



# CHAPTER 5

## Monitoring

*Daniel W. Brauning* ■ *Pennsylvania Game Commission*

---

### Table of Contents

|  |    |
|--|----|
| <b>Overview</b> .....  | 2  |
| <b>Monitoring Categories</b> .....   | 2  |
| Surveys.....   | 3  |
| Monitoring .....   | 4  |
| Evaluation Monitoring .....  | 4  |
| <b>Monitoring Considerations</b> .....                                     | 5  |
| Conservation Targets.....  | 6  |
| <b>Methodology</b> .....   | 6  |
| Scale.....   | 6  |
| Data Repositories .....  | 6  |
| • Pennsylvania Natural Diversity Inventory .....                           | 7  |
| • Federal partners.....  | 7  |
| • Pennsylvania Spatial Data (PASDA).....                                   | 7  |
| <b>Monitoring Habitats</b> .....   | 7  |
| <b>Monitoring Climate Change</b> .....                                     | 8  |
| NorEaST.....   | 9  |
| National Phenology Network .....   | 9  |
| <b>CASE STUDY: Golden-Winged Warbler Conservation and Monitoring</b> ..... | 10 |



## Overview

This chapter provides an overview to our approaches and strategies for monitoring Pennsylvania's wildlife, their habitats, and effectiveness of the actions implemented to conserve Species of Greatest Conservation Need (SGCN). Monitoring is essential in every step of conservation, from establishing species lists to evaluating the effectiveness of actions. Conventional approaches to natural resource management frequently neglect monitoring, but monitoring is critical to improve practices and policies. Monitoring is the key to assess how actions affect targeted species and it enables us to evaluate the merit of alternate actions, adjust hypotheses of how systems function, or take appropriate corrective action.

In the 2005 Pennsylvania Wildlife Action Plan (Plan) (PGC-PFBC 2005), lack of inventory and monitoring data for many wildlife species was recognized as one of the more urgent needs for wildlife conservation. This begins at the most basic level; the status of wildlife or condition of habitats cannot be adequately evaluated – let alone appropriate conservation actions determined – without basic knowledge of the species involved. Foundational questions of monitoring are presupposed in every conservation action: what species are present, where they are found, or what habitats are used throughout the year. A comprehensive approach to species monitoring is needed, based on an understanding of population distribution and size. Ideally, monitoring of species' vital population parameters will guide the most critical conservation actions. Despite the contributions of many past monitoring programs, vast areas of basic information on many species remain unknown and fundamental monitoring gaps remain.

Monitoring is integrated into all aspects of this plan, from the selection of SGCN to evaluating recommended actions. The selection of SGCN incorporates monitoring elements at many nodes in the selection flowchart (Chapter 1, Fig 1.2). This plan embraces the Best Practices for State Wildlife Action Plans (AFWA 2012) to:

1. Design monitoring programs with the aim of making the resulting data as useful to conservation and science as possible (Nichols and Williams 2006), and;
2. Use scientifically-sound monitoring protocols designed to detect changes that will inform assessments of SWAP effectiveness.

## Monitoring Categories

Monitoring can be categorized as follows, from less complex to more involved and detailed, as suggested in this hierarchical list:

- Presence (and absence) *surveys* ask "Is it here?" Depending on the spatial scale, this may reflect the state's species list for consideration as SGCN, or provide baseline data for future monitoring at a particular location. A species' distribution provides a critical element of the state's responsibility (percent of population or range) which also has been incorporated into SGCN determination for this Plan.



- *Monitoring* of population size within a particular area over time (either presence/absence or relative abundance) establishes a *trend*, a key metric to determine the health of the population. Trends provide one of the major drivers in defining state, “S”, and global, “G”, conservation status ranks (Faber-Langendoen et al. 2012).
- Spatial and temporal patterns in population parameters provide much more rigorous monitoring information that may define the most effective conservation actions. Fitness, productivity, or life-history traits are typically evaluated to understand limiting factors in research scenarios for evaluating threats to populations.
- *Evaluating* conservation actions may take the form of certification or effectiveness measurement (Stem et al. 2005). Generally speaking, conservation actions in this Plan will employ monitoring within an *Adaptive Management* framework (Berkes et al. 2000; Williams et al. 2007).

## Surveys

Conservation actions start with the question: “Where does this species occur?” Or more specifically, “Does it occur here?” This could be considered a pre-monitoring step, or the baseline for a series of monitoring iterations. For conservation priorities to be fully formed, a comprehensive list of taxa must first be established. Illustrating this most dramatically, and reflecting the most foundational monitoring need, are the taxa recognized herein as “Data Deficient.” The foundational question for these taxa is the most basic inventory question of their presence within the state, to the point that a conservation rank could not be established. These taxa are assigned this distinct SGCN category because, without sufficient information to provide a conservation rank, neither prioritization or conservation actions can be established. Broad-scale surveys designed to detect a broad spectrum of species, but not directed at a particular hypothesis, are referred to as *surveillance monitoring* (Nichols & Williams 2006). Guidance on survey and monitoring techniques is extensive (e.g., Manley et al. 2006).

Invertebrates traditionally are poorly studied, and historically have been the taxa with the least-available baseline data, yet in this Plan, a couple of vertebrate taxonomic groups have data deficient species. Approximately 93% of the data deficient species in this Plan are invertebrates. A status rank was computed for most vertebrates, although these assessments were based on old or inadequate data in some cases (e.g., mammals). Spatial distribution of species’ data is haphazard even for many vertebrates, or range maps reflect the distribution of surveyors rather than the species themselves. Most taxonomic groups, other than birds, have not undergone a systematic survey that would define the distribution of these species across the state. Pennsylvania’s State Wildlife Grant-funded [Second Breeding Bird Atlas](#) (Wilson et al. 2012) provides a high bar nationally, even for birds. Ongoing projects, like the [Pennsylvania Reptile and Amphibian Survey](#) (PARS) (2013-2022) and the Pennsylvania Mammal Atlas (2014-2024) are designed to address broad gaps in distributional data for poorly known species. These mimic the success of Breeding Bird Atlas projects, designed to define the geographic distribution of a group of species. Basic survey data is a clear conservation need for many species, although that need is always a difficult one to promote as a high priority when documented concerns remain unaddressed.



## Monitoring

Starting with basic survey and baseline data, monitoring may provide, over time, trend data that form the basis of conservation hypotheses about a species' status, conservation threats, requirements, and ultimately the effectiveness of actions (Appendix 5.1). Long-term trends become a core feature in assessing species' status and should direct conservation actions to those species with significant needs, in particular places. Here again, bird trend data have been a central element of prioritization in the Partners in Flight system for many years (Panjabi et al. 2012).

The state of knowledge varies greatly among taxonomic groups. Birds, particularly breeding populations, have received an extraordinary level of monitoring effort, up to the level of trends in relative abundance. Beyond such spatially explicit abundance data, we also know a lot about birds' reproductive rates and other biometric features. Other groups (e.g., reptiles, amphibians, invertebrates), however, have received but the faintest determination of distribution, or, in some cases, even lack presence/absence data. Even among birds, species that are highly vocal and diurnal receive much more attention than those that may be secretive and nocturnal. Specialized surveys for night birds, wetland birds, raptors, and others still are needed. The level and intensity of monitoring data currently available is often rooted more in popular support than targeted to the degree of conservation concern. Many people contribute bird data through recreational activities. The exponential rise in eBird data has expanded the site-specific relative abundance data for most bird populations year-round.

One of the most obvious examples of broad-scale monitoring programs is the Breeding Bird Survey (BBS) (Sauer et al. 2013). The BBS is a long-term monitoring program, designed to address the question of population trend at various scales, over long periods of time. It provides a statistically-valid trend of relative abundance across North America, which is viable at the state (or smaller) scale for about half of Pennsylvania's breeding bird species. The BBS is built on multi-year trends of road routes randomly distributed across the landscape. This monitoring is not designed to explain any particular threat, but rather reflects the cumulative stresses on a wide range of breeding birds at broad geographic scales. This has been successful largely due to its longevity (established in 1965 and run continuously), random geographic distribution, and fairly robust sampling effort (about two thousand routes run annually). Christmas Bird Counts have a longer history (since 1900), but less stringent design parameters and considerably smaller sample size. No comparable broad-scale monitoring effort exists for other taxonomic groups. This Plan summarizes the monitoring status and needs for all SGCN, with the details in each species' account (Chapter 1, Appendix 1.4).

## Evaluation Monitoring

Effectiveness measures will be incorporated into conservation programs supported by this Plan following an Adaptive Management framework. As described by the [British Columbia Forest & Range Evaluation Program \(BCFREP 2015\)](#), adaptive management is "a formal, systematic and rigorous approach to learning from the outcomes of management actions, accommodating change, and improving management. It involves synthesizing existing knowledge, exploring alternative actions, and making explicit forecasts about their outcomes. Developed in the 1970s by C.S. Holling and several colleagues at the University of British Columbia and the International Institute of Applied Systems



Analysis (Holling 1978), it has been applied to many specific natural resource issues” and has since been adopted widely.

Ecological monitoring and evaluation are developed to conduct status assessment and effectiveness measurement. A range of approaches may be taken for effectiveness evaluation (Stem et al. 2005). Monitoring the effectiveness of conservation actions is a specific expression of adaptive management. Effectiveness evaluation focuses on evaluating the results and comparing them to outcomes predicted in the first step of the cycle.

## Monitoring Considerations

Extensive literature is available to help develop high-level monitoring decisions (e.g., Heinz Center 2009; Stokes et al. 2010), and tremendous resources are available through partners at the U.S. Geological Survey, and area universities. This chapter articulates several principles that will be embraced in the implementation of recommended actions, but does not attempt to summarize the diverse decisions and principles behind effective monitoring. Weighing the extent of monitoring effort required, and matching the monitoring approach to the questions at-hand, remains an ongoing challenge.



Fig. 5.1. Adaptive Management Cycle (Conservation Measures Partnership, (CMP 2013).



## Conservation Targets

Monitoring efforts should be designed to measure, over time, a parameter that reflects the selected conservation target and will address a particular question established for the monitoring program (Stem et al. 2005; Heinz Center 2009). A range of biological parameters, such as reproductive rates or basic occupancy, may be selected to evaluate specific conservation questions. The most typical conservation target is some metric of the overall species population size.

Species are sometimes selected to represent other species, an ecosystem, or a biological process as surrogates, indicators, or some other form of representation. A prominent example of this is *surrogate species* (see Caro 2010), an approach adopted by the U.S. Fish and Wildlife Service (Williams et al. 2007). In such schemes, species are selected as representatives of the quality of habitats or species diversity, on behalf of poorly known species, or for lower costs than a species-by-species approach. With a sense of habitat-based species assemblages, not all species need to be monitored for trends, *indicator species* may represent a habitat or species assemblages; to provide condition analysis for the group. Yet, before indicator species are selected for a group of wildlife that could be monitored, an inventory and understanding of habitat associations among all these wildlife species is needed, as well as relative relationship of the community.

## Methodology

Monitoring efforts are most effective when results are comparable with other studies. While individual project objectives do not always make this possible, standardized protocols will be employed, when available, to provide results comparable to other studies.

## Scale

The scale of a monitoring project should parallel the scope of the question being evaluated. Determination of statewide status requires a broad-based sampling design to capture the range of a species' distribution and the most basic parameters of its population – often at a presence-absence level. Assessment of the response to conservation actions (e.g., see the [Golden-winged Warbler Case Study](#) below), or a before-after-control-impact (BACI) design will, by necessity, be sampled on a smaller spatial scale in a way to represent the broader population. This standard is rarely reached. For the vast majority of species, methods and scale will be constrained by practical limitations and the purpose of the monitoring. Sampling design becomes paramount in these situations.

## Data Repositories

Digital data and distribution networks have provided huge advances in data storage and availability in recent decades. New tools are available to solve a longstanding challenge for conservation practitioners: storage and accessibility of monitoring data. Appropriate data-sharing procedures are needed to make the results of studies available beyond the principal investigator. Making results, and even raw data, available to others is increasingly recognized as the responsible action to extend the benefits of studies. With an understanding that investigators have a primary right to publish scientific results, a reasonable expectation will be made that work recognized within this plan and supported by the agencies will be



made available in summarized form. Further, to the extent possible after a reasonable time, the raw data will be made available where sensitive locality data do not jeopardize species.

Data repositories are established to hold, manage, and disseminate data important to this Plan. The following are some of Pennsylvania's primary species data repositories:

- **Pennsylvania Natural Diversity Inventory (PNDI)** is maintained through a partnership of the Western Pennsylvania Conservancy, and Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Game Commission, Pennsylvania Fish and Boat Commission, and the U.S. Fish and Wildlife Service. PNDI represents our best inventory data across the state for rare species – including, minimally, all state-listed species. PNDI is focused on a subset of Pennsylvania's species, the rarest. To that end, all studies supported by agencies require that resulting state-listed species data be incorporated into PNDI. Data maintenance and storage are consistent with NatureServe<sup>®</sup> programs across the continent, typically managed by other states and provinces. Environmental assessments are legally required by Pennsylvania Department of Environmental Protection permits to scan PNDI data for conflicts, and are used in setting priorities for land conservation activities (PNHP 2015). The web-based platform is being renovated even as this Plan is being compiled. The new system, anticipated to be available in November 2015, will provide basic spatial patterns of the latest information of all threatened & endangered species statewide, visible for anyone, and providing species information and management recommendations upon logging into the system with a specific project.
- **Federal partners**, including the U.S. Geological Survey and the U.S. Fish and Wildlife Service provide repositories for many ongoing monitoring programs.
- **Pennsylvania Spatial Data (PASDA)** is the official public access geospatial clearinghouse for Pennsylvania and is maintained at Penn State University

## Monitoring Habitats

All of Pennsylvania's habitats are influenced directly by human activity, and changes in habitat composition and distribution have dramatic impacts on wildlife populations. Many threats identified for SGCN are tied to habitat condition.

The U.S. Department of Agriculture maintains several long-term, standardized land-cover/land-use assessments that are very informative concerning the availability of habitats on a broad scale, and at a coarse scale. Specifically, the [Forest Inventory and Analysis \(FIA\)](#) program, within the U.S. Forest Service, maintains a rigorous spatially-balanced long-term monitoring tool for forest plants (particularly trees), which provides an assessment of the extent and condition of the nation's forests from a forestry standpoint. But, these inventories can provide an overall perspective of forest species composition, regeneration, and extent, which for decades has informed assessments of the many species dependent on forest land-cover. For example, with supplemental plots conducted by the Game Commission, this is a significant component to the agency's deer management program. Similarly, the USDA Natural Resource Conservation Service, has been monitoring the extent of various agricultural crops which have



direct impacts on many species associated with early successional habitats, such as hayfields and pasture. With the importance of wetland habitats to many SGCN, documentation of the location and condition of wetland habitats is a critical need. The U.S. Fish and Wildlife Service maintains the [National Wetland Inventory](#), but local scale improvements are needed.

A regionally standardized classification of terrestrial and aquatic habitats in the Northeast has been completed and mapped (see Chapter 2, Habitats), and made available at the [Northeast Regional Conservation Needs](#) web portal.

## Monitoring Climate Change

*Adapted from Staudinger et al. (2015c). Scale-Appropriate Adaptation Strategies and Actions in the Northeast and Midwest United States; Chapter 4 in Staudinger et al. (2015a).*

Climate change will require novel management decisions with unknown outcomes; thus monitoring is essential to tracking successes and failures, helping refine future actions and approaches, and identifying effective adaptation strategies and management practices (West et al. 2009; Lawler et al. 2010). Monitoring also reduces uncertainty by providing baseline data, as well as insight on how species and habitats are responding to climate change and other stressors. In many cases, monitoring programs were not designed with climate-change impacts in-mind and may need to be adjusted to accommodate new challenges and information needs (Heinz Center 2008). This includes identification of key indicators and metrics that track ecological responses, including certain demographic parameters and the seasonal timing of life-history events (phenology) across components of biodiversity (species, ecosystems, and biomes). Monitoring also can provide advanced warning of the direct and indirect impacts of climate change and other stressors (Heinz Center 2008; Staudinger et al. 2012). A recent report that served as input to the National Climate Assessment (Staudinger et al. 2012) made a series of recommendations on monitoring in the context of climate change, as summarized here:

- Improved, better-integrated, and increasingly coordinated monitoring systems are needed to detect, track, and attribute species and habitat shifts to climate change over varying spatiotemporal scales.
- Existing long-term monitoring sites provide a historical context of the underlying trajectories of fish and wildlife populations and dependent habitats, and are useful in detecting drivers of change, the places where ecological systems are adapting (or not), as well as novel shifts in range, phenology and species interactions.
- Locally based observation networks can be “nested” within a larger-scale network to deliver information to a wider range of managers and policy makers to better detect changes due to climate and interactions with other anthropogenic stressors.
- Inserting monitoring protocols with consistent metrics into projects will be critical to make inferences across studies and document large scale trends in impacted fish and wildlife species.
- Ecological monitoring of transition zones between ecosystems may provide early warning of potential biome shifts.



Increased monitoring is needed to detect and subsequently eradicate invasive species before they become established in new locations or expand their range into new territories. Described below, Staudinger et al. (2015c), provided examples of a regional project (*NorEaST*) and national program (National Phenology Network) that are addressing these monitoring recommendations. Additionally, Staudinger et al. (2015c) ([Appendix 4.1](#)) identified numerous examples (searchable by the Field: Source Document Descriptor) of how monitoring can address climate change and other anthropogenic stressors through specific adaptation strategies and tactics.

### **NorEaST** - *A coordinated regional monitoring initiative*

The [NorEaST web portal](#) was developed to serve as a coordinated, multi-agency regional framework to map and store continuous stream-temperature locations and data for New England, mid-Atlantic, and Great Lakes States. Stream temperature monitoring locations and metadata contributed by 47 different organizations can be viewed for over 10,000 monitoring locations across 22 states. Stream temperature sites can be viewed on the *NorEaST* mapper. Ultimately, the goal of this project and portal is to make these data available to managers and the public to aid in adaptation and management planning, and implementing conservation actions.

Preliminary applications of this project have allowed evaluations of seasonal associations of fish species with stream-thermal conditions (e.g., range of summer and fall temperature ranges), the identification of thermally sensitive fish species, and potential differences of fish-temperature associations across regions that were previously unknown. Updates on this project can be found on the [NE CSC website](#).

### **National Phenology Network**

The [National Phenology Network](#) (NPN) provides national standardized protocols for collecting phenology observations, advice and education materials for the collection and organization of new phenology data, and supports the development of tools and approaches for natural resource decision-making. NPN developed *Nature's Notebook*, as a citizen-science tool to gather phenology observations on plants and animals nationally. Citizen science monitors and tracks changes in species responses to climate change, and supplements existing scientific monitoring networks (Newman et al. 2012). Public engagement increases awareness of conservation and climate adaptation issues and can help extend limited resources for activities like monitoring. There are numerous institutions across the Northeast and Midwest using NPN's *Nature's Notebook* tool and contributing to a larger network of monitoring programs to inform our understanding of phenological responses to climate change.



## Pennsylvania Wildlife Action Plan

### CASE STUDY: Golden-Winged Warbler Conservation and Monitoring

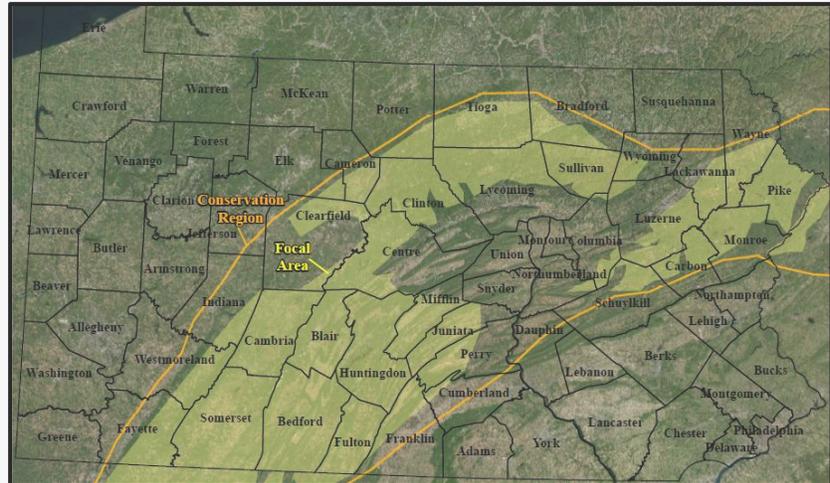
Jeffery L. Larkin, PhD, Department of Biology, Indiana University of Pennsylvania & American Bird Conservancy's Golden-winged Warbler Breeding Habitat Coordinator

#### Project Location

Statewide within Golden-winged Warbler Conservation Region

#### Species of Greatest Conservation Need/Priority Habitat affected

The golden-winged warbler (*Vermivora chrysoptera*) is a migratory songbird that breeds in young forest and shrubland habitats of eastern North



America. The species has experienced significant population declines over that past 50 years. In 2010, the species was petitioned for listing under the U.S. Endangered Species Act, and the USFWS found that the petition was substantial enough to warrant further review. Several factors are thought to be contributing to the species' decline including the expansion of and hybridization with the blue-winged warbler, nest parasitism by the brown-headed cowbird, and loss of non-breeding and breeding grounds habitat. Experts believe, however, that the loss of breeding habitat contributes most to the decline of this species. As such, the golden-winged warbler is currently a focal species for several efforts to create young forest habitat in the Appalachian Mountains and Upper Great Lakes regions. Many other game and non-game species will benefit from increased availability of young forest habitat including American woodcock, ruffed grouse, Appalachian cottontail, eastern whip-poor-will, eastern towhee, and many other songbirds. While Pennsylvania has experienced one of the highest rates of annual population declines, experts believe the Commonwealth has the greatest potential to reverse the species' decline, and thus, significantly contribute to the long-term conservation of golden-winged warblers in the Appalachian Mountains. A multi-agency partnership was initiated in 2008 with the intent to develop and implement science-based habitat-management guidelines for golden-winged warblers and associated species in Pennsylvania. A major accomplishment of our partnership was the 2011 publication *Golden-winged Warbler Habitat Best Management Practices for Forestlands in Maryland and Pennsylvania (GWWA-BMP)*.



### Project Purpose

The development of science-based golden-winged warbler breeding habitat guidelines for Pennsylvania was an important first step toward stabilizing/reversing the species' population decline. We are now faced with the task and challenges of implementing large-scale habitat projects that are critical for the species' recovery. Key to meeting this challenge was a project funded by a State Wildlife Grant awarded to Indiana University of Pennsylvania in 2011. The purpose of this project was to fund the salary and associated operational expenses (i.e., vehicle, fuel, supplies) for a full-time public lands golden-winged warbler forester.



### Project Description

The implementation phase of our partnership has been driven by a State Wildlife Grant and several National Fish and Wildlife Foundation grants awarded to the Indiana University of Pennsylvania-Research Institute and the American Bird Conservancy.

These grants fund: 1) One public lands forester who works closely with PGC on State Game Lands; and 2) Three private-lands foresters and two private-lands conservation planners who work closely with NRCS, PGC, and DCNR. These positions alone have resulted in over 8,000 acres of young forest habitat in since 2011. Of these 8,000 acres, 2,700 were planned and prepared by the SWG-funded public lands golden-winged warbler forester. Point-count surveys will be conducted on treatment plots to gauge effectiveness of the conservation action.

### Project Partners

The continuation of our partnership into the implementation phase has been effective at overcoming many financial, staffing, administrative, and time constraints that can often inhibit large-scale conservation implementation. It also has resulted in our partnership's growth in membership and long-term vision. This partnership consists of

Pennsylvania Game Commission , U.S. Fish and Wildlife Service-Partners for Fish and Wildlife , USDA-Natural Resource Conservation Service , Pennsylvania Department of Conservation and Natural Resources , Indiana University of Pennsylvania , American Bird Conservancy , Pheasants Forever, National Fish and Wildlife Foundation , National Wild Turkey Federation , Golden-winged Warbler Working Group , and the Appalachian Mountain Joint Venture .



### References

Bakermans, M. H., J. L. Larkin, B. W. Smith, T. M. Fearer, and B. C. Jones. 2011. Golden-winged Warbler Habitat Best Management Practices for Forestlands in Maryland and Pennsylvania. American Bird Conservancy. The Plains, Virginia.


**Appendix 5.1** Established monitoring programs in Pennsylvania that include Species of Greatest Conservation Need.

| <b>Taxonomic Group</b> | <b>Monitoring Program</b>              | <b>Lead</b>  | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|--|--|---|---|
| <b>Birds</b>           | Audubon PA Important Bird Area Surveys | Audubon Pennsylvania   | Marsh bird surveys at Important Bird Areas designated due to their importance to wetland birds. Standardized marsh bird protocols as described in PGC Marsh Bird Surveys and volunteer surveys. |   |
|                        | A Swift Night Out                      | Chimney Swift Conservation Association   | An annual nationwide survey of swifts returning to roost. Volunteers count chimney swifts entering roosts in August and September.  | <a href="http://www.chimneyswifts.org">www.chimneyswifts.org</a>                  |
|                        | American kestrel nest box programs     | Hawk Mountain Sanctuary Association; American Kestrel Partnership, private banders | Many people maintain kestrel nest box networks that they monitor for nest success and band young; Hawk Mt's was established in 1960s. Partnership is new effort to coordinate across continent. | <a href="http://kestrel.peregrinefund.org/">http://kestrel.peregrinefund.org/</a> |
|                        | Annual count of nesting pairs          | Pennsylvania Game Commission   | Periodic inspection of nesting colony.  |   |
|                        | Annual nest/pair count at Wade Island  | Pennsylvania Game Commission   | A single day count of pairs/nests at Wade island coordinated by the Pennsylvania Game Commission with volunteers from the PGC, DCNR and other organizations/NGOs depending upon the year.       |   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>                  | <b>Lead</b>                  | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|--|------------------------------|---|---|
| <b>Birds</b>           | Appalachian Eagles Project                 | West Virginia University     | Volunteers operate trail cameras at bait piles (road-killed deer) during the winter.  | <a href="http://www.appalachianeagles.org">www.appalachianeagles.org</a>  |
|                        | Atlantic Flyway Breeding Waterfowl Survey  | U.S. Fish & Wildlife Service | This survey has been conducted annually since 1989 in Pennsylvania and other AF states from Virginia to New Hampshire. It provides breeding population estimates for the major breeding waterfowl species. A total of 346 1-km <sup>2</sup> plots are surveyed across six physiographic regions in Pennsylvania using a stratified random design.           | <a href="http://migbirdapps.fws.gov">http://migbirdapps.fws.gov</a>   |
|                        | Atlantic Flyway Midwinter Waterfowl Survey | U.S. Fish & Wildlife Service | Annual (January) count of all waterfowl species on major wintering areas within the Atlantic Flyway.  | <a href="https://migbirdapps.fws.gov/metadata/databases/mwi/mwidb.asp?opt=mwidb">https://migbirdapps.fws.gov/metadata/databases/mwi/mwidb.asp?opt=mwidb</a>                             |
|                        | Bald Eagle Breeding Survey                 | Pennsylvania Game Commission | Each breeding season the Bureau of Wildlife Management's Wildlife Diversity Division coordinates monitoring efforts through regional office wildlife supervisors. PGC staff and many volunteers collect breeding and nest productivity data throughout breeding and nesting periods from known nests and identify and document new nests or breeding pairs. | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1931628&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1931628&amp;mode=2</a> |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>  | <b>Lead</b>   | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|--|---|---|---|
| <b>Birds</b>           | Bandedbirds.org  | Multiple  | Web-accessible database for reporting and retrieving information on color-banded shorebirds along the Atlantic Flyway.  | <a href="http://Bandedbirds.org">Bandedbirds.org</a>  |
|                        | Banding at migration banding stations, e.g., Powdermill Avian Research Center.                     | Non-governmental organizations, data centralized at the U.S. Geological Survey Bird Banding Laboratory. | The timing and relative frequency of this species can be assessed at sites where migration banding occurs (or used to occur).   |   |
|                        | Barn Owl Conservation Initiative   | Pennsylvania Game Commission  | Each year PGC biologists across the state monitor potential nest sites to determine nesting success and band nestlings.   | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1702875&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1702875&amp;mode=2</a> |
|                        | Targeted surveys for blue-winged and golden-winged warbler/hybrid on state land and in focal areas | Pennsylvania Game Commission  | PGC staff and volunteers collect blue-winged warbler and hybrid count data on searches for golden-winged warbler on game lands, forest lands and other areas where there is potential for management. | <a href="http://www.portal.state.pa.us/portal/server.pt/document/1460133/71040-13z_pdf">www.portal.state.pa.us/portal/server.pt/document/1460133/71040-13z_pdf</a>                      |



| Taxonomic Group | Monitoring Program   | Lead   | Description  | Website (if available)  |
|-----------------|--|--|--|---|
| <b>Birds</b>    | Carnegie Museum of Natural History's Powdermill Avian Research Center                              | Carnegie Museum of Natural History                                 | Powdermill Avian Research Center operates a bird banding station, conducts bioacoustical research, and performs flight tunnel analysis with the goal of reducing window collisions. With more than 50 years of experience, and having surpassed a milestone of 500,000 birds banded in 2001, PARC is uniquely situated to capitalize on its bird capture techniques. Birds studied through their banding program may also be utilized for bioacoustical, window avoidance, telemetry studies and more, all while handling these species in a gentle and humane manner. | <a href="http://www.powdermillarc.org/">http://www.powdermillarc.org/</a>                                   |
|                 | Colony Registration  | Purple Martin Conservation Association                             | Colony Registration: Supplies a method for locating and mapping colonies throughout North America, while collecting other data such as colony age and size.  | <a href="http://www.purplemartin.org/main/research.html">http://www.purplemartin.org/main/research.html</a> |
|                 | Contaminant Exposure Food Web Transfer and Effects on Ospreys in Chesapeake Bay Regions of Concern | Patuxent Wildlife Research Center                                  | Ecotoxicological investigation of osprey eggs and nestling's blood, which are sampled for contaminants.  |   |
|                 | Crossbill research conducted by Cornell Laboratory of Ornithology (Matt Young).                    | Pennsylvania Game Commission/<br>Cornell Laboratory of Ornithology | Cooperative searches and research for crossbills with M. Young. Red crossbills nest in New York. Similar conditions may occur in PA also.  |   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>                                | <b>Lead</b>  | <b>Description</b>   | <b>Website (if available)</b>   |
|------------------------|--|--|--|---|
| <b>Birds</b>           | Dickcissel surveys based on observation reports          | Pennsylvania Game Commission   | Follow-up surveys based on reports submitted to eBird, PA Birds Listserve and other sources.   |   |
|                        | Eastern Population Tundra Swan Fall Productivity Survey  | U.S. Fish & Wildlife Service   | Annual (December) survey of percentage of juveniles in the population and the number of juveniles per family group during latter stages of fall migration or early stages of winter residency.   | <a href="http://www.fws.gov/migratorybirds/Newreportspublications/PopulationStatus.html">http://www.fws.gov/migratorybirds/Newreportspublications/PopulationStatus.html</a> |
|                        | eBird (PA eBird as state portal)                         | Pennsylvania Game Commission / Cornell Laboratory of Ornithology                         | Open database of geospatially designated locations with on-line data entry and portals to the database with news and stories that provide guidance, education, and instructions to participants. | <a href="http://ebird.org/content/pa/">http://ebird.org/content/pa/</a>   |
|                        | Flyway waterfowl surveys - include rusty blackbirds      | U.S. Fish & Wildlife Service / Pennsylvania Game Commission                              | The Flyway waterfowl surveys are made in randomized plots, many of which are appropriate RUBL migration habitat.   |   |
|                        | Lake Erie fall migration survey                          | Gerald MacWilliams   | Daily bird count at Presque Isle from mid-September through December.  |   |
|                        | Golden-Winged Warbler Conservation Initiative Monitoring | Golden-winged Warbler Working Group; Coordinated by the Cornell Lab of Ornithology (CLO) | The study monitors golden-winged warblers, blue-winged warblers and hybrids during the breeding season in PA as part of a regional and national conservation monitoring project.                 | <a href="http://www.gwwa.org/">http://www.gwwa.org/</a>   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>  | <b>Lead</b>                  | <b>Description</b>   | <b>Website (if available)</b>   |
|------------------------|--|------------------------------|--|---|
| <b>Birds</b>           | Golden-winged warbler monitoring on state game lands, forest land and adjacent lands within focal areas. | Pennsylvania Game Commission | In addition to CLO surveys, the PGC staff and volunteers conduct GWWA surveys of game lands, forest lands and other areas where there is potential for management within GWWA focal areas. | <a href="http://www.portal.state.pa.us/portal/server.pt/document/1460133/71040-13z_pdf">www.portal.state.pa.us/portal/server.pt/document/1460133/71040-13z_pdf</a>                    |
|                        | Great Lakes Pelagic Bird Surveys   | Great Lakes Commission       | Aerial transect surveys completed during fall and spring migration periods, and mid-winter as practicable  | <a href="http://glc.org/files/Pelagic-surveys-in-the-Great-Lakes-2012-2014.pdf">http://glc.org/files/Pelagic-surveys-in-the-Great-Lakes-2012-2014.pdf</a>                             |
|                        | Grouse Hunter Cooperator Survey  | Pennsylvania Game Commission | Cooperating hunters keep field diaries of hunting trips (county, # flushes, # bagged) annually as a way to monitor population trends in appropriate habitat.                               | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=601998&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=601998&amp;mode=2</a> |
|                        | Grouse Parts Collection Survey, 2014-2017  | Pennsylvania Game Commission | Classification by age and sex of grouse wings and tails submitted by cooperating hunters.  |   |
|                        | Grouse Summer Sighting Survey  | Pennsylvania Game Commission | Pennsylvania Game Commission employees tally grouse broods and adults seen during normal work hours. Conducted annually as a way to monitor trends in juvenile production.                 |   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>   | <b>Lead</b>                              | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|---|--|---|---|
| <b>Birds</b>           | Habitat reclamation projects: present and future Surface Mine Reclamation Act (SMCRA) | Pennsylvania Game Commission             | Surface mine reclamation in areas near known nesting areas that result in beneficial habitat supporting foraging and or nesting northern harriers during breeding season.                               | <a href="http://www.portal.state.pa.us/portal/server.pt/community/abandoned_mine_reclamation/13961">http://www.portal.state.pa.us/portal/server.pt/community/abandoned_mine_reclamation/13961</a>         |
|                        | Hawk Mountain Broad-wing Hawk Project   | Hawk Mountain Sanctuary Association      | In 2014 with SWG grant, HMS established a webpage to collect sightings of nesting broadwings from the general public; observations are solicited from birders through e-lists and collected from eBird. | <a href="http://www.hawkmountain.org/Broadwing">www.hawkmountain.org/Broadwing</a>  |
|                        | International Shorebird Survey  | Manomet Center for Conservation Sciences | A volunteer-based international shorebird survey conducted in spring and fall at focal sites to detect trends in migrant shorebirds.  | <a href="https://www.manomet.org/program/shorebird-recovery-project/international-shorebird-survey-iss">https://www.manomet.org/program/shorebird-recovery-project/international-shorebird-survey-iss</a> |
|                        | Loggerhead shrike searches based on observation reports                               | Pennsylvania Game Commission             | Follow-up surveys based on reports submitted to eBird, PA Birds Listserve and other sources.  |   |
|                        | Long-eared owl monitoring   | Pennsylvania Game Commission             | Searches for long-eared owl nesting in target areas.  |   |



| Taxonomic Group | Monitoring Program  | Lead                               | Description   | Website (if available)  |
|-----------------|---|------------------------------------|---|---|
| <b>Birds</b>    | Middle Creek Wildlife Management Area waterfowl migration updates | Pennsylvania Game Commission       | Early morning estimate of number of tundra swans roosting on Middle Creek Lake, obtained approximately daily (at minimum 2-3 times per week) from early February through early April.   | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=621427&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=621427&amp;mode=2</a>   |
|                 | Mid-winter Bald Eagle Survey                                      | Pennsylvania Game Commission       | This annual survey is conducted during a selected period in early January along standard survey routes.   | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1661526&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1661526&amp;mode=2</a> |
|                 | Monitoring Avian Productivity and Survivorship (MAPS)             | The Institute for Bird Populations | A continent-wide network of constant-effort mist netting stations, including several stations in Pennsylvania. Data collected provides survival and productivity information for many songbird species, and can be used to measure temporal patterns in these measures as well. | <a href="http://www.birdpop.org/MAPSPROG.htm">http://www.birdpop.org/MAPSPROG.htm</a>   |



| Taxonomic Group | Monitoring Program                             | Lead                          | Description   | Website (if available)  |
|-----------------|--|-------------------------------|---|---|
| <b>Birds</b>    | Mountain Bird Watch                            | Vermont Center for Ecostudies | <p>Mountain Birdwatch (MBW) monitors songbirds that breed in the montane fir and spruce forests of the Northeast. MBW data provide the only region-wide source of population information on these high-elevation breeding birds. MBW's primary focus is Bicknell's thrush, a montane fir specialist that breeds only in the northeastern U.S. and adjacent areas of Canada, but this project also tracks nine other high-elevation avian breeders, red squirrels, and the conifer seeds that these avian nest predators eat. A PA version of this project will not include Bicknell's thrush and will focus on state priority mountain forest species for the PA and the Appalachian Mountains.</p> | <a href="http://vtecostudies.org/projects/mountains/mountain-birdwatch/">http://vtecostudies.org/projects/mountains/mountain-birdwatch/</a> |
|                 | National Audubon Society Christmas Bird Counts | National Audubon Society      | <p>Since 1900, this is an annual winter survey of more than 2,300 count circles worldwide. The longest running Citizen Science survey in the world, Christmas Bird Count provides critical data on population trends.</p>   | <a href="http://birds.audubon.org/christmas-bird-count">http://birds.audubon.org/christmas-bird-count</a>                                   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>                                    | <b>Lead</b>                                   | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|--|---|---|---|
| <b>Birds</b>           | National Wetlands Inventory                                  | U.S. Fish & Wildlife Service                  | A nationwide inventory of wetlands providing distribution maps of wetlands.   | <a href="http://www.fws.gov/Wetlands/NWI/Overview.html">http://www.fws.gov/Wetlands/NWI/Overview.html</a> |
|                        | Nicaragua Highlands Project                                  | El Jaguar Reserva / American Bird Conservancy | PGC supports this important project which monitors wintering grounds in Central America shade grown coffee plantations.   |   |
|                        | Nightjar Survey Network                                      | Center for Conservation Biology               | Nationwide survey effort that uses volunteers to conduct night-time, roadside counts of all nightjars along fixed survey routes systematically distributed throughout Pennsylvania, and all other states. | <a href="http://www.nightjars.org/">http://www.nightjars.org/</a>   |
|                        | North American Breeding Bird Survey                          | U.S. Geological Survey                        | The BBS is a long-term, large-scale, international avian monitoring program initiated in 1966 to track the status and trends of North American bird populations.  | <a href="https://www.pwrc.usgs.gov/bbs/">https://www.pwrc.usgs.gov/bbs/</a>                               |
|                        | Northern saw-whet owl breeding surveys ("Toot-Route" survey) | Pennsylvania Game Commission                  | Point count routes with 8-points each using an audio-lure protocol.   |   |



| Taxonomic Group | Monitoring Program   | Lead   | Description  | Website (if available)  |
|-----------------|--|--|--|---|
| <b>Birds</b>    | Ongoing monitoring of population densities and productivity in areas of high Marcellus Shale drilling activity (Steven Latta and Margaret Brittingham) and Hemlock Woolly Adelgid infestation (Terry Master and graduate students) | Marcellus Shale impacts - Penn State University and The National Aviary, Hemlock Woolly Adelgid Impacts - East Stroudsburg University. | Monitoring of population densities on designated stream reaches, nest monitoring to determine productivity, tissue analysis and Hemlock woolly adelgid infestation level surveys.    |   |
|                 | Osprey nest monitoring   | Pennsylvania Game Commission   | During the breeding season volunteers and staff monitor nests for activity and productivity. Moving forward these surveys are likely to focus on sub-sampling to concentrate effort. | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=721226&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=721226&amp;mode=2</a> |
|                 | Pennsylvania Farmland Raptor project (Hawk Mountain) and eBird may be useful in locating possible nesting areas within the state by tapping birdwatchers and farmland owners   | Hawk Mountain Sanctuary for Farmland Raptors; eBird at Cornell Lab of Ornithology  | Birder or landowner driven reporting through website.  | <a href="http://www.hawkmountain.org">www.hawkmountain.org</a>  |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>                  | <b>Lead</b>  | <b>Description</b>   | <b>Website (if available)</b>   |
|------------------------|--|--|--|---|
| <b>Birds</b>           | Pennsylvania Winter Raptor Surveys         | Pennsylvania Society for Ornithology and HMANA   | Roadside counts during winter months of raptors, conducted by volunteers and analyzed annually in PA Birds magazine.   | <a href="http://www.pabirds.org">www.pabirds.org</a>  |
|                        | Pennsylvania Annual Migration Count (PAMC) | Pennsylvania Society for Ornithology   | Held on the second Saturday in May, this event is similar to the Christmas Bird Count except it is done on a county basis. Participants go out and identify and count all of the birds they can find on that day (including owling at night if so inclined). | <a href="http://www.pabirds.org/PAMC/index.html">http://www.pabirds.org/PAMC/index.html</a> |
|                        | Pennsylvania Breeding Bird Atlas           | Pennsylvania Game Commission, Carnegie Museum of Natural History, Audubon Pennsylvania, Pennsylvania Society for Ornithology | Status of all breeding birds in 5,000+ 2-mile square blocks (presence/absence plus point-count data) at 20-year intervals.   | <a href="http://www.pabirdatlas.psu.edu/">http://www.pabirdatlas.psu.edu/</a>               |



| Taxonomic Group | Monitoring Program                              | Lead                         | Description   | Website (if available)  |
|-----------------|---|------------------------------|---|---|
| <b>Birds</b>    | Pennsylvania Game Commission Marsh Bird Surveys | Pennsylvania Game Commission | During breeding seasons, PGC staff, partners, and volunteers conduct standardized audio playback surveys for secretive marsh birds across the state including: pied-billed grebe, American bittern, least bittern, black rail, king rail, Virginia rail, sora, common moorhen, and American coot. Protocol adapted from North American Marsh Bird Monitoring Protocols (Conway, 2009) and is very similar to that used in the 2nd Pennsylvania Breeding Bird Atlas (Lanzone, et. al. 2006). Survey results inform management of these wetlands. | <a href="http://www.portal.state.pa.us/portal/server.pt/community/birding_and_bird_conservation/21066/marsh_bird_survey?qid=81806114&amp;rank=4">http://www.portal.state.pa.us/portal/server.pt/community/birding_and_bird_conservation/21066/marsh_bird_survey?qid=81806114&amp;rank=4</a> |



| Taxonomic Group | Monitoring Program                               | Lead                         | Description   | Website (if available)  |
|-----------------|--|------------------------------|---|---|
| <b>Birds</b>    | Pennsylvania Peregrine Falcon Management Program | Pennsylvania Game Commission | All known peregrine falcon nesting sites are monitored throughout the nesting season for nesting activity and results. Potential new nest sites (natural and man-made) are regularly searched for. Nests are visited wherever possible to verify nest results, perform medical exams on young, and band young. Nests are monitored during fledging period to reduce fledging mortality. Re-sights of banded birds are recorded to map movements, longevity, and entry of young into the breeding population. Longevity and fecundity of adults are monitored and recorded. Negotiations are conducted with property owners/managers to protect peregrines, especially while nesting. Threats are evaluated and managed. Program is ongoing. | <a href="https://www.portal.state.pa.us/portal/server.pt/document/1333817/peregrine_falcon_management_plan_pdf%20">https://www.portal.state.pa.us/portal/server.pt/document/1333817/peregrine_falcon_management_plan_pdf%20</a>   |
|                 | Pennsylvania Game Commission, Game Take Survey   | Pennsylvania Game Commission | Annual survey of license buyers that reveals WMU of hunt, effort, and harvest figures for a random sample of grouse hunters.  | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=563677&amp;contentid=http://pubcontent.state.pa.us/publishedcontent/publish/marketing/sites/game_commission/content/resources/reportsandminutes/annualwildlifemanagementreports/2013_survey_statisti">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=563677&amp;contentid=http://pubcontent.state.pa.us/publishedcontent/publish/marketing/sites/game_commission/content/resources/reportsandminutes/annualwildlifemanagementreports/2013_survey_statisti</a> |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>   | <b>Lead</b>                      | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|---|----------------------------------|---|---|
| <b>Birds</b>           | Pennsylvania Game Commission Grouse Drumming Survey   | Pennsylvania Game Commission     | Spring drumming surveys conducted at PGC locations that have received active grouse management. Used to detect presence and population response pre- and post-management. |   |
|                        | Pennsylvania Game Commission Species of Special Concern Monitoring and Pennsylvania Natural Diversity Inventory | Pennsylvania Game Commission     | Reports of northern goshawk breeding pairs, territories, nests are pursued to verify species presence and find nests  |   |
|                        | Post-season black duck banding program  | U.S. Fish & Wildlife Service     | Post-season (Jan. - March) and pre-season (August- September) banding program in Pennsylvania provides harvest and survival rates for 2 periods.                          | <a href="http://blackduck.cmi.vt.edu/populationMonitor.php?Program=Pilot">http://blackduck.cmi.vt.edu/populationMonitor.php?Program=Pilot</a> |
|                        | Powdermill bird banding program   | Powdermill Avian Research Center | Constant-effort banding station with continuous operation since 1962.   | <a href="http://www.powdermillarc.org/research/bird-banding.aspx">http://www.powdermillarc.org/research/bird-banding.aspx</a>                 |
|                        | Pre-season black duck banding program   | U.S. Fish & Wildlife Service     | Post-season (Jan. - March) and pre-season (August- September) banding program in Pennsylvania provides harvest and survival rates for 2 periods.                          | <a href="http://www.pwrc.usgs.gov/bbl/">http://www.pwrc.usgs.gov/bbl/</a>   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>                | <b>Lead</b>                                 | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|--|---|---|---|
|                        | Pre-season duck banding                  | U.S. Fish & Wildlife Service                | Banding occurs between August-September, prior to the onset of the hunting season. Banding of birds at this time provides estimates of harvest and survival rates of waterfowl populations. | <a href="http://www.pwrc.usgs.gov/bbl/">http://www.pwrc.usgs.gov/bbl/</a>       |
| <b>Birds</b>           | Presque Isle Piping Plover Recovery Team | Audubon Pennsylvania                        | Shorebird monitoring from April through July, following a protocol established through consultation between the Army Corps of Engineers and the U.S. Fish and Wildlife Service.             |   |
|                        | Presque Isle Shorebird Surveys           | Audubon Pennsylvania                        | Coordinated with piping plover survey efforts during the breeding season.   |   |
|                        | Project MartinWatch                      | Purple Martin Conservation Association      | Project MartinWatch-Reproductive success of Purple Martins at the colony site. Collects data such as parental age, first egg date and nest success.   | <a href="http://www.purplemartin.org/pmw/">http://www.purplemartin.org/pmw/</a> |
|                        | Raptor Population Index, HMANA           | Hawk Migration Association of North America | Trends in migrating birds evaluated biannually by partnership. Trends in sites to south of PA in part represent trends in PA migrating population.  | <a href="http://www.rpi-project.org">www.rpi-project.org</a>                    |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>   | <b>Lead</b>  | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|---|--|---|---|
|                        | Rusty blackbird monitoring through the International Rusty Blackbird Working Group and eBird. | International Rusty Blackbird Working Group                | Search for Rusty Blackbirds in all times of the year including winter when some visit the state, especially in wetlands.  | <a href="http://rustyblackbird.org/">http://rustyblackbird.org/</a>   |
| <b>Birds</b>           | Rusty Blackbird Spring Migration Blitz  | International Rusty Blackbird Working Group                | Search for rusty blackbirds during spring migration to determine important stopover sites and involve the birding community in monitoring this declined songbird.   | <a href="http://rustyblackbird.org/outreach/migration-blitz/">http://rustyblackbird.org/outreach/migration-blitz/</a>                               |
|                        | Saw-whet owl banding  | Project OwlNet   |   | <a href="http://www.projectowl.net/?page_id=201">http://www.projectowl.net/?page_id=201</a>   |
|                        | Scout-Arrival Study   | Purple Martin Conservation Association                     | Documents first arrival dates of adult and sub-adult purple martins throughout North America.   | <a href="http://www.purplemartin.org/scoutreport/">http://www.purplemartin.org/scoutreport/</a>   |
|                        | Singing Ground Survey   | U.S. Fish & Wildlife Service, Pennsylvania Game Commission | Roadside surveys conducted annually to detect male courtship display as an index to population trends over time.  | <a href="https://migbirdapps.fws.gov/mbdc/databases/awsgs/awsgsdb.asp?opt=1">https://migbirdapps.fws.gov/mbdc/databases/awsgs/awsgsdb.asp?opt=1</a> |
|                        | Surveys during breeding and overwintering seasons   | Pennsylvania Game Commission                               | Conduct statewide surveys focused specifically on breeding northern harrier populations to determine if changes have occurred since the completion of the 2nd Breeding Bird Atlas. Assesses changes in the breeding population of the northern harrier in Pennsylvania. |   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>  | <b>Lead</b>  | <b>Description</b>   | <b>Website (if available)</b>   |
|------------------------|--|--|--|---|
|                        | Surveys for Blue-winged Warblers and hybrids as part of the Golden-winged Warbler Conservation Initiative Monitoring | Golden-winged Warbler Working Group; Coordinated by the Cornell Lab of Ornithology | The study monitors golden-winged warblers, blue-winged Warblers and hybrids during the breeding season in PA as part of a regional and national conservation monitoring project.                           | <a href="http://www.gwwa.org">www.gwwa.org</a>  |
| <b>Birds</b>           | Upland Sandpiper Breeding Surveys  | Pennsylvania Game Commission with Gettysburg College                               | Search areas with recent UPSA activity using a visual search augmented by an audio playback in likely habitat.   |   |
|                        | U.S. Fish & Wildlife Service Harvest Information Program   | U.S. Fish & Wildlife Service   | Annual survey of migratory game bird license purchasers that provides hunter participation and harvest data for waterfowl and webless migratory game birds.  | <a href="http://www.fws.gov/hip/">http://www.fws.gov/hip/</a>   |
|                        | U.S. Fish & Wildlife Service Parts Collection Survey   | U.S. Fish & Wildlife Service   | Classification by species, age, and sex of duck wings submitted by a random sample of successful hunters.  | <a href="http://www.flyways.us/surveys-and-monitoring/hunter-surveys/parts-collection-surveys">http://www.flyways.us/surveys-and-monitoring/hunter-surveys/parts-collection-surveys</a> |
|                        | Winter Raptor Survey   | HMANA or Pennsylvania Society for Ornithology                                      | Road surveys in winter are conducted on the same road route annually; two methods in use currently. Eventually data will be available to researchers on <a href="http://www.hmana.org">www.hmana.org</a> . | <a href="http://www.pabirds.org">www.pabirds.org</a> ;<br><a href="http://www.hmana.org">www.hmana.org</a>  |
|                        | Woodcock Hunter Cooperator Survey  | Pennsylvania Game Commission   | Cooperating hunters keep field diaries of hunting trips (county, # flushes, # bagged) annually as a way to monitor population trends in appropriate habitat.   | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=601998&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=601998&amp;mode=2</a>   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>  | <b>Lead</b>  | <b>Description</b>  | <b>Website (if available)</b>   |
|------------------------|--|--|---|---|
| <b>Birds</b>           | Yellow-bellied Flycatcher / Rare Mountain Forest Bird Studies and Conservation | Pennsylvania Game Commission / Cornell Laboratory of Ornithology | Area searches in targeted locations with history of mountain forest bird breeding populations. Geospatial and behavioral data collected for each location / territory found for priority species: yellow-bellied flycatcher, blackpoll warbler, olive-sided flycatcher, Swainson's thrush, red crossbill, pine siskin.          | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=621014&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=621014&amp;mode=2</a> |
| <b>Mammals</b>         | Allegheny Woodrat Captive Breeding Program                                     | Delaware Valley University                                       | The woodrat captive breeding program originated at Purdue University and was relocated to Pennsylvania. Release of progeny will supplement low genetic diversity in our state's wild populations. Focus areas for release will be guided by the results of the genetic catalog.   | <a href="http://www.delval.edu/news/researching-the-allegheny-woodrat-population">http://www.delval.edu/news/researching-the-allegheny-woodrat-population</a>                         |
|                        | Appalachian Bat Count  | Pennsylvania Game Commission                                     | Each year, volunteers count bats exiting summer roosts between May 15th and August 1st. Species, type of structure, and weather is recorded.  | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=712212&amp;mode=2</a> |
|                        | Appalachian cottontail head collection   | Pennsylvania Game Commission                                     | In fall 2014, the Pennsylvania Game Commission began collecting heads from harvested cottontails from Appalachian cottontail habitats, or cottontails that exhibit physical characteristics typical of the Appalachian cottontail. The collection will help to increase knowledge of Appalachian cottontail distribution in PA. |   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>              | <b>Lead</b>                        | <b>Description</b>   | <b>Website (if available)</b>   |
|------------------------|--|------------------------------------|--|---|
| <b>Mammals</b>         | Bat Net and Trap database              | Pennsylvania Game Commission       | PGC biologists compile annual data from contractor mist-netting efforts in PA and then report captures per unit of mist-netting effort.  | <a href="http://www.pgc.state.pa.us/">http://www.pgc.state.pa.us/</a> |
|                        | Allegheny Woodrat Genetic Catalog      | Indiana University of Pennsylvania | Researchers from the college collected woodrat genetic samples from multiple sites across Pennsylvania and will be finalizing results in 2015. The genetic catalog will guide management actions and eventual release of woodrats from the captive breeding program. |   |
|                        | Eastern Spotted Skunk Presence Surveys | Pennsylvania Game Commission       | The PGC and Western Pennsylvania Conservancy began non-invasive eastern spotted skunk surveys in 2012, after the capture of an individual skunk by a researcher working Fayette County.  |   |
|                        | Lagomorph pellet collection            | Pennsylvania Game Commission       | Biologists are collecting all lagomorph pellets found in Appalachian cottontail habitat. The DNA in the pellets will be used to identify species and will help to increase knowledge of distribution of the three lagomorph species found in Pennsylvania.           |   |
|                        | The Pennsylvania Mammal Atlas          | Pennsylvania Game Commission       | A 10-year project (2014-2024) to capture the current distribution of Pennsylvania's mammals  |   |



| <b>Taxonomic Group</b> | <b>Monitoring Program</b>   | <b>Lead</b>  | <b>Description</b>   | <b>Website (if available)</b>   |
|------------------------|---|--|--|---|
| <b>Mammals</b>         | Pennsylvania Natural Heritage Inventories                                     | Pennsylvania Natural Heritage Program/Western Pennsylvania Conservancy | Since 2012 WPC/PNHP has been actively conducting surveys for this species to identify new populations and determine range extent.  | <a href="http://www.naturalheritage.state.pa.us/">http://www.naturalheritage.state.pa.us/</a>   |
|                        | Pennsylvania Game Commission annual occupancy surveys                         | Pennsylvania Game Commission   | Nest-box surveys and live-trapping conducted at sites throughout state to assess occupancy and gather samples.   |   |
|                        | Spring emergence mist-netting for bats near and around cave and mine openings | Pennsylvania Game Commission   | Each year, between April 15th and May 15th PGC personnel mist-net for bats emerging from hibernation and traveling to roosting and/or foraging areas.                                  |   |
|                        | Statewide Allegheny Woodrat Inventory and Monitoring Program                  | Pennsylvania Game Commission   | Each year, a subset of potential and known sites are surveyed for evidence of woodrat activity, food availability, and predators. Techniques include live trapping and visual surveys. | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1935066&amp;mode=2">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=1935066&amp;mode=2</a> |
|                        | Terrestrial Small Mammal Database   | Pennsylvania Game Commission   | A database compiling all PGC permitted terrestrial small mammal surveys in a standardized format.  | <a href="http://www.pgc.state.pa.us/">http://www.pgc.state.pa.us/</a>   |



| Taxonomic Group                  | Monitoring Program   | Lead   | Description   | Website (if available)  |
|----------------------------------|--|--|---|---|
|                                  | Winter hibernacula surveys   | Pennsylvania Game Commission   | Each year, between Jan 1st and March 15th, PGC personnel and other qualified individuals survey cave, mines, and tunnels for bats. Bat species and location, cave and roost temperatures, and presence of WNS are recorded. | <a href="http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=563677&amp;contentid=http://pubcontent.state.pa.us/publishedcontent/publish/marketing/sites/gamecommission/content/resources/reportsandminutes/annualwildlifemanagementreports/2012_diversity_71401_c">http://www.portal.state.pa.us/portal/server.pt?open=514&amp;objID=563677&amp;contentid=http://pubcontent.state.pa.us/publishedcontent/publish/marketing/sites/gamecommission/content/resources/reportsandminutes/annualwildlifemanagementreports/2012_diversity_71401_c</a> |
| <b>Amphibians &amp; Reptiles</b> | Assessment of the Impact of Habitat Restoration, Monitoring and Management Practices on the eastern massasauga rattlesnake | Pennsylvania Fish & Boat Commission, Mid-Atlantic Center for Herpetology and Conservation (MACHAC) | Monitoring of habitat use and population at two (2) properties in Venango County.   |   |
|                                  | Golden Meadows Preserve Management Plan  | Berks County Conservancy   | An 8-acre preserve in Berks County that has historically occupied breeding pools. The site is managed for the spadefoot toad; a management plan exists, with annual reporting to the PFBC.                                  |   |
|                                  | Monitoring of the Timber Rattlesnake in PA (under development)   | Pennsylvania Fish & Boat Commission, East Stroudsburg University                                   | Development of a statistically robust long-term monitoring program that incorporates long-term sites, and rapid assessment, and threats analysis.   |   |
|                                  | PA timber rattlesnake Site Assessment and Inventory Project  | Pennsylvania Fish & Boat Commission  | Assessment of over 1000 timber rattlesnake den & gestation areas across Pennsylvania. Eight sites have long-term  |   |



| Taxonomic Group                  | Monitoring Program   | Lead                                   | Description   | Website (if available) |
|----------------------------------|--|--|---|------------------------|
|                                  |  |  | monitoring (mark-recapture).  |                        |
| <b>Amphibians &amp; Reptiles</b> | Conservation of Blanding's Turtle and associated wetland SGCN in the Northeast | New Hampshire Fish and Game Department | To maintain and enhance functional wildlife habitat in New England, New York, and Pennsylvania by applying conservation principles and practices needed to support a healthy Blanding's turtle population. In the short-term, project partners will cooperate to develop a spatially-explicit conservation plan for Blanding's turtles and associated SGCN in the Northeast Region of the United States, initiate standardized monitoring of the species' status, and initiate implementation of the Plan by managing habitat to reduce road mortality and engaging key partners to prioritize land acquisition, restoration, and management activities. In the long-term, conservation partners will apply information developed through this grant to maintain viable populations of Blanding's turtle and associated SGCN. |                        |
|                                  | Northeast Regional Population and Habitat Monitoring for the bog turtle        | MACHAC                                 | Continue implementation of a previously developed standardized regional monitoring protocol (National Fish and Wildlife Foundation grant project), formalizing and expanding on intensive population and habitat sampling efforts.  |                        |



| Taxonomic Group | Monitoring Program   | Lead  | Description   | Website (if available)                           |
|-----------------|--|---|---|--|
|                 | Periodic monitoring of basking structure use by redbelly turtles   | Pennsylvania Fish & Boat Commission           | The PFBC Habitat Lake Section monitors the structures and their use in lakes across the range where structures have been placed by PFBC.  |  |
|                 | Conservation Planning and Implementation for the wood turtle ( <i>Glyptemys insculpta</i> ) and Associated Riparian Species of Greatest Conservation Need from Maine to Virginia | Massachusetts Department of Fish and Wildlife | To identify, protect, manage, and enhance functional riparian and riverine habitats for wildlife in New England, New York, Pennsylvania, New Jersey, Delaware, Maryland, West Virginia, Virginia, and the District of Columbia through coordinated conservation actions identified in the 2011–2013 (NEAFWA RCN) Wood Turtle Status Assessment, outlined in SWAPs across the region, and necessary to support healthy and persistent populations of wood turtles and other riparian and riverine Species of Greatest Conservation Need. | <a href="http://Rcngrants.org">Rcngrants.org</a> |
| <b>Fishes</b>   | Annual Alosid survey of Schuylkill River   | Philadelphia Water Department                 | Annual survey to determine species and number of shad/herring running in Schuylkill River below Fairmont Dam.   |  |
|                 | Annual benthic trawl and gill net surveys  | Pennsylvania Fish & Boat Commission           |   |  |



| Taxonomic Group | Monitoring Program   | Lead   | Description   | Website (if available) |
|-----------------|--|--|---|------------------------|
| <b>Fishes</b>   | Compliance for 401 water quality certification on lower Susquehanna, fish passage performance measures         | Pennsylvania Department of Environmental Protection, Pennsylvania Fish & Boat Commission, Susquehanna River Basin Commission, Maryland Department of Natural Resources |   |                        |
|                 | Scientific Collectors Program which allows for annual review survey work completed by entities other than PFBC | Pennsylvania Fish & Boat Commission  | Not a formal monitoring initiative, but provides the ability to consider available information.       |                        |
|                 | Monitoring by PFBC incidental during other Lake Erie surveys   | Pennsylvania Fish & Boat Commission  | This species is rarely detected, but could be captured during lake surveys targeting other fish taxa. |                        |
|                 | Lake Sturgeon annual monitoring with gill nets   | Pennsylvania Fish & Boat Commission, Lake Erie Committee of the Great Lake Fishery Commission  |   |                        |
|                 | Periodic status surveys by other states  | Delaware, National Marine Fisheries  | Population is surveyed by other states.   |                        |



| Taxonomic Group | Monitoring Program   | Lead                                  | Description   | Website (if available) |
|-----------------|--|---------------------------------------|---|------------------------|
|                 |  | Service                               |   |                        |
|                 | Surveys to monitor lamprey ammocoete densities in Lake Erie drainage streams every two years or prior to lampricide treatments   | U.S. Fish & Wildlife Service          | Surveys to monitor lamprey ammocoete densities in Lake Erie drainage streams every two years or prior to lampricide treatments.   |                        |
| <b>Fishes</b>   | The brook trout is being monitored by PFBC Fisheries Managers' game fish surveys in certain streams. A formal state monitoring plan is currently being developed to assess population trends | Pennsylvania Fish & Boat Commission   |   |                        |
| <b>Mussels</b>  | Hunter Station Mussel Relocation Pilot Study   | Pennsylvania Fish and Boat Commission | Stocking density, survival, and growth are being assessed using 3x4 factorial complete random block design wherein a total of 90 mussels are placed into a staked grid at three sites on the Shenango River and two sites on Conewango Creek. |                        |