CHAPTER 9. RESEARCH AND MONITORING

Research is an integral part of Wildlife Action Plan (WAP) implementation, as filling data gaps will allow the Louisiana Department of Wildlife and Fisheries (LDWF) and conservation partners to refine conservation priorities and better target conservation action. Monitoring is critical to ensure that the goals of the WAP are being met and to demonstrate the success of both the WAP and the State Wildlife Grants (SWG) Program in addressing the needs of SGCN. Required Element #5 for State Wildlife Action Plans directs the states to provide a three-tiered monitoring plan:

- Tier 1 – Species and Habitat Monitoring
- Tier 2 – Monitoring Effectiveness of Conservation Actions
- Tier 3 – Adaptive Management of Monitoring

Tier 1 Monitoring is described in Section B below and includes information on monitoring all SGCN taxa, as well as habitats. Tier 2 Monitoring is described in Section C below and includes information on Monitoring Effectiveness of the WAP. Tier 3 Monitoring is described in Section D below.

A. Research

The WAP contains 59 habitat types spanning six ecoregions, 12 aquatic basins, and five marine habitat types. Research needs are often provided within each basin/habitat type description (Chapter 5). As such, the WAP will drive most of the research and monitoring activities funded through Louisiana's share of the SWG program. However, this is certainly not a complete list, and research needs are fluid. Conceptually, LDWF views allocation of SWG funds for research and monitoring as a two-tiered program:

- LDWF-developed research and monitoring projects based on SGCN and/or habitat needs specified in the WAP
- Partnerships with outside contractors (universities, non-governmental organizations (NGOs), industry, etc.) to develop projects based on SGCN and/or habitat needs specified in the WAP

1. Research Priorities

Priorities for SWG projects are determined through a combination of factors including: relevance to SGCN and/or habitat priorities identified in the WAP, project design, feasibility and cost, and the amount of currently available funding. A list of all past and current SWG projects in the state can be found in Appendix A, and abstracts and final reports for all completed projects can be obtained via the LDWF website.

However, other research activities will continue to provide vital data to inform the conservation of fish and wildlife resources in the state. During the development and revision of the WAP, many academic, state, and federal partners were able to provide input into research needs for Louisiana's SGCN. The SWG program will only be able to fund a fraction of the work that will be needed to ultimately accomplish the goals of the WAP, thereby advancing conservation in the state. It is recognized that each individual institution will have its own research and monitoring interests and specialties. Nonetheless, we believe that the WAP will serve to focus all stakeholders on the conservation needs of Louisiana SGCN.

2. Database Needs

Currently, no single data management system exists in Louisiana. Although numerous habitat and species oriented studies are being conducted in the state at any given time, data are not stored in the same data management systems, collected with the same protocols, or easily retrievable by all interested stakeholders. Developing a central data storage/retrieval system is of paramount importance for accurate assessments (baseline and long-term) to be made. 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 cannot occur. As data sharing is becoming increasingly common to meet regional, national, and international conservation needs, resources such as the Louisiana Natural Heritage Program (LNHP) Environmental Review Tool will become more important due to its ability to (1) protect LDWF data from inappropriate and fraudulent use; (2) provide clients with expeditious turnaround on requests; and (3) decrease the burden on data managers for providing data in a myriad of formats for various specific projects. Utilization of national databases (e.g., eBird, Eastern Avian Knowledge Network, Butterflies and Moths of North America, etc.) should be encouraged, particularly for those data not deemed sensitive (e.g., locations of birds away from nest sites). Another data management tool that may prove valuable in sharing data and coordinating efforts in the implementation of the WAP is the Gulf Coast Prairie Landscape Conservation Cooperative (GCPLCC) Conservation Planning Atlas (CPA).

As important as establishing a data clearinghouse may be, it is just as important to understand how 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. In Section B, below, recommended survey and monitoring protocols are discussed. Although this treatment is not intended to be exhaustive, it does provide resource managers and researchers with a solid starting point for developing and implementing monitoring programs.

B. 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. Biological monitoring in this plan is divided into two major categories: terrestrial and aquatic. Where standardized protocols or established monitoring programs exist that can be used to monitor SGCN, those protocols and programs are detailed. In the absence of such protocols, standard techniques are described, and suggestions for standardizing data collection are given. All-species monitoring is, and should be, the ultimate goal for effective SGCN conservation, but the establishment and maintenance of long-term monitoring programs is often limited by both time and capacity.

1. Terrestrial Habitats and Species

Identification of changes in habitat is critical to the assessment of the effectiveness of the WAP for improving the status of SGCN. Currently, the location and size of many of the LNHP habitat types are not explicitly identified spatially or quantitatively. From some faunal perspectives, the habitat type may be less important than the structural composition of that habitat. Sources of habitat data include the LNHP Biotics database, U.S. Forest Service (USFS) Inventory and Analysis (FIA), and the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) National Resources Inventory (NRI), among others. 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, USDA, U.S. Fish and Wildlife Service (USFWS), the Louisiana Coastal Protection and Restoration Authority (CPRA), and the Louisiana Department of Agriculture and Forestry (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 WAP, because the primary threat facing many species of wildlife, including SGCN, is habitat loss and degradation. Managers and restoration ecologists recognize that recruitment into newly restored or altered areas takes time, and natural ecological processes do not develop at these sites immediately.

a. Habitat Inventory and Monitoring

Knowledge of the amount, condition, and viability of each habitat type is important to conservation planning and decision making. How much total acreage is there of a particular habitat? How much acreage is high-quality, and how much is degraded? Is the habitat improving, stable, or declining on the landscape? Are certain management actions having the desired effect? These are questions that can be best answered through inventory and monitoring. Habitat inventory entails investigating and documenting occurrences of a particular habitat to determine areal extent and condition. Monitoring involves detecting a change in some aspect of a habitat over time and can be accomplished using qualitative or quantitative approaches at both coarse and fine spatial scales.

The LNHP is the primary organization conducting habitat inventory in Louisiana and has been operating for approximately 30 years. The Natural Heritage habitat inventory procedure includes analyzing evidence such as topographic maps, soils maps, and aerial imagery to locate potential occurrences of target habitats, followed by visiting sites to confirm the presence of the target habitat and to collect detailed data on the occurrence. This approach has been especially effective in locating habitats that have distinctive signatures on aerial photography, characteristic soil types, or that occur on specific landscape positions. Examples of habitats that can be efficiently identified using one or more of these sources of evidence include (but are not limited to) Calcareous Prairie, Saline Prairie, Hillside Seepage Bog, Longleaf Pine Flatwoods Savanna, and Upland Longleaf Pine Woodlands. Aerial imagery also enables detection of remnant blocks of forested habitat and Coastal Prairie embedded in agricultural landscapes. Light Detection and Ranging (LiDAR) is a remote sensing technology that allows visualization of small elevation changes and is useful in differentiating areas that still retain natural surface topography, such as Coastal Prairie remnants with pimple mounds and potholes from land-leveled agricultural land and pasture. Remote sensing technology is an indispensable tool for habitat inventory. In fact, depending on the objective, remote sensing alone can be used for habitat inventory. For example, if the objective was to quantify the current acreage of identifiable (and presumably recoverable) Longleaf Pine Flatwoods Savanna, which has a distinctive signature on aerial imagery, remote sensing alone could accomplish this. Field studies would be required if more detailed information is desired.

The objective of monitoring is to determine trends over time. Monitoring methods and intensity are dictated by the specific habitat, site, project, and available time and resources. Habitat monitoring is usually conducted at a specific site with the aim of detecting changes in habitat over time, and often is employed to determine the effects of management and stewardship actions. Remote sensing technology can be used to monitor change in structural habitat attributes, such as woody cover in various prairie types, by comparing aerial imagery taken in different years. Site-specific monitoring in the field can be either qualitative or quantitative. In the case of qualitative monitoring, a competent biologist (usually a botanist or plant ecologist) will inspect the site prior to and during the course of management implementation. This biologist can observe the treatment effects from site visits and determine whether or not the habitat is responding in the desired direction. An example might be a Calcareous Prairie that is degraded by encroachment of woody vegetation and lack of fire. A qualified biologist can determine by visual inspection whether or not the prairie is progressing toward the desired condition following mechanical brush removal and implementation of fire at an appropriate season and return interval. More intense monitoring for hypothesis-driven research can involve quantitative sampling. Since habitats are defined by vegetation, such intensive monitoring usually involves measuring attributes of vegetation. Important vegetation attributes include measures of frequency and dominance for each species falling within the sampling area. Frequency of a species is defined as the number of samples across a study site containing that species. Percent cover (the amount of area shaded by plants if the sun was directly overhead) is an often-used measure of dominance for herbaceous plants, small shrubs, and woody vines. Basal area is often used to record dominance for trees and larger shrubs. Density can also be recorded, but is often not practical in densely vegetated habitats due to time constraints or the fact that it can be difficult to separate individual plants (e.g. rhizomatous grasses and sedges). Often, relative values of frequency, density, and percent cover/basal area are summed to obtain an importance value for each species sampled in a study area. There are many vegetation sampling protocols available, and many potential modifications that can be made based on the specific site and questions being addressed. In addition to sampling vegetation, it is prudent to also collect and test soil samples, and in some cases, to measure elevation and other abiotic factors such as slope percent and aspect. These site factors may explain more variation in the vegetation data than do the experimental treatments, and without these data, one could arrive at spurious conclusions.

b. Bird Monitoring

A number of different approaches for monitoring avian abundance, trends, and densities for breeding and nonbreeding birds were evaluated for the WAP, and several are presented here separated by species, species groups, or guilds. Many of these approaches provide means of evaluating change at the landscape level, but may also be scalable for other needs. Additionally, we believe that several presented methods provide mechanisms to confirm apparent trends suggested by U.S. Geological Survey (USGS) North American Breeding Bird Survey (BBS) data and fit well into population goal assessments developed by programs such as Partners in Flight (PIF) and various Joint Ventures (JVs). All bird monitoring, or, at least, as close to all bird monitoring as is feasible such as BBS and National Audubon Society's (NAS) Christmas Bird Counts (CBCs), may be relatively simple and inexpensive. However, many bird species or guilds are frequently underrepresented by such sampling. In cases where such groups are apparently neglected, species or guild specific monitoring protocols may be advisable; accepted protocols for previously under-surveyed birds are discussed below in addition to more holistic approaches. Note that the list of summaries below is by no means exhaustive, and, in many cases, existing monitoring programs are evolving or may be replaced altogether; one should not assume that a project is acceptably designed simply because an approach below is chosen for his/her project. When selecting a monitoring regime, one should commit to the project for a minimum of several years of data collection.

1. United States Geological Survey (USGS) North American Breeding Bird Surveys

The current USGS BBS design has approximately four routes per degree block in Louisiana for a total of 67 currently active routes. These data, along with data collected throughout the U.S., Canada, and Mexico, are used to make inferences relative to the status and trends of North American bird species that are readily detected by this scheme. One drawback with (but also a very strong asset of) BBS routes is the expertise required to survey the routes. As a consequence, limitations in personnel and volunteers frequently result in some routes not being completed from year to year. Thanks in part to SWG funds and in part to diligent state coordinators and surveyors, participation in the BBS in recent years in Louisiana has been exemplary. A continued, concerted effort will be made to recruit enough personnel with sufficient proficiency in bird identification to survey all BBS routes in Louisiana every year. Possible future modifications to the BBS protocol may include utilization of distance annuli and time intervals as suggested by Somershoe and colleagues (2006).

Web address: https://www.pwrc.usgs.gov/bbs/

2. Christmas Bird Count

Both NAS and private CBCs may be utilized for monitoring resident and wintering landbirds, as well as most other bird guilds. Because CBCs are rarely restricted to roadsides, biases related to increased detection of edge species (as in BBSs) are less likely to affect results. With almost 30 active, 15 mile diameter count circles, the data from CBCs have great utility for calculating population indices, a relative measure of abundance and trend. Like the BBSs, CBCs cannot be considered complete censuses, but whereas BBS point counts may be modified with distance sampling, CBCs are not so easily altered in this way. This difference is important when biologists desire to calculate detection probabilities. Also, because CBCs are frequently surveyed by parties of varying sizes and experience levels, data should be carefully analyzed and vetted. Despite noted shortcomings, the CBC has been called the longest running, citizen science endeavor in the Western Hemisphere and will, clearly, continue to be the most utilized sampling method for wintering species. Future modifications and standardizations of the CBC protocols would only enhance its value to bird conservation.

Web addresses: NAS CBCs: http://birds.audubon.org/christmas-bird-count
Other CBCs: http://losbird.org/

3. The Institute for Bird Populations (IBP) Monitoring Avian Productivity and Survivorship (MAPS)

Developed in 1989, IBP's MAPS program has become the standard for the collection of demographic data utilizing constant-effort mist netting. The MAPS program provides data that are not readily produced by many of the other more recognizable efforts such as CBCs and BBSs; MAPS collects data that may be used to calculate vital rates, which may be crucial in determining causation of declines. In addition, MAPS is unique in that it links birds with habitat and has been used to measure bird response to various habitat treatments. One should be mindful, however, that as valuable as mist net data may be, like other methods, mist netting has limitations. Particularly, land managers and biologists should recognize that placing mist nests in extremely different forest types or treatment types, frequently, does not provide results that may be comparable across types and will likely bias relative abundance calculations. That is, unless nets are stacked from the ground to the canopy, mist nets will, obviously, be biased towards species occurring in lower strata. Clustering of water or food features in study sites may also impact the "catchability" of birds. Despite these possible short-comings or caveats of mist netting, the MAPS program has proven to be invaluable in collecting demographic data and should be utilized and promoted wherever and whenever possible.

The LDWF began a MAPS project in the Atchafalaya Basin in 2004 and extended the project to the Pearl River Basin in 2007. Phase I of the project was completed in 2014 when eight stations were in operation. More than 25,000 bird captures have been logged since initiation, Neotropical migratory songbirds being a very large proportion of that number. Data analysis is currently underway, but results are not available for publication in this document.

Web address: http://www.birdpop.org/maps.htm

4. Surrogates

This approach would use surrogates to determine by proxy the status of other species or, more appropriately, the quality of their shared habitat. Surrogates may be keystone, umbrella, or indicator species; but regardless of the subtype chosen, the surrogate must be appropriate based on the objective or outcome being monitored. For example, Prothonotary Warbler may be a suitable species for monitoring Bottomland Hardwood Forest sites that have been altered as a result of wildlife forestry. This surrogate species may be useful in determining whether or not desired forest conditions (DFCs) are met, which would benefit multiple SGCN. The main advantage of utilization of surrogates is that it does not require personnel with the expertise to identify all birds by sight, song, or call. As such, LDWF staff or volunteers could more easily be trained and may prove useful in limited-species point counts or other less technical surveys. An in-depth treatment of surrogate species and their ties to habitat conservation may be found on the USFWS website below.

Web address: USFWS Strategic Habitat Conservation and surrogates: http://www.fws.gov/Landscape-Conservation/index.html

5. Point Counts

Like other "all" bird monitoring, critical to successful point counts is the expertise of the observers. Casual birders would not be qualified for such extensive surveys unless the project objective only includes a small number of readily identifiable species (e.g., Prothonotary Warbler, Yellow-breasted Chat, etc.). Instead, experts in bird identification through auditory and visual cues are imperative to help ensure that the highest quality data are collected. Variable or fixed distances and time interval point counts are most frequently employed and may be utilized to investigate effects of habitat management regimes. Time intervals chosen often mirror other national protocols such as three minute BBS counts for comparison purposes. Distance annuli frequently chosen include 25 m, 50 m and >50 m and are important in calculating detection probability and species density. Without detectability estimates, bird counts may be very skewed toward the easily detected species. Degree of openness of habitats also influences detectability, because vegetation may mask aural and visual cues. Line transects are also commonly used for bird monitoring, and due to similarity to point counts will not be further discussed in this treatise except to note that limitations in point counts versus line transects and vice versa should be considered prior to initiating a field project with either technique. Also, these methods will vary in efficacy based on season and habitat (Wilson et al. 2000).

Standardization of point count protocols and sample data sheets are provided in the excellent *A Land Manager's Guide to Point Counts of Birds in the Southeast* (Hamel et al. 1996).

Web address:
http://www.pwrc.usgs.gov/point/index.cfm?fa=pointcount.whatIsAPointCount

6. Strip Transects

Unlike point or line transects which may require the observer to measure distances of birds from a center point or center line, strip transects are, instead, of fixed width. Surveyors of strip transects must be experienced birders as with the abovementioned surveys. Despite their linear nature, strip transects, which act as long, narrow plots, are very different from line transects. Whereas line transects do not assume the observer has detected all birds, the strip transect does; this means counts obtained utilizing strip transects are considered a census of birds present. An in-depth treatment of this and other distance sampling approaches may be found in Buckland et al. (1993); a free, on-line book version is available.

Web address: http://www.colostate.edu/Dept/coopunit/download.html

7. Species or Guild Specific Surveys

Waterfowl Surveys- One of the most important tools LDWF uses to monitor populations and distributions of waterfowl is an aerial survey conducted from September through January. The survey consists of 27 north-south transect lines from the Gulf northward to U.S. Highway 90 that are one-quarter mile in width and vary in length from eight to 48 miles. Survey lines are spaced at 7.5 mile intervals in the southwest and at 15 miles in the southeast resulting in 3% and 1.5% sampling rates in the two areas, respectively. A fixed wing aircraft is used for this inventory from an altitude of 125 feet flying at approximately 100 mph. The number and type of waterfowl species are recorded by habitat type on each survey line. Total censuses of waterfowl, rather than transects, are recorded for Catahoula Lake and for 30 selected survey areas in central and northeast Louisiana. A transect survey is done to estimate the number of Scaup on Lakes Pontchartrain and Borgne in December and January of each year, and in April, a visibility-corrected transect survey is conducted in the coastal zone to estimate the number of breeding Mottled Ducks. The Mottled Duck survey consists of 42 north-south transect lines with randomly-selected five-mile segments re-surveyed with a low-flying zig-zagging helicopter to generate a visibility correction factor. Inventories are used to develop an index of waterfowl populations for measuring relative changes in abundance and distribution. Information on current habitat conditions for waterfowl, weather patterns, and migrations are also recorded during surveys. Survey data aid in predicting and evaluating waterfowl hunter success and are most helpful when discussing waterfowl issues with concerned citizens, outdoor writers, and wetland specialists from around the country.

Waterbird Nesting Colonies – Perhaps no group of birds better represents Louisiana than waterbirds. To be sure, for a few species, a high proportion of the North American or global populations occur in Louisiana, which suggests a great responsibility for monitoring those species within our state (Fontenot et al. 2012).

Whereas it is strongly advisable to monitor these and other birds utilizing a statistically defensible framework such as that discussed in Green et al. (2010), to date, list frame sampling has been utilized by LDWF to determine activity of known waterbird colonies in the state. List frame sampling, or surveys of known colonies flown point-to-point, is favored by LDWF over more rigorous techniques, because (1) the goal of these surveys is not for a population census, but for gauging activity of known colonies and their distribution on the landscape; (2) these data assist the LNHP during permit reviews, whereas a different framework may not detect known or new colonies; and (3) population indices are acceptable to determine trends, which may trigger conservation action.

In Louisiana, waterbird colonies have been surveyed by both air and water routes; although aerial surveys are now the most often used method. LNHP's database of waterbird colonies extends from 1976 to 2014. Conducting surveys of Louisiana's colonies is an arduous task; the historical and current number of colony locations in Louisiana – both active and inactive – is a staggering 800+. Realistically, only a subset of active colonies can be expected to be surveyed. Data collection has been a collaborative effort; federal and state agencies (particularly Barataria-Terrebonne National Estuary Program, BTNEP), academia, nonprofit groups, private citizens and others have provided an invaluable service in assisting LDWF in keeping these records current. More recent efforts by LDWF have included double observers, who independently record estimates of nests or pairs of waterbirds at each colony, perhaps the only significant deviation from protocols set in the late 1980's by Martin and Lester (1990). Briefly:

1) Surveys of colonial nesting waterbirds are performed utilizing an aerial platform – typically helicopter, most frequently Bell Jet Rangers instrumented with emergency, inflatable pontoons for unscheduled water landings.
2) Both observers (i.e., wildlife surveyors) are seated on the left side of the helicopter.
3) One observer is seated beside the pilot, assists in navigation, and acts as Secondary Observer.
4) Auxiliary navigation is provided by an aviation GPS unit preloaded with coordinates of known waterbird nesting colonies. Colonies are filtered to include those known to be active at least once during the last three surveys.
5) Prior to the survey, the pilot and observers discuss safety and flight plans, including expected outcomes for the day and possible refueling locations. In addition, the pilot is informed of any possible hazards faced (e.g., low flying vultures, soaring Anhingas, etc.).
6) Flights begin as early as possible each morning and routes are flown point-to-point with observers noting GPS coordinates and number of nesters of each species at each new colony detected.
7) At each colony, the pilot decreases altitude to approximately 300 feet while maintaining a buffer at least as large. Airspeed is decreased to slowest speed deemed safe by the pilot.
8) Colonies are speciated and enumerated in as few passes (circles) as possible to prevent or minimize disturbance to nesters. Should birds show signs of

disturbance, the pilot is instructed to back away from the colony, and the survey recommences at a greater buffer distance.

9) When both observers have recorded all required data, the pilot is instructed to fly to the next closest colony.
10) At the end of surveys, the Biotics database is updated with all new data, and all colonies marked "NEW" are confirmed as such – occasionally, "NEW" colonies may simply be existing colonies that have moved. A new colony must be at least 0.5 km away from all other colonies before it is given a new unique identifier in Biotics.

<u>Swallow-tailed Kite Surveys</u> – The Swallow-tailed Kite Conservation Alliance identified obtaining a robust estimate of the U.S. population size (Zimmerman 2009) as one of two immediate priorities. The SWG program, the Orleans Audubon Society (OAS), and LDWF provided funds for roost surveys from 2008 to 2012. Surveys were concentrated in three major river basins – the Pearl, the Atchafalaya, and the Sabine – using a technique based on Meyer (1998, 2004). Survey dates coincided with those in Florida, where the largest roosts gather (Meyer 1998, 2004), to avoid double counting and to bracket the period when the Florida roosts contain the largest numbers of kites. Three of these years (2009–2011) involved Louisiana's participation in the first region-wide, simultaneous pre-migration roost survey project. Fixed wing aircraft were used to survey river systems from sunrise until roosts began to disperse (ca. 9:00 a.m.). Larger roosts were photographed to assist enumeration. The region-wide, simultaneous pre-migration roost surveys are planned to be repeated approximately every five years for three consecutive years (recommendations are pending the project final report). Louisiana's participation is advisable and the project should allow the development of a population index and an estimate of population trend.

The second immediate priority identified by the Swallow-tailed Kite Conservation Alliance was to determine the relative importance of limiting factors to the U.S. population (Zimmerman 2009). Accomplishing this goal will require estimating vital rates and conducting population viability and sensitivity analyses.

<u>Bald Eagle Surveys</u> – Removed from the federal list of threatened and endangered species in 2007 due to population recovery, Louisiana's Bald Eagle population continues to rise. Surveys for Louisiana's nesting eagles were started in 1984 by Rockefeller Wildlife Refuge biologist Tom Hess and continued through 2008. In 2015, approximately 650 nests were surveyed, and approximately 350 were active with chicks, eggs, or incubating adults.

Like colonial waterbirds, LDWF nesting Bald Eagle surveys are based on a list frame; nests are flown point-to-point, with possible new nests discovered while flying between points. In 2015, an effort was made to search nearby, suitable habitat as well, even if off the flight track. Brief protocol from 2015:

1) Surveys of nesting Bald Eagles are performed by helicopter and, typically, include two rounds of flights – one to gauge activity and one to gauge productivity. Because eagles are winter nesters in Louisiana, surveys can occur December through March. Round one typically occurs in February, whereas round two occurs in March. Round two should be adjusted based on the age of chicks targeted (typically, eight to ten weeks old).
2) Both observers (i.e., wildlife surveyors) are seated on the left side of the helicopter.
3) One observer is seated beside the pilot, assists in navigation, and acts as Secondary Observer.
4) Auxiliary navigation is provided by an aviation Global Positioning System (GPS) unit preloaded with coordinates of known Bald Eagle nests. In 2015, due to the last flight occurring several years prior, LDWF filtered nests to include those known to be active at least once during the last decade.
5) Prior to the survey, the pilot and observers discuss safety and flight plans, including expected outcomes for the day and possible refueling locations. In addition, the pilot is informed of any possible hazards faced (e.g., low flying vultures, territorial eagles, etc.).
6) Flights begin as early as possible each morning and routes are flown point-to-point with observers noting GPS coordinates and presence of adults, eggs, and chicks at each nest detected.
7) At each nest, the pilot decreases altitude to approximately 300 feet while maintaining a buffer at least as large. Airspeed is decreased to slowest speed deemed safe by the pilot.
8) Eggs and chicks are counted by both observers. If chicks are present, the observers confer and record age of chicks to the nearest two week period (e.g., one to two weeks old, three to four weeks old, etc.) based on photographs of known-aged chicks. Should birds show signs of disturbance, the pilot is instructed to back away from the nest and the survey recommences at a greater buffer distance.
9) When the main observer has recorded all required data, the pilot is instructed to fly to the next closest nest.
10) At the end of surveys, the Biotics database is updated with all new data.
11) Round Two surveys as many nests found to be active in Round One as is feasible. The timing of Round Two is based on when the maximum number of nests with chicks detected in Round One would be approximately ten weeks old, the age at which we may assume the nest will, ultimately, be successful.

<u>Secretive Marsh Bird Callback Surveys</u> – Marsh birds pose particular challenges to bird scientists. Often secretive in nature, several species of marsh birds prefer to remain hidden from view in dense vegetation, frequently only detectable by their songs or calls. In 1998, bird scientists met at Patuxent Wildlife Research Center (PWRC) to discuss the need for marsh bird monitoring (Ribic et al. 1999). Refinement of standardized protocols for surveys, ultimately, resulted in the Standardized North American marsh bird monitoring protocol (commonly known as the "Conway protocol") (Conway 2011). Briefly, the protocol involves point count surveys with periods of passive (i.e., no

callback allowed) survey and callback survey, and counts are usually situated along a route (water, road, etc.). Surveyors are strongly encouraged to enter data into the National Marsh Bird Monitoring Database. [As of June 2015, the database is currently being transitioned to the Avian Knowledge Network, but it should become available for data transfer again soon.]

In Louisiana, despite excellent work by academia and others, marsh birds continue to be under-surveyed and even the most basic knowledge gaps remain. Marsh birds have only recently been subject to intensive surveys in coastal Louisiana. In 2010, USGS, LDWF, and other federal and academic partners began coastwide, marsh bird callback surveys. More than 30 routes, each with approximately eight point counts, were established in *Spartina* and *Phragmites* dominated coastal wetlands.

Due to reductions in available staff, from 2011 through 2015, approximately 130 points were surveyed utilizing the Conway protocol (Conway 2011) three times each year – once each in April, May, and June. Louisiana's callback sequence was based on that utilized in coastal Mississippi (Mark Woodrey, personal communication) – Black Rail, Least Bittern, King Rail, Clapper Rail, Common Gallinule, Purple Gallinule, American Coot, and Pied-billed Grebe. Other focal birds for this work include Seaside Sparrows, Marsh Wrens, and Mottled Ducks.

Future marsh bird surveys should include additional, stratified survey points, which utilize the Conway protocol (Conway 2011), and projects that elucidate vital rates of these birds should be encouraged.

Web address: http://ag.arizona.edu/research/azfwru/NationalMarshBird/index.htm

Nightjars – The USGS BBS has collected and made available invaluable data on many species of birds. Some birds, however, are not well-surveyed by the BBS including wading birds, seabirds, nocturnal species and others. The Center for Conservation Biology's (CCB) Nightjar Survey Network was established to address the monitoring needs of this underrepresented group. Surveys are restricted to nights with bright moons, because these are times of peak detection. Many existing routes coincide with well-established BBS routes, but only ten point counts are distributed along the route rather than 50.

Web address: http://www.nightjars.org/

Finally, when initiating any new monitoring program or even for critiquing existing ones, consultation with Southeast Partners in Flight's (SEPIF) *Field Guide to Southeast Bird Monitoring Programs and Protocols* (Laurent et al. 2012) is strongly advised.

Web address: http://semonitoringguide.sepif.org/

In addition, an emerging panel of bird scientists, the Gulf of Mexico Avian Monitoring Network (GOMAMN), is (as of September 2015) becoming a major driving force in bird work in the Gulf region. This group is poised to make significant expansions and positive changes to existing monitoring programs and will likely guide a large portion of future bird science and monitoring in the region. LDWF's continued commitment to this working group and others like SEPIF will, undoubtedly, serve to promote sound monitoring decisions in this state and beyond.

c. Amphibian and Reptile Monitoring

Amphibian and reptile species are declining worldwide at an accelerated rate. Monitoring is critical to document changes in local populations and to assist in identification of the causes of population changes. These species can be more problematic to monitor than other faunal groups due to their cryptic nature, relatively small population sizes of some species, and non-random or limited distribution of others.

Several national and regional systems exist for monitoring amphibians and reptiles: the North American Amphibian Monitoring Program (NAAMP, including the Louisiana Amphibian Monitoring Program - LAMP), Partners in Amphibian and Reptile Conservation (PARC, including Southeast Partners in Amphibian and Reptile Conservation - SEPARC) (Graeter et al. 2013), and the USGS Amphibian and Reptile Monitoring Initiative (USGS-ARMI). LDWF continues to recruit volunteers to implement LAMP, and agency staff conduct routine surveys for amphibians and reptiles. State Wildlife Grant projects as well as other efforts provide presence/absence data and/or estimates of abundance for amphibians and reptiles in numerous habitat types in Louisiana. Research projects directed towards specific species, either funded through SWG or other sources, will continue to provide valuable data at a local scale for each.

The methods listed below are recommended and standardized for monitoring amphibian and reptile populations.

- Visual Encounter Surveys (VES) are used to detect species richness and/or abundance by observer(s) walking a pre-determined area in a time-constrained manner and recording all amphibians and reptiles seen. VES may consist of randomized-walk, quadrat, or transect methods, and coverboards may be used to increase detection.

- Artificial cover of various materials including plywood, carpet sections, and sheet metal, placed in systematic arrays within selected sites, are used to attract and shelter various reptile and amphibian species, which can then be sampled

- Funnel traps with/without drift fence arrays are commonly used to capture amphibians and reptiles in terrestrial and aquatic habitats. Drift fences may significantly increase capture of amphibians and reptiles when combined with funnel traps. Various funnel trap types include plywood and hardware cloth box trap, steel minnow trap, plastic minnow trap, and collapsible nylon trap.

- Automated recording units (ARUs) may be used to record calling amphibians to detect presence/absence.

- Hoop nets and Fyke nets are used to trap turtles. Fyke nets use net wings to guide turtles into an escape-proof enclosure, whereas hoop nets are baited to attract turtles. Replicate surveys should use nets of similar size and mesh and use the same bait.

- Basking turtle traps can be used for species that readily bask, but are difficult to capture using other techniques. One design adapted for high flow riverine systems uses existing basking structures (e.g., logs, branches) to which open-topped, crawfish wire basking traps are attached just below the water's surface with twine and nails. Basking turtles fall into the traps as they attempt to escape from the researchers approaching by boat. The turtles can easily escape from these traps so researchers must collect the turtles immediately. Free floating basking traps can be used successfully in lentic systems where basking structures are lacking. These are difficult to escape from if properly designed and do not require monitoring as frequently.

- Basking surveys use spotting scopes and binoculars to monitor basking turtle populations in locations where structures suitable for basking can be found. It is possible to identify species, sex, and age class using this technique. If turtles have been previously marked using a highly visible method (such as waterproof spray paint), density estimates can also be calculated.

- Line Transect Distance Sampling (LTDS) is used as the standardized method of surveying and monitoring Gopher Tortoise populations.

- Box traps with drift fence arrays are often used to capture snake species for presence/absence and for mark-recapture of specific species, such as the Louisiana Pinesnake, to obtain population data.

- PVC pipe traps can be placed vertically within selected microhabitats, either in the ground or attached to standing structures, to create refugia for amphibians which can then be sampled within wetland and surrounding upland habitat.

- Leaf litter bags are a commonly used method to capture and detect presence of aquatic amphibians, such as stream-dwelling salamanders and their larvae.

- Call surveys are used to quantify nocturnal breeding activity of anurans. For each species, chorus sizes are assigned values based on intensity.

d. Mammal Monitoring

Mammal monitoring faces many of the same challenges as amphibian and reptile monitoring in the sense that the majority of the species are often not readily observed through sight or sound. Standard methods for monitoring mammals typically involve some sort of catch-per-unit-effort (CPUE) or mark-recapture technique. Volant mammals are one exception to this; whereas they are routinely sampled using mist nets or harp traps, they can also be sampled using ultrasonic recording devices and are sometimes observed while roosting or as they emerge. There are numerous trapping methods available for capturing terrestrial mammals; however, lethal techniques are not recommended for monitoring mammal SCGN.

Examples of recommended standardized survey techniques are listed below:

- Pitfalls are very effective at capturing the smallest of our terrestrial mammals such as shrews. Their effectiveness can be greatly enhanced when used in combination with drift fences.

- Small to medium sized mammals can be sampled effectively using appropriately sized box traps. Arranging traps in a grid or web design allows the researcher to obtain density estimates.

- Mist nets or harp traps placed in flyways or emergence points can be used to capture bats.

- Ultrasonic recording devices are gaining popularity due to their relative ease of use. Distinguishing between similar species can be problematic with the current software packages available; nonetheless, this method can be useful for detecting certain species.

- When a day roost or hibernaculum is known, roost or emergence counts are routinely used to monitor bat populations over time.

- Track plates can be used to sample small to medium sized mammals. This technique requires that the target (1) traverses an ink pad and (2) deposits a print on an appropriate medium.

- When placed in a soft substrate which can record track imprints, scent stations with centrally placed attractants can be used to detect the presence of carnivores.

- Various methods for acquiring mammalian hair such as barbed wire or sticky paper are available. Mammals can often be identified through the hairs collected, and densities of mammals can be determined through genetic techniques.

- Motion activated or time lapse cameras can be very effective for detecting the presence of appropriately sized mammals. Widespread use of these cameras by the hunting community provides an excellent opportunity for a statewide citizen science project.

- Scat surveys are often employed to detect presence, and in some cases, may be utilized to estimate densities of certain mammals especially carnivores.

When applicable, LDWF will require the use of standard survey techniques by researchers conducting surveys and monitoring for SWG funded projects. In addition, CPUE data from projects outside of the SWG program can be captured by requesting that researchers include a measure of effort on their Louisiana Scientific Collecting Permit annual report. Acquiring these data will allow us to utilize the efforts of our partners to more effectively make comparisons of mammal populations over time.

e. Terrestrial Arthropod Monitoring

The techniques for sampling terrestrial arthropods (e.g., insects, arachnids, etc.) are as diverse as the groups themselves and, as such, the techniques utilized are dependent upon the target organism(s) and cannot be addressed at length here. Active techniques include sweep netting, aerial netting, and employing traps that use pheromones or ultraviolet light, whereas more passive techniques such as pitfalls, flight intercept, and malaise traps are commonly used as well. Although proper setting and collection of traps, and even active sampling and collection, may be readily taught to seasonal technicians, identification of most arthropods, especially to family, genus, or species, is time consuming and requires special expertise. In fact, for these reasons, arthropods are often not identified to species level during projects, a lack of specificity that hamstrings efforts of conservation of SGCN in Louisiana. Because of the paucity of these data, even baseline information on arthropod distribution is lacking. To address this knowledge gap, LDWF plans to collect data on arthropod SCGN both through in-house efforts as well as partnering with local experts. Surveys of current at-risk species are vital to elucidate the distribution and abundance of these species so management or conservation actions can be applied if necessary. Due to their high fecundity and short generation times, arthropods often respond rapidly to habitat manipulation and can be excellent early indicators of successful habitat management.

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 many SGCN listed in this strategy, monitoring efforts should focus on documenting new occurrences of fish SGCN and maintaining or establishing long-term monitoring programs. Information needed beyond species occurrence within all river basins include species trends and abundance with emphasis on SGCN. For those species for which we have adequate occurrence data, monitoring efforts should focus on population trends and changes in habitat availability.

An established monitoring framework has been devised for some species, such as the Gulf Sturgeon, and partnerships with the Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP) and USFWS have been established and will continue to aid in monitoring the recovery of this species. For other aquatic SGCN or suites of SGCN, similar monitoring plans should be developed and implemented. Monitoring efforts should be geared toward identifying species occurrences, species abundance, habitat preference, available habitat, and effects of habitat changes on these species.

Periodic monitoring should be conducted every 5 to 10 years, with reevaluation of goals and objectives after 5 years. Monitoring efforts will be conducted using standard LDWF protocols or other fish sampling methods recognized by the American Fisheries Society (Murphy and Willis 1996, Bonar et al. 2009). During the revision of the WAP, monitoring strategies were written to address freshwater aquatic SGCN found in each river basin and are listed in Table 9.1.

Large river systems serve as major conduits for the inflow of invasive fish and mussel species into the waters of Louisiana. Therefore, additional monitoring efforts are needed for identifying trends in the current range and abundance of these species and for determining what degree of impact the invasives have on native species.

For systems that are highly altered, such as the Red and Sabine Rivers, surveys may also provide information about the population-level impacts of such alterations. Impoundments and the effects of navigational and flood control projects lead to habitat alterations, and LDWF will partner with the Sabine River Authority (SRA) and USACE to monitor their effect on SGCN.

Coastal basins offer unique and ever changing habitats. Coastal restoration projects such as Davis Pond Freshwater Diversion and the Caernarvon Freshwater Diversion 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. Impacts on freshwater habitat and species from saltwater-barrier placements in steams and river channels to prevent saltwater intrusion must be monitored.

Habitat degradation in river basins has led to a reduction in aquatic species richness and abundance. Land use practices in these basins have impacted water quality. Partnering with state and federal partners such as the Louisiana Department of Environmental Quality (LDEQ) and USDA NRCS to monitor and improve water quality is a long term need.

Intensive inventories are needed to better understand the distribution and status of aquatic mollusks and crustaceans. To date, the technique most commonly used to sample freshwater mussels in Louisiana has been time-constrained, hand searches. Future inventories using this method will allow comparisons to be made over time. Additional information on this and other standard methods for sampling mussels can be found in Strayer and Smith (2003). Alternative techniques may be warranted for species specific surveys, especially for mussels like the Louisiana Pearlshell which occurs in headwater streams, often in dense aggregations. A standardized monitoring protocol for this species is now available and could serve as a template for the development of other such protocols.

Techniques for sampling crustaceans vary widely with habitat type. Various trap designs, electroshocking, seines, dip nets, and hand capture have all been used to study the distribution of these organisms in Louisiana. Much work remains to be done with crustacean and mollusk SGCN, including the development of standardized population monitoring protocols as well as basic life history studies.

b. Marine

The status of marine SGCN is closely related to habitat threats in the coastal ecosystem, especially marsh loss and degradation, and therefore these species may be some of the first to exhibit population declines. Habitat threats are at a critical level in the coastal zone, and LDWF Office of Fisheries prioritizes these habitat threats rather than having a species-oriented focus. Data developed through this process provides 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 protocols.

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 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 set for the various habitats and fish and invertebrate species in Louisiana coastal habitats.

Many marine and estuarine species are understudied, and long-term trends in their abundance are seldom known. It will be necessary to identify methods to monitor and verify the status of cryptic species by documenting presence, habitat use, and life history characteristics. 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.

Many conservation efforts are 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 impacted by 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.

c. Coastal Restoration

Created in 2005, the Louisiana Coastal Protection and Restoration Authority (CPRA) is responsible for oversight of hurricane protection and coastal restoration activities. CPRA Board Members include Secretaries of several Louisiana natural resource agencies including LDWF, LDEQ, and the Louisiana Department of Natural Resources (LDNR). The group was tasked with producing the Comprehensive Master Plan for a Sustainable Coast, which outlines the State's sound science approach to ensuring longevity of our coastal communities and habitats; the current Master Plan (CPRA 2012) may be viewed at http://coastal.la.gov/a-common-vision/2012-coastal-master-plan/ and is currently under revision.

As of April 2015, CPRA and its partners have "used more than 95-million cubic yards of dredged sediment, benefitted more than 26,000 acres of land, improved 256 miles of levees, and constructed 45 miles of barrier islands and berms (CPRA 2015). Whereas the primary goal of a portion of those projects is protection of the Louisiana coast through land building, where possible, projects benefit both humans and the ecosystem by taking the needs of both interests into account during design and construction. For example, Whiskey Island, in the Isles Dernieres Barrier Island Refuge, in Terrebonne Parish, provides protection from storm surge. The island gained significant subaerial land in 2009 due to restoration efforts by the State; approximately 319 acres of marsh and dune habitat were created and planted, acreage that both increases the island's usefulness as a storm buffer and its value as bird habitat.

Funding for these projects, which involve diverse methodologies for achieving the desired goals, comes from a variety of sources including the Coastal Wetlands Planning Protection and Restoration Act (CWPPRA) and the State of Louisiana Wetlands Trust Fund. A complete list of funding sources, collaborators, and projects including cost, size, and type can be found in CPRA's Annual Plans (http://coastal.la.gov/resources/library/reports/). Frequently, projects result in a change in habitat type (open water to marsh, Salt Marsh to Intermediate Marsh, non-vegetated area to vegetated (planted) area, etc.). Careful monitoring of restoration and enhancement activities, particularly comparisons of utilization by fish and wildlife before and after project implementation and completion, is especially vital for determining if project goals are actually met.

Concerns regarding habitat and fish and wildlife resources are resolved during both the engineering and design phase and the construction phase. Through CPRA's ecological review process, presumed ecological benefits and potential negative impacts 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 greatly improved. Throughout the process, the National Marine Fisheries Service (NMFS) will oversee project impacts on essential fish habitat, whereas the USFWS will address project impacts on other fish and wildlife. Concerns may include disruption of nutrient and water flow through tidal marshes, temporary displacement of foraging shorebirds, or hazards to sea turtles or other aquatic organisms near dredging operations. During construction, CPRA is careful to request consultation should SGCN be detected in the project footprint.

In 2003, CPRA (known at that time as the Office of Coastal Protection and Restoration) and USGS received funding from CWPPRA to develop a monitoring system and metrics to determine success of individual CWPPRA projects as well as their cumulative impacts on the landscape. The result is an overwhelmingly successful monitoring framework known as the Coastwide Reference Monitoring System (CRMS). Since 2005, 390 CRMS stations have been placed throughout coastal Louisiana. Stations (all or a subset) collect hydrographic data (continuous hourly salinity, temperature, and water level). Information on soil properties, soil porewater salinity, herbaceous and woody vegetation, and vertical accretion and surface elevation are collected by staff at varying intervals at these sites (additional information may be obtained from https://lacoast.gov/crms2/Home.aspx). Such an existing framework with continuous data could provide a tremendously beneficial backdrop for biological monitoring in the Coastal Zone.

Table 9.1 Monitoring needs for individual aquatic basins in Louisiana.

Atchafalaya Basin
Monitor population trends of SGCN
Develop long-term water quality monitoring sites
Develop long-term monitoring sites for SGCN
Monitor trends of invasive species catch in commercial fisheries landings

Barataria Basin
Monitor population trends of SGCN
Monitor the effects of freshwater diversions in the basin
Monitor the effects of severe land loss in the basin

Calcasieu Basin
Monitor annual salinity wedge in the river above the salt water barrier
Monitor population trends of SGCN

Mermentau Basin
Monitor population trends of SGCN
Develop long-term water quality monitoring sites
Develop long-term monitoring sites for SGCN
Sampling is needed to identify trends in range and abundance of invasive species

Mississippi Basin
Monitor population trends of SGCN
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
Monitor population trends of SGCN
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 SGCN
Develop protocol for gear-type to ensure sampling is repeatable
Monitor population trends of SGCN

Pontchartrain Basin
Monitor the effects of freshwater diversions in the basin
Develop protocol for gear-type to ensure sampling is repeatable
Develop long-term monitoring sites for SGCN
Conduct sampling to identify trends in range and abundance of invasive species
Monitor population trends of SGCN

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 SGCN
Monitor population trends of SGCN

Sabine Basin
Evaluate the impacts of dam operations on fish populations post new SRA hydropower license implementation
Monitor the effectiveness of mitigation features
Monitor population trends of SGCN
Conduct sampling to identify trends in range and abundance of invasive species

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

Vermilion-Teche Basin
Monitor population trends of SGCN
Sampling is needed to identify trends in range and abundance of invasive species
Develop long-term water quality monitoring sites

C. Measuring Effectiveness of Conservation Actions

Success of the Louisiana WAP will rest on implementation of the various conservation actions developed during the revision process. These actions present explicit and concise approaches to addressing the identified threats to Louisiana's SGCN and their associated habitats. Since the completion of the 2005 WAP, there have been several major developments that directly impact this aspect of the WAP. The first was the completion of a report on measuring the effectiveness of State Wildlife Grants (AFWA 2011). This document provides a framework for evaluating and adaptively managing the actions taken towards conservation of SGCN. That document should be referenced for more information on the framework and how it will be implemented.

Additionally, there is a new system for reporting on SWG projects developed by USFWS. This program is known as Wildlife Tracking and Reporting on Actions for the Conservation of Species (Wildlife TRACS). Wildlife TRACS was developed to incorporate the Effectiveness Measures developed by AFWA, as well as the standard lexicon set forth by Salafsky et al. (2008). As recommended by AFWA, Wildlife TRACS will be used to monitor the effectiveness of WAP implementation (AFWA 2012).

When reporting on a conservation action in Wildlife TRACS, the user must select from a set of Conservation Actions, which have three levels (Appendix L). The first level conservation actions are comprehensive and fall into several categories including:

- Direct Management of Natural Resources
- Data Collection and Analysis
- Education and Outreach
- Land Acquisition and Protection
- Planning

- Species Reintroduction
- Technical Assistance

Second level Conservation Actions are also comprehensive, but for the Third Level Actions, only examples are provided, as a comprehensive list would be prohibitively lengthy.

Wildlife TRACS also provides standard output measures for each conservation action, and these measures will allow LDWF to monitor our success in implementing the WAP and the effectiveness of our conservation actions. To facilitate monitoring of WAP implementation and to maximize the utility of Wildlife TRACS outputs in reporting on SWG effectiveness, SMART (Specific, Measurable, Achievable, Relevant, and Time Bound) objectives will be developed for all future internal SWG projects and required for all external proposals as well.

In addition to replacing the overly complicated monitoring protocol detailed in the 2005 WAP, adoption of Wildlife TRACS actions and outputs will allow for data from Louisiana to be combined with data from other states, providing a better picture of the effectiveness of WAPs across the nation.

D. Adaptive Management

An important aspect of monitoring is to ensure that conservation actions and management approaches that are proven to be beneficial to SGCN are incorporated into LDWF's management practices and promoted among all state and federal natural resource agencies and private land managers and that those actions that are most effective are identified. It is critical that mechanisms are in place to measure the effectiveness of conservation actions taken by LDWF and other partners, as discussed above. This will enable LDWF to adapt conservation actions as needed to achieve the desired result. Additionally, it will be important to periodically evaluate the effectiveness of our monitoring, if the monitoring protocols in place are not adequately documenting the impact of conservation actions.

Adaptive management is a four-phase cycle, in which each phase leads into the next, and is a continual process (Stankey et al. 2005). The four phases are as follows, adapted from Stankey et al. (2005):

Phase 1 – planning (either at the project or the WAP level)
Phase 2 – on-the ground conservation action
Phase 3 – the results of the conservation actions are monitored
Phase 4 – the results are evaluated, leading back to Phase 1

This is a continually evolving process, with lessons learned from each project and action feeding back into the loop, and improving the outcomes of future conservation actions.

LDWF will complete the next comprehensive revision of the WAP by 2025 and will continue to utilize the Emerging Issues process to address high priority conservation issues outside the scope of the 2015 WAP that may arise within the next decade. The use of SMART objectives, effectiveness measures (AFWA 2011), and Wildlife TRACS will enable LDWF to continually monitor and evaluate the success of WAP implementation and adjust goals and actions as needed to ensure that benefits to SGCN are maximized.