



U. S. Fish and Wildlife Service National Wildlife Refuge System

Southeast Region Inventory & Monitoring – Gulf I&M Zone

Refuge Inventory and Monitoring Status and Needs Assessment

Gulf I&M Zone Summary Report Appendices

Contents

Appendix A. Assessment Tools.....	2
Refuge PRIMR Assessments.....	2
Refuge Needs Assessments.....	2
Appendix B. Status & Needs Assessment – Information Summaries.	5
<i>Status of Refuge Natural Resource Assessments</i>	5
<i>Refuge Inventory and Monitoring Strengths</i>	6
<i>Natural Resource Management Activities</i>	6
<i>Biotic Inventories</i>	9
<i>Resident and breeding waterfowl monitoring</i>	10
<i>Opportunities</i>	10
<i>Potential Roles for I&M</i>	10
<i>Bat Monitoring</i>	11
<i>Freshwater Fish and Mussels</i>	11
<i>Reptile and Amphibian Monitoring</i>	12
<i>Invertebrates and Fungi</i>	13
<i>Species Inventory Needs</i>	14
<i>Opportunities</i>	15
<i>Priority Biological Resources</i>	15

<i>Opportunities</i>	18
<i>Refuge Targeted Restoration Activities</i>	19
<i>Opportunities</i>	20
<i>Water Resources</i>	20
<i>Opportunities</i>	22
<i>Climate Change</i>	22
<i>Opportunities</i>	23
<i>Data Management</i>	24
<i>General Refuge Comments</i>	27
<i>I&M Capacity</i>	27
<i>Habitat Management Activities</i>	27
Appendix C. Gulf Zone Needs Assessment Data Form	29

Appendix A. Assessment Tools

Refuge PRIMR Assessments

The national [Planning and Review of Inventory and Monitoring \(PRIMR\)](#) database is a web-based, centralized database application designed to document current inventory and monitoring activities occurring throughout the entire National Wildlife Refuge System. Its purpose is to inform national and regional survey prioritization and planning as well as facilitate the development of refuge Inventory and Monitoring Plans (IMP). PRIMR is meant to be used by refuge staff to document and prioritize inventory and monitoring surveys and help guard against loss of information about survey activities over time. PRIMR surveys are also directly linked to goals and objectives of refuge management plans and can be used to assess importance of survey activities to refuge resource management objectives. PRIMR can be used by regional and national I&M staff to identify refuges with similar survey activities that are good opportunities for survey coordination and standardization, and help prioritize recommendations for survey implementation on refuges. The ultimate goal of PRIMR and the IMP process is to improve efficiency and scientific rigor of inventory and monitoring surveys on refuges, such that data collected can be used to inform adaptive management of refuge resources and contribute to landscape-scale conservation efforts.

Refuge Needs Assessments

The Gulf Zone I&M Needs Assessment was conducted in concert with population of the national PRIMR database during each refuge Status and Needs visit (Table A1). The Needs Assessment questionnaire (Appendix C) was developed to assess refuge biological program needs with respect to inventory and monitoring activities on refuges in order to more fully assess not only refuge survey activities, but key issues, assistance needs, and knowledge gaps regarding inventory and monitoring on refuges. Results from the Needs Assessment will be used alongside the PRIMR database to develop I&M priorities in the Gulf I&M Zone. The Needs Assessment component of each refuge visit began with basic questions concerning the status of existing refuge planning documents and resource assessments (see Needs Assessment questionnaire in Appendix C). We also assessed staff opinion pertaining to refuge strengths relative to inventory and monitoring, their most expensive and time consuming resource management activities, priority biological resources, existing and needed species inventories, adequacy of information used for refuge management decisions, and use of adaptive management in decision processes.

Table A1. List of Southeast Region Refuges by Complex, date, number of participants (Refuge staff, I&M staff excluded), and LCC geography that were involved in the PRIMR survey inventory and Needs Assessment in the Gulf I&M Zone.

Complex	Refuge	Date of Needs Assessment	Number of Participants	Sub-geography
Central Arkansas Refuge Complex	Bald Knob National Wildlife Refuge	5/9/2013	5	MAV ¹
	Big Lake National Wildlife Refuge	5/9/2013	5	MAV
	Cache River National Wildlife Refuge	5/9/2013	4	MAV
	Wapanocca National Wildlife Refuge	5/9/2013	5	MAV
Central Louisiana Refuge Complex	Catahoula National Wildlife Refuge	10/19/2012	1	MAV
	Grand Cote National Wildlife Refuge	10/18/2012	3	MAV
	Lake Ophelia National Wildlife Refuge	10/18/2012	3	MAV
	Clarks River National Wildlife Refuge	10/12/2012	2	EGCP ²
	Eufaula National Wildlife Refuge	8/8/2012	2	EGCP
Gulf Coast Refuge Complex	Bon Secour National Wildlife Refuge	1/23/2013	3	GC ³
	Grand Bay National Wildlife Refuge	1/17/2013	6	GC
	M Sandhill Crane National Wildlife Refuge	1/17/2013	4	GC
	Holla Bend National Wildlife Refuge	9/26/2012	1	WGCP ⁴
	Logan Cave National Wildlife Refuge	9/26/2012	1	IH ⁵
Lower Mississippi River Refuge Complex	Bayou Cocodrie National Wildlife Refuge	7/18/2012	5	MAV
	Cat Island National Wildlife Refuge	7/18/2012	5	MAV
	St. Catherine Creek National Wildlife Refuge	7/18/2012	5	MAV
North Louisiana Refuge Complex	Black Bayou Lake National Wildlife Refuge	6/28/2012	4	WGCP
	D'Arbonne National Wildlife Refuge	6/28/2012	4	WGCP
	Handy Brake National Wildlife Refuge	6/28/2012	4	WGCP
	Red River National Wildlife Refuge	6/28/2012	4	WGCP
	Upper Ouachita National Wildlife Refuge	6/28/2012	4	WGCP
North Mississippi Refuge Complex	Coldwater River National Wildlife Refuge	6/27/2012	3	MAV
	Dahomey National Wildlife Refuge	6/22/2012	3	MAV
	Tallahatchie National Wildlife Refuge	6/27/2012	2	MAV
Noxubee Refuge Complex	Choctaw National Wildlife Refuge	2/12/2013	4	EGCP
	Sam D. Hamilton Noxubee National Wildlife Refuge	10/26/2012	4	EGCP
South Arkansas Refuge Complex	Felsenthal National Wildlife Refuge	9/12/2012	2	WGCP
	Overflow National Wildlife Refuge	9/12/2012	3	MAV
	Pond Creek National Wildlife Refuge	9/13/2012	1	WGCP
Southeast Louisiana Refuge Complex	Atchafalaya National Wildlife Refuge	4/2/2013	4	MAV
	Bayou Sauvage National Wildlife Refuge	4/2/2013	5	GC
	Bayou Teche National Wildlife Refuge	3/12/2013	2	GC
	Big Branch Marsh National Wildlife Refuge	4/2/2013	4	GC
	Bogue Chitto National Wildlife Refuge	4/2/2013	4	GC
	Breton National Wildlife Refuge	4/2/2013	5	GC
	Delta National Wildlife Refuge	4/2/2013	5	GC
	Mandalay National Wildlife Refuge	3/12/2013	2	GC
Southwest Louisiana Refuge Complex	Cameron Prairie National Wildlife Refuge	3/1/2013	6	GC
	Lacassine National Wildlife Refuge	3/1/2013	6	GC
	Sabine National Wildlife Refuge	3/1/2013	6	GC

	Shell Keys National Wildlife Refuge	3/1/2013	6	GC
Tennessee Refuge Complex	Cross Creeks National Wildlife Refuge	10/10/2012	5	AP ⁶
	Tennessee National Wildlife Refuge	10/10/2012	5	AP
	Tensas River National Wildlife Refuge	10/16/2012	4	MAV
Theodore Roosevelt Refuge Complex	Hillside National Wildlife Refuge	8/15/2012	1	MAV
	Holt Collier National Wildlife Refuge	8/22/2012	2	MAV
	Mathew's Brake National Wildlife Refuge	8/15/2012	1	MAV
	Morgan Brake National Wildlife Refuge	8/15/2012	1	MAV
	Panther Swamp National Wildlife Refuge	8/14/2012	5	MAV
	Theodore Roosevelt National Wildlife Refuge	8/22/2012	2	MAV
	Yazoo National Wildlife Refuge	8/14/2012	5	MAV
West Tennessee Refuge Complex	Chickasaw National Wildlife Refuge	7/25/2013	2	MAV
	Hatchie National Wildlife Refuge	7/25/2013	2	EGCP
	Lake Isom National Wildlife Refuge	7/25/2013	2	MAV
	Lower Hatchie National Wildlife Refuge	7/25/2013	2	MAV
	Reelfoot National Wildlife Refuge	7/25/2013	2	MAV
Wheeler Refuge Complex	Cahaba River National Wildlife Refuge	1/8/2012	1	AP
	Fern Cave National Wildlife Refuge	3/27/2013	5	AP
	Key Cave National Wildlife Refuge	3/27/2013	5	AP
	Mountain Longleaf National Wildlife Refuge	1/8/2012	1	AP
	Sauta Cave National Wildlife Refuge	3/27/2013	5	AP
	Watercress Darter National Wildlife Refuge	1/8/2012	1	AP
	Wheeler National Wildlife Refuge	3/27/2013	5	AP
	White River National Wildlife Refuge	2/19/2013	5	MAV

¹Mississippi Alluvial Valley subgeography of the Gulf Coastal Plains and Ozarks LCC that falls within the Gulf I&M Zone.

²East Gulf Coastal Plain subgeography of the Gulf Coastal Plains and Ozarks LCC that falls within the Gulf I&M Zone.

³Gulf Coast subgeography of the Gulf Coastal Plains and Ozarks LCC and eastern portion of the Gulf Coast Prairie LCC that fall within the Gulf I&M Zone.

⁴West Gulf Coastal Plain subgeography of the Gulf Coastal Plains and Ozarks LCC that falls within the Gulf I&M Zone.

⁵Interior Highlands subgeography of the Gulf Coastal Plains and Ozarks LCC that falls within the Gulf I&M Zone.

⁶Appalachian LCC geography that falls within the Gulf I&M Zone.

Appendix B. Status & Needs Assessment – Information Summaries.

The material presented here is a supplement to the PRIMR and Needs Assessment results presented in the Refuge Inventory and Monitoring Status and Needs Assessment – Gulf I&M Zone Summary Report. This appendix describes results not previously presented in the report and some additional detail about those topics discussed in the report.

Status of Refuge Natural Resource Assessments

An initial component of the refuge Needs Assessment was to evaluate the status of refuge natural resource assessments. Natural Resource assessments are done on refuges periodically to provide management information and/or assess progress toward management goals. Twenty refuges have an existing Hydrogeomorphic Model (HGM) derived primarily from a larger 2011 project by the [Lower Mississippi Valley Joint Venture](#) for the northern MAV region. No refuges in the Gulf Zone have an HGM developed specifically within refuge boundaries, although one is in development for Dale Bumpers White River NWR. Fifty refuges in the Gulf Zone have completed a recent full biological review and/or pulse check biological review (refuge or complex wide). Cache River, Cahaba River and White River NWRs currently have a [Water Resources Inventory & Assessment \(WRIA\)](#) in development. Upcoming WRIAs will be incorporated into a new centralized WRIA database application developed by the Natural Resources Program Center and housed on the Service ECOS platform. Contaminants Assessment Processes (CAPs) have been completed on 28 of the Gulf I&M Zone refuges since 1997. All refuge CAPs reports are now available on the FWS digital library [ServCat](#) by searching on the keywords “environmental contaminants investigation” (Fig. B1). Other types of resource assessments indicated by refuges in the Needs Assessment included fire reviews, site profiles, Forest Habitat Management Plan review, community assessments, and forest inventory assessments.

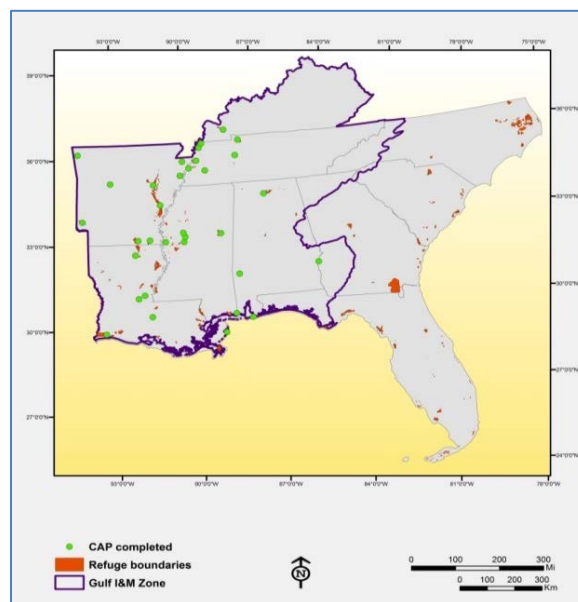


Figure B1. Refuges in the Southeast Region Gulf I&M Zone with completed Contaminants Assessment Processes on all or a portion of the refuge since 1997.

Refuge Inventory and Monitoring Strengths

Refuge staff were asked to list the top 3 strengths of the refuge relative to inventory and monitoring of natural resources, most included specific refuge staff, relationships with universities, partners, and other volunteers. Refuges in the Gulf I&M Zone recognized 19 different universities, eight NGOs, six state and local, and five federal partners as key I&M strengths (Table B1). Volunteers included unpaid interns or student-workers (e.g., SCA, Pathways), Friends groups, local cavers and bird groups, and unaffiliated community volunteers, all of which are critical to the operations of many refuges. Other strengths specified included the availability of on-site housing and facilities for interns and other researchers, the refuge's ability to act as a research study site, various grant-funding opportunities, and conservation fund projects. It is important to note that the examples we provided on the Needs Assessment form may have biased refuge answers as the three most common responses coincided with the three examples provided on the questionnaire.

Table B1. Partners/collaborators listed by refuges as top inventory and monitoring strengths by Gulf I&M Zone refuges in the Needs Assessment portion of the Status and Needs visit.

NGO Partnerships: Alabama Bat Working Group, Audubon Society (state/local chapters), Cahaba River Society, Ducks Unlimited, Friends Groups, Kentucky State Nature Preserves, National Estuarine Research Reserve, The Nature Conservancy.

State/Local Agency Partnerships: Alabama Dept. of Conservation and Natural Resources, Arkansas Game and Fish Commission, Cities of Gulf Shores and Orange Beach, AL, Gulf State Park, AL, Louisiana Department of Wildlife and Fisheries, Louisiana Coastal Protection and Restoration Authority

Federal Agency Partnerships: Natural Resources Conservation Service, U.S. Army Corps of Engineers, U.S. Geological Survey, U.S.F.W.S. - Ecological Services, U.S. Forest Service

University Partnerships: Arkansas Tech University, Auburn University, Austin Peay State University, Birmingham Southern College, Centenary College, Jacksonville State University, Louisiana State University, Louisiana State University – Shreveport, Mississippi State University, Samford University, Tennessee Tech University, University of Alabama – Birmingham, University of Arkansas – Monticello, University of Arkansas - Pine Bluff, University of Louisiana – Monroe, University of New Orleans, University of Southern Mississippi, University of Tennessee

Natural Resource Management Activities

Each refuge was asked to list the top 3 natural resource management activities that currently take up the majority of refuge staff time and money. Responses were then grouped into broad categories and summarized below (Fig. B2). Over half of refuges stated invasive/nuisance species management is the most intensive natural resource management activity (see Natural Resource Threats section of Status & Needs Report). Aquatic resource management was the second most commonly listed activity that required a majority of refuge staff time and money. This predominately included wetland habitat/aquatic plant management, water quality issues, and water quantity management. Also, nearly half of refuges in the Gulf I&M Zone specified management activities to support resident and migratory waterfowl populations, and a third of refuges specified forest management required the majority of refuge management resources (Fig. B2). Forest management activities predominantly included management of bottomland hardwood forests, but also included upland pine (e.g., longleaf) and mixed

pine-hardwood communities. It was not possible to discern from this survey if fire management was included in those refuges with a general forest management response. Nine refuges have extensive public use programs that include management of public hunting units (typically for deer hunts), but also included road and trail maintenance, environmental education, and law enforcement. Other efforts listed as the top resource management activities included oil/gas extraction management, time spent in preparation of required planning documents, issues related to land ownership, time spent coordinating with partners, contaminants cleanup, and disaster response.

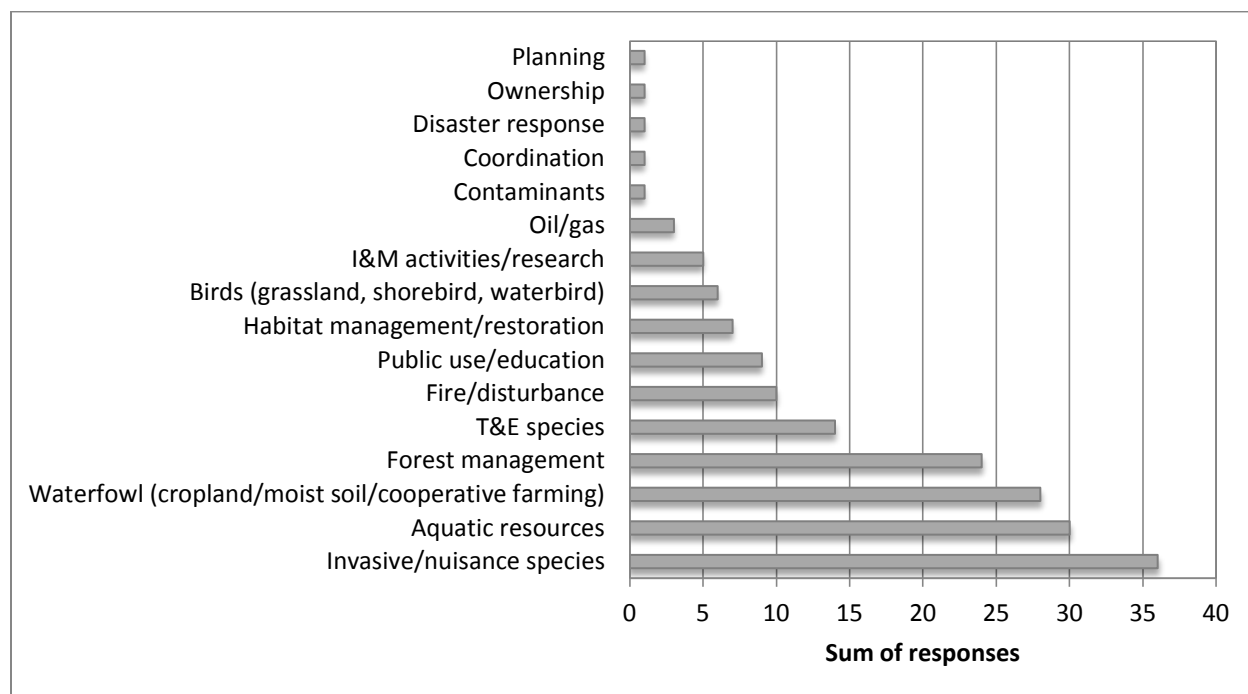


Figure B2. Top natural resource management activities indicated as being most consumptive of refuge staff time and resources on Gulf I&M Zone refuges.

Natural resource management activities varied geographically within the Gulf I&M Zone. We evaluated management activities within subgeographies designated by the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative (East and West Gulf Coastal Plain, Mississippi Alluvial Valley, Gulf Coast, Interior Highlands), and within the Appalachian LCC geography that fell within the Gulf I&M Zone (Fig. B3). Aquatic resource management was a top management activity on refuges in the Mississippi Alluvial Valley, and Interior Highlands. Activities related to waterfowl management were dominant on refuges in the Mississippi Alluvial Valley subgeography, but also fairly prevalent in the East Gulf Coastal Plain and Appalachian LCC refuges. Refuges in the Interior Highlands subgeography and Appalachian LCC spent most of their management resources on T&E species, which is a direct result of having several refuges in these areas designated specifically for endangered species management (e.g., Logan Cave NWR). Invasive/nuisance species (discussed in detail in the Natural Resource Threats section of the Status & Needs report) dominated refuge management activities in the Gulf Coast and West Gulf Coastal Plains subgeographies. Forest management was also prevalent on refuges in the Mississippi Alluvial Valley, and East and West Gulf Coastal Plains subgeographies.

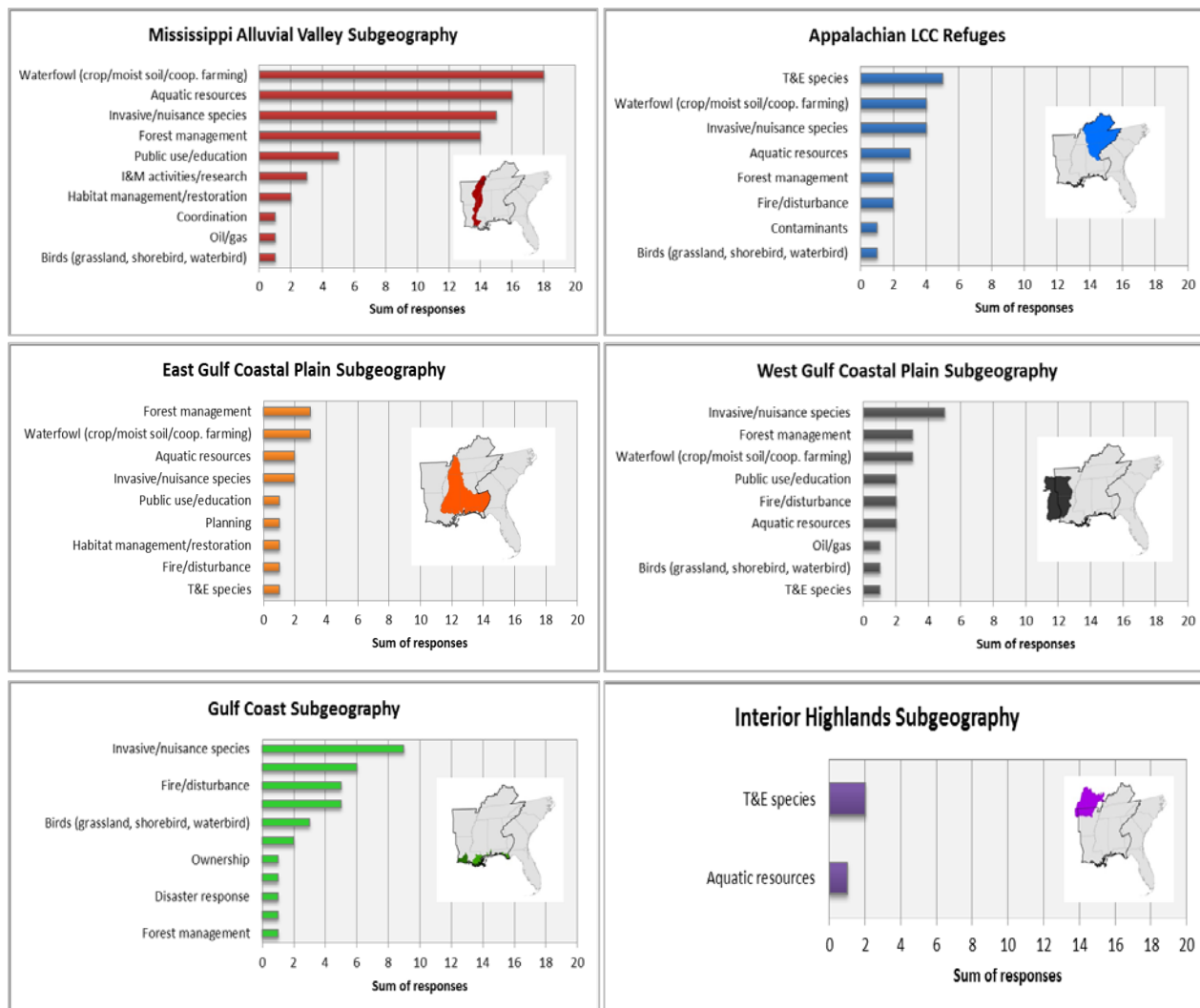


Figure B3. Top natural resource management activities indicated as being most consumptive of refuge staff time and resources on Gulf I&M Zone refuges.

When refuges were asked whether they had adequate information to make decisions regarding the top natural resource management activities listed above, 68% of refuges stated they had adequate to good information, 30% stated they had minimal to inadequate information, and 1 refuge abstained. Several refuges commented that the level of information was improving, or that they had an excellent level of information pertaining to one species (e.g., MS sandhill crane), but were in need of more information about other species and habitats. Refuges that said they had minimal or inadequate information suggested that was caused by a lack of knowledge about how to effectively control invasive/nuisance species, only limited information was available about a particular species, or that their station has limited staff so they had little ability to manage habitat or monitor resources. Whether or not a refuge was associated with a complex did not appear to influence this response. Seven of 11 refuges not associated with a complex stated they had adequate to good information to make management decisions pertaining to their top natural resource management activities.

Biotic Inventories

Knowing what species exist on refuges is the essential first step toward effective management and part of the Refuge Improvement Act responsibility towards Biological Integrity, Diversity and Health. A large component of the PRIMR/Needs Assessment process was to identify existing inventories of refuge natural resources and where gaps exist (*what* resources do refuges have, *where* on the refuge are they located, *who* made species observations, *when* observations were recorded). We asked refuge staff to first specify what biotic inventories exist, followed by the top 3 needs for biotic inventories on their refuge. Most (85%) refuges have existing, high quality inventories of all bird species. Refuges in the Gulf I&M Zone participate in a variety of local and national surveys including migratory landbird surveys (discussed in detail in the At-risk Landbirds/Bottomland Hardwood Forest section of Status & Needs Report), waterfowl surveys (discussed in detail in the Wintering Waterfowl section of Status & Needs Report), and for eagles and waterbirds (Fig. B4 (left)). Twenty-two refuges in the Gulf Zone participate in the annual National Midwinter Eagle Survey, and 2 refuges specified a current or former eagle nest survey. Thirteen refuges specified they participated in shorebird surveys conducted by refuge staff or collaborators. Four refuges specified they participated in general waterbird surveys, although only one of those indicated their survey was part of the Greater Gulf Refuge Waterbird Count. Six refuges specified they conducted a colonial waterbird rookery survey. Eight refuges specified that they participated in marshbird or rail surveys, half of which were located on or near the Gulf coast, and 4 of which were specified as Secretive Marshbird Surveys. Gamebird monitoring is sometimes done by refuges in the Gulf Zone to assess the success of habitat management, as in the case of Northern Bobwhite, or as part of state or federal population monitoring efforts (Fig. B4 (right)).

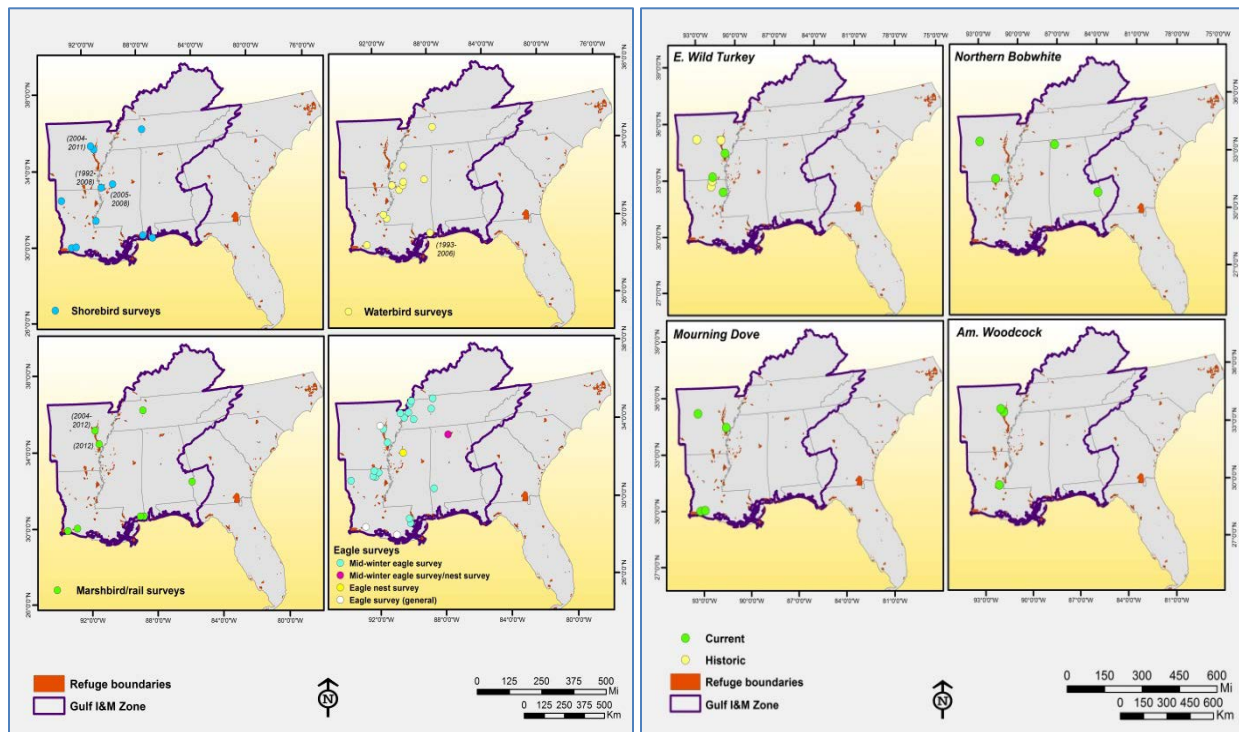


Figure B4. Refuges that indicated they conducted waterbird/eagle surveys (left), and game bird surveys (right).

Resident and breeding waterfowl monitoring

Resident and breeding waterfowl surveys, primarily consisting of wood duck banding and nest box monitoring have been ongoing on 24 Gulf I&M Zone refuges for as long as 50 years or more (Fig. B5). Wood duck banding data represents a valuable contribution to landscape-level information maintained by FWS Migratory Birds, but often holds little value to refuge management. Wood duck nest box monitoring is typically conducted on an ad-hoc basis and is often poorly used in assessing recruitment in refuge wood duck populations.

Opportunities

Long-term banding data and information on productivity of resident waterfowl populations in the Gulf I&M Zone are invaluable at a landscape scale. However, there is a clear disconnect between banding and nest-box monitoring operations and utility of this data for refuge management.

Potential Roles for I&M

- Critically assess value and utility at multiple scales of resident waterfowl banding and nest-box data relative to effort put forth in data collection on refuges.
- If efforts continue to be a worthwhile investment of refuge resources, develop a means to provide feedback on population status and trends, such that resident waterfowl banding and nest box data may be used in an adaptive management framework.

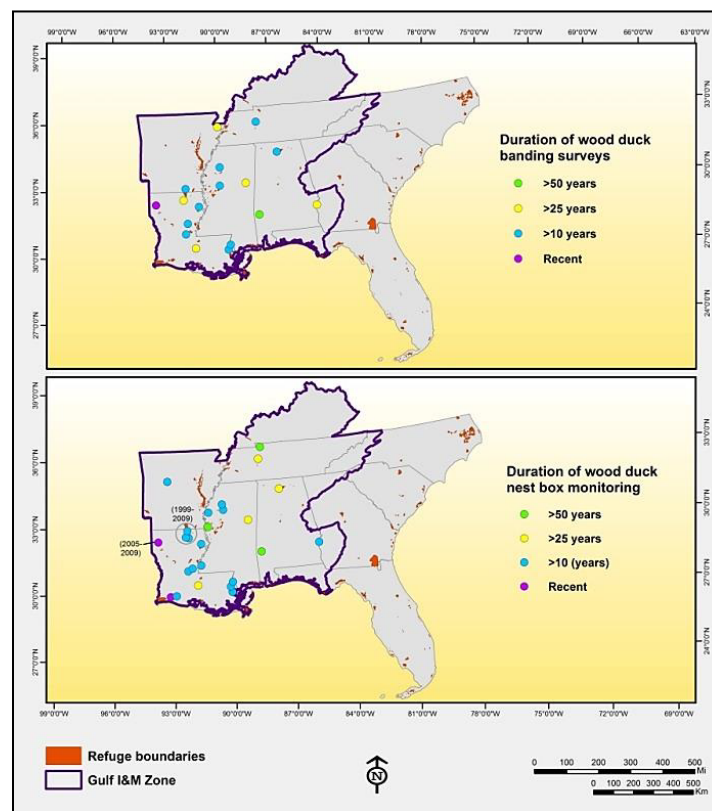


Figure B5. Refuges conducting wood duck banding (top) and wood duck nest box monitoring (bottom).

Bat Monitoring

The coordinated Mobile Acoustical Bat Monitoring (MABM) program is a multi-region USFWS effort centered in the Southeast region to determine baseline species occurrence, monitor population trends, and assess habitat relationships on refuges. Currently 43 Refuges and 2 Ecological Services field offices have MABM routes, which are typically surveyed 2-3 nights per year in June and July (Fig. B6). Most of the MABM participating refuges are located within the Mississippi Valley, though routes are present throughout the Gulf I&M Zone. Other bat inventory and monitoring activities are refuge-based, typically on refuges with a focus on cave habitat.

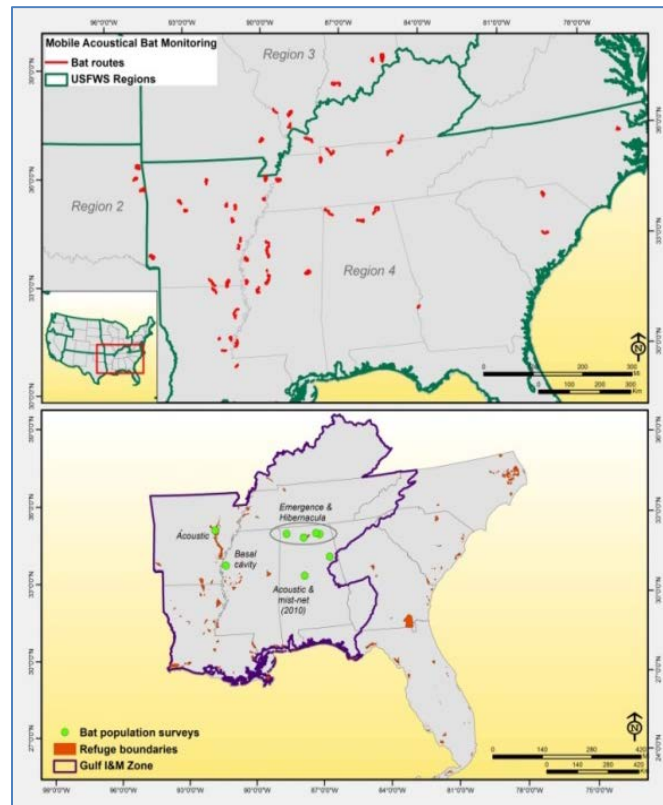


Figure B6. Mobile Acoustical Bat Monitoring program routes (top) and other bat population surveys (bottom).

Freshwater Fish and Mussels

Freshwater mussel and fish surveys are less common on refuges and typically involve conducting a one-time inventory. Freshwater mussel inventories have taken place on 10 Gulf I&M Zone refuges since the late 1990's and have provided valuable occurrence data for several Endangered, Threatened, and Candidate species (Fig. B7). Fish surveys are typically refuge-based, and may be conducted cooperatively with the Division of Fisheries, state agencies, or other research institutions. All refuges should have a baseline inventory of these taxa that is more specific than county or state records, but many do not for some or all of the waterbodies within their boundaries.

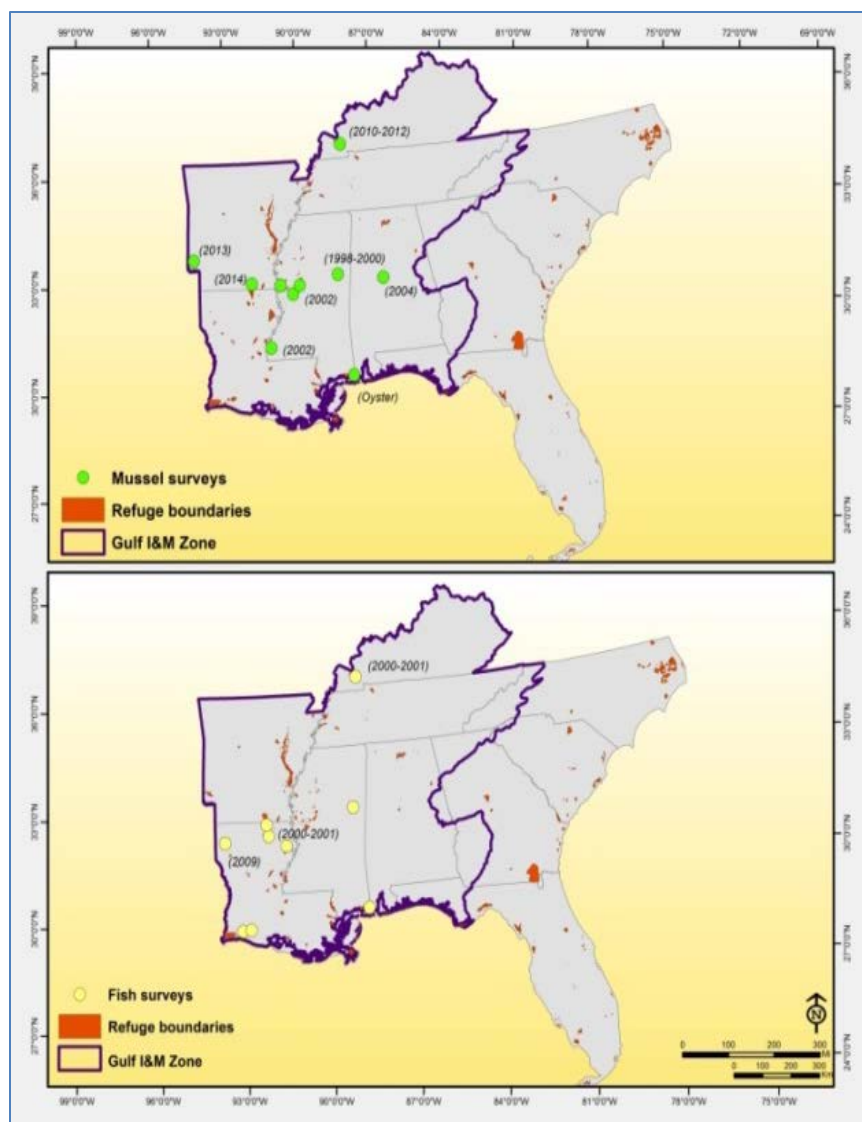


Figure B7. Refuges that have had a freshwater mussel (top) or fish (bottom) inventory conducted in recent history.

Reptile and Amphibian Monitoring

Monitoring of herpetofauna is currently being conducted or has recently been conducted on 27 Gulf I&M Zone refuges. Eleven refuges specified that they currently participate or have recently participated in the cooperative North American Amphibian Monitoring Program (NAAMP) (Fig. B8). Ten refuges specified that they conducted some other type of refuge-based frog survey. An additional 14 refuges specified that they have participated in the cooperative National Abnormal Amphibian Monitoring Project.

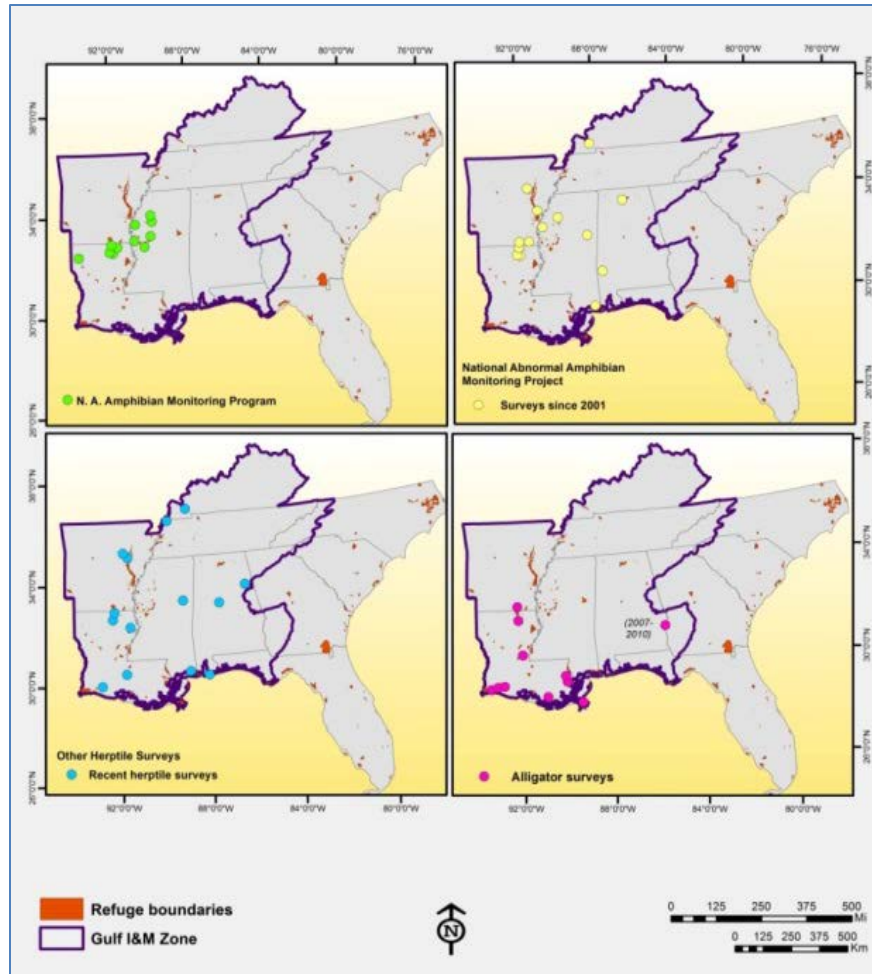


Figure B8. Refuges that indicated they conducted surveys as part of the North American Amphibian Monitoring Program (NAAMP) (top left), National Abnormal Amphibian Monitoring Project (top right), some other general herp survey (bottom left), or an alligator survey (bottom right).

Invertebrates and Fungi

Few (30%) refuges have had invertebrate inventories conducted across this large group of taxa and no refuges specified existing inventories of fungi (Fig. B9). On-going refuge insect surveys consist primarily of butterfly surveys, including participation in the Xerces Society 4th of July Butterfly Count which can provide important inventory information for refuges. The limited other insect surveys are refuge-based and often part of collaborative research projects.

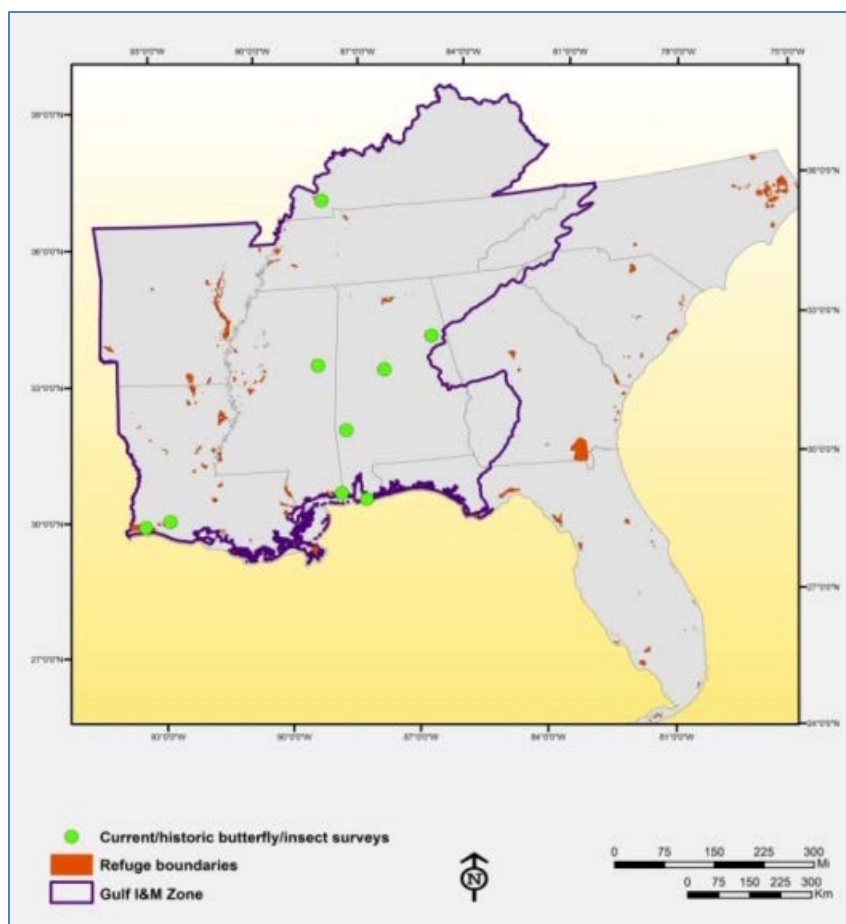


Figure B9. Refuges that recently conducted or have on-going insect surveys in the Gulf Zone.

The quality and thoroughness of species inventories were assessed by asking the level of completeness and documentation of the inventory. For example, 32 of 52 refuges that had an existing inventory of all bird species specified a high level of completeness. In contrast, only 7 of 38 refuges with a mammal inventory specified a high level of completeness, and only 10 of 30 refuges with a fish inventory specified a high level of completeness. This is likely due to partial inventories being completed (e.g., refuge has an extensive bat inventory but lacks information on other mammal species) or relying on species occurrence data from outside sources at the county or coarser scale.

Species Inventory Needs

When refuges were asked to list the top 3 species inventories needed on their refuge, the most commonly listed were plant, invertebrate, and herptile inventories (Fig. B10). Though 53% of refuges specified they had existing plant inventories, 65% stated a high need for plant inventories, indicating that existing inventories of plants may not be complete or sufficient enough to meet refuge management needs. Some refuges specified only particular units or habitats (e.g., forest, dune) have existing plant inventories, and only 7 of the 32 refuges having a plant inventory stated their list had a high level of completion. Few (<10%) refuges specified waterfowl, passerine, wading bird, and shorebird inventories as an important need because most have existing lists of good quality.

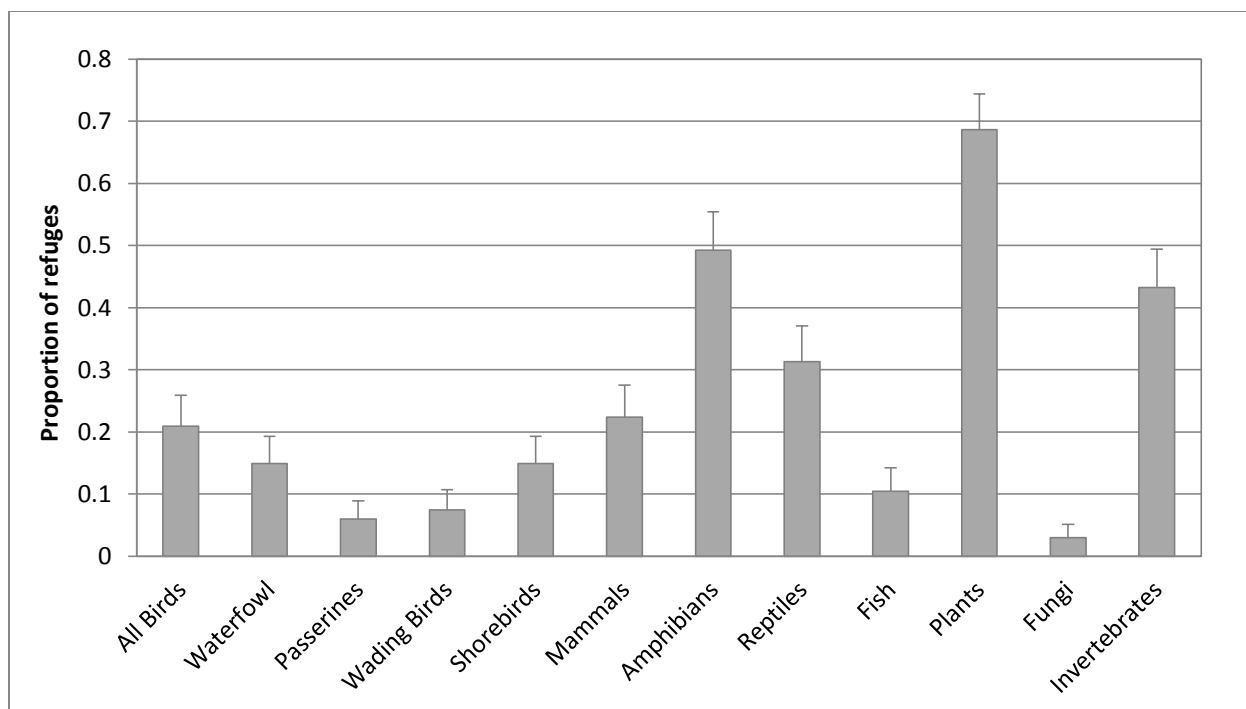


Figure B10. The proportion of refuges specifying they do not have complete species inventories of specific taxonomic groups and need these data.

Opportunities

The assessment of existing and needed biotic inventories provided valuable information about the data needs of refuges in the Gulf I&M Zone. The need for better plant, amphibian, reptile, and invertebrate baseline inventories on refuges is evident. I&M will continue to target important species inventories and work closely with partners (e.g., Ecological Services Division, Natural Heritage Programs, Southeast Aquatics Resource Partnership, Southeast Partners in Amphibian and Reptile Conservation) to strategize and implement key biotic inventories. The National I&M office is also working to develop a centralized species inventory system that will allow refuges to maintain and update species lists. I&M will work with refuges to evaluate the efficacy of some cooperative biological surveys in contributing to refuge inventory efforts and will work with partners to investigate and recommend standardized and scientifically valid monitoring protocols to address refuge population objectives.

Priority Biological Resources

During the Gulf I&M Zone Needs Assessment, refuges were asked to specify the top 5 biological resources (i.e., resources of concern) being managed or protected on their refuge. These are resources that represent the primary species, communities, or ecosystems the refuge manages. We also asked refuges whether they had or currently needed abundance, trend, distribution and condition information about these resources. We defined condition as a measure of population vitality and health. A majority of refuges specified waterfowl, bottomland hardwood forest/forest resources, and forest-dependent/neotropical migrant songbirds as priority biological resources (Fig. B11, also see Wintering

Waterfowl and At-risk Landbirds / Bottomland Hardwood Forest sections in Status and Needs Report for full discussion). Several refuges specified particular species of concern (e.g., red-cockaded woodpecker, Louisiana black bear, etc.) and/or general T&E species; therefore, T&E species in general were also a large component of priority resources.

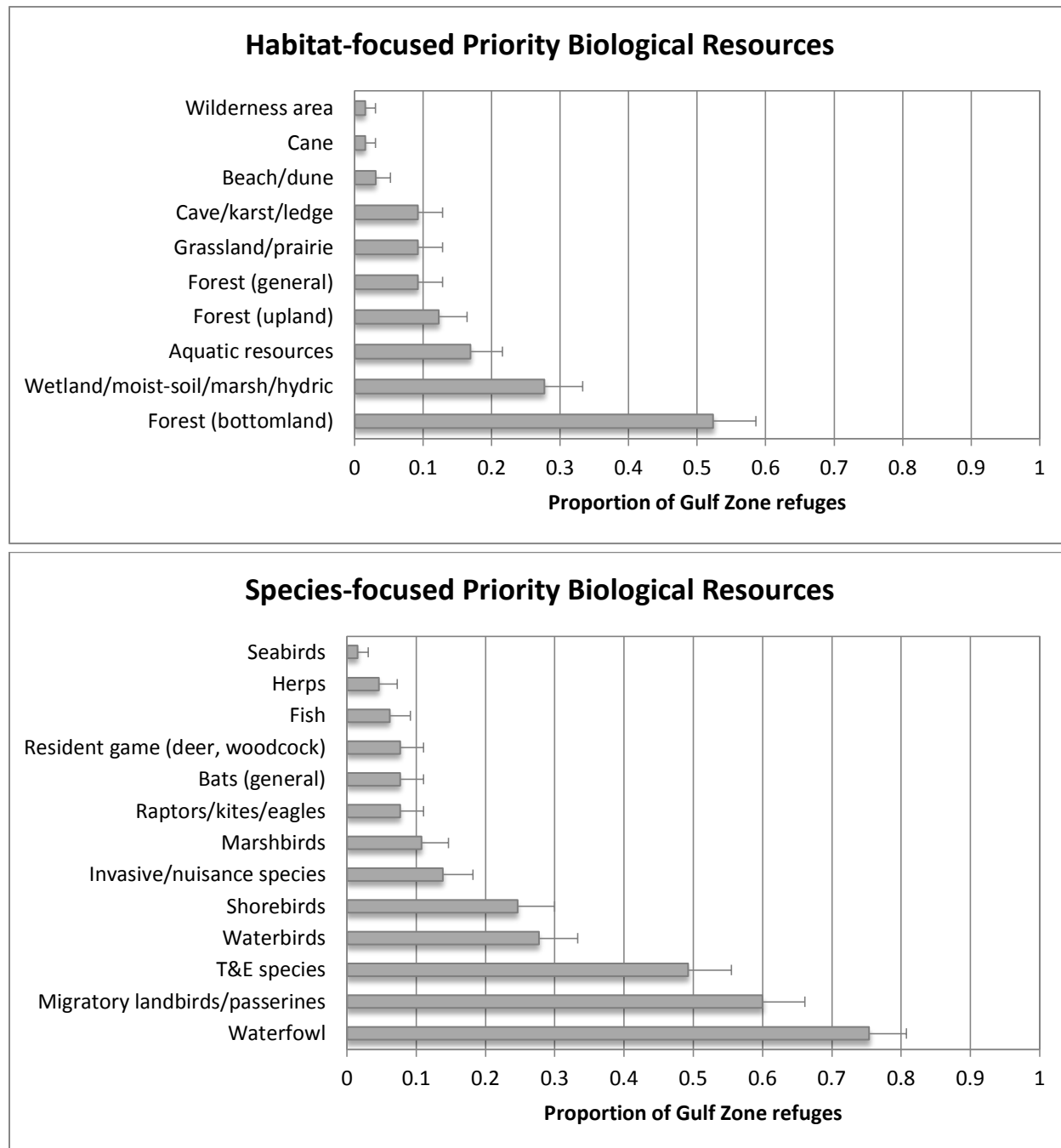


Figure B11. The proportion of refuges specifying a specific resource type as one of their 5 top priority biological resources. Priority biological resources are separated in to habitat and species-focused groups.

Similar to management activities, refuge priority biological resources varied geographically in the Gulf I&M Zone. For example, cave/karst habitat was the top priority habitat resource for the Appalachian LCC geography and the Interior Highlands subgeography of the GCPO LCC (Fig. B12). Wetland and marsh was the top priority habitat resource for the Gulf Coast subgeography, representing tidal marsh, wet pine savannah, and estuarine habitats that are common in this area.

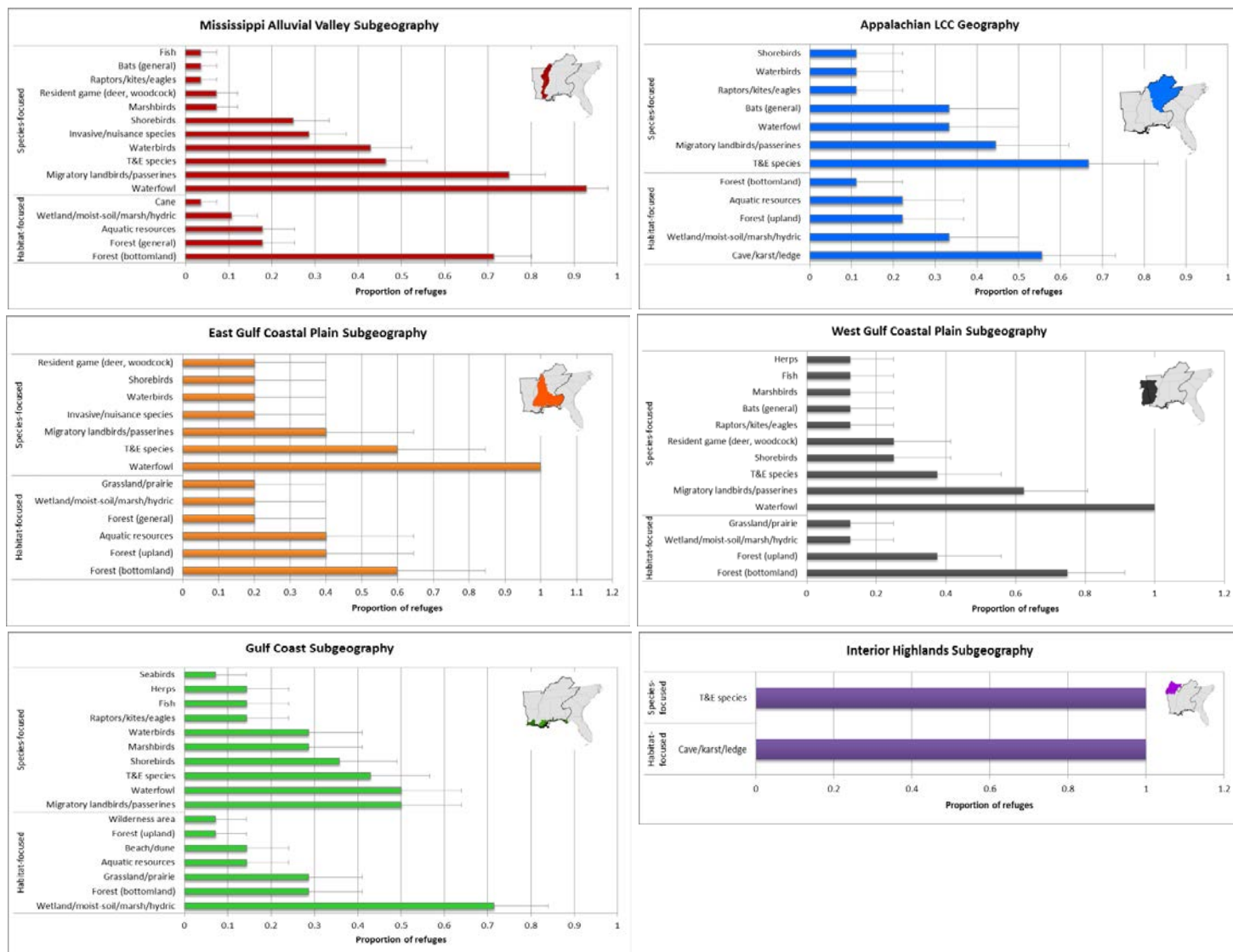


Figure B12. The proportion of refuges in each Gulf Zone I&M geography specifying a specific resource type as one of their 5 top priority biological resources. Priority biological resources are separated in to habitat and species-focused groups.

Refuges were asked to rank their need for various types of I&M support for refuge priority biological resources. The majority of refuges indicated they could most use support for field data collection (78%) and data analysis (57%) (Fig. B13). Assistance with standardized protocol development, database development, and sampling design were the most common second tier refuge support needs, ranked as

medium needs. Most refuges felt they had a low need for I&M support for assessment of legacy data, reporting, setting of conservation targets, and regional/national data sharing. Other I&M support needs specified by refuges included searching for and assisting with attaining alternative funding for monitoring and help accessing reports and data from coordinated research projects on or near refuges.

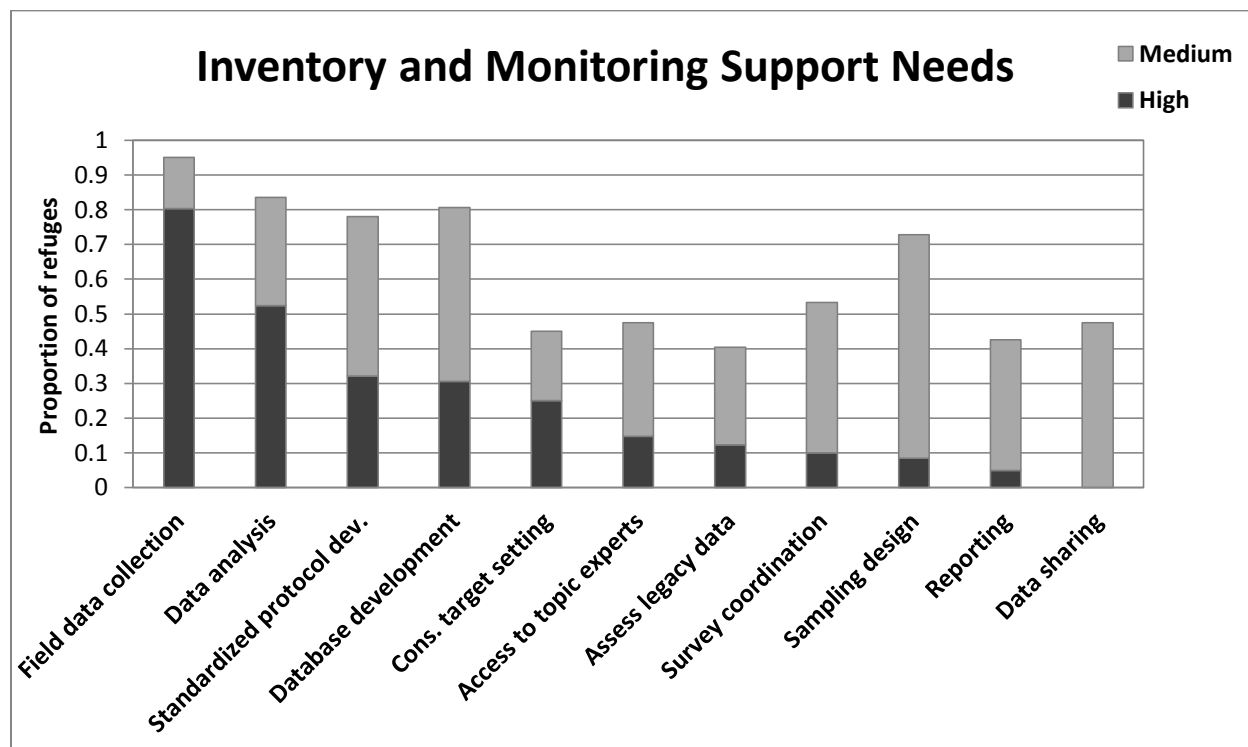


Figure B13. The proportion of refuges indicating a high or medium level of need for inventory and monitoring support by category.

Opportunities

Observed geographic differences in priority refuge biological resources suggest it is critical for I&M and the refuge system to prioritize and target efforts based on areas where a given biological resource is of greatest importance to improve efficiency and effectiveness of our biological program. Refuges expressed a clear need for assistance with field data collection (i.e., assistance with implementation of biological surveys), reflecting an overall refuge feeling that they are short on staff resources (see Field Capacity section of Status and Needs Report). Though I&M staff are limited, we can strategically facilitate assistance for field data collection through mutually beneficial partnerships in addition to I&M staff conducting field surveys when and where possible. Data analysis assistance was also an expressed I&M need by over half of the Gulf I&M Zone refuges. I&M is able to provide guidance and assistance on survey design and analysis, and provide links to additional outside partnerships for data analysis projects.

Refuge Targeted Restoration Activities

Refuges were asked about their monitoring needs for habitat or species-targeted restoration efforts that are on-going on refuge lands. Help with monitoring of reforestation activities, including species composition, tree survival, and succession was requested by 22 refuges (Fig. B14). Monitoring of hydrologic restoration activities, including monitoring of contaminants, water levels, assessment of water control structures and their effects on ecosystem health, and monitoring of moist-soil units, was requested by 11 refuges. Two additional refuges specified they need assistance with monitoring activities related to hydrologic restoration through the Coastal Wetlands Planning, Protection and Restoration Act. Nine refuges need assistance monitoring population changes for specific species, including orchids, bats, pondberry, black bear, RCWs, mussels, snails, and grassland birds. A few refuges (7) expressed a need to monitor prairie restoration efforts at specific units through expansion of long-term vegetation plots and visual monitoring. Five refuges expressed a need to monitor coastal marsh restoration efforts, both pre- and post-establishment, under the Coastwide Reference Monitoring System. Lastly, five refuges indicated a need to monitor current or potential species re-introduction efforts, and specified pondberry, freshwater mussels, cranes, kestrels, and gopher frog as target species.

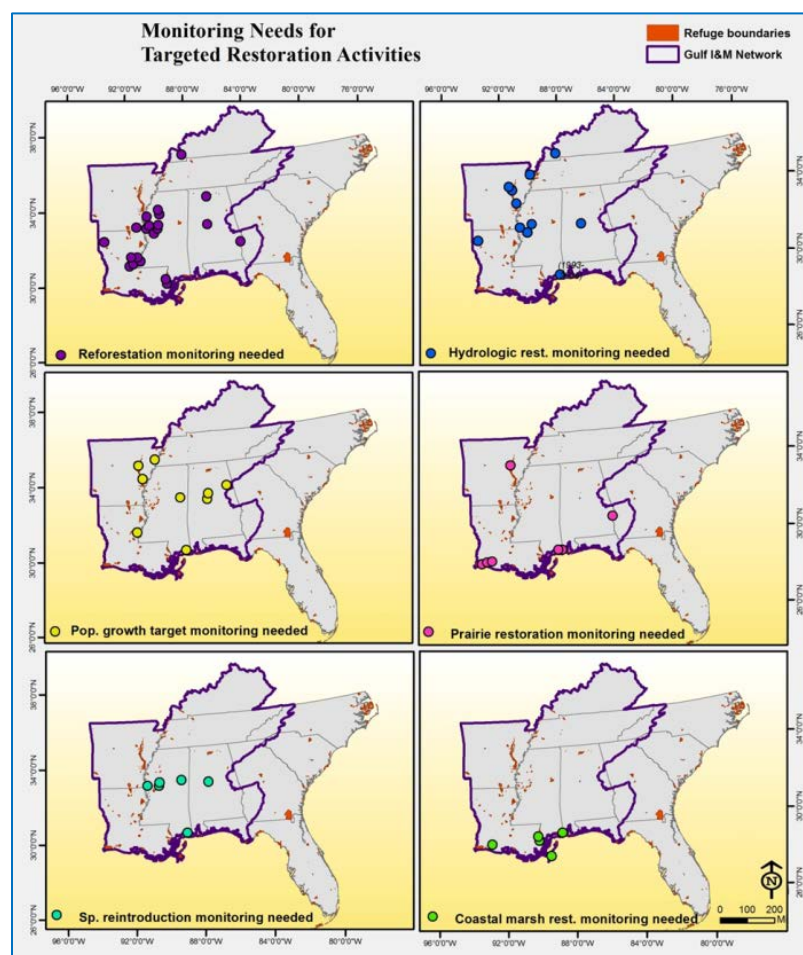


Figure B14. Needs for targeted monitoring of restoration efforts specified by Gulf I&M Zone refuges.

Opportunities

Refuges play an important contributory role toward larger restoration monitoring efforts (e.g., Coastwide Reference Monitoring System). I&M has the ability to serve as a bridge between refuges and other FWS programs and partners to assist in collaborative restoration monitoring efforts, and can provide technical support to assist in refuge-based restoration monitoring to inform local management.

Water Resources

Refuges were asked to address specific resource issues and environmental threats related to water resources on refuge lands (i.e., water quantity and quality) with the objective of identifying water resources inventory and monitoring needs in the absence of any completed WRIs in the Gulf I&M Zone. Water supply was listed as a management issue or concern at 42 (71%) Gulf Zone refuges (Fig. B15). Primary concerns were related to altered hydrology from addition/changes in levee systems related to rivers and reservoirs, irregular seasonality of flooding events, changes in local rainfall, water management by other agencies, and water table reduction. Some refuges were also concerned about their limited ability to control water supply within the refuge. Concerns regarding water management were related to the timing, duration, depth and frequency of flooding in reservoirs and impoundments managed by outside agencies with conflicting goals.

Water quality was a management issue or concern at 39 (66%) Gulf Zone refuges (Fig. B15). Primary water quality concerns were related to runoff from agriculture and household waste, sedimentation, inflow contamination, dissolved oxygen, salt water intrusion, turbidity, PCBs, DDT, mercury contamination, coal, oil, and gas contaminants, fecal coliform, and other general industrial waste. Twenty-nine refuges specified both water quantity and water quality issues were of concern. Thirty-one refuges (53%) have some sort of current or recent effort to monitor water quantity and/or quality occurring on or near refuge land (Fig. B16). However, these water resource data are typically collected and used by state DEQs, university research projects, Army Corps of Engineers, NOAA, municipal water districts, Tennessee Valley Authority, Georgia Pacific, or state game and fish agencies, and not by the refuge, although these data are likely available to the refuge if desired. A few refuges do have staff monitoring water levels to manage water depths for waterfowl and fishing regulations, tracking salinity levels and soil accretion, sampling for contaminants to manage public health issues, and tracking industrial pollution.

When asked what specific gaps in knowledge regarding water resources need to be addressed to more effectively manage refuge resources some refuges specified an overall lack of knowledge about the aquatic system within their boundaries. Others specified a need for more data on depth and flow of streams, ground water levels, agricultural contaminant load, and sedimentation rates. However, there were no outstanding, common themes evident pertaining to water resources knowledge gaps on refuges across the Gulf I&M Zone. Some examples of specific knowledge gaps include:

- “Pathways, inputs, and outputs / overall water budget poorly understood (Hydrological model needed); Impacts of ditches, canal, railroad and road. Estimate of water turn-over rates within system.”

- “Missing flow data/fluctuation of water levels, coal contaminant effects unknown, no baseline data for reclamation projects.”
- “Measure effects on reforestation from ground water table reduction associated with off-refuge agricultural irrigation.”
- “Contaminants Assessment Process (CAP) needed - ground water table reduction measurements from adjacent farming.”
- “Flow data, contaminant sources, climate change vulnerability (rainfall), identification of ecosystem services provided by refuge.”

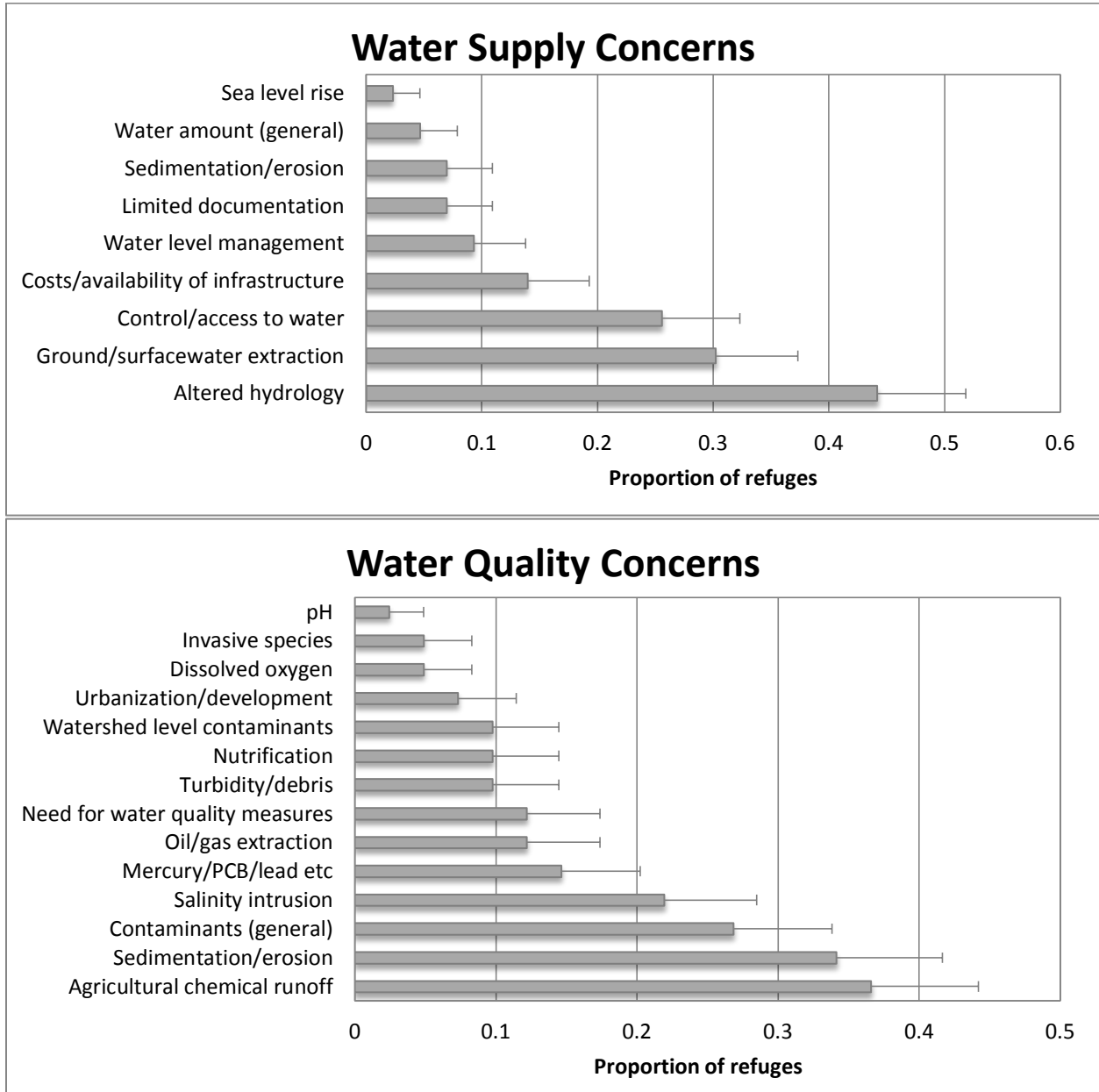


Figure B15. Concerns expressed by refuges specifying water supply/quantity and water quality issues on their refuge.

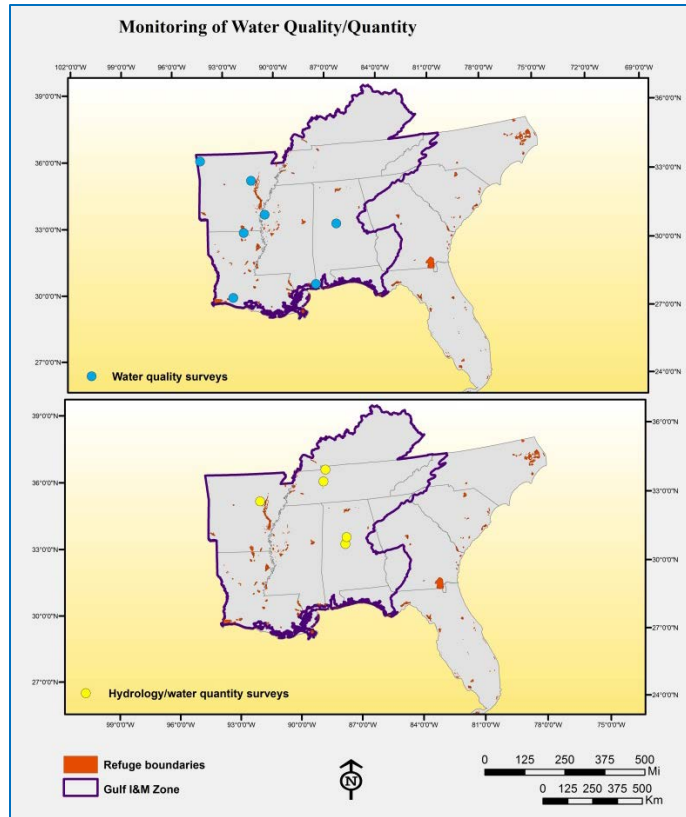


Figure B16. Refuges where water quantity and quality monitoring currently occurs on Gulf I&M Zone refuges.

Opportunities

I&M should continue pressing forward with WRIA assessments and provide support to CAP and HGM assessments where needed. I&M will work with refuges during WRIA assessments to identify key knowledge gaps pertaining to refuge water resource, and provide means to address those gaps. I&M will also provide an important linkage between refuge water management activities and landscape level water assessment projects (e.g., GCPO LCC aquatic flow modeling). In the future and where appropriate, refuges should participate in the coordinated national water monitoring system currently in development by the national I&M initiative.

Climate Change

Refuges were asked about I&M support needs to help understand potential implications of climate change at their refuge. 62% of refuges specified baseline biotic resource inventories as highly needed information to understand potential future effects of climate change (Fig. B17). Nearly half of refuges specified a high need for species vulnerability assessments, and 40% of refuges stated a need for long-term monitoring of biotic resources to track population trends and phenological shifts. These data indicate that comprehensive, quantitative knowledge of the status of refuge resources is generally low across the Gulf I&M Zone. If resources were to change in the future, refuges would have no baseline from which to quantify the changes.

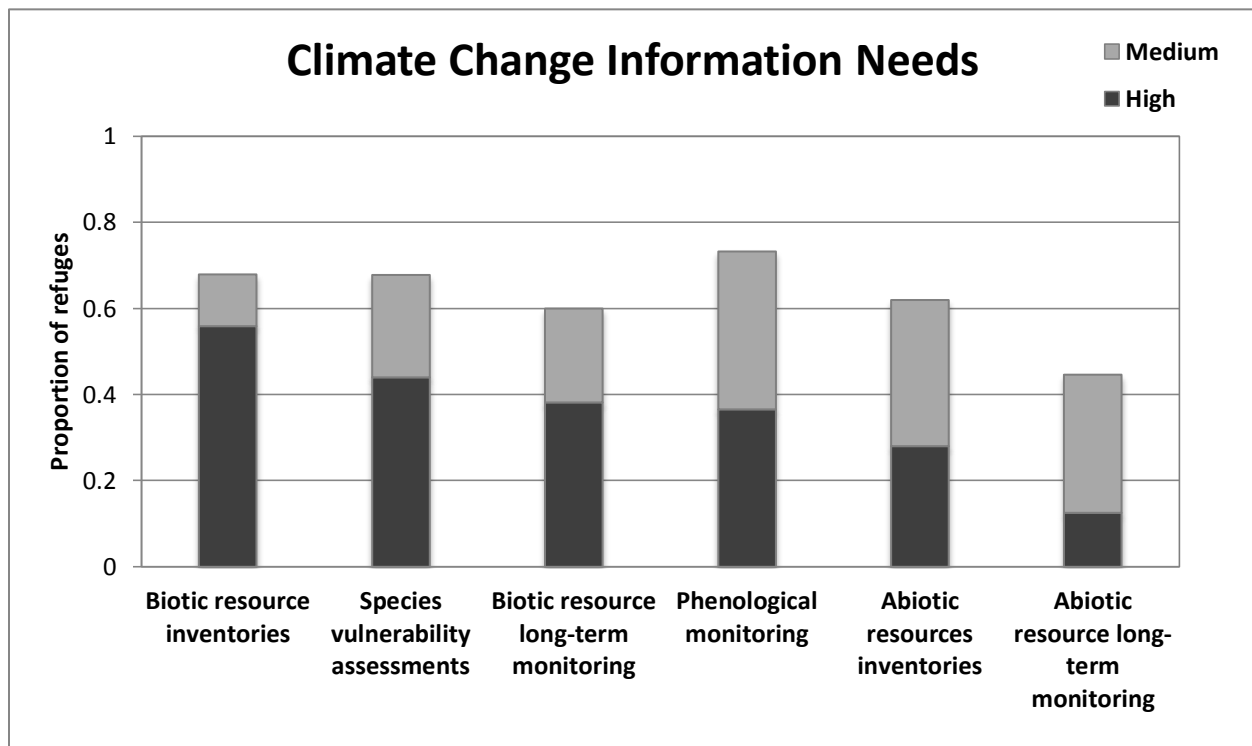


Figure B17. Proportion of refuges specifying a high need for climate change information by category.

The proportion of refuges specifying high needs for I&M support related to climate change information was greater for the Gulf Coast and Appalachian subgeographies of the Gulf I&M Zone (Fig. B18). Biotic resource inventories and long-term monitoring of biotic resources were the greatest need on all refuges in the Gulf I&M Zone subgeographies, except those along the Gulf Coast. Refuges on the Gulf Coast demonstrated greater need for phenological monitoring and species vulnerability assessments than inventory and monitoring of biotic and abiotic resources. This likely reflects a greater perceived threat from climate change related to sea level rise, and changes in precipitation and land and water temperature that may impact species distribution and phenology. Note 60% and 55% of refuges in the East Gulf Coastal Plain subgeography and Appalachian LCC geography also suggested a high need for species vulnerability assessments. Information related to abiotic resources (inventories and long-term monitoring) were suggested to be a low priority in all subgeographies except the Gulf Coast.

Opportunities

I&M will provide a direct bridge between refuges and landscape level partnerships (e.g., LCCs, Climate Science Centers) focusing on climate change vulnerability and adaptation. Refuge-based empirical data will feed landscape-level models of climate change over time.

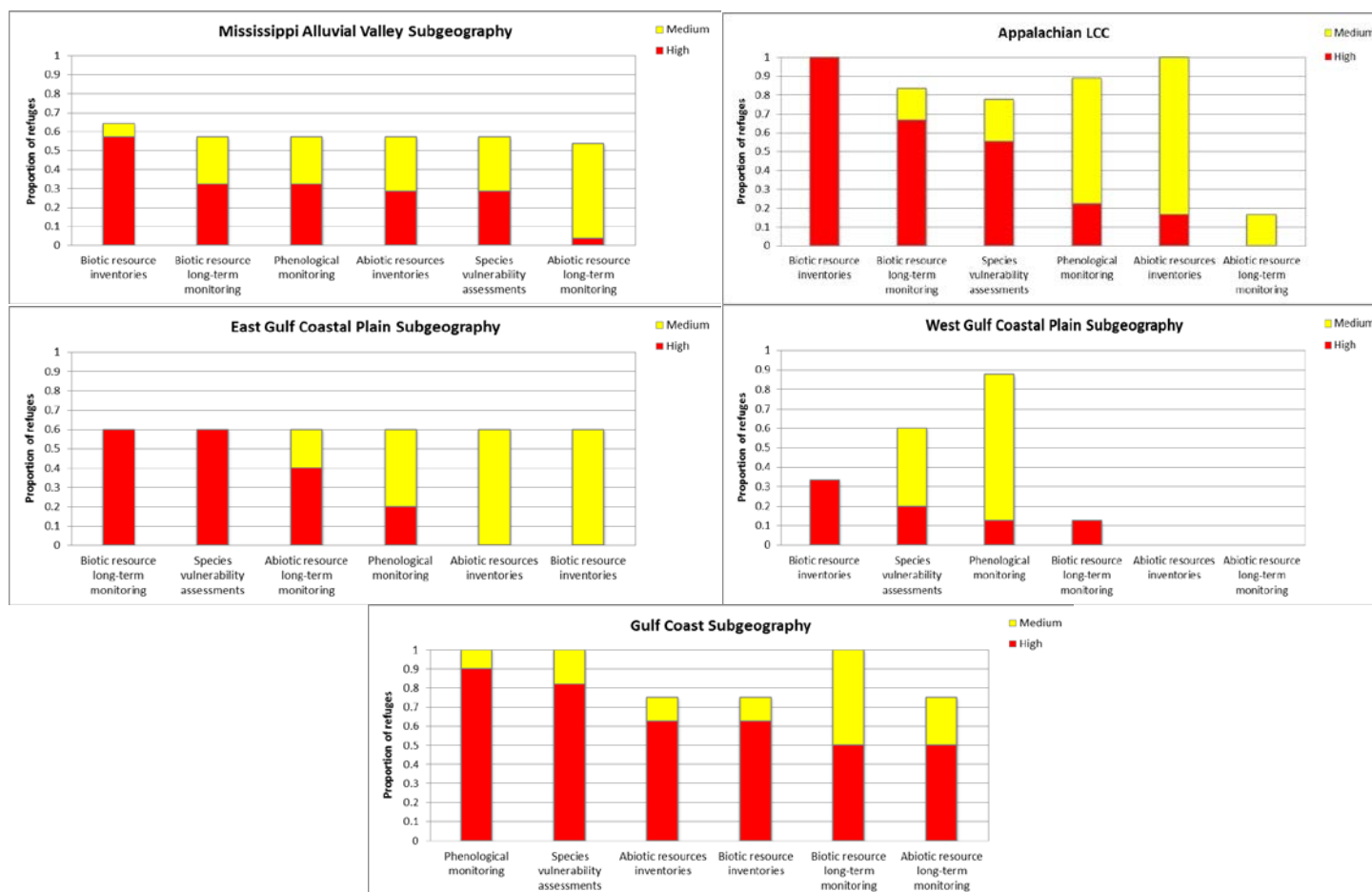


Figure B18. The proportion of refuges in each Gulf Zone I&M geography specifying needs for I&M support regarding evaluating effects of climate change on refuge resources.

Data Management

In the final section of the Needs Assessment, refuge staff were asked to assess their data management strengths and needs. This included capabilities to develop, manage, and analyze both spatial (e.g., GIS) and non-spatial survey data. Results and opportunities are described in detail in the Data Management and Analysis section of the Status and Needs Report. Additional details not discussed there are described below. Specific needs and capabilities for data management and analysis varied by refuge, but were suggested to be adequate on average.

Specific comments regarding data management capabilities and needs on refuges included:

- “Data is stored on a portable hard-drive that is passed around by managing staff.”
- “I know there is information here, but it is difficult to sift through files and find just what I need. Also it is difficult to make sense of previous data gathered.”
- “Varies with species (RCW data is more accessible) and staff/interns. Staff have their own spreadsheets.”
- “Inability to locate data following staff turnover.”

- “Scattered information; multiple storage locations but organized differently.”
- “Good databases, new server, easy for new employees/interns.”
- “Legacy data entry to national/other databases.”
- “Modeling - linking data back to sentinel site.”
- “General constructive criticism from discipline experts and evaluate refuge activities.”

Specific comments regarding data analysis capabilities on refuges included:

- “Staffing constraints”
- “Most analysis is restricted to summary reporting.”
- “Very little data to analyze. Mostly trend data and summary.”
- “Staff would have the capability if they were collecting data that could be analyzed.”
- “If there were more time and resources, better analyses could occur.”
- “Typically no extensive analysis needed, general data summaries done for internal reports.”
- “Biometrician, predictive information for disease, concern I & M may create refuge work load.”
- “Help with complex stats (e.g., detection probability point counts).”
- “Varies by program (forestry, fire, biological, etc...).”
- “Most data collection that we are done is not a subject for statistical analysis.”

Expressed needs regarding management of spatial (e.g., GIS) data on Gulf I&M Zone refuges suggested the greatest needs were on-site staff to manage GIS data, and field support for collection of GIS data (Fig. A21). GIS training for staff, development of GIS data management plans and workflows, and access to GIS data were reported as a low priority for nearly half of Gulf Zone refuges.

Specific comments regarding management of spatial data indicated a greater need for organization and staff resources on refuges and included:

- “Random structure at this point - need organization or dedicated staff.”
- “Someone to convert, project, transfer, import data to web.”
- “Having time to do GIS properly ourselves.”

When asked if the refuges had a centralized database for storing information from multiple refuge activities, 38 refuges (64%) indicated that they did have such a system. The definition of “centralized database” varied among refuges, however. Of those that answered yes, 12 said data was stored in a flat file format (e.g. Excel spreadsheets), 2 said they used relational databases (e.g., MS Access), and 24 said they used a combination of hard copies, flat files, and relational databases. For the 21 refuges that indicated they had no centralized database management system, 8 indicated a high priority need, 9 indicated a medium priority need, and 2 indicated a low priority need for a centralized database management system.

Specific comments related to database capabilities on Gulf Zone refuges included:

- “Currently are dealing with a file maze with spreadsheets in many places; difficult to address and changes so fast.”
- “Need system that is more efficient for when there are data calls.”
- “Staff have a hard-drive to save data which they pass to each other. They also have files in filing box.”
- “Refuge already has organized databases but not linked spatially. Centralized in one location by biologist.”
- “Need for IT person to assist in database management.”
- “Refuge has a server and is just getting folder structure built and SOPs for file mgt.”
- “Refuge is working to get system working on a Shared Drive at Complex HQ.”

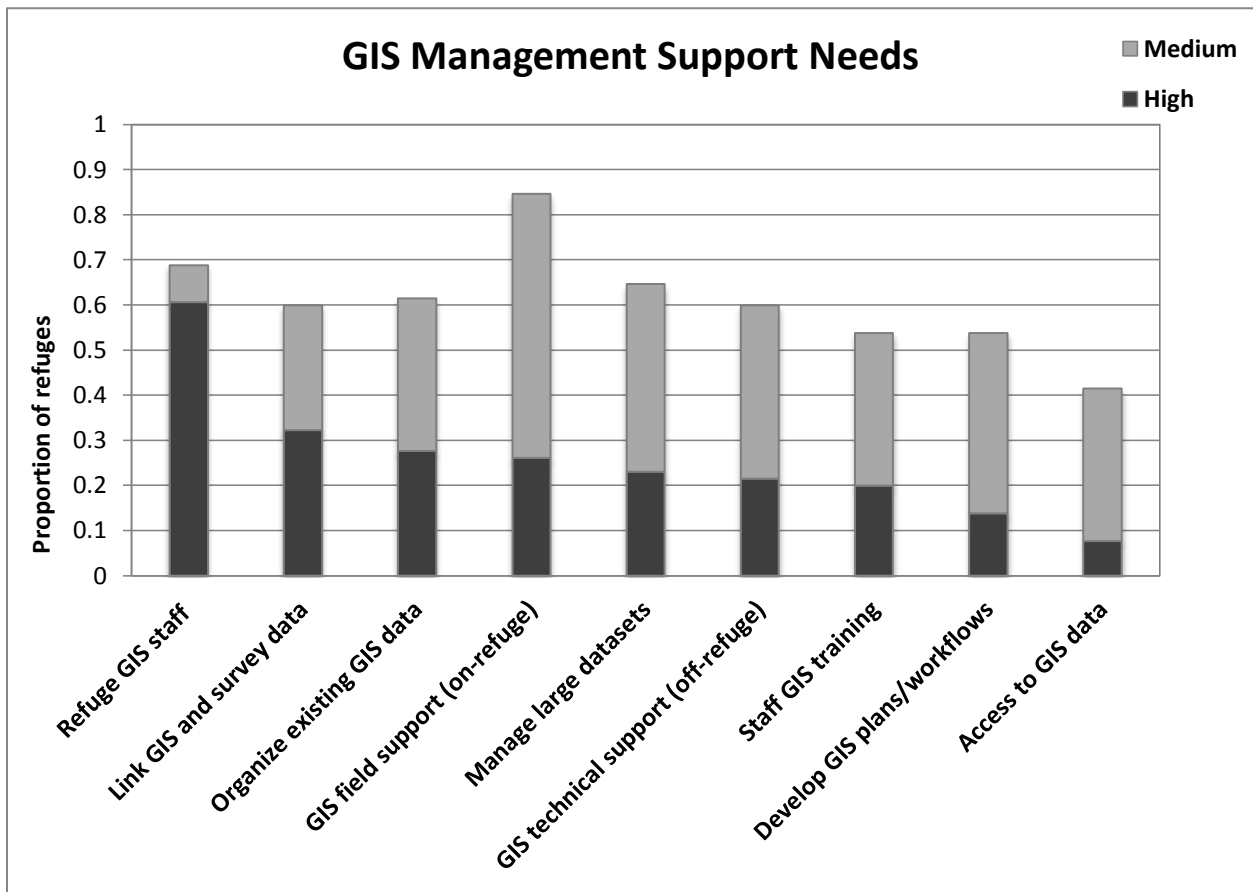


Figure B19. Proportion of refuges specifying a high need for GIS data management support by category.

General Refuge Comments

During the Status and Needs Assessment visit, I&M staff provided the opportunity for refuge staff to submit additional comments pertaining to refuge needs from I&M. Below is a highlight of quotes by topic area taken from the additional comments section of the Needs Assessment.

I&M Capacity

- “Refuge very limited in I&M capabilities due to no dedicated FTE to refuge.”
- “Need for Biometrician at refuges, ability to model invasive species spread/risk, concern over increased work load via the I&M Network.”
- “Staff has not traditionally worked on I&M projects at refuge. Lacks much baseline info.”
- “Interested in how the I&M program will provide input into refuge surveys, (e.g., mandating to do certain annual surveys), any support for on the ground assistance, will biological program be directed by I&M staff to the refuge.”
- “Major weakness: survey implementation (not enough basic qualified people to conduct surveys).”
- “Would like to see a centralized database (e.g. use the cloud) for data dumping and mapping (GIS), etc., that is kept current. This would be helpful in map making efficiency.”
- “Refuges need ways to help meet refuge purposes; help fill in gaps regarding monitoring; help fine tune the refuge purpose; smarter not harder.”
- “Strong need for I&M technical support (e.g., GIS); looking to minimize/simplify workload rather than add additional duties. Don't want to have to spend time researching protocol development if I&M can provide that resource.”
- “Need statistical analysis advice and support as well as time to do this aspect. Support and advice in protocol design and analyses is also needed.”

Habitat Management Activities

- “Concern over monitoring and issues of Source vs Sink concepts for forest bird management.”
- “Refuge is primarily reforested agricultural lands transferred to the USFWS by FmHA. Other than planting trees in fields, no other I&M activities are occurring on the refuge. “
- “Data provided to outside researchers does not come back to the refuge, particularly in a useable management format with appropriate interpretation and recommendation.”
- “Habitat Restoration is the most important focus versus active management. These refuges have different focus than most. Habitat restoration is their only control due to the vulnerability of these refuges to storms, sea level rise, etc”
- “Unique Refuge in the challenges faced for endangered species protection/conservation from human disturbance. “

- “Whooping Crane is also now an important endangered species at the refuge each winter. Condition/health category very difficult to find a common answer for species info needs. Refuge definitely wants a Contaminants Assessment Process (CAP) completed.”
- “Refuge staff feels that they have a unique situation in which they are a small refuge in a larger landscape specifically for LA black bear recovery, which emphasizes the importance of collaboration with partners like the State and Universities.”

Appendix C. Gulf Zone Needs Assessment Data Form

Date: _____ Refuge: _____ Complex: _____

Inventory and Monitoring staff present:

_____	_____
_____	_____

Refuge staff present:

Name	Title

I. Refuge Overview

1. *Identify the status of Refuge planning documents in the table below.*

Plan	Year completed or current status*	Primary contact*	Comments
Comprehensive Conservation Plan			
Habitat Mgt Plan			
Water Mgt Plan			
Nuisance Animal Control Plan (hogs, beaver, nutria)			
Forest Mgt Plan			
Prescribed Fire Plan			
Fire Monitoring Plan			
Other – please list			

2. *Identify the status of resource assessments in the table below.*

Resource assessments	Year completed or current status*	Primary contact*	Comments
Hydrogeomorphic Assessment (HGM)			
Contaminants Assessment Process (CAP)			
Water Resource Inventory & Assessment (WRIA)			
Biological Review			
Other – please list			

3. What are the top three strengths of the Refuge relative to inventory and monitoring of its natural resources (e.g., relationship with local university, friends group, staff with advanced skill set)?

1. _____
2. _____
3. _____

4. What are the top three natural resource management activities that require the majority of Refuge staff time and money (e.g., wetland habitat restoration/enhancement, water management, invasive species management, prescribed fire)?

1. _____
2. _____
3. _____

a. Do you think you have adequate information to make decisions regarding these resource management activities? _____

Comments: _____

b. Are these decisions being made using an adaptive management framework? _____

Comments: _____

II. Biotic Inventories

One of the focal areas of the Inventory and Monitoring Initiative is identifying and developing inventories of biotic and abiotic Refuge resources (*what* resources we have, *where* on the Refuge they are located, *who* observed them, and *when* were they observed). In this section, we focus on the status of species inventories, how the Refuge uses species information to support management, and what additional information is needed pertaining to Refuge inventories.

5. ***What federally listed threatened (T), endangered (E), or candidate (C) species occur on the Refuge (or have the potential to occur). Documentation: Select “Yes” if the Refuge has recent information (e.g., <10 years) on where, when, and who observed the species; select “No” if Refuge does not have documentation within the last 10 years.***

Species	Federal Listing (T/E/C)	Refuge documentation?

6. In the table below, please check the box in column 1 if you have an inventory of species for each taxonomic group, indicate how complete the list is (High = Refuge thoroughly surveyed with records spanning many years; Medium = Refuge partially surveyed or with intermittent records; Low = most or all of Refuge not surveyed or with limited records) in column 4, and indicate how well documented the list is (i.e., includes information about who observed the species, where, and when; High = list is well documented and synthesizes observations from multiple Refuge activities or includes reference specimens; Medium = partially documented, observations only; Low = minimal documentation or undocumented) in column 5. Please check boxes for your top 3 inventory needs in the last column.

Have refuge species inventory?	Taxonomic group	Subgroup	Completeness (H,M,L)	Documentation of list (H,M,L)	Top 3 inventory needs
	All birds				
	Waterfowl				
	Passerines				
	Wading				
	Shorebirds				
	Mammals				
	Amphibians				
	Reptiles				
	Fish				
	Plants				
	Fungi				
	Invertebrates				

7. If you had a database of species observed on the Refuge, what types of species-specific information would you want to have at your fingertips? Please identify the top 3 types of information that would be useful to include in a species observation database from the list or specify other information.

1. _____
2. _____
3. _____

III. Priority Biological Resources

Priority biological resources (Resources of Concern) are the primary species, communities or ecosystems the Refuge manages (e.g., migratory waterfowl, T&E species, sensitive vegetation communities, etc.). This section addresses abundance, trend and distribution information, inventory and monitoring needs, species observations/inventories and vegetation mapping related to priority biological resources.

8. ***What are the top five priority biological resources the Refuge protects or manages?***

1. _____
2. _____
3. _____
4. _____
5. _____

9. In the tables below, please select whether you have and/or need information on abundance, trends in abundance, distribution and condition/health for each of the priority biological resources on your Refuge. Leave box unchecked if you do not have information pertaining to the priority resource. Indicate the need for the information as high (H), medium (M), or low (L) using the list provided.

Priority resource	Have Information			
	Abundance	Trend	Distribution	Condition/health
Example: waterfowl	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Priority resource	<u>Need</u> Information (H,M,L)			
	Abundance	Trend	Distribution	Condition/health
Example: waterfowl	M	H	L	L

10. What inventory or monitoring support do you most need for your priority biological resources? In the table below, identify the support or tools that you have by marking a check in the first column, and rank your needs as high (H), medium (M) or low (L) priority in the second column. Limit high priority needs to a maximum of 3.

Have	Need (H,M,L)	Support/tools for inventory or monitoring priority biological resources
		Conservation target setting (e.g., target acres or population size)
		Sampling design
		Standardized protocol development
		Field data collection
		Data analysis
		Reporting
		Access to topic experts (e.g., botanist, herpetologist)
		Survey coordination with other Refuges/organizations/agencies
		Database development for storing inventory and monitoring data
		Data sharing with regional or national databases
		Assessment of legacy data
		Other – please list

11. Regarding habitat or species targeted restoration activities, do you have any priority monitoring needs? Please check if you are currently monitoring or if you need monitoring in the boxes below.

Restoration Activity	Currently Monitoring	Need Monitoring	Specifics
Hydrologic restoration			
Reforestation			
Prairie restoration			
Coastal Marsh restoration			
Species reintroduction			
Species population growth targets			
Other			

IV. Vegetation and Hydrological Mapping

12. Do you have a vegetation map? _____

a. Please select if it is digital (i.e., GIS-based) or paper? _____

b. What Vegetation Classification System was used (e.g., SAF type, National Vegetation Classification System, HGM Wetland Vegetation Classification, Refuge Defined)?

c. What part of the refuge does the map cover (e.g., entire, wetlands, pine forest)?

13. Do you have a hydrologic or wetland map? _____

a. Please select if it is digital (i.e., GIS-based) or paper? _____

b. What Classification System was used (e.g., Cowardin Wetland classification, refuge based)?

14. Who can answer detailed questions about the vegetation and/or hydrologic/wetland map (scale, methods, etc.)?

15. Do you have information documenting the historical (pre-European settlement) ecological conditions on the Refuge (e.g., historical vegetation types, hydrology, fire frequencies and/or wildlife)? _____

a. Please select below if this information is of High, Medium or Low value to the refuge.

Value: _____

V. Natural Resource Threats

This section addresses environmental threats that can negatively impact Refuge resources. The purpose of this section is to understand the threats affecting the Refuge and to identify Inventory and Monitoring support needed to monitor the impacts of these threats.

16. *Please check the top three environmental threats that currently impact Refuge resources.*

Top 3 threats	Threats	Specifics
	Water quantity or quality conditions	
	Invasive species (plants or animals)	
	Native nuisance species (e.g., beaver, predators)	
	Pest Plants (native)	
	Environmental contaminants	
	Changes in disturbance regime (e.g., fire, flood)	
	Disease	
	Human use/disturbance	
	Other – please list	

VI. Water Resources

This section addresses specific resource issues and environmental threats related to water quantity and water quality. The objective of this section is to identify water quantity and quality inventory and monitoring needs that impact your ability to achieve Refuge goals and objectives. This section builds on information already collected in May/June 2012 associated with the Water Resources Inventory and Assessment (WRIA) process prioritization for Region 4.

17. Is Refuge water supply a management issue or concern? _____

If yes, please identify the top three issues or concerns:

1. _____
2. _____
3. _____

18. Are water quality impacts to Refuge resources a management issue or concern? _____

If yes, please identify the top three issues or concerns related to water quality:

1. _____
2. _____
3. _____

19. Are there any water-related infrastructure or restoration activities currently underway or in the planning stage at the Refuge? _____

If yes, please specify any plans for pre- or post-assessment (monitoring)?

20. Do you or another agency monitor Refuge water quantity and/or quality? _____

If yes, please select the top three uses of this data by the refuge from the list provided below.

1. _____
2. _____
3. _____

21. What gaps in knowledge related to water quantity or water quality issues need to be addressed for more effective management of Refuge resources (e.g., flow data, land use change, contaminant sources, vulnerability to climate change)?

VII. Invasive Species

22. Have you inventoried (abundance, distribution, or presence/absence) or are you actively monitoring any invasive species? _____

- a. If yes, please specify what species and please check whether you are conducting an inventory or monitoring (check both when applicable).

Species	Inventory	Monitoring

23. What invasive species are the greatest threats to refuge resources?

24. What types of invasive species Inventory and Monitoring support or information would be useful to you? In the table below, indicate whether you already have support by checking the first column and rank your needs as high (H), medium (M) or low (L) priority in the second column. Limit high priority needs to a maximum of 3.

Have	Needs (H,M,L)	Invasive species management support
		Baseline inventory (distribution, abundance, mapping)
		Inventory or monitoring protocol development
		Data management and storage
		Data analysis
		Early detection of highly invasive species
		Predict the future spread of invasive species
		Other – please list

VIII. Climate Change

25. What information would be most useful to you to understand how climate change will affect Refuge resources? In the table below, identify support you already have by checking the first column and rank your needs as high (H), medium (M) or low (L) priority in the second column. Limit high priority needs to a max of 3.

Have	Needs (H,M,L)	Climate change support
		Baseline inventories of Refuge <u>abiotic</u> resources
		Baseline inventories of Refuge <u>biotic</u> resources
		Long-term monitoring of <u>abiotic</u> resources to track trends
		Long-term monitoring of <u>biotic</u> resources to track trends
		Assess vulnerability of species, habitats, or ecosystems to climate change
		Phenological monitoring (e.g., migration arrival/departure, plant development)
		Other – please list

IX. Data Management

This section addresses data management needs. In this section, we are trying to assess what your current level of support is, where the gaps in support are and to identify your greatest needs. The information will help us prioritize GIS and data management projects and identify projects that will provide assistance to multiple Refuges.

26. How would you rate survey and monitoring data management at your Refuge on a scale of 1 – 10?

10 = Easy to find documents and data. Refuge management activities and outcomes are well documented. New staff can easily pick up the system. Files can be shared or accessed by others within and outside FWS.

5 = It takes a little time to find documents. Refuge management activities and outcomes are partially documented. It requires a few months or a year for new staff to figure out the system.

1 = Difficult to find documents and staff frequently have to redo things because originals cannot be found. Refuge management activities and outcomes are not well documented. New staff start their own systems because the existing system is difficult to work with.

Rating: _____

Comments: _____

27. Does the Refuge use Refuge Lands GIS (RLGIS) for data management? _____

If No, does the Refuge have its own structured system of data management? _____

28. What are your greatest GIS needs? Rank your needs as high (H), medium (M) or low (L) priority. Limit high priority needs to a maximum of 3.

Needs	GIS management support
	Someone to do GIS work
	Additional GIS training for staff
	GIS technical support (someone to call when you have questions)
	GIS technical field support (someone to come to the Refuge and develop datasets)
	Accessing GIS data
	Organizing existing GIS data to improve efficiency
	Developing plans/workflows for GIS data collection and management
	Large datasets such as LiDAR data collection or vegetation mapping
	Linking spatial (GIS) data with survey data
	Other – please list

29. Does the Refuge have a centralized database for storing information from multiple Refuge activities? _____

a. If yes, please indicate the type of data management system the Refuge currently uses by selecting from the list below:

b. If no, please indicate if this would be a High, Medium or Low priority need? _____

c. Comments: _____

30. What are your most urgent survey and monitoring data management needs? Rank your needs as high (H), medium (M) or low (L) priority. Limit high priority needs to a maximum of 3.

Needs	Data management support
	Someone to enter data from hard copy data sheets
	Training for staff on development and maintenance of databases
	Off-site database technical support (someone to call when you have questions)
	On-site database technical support (someone to come to the Refuge and develop databases)
	Linking survey data to spatial data (GIS)
	Organizing and maintaining/updating data
	Developing plans/workflows for data collection and management
	Analyzing data stored in databases
	Archiving long-term data
	Other – please list

31. How would you rate data analysis capabilities at your Refuge on a scale of 1 – 10?

10 = Can rapidly analyze data using advanced statistical methods with various specialized software programs and generate informative figures and tables.

5 = Data analysis takes some time but includes a combination of basic statistical methods and summaries. Specialized software is sometimes used. Figures and tables are adequate.

1 = Data presentation is limited and typically only summary in nature.

Rating: _____

Comments: _____

Additional Comments:
