



CHAPTER 1

Species of Greatest Conservation Need

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SNAPSHOT

Summary of Changes Since 2005

- ✓ **Updated Species of Greatest Conservation Need selection process.**
- ✓ **664 Species of Greatest Conservation Need (90 birds, 19 mammals, 65 fishes, 18 amphibians, 22 reptiles, 450 terrestrial and aquatic invertebrates).**
- ✓ **Development, pollution, and invasive species identified as primary threats to Species of Greatest Conservation Need.**
- ✓ **Conservation planning, direct management of natural resources (e.g., prescribed fire, dam removal, forest management for SGCN), law and policy, and technical assistance are the primary conservation actions needed.**

Summary of Changes to the List Since 2005

Approach

Selecting Species of Greatest Conservation Need (SGCN) is a foundational feature of State Wildlife Actions Plans (SWAPs). In the 2015 Pennsylvania Wildlife Action Plan (Plan), the approach for selecting SGCN is one of the most significant changes from the 2005 Plan. The national [Best Practices for State Wildlife Action Plans](#) (AFWA 2012) suggests being “*explicit and transparent about which criteria are used so it will be clear and repeatable to any user of a plan how priorities were established*” (sensu Groves 2003). Whereas the 2005 Plan was driven by an expert-opinion based process through consultation with the [Pennsylvania Biological Survey](#) (PABS) technical committees, the 2015 methods used objective, data-driven considerations to the greatest extent practicable. Rather than ask technical committees to generate the lists independently, we relied on members to contribute species data, advance methodology, comment on the selection criteria, and peer-review the entire process. We developed a flowchart (Fig. 1.2) and guidance document (Appendix 1.2) to illustrate and explain SGCN selection criteria, which will serve as a reference in future revisions of this Plan.

Selection Criteria

Though many of the 2005 considerations remained consistent in the development of the 2015 list (e.g., global, national, regional, state imperilment), there are several notable differences in this version. First, Pennsylvania responsibility species were defined in 2005 as, “*...those species in which core populations occur in PA and/or a significant proportion ($\geq 5-10\%$) of the regional population occurs in PA so that PA has a high responsibility for conserving the species.*” (PGC-PFBC 2005). Upon review of this definition, we found it unnecessary to include a percentage range, preferring to agree on a specific threshold for responsibility species, and to determine this percentage based on the North American distribution, rather than regional, to preclude uncertainty in the term ‘region.’ Subsequently, the 2015 definition was simplified to “*a species for which Pennsylvania supports $\geq 10\%$ of its North American population/subpopulation or $\geq 25\%$ of its North American distribution.*”



Second, the 2005 SGCN list included flagship or indicator species that “may be used to monitor the effectiveness of habitat management efforts.” Review of this criterion resulted in significant debate between PFBC and PGC taxonomic leads over the selection of indicator species; e.g., questioning if single species are truly the best indicators (see Caro 2010), *a priori* determination of a management indicator species, if indicator species can be determined objectively, and if a species that would be a good management indicator would necessarily warrant inclusion as a SGCN. For these reasons, we excluded flagship or indicator species from the 2015 Species of Greatest Conservation Need selection flowchart.

Lastly, we more thoroughly evaluated Pennsylvania’s role for passage migrant and wintering birds for this revision. Though full life-cycle conservation of species had been embraced in the 2005 Wildlife Action Plan, newly accessible datasets (e.g., eBird) enabled a more comprehensive assessment. In addition to breeding and migrant bird species included in 2005, winter resident SGCN are reflected in the 2015 list.

These modifications accounted for the majority of species additions and deletions from the 2005 SGCN list. However, in some cases (e.g., fishes), new survey data indicated populations were more abundant than previously realized, resulting in removal of the species as a SGCN.

Standard Terminology

Nationally, species identified in Element 1 of State Wildlife Action Plans are referred to as *Species of Greatest Conservation Need (SGCN)*. In this version of the Pennsylvania Wildlife Action Plan, we adopt this convention for referring to the entire list of species for consistency, rather than use the 2005 term “priority species.” SGCN were defined in the 2005 Pennsylvania Wildlife Action Plan as species vulnerable in the Commonwealth *and* for which Pennsylvania has high responsibility for population persistence. The Steering Committee concurred to use the nationally recognized term, Species of Greatest Conservation Need, for the inclusive list.

Introduction

In keeping with Congressional intent of the State & Tribal Wildlife Grants Program to prevent further federal endangered species listings, we give special attention in the 2015 Pennsylvania Wildlife Action Plan to native species that are approaching the point of federal listing, are impacted by pervasive and severe threats, and/or experiencing significant declines. Working with partner organizations through the State & Tribal Wildlife Grants Program, the Commissions can strive to intervene in wildlife conservation and management at the state level before imperiled species require protection under the federal Endangered Species Act. Investing State & Tribal Wildlife Grants Program funding now to protect or restore wildlife populations within a state is far more effective than waiting until the populations reach critically low levels and need expensive critical recovery efforts at the federal level.

However, limiting the scope of the Pennsylvania Wildlife Action Plan to rapidly declining or imperiled species would continue the inefficient pattern of “reactive” rather than “proactive” management. State & Tribal Wildlife Grants Program funding and the Pennsylvania Wildlife Action Plan provide the agencies



and conservation partners with an opportunity to focus beyond imperiled species, to keep common species common. Since 2005, the overarching goal of the Pennsylvania Wildlife Action Plan has been to move toward proactive management of the species and habitats for which Pennsylvania has some regional, national or global responsibility. This move from reactive to proactive management can increase conservation success on the ground and promote more efficient use of limited staff and funding resources.

Notably, development of Wildlife Action Plans by all states has spurred staff to think about wildlife conservation beyond state boundaries. Therefore, we made a significant effort during the course of the Pennsylvania Wildlife Action Plan development and revision to identify and emphasize the unique role, and regional responsibility, of Pennsylvania in conserving Species of Greatest Conservation Need. An objective of the 2015 Pennsylvania Wildlife Action Plan planning effort was to reach beyond rarity – which often forces managers to simply document the declines of a species – so we may achieve comprehensive, proactive management.

Species of Greatest Conservation Need Selection Regional and State Species Conservation Status Assessments

Regional Species of Greatest Conservation Need (RSGCN)

Adapted from Terwilliger Consulting & NEFWDTC 2013

The northeast states began developing the concept of Regional Species of Greatest Conservation Need (RSGCN) in the 1980s. This approach evolved through several complementary efforts focused on the conservation of specific taxonomic groups, and more recently has been applied across taxonomic groups by the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC). This recent RSGCN review and re-evaluation was conducted by the NEFWDTC regional taxa teams in 2011-2013 with assistance from the North Atlantic Landscape Conservation Cooperative (NALCC), and is provided here along with ongoing additional species prioritization efforts by NALCC. The effort highlights collaboration between the NEFWDTC and the NALCC to improve and implement a screening of northeast wildlife for conservation need and responsibility, and better capture and quantify species risk in the region.

All major taxonomic groups were considered for the RSGCN screening process described below: birds, mammals, marine mammals, freshwater and marine fish, amphibians, reptiles, and invertebrates. Due to insufficient information, many groups of invertebrates were not included. Instead, except for tiger beetles and freshwater mussels, only the federally listed or candidate species are included until a more thorough review can be completed for these important taxa. Several invertebrate taxa (e.g., dragonflies, damselflies, and mussels) are the subject of current Regional Conservation Need (RCN) project status reviews by experts in the region and will result in updated invertebrate lists.

The RSGCN screening criteria were applied to all 13 states in the northeastern U.S. and the District of Columbia, with the intention that 1) the list is available for voluntary adoption by states in their planning processes including Wildlife Action Plan revisions, and 2) the process and results satisfy certain Wildlife Action Plan requirements under Element 1. Additional factors also were considered in updating the



process and list. Emerging threats (such as disease), changes in taxonomy, and other important updates are incorporated into the process as well.

Species on the RSGCN list are categorized according to *conservational need* (the percentage of northeast states that list the species as SGCN in their 2005 SWAP) and *regional responsibility* (the percentage of the species’ North American range that occurs in the Northeast) (Fig. 1.1). This methodology was adapted from distribution and risk-based prioritizations used for birds (Carter et al. 2000; Wells et al. 2010), reptiles and amphibians (NEPARC 2010), and state agency endangered species lists (Hunt 2007; Joseph et al. 2009; Wells et al. 2010). The NALCC applied additional analyses to a composite list of 2,398 species published in northeastern U.S. SWAPs (Whitlock & Carpenter 2007) and applications will continue to be developed through collaboration with the northeast states and NEFWDC.

In total, 355 species or subspecies met the prescribed inclusion criteria. NALCC, NEFWDC, and state staff initiated an effort to assemble the best available data from diverse sources for each of the 355 species and subspecies. Species scoring below 50% for both factors were excluded from the list as RSGCN (shown in gray in Fig. 1.1). Species scoring above 50% on one factor were included and assigned to categories according to the scores. Figure 1.1 highlights these categories in red. Ultimately, a thorough evaluation of data quality for each species, including maps of probable distribution and known occurrence will be conducted during this ongoing effort.

The complete Regional Species of Greatest Conservation Need list, and further explanation of selection criteria and methods, can be found in the [Northeast Regional Conservation Synthesis report](#) (Terwilliger Consulting & NEFWDC 2013). A guiding principle of the 2015 Pennsylvania Wildlife Action Plan is to recognize Pennsylvania’s regionally important roles in conserving species and habitats. We therefore considered Regional Species of Greatest Conservation Need that are native, occur regularly in Pennsylvania, and which face high or very high threats to their populations within the state as Pennsylvania SGCN (Fig. 1.2).

Conservation Need (N^*)= $\frac{N \text{ States in need}}{\text{States in NE range}}$	Regional Responsibility (R^*)	
	High	Low
	>50% of Range	<50% of Range
Very High ($\geq 75\%$)	1	2
High ($\geq 50\%$)	3	4
Moderate ($\geq 25\%$)	5	
Low (<25%)	7	
<3 states in NE	9	

Fig. 1.1 RSGCN Inclusion Criteria Categorization. N = the number of states listing the species in 2005 State Wildlife Action Plans and R= the percentage of a species’ North American range that occurs in the Northeast.

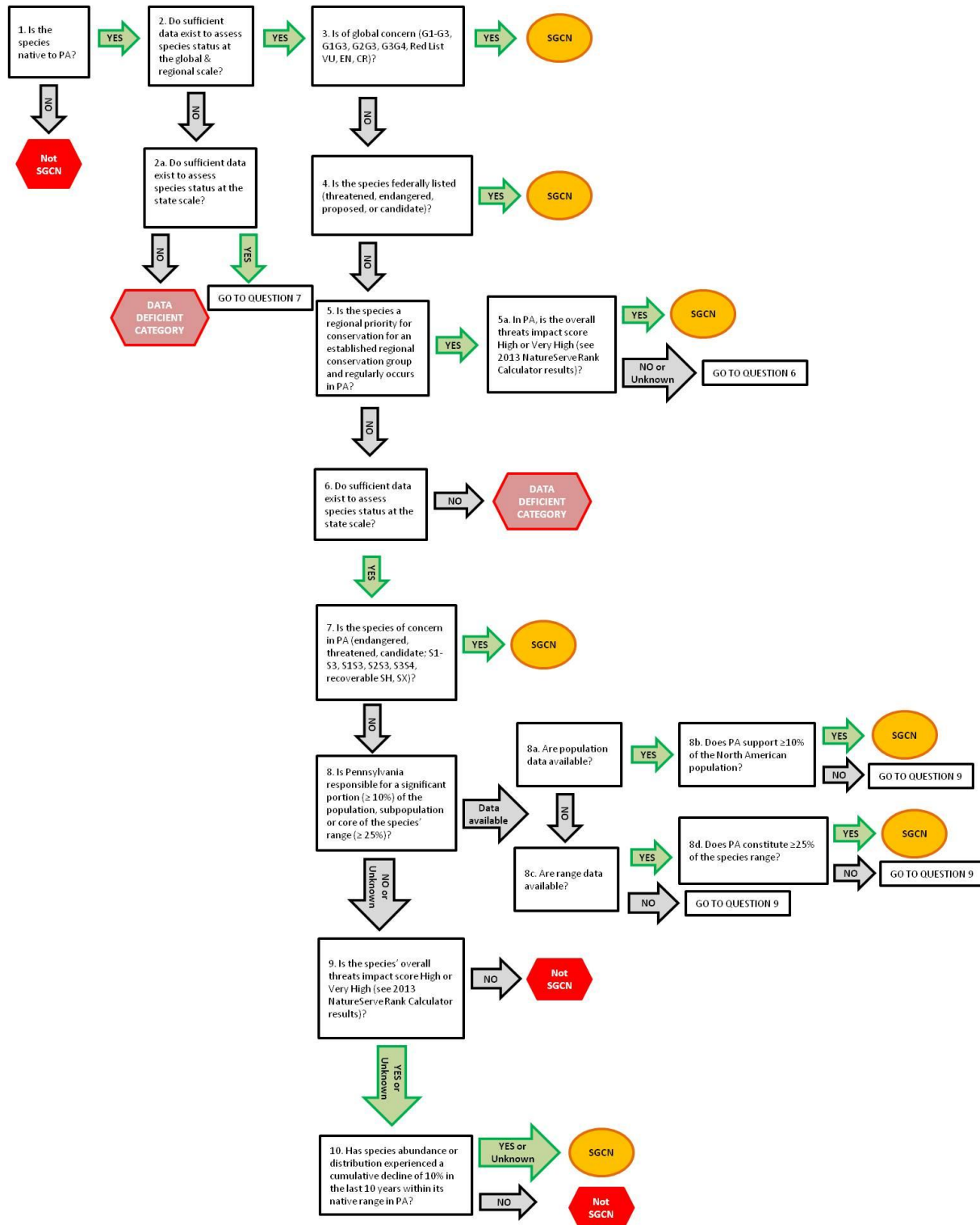


Fig. 1.2. Decision model used for identifying Species of Greatest Conservation Need (SGCN) in the 2015 Pennsylvania Wildlife Action Plan. Any fish, amphibian, reptile, terrestrial and aquatic invertebrate, bird or mammal known to occur regularly (i.e., not vagrants) in Pennsylvania for any part of its life cycle was eligible for review against these criteria. Passage migrant and wintering birds were selected using modified flowchart criteria. Data deficient species are not SGCN (Appendix 1.3 Table 3).



Pennsylvania Conservation Status Assessments

For consistency in status assessments across taxonomic groups and to implement a national best practice for State Wildlife Action Plans (AFWA 2012), contractors with specific taxonomic expertise used the NatureServe[®] rank calculator version 3.1 (Master et al. 2012) to update state-level conservation status ranks (i.e., S-ranks). All regularly occurring, native birds (breeding and nonbreeding), mammals, reptiles, amphibians, freshwater and marine fishes were evaluated. Due to the quantity of invertebrate species in Pennsylvania (over 11,000; [Pennsylvania Biological Survey Box Score 2013](#)), it was neither financially nor temporally feasible to evaluate the conservation status of all invertebrates through the rank calculator. Thus, conservation status assessment for invertebrates included the 2005 Pennsylvania Wildlife Action Plan SGCN invertebrate species ($n = 425$) and select invertebrate orders which taxonomic experts considered important for review. In total, 750 terrestrial and freshwater invertebrate species were assessed for this revision (see [Special Cases – marine species](#)). Species occurring in the state during various stages of their life cycle (e.g., migratory and wintering birds) were assessed separately for each occurrence period (see [Special Cases – passage migrant and wintering birds](#)). The Pennsylvania Biological Survey taxonomic technical committees reviewed data used for S-rank calculations and resulting S-ranks prior to finalization by the Pennsylvania Game Commission (birds and mammals) or Pennsylvania Fish and Boat Commission (fishes, amphibians, reptiles, and invertebrates).

Conservation status assessment reports can be found in Appendix 1.1, which each include a description of the rank calculation process. The NatureServe[®] rank calculator version 3.1 (Master et al. 2012) provides an objective conservation status assessment based on population rarity, trends, and threats (see Faber-Langendoen et al. 2012). The best available data were used to evaluate population size, distribution, threats, and trends (Table 1.1). Taxonomic experts completed species threats assessments using the standard threats classification system developed by Salafsky et al. (2008) and adopted by the International Union for Conservation of Nature (IUCN 2012). This threats classification also has been adopted by the northeastern states to facilitate consistency between State Wildlife Action Plans (Crisfield 2013).

Table 1.1 Reference data for comprehensive, state-level conservation status assessments (i.e., S-ranks) using the NatureServe[®] Rank Calculator version 3.1 (Master et al. 2012). Complete references are provided in the respective status assessment reports (Appendix 1.1).

Taxonomic Group	Reference Data for Status Assessments
Birds	
<i>Breeding</i>	Second Atlas of Breeding Birds in Pennsylvania (see Case Study ; Wilson et al. 2012); USGS Breeding Bird Survey (Sauer et al. 2014); Partners in Flight Landbird Population Estimates Database Version 2.0 (http://rmbo.org/pifdb/); PGC Wildlife Management annual reports for colonial waterbirds, bald eagle, waterfowl (Pennsylvania Game Commission unpublished data); Pennsylvania Natural Diversity Inventory element occurrences (PNHP 2013)



<i>Passage migrants</i>	eBird; Raptor Population Index (RPI-project.org 2013)
<i>Wintering</i>	eBird; Audubon Christmas Bird Count (National Audubon Society 2014)
Mammals	Webster et al. 1985; Merritt 1987; Lindzey 1998; Whitaker and Hamilton 1998; Steele et al. 2010; PGC Wildlife Management annual reports (Pennsylvania Game Commission unpublished data); Pennsylvania Natural Diversity Inventory element occurrences (PNHP 2013)
Fishes	Pennsylvania Natural Diversity Inventory element occurrences (PNHP 2013); PFBC and Penn State University (unpublished data); taxonomic experts
Amphibians & Reptiles	Pennsylvania Natural Diversity Inventory element occurrences (PNHP 2013); Pennsylvania Amphibian and Reptile Survey (unpublished data); taxonomic experts
Invertebrates	See pages 50-62 in Leppo et al. 2015, Appendix 1.1

Selection Criteria for Pennsylvania Species of Greatest Conservation Need

The *Best Practices for State Wildlife Action Plans* recommends a well-defined method for determining Species of Greatest Conservation Need (SGCN) to provide a clear and repeatable process for users (AFWA 2012; also see Groves 2003). To implement this “best practice” during the comprehensive review and revision of the 2005 Pennsylvania Wildlife Action Plan, we developed a flowchart to illustrate decision nodes for determining Pennsylvania Species of Greatest Conservation Need (SGCN) based on a variety of factors (Fig. 1.2). The final selection criteria emerged after several iterations over the course of a year with input from the State Wildlife Action Plan Steering and Advisory Committees, Pennsylvania Biological Survey members, and agency staff. For clarity, we developed an accompanying guidance document that included definitions for each decision question (Appendix 1.2). Any fish, amphibian, reptile, terrestrial and aquatic invertebrate (those assessed), bird or mammal known to occur regularly (i.e., not vagrants) in Pennsylvania for any part of its life cycle was eligible for review against flowchart criteria (Table 1.2), with some exceptions.

Considerations in the Pennsylvania Species of Greatest Conservation Need flowchart included:

1. *Pennsylvania native*
2. *Data deficiency (global, regional or state)*
3. *Global imperilment*
4. *Federal imperilment*
5. *Regional concern*
6. *State imperilment*
7. *Pennsylvania responsibility*
8. *Significant threats & declining populations*

“Data deficient” species were those with undocumented abundance and/or distribution data and were therefore unreliable for making an informed assessment of the extirpation risk to a species with a level of certainty (i.e., insufficient data to calculate a G-rank (GU), IUCN Red List category (DD) or S-rank (SU)) (Appendix 1.2). This category also includes species with published taxonomic uncertainties that precluded our ability to assess its conservation status. Though not considered Pennsylvania Species of Greatest Conservation Need, we include a list of data deficient species to highlight the need for information on these species (Appendix 1.3 Table 3).



Exceptions to SGCN consideration: The PGC, with concurrence from the Ornithological Technical Committee of the PA Biological Survey, identified several species that did not warrant evaluation for Species of Greatest Conservation Need (SGCN) in the 2015 State Wildlife Action Plan revision. These were Trumpeter Swan, Double-crested Cormorant, Herring Gull, Great Black-backed Gull, Sandhill Crane, Merlin, Clay-colored Sparrow, House Finch, Black Vulture and Blue Grosbeak. Omitted species were either not a priority for conservation (e.g., House Finch) or are experiencing a recent range expansion without a history (since ~1900) of nesting in the state (e.g., Merlin). They also tend to have few threats and adapt well to anthropogenic landscapes.

Table 1.2. Number of regularly occurring Pennsylvania native species considered for inclusion as Species of Greatest Conservation Need in the 2015 State Wildlife Action Plan. Bird species include breeding and nonbreeding seasons.

Taxonomic Group	Number of species considered
Invertebrates	750
Amphibians	38
Reptiles	39
Fishes	211
Birds	243
Mammals	59

Special cases

Passage migrant and wintering birds

There were exceptions to flowchart application. To embrace full life-cycle stewardship of bird species (e.g., Berlanga et al. 2010), we wished to represent passage migrant and wintering birds within the Species of Greatest Conservation Need list. The challenge, however, was two-fold. First, Pennsylvania is a thoroughfare for hundreds of species of migratory birds (Rodewald and Brittingham 2004, 2007; Leppold and Mulvihill 2011; Dennhardt et al. 2015). We aimed to include as Pennsylvania SGCN species occurring in large enough numbers for conservation actions taken in Pennsylvania to be meaningful to their population. Specifically, we avoided inclusion of species that occur in the state only incidentally. Second, data for nonbreeding periods are not as robust as those for breeding bird species, though eBird and Christmas Bird Count data informed the analyses. Therefore, we filtered all regularly occurring nonbreeders to focus on species that are of concern globally, in the northern range (e.g., northern Bird Conservation Regions), nationally (i.e., USFWS threatened or endangered), or in the state (i.e., threatened or endangered). This list of species was evaluated for all seasons in which they occur in Pennsylvania.



Pennsylvania Wildlife Action Plan

CASE STUDY: Second Atlas of Breeding Birds in Pennsylvania

Dan Brauning, Wildlife Diversity Division Chief
Pennsylvania Game Commission

Project Location: Statewide

Project Purpose

To determine the *composition, distribution, and relative abundance* of the state's breeding bird fauna, inclusive of documented precise locations for a subset of the state's rarer species, to serve as the raw material for prioritized conservation.

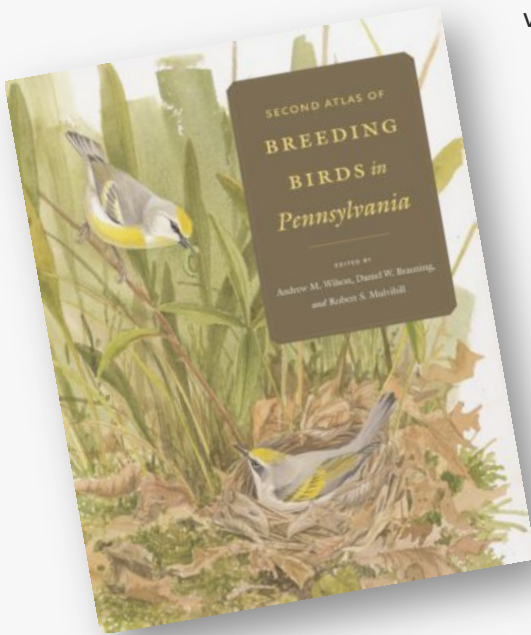


Species of Greatest Conservation Need/Priority Habitat Affected

Breeding Bird Atlas projects are truly comprehensive in their scope, with the stated intent of documenting the distribution of *all breeding bird species* in the state during the defined period (usually 5 or 6 years). The methods also are intensive in that a thorough inventory of breeding birds is generated for a large number of locations. The intent is to cover all habitats and all seasons. No other survey aspires to achieve so much, and the Second Atlas achieved this during 2004-2009.

Project Description

Fieldwork was built upon the skills of over 2,000 volunteer birders statewide surveying species within a grid of 4,937, 10-mi² blocks statewide. A strong network of volunteer regional coordinators guided the activities of field observers, and were overseen by a statewide coordinator. A web-based data-management tool streamlined acquisition of the resulting 854,773 bird records during 2004 through 2009, representing 218 species, of which 190 were considered breeding during this period. Compiled at the block level, the result is an average of 69.5 species per block. From this was produced a detailed distribution map for every species, in addition to site-specific information for a suite of conservation-sensitive species. The volunteer network was supplemented by a force of paid summer staff to perform a parallel effort, over 32,000 standardized point-counts statewide to add a quantitative dimension to the volunteer-based distribution. The resulting density map and population estimates supplemented the distribution map for about 100 of the most common breeding species.





Many dramatic changes (expansions and retractions) in species distribution were demonstrated, including species newly confirmed breeding in the state, such as Merlin and Eurasian Collared-Dove. The conservation value for birds of this effort is incalculable.

Like Pennsylvania's first atlas, the second resulted in revision of the state's threatened and endangered species list and served as a primary source for the revision of the state's list of Species of Greatest Conservation Need. Many locations were identified where conservation actions would be targeted for priority species. The detailed checklists subsequently have contributed to many additional analyses. The resulting book published by Penn State University Press was received with acclaim.

Project Partners

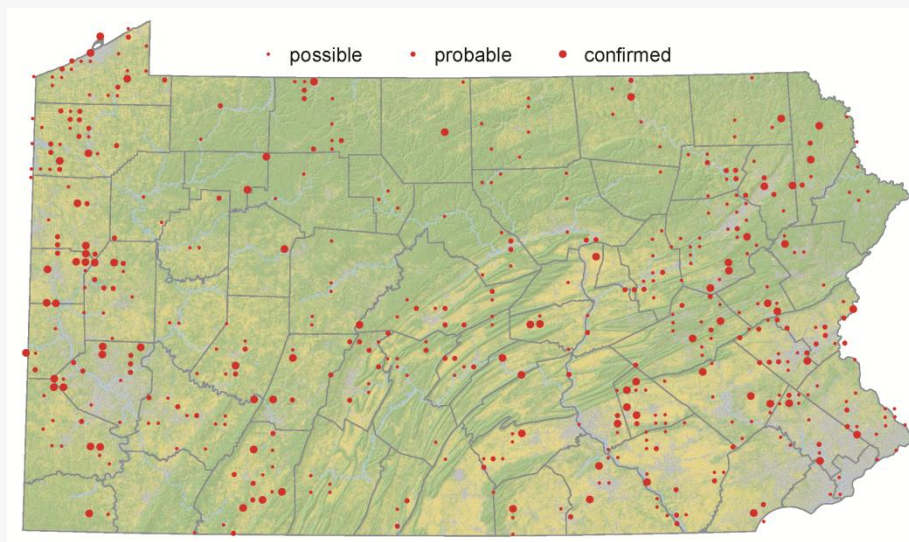
The Second Atlas was sponsored by four primary organizations: Pennsylvania Game Commission, Carnegie Museum of Natural History, Pennsylvania Society for Ornithology and Audubon Pennsylvania. Primary funding came from U.S. Fish and Wildlife Service State and Tribal Wildlife Grants program and the DCNR Wild Resource Conservation Program. Penn State University Press published the volume.

The full listing of individual and organizational partners is extensive, and may be found in the book's acknowledgements, the core of which are many individuals who volunteered many hours of their lives to this project to complete fieldwork and to draft the results.



Reference

[Wilson, A. M., D. W. Brauning, R. S. Mulvihill, Editors, 2012. Second Atlas of Breeding Birds in Pennsylvania. The Pennsylvania State University Press, State College, Pennsylvania](#)





To elucidate *migratory* bird species for which Pennsylvania plays a major role, Wilson (unpublished data; Appendix 1.1) evaluated passage migrant and wintering birds with respect to the relative proportion of birds in the Atlantic and Mississippi Flyways passing through Pennsylvania at the peak of spring and fall migration seasons. Pennsylvania is 20.7% of the width of the two flyways, thus, if we estimate that >41.4% of the population passes through Pennsylvania, we thereby assess that the species is a Pennsylvania priority for conservation action and included as Species of Greatest Conservation Need during migration. A full description of methods is provided in Appendix 1.1. In addition to these responsibility species, globally vulnerable (G1-G3) and federally or state listed species were included as SGCN (similar criteria to the flowchart) for the migratory period, where applicable.

For *wintering* bird Species of Greatest Conservation Need selection, we started with species that are of high concern to the north, globally imperiled (G1-G3), federally protected, regional concern or state listed or vulnerable (i.e., S3N) (Table 1.3). Because data are less consistent for the wintering period, Game Commission leads for game and nongame birds reviewed and modified the list based on expert knowledge of frequency and abundance of the species in the state during the wintering period and concern for species in eastern North America flyways (e.g., rusty blackbird).

Table 1.3. Existing conservation status lists referenced during the Pennsylvania wintering bird 2015 Species of Greatest Conservation Need evaluation process.

Conservation status list	Threshold criteria for PA SGCN consideration	Source
Appalachian Mountain Joint Venture	High or Highest	Unpublished data from 2012
U.S. Shorebird Conservation Plan	High or Highly Imperiled	Brown et al. 2001
Bird Conservation Regions 3, 13, 14; Bird Conservation Region 12	High or Highest; Regional Concern	Dettmers 2006; Atlantic Coast Joint Venture 2007; Matteson et al. 2009

Marine species

For marine or estuarine invertebrates, we evaluated the blue crab (*Callinectes sapidus*) because the Pennsylvania Fish and Boat Commission regulates harvest of this species. The review resulted in assessing the species as Data Deficient. In the mid-1980s, young blue crabs (15-20 mm) were collected in Pennsylvania waters, but it was uncertain if these were spawned in Pennsylvania or moved into the area collected from downstream (Mike Kaufmann, PFBC Fisheries Biologist, personal communication). Further, Kaufmann notes reliable incidental reports of blue crabs in all major tidal tributaries. However, the frequency of occurrence is unknown. Occurrence also may be influenced by climatic factors that affect salinity, location of the salt wedge, and temperature.

No exclusively marine or estuarine fishes were found to be SGCN. Marine or estuarine fishes found in Pennsylvania waters were either considered occasional/accidental or, if they regularly occurred, were not a suitable species for conservation in Pennsylvania.



Species Status Definitions

Many terms are used to describe the status of a species in Pennsylvania, which often causes confusion. Some of these terms refer to legal protections (e.g., state threatened) while others indicate the conservation status of a species within the Commonwealth (e.g., Species of Special Concern) relative to all species in the state. *Species of Special Concern* and *Species of Greatest Conservation Need* do not carry any legal protection simply by having these designations, though species protected through statute also are typically included in these lists (Fig. 1.3).

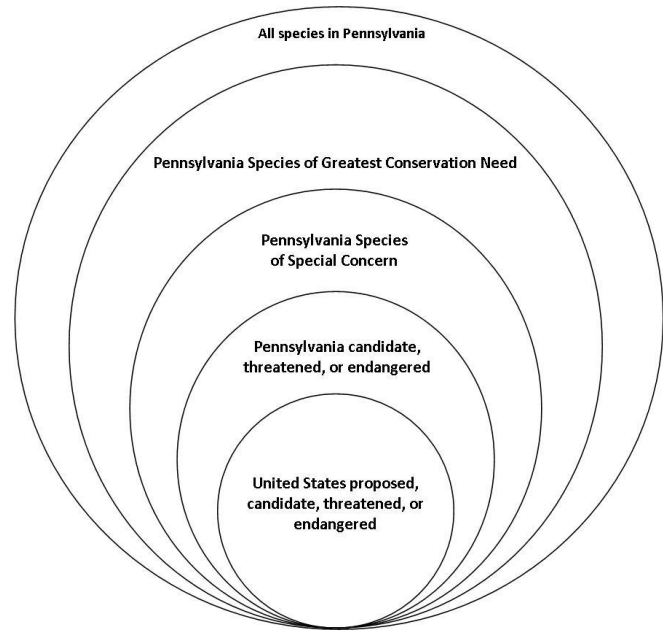


Fig. 1.3. Relationship of Pennsylvania Species of Greatest Conservation Need to other species lists in the state. United States proposed, candidate, threatened, or endangered and Pennsylvania candidate (PFBC only), threatened, or endangered are protected through statute.

Species of Greatest Conservation Need: The most inclusive of the 4 lists, this term refers to the species within this Pennsylvania Wildlife Action Plan. These represent fish and wildlife species conservation priorities for targeted conservation action, 2015-2025. All birds, mammals, fish, reptiles, amphibians and aquatic invertebrates are considered “protected” in the Commonwealth, meaning that it is unlawful to harm or harass these species outside of legal hunting/fishing seasons or without proper permits or licenses from the PGC, PFBC, and/or U.S. Fish and Wildlife Service.

Pennsylvania Species of Concern: Often used generically to describe at-risk species in the state, this term represents the lists maintained by the taxonomic technical committees of the [Pennsylvania Biological Survey](#). These include endangered, threatened and common, but declining, species. The list of Species of Greatest Conservation Need is inclusive of these special concern species.

Pennsylvania candidate (PFBC only), threatened, endangered: A legal designation within Pennsylvania, “state listed” species are protected under the Pennsylvania Code Title 58, Chapter 75 (relating to PFBC) & Chapter 133 (relating to PGC).

United States proposed, candidate, threatened, or endangered: Referring to species receiving, or deemed eligible to receive, federal protection under the Endangered Species Act of 1973, as amended. These include endangered, threatened, candidate or proposed fish, amphibian, reptile, terrestrial and aquatic invertebrate, bird or mammal species known to occur in Pennsylvania during any stage of its life cycle. The [U.S. Fish and Wildlife Service](#) provides definitions for these categories.



Prioritizing Pennsylvania Species of Greatest Conservation Need

With 664 Pennsylvania Species of Greatest Conservation Need (SGCN), prioritization is necessary to focus conservation actions and provide the most efficient use of limited resources. Often species prioritization emphasizes rarity; however, this could potentially lead to misplaced resources toward efforts that will not succeed (Possingham et al. 2002; Bunnell et al. 2009). Moreover, critical imperilment is not the only decision problem faced by fish and wildlife managers responsible for the management and conservation of native species diversity (Game et al. 2012).

Consequently, working with fish and wildlife decision-makers on the State Wildlife Action Plan Steering Committee, we agreed on several purposes for prioritizing species. Through the species selection process, and in the species accounts, we identified characteristics of species (e.g., levels of imperilment, threats) and future needs (e.g., surveying, monitoring and research). This information, along with the guiding principles and goals of the 2015 State Wildlife Action Plan (Plan), forms the foundation for the prioritization process applied in this document. A species prioritization framework aligned with stated guiding principles and goals in the Plan provides continuity and increases the likelihood for implementing conservation actions (Bunnell et al. 2009).

Methods

Pennsylvania Fish & Boat Commission (PFBC) and Pennsylvania Game Commission (PGC) Wildlife Action Plan Coordinators reviewed published prioritization frameworks for utility in the state (e.g., Millsap et al. 1990; Bunnell et al. 2009; Joseph et al. 2009; Reese & Noss 2014). We aimed to optimize the use of existing species assessment data within a defensible, transparent prioritization scheme that focuses on preventing imperilment in addition to recovering critically imperiled species. The approach outlined by [British Columbia](#) (Bunnell et al. 2009) most closely met these considerations. British Columbia has successfully employed this conservation planning framework to prioritize species for conservation action for more than five years (D. Fraser, personal communication). The Pennsylvania SGCN selection process considered many of the same parameters used in British Columbia (Fig. 1.4), thus consistency with the SGCN selection criteria was an additional benefit.

A working group from the PGC Wildlife Diversity Division and PFBC Fisheries Bureau and Natural Diversity Section reviewed the Bunnell et al. (2009) prioritization goals for application to Pennsylvania. Additionally, we asked SWAP Steering Committee members to specify the primary reason for prioritizing the Species of Greatest Conservation (SGCN) list (Table 1.4). With this information, the working group modified the Bunnell et al. (2009) goals statements, as needed, to accommodate the Pennsylvania Wildlife Action Plan goals and purposes more explicitly (Table 1.5). We use the word “category,” rather than “goal” for the Pennsylvania Wildlife Action Plan species priorities to prevent confusion with the overarching Plan goals. Note that the numbers associated with each category do not imply an order of importance.



Table 1.4. State Wildlife Action Plan Steering Committee input on the reasons why to prioritize Species of Greatest Conservation Need, 21 July 2014.

State Wildlife Action Plan Steering Committee responses to the question: *What is the objective for prioritizing SGCN?* 21 July 2014.

- Better direct (limited) funding to the species of most urgent need.
- Increase attention to, and direct effects toward, the most at-risk species.
- Keep species off of federal threatened & endangered species list.
- Identify species at the greatest risk of extirpation, becoming threatened or endangered.
- Help develop/guide conservation actions intended to conserve those species.
- Help prioritize conservation actions where multiple species overlap.
- Keep “common species common.”
- Determine allocations of limited resources that address the most critical needs.

Table 1.5. Species prioritization goals from Bunnell et al. (2009) and species prioritization categories identified for the 2015 Pennsylvania Wildlife Action Plan. Bunnell et al. (2009) goals are listed in priority order. All Pennsylvania categories are equivalent.

Bunnell et al. (2009)	Pennsylvania Wildlife Action Plan (2015)
Goal 1: Contribute to global efforts for conservation.	Category 1: Contribute to the conservation of globally or regionally important species.
Goal 2: Prevent species from becoming at risk.	Category 2: Prevent common species from becoming at-risk.
Goal 3: Maintain the diversity of native species.	Category 3: Maintain rare native species.
N/A	Category 4: Reduce knowledge gaps to better assess conservation status of species.

Pennsylvania Species of Greatest Conservation Need Prioritization Category descriptions

- Category 1 – Contribute to the conservation of globally or regionally important species.**
 A guiding principle of the SWAP is to contribute to the range-wide conservation of species. This prioritization category favors globally and state-imperiled species for which the U.S. northeast region has a high responsibility and that are experiencing very high or high threats in Pennsylvania. Additionally, we considered high confidence in extreme or high climate change vulnerability as this is a stressor on the range-wide conservation of the species. Targeted conservation actions towards priority species in this category will serve the range-wide conservation of the species (i.e., think globally, act locally).
- Category 2 - Prevent common species from becoming at-risk.**



To keep common native species common, we needed to determine which species were at the greatest risk of imperilment and thereby work towards preventing further declines. Species that are generally more secure (i.e., S3, vulnerable; S4, apparently secure) were prioritized initially. We then ranked highest the conservation concern of the species within the U.S. northeast region or for which Pennsylvania has a high stewardship responsibility for persistence of the species within its range, species with declining trends, high or very high threats in Pennsylvania, extreme or high vulnerability to climate change, or if gene flow between populations is limited. Addressing the needs of priority species in this category will serve to proactively manage populations before more costly recovery efforts are needed.

- **Category 3 - Maintain rare native species.**

The comprehensive list of SGCN reflects Pennsylvania's native imperiled species, though the conservation statuses range from critically imperiled (i.e., S1) to secure (i.e., S5). Many of the state's critically imperiled species are at the edge of their range and will likely never be abundant due to habitat limitations. However, these rare species are still critical components of ecosystems and may allow greater adaptability to emerging stressors, such as climate change (Steen & Barrett 2015). This category ranks highly the rare species with the greatest feasibility for recovery (in the case of suppressed populations) or sustainability (in the case of extant, relatively abundant species) in the next 10 years.

- **Category 4 - Reduce knowledge gaps to better assess conservation status of species.**

With a SWAP goal to use the best available science to make conservation decisions, and with many existing data gaps, we needed to identify the species to target first for research, inventory and monitoring. Thus, we prioritize species that have the core of their range in Pennsylvania and for which we could not evaluate conservation statuses due to data deficiencies at the state scale (i.e., SU, state unrankable), or that have S-ranks with the greatest uncertainty (i.e., S1S3).

Evaluation of Pennsylvania SGCN assessment data informed the applicable criteria with which to assess each SGCN under a respective prioritization category (Fig. 1.4). We generally adopted the Bunnell et al. (2009) prioritization system because it uses readily available conservation parameters such as conservation status (i.e., NatureServe® global and state ranks), population size and trend, threats, feasibility of recovering or sustaining the species in the state, and stewardship responsibility.

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Step 1 (All Categories). Link and simplify NatureServe[®] global and state ranks. For each prioritization category, select applicable initial score (or range of scores) based on the combined G- and S-ranks (Fig. 1.5). As in Bunnell et al. (2009), SH (historic) and SX (extirpated) are treated as S1 (critically imperiled) and SNA (S-rank not applicable; accidental or non-resident species) are not assessed.

Follow subsequent steps under each prioritization category to determine the final priority ranking of species within that category.

Species Prioritization Category 1. Contribute to the conservation of globally or regionally important species.

Step 2. Adjust the initial score from Step 1 by feasibility. Low feasibility receives the lowest priority score. Conversely, the highest priority score is selected for species with high feasibility. If only one initial score is available and the species has high feasibility, increase the priority by one (e.g., 6 -> 5). Similarly, if only one initial score is available and the species has low feasibility, decrease the priority by one (e.g., 5 -> 6). For medium feasibility species, or if feasibility is unknown, select the middle score of three options or the higher priority of two options. Result: Each species has an initial priority ranking between 2 and 6.

Step 3. The feasibility adjusted scores from Step 2 are adjusted to a higher priority score (-1) if ONE of the following considerations are true:

- IUCN Critically Endangered, Endangered, or Vulnerable (IUCN 2012).
- Northeast Regional Responsibility (Terwilliger et al. 2013) Very High or High.
- Pennsylvania Overall Threat Impact Score (Faber-Langendoen et al. 2012) Very High or High.
- Extremely or Highly Vulnerable to climate change with very high or high confidence (Furedi et al. 2011; Cullen et al. 2013; Furedi 2013; Keating et al. 2013; Sargent and Fidorra 2013).

If no adjustments are made in Step 2, lower the priority score by one rank (i.e., +1).

Species Prioritization Category 2. Prevent common species from becoming at risk.

Step 2. If priority scores from Step 1 are 2 or 4, select a 2 or 4 as an initial score based on the following rules for population trend or threats:

- Pennsylvania Overall Threat Impact Score (Faber-Langendoen et al. 2012) Very High or High = 2.
- Short-term (10 yr) trends – Declining with High, Moderate, Low or Unknown confidence = 2. Relatively stable with High, Moderate, Low or Unknown confidence = 4. Increasing with High, Moderate, Low or Unknown confidence = 4.
- Unknown trend or threat = 4.

Step 3. Adjust all scores to a higher priority score (-1) if ONE of the following considerations are true:

- Northeast Regional Species of Greatest Conservation Need (Terwilliger & NEFWDC 2013) OR Pennsylvania responsibility species (i.e., ≥10% population or ≥25% of range).
- Extremely or Highly Vulnerable to climate change with very high or high confidence (Furedi et al. 2011; Cullen et al. 2013; Furedi 2013; Keating et al. 2013; Sargent and Fidorra 2013).
- High certainty that there is limited to no gene flow between populations within Pennsylvania or other populations within the species' range (i.e., disjunct).

Step 4. Adjust all scores for feasibility. Low = lower one priority rank (+1) unless the score is already 6; Medium feasibility = no change; High = raise one priority rank (-1) unless the score is already 1.

Species Prioritization Category 3. Maintain rare native species.

Step 2. Adjust the initial priority score from Step 1 for feasibility. Low = lower one priority score (+1) unless the score is already 6; Medium or Unknown feasibility = no change; High = raise one priority score (-1).

Species Prioritization Category 4. Reduce knowledge gaps to better assess conservation status of species.

Step 2. Adjust for feasibility. If two possible scores resulted from Step 1, low feasibility receives the lowest priority score. Conversely, the highest priority score is selected for species with high feasibility. For medium or unknown feasibility species, select the higher priority of two options. Single scores remain the same for medium or unknown feasibility, -1 for high and +1 for low feasibility.

Step 3. Decrease the priority score (+1) if Pennsylvania does not fall within the primary (extant or historic) range of the species (i.e., fringe species), unless the initial score is 6. If yes or unknown, do not change the priority score from Step 2.

Fig. 1.4. 2015 Pennsylvania Wildlife Action Plan Species of Greatest Conservation Need prioritization steps, by priority category, adapted from Bunnell et al. (2009). Feasibility is defined as the likelihood of recovering or sustaining the species within a 10-year period of action implementation. Priority score 1 = highest, 6 = lowest.



Prioritization Steps

Step 1: The initial step for all categories is to concatenate and simplify, as needed, the NatureServe® global conservation status (i.e., G-rank) and state conservation status (i.e., S-rank). This step allows evaluation of the local conservation status within a context of global imperilment. As in Bunnell et al. (2009), SH (historic) and SX (extirpated) are treated as S1 (critically imperiled), and SNA (i.e., state rank not applicable; accidental, non-resident species) are not assessed. We prioritized bird species for each season in which they are listed as SGCN.

We derived initial scores under Species Prioritization Categories 1-3 from matrices provided in Figure 1 of Bunnell et al. (2009) (Fig. 1.5). Because Species Prioritization Category 4 is a Pennsylvania construct, the working group developed an initial scoring matrix following discussion of priority S-ranks for the category (Fig. 1.5). Priority scores for all categories range from 1 (highest priority) to 6 (lowest priority). The highest priority initial score for all prioritization categories is 2 so that adjustments based on subsequent parameters, such as feasibility, stewardship responsibility, etc., are possible. Species cannot be scored higher than a 1 or lower than a 6. For some categories (e.g., 1, 2 and 4), a range of initial values is provided for the G-S rank combination to allow for initial score selection based on the first criterion under Step 2.

Step 2: This step varies among the Species Prioritization Categories. The purpose is to select the most suitable initial score, from all possible scores in Step 1, based on specified criteria for a particular Category (Fig. 1.4). For example, Category 1 seeks to contribute to range-wide conservation of the species. To increase likelihood of success of achieving this, we de-emphasize species with a low feasibility of recovery or sustaining the population within the state for the next 10 years. In this example, we would select the lowest priority initial score from the choices available under Step 1 (Fig. 1.5).

Steps 3-4: These last steps increase or decrease the priority rank based on specified parameters. The working group selected the most relevant and readily available parameters after significant discussion about their applicability to the stated prioritization category. We recognize that one could consider many other prioritization factors under each category.

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A. Species Prioritization Category 1. Contribute to the conservation of globally or regionally important species.

		STATE CONSERVATION STATUS RANK				
		S1	S2	S3	S4	S5
GLOBAL CONSERVATION STATUS RANK	G1	G1S1 (2)				
	G2	G2S1 (2 or 3)	G2S2 (2 or 3)			
	G3	G3S1 (2, 3 or 4)	G3S2 (2, 3 or 4)	G3S3 (2, 3 or 4)		
	G4	G4S1 (3, 4 or 5)	G4S2 (3, 4 or 5)	G4S3 (4 or 5)	G4S4 (4 or 5)	
	G5	G5S1 (4, 5 or 6)	G5S2 (4, 5 or 6)	G5S3 (5 or 6)	G5S4 (5 or 6)	G5S5 (6)

B. Species Prioritization Category 2. Prevent common species from becoming at-risk.

		STATE CONSERVATION STATUS RANK				
		S1	S2	S3	S4	S5
GLOBAL CONSERVATION STATUS RANK	G1	G1S1 (6)				
	G2	G2S1 (6)	G2S2 (6)			
	G3	G3S1 (6)	G3S2 (6)	G3S3 (2 or 4)		
	G4	G4S1 (6)	G4S2 (6)	G4S3 (2 or 4)	G4S4 (2 or 4)	
	G5	G5S1 (6)	G5S2 (6)	G5S3 (2 or 4)	G5S4 (2 or 4)	G5S5 (6)



C. Species Prioritization Category 3. Maintain rare native species.

		STATE CONSERVATION STATUS RANK				
		S1	S2	S3	S4	S5
GLOBAL CONSERVATION STATUS RANK	G1	G1S1 (2)				
	G2	G2S1 (2)	G2S2 (3)			
	G3	G3S1 (2)	G3S2 (3)	G3S3 (4)		
	G4	G4S1 (2)	G4S2 (3)	G4S3 (4)	G4S4 (5)	
	G5	G5S1 (2)	G5S2 (3)	G5S3 (4)	G5S4 (5)	G5S5 (6)

D. Species Prioritization Category 4. Reduce knowledge gaps to better assess conservation status of species.

		STATE CONSERVATION STATUS RANK							All other ranks
		SU	S1S3	S1S2	S2S4	S2S3	S3S5	S3S4	
GLOBAL CONSERVATION STATUS RANK	G1	G1SU (2)							6
	G2	G2SU (2)	G2S1S3 (2 or 3)	G2S1S2 (3)	G2S2S4 (3 or 4)	G2S2S3 (4)			6
	G3	G3SU (2)	G3S1S3 (2 or 3)	G3S1S2 (3)	G3S2S4 (3 or 4)	G3S2S3 (4)	G3S3S5 (4 or 5)	G3S3S4 (5 or 6)	6
	G4	G4SU (2)	G3S1S3 (2 or 3)	G4S1S2 (3)	G4S2S4 (3 or 4)	G4S2S3 (4)	G4S3S5 (4 or 5)	G4S3S4 (5 or 6)	6
	G5	G5SU (2)	G3S1S3 (2 or 3)	G5S1S2 (3)	G5S2S4 (3 or 4)	G5S2S3 (4)	G5S3S5 (4 or 5)	G5S3S4 (5 or 6)	6

Fig. 1.5. Initial priority scores [see Step 1 Fig. 1.4] for each Species Prioritization Category (A-D), derived from combining and simplifying G (global) and S (state) conservation status ranks (see Bunnell et al. 2009, Figure 1). For instances when the G-rank includes two status levels (e.g., G1G3), and the resulting simplified GS rank score is not presented (e.g., G1S2), defer to the lowest G-rank score (e.g., 2). Initial priority scores, noted in parentheses below the combined G-S ranks, range from 2 to 6 (1 = highest priority, 6 = lowest priority).



Species of Greatest Conservation Need Results and Discussion

Selection Results and Discussion

The Species of Greatest Conservation Need (SGCN) selection process resulted in 664 fish, reptile, amphibian, bird, mammal and invertebrate species on which to focus conservation actions over the next 10 years (Table 1.6). We retained many species from 2005 because their conservation status had not improved sufficiently to warrant removal from the list (Table 1.7). Recovering populations is a significant undertaking that can require decades of dedicated attention (e.g., bald eagle). However, significant gains have been made since 2005, with support from State & Tribal Wildlife Grants program funding and other sources, that enabled removal of several species from the Wildlife Action Plan list of Species of Greatest Conservation Need (e.g., fisher, river otter; see [fisher Case Study](#)) and, in some cases, the state threatened and endangered species list (Introduction, Table 3).

Table 1.6. Box score of Pennsylvania Species of Greatest Conservation Need, 2015-2025.

	Total	U.S. Threatened or Endangered	Pennsylvania Threatened, Endangered, or Candidate ^a	Pennsylvania Recovered ^b (2005-2015)
Birds[†]	90	0	20	1
Mammals[†]	19	2	7	0
Fishes[‡]	65	2	43	15
Reptiles[‡]	22	2	9	0
Amphibians[‡]	18	1	7	0
Invertebrates[°]	450	12	11	0
Grand Total	664	19	97	16

^a Includes currently extirpated species. Candidate category – Pennsylvania Fish & Boat Commission only; ^b Delisted from state or federal threatened or endangered species lists due to reaching recovery goals; ^{†,‡,°} State legal authority: [†] Pennsylvania Game Commission; [‡] Pennsylvania Fish & Boat Commission; [°] Aquatic - Pennsylvania Fish & Boat Commission, Terrestrial - None.

Table 1.7. Number of species maintained or removed from the 2005-2015 Pennsylvania Species of Greatest Conservation Need list or new Species of Greatest Conservation Need for 2015-2025.

	Total	Removed since		
		Maintained from 2005	2005	New in 2015
Birds[†]	90	67	12	23
Mammals[†]	19	14	7	5
Fishes[‡]	65	54	22	11
Reptiles[‡]	22	20	2	2
Amphibians[‡]	18	12	1	6
Invertebrates[°]	450	319	106	131
Grand Total	664	486	150	178

^{†,‡,°} State legal authority: [†] Pennsylvania Game Commission; [‡] Pennsylvania Fish & Boat Commission; [°] Aquatic - Pennsylvania Fish & Boat Commission, Terrestrial - None.



Not surprisingly, invertebrates comprise the largest proportion (68%) of the SGCN list (Fig. 1.6); indeed, the PA Biological Survey estimates there to be more than 10,000 terrestrial and aquatic species in Pennsylvania within this group ([PABS Box Score 2013](#)). In addition, the majority of invertebrate SGCN are critically imperiled (S1), imperiled (S2) or vulnerable (S3)(Fig. 1.6). Nearly 14% of Pennsylvania’s SGCN are avifauna, primarily songbirds. Birds are particularly good indicators of environmental conditions due to their relative ease of detection, fecundity, and, in some cases, habitat specificity. For these reasons, they are the most studied taxonomic group in the world. Thus, birds included as SGCN serve as totems for condition of the habitats on which they depend and reflect concerns for forest fragmentation and lack of structural diversity, wetland loss to development and invasive species, and natural succession of grassland habitats within Pennsylvania (see Chapter 2, Habitats). In the aquatic realm, fishes, amphibians, and reptiles are similarly harbingers of environmental condition and change, comprising approximately 10% and 6% of the SGCN list, respectively. Though reptiles and amphibians comprise a small percentage of SGCN, nearly half of the native species considered are either vulnerable, imperiled, or critically imperiled (Fig. 1.6). Point and non-point source pollutants, habitat loss to development and energy infrastructure, illegal harvest, and impacts from climate change are significant threats facing aquatic species. Only 3% of the SGCN list includes Pennsylvania mammals; however, these mammal SGCN represent nearly 30% of the state’s 66 mammal species. White nose syndrome (Chapter 3, Threats) has devastated cave-hibernating bat species since 2009, resulting in their inclusion as SGCN in this Plan.

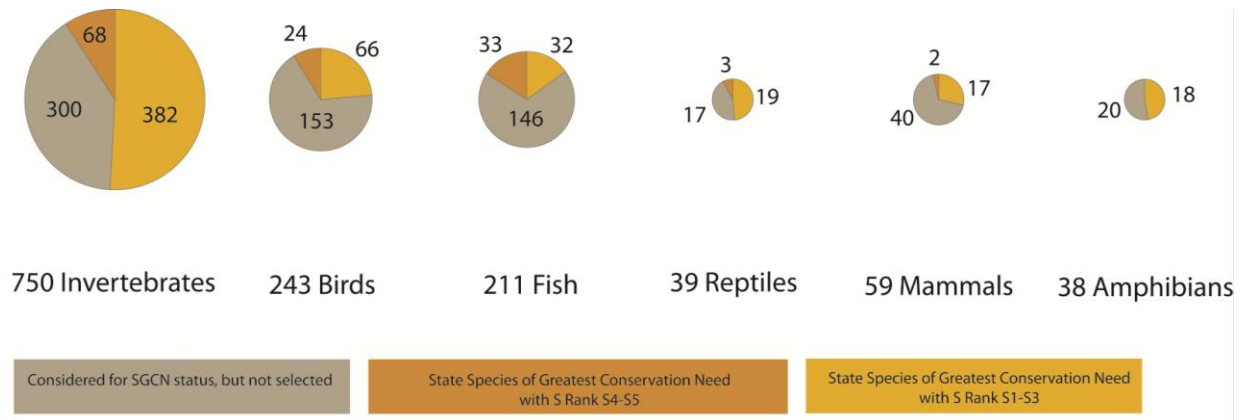


Fig. 1.6. Scaled total number of Pennsylvania native species considered during the Species of Greatest Conservation Need (SGCN) selection process (i.e., pie sizes), number of species not selected as SGCN (gray), number of species selected as SGCN that are S4 (apparently secure) or S5 (secure) (orange), and the proportion of SGCN that are S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable). (Courtesy of E. Crisfield).



Pennsylvania Wildlife Action Plan

CASE STUDY: Estimating Pennsylvania Fisher Population Size and Distribution

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Pennsylvania Game Commission

Project Location: *Indiana University of Pennsylvania research project:* Blue Knob State Park, State Game Lands 26, Gallitzin State Forest, Sproul State Forest, Quehanna Wild Area, Allegheny National Forest; *Reports of incidental captures and sightings:* Statewide

Project Purpose: To estimate fisher home range size, as well as population size, density and distribution in parts of northwestern and southwestern Pennsylvania. Monitoring spatial and demographic attributes of recovering fisher populations was identified as a primary research priority in the 2005 Pennsylvania Wildlife Action Plan.

Species of Greatest Conservation Need/Priority Habitat Affected:
Fisher (*Martes pennanti*)

Project Description

Fishers were once extirpated from the state, with the last captures in the 1920s. From 1994 to 1998, 190 fishers were reintroduced at 6 sites in northern Pennsylvania. Natural dispersal from a West Virginia reintroduction in 1969 and a New York reintroduction in 1979 also contributed to fisher recovery in Pennsylvania. However, a greater understanding of fisher population size and density was needed. In 2006, the PGC funded a fisher research project, led by Indiana University of Pennsylvania, with State Wildlife Grants. Twenty-three fishers were radio collared in southwestern Pennsylvania to determine home range size. Hair snares and subsequent genetic analysis of hair were used to detect and identify individual fishers. Measurements of habitat variables at occupied and unoccupied sites were used to create occupancy models to provide insight into habitat characteristics influencing fisher distribution.



Results of this study, evidence of an established population, and increased reports of sightings enabled the PGC to open a conservative fisher trapping season, conducted annually since 2010. The increasing population and expanding range led to the removal of the fisher from the 2015 list of Species of Greatest Conservation Need.

Project Partners: Indiana University of Pennsylvania; Pennsylvania Game Commission; U.S. Fish and Wildlife Service State and Tribal Wildlife Grants Program

References

Gess, S.W., E. H. Ellington, M. R. Dzialak, J. E. Duchamp, M. Lovallo, and J. L. Larkin. 2013. Rest-site selection by fishers (*Martes pennanti*) in the eastern deciduous forest. *Wildlife Society Bulletin* **37**: 805-814.

Lovallo, M. J. 2008. [Status and Management of Fisher \(*Martes pennanti*\) in Pennsylvania 2008-2017](#). Pennsylvania Game Commission, Harrisburg, Pennsylvania.



Prioritization Results and Discussion

We considered all prioritization categories to have equal importance. Therefore, we retained all bird, mammal, fish, reptile, amphibian and invertebrate Species of Greatest Conservation Need under each Prioritization Category, in ranked order (Table 1.8; Appendix 1.3). The lower the prioritization score, the higher the priority. In many cases, species have similar scores within a category, thus indicating shared priority among categories.

Table 1.8. Example results from the Pennsylvania Wildlife Action Plan species prioritization process. See Appendix 1.3 for complete results. Scores range from 1 to 6, with 1 the highest priority under a category. For example, focusing on the migratory population of tundra swan will proactively conserve the species before it becomes at risk. Actions for the Chesapeake logperch will contribute to the range-wide conservation of the species.

Common Name	Scientific Name	Category			
		1 ^a	2 ^b	3 ^c	4 ^d
Tundra swan (Migratory)	<i>Cygnus columbianus</i>	4	1	4	6
Green-winged teal (Breeding)	<i>Anas crecca</i>	3	6	1	6
Ruffed grouse (Breeding)	<i>Bonasa umbellus</i>	4	1	5	6
Rusty blackbird (Wintering)	<i>Euphagus carolinus</i>	3	5	5	6
Appalachian cottontail	<i>Sylvilagus obscurus</i>	3	5	2	3
Northern water shrew	<i>Sorex palustris albibarbis</i>	4	1	4	6
Northern long-eared bat	<i>Myotis septentrionalis</i>	1	5	2	6
American eel	<i>Anguilla rostrata</i>	3	5	6	6
Chesapeake logperch	<i>Percina bimaculata</i>	1	5	2	6
Fowler's toad	<i>Anaxyrus fowleri</i> –PFBC	6	3	4	5
Pennsylvania cave amphipod	<i>Crangonyx dearolfi</i>	1	3	4	6
Monarch	<i>Danaus plexippus</i>	5	6	3	3
Vannote's cheumatopsyche caddisfly	<i>Cheumatopsyche vannotei</i>	1	6	2	5
Dwarf wedgemussel	<i>Alasmidonta heterodon</i>	1	5	2	6
Eastern massasauga	<i>Sistrurus catenatus catenatus</i>	6	1	3	6

^a Category 1: Contribute to the conservation of globally or regionally important species ; ^b Category 2: Prevent common species from becoming at-risk; ^c Category 3: Maintain rare native species; ^d Category 4: Reduce knowledge gaps to better assess conservation status of species.

In this example (Table 1.8; for complete results, see Appendix 1.3), northern long-eared bat, Chesapeake logperch, Pennsylvania cave amphipod, Vannote's cheumatopsyche caddisfly, and dwarf wedgemussel would be highest priority species for contributing to range-wide conservation of the species. Tundra swan, ruffed grouse (breeding), northern water shrew, and eastern massasauga are highest priority for preventing species from becoming at-risk. Proactive measures to enhance these populations could prevent further decline toward critical imperilment. A high priority for maintaining species diversity,



Category 3, is green-winged teal. As a regular but rare breeder in Pennsylvania, focusing conservation efforts on this species will increase the likelihood of sustaining it in Pennsylvania. Many other wetland-associated SGCN would benefit as well. Lastly, in this example, the highest ranked species on which to focus inventory and monitoring to reduce knowledge gaps are Appalachian cottontail and monarch butterfly. Note that Appalachian cottontail is ranked higher under Category 3. By targeting inventory, monitoring, and management efforts on this species, we are maintaining species diversity while reducing knowledge gaps.

Prioritizing species using unique criteria in four categories can help focus efforts toward a particular goal. We considered species with priority scores of 1, 2, or 3 in any category priorities for conservation action in the next 10 years. The majority of species (65%) ranked highly in Category 3, maintain native species diversity, reinforcing that actions for all SGCN are important to conserve Pennsylvania biodiversity (Table 1.9). Preventing species from becoming at-risk, Category 2, is notable for birds, with over half of the species ranking highly in this category (Table 1.9). This may be explained by many bird SGCN having S3 and S4 conservation statuses. Actions for mammals will largely help contribute to the range-wide conservation of the species, in particular cave-hibernating bat species. With many data deficient invertebrate species, Category 4, which aims to fill knowledge gaps, is most applicable to that group.

Table 1.9. Count and percent of total within a taxonomic group of species scoring 1 (highest), 2 (high), or 3 (moderate) in four species prioritization categories (Cat.). Percentages do not sum to 100 because species can rank highly in more than one category.

	Cat. 1^a	Cat. 1	Cat. 2^b	Cat. 2	Cat. 3^c	Cat. 3	Cat. 4^d	Cat. 4
	Count	%	Count	%	Count	%	Count	%
Birds	11	12%	53	59%	41	46%	3	3%
Mammals	12	63%	3	16%	13	68%	1	5%
Fishes	18	28%	22	34%	37	57%	5	8%
Reptiles	8	36%	11	50%	12	55%	1	5%
Amphibians	3	17%	3	17%	14	78%	0	0%
Invertebrates	78	17%	15	3%	315	70%	71	16%
	130	20%	107	16%	432	65%	81	12%

^a Category 1: Contribute to the conservation of globally or regionally important species ; ^b Category 2: Prevent common species from becoming at-risk; ^c Category 3: Maintain rare native species; ^d Category 4: Reduce knowledge gaps to better assess conservation status of species.

Threats to Species

While specific threats to several Pennsylvania Species of Greatest Conservation Need remain unknown ($n = 20$), taxonomic experts identified at least one direct threat to the majority of species during the conservation status ranking process (Fig. 1.7, Table 1.10). Specific threats to each species can be found in individual species accounts (inclusive of all vertebrates and threatened or endangered mussels) (Appendix 1.4) and the Invertebrate Assessment report (Appendix 1.1 see Leppo et al. 2015). Chapter 3, Threats, provides an overview of each threat and potential or documented impacts to Pennsylvania SGCN and habitats. Threat descriptors, such as scope (i.e., the percentage of the species range in



Pennsylvania potentially impacted by the threat) and severity (i.e., within the threat scope, the degree to which the population is affected), accompanied each threat category within the NatureServe® threat assessment to determine and overall ‘threat impact score’, ranging from low to very high (Faber-Langendoen et al. 2012). Additionally, species account authors further described each threat characteristic as specified in the Northeast Lexicon (Crisfield 2013), including immediacy, reversibility, certainty, and likelihood of the threat (see Chapter 3). The combination of all, or several, threat descriptors highlight the relative impact of a threat to a species (e.g., Table 1.11) and, thus, inform conservation action prioritization.

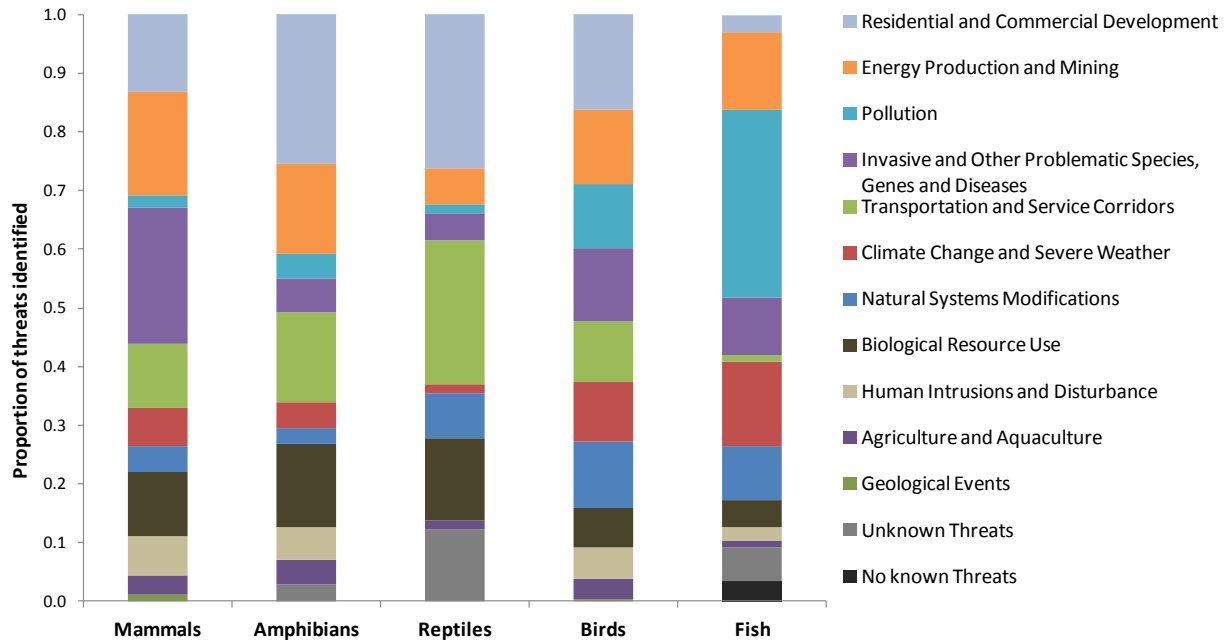


Fig. 1.7. Proportion of threat categories (Salafsky et al. 2008) identified for vertebrate Species of Greatest Conservation Need during species conservation status assessments, by taxonomic group.

threat categories:

- **Residential and Commercial Development** (15%)
- **Energy Production and Mining** (13%)
- **Pollution** (13%)
- **Invasive and Other Problematic Species, Genes and Diseases** (12%)

Major threat categories differed among some taxonomic groups, as one might expect (Fig. 1.7, Table 1.10). For example, *Invasive and Other Problematic Species, Genes and Diseases* accounted for 23% of the mammal threats. This is explained by the dramatic bat population declines due to white nose syndrome (see Chapter 3, Threats), an invasive fungus, and hybridization concerns for northern flying squirrel and Appalachian cottontail. Thirty-two percent (32%) of threats for fishes were attributed to the *Pollution* threat category. Specific threats included point and non-point sources of pollution to waterways, such as acid mine drainage, sewage effluent, sedimentation and nutrient loading, run-off from poorly maintained agricultural fields and logging operations, and mercury contamination from acid



rain. Bird, reptile and amphibian primary threats are related to the *Residential and Commercial Development* threat category (16%, 26%, and 25% respectively). Specifically noted in the species accounts were concerns such as permanent conversion to non-habitat or degradation or fragmentation of existing habitat, improper habitat management/manipulation in recreational areas and privately owned forests, and removal of snags for aesthetic purposes. Further detail can be found in the individual species accounts (Appendix 1.4).

To look at the imminent threats to vertebrate Species of Greatest Conservation Need, we filtered for threats that received a very high or high threat score in the threats assessment process (see Master et al. 2012 for methods), are considered immediate, have a high certainty of impacting the species, and are occurring right now. *Invasive and Other Problematic Species, Genes and Diseases* were the overwhelming problems identified within this criterion (Table 1.11), indicative of a priority for conservation actions in the short term.

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Table 1.10. Primary threats affecting vertebrate Species of Greatest Conservation Need. International Union for the Conservation of Nature (IUCN) Level 1 threat categories (Salafsky et al. 2008) accounting for over 50% of all threat categories identified within each taxonomic group. The number of threats identified for each taxonomic group is noted parenthetically.

Taxonomic Group (Total threat count)	IUCN Level 1 Threat Category (Threat count)	Percent of Threats for Group
Mammals (91)	Invasive and Other Problematic Species, Genes and Diseases (21)	23%
	Energy Production and Mining (16)	17%
	Residential and Commercial Development (12)	13%
Birds (488)	Residential and Commercial Development (79)	16%
	Energy Production and Mining (62)	13%
	Invasive and Other Problematic Species, Genes and Diseases (61)	13%
	Natural Systems Modifications (56)	12%
Fish (174)	Pollution (56)	32%
	Climate Change and Severe Weather (25)	14%
	Energy Production and Mining (23)	13%
Reptiles (65)	Residential and Commercial Development (17)	26%
	Transportation and Service Corridors (16)	25%
	Biological Resource Use (9)	14%
Amphibians (71)	Residential and Commercial Development (18)	25%
	Energy Production and Mining (11)	16%
	Transportation and Service Corridors (11)	16%

Refer to Chapter 3, Threats, for a full description of each threat category within Pennsylvania.

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Table 1.11. Imminent threats, and associated species, identified for vertebrate Species of Greatest Conservation Need during the species conservation status assessment process, by International Union for Conservation of Nature (IUCN) Level 1 threat category (Salafsky et al. 2008). Threats to birds are during the breeding season. Imminent threats are defined as immediately occurring with a very high or high threat impact score (Master et al. 2012) and a high certainty of affecting the species.

IUCN Level 1 Threat Category	Species	Scientific Name
Residential and Commercial Development	Jefferson salamander	<i>Ambystoma jeffersonianum</i>
Agriculture and Aquaculture	Barn owl	<i>Tyto alba</i>
	Sedge wren	<i>Cistothorus platensis</i>
	North American least shrew	<i>Cryptotis parva</i>
Energy Production and Mining	Bank swallow	<i>Riparia riparia</i>
	Northern waterthrush	<i>Parkesia noveboracensis</i>
	Longear sunfish	<i>Lepomis megalotis</i>
Biological Resource Use	Copperhead	<i>Agkistrodon contortrix mokasen</i>
Human Intrusions and Disturbance	Piping plover	<i>Charadrius melodus</i>
	Little brown bat	<i>Myotis lucifugus</i>
Natural Systems Modifications	American bittern	<i>Botaurus lentiginosus</i>
	Least bittern	<i>Ixobrychus exilis</i>
	Golden-winged warbler	<i>Vermivora chrysoptera</i>
	Black tern	<i>Charadrius melodus</i>
	Yellow-breasted chat	<i>Icteria virens</i>
	Atlantic sturgeon	<i>Acipenser oxyrhynchus</i>
Invasive and Other Problematic Species, Genes and Diseases	Piping plover	<i>Charadrius melodus</i>
	American bittern	<i>Botaurus lentiginosus</i>
	Golden-winged warbler	<i>Vermivora chrysoptera</i>
	Burbot	<i>Lota lota</i>
	North American least shrew	<i>Cryptotis parva</i>
	Appalachian cottontail	<i>Sylvilagus obscurus</i>
	Allegheny woodrat	<i>Neotoma magister</i>
	Big brown bat	<i>Eptesicus fuscus</i>
	Indiana bat	<i>Myotis sodalis</i>
	Little brown bat	<i>Myotis lucifugus</i>
	Northern long-eared bat	<i>Myotis septentrionalis</i>
	Tricolored bat	<i>Perimyotis subflavus</i>
Pollution	Chesapeake logperch	<i>Percina bimaculata</i>
	Longnose sucker	<i>Catostomus catostomus</i>
	Northern brook lamprey	<i>Ichthyomyzon fossor</i>



Terrestrial and Aquatic Invertebrate Threats

With limited capacity and several hundred invertebrate species to evaluate, a comprehensive threats assessment for every species was unfeasible. Taxonomic experts were able to classify specific IUCN threat categories for informal taxonomic groups for which there was sufficient information on threats (e.g., bees, butterflies, caddisflies, etc.), representing 375 (83%) invertebrate Species of Greatest Conservation Need (Fig. 1.8) (Appendix 1.1 see Leppo et al. 2015).

Residential and Commercial Development (16%), *Pollution* (16%), *Agriculture and Aquaculture* (13%), and *Transportation and Service Corridors* (11%) accounted for nearly 60% of the threats identified for these 375 SGCN (Fig. 1.8). Specific threats within the respective categories included habitat loss to residential, commercial and tourism development, point and non-point source pollution such as sewage, wastewater, agricultural run-off and air pollution, conversion of natural lands to cropland, rangeland and plantations, and dirt and paved roads, railroads, shipping lanes, flight paths, and power-line and pipeline rights-of-way.

As with terrestrial vertebrates, primary threats varied among informal invertebrate taxonomic groups (Table 1.12). To normalize the count of SGCN invertebrates within an informal taxonomic group, the number of species impacted by a particular threat was divided by the total number of species evaluated within that group. This proportion allows evaluation of the threat categories most relevant (i.e., closer to 1) to a particular taxonomic group.

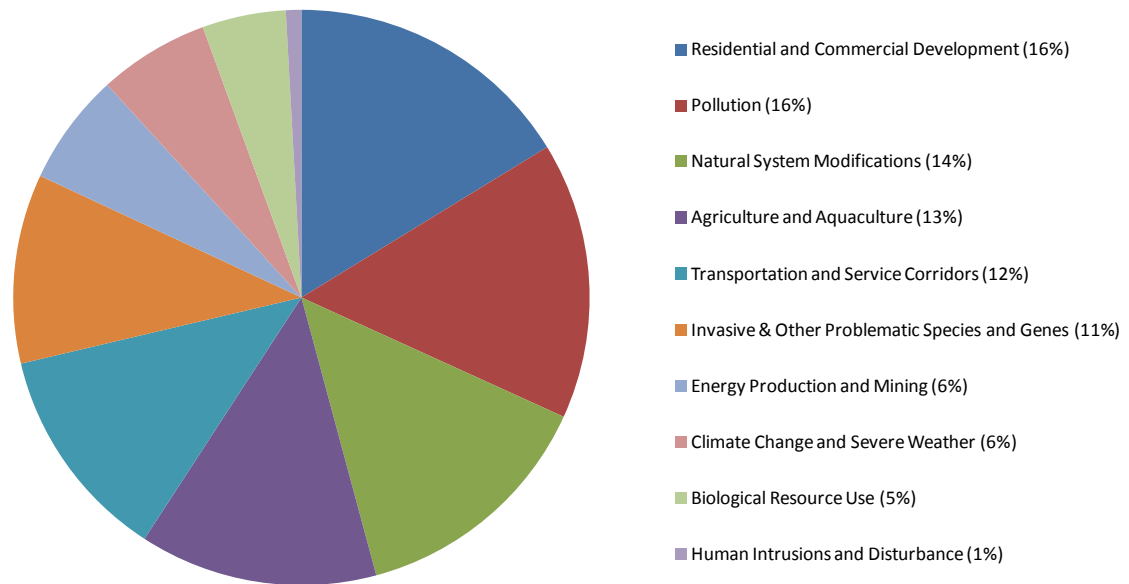


Fig. 1.8. Proportion of International Union for Conservation of Nature (IUCN) threat categories (Salafsky et al. 2008) identified for 375 invertebrate Species of Greatest Conservation Need during species conservation status assessment (see Leppo et al. 2015, Appendix 1.1 for details).



Table 1.12. Normalized count of species within each informal invertebrate taxonomic group categorized by International Union for the Conservation of Nature (IUCN) threat category (Salafsky et al. 2008). Adapted from Leppo et al. (2015).

	Agriculture & aquaculture	Biological resource use	Climate change & severe weather	Energy production & mining	Geological events	Human intrusions & disturbance	Invasive & other problematic species & genes	Natural system modifications	Pollution	Residential & commercial development	Transportation & service corridors
Bees	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Beetles	0.3	0.1	0.0	0.1	0.0	0.0	0.0	0.8	0.0	0.7	0.0
Butterflies	0.5	0.2	0.3	0.3	0.0	0.0	0.6	0.9	0.0	0.7	0.7
Caddisflies	1.0	0.7	0.7	0.7	0.0	0.1	0.0	0.1	1.0	1.0	0.9
Cave Invertebrates	1.0	0.0	0.9	1.0	0.1	0.0	0.0	0.0	1.0	1.0	1.0
Craneflies	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
Crayfishes	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Dragonflies & Damselflies	1.0	0.2	0.1	0.2	0.0	0.0	0.0	0.0	1.0	1.0	1.0
Freshwater Snails	0.8	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.8	0.4	0.0
Mayflies	0.8	0.5	0.9	0.8	0.0	0.2	0.0	0.2	0.8	0.9	0.6
Moths	0.1	0.1	0.1	0.1	0.0	0.0	0.7	0.8	0.1	0.7	0.2
Mussels	0.6	0.0	0.0	0.3	0.0	0.0	0.2	0.7	0.8	0.0	0.3
Sawflies	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Spiders	0.6	0.0	0.1	0.4	0.0	0.4	0.0	0.1	0.0	0.6	0.0
Springtails	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Stoneflies	0.7	0.6	0.9	0.3	0.0	0.1	0.0	0.0	0.9	0.8	0.6
Terrestrial Snails	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	0.0	0.0
True Bugs	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0



Species Conservation Actions

During the species account-writing process (see Species Accounts, Appendix 1.4), taxonomic experts used the U.S. Fish and Wildlife Service's Tracking and Reporting Actions for the Conservation of Species (TRACS) categories (USFWS 2015) to identify general groupings for specific conservation actions (Fig. 1.9). TRACS is a tiered categorization using three levels, with Level 1 representing the broadest category (e.g., *Direct Management of Natural Resources*). We encouraged use of Level 2 categorization of conservation actions to provide more specificity, though this was not possible for all species. For example, within *Direct Management of Natural Resources*, the author could specify one of several other categories including *Water Management*, *Vegetation Management*, *Fire Management*, *Invasive Species Control*, etc. to categorize the specific action needed for SGCN conservation. Each conservation action directly tied to a specific threat. Species account authors numbered actions for each species, 1 through 3, to represent the prioritization of actions for the particular species, 1 representing the highest priority action and 3 indicating a lower priority. In some cases, concurrent actions are needed, thus the authors were able to label each action as a priority. Although this may seem counterintuitive to a conservation-action-prioritization scheme, we recognize that certain species have many needs and conservation partners may be able to share implementation of distinct conservation actions simultaneously.

Descriptions of IUCN conservation action categories as they apply to Pennsylvania can be found in Chapter 4, Conservation Actions. Prioritized specific conservation actions and details for each SGCN can be found in the species accounts (Appendix 1.4). In this section we provide a synopsis of conservation actions at the coarsest scale (i.e., Level 1) that were identified during the species account-writing process for vertebrate and invertebrate SGCN, respectively.

Terrestrial and Aquatic Vertebrate Conservation Actions

With top threats of *Residential and Commercial Development*, *Energy Production and Mining*, *Pollution*, and *Invasive and Other Problematic Species, Genes and Diseases*, it follows that top conservation actions for vertebrate SGCN included:

- **Planning** (27%)
- **Direct Management of Natural Resources** (26%)
- **Law and Policy** (11%)
- **Technical Assistance** (10%)

Planning activities were considered important for each vertebrate taxonomic group, though this action was most commonly used for amphibians, reptiles and mammals (Fig. 1.9). This Level 1 action includes *Land Use* planning to avoid or minimize impacts to SGCN and *Species and Habitat Management* planning to ensure appropriate goals are established for populations, and habitat management practices are developed to maximize benefit to the SGCN. *Direct Management of Natural Resources* is a broad category inclusive of several Level 2 action types such as:



- creating new habitat or natural processes
- planting/seeding
- vegetation management
- water management
- wildlife damage management
- fire management
- grazing/farm management
- invasive species control
- living shorelines
- wildlife disease management
- fish and wildlife habitat structures
- hazard or infrastructure removal
- instream modification

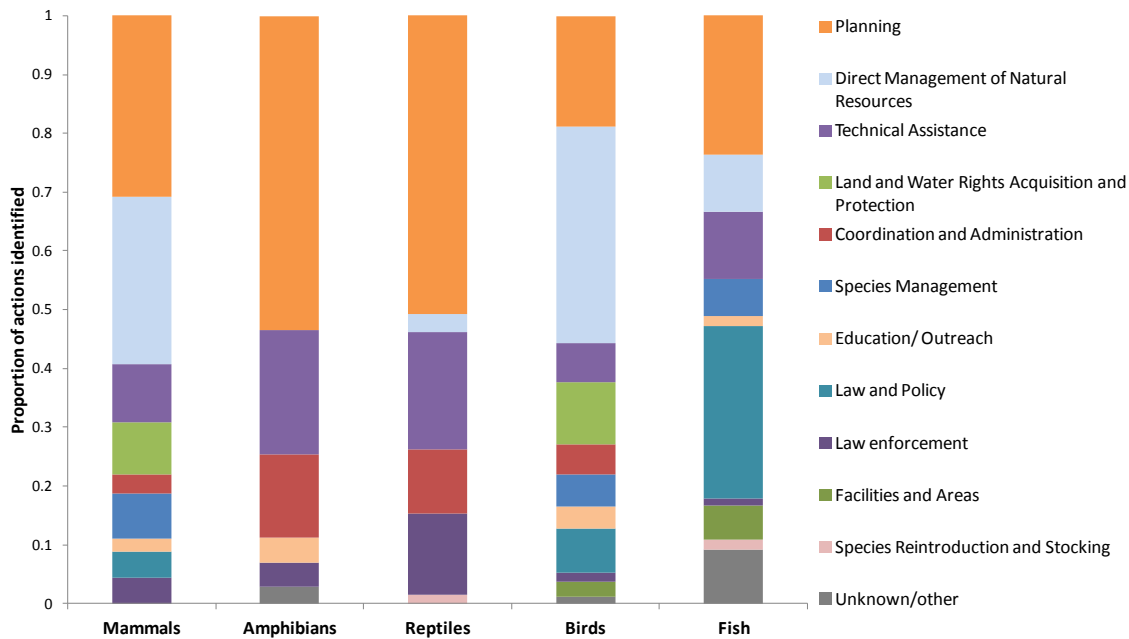


Fig. 1.9. Proportion of U.S. Fish and Wildlife Service Wildlife Tracking and Reporting of Actions for the Conservation of Species (Wildlife TRACS) action categories (USFWS 2015) identified for vertebrate Species of Greatest Conservation Need, by taxonomic group. See Appendix 1.4 (species accounts).

This category was most often used for birds (Table 1.13), highlighting issues such as fire suppression, invasive plant impacts on habitats, controlling water levels in impoundments appropriately to maximize SGCN benefit, and managing forests for structural and species diversity. All taxonomic groups noted *Technical Assistance* needs, though this was most commonly used for amphibians (21% of amphibian actions), reptiles (20% of reptile actions), fish (12% of fish actions), and mammals (10% of mammal actions). Technical assistance is an important component to bird conservation; it simply may not have taken precedence over more pressing needs. This category includes *Environmental Review* and *Technical Assistance* regarding species requirements (e.g., to private landowners). Environmental Review includes a regulatory framework through which project permits are issued to minimize potential impacts on federal or state listed species. The PGC (for birds and mammals) and PFBC (for amphibians, reptiles, fish,



and aquatic invertebrates) review projects for potential impacts to state threatened or endangered species and their habitats, deferring to USFWS for federally listed species, and describe the surveys and/or avoidance and minimization measures to protect species or habitat from harm. These recommendations are provided to the Pennsylvania Department of Environmental Protection, the permitting agency in the state. More information on the Pennsylvania Natural Diversity Inventory Environmental Review tool is available on the [Pennsylvania Natural Heritage Program](#) website.

Taxonomic experts also emphasized activities related to *Land and Water Rights Acquisition and Protection, Law Enforcement, and Coordination and Administration* for birds, reptiles and amphibians, respectively (Table 1.13). Private lands agreements, conservation area designation and land acquisition can protect essential habitat for avian SGCN. Poaching of reptiles (snakes and turtles) is a significant problem; hence law enforcement officers well-versed in anti-poaching regulations will be critical to abating this threat. Similarly, human intrusions and certain wood harvesting practices can be detrimental to amphibian SGCN populations. Coordinating with public and private landowners to raise awareness of the issue and demonstrate best management practices is needed over the next 10 years.

Table 1.13. Top 3 U.S. Fish and Wildlife Service Wildlife Tracking and Reporting of Actions for the Conservation of Species (Wildlife TRACS) action categories (USFWS 2015) identified for each terrestrial vertebrate taxonomic group. See Appendix 1.4 for specific actions for each Species of Greatest Conservation Need.

Mammals	Planning	31%
	Direct Management of Natural Resources	29%
	Technical Assistance	10%
Birds	Direct Management of Natural Resources	37%
	Planning	19%
	Land and Water Rights Acquisition and Protection	11%
Fish	Law and Policy	29%
	Planning	24%
	Technical Assistance	12%
Reptiles	Planning	51%
	Technical Assistance	20%
	Law Enforcement	14%
Amphibians	Planning	54%
	Technical Assistance	21%
	Coordination and Administration	14%

Terrestrial and Aquatic Invertebrate Conservation Actions

Similar to threats, conservation actions were not able to be categorized for all 450 Invertebrate Species of Greatest Conservation Need. Rather, Leppo et al. (2015) prioritized conservation actions for species when sufficient information was available ($n=189$ species). Family group or informal taxonomic group was used to identify conservation actions for the remaining species ($n=261$). Note that no state agency has legal oversight of terrestrial invertebrates in Pennsylvania, though these species are voluntarily



considered in state land planning. A collaborative approach with non-government organizations will be paramount to addressing actions for these species.

Direct Management of Natural Resources accounted for over half (53%) of the needed conservation actions for invertebrate Species of Greatest Conservation Need. This category is most applicable to crayfishes, freshwater snails, giant silkworm and royal moths, dragonflies and damselflies, and notodontid moths, with over 60% of actions identified for species in each of these taxonomic groups in this category (Fig. 1.10). *Law and Policy* and *Outreach* each comprised 15% of conservation actions identified. The majority of taxonomic groups will derive some benefit from these actions (Fig. 1.10), though identified actions for grasshoppers and ground beetles were more often in these categories.

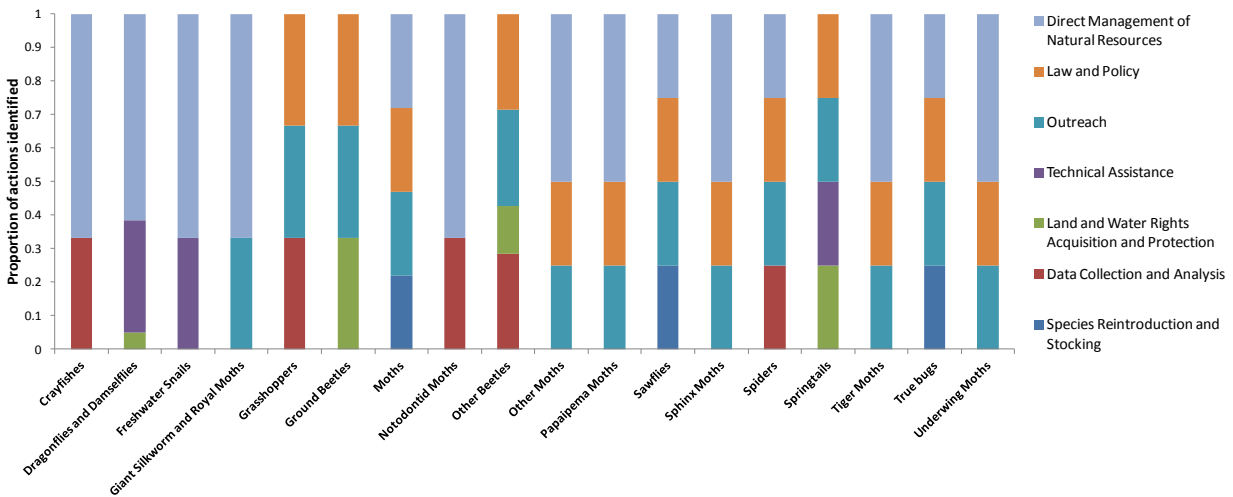


Fig. 1.10. Proportion of Wildlife TRACS action categories (USFWS 2015) identified for invertebrate Species of Greatest Conservation Need, by taxonomic group. See Appendix 1.1, Leppo et al. 2015.

Leppo et al. (2015) identified conservation actions for family groups of bees, freshwater mussels, tiger beetles and spiders. Priority actions included *Direct Management of Natural Resources* (e.g., fire management, vegetation management), *Planning* (e.g., species and habitat planning), *Data Collection*, *Law and Policy*, *Outreach*, and *Land and Water Rights Acquisition and Protection* (Table 1.14).

Often, similar conservation actions are applicable to all species within an informal taxonomic group or insufficient information on specific species needs exists. Thus, Leppo et al. (2015) used informal taxonomic groups when species-specific actions were not possible or family groups were not necessary. For many of these groups, *Data Collection and Analysis* is noted as a priority action to learn more about species distribution and abundance (Table 1.14). *Direct Management of Natural Resources* (e.g., invasive species control, grazing/farm management), *Planning*, *Technical Assistance* (e.g., environmental review), and *Outreach* ranked among the top actions among these groups (Table 1.15).



Table 1.14. Top three Wildlife TRACS action categories (USFWS, personal communication) identified for terrestrial and aquatic invertebrate family groups. See Leppo et al. 2015, Appendix 1.1.

Taxonomic Group	Family	Priority Action Category (Level 1)
Bees	Apidae	Direct Management of Natural Resources Law and Policy Outreach
Freshwater Mussels	Margaritiferidae	Planning
	Unionidae	Planning Data Collection
Tiger Beetles	Cicindelidae	Direct Management of Natural Resources Law and Policy Outreach
Spiders	Anyphaenida	Law and Policy Outreach
	Lycosidae	Direct Management of Natural Resources Data Collection Law and Policy Outreach
	Linyphiidae	Law and Policy Land and Water Rights Acquisition and Protection Outreach

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Table 1.15. Top three Wildlife TRACS action categories (USFWS, personal communication) identified for terrestrial and aquatic invertebrate informal taxonomic groups. See Leppo et al. 2015, Appendix 1.1.

Taxonomic Group	Priority Action Category (Level 1)
Amphipods	Data Collection and Analysis Direct Management of Natural Resources Technical Assistance
Isopods	Data Collection and Analysis Direct Management of Natural Resources Technical Assistance
Caddisflies	Data Collection and Analysis Planning Technical Assistance
Mayflies	Data Collection and Analysis Planning Technical Assistance
Stoneflies	Data Collection and Analysis Planning Technical Assistance
Craneflies	Planning Direct Management of Natural Resources Technical Assistance
Butterflies and Skippers	Outreach Direct Management of Natural Resources
Terrestrial Snails	Data Collection and Analysis Direct Management of Natural Resources
Flatworms	Data Collection and Analysis Direct Management of Natural Resources Planning

Research, Survey and Monitoring Needs

Chapter 5 (Monitoring) provides an overview of an adaptive management framework embraced by the PGC and PFBC, and hopefully conservation partners, over the next 10 years. For vertebrates, this section highlights themes that emerged for research, survey and monitoring needs, by taxonomic group, in the species accounts. Information related to invertebrates was excerpted from Leppo et al. (2015). Summary information below is not meant to be comprehensive; readers should reference individual species accounts (Appendix 1.4) or the invertebrate assessment report (Leppo et al. 2015) for specifics.

Definition of terms

Research in this document refers to enhancing knowledge related to a species abundance, distribution, or life history (e.g., habitat use) for the purpose of fish and wildlife management decision-making.



Species account authors were encouraged to identify applied research questions for each SGCN, though it was not required.

Survey is used to address data gaps for a species. This represents new information gathered spatially for a Species of Greatest Conservation Need. A survey would be needed when no data exist in a particular location or for a particular species.

Monitoring is distinguished from a survey by inclusion of a temporal component. Monitoring applies when an observer makes repeated observations at the same, or similar, location to track changes in occupancy and/or abundance over time. In addition to population monitoring, however, is monitoring effectiveness of a conservation action. For each action specified in a species account, information on effectiveness measures is provided.

Fishes

Research: Effects of dredging projects; epidemiology; habitat use; causes of populations declines; immigration/emigration of anadromous fish; reintroduction potential

Survey: Species distribution and status assessments; habitat condition assessments; acoustic tagging of shortnose sturgeon (*Acipenser brevirostrum*); expansion of existing surveys into additional drainage basins

Monitoring: Development of standardized monitoring protocols and programs where they currently do not exist; continuation of annual surveys to track population trends

Amphibians and Reptiles

Research: Landscape analyses around occupied and unoccupied sites; population genetic studies; development of reintroduction and augmentation protocols; radio telemetry to understand habitat use; effects of fire management on populations; population estimates at known sites; effects of forest management on habitats and populations

Survey: Expand searches to new sites; pre-and post-treatment surveys; surveys of historic sites

Monitoring: Development of standardized monitoring protocols and long-term monitoring programs where they currently do not exist; establish databases for long-term monitoring; continue long-term surveys at established sites

Mammals

Research: Hybridization extent and impact; effects of habitat fragmentation and human disturbance on populations; population responses to habitat manipulations; life history and genetic studies of lesser known species; home range, habitat use and dispersal; effects of energy development on populations; white nose syndrome survivorship and solutions; effects of forest management on habitats and populations

Survey: Abundance and distribution surveys; core activity area delineation; PA Mammal Atlas



Monitoring: Continuation of summer roost and winter hibernaculum bat surveys; annual live-trapping and nest box surveys for northern flying squirrel

Birds

Research: Habitat use by wintering birds; enhanced population modeling; development of best-management practices; exposure to wildlife disease (e.g., West Nile Virus) and contaminants (e.g., lead, mercury); linkage between breeding and migratory populations; home range, habitat use and dispersal; effects of habitat fragmentation and degradation on bird populations; effects of forest management on habitats and populations

Survey: Comprehensive habitat condition assessments (e.g., wetlands); develop, where needed, or improve standardized protocols for data collection and storage; initiation of statewide surveys where they do not exist; develop a volunteer network for surveying urban bird SGCN (e.g., Chimney Swift); establish an off-road point count survey; private lands surveys for SGCN

Monitoring: Utility of existing databases (e.g., Audubon Christmas Bird Count, eBird) to monitor population trends; invasive plant species impacts; population responses to habitat manipulations and disease outbreaks; participation in existing coordinated bird monitoring programs (e.g., Great Lakes Marsh Monitoring Survey); continuation of long-term statewide monitoring programs (e.g., colonial waterbirds, osprey, marshbirds); participation in international bird monitoring programs.

Invertebrates

Source: Leppo et al. 2015

Many taxonomic groups have not been studied enough to develop a basic understanding of their life history, habitat requirements, number of occurrences, or distribution. With limited exceptions, species level information for most invertebrates is still rare and based on a single-collection event at a particular site. Some sites have been visited repeatedly, but too infrequently or inconsistently with respect to time of year, species habits and behaviors, local weather and environmental conditions, or sampling methodology, to be considered monitoring. The cost and logistics involved with routinely surveying for species that must be sampled with special equipment, occupy habitats that are difficult to access, or are very rare or difficult to find may be prohibitive for monitoring efforts. More efficient ways of detecting rare and/or difficult-to-find species are needed, as are better methods for monitoring species of sensitive habitats that may be degraded or destroyed by repeated surveys.

Future monitoring efforts can build upon the occurrence information compiled for this assessment. Monitoring programs may become more feasible with increased use of technologies such as genetic barcoding to identify species, environmental DNA testing that can detect the presence of aquatic species within a water body, and miniature electronic tags that allow for the tracking of very small animals.

Adequate funding for invertebrate monitoring is necessary to develop and implement systematic, successful statewide monitoring programs. There is a great need for experts and funding to support the training of new taxonomists. Species level identification of most invertebrate species requires extensive



training, a well-maintained reference collection, lab equipment, and a library of reference texts. Many invertebrate species simply have few or no experts that specialize in their taxonomy and systematics.

Special case – Recoverable Extirpated Species

Species no longer occurring regularly in Pennsylvania but extant in other parts of their range (i.e., extirpated species) were considered for inclusion as a Species of Greatest Conservation Need if there was a reasonable expectation (e.g., available habitat, nearby source population) that the species could return to Pennsylvania with modest assistance (i.e., recoverable). A good example is the federally endangered Great Lakes Piping Plover (*Charadrius melodus*). Absent as a breeding shorebird from Pennsylvania since the 1950s, habitat improvements at Presque Isle State Park (Erie Co.), an expanding Great Lakes population, and regular migrants provide hope that this species may once again breed in Pennsylvania. For Piping Plover and other well-studied extirpated species with known threats and needed actions, species account is included herein (Appendix 1.4). However, other recoverable, but currently extirpated species have not received as much attention and require further study. Many of these species were included in the Data Deficient category and, thus, documenting species presence or absence is a priority over monitoring activities. Monitoring programs will be developed once comprehensive recovery assessments are completed.

Summary

One of the major revisions from the 2005 Pennsylvania Wildlife Action Plan (formerly Comprehensive Wildlife Conservation Strategy) is the inclusion of criteria for Species of Greatest Conservation Need (SGCN) that could be applied consistently across taxonomic groups considered in this 2015 Plan. This process, with a few taxonomic exceptions, resulted in slightly more SGCN being included in the 2015 update; however these were largely a result of the selection parameters used. For example, we specifically evaluated passage migrant and wintering birds more thoroughly to enhance one of the Plan's Guiding Principles of recognizing Pennsylvania's role in northeast regional wildlife diversity. Though this Plan includes 664 SGCN, the new prioritization process – focused on addressing conservation goals – assists with selecting the highest priority species to target conservation action (Appendix 1.3).

The individual Species Accounts (Appendix 1.4) for each SGCN provide a firm foundation for the 2015 Plan. Each account includes a photo; conservation profile; habitat association and specific habitat requirements; threats, actions, and action location; measure for action; research and survey needs; and monitoring programs to track the species in the long-term. We summarized information contained in these accounts within this chapter, but readers are encouraged to reference the individual accounts frequently.

Species of Greatest Conservation Need continue to face existing and emerging challenges across the state, yet with these challenges come opportunities. For example, treatments for white nose syndrome are actively being investigated, with encouraging preliminary results. Hundreds of local watershed associations and County Conservation Districts are remediating acid mine drainage and breathing new life into these impaired streams. Non-governmental partners, with cooperation from industry, are taking



stock of energy development impacts and crafting best practices to minimize impacts. Through research to understand the problem, species requirements, and responses, systematic conservation planning to expertly illustrate solutions, and proper execution through direct management, we are optimistic for the future of the Species of Greatest Conservation Need over the next 10 years.