CHAPTER 8. RESEARCH AND MONITORING

Research and monitoring aspects of this plan are complex. Clearly they should be:

- Hypothesis-driven with clearly defined objectives
- Based on sensitive indicators of change
- Based on mechanistic or causal relations between indicators and system state
- A sampling strategy appropriate for detecting change
- A format and framework for organizing, analyzing, and storing, and retrieving monitoring data
- A procedure for incorporating monitoring results into future decision making

During the development of the CWCS, one issue that surfaced repeatedly from researchers, managers, and the public in general was the critical need for a depository for wildlife issues and information in Louisiana. Specifically, a database is needed that contains current statewide research or monitoring efforts with specifics such as principal investigator or primary contact, organization, research methods, target species and habitats, etc. It was evident that university researchers, federal and state agency biologists, and the public wanted and could benefit from having access to this information. In light of this, LDWF developed a list of projects on federal and state-managed lands. This quickly expanded to include all research in the state that could provide additional information on habitats or species of conservation concern outlined in the CWCS. Appendix P lists more than 500 biological research and monitoring projects currently under way in the state and this list, in an expanded version that includes cooperators, principal investigator, and project date, will be made available on the LDWF web site. These projects include monitoring species populations and habitat conditions. Much of the list is current biological monitoring occurring on federal and state managed areas (refuges, management areas, parks, etc.). In addition, Appendix Q discusses coastal restoration and monitoring efforts currently ongoing or proposed in Louisiana's coastal zone. LDWF is committed to continuing monitoring projects currently ongoing within the agency or funded by this agency, to developing new monitoring projects tailored to species in conservation need and their habitats, and to annually updating this list, and making it available on our web site.

A comprehensive monitoring plan arguably includes review at both the biological and programmatic levels. As an agency with a mandate to conserve our wildlife and its habitat, LDWF tends to stress biological monitoring. Though necessary, this approach is expensive. In fact, the development and implementation of a monitoring plan may very well consume the bulk of available SWG funds. The development of any detailed monitoring plan will address the issues of scale (geographic and temporal), but its depth will be ultimately determined by affordability. The development of the CWCS has helped to solidify the need for a detailed comprehensive monitoring plan for wildlife species of conservation concern. To achieve this goal, our adaptive management approach will track that identified by Schoonmaker and Luscombe (2005).

A. Research

The CWCS is divided into 38 habitat types across 6 ecoregions, 12 aquatic basins, and 6 estuarine habitat types. Research needs are often provided within each basin/habitat type description (Chapter 4). As such, the CWCS will drive most of the research and monitoring activities funded through Louisiana's share of the SWG program. However, this was certainly not intended to be a complete list and the topics considered are fluid. Conceptually, LDWF views allocation of SWG funds for research and monitoring as a three-tiered program:

- LDWF-developed research and monitoring projects based on species and/or habitat needs specified in the CWCS
- Partnerships with outside contractors (universities, NGO's, industry, etc.) to develop projects based on species and/or habitat needs specified in the CWCS
- Proposals submitted to LDWF from the research community, business community, and the public based on species and/or habitat needs specified in the CWCS

Priorities for SWG projects are determined through a combination of factors including: relevance to species and/or habitat priorities identified in the CWCS, project design, feasibility and cost, and the amount of currently available funding. The LDWF SWG Core Committee will rank project proposals using the above set of defined criteria along with other criteria still under development. Table 8.1 contains a list of all past and current SWG projects in the state.

However, as exemplified by the 500-plus monitoring and research projects which are almost exclusively funded without SWG funds, other research activities will continue to provide vital data of fish and wildlife resources in the state. With the development of the CWCS, many academia, state, and federal staff were able to provide input into research needs. The SWG program will only be able to fund a fraction of the work that will be an integral part of expanding our knowledge base for accomplishing our goals. It is recognized that each individual institution will have its own research and monitoring interests and specialties. Nonetheless, we believe that the CWCS will serve to focus everyone on the conservation needs while allowing institutions to continue to maximize the use of their expertise.

B. Database Needs

Currently there is no single data management system in Louisiana. Although over 500 habitat and species oriented studies are currently being conducted in the state, the availability of data for modeling, determination of habitat changes, species abundance by habitats, etc. are not stored in the same database management systems, collected with the same protocols, easily retrievable, nor available for the entire wildlife community. Developing a central data storage/retrieval system is of paramount importance for accurate assessments (baseline and long-term) to be made. It may be possible to utilize

Table 8.1. State Wildlife Grants Projects from 2002 to 2004.

Year*	Grant #	Project Title	Status
2002	T-1	Planning Grant (involving multiple projects)	Closed 06/30/03
	T-2	Implementation Grant (involving multiple projects)	Closed 06/30/03
	T-3	Avian/Herp WMA Studies (Ouachita, Russell Sage, Sicily Island Hills, Buckhorn)	Completed - 06/30/05
	T-4	Wood Thrush Study	Completed - 06/30/05
	T-5	Avian/Herp WMA Studies (Sherburne, Sandy Hollow, Ben's Creek)	Completed - 06/30/05
	T-6	Avian/Herp WMA Studies (Big Lake, Dewey W. Wills, Red River, Three Rivers)	Completed - 06/30/05
2003	T-7	SWG Coordination and CWCS Development	Ongoing - ends 06/30/06
	T-8	Gulf Sturgeon Winter Habitat Study	Completed - 06/30/05
	T-9	Identifying Swallow-tailed Kite Activity Centers	Completed - 06/30/06
	T-10	Statewide S1/S2/S3 Species Research	Ongoing - ends 12/31/06
	T-11	Statewide Wading Bird and Seabird Nesting Inventory	Ongoing - ends 06/30/06
	T-12	Database for Tracking S1-S2-S3 Species	Ongoing - ends 06/30/06
	T-13	Breeding Bird Surveys Improvements	Completed - 06/30/05
	T-14	Louisiana Marine Animal Stranding Network	Completed - 06/30/05
	T-15	Louisiana Statewide RCW Safe Harbor Agreement	Ongoing - ends 12/31/06
	T-16	Natural Areas Registry Program	Ongoing - ends 06/30/06
	T-17	Avian/Herp WMA Studies (Spring Bayou, Pomme de Terre, Tunica Hills, Pearl River)	Ongoing - ends 06/30/06
	T-18	Waterbird Study	Ongoing - ends 06/30/06
	T-19	Statewide Big River Fish Inventory	Ongoing - ends 06/30/06
	T-20	Ornate Box Turtle, Crested Caracara and Burrowing Owl Habitat Study	Completed - 06/30/04
	T-21	Natural Heritage Statewide Workshop	Completed - 06/30/05
	T-22	Savanna Sparrows Project	Ongoing - ends 06/30/06
	T-23	Lake Maurepas Ecosystem Breeding Bird Study	Ongoing - ends 06/30/06
	T-24	Herp WMA Studies (Bayou Pierre, Loggy Bayou, Jackson-Bienville)	Ongoing - ends 06/30/06
	T-25	Avian WMA Studies (Bayou Pierre, Loggy Bayou, Jackson-Bienville)	Ongoing - ends 06/30/06
2004	T-26	Avian/Herp/Mammal WMA Studies (Bayou Macon, Boeuf)	Ongoing - ends 06/30/07
	T-27	Identifying, Prioritizing, and Conserving Important Bird Areas in Louisiana	Ongoing - ends 06/30/08
	T-28	Survey for S1 Amphibians in St. Tammany Parish	Ongoing - ends 06/30/06
	T-29	Alligator Snapping Turtle Study	Ongoing - ends 12/31/06
	T-30	Sherburne WMA Bird Productivity and Survivorship Study	Ongoing - ends 06/30/06
	T-31	WMA Water Management for Migrating Shorebirds	Ongoing - ends 06/30/06
	T-32	Statewide Henslow's Sparrow Study	Ongoing - ends 06/30/08

* Based on the fiscal year beginning July 1

existing systems such as the National Biological Information Infrastructure (NBII). Whichever system is used, it must allow easy access to data for appropriate baseline and impact assessments yet must be secure enough so that data utilization without permission can not occur.

As important as establishing a data clearinghouse is, it is just as important to understand how the data were collected and what the data mean. If different protocols for studies are used in the data collection phase, pooling across data sets may not be appropriate. This could result in the erroneous interpretation of results thus negatively impacting assessment efforts. As such, it is extremely important that monitoring efforts be standardized whenever possible. When the first SWG funds were allocated, LDWF worked collaboratively with academia, the USFWS, and the USGS to develop standardized protocols. These were consistent with the most current methodological practices and would allow for comparisons among sites within and outside of Louisiana. Further, if standardization is not possible, collection protocols for each data set must be documented to allow for appropriate interpretation or application and allowance of acknowledgement of weaknesses. There are a number of sources for standardized protocols including the USGS through its Status and Trends of Biological Resources Program (USGS 2005).

C. Biological Monitoring

The primary goals of our biological monitoring are to guide the ongoing management of populations and habitats, and to detect long-term population changes in species. Monitoring was divided into 2 major categories: terrestrial and aquatic. Terrestrial monitoring/population estimation will be conducted on the ecoregional scale, and, in some instances, across ecoregions. For aquatic habitat monitoring, freshwater systems were divided into drainage basins while estuarine/marine systems follow the 7 coastal study areas (Fig. 2.12) as currently defined by the LDWF's Marine Fisheries Division. We also recognize that localized research and monitoring will provide critical data for species of restricted range and small populations. However, conceptually, the bigger long-term question that we want to address is whether we impacted the ecoregion and not one small specific site.

1. Terrestrial Habitats and Species

Identification of changes in habitat is critical to the assessment of the effectiveness of the CWCS for wildlife species. Currently the location and size of many of the LNHP habitat types are not explicitly identified spatially or quantitatively. Providing this information in both spatial and tabular format will be one of the first actions undertaken by LDWF, and SWG funds have already been allocated to begin this task. However, it is likely that even broader habitat categories will be used for determination of habitat status for some wildlife species with less specific habitat needs. From some faunal perspectives, the habitat type per se is probably less important than the structural composition of that habitat. Other sources of habitat data include the USFS Inventory and Analysis (FIA), the NRCS National Resources Inventory (NRI), and the Louisiana GAP analysis. In addition,

a number of state and federal agencies monitor programs designed for habitat enhancement and/or restoration. These include, but are not limited to, NRCS, FSA, USFWS, and LDAF, which have programs that encourage reforestation and forest management as well as native grass planting and wetland restoration. Habitat monitoring is an integral part of the CWCS because our underlying premise, as with most habitat programs, is like that of the film *Field of Dreams*—"build it and they will come".

Bird Monitoring

In considering species issues, a number of different approaches for monitoring avian trends/densities for breeding birds were evaluated for the CWCS and 3 are presented in this initial draft because they provide a means of evaluating change at the landscape level. Additionally, we believe the 3 methods provide a mechanism to confirm apparent trends suggested by Breeding Bird Survey (BBS) data and fit well into population goal assessments for programs such as PIF. However, it should be recognized that the All Bird Monitoring Program protocols, which are not finalized as yet, might become the prominent avian monitoring program. Further, specific research projects on Louisiana's avian species of concern resulting from implementation of strategies and research needs listed within specific habitats will provide other indices as to their current status on more local scales.

Bird Monitoring - Approach A.

The current BBS design has approximately 4 routes per degree block in Louisiana for a total of 59 routes. These data, along with data collected throughout the United States, Canada and Mexico, are currently used to make inferences relative to the current status and trends of bird populations. Based on minimum point sampling provided by USGS guidance, this should be more than sufficient to identify trends within an ecoregion. However, from an avian perspective, BBS data for Louisiana often are only analyzed within 4 broad habitat strata: Coastal Prairie, Coastal Flatwoods, Upper Coastal Plain, and Mississippi River Alluvial Plain. One drawback with BBS routes is the expertise required to run the routes. As a consequence, limitations in personnel/volunteers frequently result in some routes not being run from year to year. Nonetheless, we believe this can provide a good index for breeding bird abundance trends within ecoregions or the 4 broad habitat strata. In addition, a concerted effort will be made to recruit enough people with sufficient proficiency in bird identification to run all BBS routes in Louisiana every year. One of the SWG projects was to provide monetary compensation to BBS volunteers to cover a portion of their expenses associated with running their routes.

Bird Monitoring - Approach B.

This approach would use a group of umbrella species to determine the status of species of concern. One advantage of this approach is that it does not require someone who has the expertise to identify all birds by song. As such, LDWF staff/volunteers could more easily be trained and all BBS routes would have a better chance of being run each

year. Additional routes could be added in the future to provide better estimates by ecoregion.

Bird Monitoring - Approach C.

A more complicated approach could provide more quantitative estimates of impacts. This approach would involve developing density estimates for broad habitat types (pine sawtimber, pine poletimber, pine sapling/seedling, etc.--something that could be derived from the FIA data or GAP data) based on the various fixed and variable distance point counts that have been made across the state by different researchers/agencies. Mid-cycle data or net changes of other conservation practices in the state could be used for re-estimation. For example, a number of agencies have programs that contribute to positive habitat impacts. One such agency is the NRCS. Increases in acres of habitat x (such as longleaf pine) could be tracked over 5-year intervals and estimates of the expected impact could be projected based on fixed and variable distance point counts for that habitat type and its successional stage. Obtaining adequate data for this estimation may necessitate pooling across ecoregions. This should not be an unrealistic assumption from a bird perspective, particularly in light of BBS data analyses often conducted at only 4 broad strata for Louisiana. This evaluation provides an estimate independent of the BBS and can serve as a verification tool of trends exhibited in approaches A and B that use BBS protocol.

Other Bird Monitoring

Not all birds lend themselves to detection with BBS-type surveys. Rookeries, bald eagles, and swallow-tailed kites will continue to be monitored by aerial and on-the-ground surveys. Additionally, monitoring programs for shore birds will be done through continued and expansion of counts using Program for Regional and International Shorebird Monitoring (PRISM) protocols. Colonial waterbirds will be monitored by air and on the ground via LDWF personnel and contractors. Some form of monitoring program must also be developed to track nocturnal bird species.

Amphibian, Reptile, and Small Mammal Monitoring

Amphibian, reptile, and small mammal species are more problematic in their monitoring for a number of reasons including:

- the need to have access to private properties for many of the surveys
- non-random or limited distribution of many species of conservation concern
- relatively small population sizes of many species of conservation concern

However, there are several systems in place for the monitoring of amphibians and reptiles such as North American Amphibian Monitoring Program (NAAMP), Louisiana Amphibian Monitoring Program (LAMP) and PARC. We propose to recruit a group of volunteers across the state to implement a comprehensive amphibian monitoring program. Additionally, SWG projects as well as other sources provided estimates of

abundance (or at minimum presence/absence) for amphibian, reptiles, and small mammals on various habitats in Louisiana. Similar to that of breeding birds, density estimates are available for various broad habitat types. By tracking programs that add acres of a habitat, an estimate of its impact on the amphibian, reptiles, and small mammal communities can be made. Research projects directed towards specific species, whether funded through the SWG process or not, will continue to provide valuable data at a local scale for these faunal species of concern.

2. Aquatic Habitats and Species

a. Freshwater

Due to the diverse nature of the freshwater ecosystems and the lack of recent fish population data on the species of conservation concern listed in this strategy, the starting point of the monitoring efforts will focus around enumeration and identification of population structure and habitat types.

The initial monitoring efforts will focus on areas in southeast Louisiana in the Pearl, Mississippi, and Pontchartrain Basins. These basins represent habitat types for 77% of the listed species of conservation concern. Of all species listed, 40% occur only in these basins. New initiatives would focus on the Alabama shad and its reintroduction. Information needed on species occurrence within these basins include species trends and abundance with emphasis on several species of darters (channel, freckle and pearl). Since species occurrence has been documented for the shiners, monitoring the populations of the Blunt face and Bluenose shiners and the effects of habitat changes on their populations is essential. An established monitoring framework has been devised for the Gulf sturgeon and partnerships with MDWFP and USFWS have been established and will continue to aid in monitoring the recovery of this species.

Systems such as the Red, Mississippi, and Ouachita Basins serve as a major conduit for the inflow of invasive fish and mussel species into the waters of Louisiana. Monitoring efforts will be geared toward identifying trends in the current range and abundance of these species, particular the Asian carp and Zebra mussel, and what impact they are having on native species.

Due to the locks and dams on the Red River and the impoundment of the Sabine River at Toledo Bend, initial taxonomic surveys are needed to identify populations in these systems. Impoundments and the effects of navigational and flood control projects lead to habitat alterations and LDWF will partner with the COE to monitor their effect on species of conservation concern.

Coastal basins such as the Mermentau, Barataria, and Calcasieu offer unique and ever changing habitats. Coastal restoration projects such as Davis Pond and Caernarvon have been documented from a marine aspect but the impacts on freshwater species and habitats are relatively unknown. Long-term monitoring of these areas is essential. The effects of

barrier placements in steams and river bottoms to protect from saltwater intrusion and the impacts on the freshwater habitat and species must be monitored.

Habitat degradation in several portions of the Terrebonne, Vermillion-Teche, and Mermentau Basins has lead to a reduction in fish species. Due primarily to land use practices, these basins struggle due to poor water quality. LDWF will continue to partner with LDEQ to monitor long term water quality within these basins. Data will provide indices to show the direction the habitat is heading and allow managers the opportunity to work towards corrective measures. Very little recent data exist on the proposed listed species of conservation concern. Initial monitoring efforts should be geared toward identifying: species occurrences, species abundance, habitat preference associated with each species, available habitat, and effects of habitat changes on these species.

Monitoring will be structured in 5 to 10 year increments with reevaluation of goals and objectives after 5 years. In the development of the CWCS, monitoring strategies were written to address freshwater aquatic species found in each river basin and are listed in Table 8.2.

For crustaceans and molluscs, intensive inventories are needed to better understand the distribution and status of each species. Additional life history studies need to be completed as well, especially for crustaceans. To stop the declines of species of concern, we will attempt to manage at the ecosystem level instead of at the local level, since water quality and other issues are frequently affected by factors outside the immediate area.

b. Marine

The status of the various marine species of conservation concern are closely related to habitat threats in the coastal ecosystem, especially marsh loss and degradation, and therefore may be some of the first species to exhibit population declines. Table 4.1 provides a list of marine species of concern and their associated habitats. Habitat threats are at a critical level in the coastal zone, and LDWF Marine Fisheries Division has decided to prioritize these habitat threats rather than having a species-oriented focus. Data developed through this process will provide indices to community structure within and across habitats, and trends in population abundances by habitat type.

Fixed-location stations, stratified by habitat type, are established in each study area, and fishing gear appropriate to that station is used to collect physical, chemical and biological data, as appropriate. Sampling gear is deployed and data collected and recorded according to standard protocol established in the Marine Fisheries Division Field Procedures Manual.

The basic framework for marine/estuarine monitoring in Louisiana was established in 1968 with the Gulf-wide Cooperative Gulf of Mexico Estuarine Inventory (GMEI) and Study (Perret 1971, Perret et al. 1971), and further refined with the implementation of the watershed-based Coastal Study Area (CSA) management system for penaeid shrimp (White and Boudreaux 1977) that also was adapted for finfish monitoring in 1985. Other

Table 8.2 Monitoring needs for individual aquatic basins in Louisiana.

Atchafalaya Basin
Monitor population trends of species of conservation concern
Develop long-term water quality monitoring sites
Develop long-term monitoring sites for species of conservation concern

Barataria Basin
Monitor the effects of freshwater diversions in the basin

Calcasieu Basin
Monitor annual salinity wedge in the river above the salt water barrier

Mermentau Basin
Monitor population trends of species of conservation concern
Develop long-term water quality monitoring sites
Develop long-term monitoring sites for species of conservation concern

Mississippi Basin
Sampling is needed to identify trends in range and abundance of invasive species
Monitor trends of invasive species catch in commercial fisheries landings

Ouachita Basin
Conduct pre-impoundment taxonomic survey of proposed impoundments
Conduct sampling to identify trends in range and abundance of invasive species
Monitor trends of invasive species catch in commercial fisheries landings

Pearl Basin
Develop long-term water quality monitoring sites
Develop long-term monitoring sites for species of concern
Develop protocol for gear-type to ensure sampling is repeatable
Partner with academia to monitor populations of species of conservation concern

Pontchartrain Basin
Monitor the effects of freshwater diversions in the basin

Red Basin
Conduct pre-impoundment taxonomic survey of proposed impoundments
Conduct sampling to identify trends in range and abundance of invasive species
Monitor trends of invasive species catch in commercial fisheries landings
Monitor the effectiveness of mitigation features
Monitor the effects of navigation and flood control projects on species of conservation concern

Sabine Basin
Evaluate the impacts of dam operations on fish populations

Terrebonne Basin
Develop long-term water quality monitoring sites
Develop monitoring protocols to determine population trends of species of conservation concern
Develop long-term monitoring sites for species of conservation concern
Sampling is needed to identify trends in range and abundance of invasive species

Vermilion-Teche Basin
Sampling is needed to identify trends in range and abundance of invasive species

long-term projects collecting species/habitat data within the overall study area are the Caernarvon (1987 to present) and Davis Pond (1994 to present) Freshwater Diversion Monitoring Projects located in CSA 2 and 3, respectively. All projects rely on sampling with standardized gear over a range of habitats to characterize biological and environmental conditions. The general system for data collection established in 1968 has been used continuously since that time. The focus of the GMEI and CSA projects was primarily to document and monitor the importance of Louisiana's estuaries as contributors to Gulf of Mexico recreational and commercial fisheries. In their implementation all collected taxa were recorded, thus establishing a long-term data sequence for the various habitats and fish and invertebrate species in Louisiana coastal habitats.

Many marine and estuarine species are not well known, and long-term trends in their abundance are seldom well-described. It will be necessary to identify methods to monitor and verify status of cryptic species by periodically confirming presence, habitat use, life history characteristics, etc. This type of monitoring must be in addition to and linked to the evaluation of more well-known species for validation of trends seen in both types of monitoring programs.

Habitats are rapidly changing in the Louisiana coastal zone, due to a multiplicity of factors, both natural and anthropogenic. Methods to evaluate those changes and their effects on the aquatic and terrestrial populations that depend on them will be important in understanding trends in productivity of the habitats and the dynamics of the populations. This may require such methods as remote sensing, environmental constant data recorders, etc. to evaluate the rates and magnitude of these changes.

A variety of conservation efforts is underway to protect, enhance, or modify coastal wetlands. These projects will also affect their associated aquatic habitats and the fauna associated with those habitats, sometimes in ways that are not predictable or that are poorly understood at present. Special purpose assessment and monitoring studies must be developed and maintained to assess the performance of these actions on the maintenance of both the terrestrial and aquatic ecosystems involved in those actions.

Areas may be identified for habitat conservation and/or restoration purposes through a variety of assessment procedures. Selection criteria may include species diversity (current or potential), unique nature of the habitat in the state or region, and areas recognized by previous national or state prioritization processes (e.g., CWPPRA).

c. Coastal Restoration

To date 467 coastal restoration projects (Appendix Q) have been constructed under the authority of the Louisiana Department of Natural Resources/Office of Coastal Restoration and Management/Coastal Restoration Division at an approximate cost of $500 million. Funding for these projects comes from a variety of sources including: the Coastal Wetlands Planning Protection and Restoration Act (CWPPRA), the Water Resources Development Act (WRDA), and the state of Louisiana Wetlands Trust Fund.

These projects use a variety of techniques to achieve their goals. A complete list of projects including cost, size, and type can be found in the Coastal Restoration Annual Project Reviews (Stead and Hill 2004). Often times the projects result in a change in habitat type (open water to marsh, salt marsh to intermediate marsh, non vegetated area to planted area, etc.). While the primary goals of these projects generally are ecosystem restoration, secondary benefits include enhancement of critical fish and wildlife habitat.

Most coastal restoration projects are constructed through the CWPPRA program, where design and implementation is overseen by the LDNR/OCRM in cooperation with the following federal agencies: COE, USDA, U.S. Department of Commerce (Commerce), USDI, and the EPA. Typically, concerns regarding fish and wildlife habitat are resolved during the engineering and design phase. During this time, the various federal agencies have the opportunity to comment on project aspects that may have an impact on species they regulate. For example, the NMFS, under Commerce, will oversee project impacts on essential fish habitat, while the USFWS will address project impacts on other fish and wildlife issues. Furthermore, the LDNR/OCRM has implemented measures to examine the ecological impacts of projects. Through the “Ecological Review” process, the projects' ecological benefits can be assessed during the design phase of a project. By having engineers work with ecologists in the project design phase, the likelihood of a project successfully achieving its intended ecological goals is improved.

The Biological Monitoring Section of LDNR/OCRM/CRD is responsible for the management of all biological monitoring activities associated with coastal restoration projects. This includes monitoring plan development and implementation (data collection and storage, statistical analysis, quality control and data interpretation), and report generation. These activities provide a scientific evaluation of the effectiveness of each coastal wetlands restoration project in achieving long-term solutions to coastal wetlands loss in Louisiana. Data collected are used to determine the success or failure of existing projects, to determine if existing projects require modifications, and to support future decisions on selection of proposed coastal restoration projects. Currently over 40 variables are measured at over 3,000 locations. Data types include: hydrography, vegetation, sediment elevation, shoreline change, soil properties, and elevation. Although these stations are currently distributed by project location, LDNR/OCRM/CRD is transitioning towards a large-scale programmatic monitoring effort called Coastwide Reference Monitoring System (CRMS-Wetlands). Implementation of CRMS-Wetlands will provide a cost-effective means of evaluating individual projects and the collective effects of projects at the hydrologic basin and ecosystem scale. Information gathered by the program will be used for planning activities, adaptive management, and predicting future changes in Louisiana’s coastal ecosystems with an increased degree of accuracy, and will help guide future management decisions.

D. Measuring Strategy Success

Success of the Louisiana CWCS will rest on implementation of the various conservation actions or strategies developed in the writing of the plan. These strategies present explicit and concise approaches to addressing the identified threats to Louisiana's species of conservation concern and their associated habitats. The conservation actions or strategies fall into several categories including:

- Land protection efforts
- Information management
- Partnerships
- Education and outreach
- Technical interactions
- Restoration efforts
- Surveys and research
- Monitoring
- Conservation design

In order to accurately measure the success of these strategies, a series of performance indicators was devised (Tables 8.3 through 8.7). These performance indicators give concrete, quantitative measures on which LDWF can base its evaluation of the success of the CWCS. A specific schedule for reporting on the implementation of strategies and a database of the corresponding performance indicators is essential. Tables 8.8 and 8.9 present the schedules for accomplishing these tasks.

Table 8.3. Performance indicators for general conservation actions.

Strategy	Performance Indicator (tracked annually)
Surveys and research	# of areas surveyed; # of new survey sites; # of species located; # of new locations of species of concern; new estimates of population size; measures of life history metrics; # of technical committee meetings/workshops
Monitoring	# of new monitoring sites or species protocols established; # of species for which trend information can be assessed; # of species for which population targets can be assigned; trends in habitats necessary for species of conservation concern; # of projects for which monitoring information led to adaptive management
Land protection efforts	# of acres protected through conservation servitudes, acquisition, etc. by LDWF or other partner; # Natural Areas Registry sites enrolled; # of cooperative projects with LDWF and partners
Information management	# of species tracked; # of species with new data being collected; # of data exchanges with partners or users; # of projects completed for species of concern
Partnerships	# of partnerships extended or created; # of information exchanges via meetings, reports, data, etc: # of MOUs developed or renewed
Education and outreach	# of news releases; # of public presentations; # of participants in Natural Areas Registry Program; # of reports generated; # of positive/negative comments from public and partners
Technical interactions	# of private lands visited to discuss species of concern; # of measures implemented; # of permits reviewed; # of BMPs developed or recommended
Restoration efforts	# of acres reforested; # of projects funded; # coastal projects funded; # projects implemented; # of restoration projects completed
Conservation design	# of workshops/meetings hosted; # conservation plans written; # recovery plans developed

Table 8.4. Goal 1. Species Conservation.

Goal	Objectives	Strategies	Performance Indicators	Threats Addressed
Provide the habitat and ecosystem functions that support healthy and viable populations of all species, avoiding the need to list additional species under the Endangered Species Act	Conduct a comprehensive review of the current status of all wildlife in Louisiana with a focus on species of conservation concern	Inventory and survey for species of conservation concern which have limited or no baseline occurrence data Inventory and survey for species of conservation concern to update historic occurrence data Support research which focuses on life history, reproductive success, and mortality factors for species of conservation concern Support research on the diversity and ecology of the lesser-known groups of invertebrates such as butterflies and moths, aquatic insects, snails, arachnids, beetles, etc.	# of species for which baseline data has been collected # of species for which threats are definitively identified # new and updated species EOs entered into database # of species for which life history, reproductive success, and mortality factors are assessed # of research projects focusing on lesser-known species	Data gaps Limited knowledge Lack of data
	Develop concrete management strategies which focus on species of conservation concern and their associated habitats identified in the CWCS	Expand current knowledge of habitat trends and priority habitat needs for species of conservation concern Continue and expand monitoring of priority species/groups to formulate conservation strategies and management decisions Conduct geographical analysis to identify gaps where managed areas are lacking in the state, relative to protection needs of Tier 1 habitats and important focal areas discussed in the habitat accounts in Chapter 4 Produce maps showing areas where land acquisition and the establishment of conservation areas would be the most valuable conservation tool	# of habitats assessed # of habitat threats for which specific strategies have been developed and implemented # of species/ populations monitored # of new monitoring strategies developed # of projects initiated # of identified areas # of maps produced	Data gaps Limited knowledge Lack of data Few defined strategies
	Formulate partnerships with federal and state agencies, national and local non-governmental organizations, universities, businesses, and the public in the development and implementation of these strategies	Continue to develop and improve contacts with all potential partners in the state Hold species strategy meetings and invite all interested partners	# of partners contacted # of contacts developed # of meetings held and commitments given to implement recommended conservation strategies	Lack of species and habitat conservation strategy coordination

Table 8.5. Goal 2. Habitat Conservation.

Goal	Objectives	Strategies	Performance Indicators	Threats Addressed
Identify, conserve, manage, and restore terrestrial and aquatic habitats which are a priority for the continued survival of species of conservation concern	Utilize Natural Heritage Program database to identify habitat types which are important to the conservation of species of concern, and continually evaluate and update the status of these habitats to direct conservation and restoration efforts	Increase data collection in habitats important to species of conservation concern, expanding resources and staff to meet this need Expedite input of field data on habitats of concern, expanding resources and staff to meet this need Improve spatial data available for habitats and species of conservation concern (mapping of species locations and habitat coverages) Utilize the Natural Heritage database and other sources to identify priority sites for habitat conservation and restoration efforts through acquisition and conservation servitudes Develop and publish species lists (including both wildlife and plants) for WMAs, refuges, and state parks Step-up surveys in aquatic habitats to fill data gaps regarding: Species diversity Rare or endemic species Ecosystem processes Areas critical to survival of species of concern	# of new sites surveyed # of known sites surveyed to update status # field survey days # new and updated EOs entered into database # of GIS mapping projects initiated # of habitats accurately mapped # of comprehensive habitat status surveys or research projects initiated # of priority sites/acres identified for protection # of species publications for WMAs and refuges	Data gaps Limited knowledge Lack of data
	Monitor threats to terrestrial and aquatic habitats of priority concern	Complete habitat threats analysis every 5 years Create a database of threats and continually consider and incorporate new information concerning threats into this database	Documentation of habitat threats analysis # of threats identified for key habitats Incorporate information into threats database quarterly or as available	Basing decisions on outdated threat information
	Promote and support terrestrial and aquatic habitat protection efforts	Protect or restore key areas supporting or having the potential to support priority habitats (Table 7.1) through acquisition and conservation servitudes Expand Natural Areas Registry Program to include incentives such as tax breaks, conservation servitudes, management assistance, etc. Provide local and parish planning boards with information regarding sensitive terrestrial and aquatic habitats and species of concern, and work to redirect development of these areas Continue to support LA RCW Safe Harbor Program and associated habitat protection efforts	# of sites/acres acquired or protected # of long-term cooperative projects initiated to protect priority habitats # of active registries/acres in the Natural Areas Registry Program # of meetings/contacts with planning boards # sites/acres where development redirected # acres enrolled in LIP; RCW Safe Harbor Prg	Habitat destruction or conversion Habitat fragmentation Residential and commercial development

Table 8.5. Goal 2. Habitat Conservation cont.

Goal	Objectives	Strategies	Performance Indicators	Threats Addressed
Identify, conserve, manage, and restore terrestrial and aquatic habitats which are a priority to the continued survival of species of conservation concern	Develop and implement terrestrial and aquatic habitat conservation and management recommendations	Provide management guidelines and technical assistance to non-industrial private landowners to benefit habitats and species of conservation concern Provide management guidelines and technical assistance to public agencies/land managers (e.g., state parks, state lands, parish parks) to benefit habitats and species of concern	# of technical guidance interactions with private landowners # of technical guidance interactions with public agencies/ land managers	Habitat degradation Incompatible management practices
	Monitor distribution and impacts of invasive/alien species and develop management strategies to abate this threat	Work with Invasive Species Task Force, LA Sea Grant Program and others to monitor occurrences and spread of invasive/alien species Provide public education and support existing efforts/programs regarding invasive species, working through the Invasive Species Task Force Promote use of state and federal cost share programs to address invasive species problems Partner with local hunting clubs through DMAP to support wild hog eradication	# of specimens of invasive plant species collected and deposited in herbaria # of monitoring and survey projects initiated # of technical guidance interactions with private and public land managers # of eradication projects initiated	Altered structure and composition Habitat disturbance
	Promote reintroduction and continued use of prescribed fire in fire-dependent habitats	Educate landowners, adjacent residents, developers, and the general public about the crucial role of prescribed fire in the management of: Longleaf pine systems and imbedded habitats Shortleaf pine-Oak-Hickory Forests Coastal and Calcareous Prairies Coastal Marsh types Western Xeric Sandhill Woodlands Provide additional cost share funds through programs such as FLEP in order to drastically reduce or eliminate landowners' costs associated with conducting prescribed burns Encourage burning on state lands to perpetuate fire-dependent habitats (e.g.., state parks, state lands office)	# of educational programs # of sites/acres burned on private lands # of sites/acres burned on state lands Amount of funding for cost share programs used to support prescribe burning on private lands	Altered structure and composition Incompatible forestry practices

Table 8.6. Goal 3. Public Outreach and Education.

Goal	Objectives	Strategies	Performance Indicators	Threats Addressed
Support educational efforts to improve the understanding by the general public and conservation stakeholders regarding species of conservation concern and related habitats	Provide educational information using various media types	Improve, maintain and develop web-based resources to share information on priority habitats and species of conservation concern Develop field guides for habitats and species of conservation concern Develop manual to the flora of Louisiana Develop publication on natural communities of Louisiana	# of web-based resources developed or enhanced # of "hits" for web-based educational resources # of field guides for habitats and species of concern published # of audiences reached # of requests for educational materials	Inefficient information exchange Public indifference Fear/ misunderstanding Lack of information
	Increase direct interactions between biologists and public and private stakeholders regarding species of concern and associated habitats	Provide presentations and workshops to various groups interested in wildlife and plant resources Provide educational field trips for the general public or various organization Meet one-on-one with public and private landowners to discuss possibilities for habitat improvement and management needs (utilize existing programs such as Natural Areas Registry, Forest Stewardship, DMAP, etc.)	# of presentations or workshops conducted # of educational field trips conducted # of landowners interactions # of acres enhanced	Public indifference Fear/ misunderstanding Lack of information
	Enhance the user's educational experience on WMAs and refuges	Develop animal and plant species lists for WMAs and refuges, and disseminate this information to interested persons	# of lists requested # of comments regarding lists	Public indifference Lack of information

Table 8.7. Goal 4. Partnerships.

Goals	Objectives	Strategies	Performance Indicators	Threats Addressed
Improve existing partnerships and develop new partnerships between LDWF and State and Federal natural resource agencies, non-governmental organizations and environmental groups, private industry, academia, and the general public	Improve cooperative efforts to achieve common goals, improve efficiency, and prevent duplication of efforts	Develop MOUs regarding species of conservation concern and their habitats Partner with the Louisiana Forestry Association to develop web-based educational materials on target species and their habitats Organize workshops with partners to discuss mutual issues	# of MOUs developed/ implemented Completion of web-based material # of workshops held # of partner participants	Habitat fragmentation Habitat conversion/ destruction Incompatible forestry practices Altered composition and structure
	Improve data collection, data management, and the dissemination of information between conservation partners	Develop Data Utilization agreements Develop database of research and monitoring projects	# of agreements developed Completion of database	Habitat conversion
	Increase collaboration and communication with local, state, and regional conservation partners	Organize workshops, hold regular meetings, and distribute results through appropriate media releases (print, website, radio, TV, etc.)	# of meetings held # of workshops implemented/attended # news releases sent	Habitat disturbance/ destruction/ conversion/ fragmentation

Table 8.8. Effectiveness of the strategies

Work Level	Time Scale	Types of Evaluation Questions	Conducted By
Individual Projects	Semi-annual reporting	Did the project occur? Did it stay within budget? Did it use funds as planned? Are budgeting proportions accurate? Who did the work?	District Biologists; Program Supervisors, and staff
Adaptive management of project	Annually	Based on evaluation, how should future projects be changed or retained?	District Biologists; Program Supervisors, and staff
CWCS conservation actions (Program-level strategies)	Annually	What is the status of the desired outcomes associated with each activity, as measured by performance indicators? Are the performance indicators valid measures? Are the individual projects meeting the conservation actions called for in the CWCS?	Program supervisors, Core Committee
Adaptive management of conservation actions	Annually	Based on evaluation, how should future program-level activities and projects by changed or retained?	Program supervisors, Core Committee
CWCS goals	Every 10 years	Are the conservation actions meeting the state's goals of the Louisiana CWCS?	Program supervisors, Core Committee

Table 8.9. Evaluation and Reporting Schedule

Component	Time Frame	Methodology
Investments (time and money)	Acquired quarterly, reported annually on fiscal year cycle	Cost accounting system tracking by project cost center
Activities (strategies in Tables 8.2-8.7)	Acquired quarterly, reported annually on fiscal year cycle	Cost accounting system tracking by project cost center
Outputs (see Performance Indicators in Tables 8.2-8.7)	Acquired quarterly, reported annually on fiscal year cycle	District biologists and project managers report on outputs of implementing conservation strategies
Outcomes (improved populations of target species and their habitats; improved public satisfaction)	5-year report 10-year report	Reports based on performance indicators; surveys of public attitudes

E. Adaptive Management

An important aspect, if not the most important aspect, of research and monitoring is to ascertain whether strategies and management approaches that are proven to be beneficial to species of conservation concern are incorporated into LDWF's management practices and promoted among all state and federal natural resource agencies that manage or have an impact on Louisiana's fish and wildlife resources. LDWF's major land management programs are in the coastal marshes and forest habitats (predominantly bottomland hardwoods) which are owned by the department. Forest management has been and will continue to be an important research issue within the CWCS. The LDWF forest management program is an example of how our agency promotes sound habitat management programs. It led the nation in the development of bottomland hardwood restoration techniques and has hosted many workshops and field days to showcase effective management practices. Initial findings of supported research already suggest that the agency's forest management program is moving in the direction that positively impacts many species of conservation concern. The primary objective of LDWF's forest management program is wildlife habitat enhancement, and future research resulting from recommendations in the CWCS will continue to be considered in the development of forest prescriptions. Additionally, longer-term monitoring of avian, amphibian, and reptilian species will continue. As new forest management techniques are implemented, monitoring programs will be implemented concurrently to determine if these techniques provide better habitat for species of conservation concern than older techniques. This is essential since habitat improvement, after all, is the overall goal of our management practices.

Undoubtedly some management practices that provide good habitat enhancement for species of conservation concern will not be implemented. An evaluation to determine the success of approaches will routinely be conducted on a specific timetable, such as every 5 years. It will be necessary to determine why these practices were not selected despite promotion through various strategies. For these practices, LDWF must review its targeted audience, as well as, who was the delivering agency. Surveys of both groups must be made to determine what it would take to make the practices viable. A number of factors could be involved. Was the message unclear? Were the incentives insufficient? Was the practice not sufficiently pushed by the agency responsible for practice implementation? Or even, was the wrong audience targeted? After ascertaining the reason certain beneficial practices were not used, new strategies addressing prior deficiencies would be developed and implemented. Re-evaluation would occur again on the previously determined schedule.

LDWF proposes to complete a comprehensive revision of the CWCS in ten years, and to review, evaluate and update sections annually through the existing Federal Assistance reporting system and SWG grant administration process. Further, a database is being developed to track each aspect of progress on species of conservation concern and their habitats. Any changes in status will be entered annually, both in the database and spatially. Progress on conservation actions, research, surveys, and monitoring will be captured annually, and will be tracked annually. The database will provide for information tracking, management and dissemination to internal and external partners. The Core Committee will be responsible for implementing this annual review and evaluation.

The USFWS requires establishment of procedures to review the CWCS at intervals not to exceed ten years. LDWF will comprehensively revise this CWCS in 2015. Meanwhile, we will sponsor workshops and symposia and utilize scientific review to update our species of conservation concern, key habitats, and conservation actions in preparation for the next iteration of the CWCS. This level of effort will guarantee our commitment to involving conservation partners and interested stakeholders in the CWCS process.

Over the next ten years, LDWF will utilize both short- and long-term iterative, existing mechanisms and processes with built-in review and evaluation to maximize opportunities for both internal and external implementation. Each program in the agency will report no less than annually on implementation progress. These will be summarized annually as part of existing federal aid requirements, and integrated into the CWCS for each annual review. The Core Team is the responsible party for implementing this annual evaluation.

Perhaps the most efficient and effective outcome of the Louisiana CWCS will be the incorporation of priority conservation strategies into future LDWF's strategic plans and the plans of its partners. This is expected to produce a riffle effect for conservation efforts across the state, and will lead to a consistent, more unified approach to conservation in Louisiana.

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