stored with Prestby (until data are entered), and the photocopies and scans will be stored with Giese at the Data Management Center for backup storage.

Giese will oversee double entry of data following procedures used for other field projects at the Cofrin Center for Biodiversity (CCB). Prestby will review data discrepancies (issues not resulting from simple typographical errors) and revise digital records as needed. Once data entry has been completed, original data forms will be permanently archived, with metadata, at the Data Management Center.

Analytical Methods Requirements

Data files will be created in Microsoft Excel and subsequently converted into comma-separated values (.csv) files for statistical analysis in R version 3.1.0 (R Development Core Team 2014) and storage as a relational database in Microsoft Access. Database system requirements at the UW-Green Bay are typically Intel or AMD multi-core processors running at 2.4+ GHz with 0.5+ TB of local storage. Internal networking is mixed 100 and 1000 Mbit Ethernet, with dual T1 line Internet connectivity. Because of the backups provided with this system, failure of any component will not result in loss of data. The redundancies built into the system should allow the system to be brought back on-line by Cofrin Center for Biodiversity or UW-Green Bay staff with a minimum of delay.

Quality Control Requirements

Automated data analysis procedures from double-entry digital files will be implemented to check for data entry errors. Based on previous experience with other field projects, we expect to find and eliminate all entry errors as a result of this process. Rare species or questionable records will be documented with supporting information, a process familiar to Prestby, who serves on the Records Committee of the Wisconsin Society for Ornithology and who is an editor for the web-based [eBird](#) program of the Cornell Laboratory of Ornithology. All sampling points will be georeferenced using recreational GPS, which is sufficient for this project.

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Green Bay Shorebird & Waterbird Survey- Fall 2014 Details for shorebirds/terns in this survey. Total for gulls, waterfowl, cormorants, pelicans using shorebird labels

Point		Chart Habitat Codes	12= Dry Algae	Distance (m)	General Hab.	% Cover
Time Start		0= Vegetation	13= Log/stick	0= Flyover	Vegetation	
Time End		1= Rock	14= Buoy	1= 0-50	Water	
Surveyor		2= Sand	5ky	2= 50-100	Rock	
Date		3= Dry mud	0= <10% clouds	3= 100-150	Sand	
Sky		4= Wet mud	1= 10-50%	4= 150-200	Mud	
Temp		5= Mud/water Film	2= 50- 90%	5= 200-300	Shells	
Wind mph		6= 2-8cm water	3= Overcast	6= 300-400	Algae	
Wind dir		7= 8+cm water	4= Fog	7= 400+	Other (note)	
Bar Press.		8= Shells	5= Mist	Habitat Comments		
Front 24hr?		9= Wet Algae	6= Light rain			
# Hab pics		10= Flyover	7= Rain			
See Comments		11= Water/Algae Film	8= Haze			

Species	#	Voc?	Age	Distance	Direction	Time Detected	Time Depart	Habitat	Camera Area?	Comments

Cat Island: Species (& total) on road/armor stone within 300m:
Shorebirds/Terns (or others) seen not at point counts:

Figure 4. Field form for shorebird sampling at the Cat Island Restoration site (main page).

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Code	Species	Species	Tarsus (cm)
AWPE	American White Pelican	LESA	1.9
DCCO	Double-crested Cormorant	SESA	2.1
BBPL	Black-bellied Plover	BASA	2.2
AGPL	American Golden-Plover	SEPL	2.4
PIPL	Piping Plover	SPSA	2.4
SEPL	Semipalmated Plover	WRSA	2.4
KILL	Killdeer	RUTU	2.6
AMAV	American Avocet	SAND	2.6
GRYE	Greater Yellowlegs	DUNL	2.6
LEYE	Lesser Yellowlegs	PESA	2.9
Yell		SOSA	3.1
Sp.	Yellowlegs species	WISN	3.1
SOSA	Solitary Sandpiper	REKN	3.2
WILL	Willet	WIPH	3.3
SPSA	Spotted Sandpiper	KILL	3.6
UPSA	Upland Sandpiper	SBDO	3.7
WHIM	Whimbrel	LBDO	3.8
HUGO	Hudsonian Godwit	STSA	4.2
MAGO	Marbled Godwit	AGPL	4.3
RUTU	Ruddy Turnstone	BBPL	4.4
REKN	Red Knot	LEYE	5.1
SAND	Sanderling	WHIM	5.8
DUNL	Dunlin	WILL	6
PESA	Pectoral Sandpiper	GRYE	6.3
WRSA	White-rumped Sandpiper	HUGO	6.5
BASA	Baird's Sandpiper	MAGO	7.8
SESA	Semipalmated Sandpiper	BCNH	7.8
LESA	Least Sandpiper	SNEG	9.3
Peep		AMAV	10
Sp.	Peep Species	BNST	11.3
STSA	Stilt Sandpiper	GREG	15.2
LBDO	Long-billed Dowitcher	GBHE	18.3
SBDO	Short-billed Dowitcher		
Dow			
Sp.	Dowitcher Species		
BBSA	Buff-breasted Sandpiper		
WISN	Wilson's Snipe		
WIPH	Wilson's Phalarope		
RNPH	Red-necked Phalarope		
Sho			
Sp.	Shorebird Species		
BOGU	Bonaparte's Gull		
RBGU	Ring-billed Gull		
HERG	Herring Gull		
CATE	Caspian Tern		
COTE	Common Tern		
FOTE	Forster's Tern		
BLTE	Black Tern		

Figure 4 (continued). Field form for shorebird sampling at the Cat Island Restoration Project site.

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QA/QC specifics: Because this investigation will record information from thousands of individual birds, unavoidable sources of variation in numbers and possibly identification of distant birds will be inherent in the sampling plan; however, our sampling methodology attempts to minimize this variation (e.g., sampling during optimal time-of-day and weather conditions). An objective online testing of observers is being deployed to document the identification skills of field observers (<http://www.birdercertification.org>). Field researchers will be required to demonstrate their knowledge of the survey protocols prior to field activities. The project team includes biologists who have been instrumental in developing bird and amphibian monitoring protocols and who have many years of experience in training field workers. Professional quality field equipment (high quality binoculars, telescope, digital cameras, and accurate GPS receivers) will be used by field observers throughout the investigation. These tools will help ensure the highest quality species identifications and locality data, the major targets of data quality control. Documentation of weather conditions and timing of counting periods will provide a context for assessing the integrity of our results.

The PIs will coordinate data validation among the different components of the study. Quality control of point data will include inspection of results in the context of site history, extent of available habitat (as determined from satellite images or other sources), and information about surveys (e.g., survey time, weather conditions, unusual abundance values). Records with the following attributes will demand explicit documentation or follow-up field investigation: 1) rare species recorded during only one year and not during subsequent years, 2) rare species observed by a field worker but not known to occur in specific sites by the PIs, and 3) rare breeding species recorded in areas where little or no appropriate breeding habitat is present. A list of rare species that require further documentation is available from existing bird reporting networks (e.g., Wisconsin Society for Ornithology and eBird).

Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Data collection for this project will not employ sensitive equipment that requires testing or calibration. However, GPS receivers and weather recorders will be checked before the field season to ensure that they are providing accurate readings. A system of testing with independently established reference points at the UW-Green Bay campus data will be used to test for GPS accuracy. Kestrel weather devices will be tested against current conditions provided by the NOAA [Weather Service](#).

Instrument Calibration and Frequency

N/A

Inspection/Acceptance Requirements for Supplies and Consumables

N/A

Data Acquisition Requirements (non-direct measurements)

Although the core data for this project will be original, some external data may be used to provide context for field observations. This information will come from peer-reviewed publications and GIS or digital sources with established metadata lineages, which will be maintained. In cases in which unpublished data are used, appropriate metadata will be generated to describe its origin. For example, some data from eBird (2012) and Robbins (1991) will likely be used to compare our field data with past shorebird and waterbird trends and possibly to results from other locations. Any eBird data that are analyzed will be provided in Microsoft Excel comma-separated values (.csv). Green Bay water level data from NOAA (<http://tidesandcurrents.noaa.gov/waterlevels.html?id=9087079>) will be used as another source of water level and habitat data.

Mid-Year QA/QC Checks:

PIs will evaluate accuracy and correctness of sampling at the Cat Island site by reviewing data forms and discussing unusual or extraordinary field records.

Performance criteria will include:

- Correct location of sampling points (100%)
- Accuracy of species-level identifications (98%; 100% for rare species – with follow-up if needed)
- Accuracy of abundance category estimates (90%)
- Correct criteria and techniques for the identification of rare species (100%)
- Correct use of field survey forms (100%)

Failure to meet performance criteria will trigger corrective action (see Table 3).

Data Management

In the field, data will be recorded on standardized forms (Figure 4) and stored in a water-proof clipboard during field sampling. The field forms contain basic information about each sampling station, including a standard site name, date, start and end time, weather and air temperature, all names of observers, and a signature of the people entering the data. Permanent sampling stations will be marked geographic landmarks, described in detail at the beginning of the sampling period. This description will include geospatial coordinates and waypoint name. Habitat photographs will be stored digitally with date identifier. Photographs of rare species will also be

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stored digitally. All completed data sheets will be kept in a secure location by Prestby and photocopied at the earliest opportunity. Photocopies will be archived in a separate location from the original data sheets.

Data entry and organization will be led by Giese using metadata protocols and data storage procedures developed for similar projects at the Cofrin Center for Biodiversity. The system will be improved based on more than 30 years' experience of data management by the PIs and collaborators from many other institutions, including large-scale projects like the EPA-funded Great Lakes Environmental Indicators-I project (GLEI-I) and the Great Lakes Coastal Wetland Monitoring Program. Because the digital data entry system is similar to field data sheets, support staff can enter data quickly and efficiently, reducing data entry errors.

Data will be entered into a pre-prepared Microsoft Excel spreadsheet that employs Microsoft Excel's "Data Validation" data tool, which will be used to force data enterers to use specific values, codes, dates, times, etc. from an expected list of data for each field. This process also will offer drop-down menus of expected values/text. For example, if field work was only conducted between 1 Apr 2015 and 10 June 2015 and the data enterer tried to enter 11 June 2015, Microsoft Excel would alert the user with an error message and prevent him or her from entering that particular date (11 June 2015). These data validation rules not only significantly minimize data entry errors, but they also draw attention to other potential issues missed during the auditing stage of the project's data management system. The data management system will include metadata that accompanies the final data products (e.g., methods, study design, field data error codes, description of indicator calculations, etc.), which will help ensure the system's usefulness to future researchers, managers, and the public.

ASSESSMENT AND OVERSIGHT

Response/Corrective Actions

Real-Time Remediation of Problems:

A policy of immediately reporting field problems or mistakes in sampling protocols, etc. will be implemented. Corrective actions will include replacing lost data if possible and omitting any suspect data that cannot be replaced by taking additional samples. Regular (at least weekly) communication among the PIs during the field season has been in place throughout earlier stages of this investigation and will continue through the duration of the current project. These regular meetings will be used to discuss and deal with problems that arise in sampling, data processing, data entry, or quality assurance/quality control (QA/QC). Prestby will also regularly audit incoming data sheets, which will allow him to ensure that data are being collected as outlined in the protocols and sampling design and to address issues early in the project. An environment of frequent communication greatly reduces the need for corrective actions later. Cell phone

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availability by the project team also helps provide a second layer of safety for field sampling by Prestby and assistants.

Failure to meet QA/QC objectives will trigger corrective actions. In most cases, monthly QA/QC checks are conducted by PI oversight. Table 3 lists corrective actions to be taken when QA/QC performance criteria are not met.

Table 3. Quality assurance/quality control performance standards and corrective actions when performance standards are not met during mid-year evaluations.

Protocol	Performance Standard	Corrective Actions
Site Selection	100% of sites are georeferenced and sampled at prescribed locations.	Analysis of maps and current conditions will result in re-establishment of sampling locations or, if conditions warrant (e.g., high water levels preventing access or eliminating bird habitat), PIs will jointly establish new sampling localities, which will be rigorously documented for later analysis.
Field Surveys	95% of sampling locations are located correctly.	Data sheets are flagged so GPS sample locations can be checked.
	98% of individuals are accurately identified.	Data sheets are corrected, if possible, or flagged. Rare species documentation provided if needed.
	100% of rare species records are documented according to professional standards.	Data sheets are corrected, if possible, or flagged.
	100% of field survey forms are completed correctly.	Additional review of methods conducted in consultation with PIs.

Any corrective actions will be noted and included in our quarterly reports to the AOC Coordinator.

Reports to Management

Regular (approximately bi-weekly) meetings or email updates among PIs and Data Specialist Erin Giese will cover the following general topics: overall project status, field work status, data entry status, recent problems and solutions, quality assurance/quality control (QA/QC) report and

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analysis, and other topics as needed. These communications will keep co-PIs working in close collaboration and help ensure that problems are solved as they become known. Email correspondence and notes from PI meetings will be retained in order to document project activities.

PIs Howe and Wolf will be primarily responsible for scheduling meetings and email communications and for ensuring that reports are provided on time. Reports will include a project status update, a discussion of QC problems and their solutions and corrective actions, results of QC checks, and a brief summary of results to date. Serious issues that have a major impact on the project will be reported to the AOC Coordinator immediately.

QC audits will take place at the end of each field season for field data collection activities. The field season audit will cover completeness of sampling activities at each site for all project elements. Sites with incomplete data will be flagged and reported to the PIs. Other elements of the field season audit include sampling gear status, data flags on data sheets and how these are being investigated, and summaries of data files produced by the data entry/management process.

QC audits on data entry and data management will occur during late 2014 and early 2015 after most data have been entered into the database system. Data audits will assess completeness of checks for data entry errors; investigations into data 'flags' in the database, how these are being resolved, and identification and resolution of outlying data records. All sample points will be georeferenced based on GPS readings with double checks on location validity by Prestby. The project PIs will also audit the documentation of rare species records and the method of verification.

A final report from this work will be written in a similar fashion as the quarterly reports (see Scope of Work) and will be submitted to the AOC Coordinator in Microsoft Word format at the end of the project in 2015. This report will include all scientific manuscripts published or in preparation, the Master's thesis of Prestby, and listings of archived photographs and databases generated during the course of the project. Peer-reviewed scientific publications are a goal of this project and will follow the standard format of published scientific articles: 1) introduction, 2) description of methods and study area, 3) presentation of results, 4) discussion of the relevance of findings, and 5) a bibliography of pertinent literature. A detailed account of field results, additional descriptions of statistical methods, and results of QC audits will be provided as appendices.

DATA VALIDATION AND USABILITY

Data Review, Validation, and Verification Requirements

Quantitative data: After data are entered into the data management system, the data will be checked for out-of-range values. In other words, the data will be checked for values that are unlikely to occur and thus may be the result of some sort of error (e.g., incorrect species code, typographical error in date, etc.). Additionally, the highest values in all datasets will be double-checked for data entry errors. Checks will consist of reviewing original field data sheets for data entry errors or notes that may provide evidence of a cause for a suspicious value. Checks will also confirm that appropriate methods were being implemented in the field. Unlikely values that remain (e.g., records of rare species that lack supporting evidence) will be deleted from the database used for analyses. These records will be retained for later reference but will be flagged and annotated. These data flags will allow future observers to conduct additional investigations of records that might be valid but lack appropriate evidence for verification. During statistical analyses, outliers will be investigated to determine how much they are influencing statistical results.

Qualitative data: Review of the data will be the responsibility of the PIs, who will devote at least a portion of the post-field season meetings to this subject. Information from existing data sources as well as experience of the PIs will help identify data records that need to be validated. In many cases, the taxonomic identification errors or transient bird taxa can be detected by evaluating results from multiple surveys at the same site or from knowledge of the natural history of the taxa. Background knowledge about the taxa will play an important role in data review, although unexpected but potentially significant observations will not be dismissed without follow-up information.

Validation and Verification Methods

All field data entered into the data management system will be checked against the original field data sheets by Prestby through double-entry of data. Like other researchers (Scott et al. 2008, Paulsen et al. 2012), we have found that double-entry and subsequent diagnostic analyses are effective at catching data entry errors.

Data that are flagged as suspicious will first be checked against field data sheets by the PIs and Giese; if the data are not typos, then they will be discussed by the PIs, who will apply the appropriate cautionary code flags or remove the data from the database, depending on the data type and error.

Field data sheets will be photocopied and scanned as soon as crews return from the field. Original data sheets will be used for data entry and data verification in the data management system, and

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thus will remain in the custody of Prestby or the Data Management Center, depending who is currently entering the data. After this is complete, Giese will archive the original data sheets.

The data management system will be maintained by UW-Green Bay's Cofrin Center for Biodiversity (CCB). As soon as the data have been entered, files will be stored on the UW-Green Bay data server by CCB staff led by Giese. After quality control is complete, the revised data will be identified and archived in UW-Green Bay's faculty/staff server as well as a permanent "data farm" maintained by the CCB in collaboration with UW-Green Bay's Computer and Information Technology Department. All flags on data that have not been resolved will remain in the data management system and will be stored with the archived data files. The metadata accompanying the data will explain the various types of flags. In most cases, notes will explain the cause of flags in more detail. Data users will have to be pro-active in searching for flags, their cause, and explanation within datasets that they download for use.

Reconciliation with Data Quality Objectives

The primary data quality objective (DQO) for this study is to produce accurate and representative records of birds using the Cat Island Restoration Project site and related sites in lower Green Bay. This outcome will help fulfill our project objectives, framed in the form of questions described in the "Project Description." The first question, 1) Which migratory shorebird species use the Cat Island Restoration Project, how abundant is each species, and how does phenology partition these birds?, will be answered mainly by results from the point counts at the four fixed localities on the Cat Island wave barrier (Figure 3). Field work supported by this project will be added to results from 2013 and spring 2014 to give more than two full years of point count data from April to November, the periods when shorebirds and terns are present in lower Green Bay.

Our second question, 2) What specific habitat features (water depth, substrate type, and shoreline topography) are most important for migratory shorebirds and colonial waterbirds such as terns in lower Green Bay?, will be addressed with the same dataset. Each record of shorebird/tern occurrence is associated with a description of the substrate used by the bird when it was first observed. If the bird was flying, this was noted on the data form (Figure 4). Habitat descriptions are accompanied by locational information (distance and direction from observer), so the descriptions can be evaluated by examining the locations on recent aerial photographs. Of course, water levels and shorelines vary significantly even during the same year, so this variation will need to be taken into account when interpreting the images. Mixed effects general linear models (R package lme4 and lmerTest) will allow us to evaluate the habitat/substrate conditions that are best associated with feeding and resting by each species. We also will evaluate locations of shorebird observations in light of water level data provided by NOAA. Wherever possible, GIS analysis will be used to help identify shoreline features and large-scale habitat characteristics that are associated with bird observation points. A detailed map of the foraging sites around each sampling point will be created during 2014-15 in order to improve interpretation of the localities of birds during the point counts. This map will use recent georeferenced aerial photographs as a

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guide to mapping these foraging sites and for resolving questions about bird foraging locations in the raw data. During each point count, macrohabitat (percent coverages of sediment types and vegetation) will be evaluated, which will further improve the resolution of bird foraging localities.

Our third question, 3) How do waterbird species (including gulls, cormorants, and pelicans) interact at the Cat Island facility and nearby shoals and islands?, will be evaluated in several ways, again using the core data recorded on the standard field forms (Figure 4). First, direct observations of antagonistic interactions are recorded in the “Comments” column on the data form. Although these records will be relatively uncommon, they provide direct information about species interactions. Indirect evidence of interactions will be acquired by comparing locations of shorebirds/terns vs. locations of other species during the point counts. Given the precise GPS locations of the sampling points, estimates of distance and direction on the data form (Figure 4) will enable us to use several types of analyses for assessing interspecific interactions. We will explore that use of spatial point pattern analysis (Wiegand and Maloney 2013) to compare the distribution of target species with respect to the distribution of other species that might be avoided. Wiegand and Maloney’s (2013) methods use spatially explicit null models to test for non-random patterns of avoidance or attraction. Simpler models will be feasible, however, given the discrete nature of available habitats at the study area. For example, we can use simple χ^2 tests of association to compare the frequency of occurrence of Piping Plovers (or any other species) at the northern shore of Willow Shoal, one of the most conspicuous habitats near the Cat Island causeway, in the presence of Herring Gulls versus frequency in the absence of Herring Gulls. Again, the accurate estimation of distance and direction (along with GPS coordinates of the observation point) will allow us to identify discrete foraging sites for making these comparisons. Careful review of the distance/direction data will be important in achieving the DQO for this element of the study. Prestby will review data sheets and computerized data for targeted foraging sites in preparation for this analysis.

Our fourth question, 4) How does the presence of humans affect bird activities at the Cat Island facility?, will be answered by comparing bird abundances and foraging localities when activity levels were high (weekdays during 2013) with bird abundances and foraging localities when human activity levels were low (weekends during 2013 and most observation days during 2014). Disentangling other factors (besides human activity levels) between the two years will be helped by comparing bird occurrences on weekends versus busy days within years. Results will not be as clear as they might be if we could have controlled the levels of activity, but the large sample size should enable us to address this question with adequate statistical power. Observations of bird numbers and spatial distributions from the remote cameras in 2014 will also provide a comparison between periods when field observers were present versus periods when no one was present on the wave barrier.

We plan to submit results from this work to peer-reviewed journals, providing another level of review by professional biologists who have expertise in migratory shorebirds and other

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waterbirds, particularly terns and colonial nesters like herons and egrets. The scientific peer review presents a well-established system of oversight that we will use as the end product of this work. Additionally, results will be provided to biologists in local agencies, notably the WDNR and U.S. Fish and Wildlife Service.

A secondary DQO is to provide useful information and recommendations for decision makers involved with the Cat Island Restoration Project. The PIs are active participants in the Biota and Habitat Subcommittee of the Lower Green Bay and Fox River Area of Concern Advisory Committee and will keep members informed about the progress of this work during all phases of the project. We also will maintain regular communication with the Cat Island Advisory Committee. In the final report, we will make the information available in the form of objective results in addition to informed recommendations for managers, management agencies, other researchers, and other interested parties. Our intention is that accurate findings using quality controlled data will be easily accessible for use by everyone involved in the Cat Island Restoration Project.

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