Chapter 3. Monitoring, Evaluation, and Adaptive Management

3.0 Introduction

Adaptive management will be the cornerstone of the Action Plan in terms of conservation actions and the threats they are focused upon. Actions in the Plan are developed using the best information available at the time. As we move forward, data will be collected, new information will be acquired, evaluations will be conducted, and new issues will arise. The process of conducting effective conservation programs is a continuous cycle of implementation, assessment, and adjustment.

Conservation actions identified to abate threats to species and habitats will drive project development. As projects are implemented, progress will be monitored, performance will be measured, and adaptation will occur where necessary. We will work with other public agencies and NGO conservation organizations to coordinate monitoring programs on a statewide basis. This will improve monitoring efficiency by leveraging expertise as well as proximity of personnel and resources to monitoring sites. Stakeholder and partner involvement will also aid data sharing and improvements to monitoring design.

Monitoring and evaluation will be conducted utilizing existing sampling and survey structures, and will be utilized to modify or adjust management activities. New survey or sampling protocols will be developed as needed in order to obtain the best and most useful information to effectively manage species and habitats. As discussed in Chapter 1 under Action Plan Evaluation and Updates, project reporting requirements necessitate an annual evaluation process, and the operational planning process facilitates annual project updates and modifications.

Proper monitoring is key to our ability to track the success of conservation actions, ensuring the most efficient and effective use of staff, funds, and resources. As conditions change (e.g., land use patterns, climate change, population trends, new data and information acquired), adaptive management and implementation of the conservation actions identified in Chapter 6 (Ohio's Habitats) will allow us to respond appropriately. Adaptive management has been built into the Division's Comprehensive Management System since inception (See Chapter 1 under Action Plan Evaluation and Updates).

This chapter describes how Ohio will use tools for information management and conservation planning to track the implementation and effectiveness of conservation actions. These tools are described in the Measuring the Effectiveness of State Wildlife Grants (AFWA 2011) final report, and the national Wildlife Tracking and Reporting Actions for the Conservation of Species (*TRACS*) database funded by U.S. Fish and Wildlife Service. The framework starts with a specific conservation action, then a basic results chain is created linking the action to objectives, relevant threats, and targets (habitats and species). Appropriate indicators and measures are determined for each step in the chain, and monitoring data are used to track and populate those indicators. Information about the results chain, indicators, and measures is then entered into the *Wildlife TRACS* database. Effectiveness Measures is the process, and *TRACS* is the IT system used for reporting and tracking. Measurement of indicators for each step in the results chain provides the essential information needed for evaluating the effectiveness of conservation actions. Conservation actions will be monitored and measured throughout the 10-year implementation of Ohio's Action Plan.

3.1 State Wildlife Grants Effectiveness Measures Project

In an effort to develop an approach for measuring the effectiveness of wildlife conservation activities funded under the USFWS's State Wildlife Grants (SWG) program, the Association of Fish and Wildlife Agencies' (AFWA) Teaming With Wildlife (TWW) Committee formed the Effectiveness Measures Working Group (Working Group) in September 2009. This Working Group included representatives from state fish and wildlife agencies and key conservation partners with expertise in wildlife conservation and performance management.

In 2011, the Working Group released a final report that includes an agreed upon set of effectiveness measures that can be used by states to improve performance reporting under the SWG program. The report recommends a set of common indicators for measuring status, trends, and/or effectiveness of 11 categories of generic conservation actions that are most commonly funded with SWG dollars. These actions include:

- direct management of natural resources
- species restoration
- creation of new habitat
- acquisition/easement/lease
- conservation area designation
- environmental review
- management planning
- land use planning
- training and technical assistance
- data collection and analysis
- education

The Effectiveness Measures process demonstrates that data can be collected in large part by taking advantage of existing datasets, integrated into the project management and reporting cycle currently used, and implemented. The Working Group report includes sample templates and forms that can be used for reporting the results of conservation activities, as well as a discussion of the specific methods by which these reporting methods could be incorporated into in the USFWS's grants management database. The report can be found at: www.fishwildlife.org/files/Effectiveness-Measures-Report_2011.pdf.

3.2 *Wildlife TRACS*

The State Wildlife Grants Effectiveness Measures process can utilize the *Wildlife TRACS* database designed by the USFWS to record information about conservation activities. *Wildlife TRACS* is intended to track and report project outputs, effectiveness measures, and species and habitat outcomes. *Wildlife TRACS* can also be used to track longer term outcomes for species and habitats, beyond the types of short-term output measures commonly tracked by funding agencies (e.g., number of publications, number of workshops, number of people contacted). The *Wildlife TRACS* database includes classifications of conservation actions and threats, based in part on the classifications developed jointly by the International Union for Conservation of Nature (IUCN) and the Conservation Measures Partnership (see Salafsky et al. 2008). More information about *Wildlife TRACS* can be found at: https://tracs.fws.gov/learning

3.3 Ohio's Monitoring Framework

Inventory and monitoring information on species and habitats is collected by numerous government (federal and state), academic, and conservation organizations in Ohio. Citizen science programs are also utilized to augment monitoring capacity where appropriate and practical. In concert with species and habitat monitoring recommendations in this Plan, efforts need to be made to identify, inventory, coordinate, and catalog the data being collected by all entities in the state.

Efficiency and effectiveness of monitoring efforts can be improved by taking a mile-high view of the data collection landscape in Ohio, and then taking steps to avoid duplication of effort, improve cost effectiveness of efforts, and focus efforts on priority conservation issues. Time, money, and resources can be saved by working in a coordinated fashion – particularly within the state and region. Increases in the amount and coverage of data collected can be leveraged in the implementation and evaluation of conservation actions from the Action Plan. Adaptive management will be facilitated by the amount and coverage monitoring data collected.

Ohio uses a number of monitoring programs to track the status and trends of species in the state, as well as the condition and location of key wildlife habitat areas. In addition to these status/trend measures,

some of these monitoring programs also track the effectiveness of wildlife conservation activities. Ohio's monitoring framework considers the appropriate geographic scale to evaluate the status of species and the effectiveness of conservation actions. Implementation of the 2005 CWCS involved monitoring at a variety of geographic scales, including local, state, regional, national, and international, as appropriate to plans and programs.

Local trends revealed by monitoring activities are viewed in the context of multiple scales, both spatially and temporally. The status of species and habitats is best ascertained by considering range and distribution, without regard to state boundaries. At minimum, ecoregion scales are be used to gain an accurate assessment when trying to determine degree of imperilment. Similarly, assessing trends utilizes the broadest temporal look that legitimate data allows.

During the life of the original 2005 CWCS, Ohio was involved with a number of regional projects to address conservation and monitoring of SGCN species and their habitats. Examples include collaboration on Ohio River projects with the USFWS, Ohio River Fisheries Management Team (ORFMT), and Mississippi Interstate Cooperative Resource Association (MICRA), and on Lake Erie projects with regional state and federal agencies and the Ontario Ministry of Natural Resources (OMNR) through the Joint Strategic Plan for the Management of Great Lakes Fisheries and Lakewide Management Plan (LaMP). Ohio's monitoring framework includes the use of standardized regional protocols such as the Breeding Bird Survey, Partners in Flight, Upper Mississippi River and Great Lakes Region Joint Venture, North American Bat Monitoring Program, and regional LCC's. Use of such standardized protocols ensure that Ohio's data will be compatible with regional and national conservation efforts.

Statewide projects are managed by the Division, often in cooperation with a multitude of other partner organizations (see Chapter 2 Ohio's First 10 Years of CWCS Implementation). Data from these projects as well as process-related information from individual projects (e.g., number of meetings held, number of reports produced, number of people contacted through outreach efforts, number of plans developed, etc.) will be reported to the USFWS and tracked using the Wildlife TRACS database.

Ohio's monitoring framework also incorporates short, mid, and long-term time scales (short-term, interim and long-term) to monitor the status and condition of SGCN and their habitats, as well as effectiveness of conservation actions. Short-term monitoring measures the degree to which conservation actions have been implemented. Mid-term monitoring evaluates the degree to which conservation actions were successful in improving the status and/or condition of SGCN and key habitats – and facilitates adaptive management. Long-term monitoring tracks spatial and temporal abundance and condition of SGCN and key habitats.

We intend to follow AFWA Best Practices recommendations to ensure that monitoring activities use the appropriate geographic scale to evaluate the status of species or species groups and the effectiveness of conservation actions. Examples of AFWA recommendations that we intend to implement are:

- Assess populations, habitats, and conservation action effectiveness at multiple scales.

- Collaborate with other agencies and conservation partners in established, long-term, multistate efforts to contribute to, and gain from, broader spatiotemporal perspectives of status and trends. Examples could include the North American Breeding Bird Survey, Audubon Christmas Bird Count, Xerces Society Fourth of July Butterfly Count, and North American Amphibian Monitoring Program.

- Coordinate in-state habitat monitoring with regional habitat condition data available from groups such as the USDA Forest Service and National Fish Habitat Partnership

- Participate in research and conservation alliances such as Landscape Conservation Cooperatives (LCCs), international bird conservation groups, and regional agency associations.

3.3.1 Species Monitoring

In order to prioritize species of greatest conservation need within taxa groups, we chose to use a scoring system developed by Millsap et al. (1990) to determine a numeric rank conservation status for each species. This scoring system was developed to rank species according to biological vulnerability, extent of current knowledge of population status, and management needs. Primary components of the system are biological scores, action scores, and supplemental variables.

Biological scores were calculated by totaling individual scores for 7 variables that included: population size, population trend, range size, distribution trend, population concentration, reproductive potential, and ecological specialization. The way this system works, higher biological scores for a given species indicate a greater probability of extirpation. As a monitoring tool, changes in biological scores for a given species can be used as an indicator of species status as well as a representation of the effectiveness (or ineffectiveness) of conservation actions. Further, changes in the scores for each of the 7 variables that comprise the biological score can be used to explain what population metric is primarily responsible for biological score changes. By monitoring changes in biological scores and their individual components (7 variables), adaptive management can occur by focusing conservation actions where they are most needed.

Action scores are the total of individual scores for 4 variables that include knowledge of distribution in Ohio, knowledge of population trend in Ohio, knowledge of Ohio population limitations, and ongoing management activities in Ohio. In this system, higher action scores for a given species indicate a lower level of knowledge about the species itself, and a low (or absent) level of management activities focused on the species. Monitoring of action scores can help point out when knowledge is lacking and research is needed, or when management activities are lacking. Action scores will be indicators of the degree of conservation action implementation. In addition, monitoring the individual component (4 variables) scores can illuminate the specific aspects responsible for low or high composite scores, and thus future focal points for research and management activities.

The Florida scoring system we have chosen to use is the primary metric by which species status will be monitored. As the SGCN taxa group ranking list is evaluated and updated, changes in scores will be used to assess the effectiveness of, and degree to which conservation actions have been implemented. At the same time, as more data is collected for species not currently included on Ohio's SGCN lists, conservation status scores can be calculated, and the scoring system can then function as a monitoring tool for these species.

Ohio utilizes a variety of databases to store species information such as population distribution, size, and trends. As action-based conservation projects are implemented, these databases will be updated with data generated by these projects. Efforts will be focused on database compatibility as we move forward. Standardization will facilitate linkage of individual databases, which will make species monitoring efforts more efficient and effective. A list of the primary databases used in Ohio can be found in Chapter 4 Species of Greatest Conservation Need.

Monitoring will be conducted at appropriate biological levels including individual species, species guilds, or natural communities. Monitoring data will be evaluated at appropriate intervals and be used to refine protocols or develop new ones that will be more effective. Basic species metrics from these monitoring programs will be maintained by project leaders and submitted to the USFWS *TRACS* database. Also (as discussed in the section above) we will support and participate in partners plans that have recommended or identified standardized monitoring actions for broader spatial consistency (e.g., USFWS, Partners In Flight, Partners in Amphibian and Reptile Conservation, Upper Mississippi River and Great Lakes Region Joint Venture).

Marshbird surveys are an example of long term monitoring. In 1996, the Ohio Department of Natural Resources – Division of Wildlife, in cooperation with The Ohio State University implemented the wetland breeding bird survey (WBBS). The WBBS was one of the pioneer techniques in the country to detect marshbirds; however, the routes and survey points were not picked randomly so it was not possible to make an inference about marshbird abundance for the state. In 2011, the Division modified the WBBS to

conform to the National Marshbird Monitoring Protocol (NMMP) so that Ohio's marshbird numbers could be used with other states to more adequately determine the status of marshbirds in the Mississippi Flyway. Points were picked randomly to allow for better inference regarding marshbird abundance in the state. Since 2011, 6 – 9 routes in some of the major wetland areas in the state (e.g. Killbuck Wildlife Area, Killdeer Plains Wildlife Area, and Magee Marsh Wildlife Area) have been surveyed annually. The routes are surveyed 3 times each breeding seasons from May to June. Targeted species are the state-endangered King Rail, American Bittern, Sandhill Crane, and Black Tern, the state-threatened Least Bittern, and the following state species of concern: Sora, Virginia Rail, and Marsh Wren. Pied-billed Grebe, American Coot, Willow Flycatcher, Swamp Sparrow, Common Gallinule and Wood Duck are also surveyed.

In cases where not enough information exists to monitor a species or group, or monitoring protocols have not yet been developed, this need is reflected in conservation actions that address information needs. This is true for some taxa groups (especially invertebrates) for which standardized protocols need to be developed, and where baseline data do not exist to form the basis of a monitoring protocol. In these cases, these overarching taxa needs are described in Chapter 4 under the appropriate taxa.
The status and trends of individual SGCN will be tracked utilizing existing databases (for example, Ohio Natural Heritage Database, Division's Wildlife and Fisheries databases). These databases include species occurrence records for flora and fauna that occur in Ohio, as well as protection status (federal and state). The Division's wildlife and fisheries databases are utilized by agency personnel as well as researchers under contract with the Division. The Natural Heritage Database can be accessed by anyone doing research and/or scientific work in Ohio (http://wildlife.ohiodnr.gov/species-and-habitats/ohio-natural-heritage-database). The Division's scientific collection permit system is tied into this database. For a researcher to renew their permit each year, they must submit the previous year's data for inclusion into the Natural Heritage Database. The database includes information from all Ohio lands without regard to protection status or ownership. The database is a clearinghouse and contains data collected by ODNR personnel, other state agency researchers, academics, and the general public.

3.3.2 Habitat Monitoring

Habitat monitoring involves both quantitative and qualitative aspects. Geographic Information Systems (GIS) have made it convenient to monitor land cover and habitat types on a landscape scale. However, most GIS systems in use do not contain all of the data layers necessary to function as a qualitative assessment tool. A goal of this Action Plan going forward needs to be to develop a habitat monitoring system that integrates sufficient data layers to coordinate and assess the success of conservation actions at the ecosystem level.

Scenic rivers, natural areas, wildlife areas, state parks, national forests, national wildlife refuges, county and metro parks, and lands owned by non-government conservation groups form the foundation of protected high-priority lands in Ohio. Additional habitat is periodically added to these areas through direct land acquisition. Habitat is also protected through incentive programs like the Conservation Reserve Enhancement Program and Conservation Reserve Program, and multiple easement programs for grassland, forest, and wetland habitats.

On a landscape scale, monitoring of habitats can be conducted by assessing changes in acreage of these protected lands. Implementation of habitat conservation actions from the Action Plan would be expected to produce increases in the amount of protected lands. Area increases provide a general quantitative assessment. For extremely small, fragmented, or rare habitats, a more detailed assessment will be necessary. Percent change in habitat amount however, is not always the best metric for assessing the success of conservation actions.

The quality of habitat is the other side of assessment of conservation actions. For some habitats, quantity does not necessarily rank above quality. A "no net loss" program that equates 10 acres of contiguous habitat with 10 one-acre habitat fragments will not provide a true picture of habitat status and function. Conservation actions in the Plan will focus on the condition of habitats as much as the percent change in area. Habitat quality assessment criteria need further development and refinement going forward in order to produce performance metrics that can be employed state and region wide.

Monitoring changes in habitat quantity with GIS, and habitat quality with appropriate metrics will indicate the success of Plan actions as well as the degree of action implementation. Work remains to be done on developing a GIS database that improves spatial and temporal components, in addition to adding habitat quality and species information. Consideration will be given to adding additional layers such as conservation threats and related actions that have been implemented. These additional data layers will significantly increase the utility of GIS as a monitoring tool for species, habitats, and conservation action effectiveness. A centralized system that could be accessed and updated by all conservation partners would contribute greatly to the robustness of the database.

Monitoring of habitats will be accomplished primarily through existing monitoring programs. They are the primary means for monitoring the distribution, condition, and status of key wildlife habitats identified in Ohio's Action Plan. Evaluating the success of conservation actions aimed at protection and improvement of key habitats will be accomplished through these monitoring programs. Basic habitat metrics will be maintained by project leaders and submitted to the USFWS *Wildlife TRACS* database.

Examples of habitat monitoring activities in Ohio include the Division's Fish Management stream survey program, Wildlife Management's land inventory and cover mapping projects, Ohio Environmental Protection Agency's statewide biological and water quality monitoring program, the Ohio River Sanitation Commission's (ORSANCO) Ohio River monitoring program, the Division sponsored Amphibian Habitat monitoring program, and various other habitat monitoring programs conducted by ODNR divisions.

Another example of habitat monitoring is the recently completed forest inventory of Division of Wildlife's Wildlife Areas. Oak-hickory is the dominant forest type and provides an important wildlife food resource in Ohio. However, an analysis of tree species composition by diameter class reveals a lack of oak and hickory, and a predominance of shade-tolerant species such as red maple, in smaller tree diameter classes (Widmann et al. 2009). The virtual absence of oak regeneration has been attributed to fire suppression and silvicultural practices that favor shade tolerant species and inhibit oak establishment. Maintaining oak-hickory forest types on publicly-owned lands will be critical to provide habitat for diverse and abundant wildlife populations. SILVAH (short for Silviculture of Allegheny Hardwoods) Oak is a forest management decision support tool developed by the USDA Forest Service that helps determine management needs for oak regeneration. It includes overstory, understory and other site variables in the analysis of future desired stand conditions and for making prescription recommendations. It will guide the Division on restoration, maintenance, and enhancement of these habitats. The Division recently collected data on more than 25,000 acres of forests on Wildlife Areas in a SILVAH Oak compatible format for subsequent analysis. Monitoring the forest habitat through time and adjusting management practices to support oak communities will help conserve Ohio's diverse wildlife.

Long-term monitoring of the key habitats will be accomplished using existing and new geographic information system (GIS) programs. A need to develop updated GIS systems has been identified (above). Expanding current programs such as updating the existing Ohio Aquatic GAP, adding a terrestrial GAP, and coordinating with other landscape level mapping projects would enhance the understanding of key habitats in a regional context.

At the state and local levels periodic updates of land use and land cover will allow the extent, distribution, and condition of habitats to be monitored as conservation actions and SWG projects are implemented. Mapping and monitoring of rare natural communities and habitats remains a statewide need. Specific areas where additional efforts are needed will be identified and incorporated as the SWAP is updated.

3.3.3 Addressing Data Gaps

The limited resources (funding, personnel, time) available to sustain monitoring programs makes it impossible to monitor many aspects of the environment relevant to fish and wildlife conservation efforts. Given that, high-priority target areas must be identified where additional data would facilitate the development of management strategies for Ohio's fish and wildlife resources. Chapter 4 and Chapter 6 both include high priority data gaps identified through the SWAP revision process. Developing monitoring

programs to address high-priority gaps will be critical going forward to provide the species and habitat information necessary to implement effective conservation actions.

3.3.4 Effectiveness of Conservation Actions

The purpose of tracking effectiveness measures is to obtain the information necessary to adaptively manage species and habitats in the state. Ohio is committed to an adaptive management approach to fish and wildlife conservation. The next sections of this chapter describe a conceptual model for the SWAP with corresponding results chains, and illustrate how the SWG effectiveness measures function within an adaptive management context. The effectiveness of conservation actions described in Ohio's Action Plan will be measured using a set of standardized effectiveness measures that have been developed by AFWA and described in their 2011 *Measuring the Effectiveness of State Wildlife Grants: Final Report* (AFWA 2011). Actual values for these measures will be entered into the USFWS *Wildlife TRACS* database, and comparisons of the values of these measures over time will be used to establish the degree of effectiveness of individual projects as well as broader conservation programs. Terms and standard definitions are derived from Margoluis and Salafsky (1998) and Salafsky et al. (2008).

Performance of conservation actions will be measured at the species, habitat, and ecosystem levels. Additionally, performance will be measured at the threat level in terms of success in abating the conservation threats described in the Action Plan. Actions will be evaluated annually as part of the project performance report process described in Chapter 1 (Action Plan Evaluation and Updates section). Actions will also be evaluated during the Plan 5-year review cycle in terms of their degree of implementation. As mentioned earlier, conservation status scores for SGCN, changes in quantity and quality of habitats, and changes in the amount of data collected on species and habitats will serve as key evaluation metrics. Examples of performance measures for conservation actions could include:

- Increased proportion of development projects that are appropriately designed and located
- Reduced rate of conversion of natural habitats
- Increased landowner participation in wastewater/fertilizer applications control programs to control urban nutrient loads
- Increased agricultural community participation in riparian buffer programs, nutrient runoff reduction programs, and topsoil conservation programs
- Increased number of stream/riparian habitat miles that meet appropriate habitat and water quality standards
- Decreased number of acres impacted by invasive plants
- Decreased number of newly introduced invasive species

3.4 Conceptual Model for Ohio's State Wildlife Action Plan

Conceptual models are the foundation of adaptive management approaches for species and habitat conservation. Models illustrate a "theory of change" for a project – that is, the causal pathways by which managers believe that a project will achieve its desired results. Although there are many different kinds of conceptual models, Margoluis and Salafsky (1998) introduced a simple form of box-and-arrow diagram that shows causal linkages between the basic conservation elements for an individual project, including targets, threats, and conservation actions. While originally created as a tool for developing individual conservation projects, conceptual models can also be developed for a larger conservation program. The following conceptual model (Figure 6) for the SWAP illustrates the linkages between the core plan elements, including species and habitats, threats, and actions. This conceptual model is intended to be a generalized representation of the interactions between the plan elements. Not all of the threats and actions shown in the diagram will apply to every species or habitat. What the diagram shows is the set of possible threats and actions that could affect a particular species or habitat.

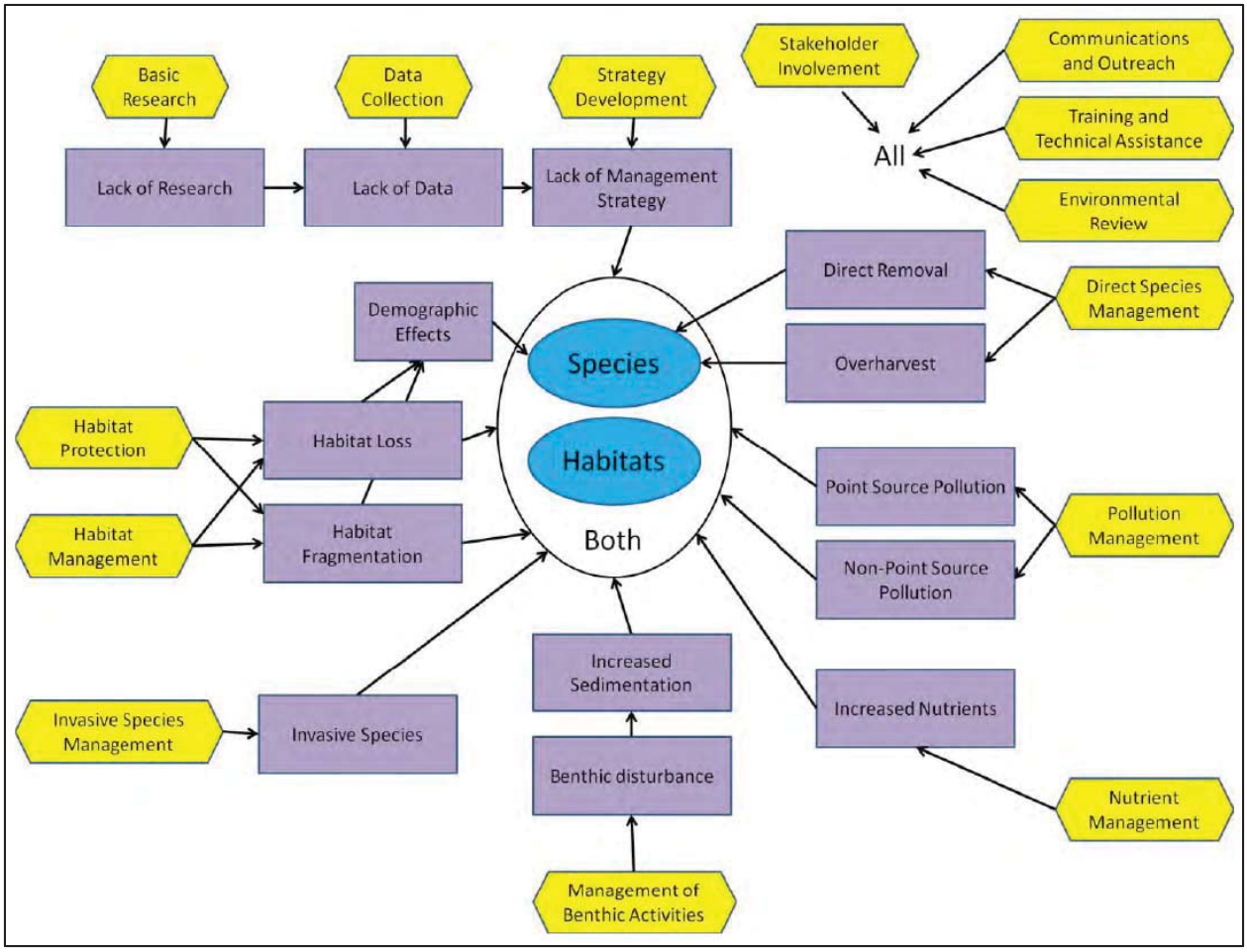
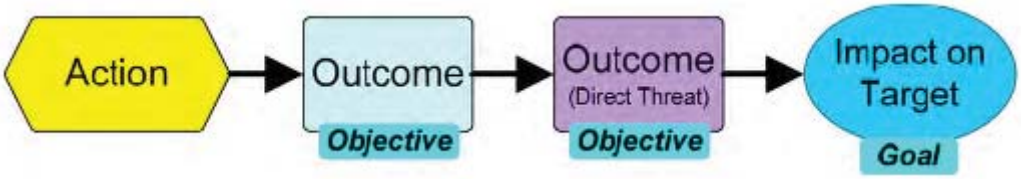


Figure 6. Conceptual model illustrating the linkages between Action Plan elements. Conservation actions = yellow hexagons; threats or information needs = lavender boxes; targets = blue ovals. Arrows indicate the logical causal linkages between the elements. Arrows between actions and threats show that the action is intended to abate the threat. Arrows between threats and targets show that the threat affects that target.

3.4.1 Results Chains

The conceptual model above can be used to construct a set of results chains for each of the different conservation actions (yellow hexagons). The results chain below shows the logical linkages between a conservation action and the target at which the action is directed. Results chains also include threats, in cases when the conservation action is intended to reduce a specific threat, and may also include intermediate outcomes between the action and its intended benefits to the target. Sample results chain:



Fully developed results chains incorporate indicators for each of the individual elements (actions, threats, outcomes, and targets). A specific measure is then identified for each indicator, showing how exactly that indicator will be measured over time. Data from existing monitoring programs can be used to track the values of these measures over time. Reviewing data from monitoring programs can help managers adjust their management strategies to adaptively manage species and their habitats.

From this Action Plan, the Division and its partners will develop project-specific results chains for the individual conservation actions selected for implementation. At the same time, we will use existing results chains that have been developed by AFWA to identify potential indicators and effectiveness measures for the categories of conservation actions in the conceptual model presented above.

3.4.2 Results Chains and Effectiveness Measures for Conservation Actions

Results chains were originally created as tools for developing an individual conservation project. However, It is also possible to develop generalized results chains that show the relationships between the basic classes of elements (actions, threats, outcomes, targets) for particular types or classes of conservation projects. These generalized results chains are useful in identifying indicators and measures that can help to track progress towards conservation goals across a suite of similar projects. If projects are tracked using identical or compatible indicators and measures, the information about project accomplishments can then be “rolled up” across the suite of projects in order to report broader progress to funding agencies and the general public.

AFWA developed sets of generalized results chains for common conservation actions described in the SWAPs. The AFWA report on SWG Effectiveness Measures (AFWA 2011) also included a set of recommended indicators for each of a set of generalized results chains. Because these indicators are intended to track progress on conservation projects, they are also known as “effectiveness measures” or “performance measures.” These effectiveness measures developed by the AFWA SWG Effectiveness Measures Working Group will be tracked for classes of conservation actions. These measures will then be reported and tracked as part of Ohio’s regular reporting to the USFWS via the *Wildlife TRACS* database.

3.4.3 Scenario: Shovelnose Sturgeon Reintroduction

The following example describes a proposed approach for Ohio’s framework for monitoring and effectiveness measures.

The shovelnose sturgeon is a large river species that prefers sand and gravel substrates with current. Shovelnose sturgeons have not been seen since the mid-1900’s and are listed as endangered in Ohio. Shovelnose sturgeon were once common in the Ohio River and its larger tributary rivers. They were reportedly abundant upstream as far as Washington County (Ohio) until about 1910.

The damming of large rivers has contributed significantly to this species’ decline by blocking access to ancestral spawning areas and greatly reducing its required habitat. The lack of pollution laws and increased siltation from changing land use patterns in the watershed also negatively impacted habitat and its primary food source of mussels and snails.

Priority conservation actions that have been identified to improve the conservation of shovelnose sturgeon and their riverine habitat include: (1) improve water and habitat quality by supporting riparian and habitat restoration projects; (2) supporting management plans that improve land-use practices in the Scioto watershed; (3) identification of a genetically similar brood source and development of techniques for production of large numbers (1000’s) of advanced fingerlings; and (4) reintroduction of fingerling shovelnose sturgeon to suitable habitat sites on the lower Scioto River.

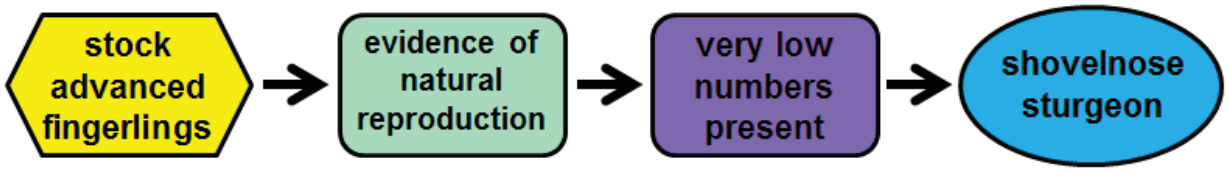
Priority research needs are to: (1) conduct a comprehensive survey in the lower Scioto River for potential reintroduction sites, and (2) identify a shovelnose sturgeon brood source and develop hatchery production techniques. Products of this research will help fill information gaps to identify potential reintroduction sites, and provide fingerling fish for stocking at those sites.

Key partners to implement these conservation actions include the U.S. Fish and Wildlife Service, Indiana DNR, and Illinois DNR for the collection of brood shovelnose sturgeon. The Division of Wildlife will partner with various land conservation organizations to protect riparian corridor on the Scioto River. The Division of Wildlife will also work with local Soil and Water Conservation Districts to promote best management land-use practices in the Scioto River watershed.

In this example, from the list of priority conservation actions above, we will focus on conservation action #4: *stock advanced fingerling shovelnose sturgeon in an effort to re-establish a self-sustaining population*.

For this example conservation action, a basic results chain which shows the connections between the four basic conservation elements is then developed: action, objectives, threats, and targets. In this example, these elements are defined as follows:

- **Action:** stock advanced fingerling shovelnose sturgeon
- **Objective:** establish a self-sustaining shovelnose sturgeon population
- **Threat:** extremely low (possibly extirpated) remaining numbers of shovelnose sturgeon - below threshold necessary for reproduction
- **Target:** Species = shovelnose sturgeon



For each element in the results chain above, an indicator and a method or measure by which that indicator will be tracked is identified.

AFWA's 2011 report on effectiveness measures for SWGs classifies stocking fish to re-establish a self-reproducing population as "Species Restoration". Recommended indicators and performance measures for projects that involve Species Restoration include the following:

- "Good" overall plan exists for restoring the species
- "Good" restoration plan completed for project site(s)
- Key stakeholders buy-in to plan
- Source population identified and/or propagated
- Species initially restored to sites (short-term)
- Species breeding at restoration sites (medium-term)
- Viability of SGCN improved

For the specific management action (stock advanced fingerlings), the indicator "percent of target number of units that are released" will be measured by tracking the number of advanced fingerling shovelnose sturgeon stocked each year.

For the objective (evidence of natural reproduction), the indicator "percent of sites with restored population successfully breeding" will be measured by conducting annual population surveys of unmarked sub-adult fish which would indicate natural reproduction.

For the threat (very low numbers present), the indicator "percent of sites with restored population" will be measured by conducting annual surveys to track the number of sturgeon per stream mile to assess the success of the stocking efforts.

For the target (shovelnose sturgeon), the indicators "species measures (e.g., population size, reproductive success)" can be measured. Population size will be estimated using mark-recapture techniques. Reproductive success will be measured using annual surveys of unmarked juvenile sturgeon and tracking changes over time.

In order to be able to track changes in these indicators over time, descriptions of the specific measures for each indicator must be established, including units for each measure, and benchmark values for those measures must be determined at the start of the project. In addition to activities involving project participants, other monitoring programs that may provide data on indicator measures should be identified. At the end of the project, basic results chains such as the one in the example above will be used to illustrate how the values of each indicator for the chain changed over the years post-project implementation.

The *Wildlife TRACS* database (specifically *Data TRACS*) will be the project data storehouse, and the project tracking and reporting tool for project partners. It will be the primary communication mechanism to inform the USFWS regarding activities, progress, and achievements. *Public TRACS* will be used to generate summary reports and other information that can be used to demonstrate conservation successes and program efficiency to diverse audiences, including conservation partners, landowners, and policymakers.

This process of measuring the effectiveness of conservation actions is the key to adaptive management, which requires building monitoring efforts into the overall project management cycle. Under an adaptive management approach, a theory of change is developed for each action, and relevant information is collected to evaluate its effectiveness. If the activity provides the expected results, effectiveness measures help communicate that success so others may utilize it. If on the other hand, the action does not work as hypothesized, then problems are identified, and either actions are modified or alternatives are chosen. The key to adaptive management is to learn from successes, informative failures, and useless failures and respond accordingly so programs can become more effective and efficient over time (AFWA 2011).