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Strategic Bird Monitoring Guidelines for the Northern Gulf of Mexico

CHALLENGES, OPPORTUNITIES, AND STAKEHOLDER VALUES

Authors:
Auriel M. V. Fournier (1,2)
Mark S. Woodrey (1,3)
R. Randy Wilson (4*)
Stephanie M. Sharuga (5,6)
David B. Reeves (5,7)

1. Mississippi State University, Coastal Research and Extension Center, Biloxi, MS
2. Forbes Biological Station–Bellrose Waterfowl Research Center, Illinois Natural History Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign, Havana, IL
3. Grand Bay National Estuarine Research Reserve, Moss Point, MS
4. U.S. Fish and Wildlife Service, Migratory Bird Program, Southeast Region, Jackson, MS
5. National Academies of Science, Engineering & Medicine / U.S. Fish and Wildlife Service, Gulf Restoration, Southeast Region, Lafayette, LA
6. Genwest Systems, Inc./National Oceanic and Atmospheric Administration, Santa Rosa, CA
7. Gulf Environmental Benefit Fund, National Fish and Wildlife Foundation, Baton Rouge, LA

(*) Corresponding author: **randy_wilson@fws.gov**

Seeking stakeholder input. Photo credit: U.S. Fish and Wildlife Service

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Chapter 2

CHALLENGES, OPPORTUNITIES, & STAKEHOLDER VALUES

CHALLENGES AND OPPORTUNITIES

SPANNING THE COAST OF FLORIDA, ALABAMA, Mississippi, Louisiana and Texas, the coastal habitats and offshore waters comprising the northern Gulf of Mexico represents one of the most ecologically (Burger 2018) and socio-economically (Sumaila et al. 2012) important ecosystems in the world. Collectively, the natural resources in the northern Gulf of Mexico produce approximately 30% of the United States of America's gross domestic product (GCERTF 2011) through offshore oil and gas production, commercial and recreational fishing, and tourism. At the same time, these same coastal habitats and offshore waters are home to thousands of plant and animal species.

The Deepwater Horizon (DWH) oil spill directly impacted birds and their habitats at an unprecedented scale within the northern Gulf of Mexico (DHNRDAT 2016). Early efforts to determine pre-spill baseline conditions for avian resources highlighted the lack of adequate data to inform decision-makers (Love et al. 2015), including the lack of comprehensive, integrated bird data that could be used in: (1) the injury assessment phase of the Natural Resource Damage Assessment across the northern Gulf of Mexico, and (2) the evaluation of bird response to future on-the-ground restoration efforts. However, this environmental disaster has also resulted in an equally unprecedented focus on the Gulf ecosystem and resources to support its restoration and recovery (Baldera et al. 2018), as well as the ability to reduce uncertainty via large-scale coordinated monitoring efforts.

Historically, the conservation community of dedicated scientists and managers within the northern Gulf of Mexico—from on the ground habitat managers and researchers to those making programmatic, region-wide funding allocations—have done an admirable job of monitoring the "species/topic du jour," usually in the form of a short-term, small-spatial scale research projects. However, the conservation community continues to struggle to design and implement a large-scale, coordinated bird monitoring program (Lindenmayer et al. 2012; Leve et al. 2015). Designing such a coordinated, integrated, and collaborative avian monitoring program for this system has many challenges, including but not limited to: (1) the scope and scale of the Gulf ecosystem; (2) the diversity, abundance, and seasonal dynamics of birds using the Gulf; (3) the number of partners and stakeholders with diverse values and objectives; and (4) the proposed level of funding required to successfully design and implement a Gulf-wide long-term avian monitoring program. Yet meeting these challenges are imperative to understanding cause and effect relationships that underscore demographic processes and population trends, as well as providing a basis for evaluating success of Gulf restoration efforts (NASEM 2017).

Birds that use the Gulf of Mexico each year are remarkable natural resources that occupy a wide variety of habitats and ecological niches. Barrier islands, beaches, marshes, grasslands, forests, and the open ocean support hundreds of species and billions of individual birds (Farnsworth and Russell 2007, Moore et al. 2017, Horton et al. 2019). Colonial-nesting waterbirds (Portnoy 1978, 1981) feed near the top of the food chain in shallow water, while overwintering shorebirds forage on mudflats and beaches (Clapp et al. 1983, Withers 2002, Burger 2017). Marsh birds forage for a variety of prey amongst the marsh vegetation at the land-water interface. Coastal habitats provide essential stopover sites for billions of Nearctic-Neotropical migratory birds twice a year (Cohen et al. 2017, Horton et al. 2019). Whereas the bays and associated marsh serve as one of the most important areas on the continent for wintering waterfowl (De Marco et al. 2016, Ward 2017). Unfortunately, the Gulf Coast is increasingly affected by a variety of anthropogenic activities (e.g., land development, pollution, oil spills, sea-level rise/subsidence) and natural events (e.g., tropical storms, hurricanes, and floods) that often affect birds and their use of these habitats.

The value of coastal habitats for birds is sometimes at odds with human needs, creating challenges when determining the best approaches for managing and conserving important habitats and the birds that use them. Anthropogenic and natural disturbances can result in loss, fragmentation, and/or reduced quality of important habitat. Direct loss of habitat can occur because of wetland drainage, hardening shorelines, dredging, and clearing of forest and scrubland areas. In addition to direct habitat loss, urban development along the coast often yields degraded and fragmented habitat that results in increased bird mortality due to increased

predators (e.g., feral cats, raccoons), increased collisions with man-made structures and vehicles, introduction of invasive species, reduced and/or competition for food resources (Loss et al. 2015). Climate change also introduces myriad new threats such as shifting faunal community composition (Walther et al. 2002) and sea-level rise drowning emergent marsh vegetation, converting these areas to open water with resulting impacts on coastal birdlife (Rush et al. 2009).

Quantifying the magnitude of these impacts, as well as evaluating contemporary restoration and management actions, is critical to advance bird-habitat restoration and conservation. Unfortunately, the avian conservation community has long-struggled with designing and implementing a large-scale coordinated avian monitoring program given the scope, scale, and interconnectedness of the Gulf of Mexico ecosystem that includes over 500 bird species that use a variety of habitats throughout their annual life-cycle (e.g., breeding, wintering, and migration)and are impacted by a variety of ecosystem stressors.

Given the diversity of birds found in the Gulf region and the multiple stressors impacting the region, there is a clear need for a more structured and coordinated framework that supports the implementation of a bird monitoring strategy in the Gulf of Mexico. Federal and state wildlife agencies often have legal mandates to manage migratory birds while other groups (e.g., non-governmental organizations, joint venture partnerships) also have a stake in conserving birds and their habitats. However, these stakeholders often have different mandates and missions. Therefore, the successful design and implementation of a coordinated monitoring strategy for the Gulf of Mexico requires consensus among a wide variety of conservation partners regarding their values and common monitoring objectives.

As a means to reach consensus of the fundamental needs and objectives underpinning avian monitoring efforts in the northern Gulf of Mexico, we framed the discussion around the restoration and conservation efforts being deployed in the aftermath of the DWH oil spill. The DWH settlement has created an unprecedented opportunity to restore and enhance both the ecological and the socio-economic values of the northern Gulf of Mexico ecosystem. As such, this model of conservation (Figure 2.1) provides a platform by which the avian conservation community can: (1) identify their role; and (2) rally around a set of common objectives and data needs, thereby aligning monitoring efforts across agencies and organizations to facilitate learning and reducing uncertainty around restoration actions.

More specifically, as the conservation community at large moves towards a holistic vision of integrated restoration and management of the Gulf of Mexico ecosystem, a structured way of doing business is required, one that closely follows the principles of adaptive management (e.g., plan, implement, evaluate, and adjust decision making based on the evaluation)(Williams and Brown 2012). The Adaptive Management Model requires a double feedback loop to facilitate learning in that, information learned must be applied not only against the restoration and management actions being implemented, but also applied against the

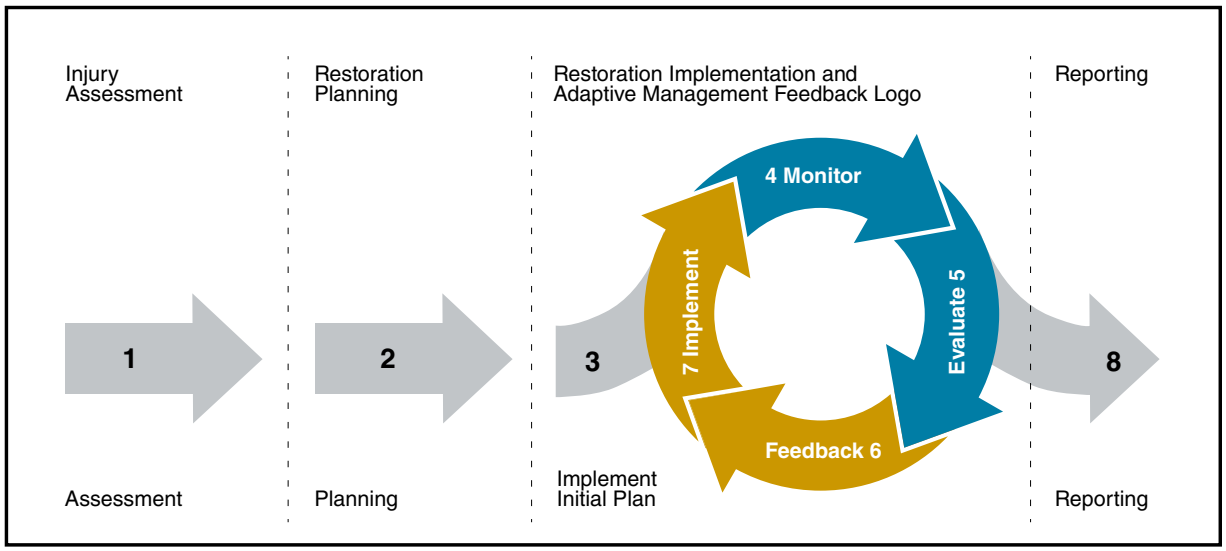

Figure 2.1. *The Monitoring and Adaptive Management Framework presented by the DWH Trustees in the Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS); adapted from the Monitoring and Adaptive Management Manual (DHNRDAT 2017).*

fundamental objectives and assumptions underpinning the initial planning process (Figure 2.1). For Adaptive Management to be fully successful, monitoring activities must be framed in context with both the original planning objectives and assumptions as well as, with the evaluation of on-the-ground restoration activities. It is within this context, that we frame bird monitoring objectives, values, and priorities.

Identifying Stakeholder Values

Historically, the avian conservation community has struggled to develop and implement a Gulf-wide, coordinated monitoring program due mainly to: (1) lack of a forum by which to coordinate across agencies and organizations; (2) the inability to dissect the many inter-dependent issues and complexities of how birds use the Gulf ecosystem (i.e., agree to common values and needs); and (3) funding limitations. However, in the wake of DWH, an enormous amount of intellectual (planning) and physical (implementation) energy and funding is now being devoted to restoring and enhancing the northern Gulf of Mexico ecosystem. This renewed interest also brings many new mechanisms (e.g., Natural Resource Damage Assessment and Restoration Trustee Council [NRDAR], Gulf Coast Ecosystem Restoration Council, and National Fish Wildlife Foundation [NFWF]) and forums (e.g., Gulf of Mexico Alliance [GoMA], Gulf of Mexico Avian Monitoring Newtork [GoMAMN]) by which to coordinate and implement Gulf-wide monitoring efforts to enhance our collective ability to learn and reduce uncertainty. Hence, the remaining limiting factor is a process by which to deconstruct the complexities surrounding what, when, and where to monitor.

To address this limitation, we have used the principles of decision theory and conceptual models (i.e., influence diagrams) to deconstruct the complexities surrounding avian monitoring in the context of Gulf restoration. In brief, decision theory allows "a formalization of common sense for decision problems which are too complex for informal use of common sense" (Keeney 1982). More specifically, Keeney (2004) describes the elements of decision making as: (1) defining the problem; (2) specifying the objective of your decision; (3) specify alternative means to accomplish the objective; (4) describe the consequences of each alternative in terms of meeting the objective; (5) identify trade-offs relative to how each alternative meets your objective; (6) identify and quantify uncertainty affecting your decision; (7) account for willingness to accept risk; and (8) plan ahead by linking current decisions with future decisions. Whereas influence diagrams are graphical representations of conceptual models that articulate relationships between decisions, external factors, uncertainties, and outcomes. These diagrams facilitate consensus building and encourage structured thinking per cause and effect relationships, as such they clearly link the "things we can affect" with "the things we care about" (Gregory et al. 2012).

Using this formal process of decision making, a series of workshops were hosted to address each of the eight steps identified by Kenney (2004). Because the actual decision and objectives are deeply rooted in stakeholder needs and values, a multitude of stakeholders, representing wide-variety of "decision makers" (e.g., on-the-ground biologists; state, federal and non-governmental wildlife program managers; program managers within NRDAR; Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act [RESTORE]; NFWF; and academic researchers) participated and contributed to the discussions and helped shape the fundamental objectives and the associated core values underpinning each fundamental objective. Here we present information related to Keeney's (2004) elements (1) (identify the decision[s]) and (2) (identify what we value about the decision). We used these two elements as a means to: (1) articulate the roles and components of an avian monitoring program; and (2) serve as a basis for informing programmatic design and implementation of monitoring activities to address key data gaps. Additional information deemed necessary (e.g., cause and effect relationships articulated via influence diagrams) for setting bird monitoring priorities are presented and discussed in Chapters 3–9. Technical information related to other elements of decision theory such as alternatives, consequences, and trade-off analysis are discussed in Fournier et al. (in press).

Based on discussions at the GoMAMN stakeholder workshops, participants agreed that the goal of GoMAMN is to maximize the utility of bird monitoring data to inform restoration and advance bird-habitat conservation across the northern Gulf of Mexico. The GoMAMN conservation community of practice identified a set of fundamental objectives and sub-objectives:

OBJECTIVE 1.0: Maximize the relevancy of monitoring data within the northern Gulf of Mexico.

SUB-OBJECTIVE 1.1: Maximize our collective ability to understand management actions and their respective impacts on avian populations.

SUB-OBJECTIVE 1.2: Maximize our collective ability to conduct population and habitat status assessments.

SUB-OBJECTIVE 1.2.1: Status assessment of birds of conservation concern

SUB-OBJECTIVE 1.2.2: Status assessment of primary (habitats) land cover

SUB-OBJECTIVE 1.3: Maximize our collective ability to understand ecological processes and their respective impacts on avian populations.

OBJECTIVE 2.0: Maximize rigor of monitoring projects.

OBJECTIVE 3.0: Maximize integration of monitoring projects.

At the core of good decision making is a set of well-defined objectives and evaluation criteria. Together they define "what matters" about a decision (Gregory 2012). Using the objectives outlined above, participants at the stakeholder workshops identified and vetted a suite of evaluation criteria as a means of further elucidating what we value about each of the fundamental objectives, as well as providing a transparent means of evaluating success in achieving monitoring objectives. This suite of values serves as the foundational components underpinning the organizational structure, data needs, and priorities presented in chapters 3–9. Additionally, these values can be used to compare alternative monitoring strategies through a series of trade-off analyses. While beyond the scope of presentation within this report, Fournier et al. (in press) provide additional information on trade-off analysis and the construction of monitoring portfolios. Here we provide a general overview of the values underpinning each of the fundamental objectives (i.e., what do we value about each of the fundamental objectives) as a means to frame our philosophical approach to informing and guiding avian monitoring efforts across the northern Gulf of Mexico. To facilitate discussions and presentation of information, we have structured the fundamental objectives and associated evaluation criteria as an objective hierarchy to better communicate the objectives and associated values (Figure 2.2)

In order to maximize the usefulness of bird monitoring data to inform restoration and advance bird-habitat conservation across the northern Gulf of Mexico, the conservation community is challenged to address three fundamental

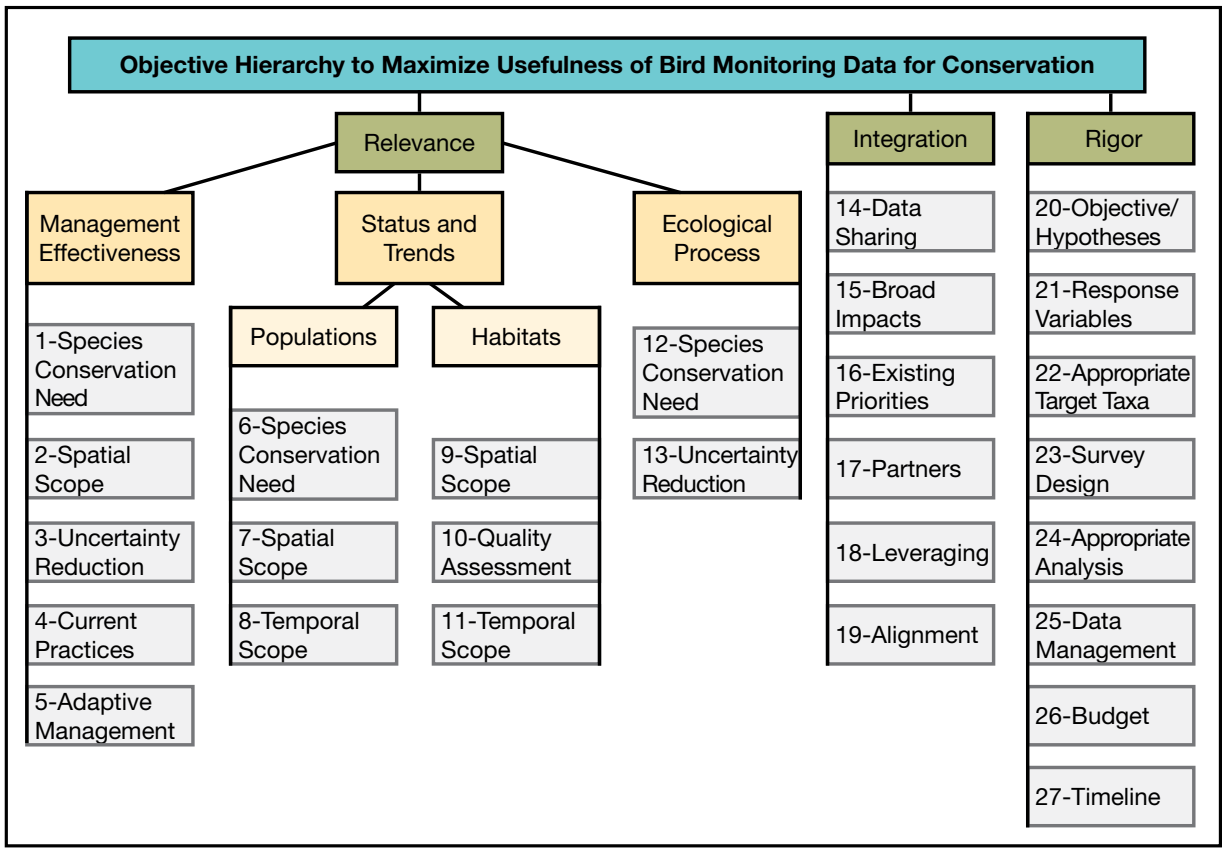

Figure 2.2. *Gulf of Mexico Avian Monitoring Network's objectives hierarchy of fundamental objectives and evaluation criteria underpinning bird monitoring in northern Gulf of Mexico.*

objectives: (1) maximize the relevance of monitoring projects; (2) maximize the integration of monitoring projects; and (3) maximize the scientific rigor of monitoring projects. Collectively, these objectives require monitoring projects to be integrated across partners and taxonomic groups and to address contemporary needs with scientific rigor. To fully understand the implications of this collective statement requires a greater understanding and appreciation for the individual parts.

Relevancy of Monitoring Data

If monitoring data is to truly be useful, it must be relevant; but relevant to what? Through the series of stakeholder workshops, discussions frequently returned to three primary needs underpinning Gulf restoration: (1) evaluation of restoration/management actions; (2) establishment of baselines; and (3) understanding ecological processes. To that end, these needs serve as sub-objectives under the fundamental objective of maximizing relevancy. In other words, if we (collectively) do not evaluate contemporary management actions, establish baselines, and reduce uncertainty around how ecological processes impact avian populations, we will have missed the mark in terms of informing Gulf restoration and bird-habitat conservation. Furthermore, it is important to note that the establishment of baselines more specifically refers to status assessments of both avian populations and habitats. Both pieces of information are required to make informed decisions, hence they are both included as sub-objectives under the establishment of baselines.

As the conservation community moves forward with Gulf restoration, it is imperative that we evaluate on-the-ground restoration and management actions, but which ones? All of them? Given the expense, it's likely not feasible nor practical to evaluate every project that "hits the ground." To answer this question, we can look at the evaluation criteria underlying the "evaluate management effectiveness" monitoring objective to see the stakeholder values: (1) focus on projects that impact Birds of Conservation Concern (see Appendix 1); (2) evaluate management actions that have broad applicability across the Gulf; (3) evaluate management actions with high uncertainty regarding potential impacts on avian populations; (4) focus on management actions that have a high frequency of implementation; and (5) evaluate projects in an adaptive management context. Based on these values, greater value is given to monitoring projects that evaluate frequently occurring management actions with broad applicability and high degree of uncertainty related to the impacts on birds of conservation concern within an adaptive management framework.

Likewise, it is important to conduct status assessments for both avian populations and their habitats (see Appendix 2) if the conservation community is to understand population responses at scales larger than the project-level implementation of a management action (e.g., state-scale, Gulf-wide). Status assessments not only provide information by which population and habitat trends can be assessed, but also provide important baseline datasets by which management effectiveness and future anthropogenic (e.g., oil spills) and natural events (e.g., hurricanes) can be assessed. Specifically, stakeholders value population status assessments that: (1) address birds of conservation concern; (2) cover large percentage of the species' gulf-wide range; and (3) spans long periods of time. Similarly, stakeholders value habitat assessments that: (1) address habitat quantity; (2) habitat quality; and (3) spans long periods of time. Thus, priority should be given to status assessments that span large portions of the Gulf, extend over long periods of time, and address birds of conservation concern and their habitats.

Bird populations are sustained via an intricate interplay of basic ecological processes, such as climate dynamics, patterns in primary and secondary productivity, hydrologic regime, formation and maintenance of habitats, interactions between and among species, movement ecology and natural disturbances (see Newton 1998). Understanding these intricate relationships can only be derived through explicit acknowledgment and understanding of the ecological processes driving avian populations. Such a body of knowledge is both fundamental to long-term conservation of avian populations and necessary to interpret effects of specific management actions on avian populations. Monitoring to understand the ecological drivers of avian populations will generally occur at much larger spatial and time scales (decades, thousands of km^2) than those typical of studies designed to monitor specific management actions (years, tens to hundreds of km^2). The separation of ecological processes and management actions in terms of designing and informing monitoring actions is based on these general differences in scaling (NASEM 2017). With respect to monitoring ecological processes, stakeholders value information that reduces uncertainty of how ecological processes impact birds of conservation concern. To provide further insight of values and priority processes to be evaluated, each of the avian-taxonomic groups has identified a suite of ecological processes that warrant further study (see Chapters 3–9).

Integration and Rigor of Monitoring Data

One major objective of GoMAMN is to provide a forum to facilitate coordination and integration of monitoring efforts across the northern Gulf of Mexico. Hence, it is not surprising that the stakeholders developed a fundamental objective that speaks to maximizing the integration of monitoring data. But what does integration of monitoring data

mean? Cambridge dictionary describes integration as "to combine two or more things in order to become more effective". Throughout the series of stakeholder meetings this was also a recurring theme—"how do we leverage resources across partners and existing monitoring efforts in an attempt to become more efficient and effective?" To facilitate the integration process, stakeholders identified seven criteria by which the conservation community could collectively work to better integrate monitoring efforts: (1) sharing of data; (2) broaden applicability of data beyond bird monitoring (e.g., curriculum development, environmental compliance, etc.); (3) address existing priorities within conservation plans (e.g., joint venture implementation plans); (4) increase collaborations /partnerships; (5) increase leveraging of resources (e.g., equipment, funding, etc.); (6) standardization of protocols and procedures; and (7) alignment with existing bird and non-bird monitoring programs. Given the vast number of partners working to restore the Gulf, it is imperative that the conservation community breaks from its respective "silos" to look for ways to become more efficient and effective. It is our expectation that, collectively, the conservation community will look for ways to incorporate the values described above into future monitoring efforts, as a means to increase collaborations and applicability of monitoring data to inform Gulf restoration and bird-habitat conservation.

Any monitoring project is only as good as the quality of its data. Which is in turn determined by the rigor with which (1) the project is conceived, designed, and implemented, and (2) the manner in which those data are managed, analyzed, and made available to others (see Chapter 11). The importance of having scientifically robust data was not lost during discussions with the various stakeholders, evident by the fact that rigor is a fundamental objective on the same level within the objective hierarchy as relevance and integration. Evaluation criteria for rigor reflect the principles of the scientific method of discovery and include: (1) clearly stated objectives/hypotheses; (2) clearly stated response variable(s); (3) identification of the appropriate target species/taxa; (4) clearly articulated survey design; (5) use of appropriate statistics; (6) clearly articulated data management plan; (7) articulation of appropriate and efficient budget; and (8) articulation of appropriate and reasonable timeline to address objectives/hypotheses. Unfortunately, many monitoring efforts continue to be implemented with little consideration of these criteria. Without explicit recognition and incorporation of these criteria, it is questionable how useful data will be to produce actionable results that inform Gulf restoration and bird-habitat conservation across the northern Gulf of Mexico. Thus, it is our hope that future monitoring efforts will incorporate these criteria a priori to implementing any avian monitoring efforts.

Defining Success

As the Gulf Restoration Enterprise of federal, state, non-governmental agencies and organizations work to implement holistic restoration of the northern Gulf of Mexico ecosystem, monitoring and adaptive management are foundational aspects (DHNRDAT 2017). As such, GoMAMN provides a mechanism to facilitate coordination, collaboration and integration of avian monitoring across a broad range of partners, stakeholders and decision makers. In summary, the goal of GoMAMN is to maximize the usefulness of bird monitoring data to inform gulf restoration and bird-habitat conservation across the northern Gulf of Mexico. To that end, GoMAMN will be successful if we can: (1) create and maintain a forum by which stakeholders can coordinate and integrate monitoring efforts for birds of conservation concern and their habitats; (2) establish clearly articulated core-values, data needs, and fundamental objectives underpinning monitoring efforts; (3) facilitate the implementation of cost-effective yet scientifically robust regional monitoring plans; and (4) standardize data collection and data management efforts that support adaptive management.

To address these challenges will require the monitoring community of practice to embrace and incorporate the stakeholder values (e.g., fundamental objectives and evaluation criteria; Figure 2.2) into their respective monitoring activities and programs. Hence success hinges upon our collective ability to collaborate and integrate on the design and implementation of region-wide monitoring activities that address stakeholder values. Furthermore, due to the nature and legal mandates of how funding is allocated (within states vs. Gulf-wide) among the various sources (e.g., NRDAR, NFWF, RESTORE Act, state wildlife grants, etc.), success will also be determined by how well we (collectively) leverage funding resources to implement region-wide monitoring to address multiple objectives (e.g., project-level and programmatic-level) in an efficient manner.

Using the GoMAMN forum, a suite of objectives and associated evaluation criteria (values) have been identified through a series of stakeholder workshops. In chapters 3–9 we used these objectives and values to identify bird monitoring priorities and provide a transparent strategic framework to guide the design and implementation of a coordinated and integrated avian monitoring program, one that will allow us to evaluate future restoration activities and conduct ecosystem assessments across the Gulf-region (Figure 2.3). Furthermore, we expect such a collaborative and integrated program will lead to cost-effective yet scientifically robust regional monitoring effort, with standardized data collection and data management procedures that support adaptive management. Finally, due to the broad spectrum of partners within GoMAMN, this network provides a forum by which

conservation planners and land managers can continue to coordinate, collaborate, and seek additional information related to bird populations and habitats, as well as to identify best management practices for restoration and management (Figure 2.3). With these objectives, values, and expectations as a foundation, hereafter, we synthesize data needs relative to birds of conservation concern (see Chapters 3–9) as a means to better articulate key uncertainties and focus monitoring efforts as we collectively work to implement holistic ecosystem restoration and monitoring.

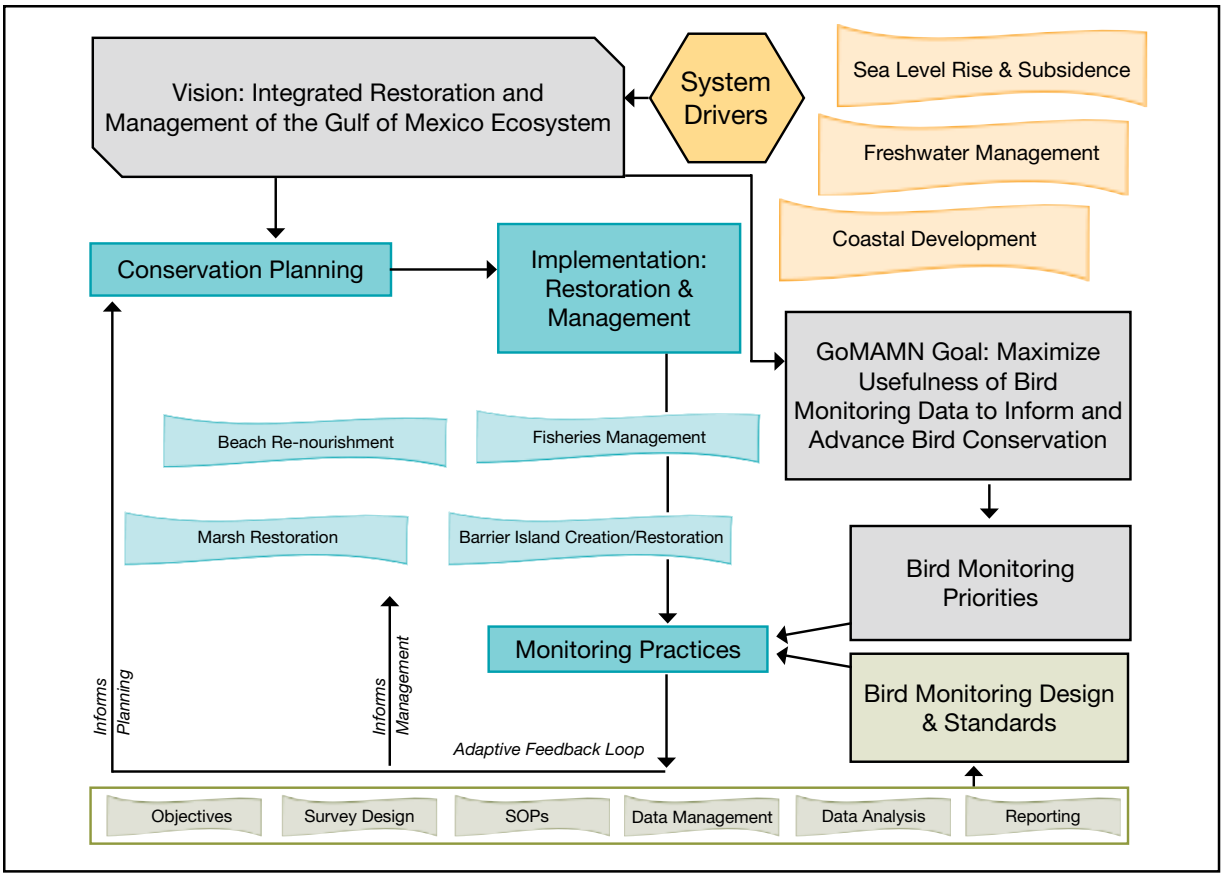

Figure 2.3. *Schematic depicting the role of the Gulf of Mexico Avian Monitoring Network within the larger context of Gulf restoration. Stakeholder values and objectives are shown in gray, the adaptive decision process in blue (with examples in wavy boxes), monitoring components in green, and system drivers (with examples) in orange.*

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