Conservation Actions
CHAPTER 4

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CONSERVATION ACTIONS

Chapter Recap

- ✓ Efficiently and effectively implementing Conservation Actions is the primary focus of this 2025-2035 Pennsylvania Wildlife Action Plan (PA WAP).
- ✓ The PA WAP uses a standardized hierarchical system for identifying conservation actions.
- ✓ Pennsylvania has many tools for taking meaningful action to conserve Species of Greatest Conservation Need and their habitat, especially YOU!

Introduction

Action is at the forefront of the 2025-35 Pennsylvania Wildlife Action Plan (PA WAP or Plan) as a necessary step to address expansive and diverse environmental threats to Pennsylvania's Species of Greatest Conservation Need (SGCN) and their habitats (see Chapter 3-Threats). In this chapter, we describe this Plan's purpose and approach for implementing conservation actions to address these threats. Fundamental to this Plan's "Action" priority is Goal 1: *Actively conserve Pennsylvania's native fish, wildlife, and their habitat*. Collectively with the other five goals of this Plan, Goal 1 provides actions necessary to minimize and avoid species imperilment; the core focus of the State and Tribal Wildlife Grants Program.

> Fundamental to this Plan's "Action" priority is **Goal 1-*Actively conserve Pennsylvania's native fish, wildlife, and their habitat*** and associated objectives and strategies.

Pennsylvania's SGCN and their habitats may be imperiled by persistent threats, which may now be intensified by factors such as climate change or increasing abundance and virulence of invasive species, genes and diseases. Nevertheless, SGCN can recover with adequately funded, well-planned and effectively implemented conservation actions. Successful SGCN recovery often relies on enduring conservation action implementation spanning decades of collaboration with federal, state, non-governmental organizations and other partners. This perseverance is possible and reflected in Pennsylvania's many achievements because of a broad range of conservation actions such habitat management, SGCN reintroductions and population augmentations, surveying to document current species' occurrences, and state regulations. Since publishing the 2005-15 PA WAP, Pennsylvania's collective efforts have recovered, delisted (at the state level), or improved the conservation status (i.e., from state endangered to state threatened) of 26 species including, Peregrine Falcon (*Falco peregrinus anataum*), Osprey (*Pandion haliaetus*), Timber Rattlesnake (*Crotalus horridus*), and Brook Stickleback (*Culaea inconstans*). Many species identified in this Plan are yet to be recovered (i.e., delisted, with self-sustaining populations), and full recovery may not be achieved by 2035, but, *critically*, the trajectory for

recovery may be established and expedited through conservation actions guided and implemented by this 2025-35 PA WAP.

Identifying and implementing effective conservation actions can be particularly challenging, especially under changing environmental conditions, or when novel conservation actions are needed. We are, though, not without options for coping with imperilments and there are many effective conservation actions that can be implemented today to chart the course for SGCN recovery. Where options for recovery are few or untested, structured data collection and analysis can help identify effective methods to support SGCN and their habitats.

Conservation Actions - Defined

Adapted from Crisfield and the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) (2013; 2022)

What is a Conservation Action?

Conservation actions are intentional and have an explicit purpose. They are beneficial to SGCN or their habitats or address a threat to SGCN and associated habitats. More formally, a conservation action is defined as, "an activity implemented to achieve a conservation objective at a site or within a thematic scope" (Crisfield and NEFWDTC 2022). Conservation actions have also been described as "interventions undertaken by project staff or partners designed to reach the project's objectives and ultimate conservation goals" and often considered synonymous with strategies, interventions, activities, responses, and monitoring (Salafsky et al. 2008).

Features of Conservation Actions

The ideal features of a *Conservation Action* include *S.M.A.R.T* attributes for implementation goals (Doran 1981; Table 4.1). These attributes clarify descriptions of conservation actions and consider best practice recommendations (AFWA 2012).

Table 4.1. S.M.A.R.T. attributes for planning. (Adapted from Doran 1981).

Specific	Target a specific area for improvement
Measurable	Quantify or suggest an indicator of progress
Assignable	Specify who will do it
Realistic	Results can realistically be achieved, given available resources
Time-bound	Specify when results can be achieved.

Additionally, *Action Descriptors* based on *S.M.A.R.T.* planning are well-aligned with the conservation action development process outlined in the Conservation Measures Partnership's Open Standards for the Practice of Conservation (CMP 2020; Fig. 4.1). Steps 1 and 2 are the basis for developing conservation actions (Fig. 4.1) with Steps 3, 4, and 5 relevant to implementing conservation actions and monitoring outcomes, discussed in Required Elements 4 and 5 of the Northeast Lexicon (Crisfield and NEFWDTC 2022). When feasible, addressing these components can improve the likelihood of project success.

Fig. 4.1. Adaptive Management Cycle. Source: Conservation Measures Partnership (CMP 2020).

More explicitly, a complete description of a proposed action should address these questions (Crisfield and NEFWDTC 2013):

- Who is responsible for the action?
- What will be done, with what benefits?
- When and where will it be done?
- How will the desired results be achieved?
- How will progress be measured?
- Why will the action be taken?

The challenge of consistently formatting conservation actions is addressed through a set of descriptors in a conservation action template, as discussed in the Northeast Lexicon (Crisfield and NEFWDTC 2013; 2022; Appendix 4.1). For all conservation actions, the Northeast Lexicon recommends that states strive to provide a name, objective, purpose and general strategy (Crisfield and NEFWDTC 2022). Additionally, for conservation action prioritization, the purpose (identifying target species or habitats and threats), benefits, costs, urgency, and likelihood of success are common factors supporting maximum conservation benefit when funding is limited.

We include several of these descriptors and provide prioritized species-specific conservation actions for all SGCN in the Species Accounts (Chapter 1, Appendix 1.4-Species Accounts). In this chapter, we generally describe conservation actions needed to support SGCN and their habitats, referring conservationists to individual Species Accounts or the COA Tool (see below) for specific action information and more.

Conservation Action Organization

We organize conservation actions in a hierarchical classification system for consistency, easier interpretation, enabling northeastern U.S. landscape-scale analyses, and other benefits. This hierarchical classification is a modified CMP 4.0 (CMP 2020) classification and discussed by Crisfield and NEFWDTC (2022) (Appendix 4.2) and has been adopted by northeast U.S. states for their Wildlife Action Plans, allowing regional or landscape-scale conservation action assessment. Compared to the framework used

in the 2015-25 PA WAP (i.e., USFWS Wildlife TRACS system), the CMP 4.0 Action Classification system is advanced with four action levels and greater overall action specificity. Here, we organize conservation action discussion by Level 0 and 1 action categories and discuss Level 2 action categories as relevant to Pennsylvania.

Best Practices for Conservation Actions

Best practices for Conservation Actions provide consistency and reliability for planning and implementing management practices and thus should be structured to consider AFWA (2012) recommendations, and:

- Use a hierarchical or tiered system to prioritize conservation actions.
- Design conservation actions to abate known threats and indicate metrics to measure effectiveness of conservation actions.
- Write conservation actions broadly enough to allow flexibility, yet with enough specificity to measure performance and engage partners.

In this chapter, we use these "Best Practices" to describe 2025-35 PA WAP conservation actions.

Pennsylvania's Tools for Taking Action

Fully supporting SGCN and their habitats must reach beyond the pages of this Plan. Certainly, it is important for these specified actions, developed by state's species' experts, to be thoughtfully classified into meaningful categories. Yet, *active* conservation - by all - is needed to advance SGCN securement over the next decade. Fortunately, Pennsylvanians have several proverbial 'tools in the toolbox' to assist conservationists in our collective goal to achieve healthy, sustainable, and resilient native fish and wildlife populations and habitats:

1. YOU!

Everyone can contribute to SGCN and habitat conservation, regardless of your income, expertise, or available time. In fact, some conservation actions require no money – or save time and money – or a thoughtful decision to take no action (e.g., deciding not to mow next to a stream or allowing certain trees to remain standing after a timber harvest). Additionally, a brief phone call or email to local leaders to share your thoughts on SGCN and habitats that you care about is a conservation action that matters. Further, voting during local, state, or federal elections where SGCNs or their habitats may be affected is a conservation action that matters. The combined benefits of thousands of small conservation actions have the potential to uplift and conserve many species. Small acts of conservation may be planting plants in garden pots for pollinators or making minor adjustments to your windows to reduce bird collisions. Your small acts of conservation are - and always will be - meaningful contributions to SGCN and habitats that support them.

> *Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.*
>
> – Margaret Meade

The information shared below, and in the Species Accounts (Appendix 1.4), provide resources and other ideas to get you started. Certainly, do not hesitate to contact the Pennsylvania Game Commission (PGC) or Pennsylvania Fish and Boat Commission (PFBC) for further guidance.

2. Wildlife Action Map (WAM)

We introduce the Pennsylvania Plan's Wildlife Action Map (WAM) upfront to highlight its value for *taking action* in the state. This tool allows resource agencies and other conservationists – like you - to plan and track conservation actions to benefit SGCN and their habitats across the state.

Spatial and data management technologies continue to develop at an increasing pace, with technological advances that greatly enhance resource manager decision capabilities and are increasingly informative to the public. The PGC and PFBC have applied this technology in recent years and developed the Wildlife Action Map (WAM) which includes a Conservation Opportunity Area (COA) Tool for conservation planning and a Conservation Action Tracker (CAT) to track conservation action implementation (WAM Fact Sheet).

a. Conservation Opportunity Area Tool

The user-guided, web-accessible COA Tool (https://wildlifeactionmap.pa.gov/) was launched in 2019. This tool allows for more convenient public and partners access to enhanced PA WAP functionality and is considered a conservation best practice (AFWA 2012). The intent of this tool is to support project planning for focused conservation action implementation and to provide information (e.g., SGCN, habitats, conservation actions) based on information in this 2025-35 PA WAP for areas of interest (AOIs) up to 100,000 acres.

Whether seeking information about a specific area to plan for conservation actions, or simply interested in species distributions, the COA Tool can be a helpful resource. This data-driven tool hosts nearly 2,200 registered users and is powered by more than 740,000 records to-date for birds, mammals, fish, amphibians, reptiles, terrestrial and aquatic invertebrates, including freshwater mussels. The PGC and PFBC developed the tool with support from Western Pennsylvania Conservancy, Pennsylvania Department of Conservation and Natural Resources, and NatureServe. Federal funding was provided by the U.S. Fish and Wildlife Service, Office of Conservation Investment, Hadley, Massachusetts through the State and Tribal Wildlife Grants Program.

b. Conservation Action Tracker

An important component of any Wildlife Action Plan is understanding the type, extent, and spatial distribution of implemented conservation actions. The PGC and PFBC developed a Conservation Action Tracker (CAT) as additional functional for the COA Tool. Together these tools function for planning (COA Tool) and implementation (CAT). The CAT allows users to delineate one or more Action Areas, then provide basic information (e.g., project name, intended outcomes), the primary focus (i.e., species or habitat), actions implemented, research, and survey needs (based on actions for the species in the PA WAP). Users are also able to specify the project visibility including the delineated action area, county or HUC 8, statewide, or not publicly visible. Launched in December 2025, the CAT has not been available for sufficient time to assess submitted projects. Except for SWG-funded projects, public and partner data entry is voluntary.

Importantly, the WAM, through COA Tool functionality, allows users to identify areas relevant to their resource-management interests and guide potential actions beneficial for the specific area and organizational financial capacities. The CAT allow users to document their implementation efforts and share information with other users thus fostering collaboration and enhancing implementation effectiveness.

3. Full Annual Cycle Conservation

Contributed by Sean P. Murphy, Ph.D., PGC State Ornithologist

Pennsylvania helps secure sustainable SGCN populations through partnerships and projects conducted beyond the Commonwealth's boundary. In the northeastern U.S., this work has focused on Regional Species of Greatest Conservation Need (RSGCN) and their habitats, through initiatives such as the Regional Conservation Needs (RCN) program and Competitive State Wildlife Grants (C-SWG) Program. Yet, many species, particularly birds, spend most of the year outside of the United States.

Overview

Pennsylvania's ecoregions extend beyond the Commonwealth's borders, and the ranges of SGCN are far larger than the state itself. Pennsylvania must work regionally, nationally, and internationally to accomplish conservation objectives for many of its priority habitats and species. To prevent migratory SGCN from continued declines, and to recover those populations, Pennsylvania must understand and address the totality of threats facing these species throughout their full annual cycle, and the role Pennsylvania plays in supporting their populations. This is particularly important for migratory birds and bats. This section is an overview of Pennsylvania's conservation actions at the international scale to address full life-cycle conservation of these species.

Bird Declines and Urgency

Considering recent research that quantified a net loss of 2.9 billion birds in the last 50 years, many of which are Neotropical migrants (Rosenberg et al. 2019). Pennsylvania cannot afford to ignore the threats that many migratory birds face across their full life-cycle ranges.

Why Full Annual Cycle Conservation Is Important

A high percentage of breeding birds, and to a lesser extent other animal taxa (e.g., Monarch butterfly, migratory tree bats), migrate out of Pennsylvania during some time of the year. Birds typically move south to avoid the boreal winter, but species can exhibit other patterns. Thus, conservation actions taken only within a given state may not be adequate for long-term species persistence. Most of these species spend the winter in the West Indies, Central America, or South America (Fig. 4.2); several others winter in, or pass through, Pennsylvania on their way to more northerly breeding grounds in Canada.

When one considers the millions of migratory birds that breed across Canada and the U.S. and winter in a relatively small geography within Mexico, Central America, South America, and the Caribbean, it puts into perspective the importance of this work. Because species are generally more concentrated on their wintering grounds than on their breeding grounds, the loss of a single acre in Central America, South America, or the Caribbean can be equivalent to losing 5 to 8 acres of North American breeding habitat (Terborgh 1980).

Threats to these vital landscapes, ecosystems, and the birds that use them vary by country and region but include deforestation, commodity agriculture, illegal logging, contaminants, and insufficient enforcement of protected areas, among others. Conservation efforts on migratory stopover sites and nonbreeding grounds work to curb these threats through acquisition and protection of key lands; education of landowners on regenerative agriculture and ranching practices, including shade-grown coffee farming; the creation and maintenance of native tree nurseries and reforestation efforts; reduced nighttime lighting to ensure safer travel routes for migratory animals; and other actions.

Multi-State and International Collaboration: Initiatives and Priority Areas

Beyond planning, management of Pennsylvania's natural resources requires working across borders on a regular basis. Many landscapes and most SGCN have ranges that extend well beyond Pennsylvania, requiring partnerships with neighboring states and regional or international partners to achieve shared conservation goals. Watersheds and flyways often encompass all or parts of multiple states and countries and require complex coordination among many partners and jurisdictions to improve habitat conditions, regulate harvest and methods, and provide needed habitat. Recovery of declining species with large ranges requires coordination with partners and agencies with interest and jurisdiction throughout each species' range.

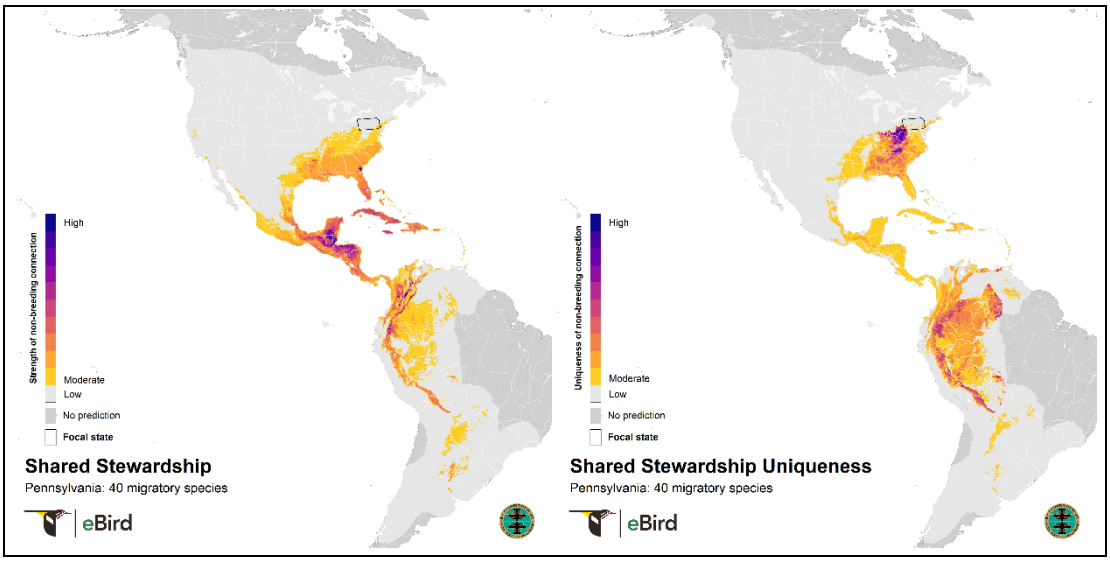

Fig. 4.2. Shared stewardship connections (left) highlight key areas where Pennsylvania's migratory species are concentrated during the nonbreeding season; darker colors represent areas with stronger connections across all 40 species. The uniqueness map (right) shows where Pennsylvania has distinct shared stewardship connections compared to other U.S. states; darker colors represent areas where Pennsylvania has a high proportion of stewardship connections relative to other states, highlighting unique opportunities to make a difference. Data source: Cornell Lab of Ornithology.

Much of this work involves protecting and maintaining migratory species' habitat throughout their annual cycles, an approach known as full annual cycle (FAC) conservation. FAC conservation of migratory species is a key part of Pennsylvania's commitment to cross-border conservation and is imperative to

the long-term sustainability of Pennsylvania's natural communities and species. Although Pennsylvania's international work has focused primarily on Neotropical migratory birds, migratory mammalian SGCN (e.g., migratory tree bats) conservation is also improved with a FAC approach. In Pennsylvania, we are building on decades of partnerships through Partners in Flight, the Appalachian Mountain Joint Venture (AMJV), the Atlantic Flyway Council and Technical Sections, and the Southern Wings program to support conservation beyond the state border.

Southern Wings and Pennsylvania's International Partnerships

The Association of Fish and Wildlife Agencies' (AFWA; https://www.fishwildlife.org) Southern Wings program (https://southern-wings.fishwildlife.org), created in 2009, facilitates state fish and wildlife agency participation in the conservation of priority migratory birds across their full life cycle. Pennsylvania and 40 other states have contributed over $4.2 million, combined, to conservation efforts on stop-over sites and wintering grounds in Mexico, Central America, South America, and the Caribbean.

Strategic actions vary by Southern Wings project and species but include slowing or reversing continued deforestation through reforestation efforts and implementation of regenerative agroforestry systems with local landowners; securing protection of core migratory bird habitat through protected area creation and management; improving or reestablishing shade-grown coffee practices that maintain or create migratory-bird foraging habitat; working with local communities to build sustainable conservation capacity and ownership; among others.

Priority Species Supported by Full Annual Cycle Conservation

Full life-cycle conservation efforts in Mexico, Central America, and South America support well over 150 species of Neotropical migrants that migrate through or overwinter in these habitats. Pennsylvania has *documented strong conservation linkages for many priority SGCN* (Table 4.2).

Table 4.2. Migratory linkages for selected Pennsylvania Species of Greatest Conservation Need (SGCN).

Species	Scientific Name	Full Life-Cycle Connection
Cerulean Warbler	*Setophaga cerulea*	Winters in the Andes, especially Colombia; supported by El Grupo Ceruleo and the Southern Wings Cerulean Warbler Conservation Corridor project in Colombia.
Wood Thrush	*Hylocichla mustelina*	Winters from northeast Mexico through Central America; strong linkage to eastern Honduras and northern Nicaragua; Motus-tagged birds from Nicaragua detected in Pennsylvania.
Golden-winged Warbler	*Vermivora chrysoptera*	Winters in Central America and northern South America; a focal species of the Golden-winged Warbler Working Group and the Pennsylvania-supported El Jaguar project; Motus-tagged birds from Pennsylvania detected in northern South America.

Species	Scientific Name	Full Life-Cycle Connection
Bobolink	*Dolichonyx oryzivorus*	Main wintering area is in the southern interior of South America, where they spend their time in grasslands, marshes, rice fields, and sorghum fields; tracking data connects Pennsylvania.
Purple Martin	*Progne subis*	Connected to communal winter roosts in the Amazon rainforest of northern Brazil; studied by the Purple Martin Conservation Association and University of Delaware.
Canada Warbler	*Cardellina canadensis*	Winters mainly in Venezuela, Colombia, Ecuador, and central Peru; a focus of the International Canada Warbler Conservation Initiative and partners such as SELVA, ECOAN, and Pronatura Sur.
Evening Grosbeak	*Hesperiphona vespertina*	Breeding primarily in Canada; resident in breeding range but often abandons portions of northernmost breeding range during winter into northern U.S.
Eastern Red Bat	*Lasiurus borealis*	Winters in southern U.S.; across North America, most bats killed at wind facilities are migratory tree bats.
Northern Hoary Bat	*Lasiurus cinereus*	Winters in southern U.S.; according to Bat Conservation International, hoary bats comprises the largest proportion of bat fatalities at wind energy facilities in North America.

Mapping Tools for Bird Full Life-Cycle Conservation

Cornell Lab of Ornithology's eBird Status and Trends tool (https://ebird.org/science/status-and-trends/abundance-maps) and its state-level Stewardship Maps can help illustrate the migratory connections between Pennsylvania and the rest of the hemisphere for these and other priority species (Fig. 4.2). The National Audubon Society's Bird Migration Explorer (https://explorer.audubon.org) is a complementary resource for visualizing breeding and non-breeding connections, including individual-level movements from a variety of movement data from Movebank (https://www.movebank.org) and Motus (https://motus.org).

Case Studies

Case Study 1: Migratory Bird Wintering Grounds Conservation in Nicaragua and Honduras — Wood Thrush and Others

Along with key conservation partners American Bird Conservancy, El Jaguar Private Wildlife Refuge (Nicaragua), Red de las Reservas Silvestres Privadas de Nicaragua, and La Asociación de Investigación para el Desarrollo Ecológico y Socio Económico (Honduras), among others, Missouri and Pennsylvania support habitat conservation projects in Nicaragua and Honduras that benefit a broad suite of

Neotropical migrants. The partnership has been implementing a long-term conservation strategy of preserving stopover and wintering habitats along the Caribbean slope and mid-elevation forests. The project area hosts over 190 Neotropical migrant birds including Black-billed Cuckoo (PA SGCN), Eastern Wood-pewee, Yellow-bellied Flycatcher (PA SGCN, PA Endangered), Wood Thrush (PA SGCN), Blue-winged Warbler, Golden-winged Warbler (PA SGCN), Cerulean Warbler (PA SGCN), Worm-eating Warbler, Louisiana Waterthrush (PA SGCN), Hooded Warbler, Scarlet Tanager (PA SGCN), Rose-breasted Grosbeak, Indigo Bunting, and Baltimore Oriole, with particular emphasis on Golden-winged Warbler and Wood Thrush research and conservation.

The project goal is to increase forest availability and connectivity in Nicaragua's BirdScapes by working with landowners and communities to implement regenerative agriculture practices, such as agroforestry, that are compatible with forest preservation (Fig. 4.3). The goal for the next ten years is to restore 3,500 acres with regenerative agriculture and bird-friendly practices.

Fig. 4.3. Nicaraguan farmer, Mister Omar Centeno, planted 170 native and fruit trees in his farm during 2025.

Case Study 2: Connecting the Dots: Wood Thrush Tracking Links Nicaragua to Pennsylvania

In 2011, a remarkable migratory link was proven when a banded Wood Thrush, tagged at the El Jaguar Reserve in Nicaragua, tragically died from a window collision later that spring in Bucks County, PA. In 2019, Pennsylvania's Southern Wings support at El Jaguar Reserva sought to strengthen the migratory connection by installing the first Motus Wildlife Tracking (Motus) receiver station in Nicaragua. Motus (https://motus.org) is an international collaborative research network that uses automated radio telemetry to track the movement and behavior of small animals, like birds, bats, and insects. To date, the El Jaguar station has detected four Pennsylvania SGCN (Swainson's Thrush, Wood Thrush, Louisiana Waterthrush, and Canada Warbler). The team also tagged individual Wood Thrush at the reserve to track birds during spring migration. Four (of the 10) Wood Thrush passed through or nested in Pennsylvania (Fig. 4.4).

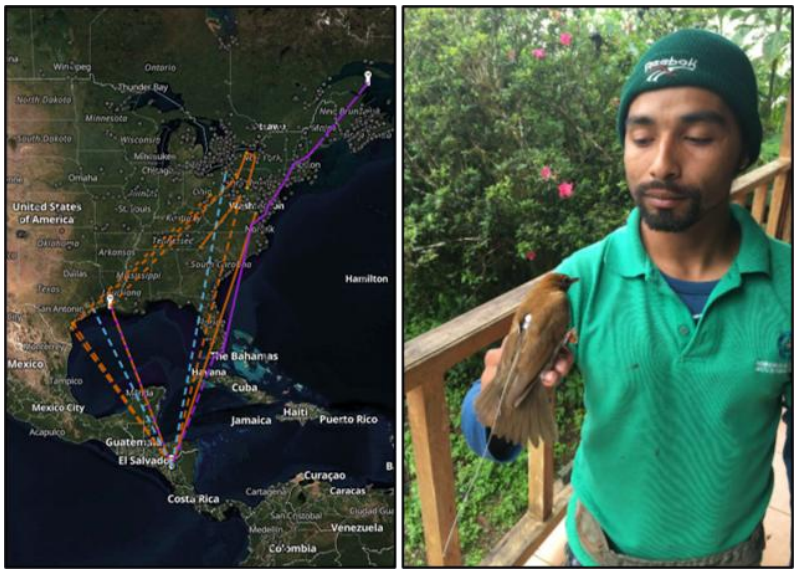

Fig. 4.4. (Left) Map of northward migration routes of Wood Thrush equipped with Motus nanotags in 2019; (right) Moises Siles of Reserva El Jaguar holds one of the Motus tagged Wood Thrush in 2019.

Simple actions we all can take to protect migratory animals on their journey

- Purchase bird-safe coffee to support shade-grown, pesticide-free forest habitats for migratory birds (https://global.si.edu/projects/bird-friendly%C2%AE-coffee-program)
- Use the U.S. Fish and Wildlife Bird Collision Reduction toolkit to reduce window collisions in your area (https://www.fws.gov/library/collections/bird-collision-reduction-toolkits)
- Clean bird feeders regularly to prevent the spread of disease
- Planting native trees, shrubs, and flowers provides both food and cover, for many wildlife species—birds, bats, bees, butterflies, beetles, and small mammals, which play an important role in sustaining healthy ecosystems (https://www.pa.gov/agencies/pgc/about-us/get-involved/six-things-you-can-do-for-wildlife)
- Participate in Bird Town Pennsylvania to promote community-based conservation actions to create a healthier environment for birds (https://birdtownpa.org)
- Support bird-friendly legislation (e.g., Piping Plover Day, State Migratory Bird)
- Participate in Lights Out campaigns by turning off excess lighting during the months migrating birds are flying overhead (https://www.audubon.org/lights-out-program)
- Encourage wind-power companies to implement best practices (REWI 2025) to reduce wildlife fatalities

Resources

- Bird Migration Explorer: https://explorer.audubon.org
- Bird Town Pennsylvania: https://birdtownpa.org
- eBird Status & Trends abundance maps: https://ebird.org/science/status-and-trends/abundance-maps

- Motus: https://motus.org
- Movebank: https://www.movebank.org
- Partners in Flight: https://partnersinflight.org
- Partners in Flight Avian Databases: https://partnersinflight.org/what-we-do/science/databases/
- Southern Wings: https://www.fishwildlife.org/afwa-inspires/southern-wings

4. Northeast Regional Conservation Actions

Adapted from: Northeast Landscape Conservation Committee and Northeast Regional Conservation Synthesis (TCI and NEFWDTC 2023) and Northeast Landscape Wildlife Conservation Committee Working Group February 11, 2025)

Northeastern state fish and wildlife agencies are committed to collaborative, proactive, landscape-scale conservation by strategically implementing conservation actions that drive tangible change across priority regional landscapes. Landscape-scale conservation conserves connected and healthy ecological systems, using science-based and culturally sensitive conservation planning, collaborative network structure, and meaningful engagement from stakeholders with various interests.

Multi-state (i.e., landscape or regional) scale conservation allows states to collectively, and more comprehensively, address their SGCN needs. As discussed above, securing Pennsylvania SGCN populations may require conservation actions beyond our state boundary as it may not be sufficient to only protect and secure the populations within Pennsylvania (e.g., migratory species). Supporting conservation actions beyond our borders can have direct and tangible benefits for these SGCN. Less mobile species also benefit from regional conservation actions, especially through various data collection and assessments (e.g., Regional SGCN or RSGCN) which can clarify information that may be less apparent when considering a more constrained geographic area or population. It is within this context that Pennsylvania is committed to initiatives which support our SGCN beyond our borders.

Northeast Conservation Actions to Address Threats

Regional Conservation Needs

For northeastern states, shared responsibilities for species and their habitat contribute to cooperative and complementary management approaches. This collective approach is fostered by the Northeast Association of Fish and Wildlife Agencies (NEAFWA) supporting a strong technical committee structure to advance regional wildlife conservation including the Northeast Fish & Wildlife Diversity Technical Committee (NEFWDTC), Wildlife Action Plan Coordinator Sub-committee, Habitat Committee and others. These species- or habitat-focused groups, and technical committees, exchange ideas and develop common approaches to wildlife issues.

Within this multi-state perspective, the RCN Program formalizes a cooperative approach to address Pennsylvania's SGCN at a landscape-scale. The RCN program develops, coordinates, and implements conservation actions that are regional or sub-regional in scope, and builds upon historical and current regional initiatives. RCN program funding uses a mechanism equitable to all northeast states and the District of Columbia, creating a fiscal foundation for regional projects.

Working collaboratively with federal, state, and non-governmental partners, we help develop and implement conservation actions for issues, threats, and opportunities most effectively addressed at a regional and multi-state scale. These actions include partners involved in creating and implementing State Wildlife Action Plans.

Regional needs are identified by NFWDTC and approved by NEAFWA Directors. Often these regional projects benefit Pennsylvania's SGCN, though not all project activities are directly controlled by Pennsylvania. Thus, for the 2025-35 PA WAP, we cannot fully anticipate specific conservation actions that may be implemented as part of regional initiatives during the next 10 years. Performance measures for conservation actions also may vary depending upon specific project requirements. Where projects involve Pennsylvania SGCN and habitats, we anticipate activities developed by the NEFWDTC will be aligned with Pennsylvania conservation actions. For those projects, where this consistency is not observed, we will use the most relevant regional conservation actions and associated performance measures. With direct importance to Pennsylvania's SGCN and habitats, we will continue to work with the NEFWDTC to develop and implement conservation actions in the northeast region. This regional collaboration will be conducted with input from multiple parties, especially federal partners, NEAFWA Directors, State Wildlife Action Plan coordinators and other members of the NEFWDTC, RCN project leaders, and relevant Non-governmental Organizations (NGOs).

Why Regional Landscape-scale Conservation Matters?

The significance of landscape-scale conservation is not just about preserving scenic landscapes; it's about safeguarding natural resources supporting our existence. Here's why it matters and how you can help:

1. **Better Access to Nature, Better Quality of Life:** Imagine a world where everyone has easy access to nature: clean, flowing rivers, lush green forests, and vibrant wildlife. Studies consistently show that spending time in nature improves mental health, reduces stress, and enhances overall well-being. By preserving large swaths of land, we ensure that future generations can experience nature's healing power and have continued opportunities for hunting and fishing.

2. **Protecting Water Quality:** Healthy landscapes mean clean water. By conserving large areas of land, we can protect watersheds and prevent pollution from contaminating our water sources. Whether it's drinking water for communities or habitats for aquatic life, landscape-scale conservation plays a vital role in ensuring water quality for all.

3. **Building Resilience to Climate Change:** Climate change is one of the most pressing challenges of our time. Extreme weather events, rising temperatures, and shifting ecosystems threaten the survival of countless species. Landscape-scale conservation creates connected habitats that allow plants and animals to adapt and migrate in response to changing conditions. Preserving corridors and refuges gives species and communities the best chance to endure and thrive in the face of climate uncertainty.

Pennsylvania supports landscape conservation through the *Northeast Landscape Wildlife Conservation Committee*. Established in 2022 and within NEAFWA, the Committee builds on decades of interjurisdictional conservation in the northeast and provides leadership and direction on large-scale landscape conservation needs and opportunities from Maine to Virginia. As a landscape-scale conservation partnership, the Committee undertakes work in the context of the long-term goal of sustaining healthy, connected, and resilient cross-border ecosystems that provide essential ecosystem and societal values for current and future generations.

The Committee seeks to fulfill the recommendations found in the AFWA (2018) resolution entitled, *Fish and Wildlife Conservation at Landscape Scales* (AFWA Landscape Resolution), which recognized the need for state, provincial and territorial fish and wildlife agencies, federal agencies, tribes, private landowners, and conservation groups to collaborate at landscape scales.

The Committee has prioritized interjurisdictional work in the following seven landscapes and themes:

- Appalachian Corridor Highlands and Streams
- Atlantic Coast: Coastal Resiliency and Coastal Habitat Restoration
- Northeast Region River, Stream and Watershed Restoration
- Appalachian and Northern Forests
- Conservation of Pine Barrens, Grasslands and other Xeric Barrens Habitat and Dependent Species in the Northeast
- NEAFWA Support and Coordination for Watershed and Other Delivery Partnerships
- Northeast One Health Initiative: Wildlife Disease Monitoring, Response, Management

Pennsylvania's Commitment to Northeastern U.S. Regional Conservation Action

Pennsylvania will support NEAFWA initiatives including the Northeast Landscape Wildlife Conservation Committee, Regional Conservation Needs Program, and other interjurisdictional landscape, and watershed scale conservation partnerships, providing opportunities for Pennsylvania to implement coordinated conservation actions, reduce redundancy, save time and money, and combine resources to conserve landscapes and habitats for the benefit of people and the future of fish and wildlife.

Pennsylvania has assisted, and will continue to assist, other regions of the United States. For example, numerous SGCN mussel species occur in Pennsylvania's Ohio River basin, a river that flows west towards the Mississippi River via the Midwest and Southeast. Conservation actions to conserve SGCN species by working with states and regions outside of the northeast are acknowledged and will continue.

Pennsylvania Conservation Actions to Address Threats to SGCN and Habitats

Coarse Level 1 and more descriptive Level 2 conservation actions to address Pennsylvania-specific threats to SGCN and habitats are discussed generally below, organized by action classification categories (Appendix 4.1). These actions are discussed more specifically, and prioritized, within individual Species Accounts (Appendix 1.4). Many conservation actions will address multiple threats simultaneously, (e.g., dam removal restores stream habitats and removes SGCN dispersal barriers), providing multispecies benefits.

Active Restoration and Stress Reduction Measures

Direct Habitat Management

Conservation actions that directly manage habitats, such as forestry, dam removals, and prescribed fire management are essential tools to address multiple threats to SGCN, such as habitat alteration caused by natural succession or dams blocking SGCN fish and freshwater mussel migration.

Direct habitat management actions can address multiple threats including:

- fire and fire suppression
- dams
- water use
- agricultural pollution and
- energy production and mining impacts

Manage plants, animals, fungi, or bacteria

Primary Threat(s) Addressed:

- Agriculture
- Energy Production and Mining
- Transportation and Service Corridors
- Biological Resource Use
- Invasive and other problematic species, genes, and diseases

Action Overview: Managing habitats using mechanical, biological, or chemical conservation actions is a useful conservation action, but specific management methods will be contingent upon the initial condition of the managed property, targeted SGCNs and their habitat needs. This conservation action may be applicable where native habitats have been degraded or eliminated due to one or more threats identified in Chapter 3-Threats. Availability of this conservation action does not imply habitats should be intentionally degraded with expectations they can be restored. However, when habitats are degraded and opportunities are available for their enhancement, this conservation action may be an option. Pennsylvania's mining legacy may offer new habitat restoration opportunities both above and below the surface.

Manage non-living habitat components

Primary Threat(s) Addressed:

- Natural Systems Modifications
  - Dams
  - Culverts

Action Overview: Dams, culverts, and other manmade barriers fragment aquatic habitats and pose direct and indirect threats to aquatic organisms by interrupting vital life history needs. Pennsylvania's aquatic habitats are extensively fragmented with an estimated 1,492 dams (USACE 2026). Recognizing this threat, Pennsylvania is among national leaders in dam removal with 433 dams removed since 1912, including about 30% (128) removed between 2016 and 2025, restoring a total of over 1,300 miles upstream (American Rivers 2025, 2026). Success of these efforts is attributable to enduring collaboration among federal, state and local agencies and non-profit partners, which has resulted in an efficient and effective dam-removal process and the ability to provide technical and financial support to dam owners.

Manage fire regime (Level 3)

Primary Threat(s) Addressed:

- Fire suppression
- Invasive and other problematic species, genes, and diseases

Action Overview: Prescribed fires (i.e., ecological restoration burns) are crucial to maintain oak forests, scrub oak-pitch pine communities, various barrens, savannas, open woodlands and native grass communities (Brose et al. 2014). Fire-dependent habitats, such as scrub-oak barrens, also can support rare animals and insects (Wagner et al. 2003; Orndorff and Coleman 2008; Leuenberger et al. 2016). Land managers employ fire in controlled situations to promote healthy natural systems; a series of low-intensity fires can thin crowded forests, resulting in less severe disease and pest outbreaks (TNC et al. 2015). Fire promotes native grasses and wildflowers and helps to regenerate oaks, which in turn increases wildlife populations. Controlled burns also reduce leaf litter and woody fuels that increase wildfire intensity. Fire, in the right place at the right time, is a land-management tool with numerous benefits for wildlife. A collaborative 2022 State Wildlife Grants project (active at the time of this writing) among PFBC, PGC, and East Stroudsburg University is assessing fire management effects on habitats and targeted SGCN reptiles, especially Timber Rattlesnake (*Crotalus horridus*) and Box Turtle (*Terrapene carolina*), and when present, Wood Turtle (*Glyptemys insculpta*), and Spotted Turtle (*Clemmys guttata*). Amphibians being assessed, as available, include Marbled Salamander (*Ambystoma opacum*), Jefferson's Salamander (*Ambystoma jeffersonianum*).

Many plant and animal species respond favorably when fire is introduced into their habitat including upland oak-hickory forests, woodlands, and pine-oak savannahs where increased sunlight reaching the ground and promotes seed germination. Periodic fires reduce competition of fire-intolerant species such as maples, beech, and white pine. Over time, upland oaks and pines gradually disappear from the landscape unless this competition is reduced. Studies of forest history show fire intolerant species were uncommon on these upland areas prior to fire suppression (TNC et al. 2015). Historical records also indicate some plants and animals difficult to find in the Appalachians today were once commonly found. When fire is reintroduced, plants sometimes reappear where they have not been recorded in decades. The controlled use of fire, under the direction of skilled resource managers, promotes wildlife and healthy forests (TNC et al. 2015).

Appendix 4.3, contributed by Bryan Whitmore (PGC Fire Program Manager), Scott Bearer (PGC Wildlife Recovery Division Chief), and Roger Latham (Ecologist, Pennsylvania Biological Survey and Continental Conservation), provides a detailed accounting of prescribed fire history in Pennsylvania and its objectives.

Manage physical and/or habitat characteristics (Level 3)

Primary Threat(s) Addressed:

- Residential and commercial development
- Energy production and mining
- Transportation and service corridors
- Natural systems modifications
- Invasive and other problematic species, genes, and diseases

Action Overview: Loss of natural structures (e.g., tree cavities) and impediments to animal movement (e.g., dams) can suppress wildlife populations. Fish and wildlife structures may replace or supplement available habitat. In some cases, structures also provide protection from human intrusion (e.g., bat gating) or may protect against invasive species. Commonly used structures include road crossing tunnels for reptiles and amphibians to minimize road mortality (Jackson 2003), turtle basking structures, bat houses, and human exclusion structures. Additional types of structures may be applied to address case-specific needs during Plan implementation. Research also may find more effective structure design and, where applicable, these newer structures would also be implemented.

Manage erosion and sedimentation (Level 3)

Primary Threat(s) Addressed:

- Agriculture

Action Overview: As noted in Chapter 2- Habitat, agriculture encompasses approximately 22% of land use in Pennsylvania. Thus, proper land, water, and nutrient management of this extensive geographic area can greatly benefit SGCN. For example, livestock grazing activities have been found to be beneficial for the Bog Turtle (*Glyptemys muhlenbergii*) (Tesauro 2001; Tesauro and Ehrenfeld 2007).

Detailed descriptions of best practices associated with erosion and sedimentation are beyond the scope of this Plan and additional conservation practices may be applicable for this conservation action. Where grazing and farm management actions are required for SGCN and associated habitats, the USDA- Field Office Technical Guide provides general references, soil and site information, conservation management systems, practice standards and specifications, and conservation effects (USDA 2015b). This conservation action supports objectives for streams, wetlands, and forests. Conservation programs may be modified or updated during the next 10 years.

Direct Species Management

Stewarding wild individuals

Primary Threat(s) Addressed:

- Biological Resource Use
- Invasive and other problematic species, genes, and diseases
- Human Intrusions and Disturbance

Direct species management actions can address multiple threats through:

- SGCN propagation,
- environmental review,
- implementing state and federal SGCN recovery plans, and
- addressing climate change impacts on particularly vulnerable SGCN.

Action Overview: Managing lands for SGCN encompasses most of the conservation actions listed under this Level 2 Action: *Stewarding wild individuals*. For example, Wildlife Management Areas are lands owned or leased for the protection and promotion of fish and wildlife resources. In Pennsylvania, PGC-owned and managed lands are “State Game Lands” (SGL) and given a unique identification number. PFBC properties provide access for water-based resources.

The primary purposes of SGLs are habitat management for wildlife and to provide opportunities for lawful hunting and trapping. Sportsmen and sportswomen have long funded habitat management and the acquisition of a large portion of SGLs through license fees and a federal tax on sporting arms and ammunition (i.e., Pittman-Robertson Act) that benefits game and non-game species alike. As public property, these areas enable the public to interact with a wide variety of wildlife and provide PGC opportunities to conduct habitat management practices to benefit SGCN. SGL habitat management practices are guided by an extensive habitat manual and PGC standard operating procedures. These procedures govern herbicide and pesticide application to minimize non-target impacts and include measures such as pesticide applicator certification requirements, banning noenicitinoid-based herbicides, application during appropriate weather conditions, and low-rate dosing. Comprehensive Management Plans are developed for all SGLs and identify habitat goals and practices for both target SGCN and game species. Supporting science-based deer management promotes forest regeneration on SGLs and private lands, which renews Penn's Woods and provides important habitat for several bird and mammal SGCN (learn more at https://www.pa.gov/agencies/pgc/wildlife/discover-pa-wildlife/white-tailed-deer and https://huntfish.pa.gov/).

Also encompassed under this action category is "managing health in the wild." Fish and wildlife diseases are found in all populations but can become epidemic when introduced into populations or because of other stressors (Chapter 3-Threats). These diseases may have the potential to quickly eliminate entire populations of fish or wildlife. Some fish or wildlife diseases are transferred between species including from wild animals to humans and from humans to wild animals. Emerging infectious diseases, (i.e., zoonoses), are all stressors in the environment that make it increasingly challenging to conserve wild populations. Significant examples include white nose syndrome (bats) and chytrid fungus (amphibians) which, in the species affected, have resulted in dramatic population declines. See the Fish and Wildlife Health section of Chapter 3-Threats for a detailed overview of fish and wildlife disease threats and suggested conservation actions.

Reintroduce or relocate individuals

Primary Threat(s) Addressed:

- All threats to SGCN, but for which threats have been ameliorated to allow restored species to maintain and expand abundance.
    - Example: Water pollution for which the source has been controlled and water quality has recovered to allow SGCN populations to survive.

Action Overview: In limited situations, when SGCN are considered either extirpated but recoverable or low in abundance, the availability of suitable habitat, likely success, and public support may be an opportunity for reintroduction or augmentation from captive breeding, hatcheries, or through translocation. The probable cause of population decline (i.e., threats) should be resolved or mitigated before fish or wildlife populations are reintroduced, either on their own or through release.

The PFBC's new Division of Aquatic Species Restoration, with the Union City and Huntsdale Aquatic Conservation Centers (ACC), supports aquatic SGCN restoration through this conservation action. Using a captive propagation plan, the Union City ACC has carefully augmented or reintroduced SGCN mussels,

fish, and reptiles to native and restored habitats following Species Action Plans and stream recovery plans. This new division will monitor these SGCN restoration efforts for the foreseeable future, providing crucial adaptive management feedback to this effort.

Working with other states, veterinarians, and researchers, the PGC Protected Mammals Section has recently begun augmenting Allegheny woodrat (PA Threatened) populations through reintroductions to increase genetic diversity of isolated individuals. Initial results are promising.

Stewardship of captive individuals

Primary Threat(s) Addressed:

- Threat types vary depending upon each SGCN's threat portfolio.

Action Overview: This conservation action has limited application for SGCN and, although used in previous Plans, the intended outcome – population restoration - of stocked SGCN fish was a driving factor. For example, the PFBC Huntsdale ACC has reared American Shad (*Alosa sapidissima*) to stock in the Susquehanna, Schuylkill, and Lehigh rivers. Although these fishes may have been caught by anglers after leaving Pennsylvania waters, these stockings were intended to build the species' population and were not strictly intended to provide fish for recreational purposes. On the Susquehanna River, fishing for American Shad is closed year-round. On the Lehigh and Schuylkill rivers and tributaries, no harvest is allowed, only catch and immediate release (PFBC 2026). American Shad restoration may also benefit native SGCN mussels using this species as hosts (e.g., Alewife Floater, *Utterbackiana implicata*).

By comparison, Brook Trout (*Salvelinus fontinalis*) are reared in PFBC state fish hatcheries for recreational purposes (i.e., stock-and-harvest) but are not stocked to enhance *wild* Brook Trout populations. Distinctions are made between wild and hatchery-reared Brook Trout, and for these stocked fish, the intended use is recreational. An exception would be their use in restoring Eastern Pearlshell (*Margaritifera margaritifera*) mussel populations in the Delaware River basin; these mussels use Brook Trout as a host fish.

For bird SGCN, captive rearing of chicks from abandoned eggs is an important component of Great Lakes Piping Plover (*Charadrius melodus*) recovery. Piping plovers have biparental care of eggs and young. If a disturbance, such as predation, human disturbance, flooding, or other factor, results in loss of an adult or the adults abandoning the eggs, the PGC and partners can rescue the eggs after consultation with U.S. Fish and Wildlife Service. These are transported by the PGC to Detroit Zoo who manage the Piping Plover Captive Rearing Center at the University of Michigan Biological Station in Pellston, Michigan. The young are released back into the wild ~30-days post-hatch. Since 2017, when Piping Plovers returned to nest in Pennsylvania after a more than 60-year absence, 14 of the 57 young fledged because of captive rearing.

Important stewards of temporarily captive SGCN are licensed and qualified wildlife rehabilitators. These volunteer-driven, donation-based organizations and individuals tirelessly care for orphaned wildlife with the intention of returning individuals to the wild. For example, PGC and PFBC often partner with wildlife rehabilitators to nurse injured or sick SGCN turtles and snakes (e.g., Woodland Box Turtle, Wood Turtle), mammals (northern long-eared bat, Allegheny woodrat), and birds (e.g., Peregrine Falcon nestlings) back to health, for which they are reimbursed. However, difficulty funding wildlife rehabilitation and few

facilities statewide constrain these stewardship efforts. Learn more about becoming a wildlife rehabilitator and find a rehabilitator near you through the Pennsylvania Association of Wildlife Rehabilitators (https://pawr.com). If you encounter sick or injured wildlife, call the PGC centralized communication center, any time, at 1.833.PGC.WILD (1.833.742.9453).

Encourage Beneficial Human Behavior

Outreach

Outreach actions can address threats requiring broad partner and public engagement, such as implementing beneficial habitat management practices.

Outreach is crucial to enlist implementation support from, and inform, the public, conservation partners, and each Commission's staff. For this Plan, outreach is grounded in Goal 6 *Inspire active public participation in Pennsylvania Wildlife Action Plan development and implementation*. Species accounts will support outreach initiatives providing individuals, partners, and stakeholders with proposed actions to target threats identified by taxonomic experts. Our objectives will *Enhance coordination among conservation partners to foster a well-informed citizenry* (Objective 6.1) and broadly support communication and outreach and assess effectiveness of this effort. Under Objective 6.2, we will *Encourage public input and participation in wildlife management decisions and activities* and through Objective 6.3, we will *Effectively convey Species of Greatest Conservation Need information.* Guiding this outreach will be a communication strategy with outreach priorities, targets and tactics, which we expect to develop early in this Plan's implementation phase. We will use multiple media formats and engage private landowners to recover SGCN and address Objective 6.4 to *Connect Pennsylvania Wildlife Action Plan relevance to Pennsylvanian's quality of life*.

Outreach, communication and distribution

Primary Threat(s) Addressed:

- Various threats requiring public or private landowner engagement
- Other Threat Options
    - Insufficient information to partners and stakeholders

Action Overview: Successful partner and stakeholder engagement will require participation and recruitment of many partners and stakeholders acknowledged throughout this Plan. We intend to maintain the administrative framework and regularly engage the Advisory Committee and Technical Committees for current, broad-based perspectives during Plan implementation.

The PA WAP needs all PA residents to assist with its implementation. Outreach and education through timely and well-developed programs and products at many different levels (school students through professionals) will advance understanding of SGCN and their habitats. The proposed communication strategy mentioned in (Chapter 8- Public Participation) will support this public outreach.

Law Enforcement and Prosecution

Detection and intervention; Prosecution and conviction; Other legal actions

Primary Threat(s) Addressed:

- Biological resource use
  - Illegal harvest

Law enforcement actions can address threats to SGCN that could potentially be fatal, such as illegal turtle harvest for the pet trade.

Action Overview: Law enforcement can be a vital function for protecting SGCN and their habitats. Currently, State and Tribal Wildlife Grant Program funding for this conservation action is limited to 10% of project costs, along with other restrictions. This conservation action is especially helpful for protecting species such as the Bog Turtle (*G. muhlenbergii*), Woodland Box Turtle (*T. carolina*), and other wild turtle species especially vulnerable to illegal harvest (Chapter 3-Threats), as well as other highly sought species for the pet trade and other demands. Beyond illegal trade, PFBC waterways conservation law enforcement officers are often called to investigate pollution events that may involve SGCN. Supporting PFBC Waterways Conservation Officers and PGC State Game Wardens with training in animal identification, anti-poaching procedures, protecting important sites (e.g., caves for hibernating bats), and enforcing laws, especially focused on SGCN, are important activities to consider within this conservation action.

Economic and Other Incentives

Economic incentives and disincentives

Primary Threat(s) Addressed:

- Agriculture and related land use
- Pollution

Action Overview: Private landowners who want to support SGCN and their habitats may be able to receive financial support through voluntary incentive programs. State and federal agencies may have specific habitat or species-specific incentives, so readers are encouraged to check with the agency or organization for options. Agriculture is a major land use and agricultural producers are stewards and land managers intrinsically involved in securing habitats and environmental quality for future generations. Soil health, fish and wildlife habitat, and water quantity and quality are all landscape features that many producers try to protect. Voluntary economic incentives are available for producers to address environmental concerns by helping producers afford infrastructure and implement conservation practices which may not provide direct financial returns. Among the leaders in voluntary incentive programs is the USDA-NRCS which, for decades, has supported producers, forest owners, and other private landowners through voluntary technical and financial programs. In FY 2025, the NRCS Pennsylvania field office, in collaboration with private landowners, applied 42,958 conservation practices to help soil, air, and water quality, enhance wildlife habitat, and preserve land (USDA-NRCS 2026). The scope and breadth of these programs is beyond discussion in this Plan, but readers are encouraged to contact the Pennsylvania NRCS field office for more information on how their programs can help SGCN and their habitats. Forests, streams and riparian areas, and wetlands are supported by specific habitat management incentive programs. The Working Lands for Wildlife program in

Pennsylvania is directed primarily at supporting forest landowners' efforts to manage Golden-winged Warblers and other species using similar habitats. The Environmental Quality Incentives Program (EQIP) provides technical and financial assistance to develop beneficial pollinator habitats (USDA-NRCS 2026).

Create Favorable Conditions for Conservation

Design and Plan Conservation

Complementary or alternative conservation measures

Primary Threat(s) Addressed:

- Residential and commercial development
- Energy production and mining
- Transportation and service corridors
- Natural systems modifications
- Pollution

Design and plan conservation actions can address many threats such as:

- improper land use planning,
- lack of a species recovery strategy,
- Non-point source pollution

Action Overview: Construction or other activities that disturb habitats or species must be evaluated through Pennsylvania Conservation Explorer (PACE; https://conservationexplorer.dcnr.pa.gov), the Pennsylvania Natural Diversity Inventory environmental review tool (PNHP 2026). This tool enables the public to perform online searches for potential impacts to threatened, endangered, special concern species and special concern resources (PNHP 2025). Information provided by this tool allows technical experts to draft recommendations to minimize and avoid harm to select SGCN. PACE is used by developers for project screening as part of the permit application to Pennsylvania Department of Environmental Protection.

Road salt and chloride contamination on freshwater ecosystems, communities, SGCN and their life stages are well documented (see Chapter 3-Threats). Alternatives to the use of road salt (chlorides) exist; however, the effects of these alternatives on bridges, automobiles, SGCN and their environments may vary or be comparable to the use of chloride road salt. Different salts may have comparable ecosystem effects or effects on SGCN and the application of sand may contribute to sedimentation of streams. The development of best practices and improved data collection may help reduce the effects of road salt on Pennsylvania's SGCN and habitats.

Conservation planning - Plan the management of protected areas or sites

Primary Threat(s) Addressed:

- Residential and commercial development
- Transportation and service corridors
- Human intrusions and disturbance

Action Overview: Land-use conservation planning as a conservation action is often considered as a broad initiative for securing open space, although fish and wildlife habitat conservation or ecotourism, may occasionally be specific objectives. Undoubtedly, local zoning and planning may offer significant benefits to fish and wildlife habitat availability. Local governments can leverage various planning tools to preserve their municipality's natural assets and quality of life. These tools may include setting specific preservation goals as part of a comprehensive planning process or working with developers to achieve

these goals step-by-step. Localities are granted authority by the state legislature to adopt and implement local planning policies, regulations, permit requirements and guidelines that shape the growth of their local community.

Natural Heritage Areas (NHAs), developed by the Pennsylvania Natural Heritage Program (PNHP), largely through the County Natural Heritage Inventory initiative, are designed to inform residents about their natural heritage and provide a tool for planning the future of their municipalities. Detailed mapping for a significant subset of the SGCN identified in this Plan are presented in this product and can help inform users in the process of detailed conservation planning. The PA WAP WAM (https://wildlifeactionmap.pa.gov) and Pennsylvania Conservation Explorer (https://conservationexplorer.dcnr.pa.gov) both include NHAs as a layer and are beneficial tools for land use planning processes.

Conservation planning - Produce an operational, management, or implementation plan

Primary Threat(s) Addressed:

- Residential and commercial development
- Energy production and mining
- Transportation and service corridors
- Natural systems modifications

Action Overview: Technical Assistance can involve all SGCN and a broad range of activities (e.g., guidance on habitat encroachment, highway, airport, and mass-transit projects, pollution, herbicide and pesticide applications, habitat management) that protect environmentally sensitive habitats and species. For example, this support may include recommendations or assistance with implementing on-the-ground activities such as habitat enhancements provided through PGC's Private Landowner Assistance Program (PLAP) (PGC-PLAP 2026) or PFBC's Technical Assistance Program (TAP) (PFBC-TAP 2026) for streams and lakes. Other agencies (e.g., USDA-NRCS, County Conservation Districts) and organizations also may offer technical assistance for program needs.

Conservation planning - Produce conservation plan for taxonomic groups or species

Primary Threat(s) Addressed:

- All threats to SGCN for which conservation plans have been developed and require implementation. Threat types vary depending upon each SGCN's threat portfolio.

Action Overview: Conservation plans demonstrate critical thought for guiding SGCN recovery and management. To support conservation needs, the PGC has developed Comprehensive Management Plans for SGL that consider all SGCN on the SGL and conservation actions that can be taken to broadly benefit wildlife and their habitats. The PFBC has developed Species Action Plans detailing recovery actions that address threats, create or improve habitat, or identify research needs for specific SGCN. More broadly, at the taxonomic level, Western Pennsylvania Conservancy and PFBC jointly completed the first comprehensive Mussel Conservation Plan (WPC-PFBC 2025) https://waterlandlife.org/watershed-conservation/freshwater-mussel-conservation-plan/. Using smaller Hydrologic Unit Code (HUC) 8 and 10 watersheds, this plan identifies mussel conservation needs within each watershed and thus offers more localized context for conservation action implementation. Further,

the PFBC Climate Action Plan (PFBC 2022) https://www.pa.gov/content/dam/copapwp-pagov/en/fishandboat/documents/conservation/plans/cap_final.pdf identifies actions addressing stormwater management, erosion and sedimentation, habitat connectivity, aquatic invasive species, and additional factors influenced by climate change.

Legislative and Regulatory Framework or Tools

Create, amend, or influence legislation, regulations, or codes; Create or amend policies, guidelines, or best practices

Primary Threat(s) Addressed:

- All threats to SGCN for which legislation is required to protect and support populations and their habitats.

Legislative and regulatory frameworks or tools actions can address all threats to SGCN where legislation and regulations can best support populations and habitats.

Action Overview: State and federal legislation can greatly affect fish and wildlife program administration, species' listing status, habitat protection, and funding to implement this Plan. Consequently, a robust SGCN and associated habitat conservation action requires that legislative offices be apprised regarding this Plan, and relevant programs, for its efficient and effective implementation. Pennsylvanians support diverse and sustainable wildlife populations and broad coalitions, from hunters and anglers to birdwatchers and businesses – are willing to assist in SGCN conservation and funding endeavors.

Research and Monitoring

Basic research and status monitoring; Evaluation, effectiveness measures and learning

Primary Threat(s) Addressed:

- Other Threat Options
  - Insufficient Information

Research and monitoring actions can address the lack of sufficient information regarding species taxonomy, population size, range, threats, and needed actions.

Action Overview: Throughout the 20+ years of PA WAP implementation, great strides have been made in acquiring data, as exemplified by the number of Pennsylvania endangered, threatened, or candidate species delisted, upgraded or recovered (26) and newly listed or downgraded (30). However, there are many additional species for which data are insufficient or unavailable to fully understand a species' range, life-history requirements and population dynamics. Therefore, data collection, research, and monitoring will remain a major component of implementing the 2025 Plan, particularly for over 600 Data Deficient species (Chapter 1-Species, Appendix 1.3).

Projects conducted (e.g., research, survey or monitoring) and their focus on populations, habitat, or utilization will be contingent upon specific data gaps and may include multiple targets. For example, *research* projects may be directed towards data gathering to help guide specific management or conservation actions, when such information is unavailable or insufficient. Examples of this research include understanding needs for managing bats infected with white-nose syndrome.

For purposes of this Plan, *surveys* are initial data-gathering or baseline events, to characterize existing biota, chemical or physical conditions for planning or future comparisons (*sensu* Roni 2005), and may gather basic ecological data (e.g., species distribution, habitat associations, population structure, and life-history information). Based on best available information, most SGCN are designated as such because they are imperiled or are likely to become imperiled, without intervention. Often, these species are difficult to find because they are in low abundance, cryptic, or have life-histories that require specific environmental conditions for them to appear. For example, it has been found in West Virginia that the Spadefoot Toad (*Scaphiopus holbrookii*) requires specific levels of relative humidity and mean air temperature for emergence (Johnson 2003). Similarly, extremely rare freshwater mussels are difficult to detect in 30 feet of water with limited or no visibility at the bottom of a several mile-long navigation pool. Further, nocturnal species, other than bats, are chronically understudied (e.g., owls). For many of Pennsylvania's SGCN, insufficient funding has limited robust data collection and thus our capacity to implement adaptive management. As funding becomes available, this information can be gathered.

Monitoring may involve a specific temporal frequency for systematically sampling to detect or evaluate a change, or lack of change in a physical, chemical or biological parameter (Roni 2005). In Pennsylvania, monitoring by agency biologists and hundreds of volunteers tracked Bald Eagle (*Haliaeetus leucocephalus*) and Peregrine Falcon (*Falco peregrinus*) recovery, leading to state delisting in 2017 and 2019, respectively. Additionally, many years of monitoring have contributed to a revised Timber Rattlesnake (*Crotalus horridus)* status assessment and its delisting as a Pennsylvania Candidate species. To avoid back-sliding into a listed status, a monitoring program for long-term population trend analysis (STWG, F15AF00411) was established. This monitoring program will develop statistically reliable trend data for detecting changes in populations. If populations show a negative trend, early intervention could curtail re-listing the species. Monitoring habitats and threats to SGCN and their habitats (e.g., fragmentation, chloride concentrations, etc.) will be crucial to improving our understanding of threat impacts and effectiveness of restoration or remediation efforts.

Education and Training

Education and training actions can address the lack of sufficient information within and among agencies and partners.

Training and individual skill development

Primary Threat(s) Addressed:

- Other Threat Options
  - Insufficient Information

Action Overview: Training is important for personnel safety and management activities with long-term implications for SGCN and habitats. This need may be especially relevant for conservation actions where potentially hazardous conditions may occur (e.g., installing in-stream structures, dam removal, prescribed fire management, road salt application). Given these concerns, in this conservation action we include instructor training as well as staff training.

Additionally, continuing education for personnel engaged with SGCN and habitat management is necessary to maintain existing knowledge, skills, and abilities as well as to gain new knowledge that could lead to additional conservation actions. Among these vital skills is species identification. Many academic institutions do not provide taxonomy training beyond a basic level, and genetic testing or

photographs have pitfalls and limitations. Trained taxonomists who can consistently and correctly identify SGCN are critical to maintaining data integrity and continued knowledge-sharing to ensure their long-term viability.

Institutional Development

Alliances and partnership development

Primary Threat(s) Addressed:

- Other Threat Options
  - Insufficient Information

Institutional development actions can address the threat of siloed agencies and organizations when collaboration is paramount to conservation success.

Action Overview: Pennsylvania is fortunate to host diverse, motivated, and knowledgeable non-governmental organizations (NGOs). NGOs were instrumental throughout this Plan's development through roles such as the Advisory Committee and as taxonomic experts. Similarly, given diverse and often intensive resource needs, the technical expertise of NGOs along with their staff capacity will be essential for Plan implementation. A communications strategy, discussed in Chapter 8-Public Participation will foster this conservation action.

Conservation Action Priorities

Species account authors prioritized specific conservation actions within individual Species Accounts to direct attention to the most important actions first. Categorical options included "Highest," "High," "Medium," "Low," or "Lowest" priority. Prioritization is helpful to allocate limited resources or assets including human resources, equipment, and facilities.

Given Pennsylvania's diverse animal SGCN, it is appropriate to discuss general trends, or themes, that relate to the "Highest" and "High" Level 2 conservation actions (Fig. 4.5). For specific SGCN priorities, please see the individual Species Accounts. For broad taxonomic and geographically specific priorities, please see statewide plans, if available (e.g., mussel conservation plan (WPC-PFBC 2025)).

Overarching Themes of Level 2 Action Category Specific Actions

We examined SGCN Species Account specific actions by Level 2 action category to discern common themes within "Highest" and "High" action prioritizations. Overarching themes for Level 2 action categories comprising 71% of these top-tier actions (Fig. 4.5) are discussed below.

Manage non-living habitat components

Actions to maintain the physical, hydrological, thermal and climatic conditions that support SGCN and their habitats and allow them to thrive are consistently referenced throughout the Species Accounts. For SGCN that depend upon rivers and streams, actions that maintain existing hydrology or flow regimes capable of supporting SGCN are critical; such actions may be maintaining wetlands environments or maintaining or mimicking natural flow regimes. Conservation actions that avoid or minimize pollution risk are essential to the persistence of many SGCN. Actions that minimize or mitigate the effects of climate change (e.g., increasing water temperatures) are often prioritized within the Species Accounts and may include streambank restoration, planting or expanding riparian corridors, or encouraging sustainable forestry practices.

Manage plants, animals, fungi, or bacteria

Conservation actions that prevent new introductions of non-native species or control or manage existing invasive species are frequently cited. The range of invasive species warranting conservation attention depended upon the SGCN threatened, but include terrestrial and aquatic species such as stilt grass, knotweed, feral cats, and Norway rats. Problematic native species, while not considered invasive, can adversely affect SGCN via predation (e.g., raccoons and SGCN turtles) or habitat loss associated with overgrazing (e.g., deer). Opportunities to create, manage or restore SGCN to scarred landscapes, such as abandoned mine lands, emerged as unique Level 2 conservation actions within the Species Accounts.

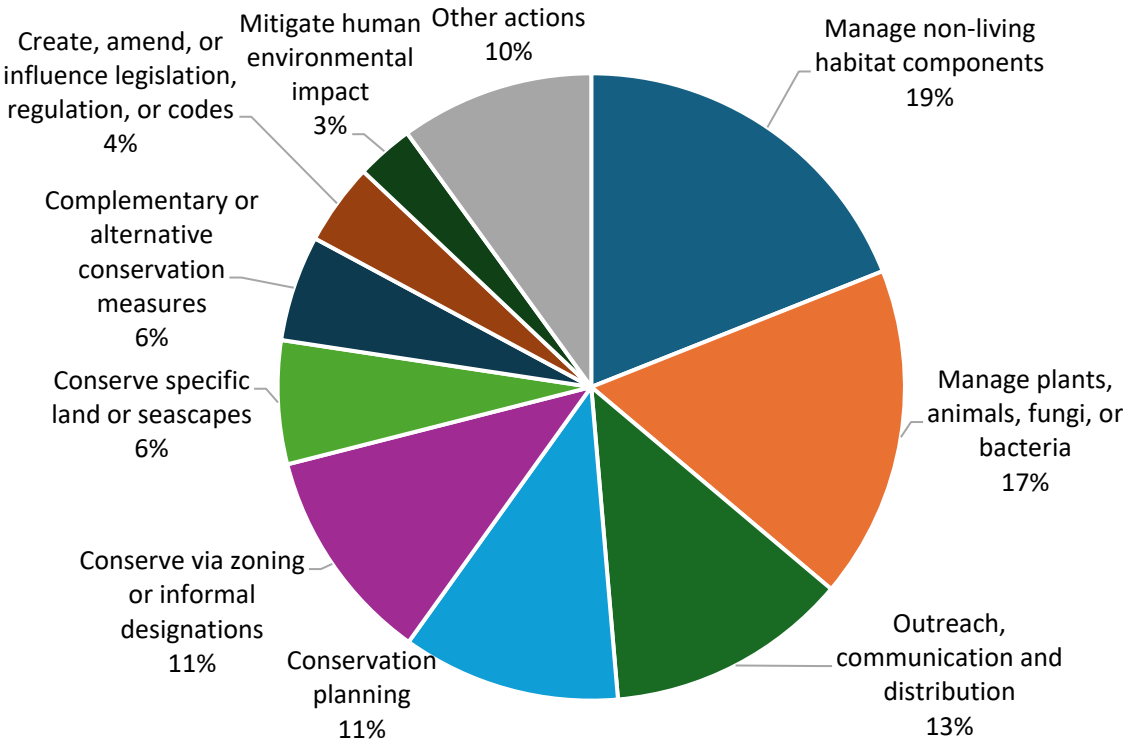

Fig. 4.5. Count frequency of Highest and High priority Level 2 Conservation Actions referenced in the SGCN Species Accounts.

Outreach, communication and distribution

Many conservation actions supporting SGCN are not time intensive, expensive, or complicated, but are not always communicated clearly to the public, landowners, partners, or other resource agencies. Developing and disseminating this information through engaging formats will assist surmounting barriers to SGCN protection and recovery. Most people and organizations share common interests, and starting conversations from those common areas may expand the range of conservation action possibilities. Examples of simple Level 2 communications include creating awareness of shorebird conservation to dog walkers, identifying native plants that benefit pollinators, and talking to landowners about the value of maintaining deep-rooted vegetation along streams.

Conservation planning

Conservation planning actions revolved around several local, statewide, and taxonomic themes. Conservation planning at the local or municipal scales is critically important to address or regulate existing or emerging threats. The incorporation of climate mitigation and resiliency into SGCN conservation planning will be necessary for the persistence of many species. Another particularly emergent theme involved terrestrial invertebrate conservation planning; this group of organisms currently does not have an agency with assigned jurisdictional responsibility. The ability to conserve terrestrial invertebrates and other invertebrate groups that do not receive much attention is reliant upon partners and interested individuals.

Conserve via zoning or informal designations

Formally evaluating potential risks to rare species for activities requiring state or federal land use permits (i.e., environmental review process) will remain a frontline conservation action to avoid or minimize impacts. Additionally, public-private voluntary conservation agreements are highlighted as a useful tool to sustain SGCN on private lands.

General Conservation Actions

The 2025-35 PA WAP is grounded in science, using the most current information available throughout Pennsylvania and the northeast region. As a science-based document though, technical terminology and on-the-ground activities can require deciphering by professional resource managers, especially when working with at-risk fish, wildlife, and habitats. We follow the premise of "do no harm" and encouraging broad public conservation action implementation wherever such actions are a priority and possible. In addition to providing specific actions to address threats, taxonomic experts noted up to five (5) General Conservation Actions to address the threat (Appendix 4.4).

A total of 32 General Conservation Actions were selected by the taxonomic experts within the Species Accounts, some with a greater frequency than others (Table 4.3). Select simple general conservation actions include turning off the lights during spring and fall bird migrations to prevent window collisions, keeping cats safely indoors, and removing trash from natural areas to prevent attracting predators.

Table 4.3. Top 10 general conservation actions, designed for broad implementation, encompassing 77% of general actions as identified by taxonomic experts during Species of Greatest Conservation Need Species Account development.

General Conservation Action Description	% Occurrence
Actively manage habitat using best practices to promote favorable habitat conditions.	20.9
Avoid or minimize use of fertilizers, herbicides, pesticides and other toxins near waterways to protect water quality and Species of Greatest Conservation Need.	11.7
Collect habitat information to guide conservation planning and implementation.	11.0
Conduct outreach to inspire and promote Species of Greatest Conservation Need protection and habitat conservation.	10.4

Remove non-native and invasive vegetation to minimize or avoid Species of Greatest Conservation Need population impacts.	4.6
Monitor species abundance and distribution over time to assess population trends.	4.3
Encourage grassroots and local governmental use of fish and wildlife conservation best practices.	4.0
Avoid or minimize use of fertilizers, herbicides, pesticides and other toxins on lawns to protect water quality and Species of Greatest Conservation Need.	3.9
Connect natural land and water habitat to support wildlife movement and aquatic organism passage.	3.4
Establish native trees, shrubs, and grasses along rivers, streams, and wetlands for erosion control and Species of Greatest Conservation Need habitat enhancement.	3.2

Relevant Management or Implementation Plans

Stewarding Pennsylvania's diverse and abundant natural resources are local, state, regional and federal partners well-aligned with 2025-35 PA WAP goals, objectives, strategies, and conservation actions and guided by their own strategic and operational plans. Partnerships are invaluable for effective and efficient conservation action implementation and this value is clearly reflected in this Plan's Goal 5, *Foster collaboration within and among public agencies and partners to advance fish and wildlife conservation planning and implementation* and - at the northeastern U.S. regional scale - by Goal 3 *Contribute to range-wide conservation of Species of Greatest Conservation Need*. Like the PA WAP, agency and partner resource management plans are dynamic and periodically updated. Thus, as implementation advances, we will continue to find synergies between the 2025-35 PA WAP and partner plans to encourage reflecting PA WAP strategies for broad implementation.

Both the PGC and PFBC maintain species recovery plans to restore listed species. PFBC plans, called Species Action Plans (https://www.pa.gov/agencies/fishandboat/conservation/species-management/threatened-and-endangered-species) are succinct, prescriptive, and PFBC-focused species recovery strategies. The USFWS maintains federal recovery plans for some SGCN.

Statewide conservation plans for some taxonomic groups have been developed. Most of Pennsylvania's freshwater mussels are SGCN and include numerous state and federal protected species. The Western Pennsylvania Conservancy and PFBC have completed a *Freshwater Mussel Conservation Plan* which is available online https://waterlandlife.org/watershed-conservation/freshwater-mussel-conservation-plan/ (WPC-PFBC 2025).

The synergistic value of aligning the goals of local, state, regional, and federal partners with PA WAP goals to conserve SGCN and habitats cannot be overstated (Table 4.4). Implementing these plans, revising plans to be considerate of SGCN and their habitats, and tracking conservation actions through the Conservation Action Tracker will be essential.

Table 4.4. Examples of state and federal plans synergistic with the 2025-2035 Pennsylvania Wildlife Action Plan.

Organization	Plan Title	Key Initiative Alignments	Link
Pennsylvania Department of Conservation of Natural Resources	Forests for All, A Plan for Pennsylvania's Forests and People	Science-based resource management supporting healthy habitats for diverse fish and wildlife populations.	PADCNR_2025_Forests for All-A Plan for PA's Forests and People
	Climate Change Adaptation and Mitigation Plan	Climate change, with insect pests, invasive species, pathogens, and other factors have broad implications for forests and other habitats.	PADCNR 2018 Climate Change Adaptation Plan Final
	Pennsylvania Land and Water Trail Network Strategic Plan 2025-2029	Trails, including water trails, provide opportunities for Pennsylvanians to learn about fish, wildlife, and their habitats.	PADCNR 2025-29 Land and Water Trail Network Strategic Plan Final Web
Pennsylvania Department of Environmental Protection	Pennsylvania Climate Impacts Assessment	Pennsylvania Climate Action Plan strategies (e.g., ecosystem restoration, ecosystem or species conservation, addressing human stressors, genetic diversity, improve connectivity) support SGCN and their habitat.	PADEP 2024 PA Climate Impact Assessment
Pennsylvania Fish and Boat Commission	Climate Action Plan	The PFBC identifies SGCN and habitats which may be especially impacted by climate change. Multiple strategies are relevant such as 1.3 (Habitat connectivity), 2.2 (Aquatic Nuisance Species), 2.3 (Species Interactions), 5.1 (Knowledge gaps), 5.2 (Conservation Planning)	PFBC 2022 Climate Action Plan
U.S. Forest Service	Allegheny National Forest (ANF)	This plan identifies several wildlife and habitat strategies aligned with the PA WAP, including wildlife, fish, and sensitive plant habitat management, controlling invasive plants, wilderness area management.	USFS ANF 2007 Land and Resource Management Plan
U.S. Fish and Wildlife Service	Cherry Valley National Wildlife Refuge Final Environmental Assessment (2008)	This plan aligns with the PA WAP by outlining broad wildlife and habitat management benefits, including for federally listed Indiana bat, Dwarf Wedgemussel, and Bog Turtle.	Contact U.S. Fish and Wildlife Service
	John Heinz National Wildlife Refuge	Goals 1, 2, and 6 of this refuge plan especially align with the PA	Contact U.S. Fish and Wildlife Service

	Comprehensive Conservation Plan (2012)	WAP by protecting native wildlife including species of conservation concern, enhancing estuarine native species diversity and migratory birds, and communicating with partners and the public.	
	Erie National Wildlife Refuge Comprehensive Conservation Plan	*Plan under development*	Contact U.S. Fish and Wildlife Service
Multiple Federal, State, Local, Private	Kittatinny Ridge Sentinel Landscape (KRSL)	Aligns with the PA WAP by increasing coordinated conservation, natural resource protection, and stewardship in the KRSL. Area is especially important for migrating raptors, Cerulean Warbler, and Eastern regal fritillary butterfly.	https://sentinellandscapes.org/landscapes/kittatinny-ridge/

Summary

The Wildlife Action Map tag line - ***Plan * Act * Share*** - succinctly reflects this chapter, and the entire Plan. Pennsylvania's SGCN require action for their recovery and, with hundreds of conservation actions needed, we encourage readers to *take action* for SGCN, habitats, or other facet for which you may have particular interest, knowledge, passion, or skill. You are vital for taking this Plan from printed page to on-the-ground project.

Throughout this chapter and, more broadly the entire document, we have developed a "***plan***" for actions needed to address diverse threats within the state and beyond. For SGCN, specific actions within the species accounts (Chapter 1- Species Accounts, Appendix 1.4) offer greater detail for the tasks needed. Yet, more than a plan is needed. We know Pennsylvanian's care deeply about natural resources (Responsive Management 2014, 2024) so we are confident of a broad, motivated, and sustained coalition of Pennsylvanians willing to "***act***" by implementing these conservation measures. Regardless of the action taken, be bold and "**share**" your efforts so others will be aware and further inspired by your initiatives. To do so, the CAT offers a convenient framework for you to document many actions supporting SGCN (https://wildlifeactionmap.pa.gov). With your enduring support over the past 20+ years, Pennsylvania has made great strides in recovering our at-risk species (see Introduction) and, we are excited to see what we can achieve together in the years ahead with this Plan as our guide.

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Appendix 4.1. Conservation Action Features

Conservation action descriptors identified by Crisfield and the Northeast Fish and Wildlife Diversity Technical Committee (2022) and used in Pennsylvania Wildlife Action Plan species accounts (Chapter 1, Appendix 1.4). Blue-filled cells (i.e., fields with an asterisk) are needed for regional roll-up.

Lexicon Terminology	Content	Explanation
***Action category**	Level 3 of the CMP Classification System, wherever possible	Every action should be classified according to the system to facilitate regional synthesis of common actions. States are welcome to use Level 4 if helpful.
***Action**	Narrative unique to action	Unique action/species or action/habitat combination
***Objective**	A concise statement of the objective of the action	An objective is a specific, measurable, achievable, relevant, and time-bound (S.M.A.R.T) statement that describes the desired short, medium, or long-term outcomes of a conservation action.
***Purpose**	A narrative statement identifying Species or Habitats directly benefiting from the action, or threats being reduced by the action	Linking an action to a threat (Element 3) and to the resource that will benefit such as target species (Element 1) or habitats (Element 2) provides a clear explanation of the motivation for the action and begins to reveal the results chain linking the strategy to the threat and the expected ecosystem response to mitigating the threat.
***Partners**	Partners can be kinds of land managers (e.g., farmers, private landowners) or specific agencies.	A land owner, organization, or agency responsible for managing the action and/or partners that should be consulted or engaged. For common partners, refer to the provided list of national and regional organizations for consistent names (Appendix D)
***Linked Species**	Species linked by database key	Species intended to benefit from the action
***Linked Habitats**	Habitats linked by Habitat Type	Habitats intended to benefit from the action
***Linked Threats**	Threats linked at Level 3 (or higher level if necessary)	Threats addressed by the action to lessen impacts to species and habitats.
***Urgency**	The urgency of the action should estimate the ideal timeframe for completing the action. Categories: • Initiate immediately • Initiate within 5 years • Initiate within 5-10 years • Can wait 10 years to initiate	This is a relative estimate of the urgency of the action given the severity of the threats and the priority of the species or habitat
***Likelihood of Success**	To what degree will the action address the threat or improve	

	species' populations or habitats? Categories • Unlikely/Unknown <30% (not tested/implemented anywhere) • Likely 30-90% (e.g., Best Management Practices or sufficient information available) • Certain/Very Likely 90-100% (demonstrated by other projects)	
***Duration**	How long will action take to complete (or need to persist)? • <2 years • 2-10 years • Regular maintenance (>10 years	
Likelihood of Implementation	Can the action be implemented: Categories • Unlikely/Unknown (<30%) • Likely (30-90%) • Certain/Very Likely (90-100%)	
Benefits	Depending on the action, benefits (direct or indirect) may be habitat improvements, species' responses, reductions in threat risk, or public or stakeholder benefits.	These answers will likely be suggested by defining what the action is and why it is being taken. However, efforts to prioritize actions will probably require specific benefits to be considered. Answering this question clearly may also help define the measures of project success. It may be helpful to explain the direct benefits and contrast them with the indirect benefits.
Estimated Costs	This should include total future costs in current dollar values, but not include any past expenses for infrastructure that will be used by proposed action. Categories: • Unknown • < $20,000 • $20,000 - $99,999 • $100,000 - $499,999	If action descriptions are intended to be used for action prioritization, cost estimates, even very rough ones, may be helpful. Estimates are available from business plans, Joint Ventures, and Partners in Flight. For prioritization purposes, states may choose to calculate cost/acre treated or cost/species to compensate for the fact that multi-species projects may be more expensive than single species projects. A very detailed process for action prioritization is described and evaluated in "Optimal Allocation of Resources among Threatened Species: a Project Prioritization Protocol" (Joseph et al. 2009).

	• > $500,000	States may add subcategories as needed but should avoid using the unknown category if possible.
Constraints/ Other factors	Describe constraints	For example: Agency Authority, Regulations or Administrative, Environmental (risks to other habitats/SGCN), or Funding resources, Staff capacity
Performance Metric	From Wildlife TRACS or other more specific sources	The performance metric is how success is measured and defined.
Location	Most states will use counties or watersheds which is consistent with Wildlife TRACS. However, some states are using TNC ecoregions or physiographic provinces.	Although County and Watershed are the most common spatial units being used by states for SWAPs and are the units endorsed by Wildlife TRACS, some actions will require more specific location information and others may be more appropriately tied to ecoregions or physiography. Aside from the habitat type, descriptions of where actions take place may include specific locations around the state, specific sites within a smaller locale, or any other geographical designation appropriate to the action. If the action requires monitoring, this description may complement the use of a standard protocol by defining the sampling strategy in a spatial context.

Appendix 4.2. Conservation Action Classification Hierarchy

Hierarchical classification of conservation actions used in the 2025-35 PA WAP based on Conservation Measures Partnership (CMP) V 4.0 (Conservation Measures Partnership 2020).

Level 0 Active restoration and stress reduction measures		
	Level 1 Direct habitat management	
		Level 2 Manage plants, animals, fungi, or bacteria
		Level 3
		Mechanical management - plants
		Biological management - plants
		Chemical management - plants
		Mechanical management - animals
		Biological management - animals
		Chemical management - animals
		Level 2 Manage non-living habitat components
		Level 3
		Manage hydrological regimes
		Manage fire regime
		Manage physical and/or chemical habitat characteristics
		Manage erosion and sedimentation
		Manage structural habitat elements
		Level 2 Mitigate human environmental impact
		Level 3
		Manage access
		Manage litter and waste
		Remove and improve anthropogenic infrastructure
		Decontamination
	Level 1 Direct species management	
		Level 2 Stewarding wild individuals
		Level 3
		Creating species-specific artificial structures
		Provide food and/or water
		Promote reproduction in the wild
		Manage wildlife health in the wild
		Prevent mortality or injury from humans
		Facilitate dispersal or migration
		Level 2 Reintroduce or relocate individuals
		Level 3
		Reintroduce species
		Augment existing populations

		Colonize new areas
	Level 2 Stewardship of captive individuals	
		Level 3
		Care and treatment for individual animals
		Breeding or raising outside of natural habitat
		Gene or seed banking
Level 0 Encourage beneficial human behavior		
Level 1 Outreach		
	Level 2 Outreach, communication and distribution	
		Level 3
		Promotion and marketing
		In-person events
		Targeted communication
		Public outreach and information
		Assistance to public inquiry
	Level 2 Detection and intervention	
		Level 3
		Surveillance and patrols
		Intervention
	Level 2 Prosecution and conviction	
		Level 3
		Prosecution
		Penalties
	Level 2 Other legal actions	
		Level 3
		Challenge and judicial review
Level 1 Economic and other incentives		
	Level 2 Conservation business development	
		Level 3
		Conservation companies
	Level 2 Development of improved products and production methods	
		Level 3
		Products
		Production methods
	Level 2 Market-based incentives	
		Level 3
		Green certification of products and services
		Create a carbon exchange program
		Green funding program
	Level 2 Economic incentives and disincentives	
		Level 3

		Direct payment for desired behavior or outcomes
		Tax undesirable behavior
		Reward the value of ecological services
		Monetary prizes and awards
	Level 2 Non-monetary benefits	
		Level 3
		Health and social benefits
		Safety and security benefits
		Spiritual and cultural benefits
Level 0 Create favorable conditions for conservation		
	Level 1 Design and plan conservation	
	Level 2 Conserve specific land or seascapes	
		Level 3
		Acquire title for conservation purposes
		Conserve without acquisition (legally binding)
	Level 2 Complementary or alternative conservation measures	
		Level 3
		Designate sustainable use area(s)
		Acquire specific rights to certain resource
		Establish temporary or transitional protection
		Establish legal or regulatory constraints
		Establish voluntary conservation agreement (stewardship)
	Level 2 Conserve via zoning or informal designations	
		Level 3
		Designate informal conservation areas (not legally binding)
		Designations and restrictions to prevent habitat degradation or conversion
		Administrative protective measures
	Level 2 Conservation planning	
		Level 3
		Plan the management of protected areas or sites
		Produce conservation plan for taxonomic groups or species
		Plan for thematic projects or programs
		Produce an operational, management, or implementation plan
	Level 2 Protect resources with site infrastructure	
		Level 3
		Site and personnel protection
		Infrastructure related to the direct management of a site
		Tourism and recreation
		Learning and research
		Administration
		Resource extraction infrastructure

		Transportation infrastructure
Level 1 Legislative and regulatory framework or tools		
	Level 2 Create, amend, or influence legislation, regulation, or codes	
		Level 3
		Create, amend, or influence treaties
		Create, amend, or influence legislation
		Create, amend, or influence regulation
	Level 2 Create or amend policies, guidelines, or best practices	
		Level 3
		Create or amend policies
		Create or amend best practices or guidelines
		Create or amend standards
		Create memoranda of understanding
Level 1 Research and monitoring		
	Level 2 Basic research and status monitoring	
		Level 3
		Field research
		Ex-situ research
		Consult indigenous communities and other stakeholders
		Compilation and analysis tools
		Literature search and analysis
	Level 2 Evaluation, effectiveness measures and learning	
		Level 3
		Project evaluations
		Cross-project or program evaluations
Level 1 Education and training		
	Level 2 Academic training	
		Level 3
		Courses, modules and lessons
	Level 2 Training and individual skill development	
		Level 3
		Practical coaching and technical assistance
		Workshops and professional development training courses
		Preparing educational materials and training programs
Level 1 Institutional development		
	Level 2 Administration and internal organizational management	
		Level 3
		Administration and project delivery
	Level 2 External support and organizational development	
		Level 3
		Direct support services

		Establishment and organizational support and capacity
		Developing and delivering organizational services
		Financial support for hiring employees
Level 2 Alliance and partnership development		
	Level 3	
	Building alliances with other collaborators	
	Maintaining or strengthening relationships	
	Facilitating consultations and engagement within organizations	
	Knowledge exchange	
Level 2 Conservation funding		
	Level 3	
	Securing/raising funds required to carry out conservation measures	

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Appendix 4.3. Prescribed fire in Pennsylvania: An essential tool for Species of Greatest Conservation Need recovery

Bryan Whitmore[1], Scott Bearer[2], Roger Latham[3]

[1]Pennsylvania Game Commission Bureau of Wildlife Habitat Management Fire Program Manager; [2]Pennsylvania Game Commission Bureau of Wildlife Management Wildlife Recovery Division Chief; [3]Pennsylvania Biological Survey and Continental Conservation

Conservation Problem Statement

Over the last century, fire-dependent and fire-maintained habitats have declined substantially in terms of extent, quality, and connectivity. This decline is particularly apparent over the last several decades, as fire suppression has become increasingly effective and a variety of other factors (e.g. white-tailed deer over browsing, oak regeneration failure, insect [spongy-moth] defoliations, shrubland senescence, woody encroachment into historic grasslands, and mesophication and homogenization of forest structure) have steered fire dependent habitats onto an alternate trajectory of succession. Often, novel habitat types resulting from fire-suppression have reduced habitat suitability for many Species of Greatest Conservation Need (SGCN). In addition, accumulated fuels from decades of effective fire suppression have increased the risk of high-severity wildfires, further threatening communities and ecosystems. Without a measured increase in the application of prescribed fire, there is the risk of continued habitat degradation, negative impacts from catastrophic wildfires, and further SGCN declines across the Commonwealth.

Purpose and Rationale

Prescribed fire is an essential ecological process for conserving Pennsylvania's biodiversity and restoring habitats used by SGCN. Many of the Commonwealth's SGCN are closely associated with fire-adapted habitat conditions including young forest, barrens, woodlands, savannas, grasslands, and old fields that occur in every physiographic region of the state (Figure 4). These habitats and their various successional stages evolved under frequent, low to moderate intensity fire disturbances (Nowacki & Abrams 2008; Dems et al. 2021). Decades of fire exclusion, in addition to several other biotic and abiotic factors, have altered the habitat structure, shifted species composition toward shade-tolerant or invasive species, reduced herbaceous species richness, and altered or reduced disturbance regimes required to perpetuate these habitats and the SGCN that rely on them (Nowacki & Abrams 2008; Hutchinson et al. 2025). Therefore, strategically expanding the use of prescribed fire as a habitat restoration and maintenance tool will be essential to meet Pennsylvania Wildlife Action Plan (PA WAP) objectives for habitat restoration, SGCN recovery, and long-term ecological resilience.

Pennsylvania Fire History

For thousands of years, fire has been a recurring and influential disturbance in Pennsylvania, shaping species' composition, structure, and function of our ecosystems (Stambaugh et al., 2014, 2018; Marschall et al. 2022). Until the early 20th century, fire was a common and widespread disturbance, often caused by lightning strikes, cultural burning by Native Americans or colonial settlers, or from industrialization actions (railroad sparks) (Figure 1). These frequent fire disturbances along with

other anthropogenic land management practices, maintained an extensive network of oak and pine woodlands, savannas, barrens, and grasslands (Tulowiecki et al. 2023).

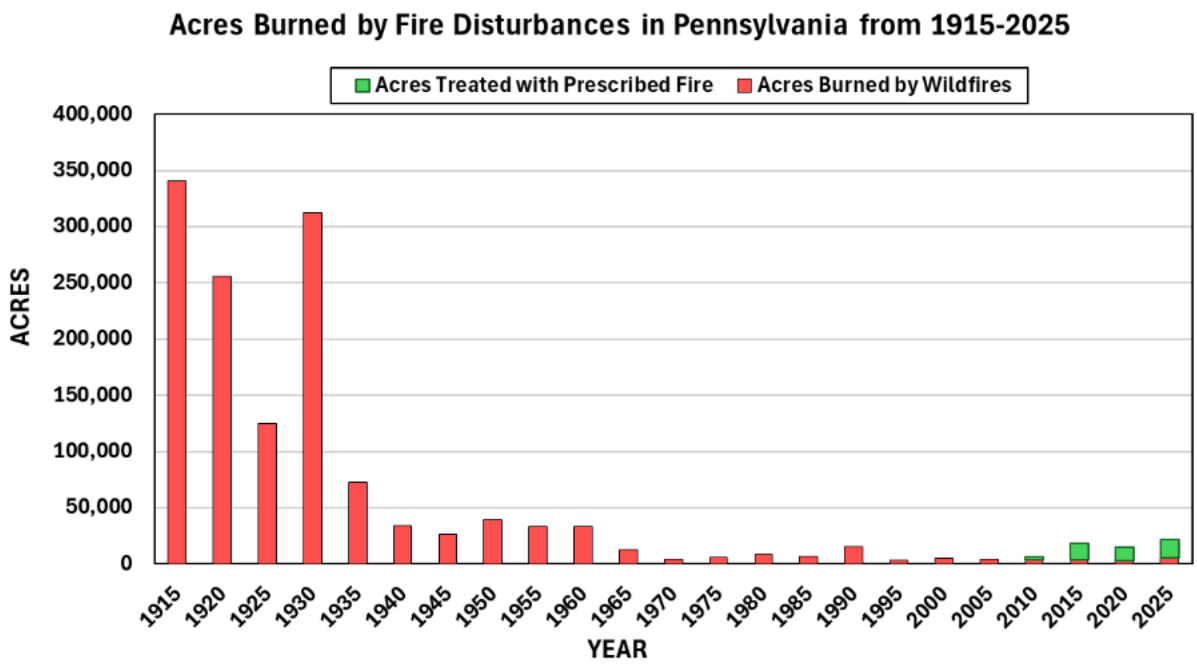

Figure 1. Acres treated with prescribed fire and acres burned by wildfires across Pennsylvania from 1915-2025, as publicly reported by the Department of Conservation and Natural Resources (DCNR) Bureau of Forestry (PA DCNR 2025).

Total acres burned per year by wildfires and average size of each wildfire has significantly declined since the early 20th century. For reference in 1915, there were 1,080 wildfires that burned 340,634 acres with each fire burning an average of 315 acres. In 2025, there were 1,536 wildfires that burned 5,527 acres with each fire burning an average of 3.6 acres (Figure 1). This decline is directly correlated with numerous pieces of federal and state legislation, focused on rapid wildfire detection and swift suppression, that were passed in the early 20th century, including the 1915 Pennsylvania Forest Fire Protection Act (PFFPA). Over the last century, this legislation, among others, has shaped the culture and perception of fire in Pennsylvania that persists today.

In 2009, the Pennsylvania Prescribed Burning Practices Act (PPBPA) was enacted, establishing a legal and regulatory framework to facilitate the use of prescribed fire as a land management tool across the Commonwealth. The Act formally recognizes prescribed burning as beneficial for public safety, ecological integrity, and resource management, including its role in reducing fuel loads and maintaining fire-dependent ecosystems. The passage of the PPBPA was influenced in part by the 2005 PA WAP, which identified numerous SGCN that depend on fire-adapted habitats (see PGC-PFBC 2015).

While the PPBPA enabled reintroduction of fire to Pennsylvania's landscapes, substantial challenges persist. Deeply ingrained cultural norms, risk perceptions, and public discomfort with fire, shaped in part

by longstanding fire suppression policies following the 1915 PFFPA, continue to constrain broader acceptance and implementation of prescribed burning. A coordinated and sustained effort is required to shift public perceptions and cultural attitudes regarding the role and benefits of prescribed fire. This will necessitate comprehensive outreach and education initiatives that clearly communicate its ecological, economic, and public safety advantages. Prescribed fire is a critical tool for restoring ecosystem function, enhancing biodiversity, and reducing hazardous fuel loads that contribute to severe wildfires.

In parallel, there must be a deliberate expansion in both the frequency and scale of prescribed fire across public and private lands to effectively maintain and restore the millions of acres of ecosystems that evolved under recurrent fire regimes. Increasing prescribed fire application will also create valuable opportunities for public engagement, workforce development, and experiential learning, thereby strengthening long-term support through education, training, and community involvement.

Fire Suppression Impact on Ecosystems

Over the past century, fire suppression and land-use change have greatly reduced the extent and frequency of natural fire disturbances, disrupting the ecological processes that historically maintained open woodlands, grasslands, shrublands, and barrens in Pennsylvania. In fire-adapted ecosystems, periodic fire historically limited the establishment and spread of woody vegetation, maintained open conditions, and reduced vegetation fuel loads, thereby promoting herbaceous and shrub species adapted to frequent disturbances and increased light conditions (WeConservePA 2025; Ling et al. 2023).

In these habitats, the absence of fire has resulted in the accumulation of organic duff, woody encroachment, and non-native plant invasion, which outcompete native grasses and forbs for light and soil resources, thereby altering soil conditions and reducing viability of fire-dependent species (Breininger et al. 2000; Fuhlendorf & Engle 2001; Ling et al. 2023; WeConservePA 2025). Ecological research shows that reduced fire frequency allows tree and shrub species to gain dominance, shading out fire-dependent grasses and shrubs, ultimately shifting successional trajectories toward closed canopy forests (Collins & Gibson 1990; Ling et al. 2023).

In many Pennsylvania physiographic regions, decades of fire exclusion have allowed uninterrupted succession in these fire-adapted habitats, enabling closed-canopy forests to now dominate the landscape which has effectively eliminated the extensive patches of open woodlands, grassland, shrubland, and barrens historically supporting diverse, fire-dependent plant and wildlife communities. In the absence of frequent fire, shade-tolerant, fire-sensitive tree species such as red maple (*Acer rubrum*), American beech (*Fagus grandifolia*), and various birch species (*Betula* spp.) increasingly recruit and occupy understory and mid-story strata, outcompeting fire-adapted oaks and pines (Nowacki & Abrams 2008). This shift in species composition contributes to a process termed mesophication (Figure 2). Mesophication results in cooler, darker, and more humid microenvironment with less flammable fuels, further inhibiting fire spread and reinforcing canopy closure (Nowacki & Abrams 2008). As mesophication proceeds, positive feedback loops between vegetation and microclimate increasingly favor fire-intolerant, shade-tolerant species over fire-adapted

species, further homogenizing forest structure and making the landscape less hospitable to many SGCN (Nowacki & Abrams 2008; Alexander et al. 2021).

Restoring historical fire regimes through prescribed burning is recognized in both ecological literature and the PA WAP as a key conservation action needed to reestablish and maintain early successional, fire-maintained habitats that are critical for many SGCN.

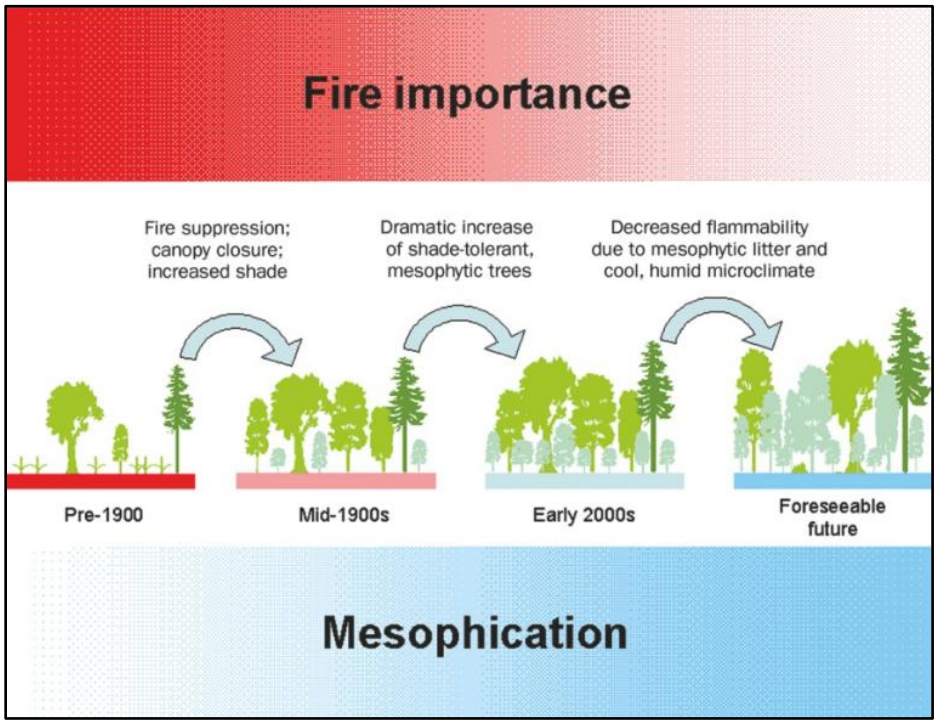

Figure 2. Mesophication illustration from Nowacki & Abrams (2008). Temporal changes in fire importance (fire frequency and severity) and mesophication (development of cool, moist understory conditions) for oak-pine ecosystems in the eastern United States. Olive green trees represent oaks, dark green trees represent pines, and aquamarine trees represent mesophytic species (e.g., red maple).

Ecological Effects and Ecosystem Resilience

Prescribed fire serves as a primary management tool for interrupting the mesophication cycle and restoring ecological function in fire-adapted ecosystems. By reducing midstory stem density and foliage, repeated burning increases understory light availability, creating conditions that are more favorable for oak and pine regeneration (Dems et al. 2021; Vander Yacht et al. 2025). This increase in light, coupled with reductions in litter and competition, enhances seedling growth and improves the ability of fire-adapted species to recruit into the overstory. Prescribed fire also consumes accumulated leaf litter and surface fuels, accelerating nutrient cycling while maintaining ecosystem nutrient pools and stimulating soil processes that support plant growth (Little & Moore 1953; Smithwick et al. 2021; Clark et al. 2024). In doing so, it promotes exposed mineral soil conditions that facilitate native herbaceous plant and shrub germination, while also restoring key ecosystem functions such as carbon and hydrologic cycling.

When applied deliberately and repeatedly under controlled conditions, prescribed fire mimics the low-intensity disturbance regimes under which many eastern ecosystems evolved, thereby sustaining fire-adapted vegetation communities and ecological processes (Hutchinson et al. 2025). Repeated burning reduces the accumulation of fine, fast-drying fuels (e.g., "1-hour fuels"), disrupts fuel continuity, and results in more heterogeneous fuel beds, which in turn produce lower-intensity and less uniformly distributed future fires. This feedback not only reduces the likelihood of high-severity wildfire but also enhances structural complexity by creating a shifting mosaic of open ground, herbaceous cover, shrubs, and regenerating trees across the landscape (Stutzman et al. 2025). These heterogeneous conditions are critical for supporting SGCN, including forest and grassland birds, reptiles, pollinators, and fire-adapted plant communities. Additionally, by reducing woody debris and fuel loads while promoting disturbance-adapted species, prescribed fire strengthens ecosystem resilience to future stressors such as climate variability, insect outbreaks, and other disturbances (Dudley & Lajtha 1993; Hutchinson et al. 2025).

Collectively, these processes restore understory light regimes, nutrient dynamics, habitat complexity, and fuel structures necessary to recover and sustain Pennsylvania's fire-adapted ecosystems and the SGCN that depend on them.

As climate change impacts temperature and precipitation patterns (PA DEP 2024), conditions favorable to wildfire (such as higher heat; more frequent, prolonged, and severe droughts; and resulting lower fuel moisture) are expected to become more common in the Northeastern U.S. and Pennsylvania, lengthening fire seasons and increasing wildfire risk (Clark et al. 2014). In this context, proactively using prescribed fire will be increasingly important. Without such measures, ecosystems will continue to accumulate higher fuel loads and lose adaptive fire dynamics, making them more susceptible to the increasingly frequent and higher intensity wildfires that are harder and more costly to control, as well as cause more damage to both natural ecosystems and human communities (Ross et al. 2025; Clark et al. 2024).

The conditions mentioned in Ross et al. 2025 and Clark et al. 2024 are already occurring regularly across Pennsylvania. From 2020 – 2025 record warm temperatures and prolonged droughts have led to recurring record wildfire seasons both in the number of large destructive wildfires and costs to suppress them. In 1915, 1080 wildfires burned 340,634 acres (315-acre average size) with a total suppression cost of $27,155 or $0.08 per acre. In 2025, 1,536 wildfires burned 5,527 acres (3.6-acre average size) with a total suppression cost of $2,179,752 or $394.38 per acre. When adjusted for inflation, $0.08 in 1915 would be $2.52 in 2025. The cost disparity between $2.52 and $394.38 per acre demonstrates the unsustainable increase in wildfire suppression costs that have occurred over the last century.

The average wildfire size has significantly decreased since 1915 but the economic costs to suppress them have grown exponentially Figure 3). Maintaining the current wildfire suppression tempo and culture is not only disrupting natural ecosystem processes and resilience but is quickly becoming a sizeable economic cost for the state. A "let burn" or "managed wildfire" policy should be considered across state agencies to allow some wildfires to burn that are not a risk to the public and are achieving SGCN habitat objectives, while others are quickly suppressed that pose a significant risk to life or property. This type of policy will benefit both SGCN and citizens of this Commonwealth.

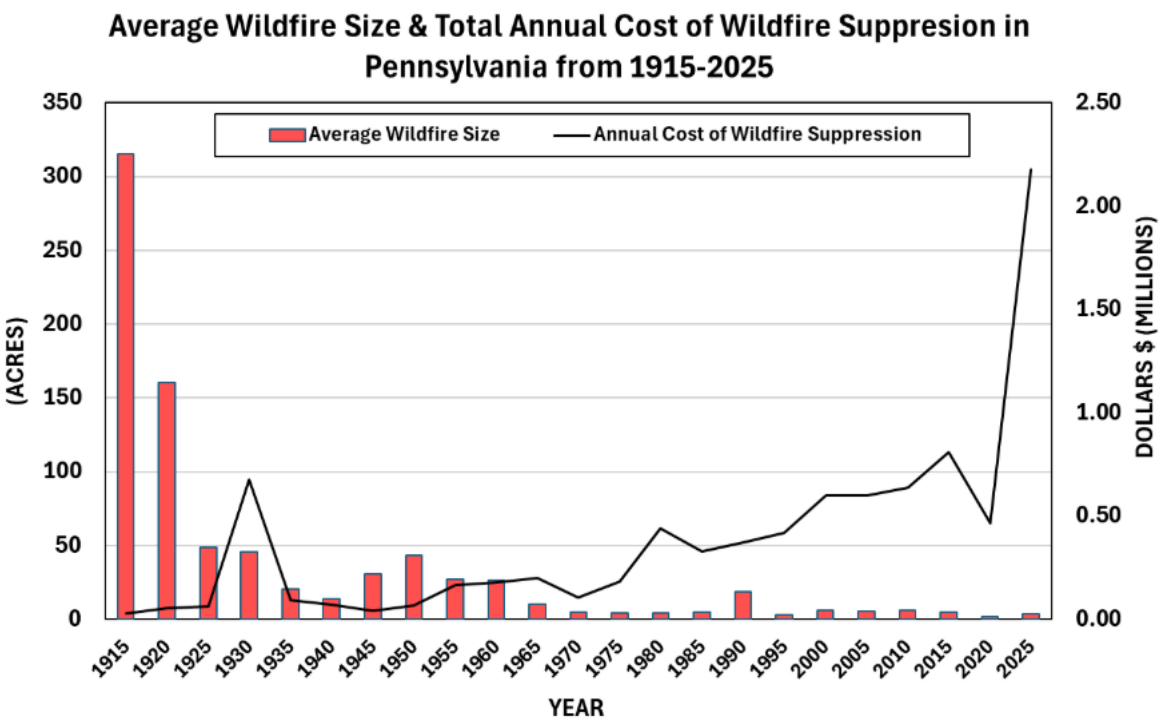

Figure 3. The average wildfire size and total annual wildfire suppression costs in Pennsylvania from 1915 to 2025, as reported by the Department of Conservation and Natural Resources (DCNR) Bureau of Forestry (PA DCNR, 2025).

Habitats Requiring Prescribed Fire

Forests & Woodlands

Forests and woodlands support unique SGCN but open forest habitats are limited and declining due to widespread overstory canopy closure, poor oak regeneration, mesophication, and loss of understory native shrub and herbaceous diversity. Prescribed fire can be used to restore and maintain forests and open woodland conditions, reduce mesophytic competition, and sustain the native ground-layer diversity required by many declining wildlife species.

Select SGCN supported by forest and woodland habitats:

- Birds: Red-headed Woodpecker (*Melanerpes erythrocephalus*), Eastern Whip-poor-will (*Antrostomus vociferus*), Golden-winged Warbler (*Vermivora chrysoptera*), Ruffed Grouse (*Bonasa umbellus*)
- Mammals: Allegheny woodrat (*Neotoma magister*), northern long-eared bat (*Myotis septentrionalis),* Indiana bat (*Myotis sodalis*), eastern fox squirrel (*Sciurus niger*), Maryland shrew (*Sorex fontinalis*), Appalachian cottontail (*Sylvilagus obscurus*), snowshoe hare (*Lepus americanus*), little brown bat (*Myotis lucifugus*)

- Reptiles: eastern box turtle (*Terrapene Carolina*), eastern hog-nosed snake (*Heterodon platirhinos*), timber rattlesnake (*Crotalus horridus*), wood turtle (*Glyptemys insculpta*), shorthead garter snake (*Thamnophis brachystoma*)
- Invertebrates: persius duskywing (*Erynnis persius*), regal fritillary (*Argynnis idalia*), monarch butterfly (*Danaus plexippus*)

Select native plants associated with these habitats include wild lupine (*Lupinus perennis*) and yellow giant hyssop (*Agastache nepetoides*).

Glades, Barrens, & Savannas

The glade, barren, and savanna ecosystems that occur across Pennsylvania are among the most imperiled habitats identified in the PA WAP. Frequent prescribed fire is required to maintain shrub dominance, prevent tree encroachment, and sustain nutrient-poor conditions that support highly specialized SGCN.

Select SGCN supported by glades, barrens, and savanna habitats:

- Birds: Golden-winged Warbler (*Vermivora chrysoptera*), Eastern Whip-poor-will (*Antrostomus vociferus*), Prairie Warbler (*Setophaga discolor*), Yellow-breasted Chat (*Icteria virens*)
- Mammals: Appalachian cottontail (*Sylvilagus obscurus*), snowshoe hare (*Lepus americanus*)
- Reptiles: timber rattlesnake (*Crotalus horridus*), eastern fence lizard (*Sceloporus undulatus*), rough green snake (*Opheodrys aestivus*)
- Invertebrates: frosted elfin (*Callophrys irus*)

Select native plants associated with these habitats include scrub oak (*Quercus ilicifolia*), new jersey tea (*Eanothus americanus*), and round-leaf sundew (*Drosera rotundifolia*).

Shrublands & Grasslands

Shrublands and grasslands are critically limited and declining in Pennsylvania. Prescribed fire treatments, when integrated with periodic mowing, tillage, herbicide, or grazing can improve native plant dominance, reduce woody encroachment, and increase habitat heterogeneity at various scales.

Select SGCN that rely on shrubland and habitats:

- Birds: Grasshopper Sparrow (*Ammodramus savannarum*), Henslow's Sparrow (*Centronyx henslowii*), Eastern Meadowlark (*Sturnella magna*), Yellow-breasted Chat (*Icteria virens*), Upland Sandpiper (*Bartramia longicauda*), Bobolink (*Dolichonyx or yzivorus*), Northern Harrier (*Circus hudsonius*), American Barn Owl (*Tyto furcata*), Short-eared Owl (*Asio flammeus*)

- Mammals: prairie deermouse (*Peromyscus maniculatus bairdii*), North American least shrew (*Cryptotis parva*), Indiana bat (*Myotis sodalis*), little brown bat (*Myotis lucifugus*), Alleghanian spotted skunk (*Spilogale putorius*)
- Invertebrates: monarch butterfly (*Danaus plexippus*)

Select native plants associated with these habitats include little bluestem (*Andropogon scoparius*) and yellow prairie grass (*Sorghastrum nutans*).

Non-Tidal Wetland, Riparian & Floodplains

While not universally applicable in all wetlands or riparian systems found in Pennsylvania, prescribed fire can be a useful tool to manage riparian areas, floodplains, and other non-tidal wetlands such as shrub wetlands, marshes, and fens. Fire can help maintain open conditions and suppress tree encroachment, especially by red maple, sweet birch, and black gum. Prescribed fire is regularly used in conjunction with herbicide treatments to combat non-native species such as common reed (*Phragmites* spp.) in native wetland or riparian habitats.

Select SGCN supported by riparian, floodplains, and non-tidal wetland habitats:

- Birds: American Bittern (*Botaurus lentiginosus*), Least Bittern (*Botaurus exilis*), Marsh Wren (*Cistothorus palustris*)
- Amphibians: Jefferson salamander (*Ambystoma jeffersonianum*)
- Invertebrates: Baltimore checkerspot (*Euphydryas phaeton*)

Select native plants associated with these habitats include swamp pink (*Helonias bullata*) and American globeflower (*Trollius laxus*).

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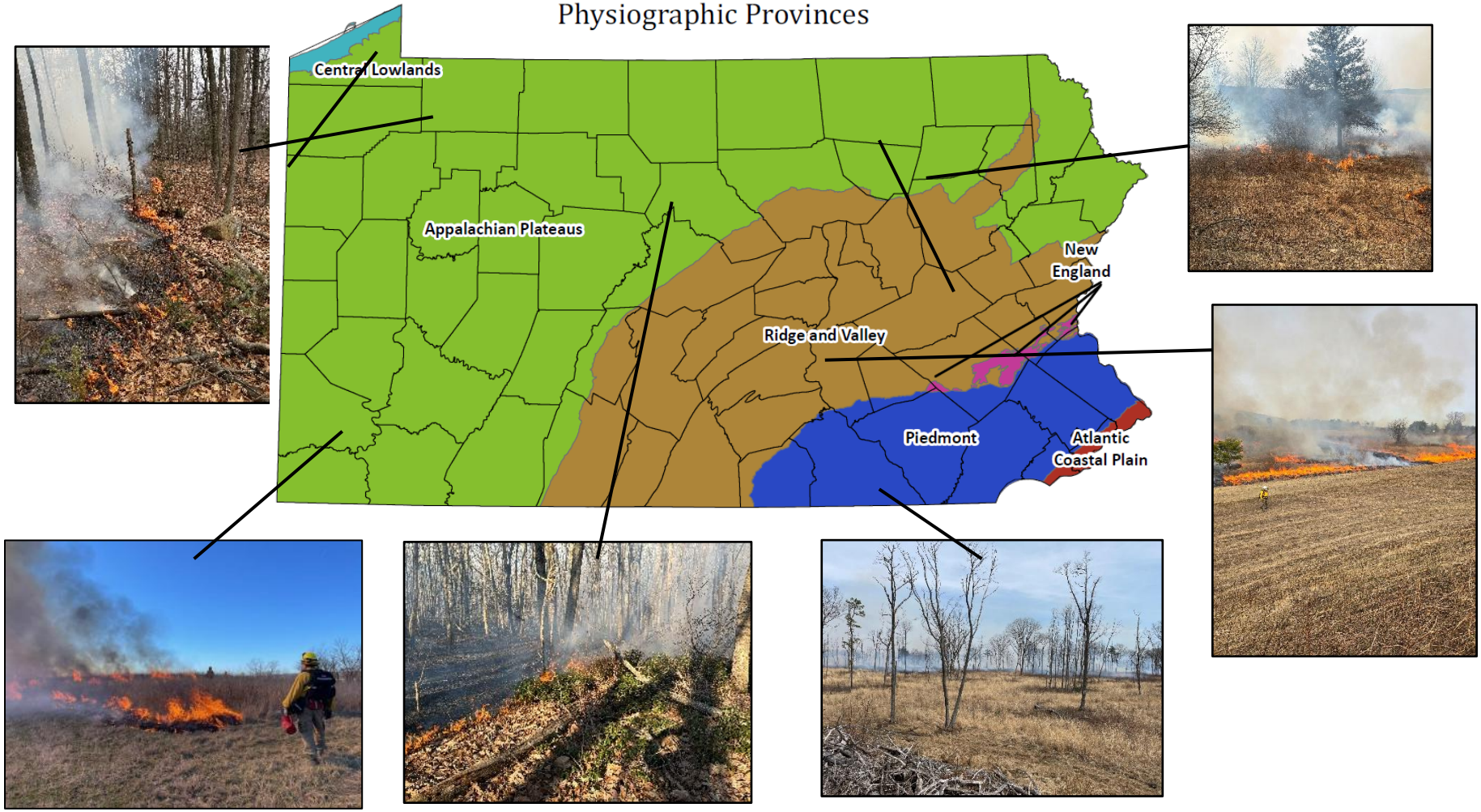

Figure 4. Fire is an essential ecological process that has helped shape every physiographic region in Pennsylvania. There are pyric (fire dependent) habitats in each of the physiographic regions within the state, including but not limited to wetlands, old fields, scrub oak shrublands, oak woodlands and savannas, barrens complexes and grasslands. All require fire disturbances to persist and support Pennsylvania Species of Greatest Conservation Need.

Prescribed Fire on Private Land

The desire to use prescribed fire on private land for ecological benefits is significant and growing. (Regmi et al. 2025). The recently established Certified Prescribed Burn Manager (CPBM) program following 2009 Pennsylvania Prescribed Burning Practices Act passage provides a critical mechanism for expanding prescribed fire use on private lands. The act required the creation of a formal training and certification process, while also providing liability protection to practitioners that possess the CPBM certification. Overall, the CPBM program provides the framework to address primary barriers to private land burning, namely lack of technical expertise and liability protection from the state (PAPFC 2026).

Given that more than 84% of Pennsylvania's land area (and 70% of its forestland) is privately owned (see Chapter 2-Habitats), and that prescribed fire has been infrequently implemented on private lands, expanding prescribed fire beyond current public land applications will be key to meeting long-term PA WAP objectives and reversing SGCN declines across the Commonwealth. CPBMs can plan and lead burns that meet ecological objectives while adhering to safety, smoke management, and contingency standards consistent with state law. This program enables agencies to leverage non-governmental capacity by empowering trained private practitioners, consultants, land trusts, and cooperative Prescribed Burn Associations (PBA) to conduct prescribed fires beyond the limits of public agency staffing or capabilities. When paired with technical assistance, cost-share incentives, and landscape-level prioritization, the CPBM program allows Pennsylvania to scale prescribed fire across fragmented ownerships, improve habitat connectivity, and deliver meaningful gains for SGCN on private lands.

Partnerships

Achieving prescribed fire goals and habitat objectives for wildlife will require strong, durable partnerships across federal, state, county, and municipal governments and non-governmental organizations (NGOs). Core public partners include the Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Game Commission, Pennsylvania Fish and Boat Commission, U.S. Forest Service, U.S. Fish and Wildlife Service, and the Pennsylvania Department of Environmental Protection. Coordination among these agencies is essential to align burn priorities, share qualified personnel and equipment, streamline burn approvals and smoke management processes, and implement landscape-scale burns that transcend jurisdictional boundaries. Interagency agreements and shared training – such as joint training academies and standardized personnel qualifications – will be necessary to efficiently expand prescribed fire capacity while maintaining high safety and ecological restoration standards.

Local governments should be recognized as an important additional partner in expanding prescribed fire and habitat restoration. Townships, boroughs, cities, counties, and local park authorities collectively manage or influence thousands of acres of parks, recreation areas, rights-of-way, and other green spaces across Pennsylvania. DCNR identifies local parks as important community assets and provides technical support and grant funding to Pennsylvania communities for local park development and management. The PA WAP should therefore encourage municipalities and other local governments to evaluate appropriate sites for prescribed fire as part of broader natural-resource and park-management planning, particularly where degraded lawns, old fields, or other open spaces could be restored to native meadow, grassland, prairie, or shrubland habitat.

State agencies and conservation partners should provide municipalities with technical assistance, planning resources, training opportunities, and connections to CPBMs, PBAs, and qualified burn crews. Municipal participation could include identifying suitable public lands, incorporating prescribed fire into park and open-space management plans, coordinating public communication and access restrictions, and developing partnerships with neighboring municipalities and local fire departments. Regional approaches could allow multiple municipalities to coordinate equipment, personnel, training, and burn planning, increasing the feasibility of prescribed fire on smaller and fragmented parcels. Pennsylvania already recognizes the value of regional partnerships among municipalities and fire organizations for coordinating resources and training, providing a potential model for building local prescribed-fire capacity.

Prescribed fire may also contribute to integrated invasive-species management and reduce the frequency and scale of herbicide treatments. Fire can suppress or reduce some invasive plant species and can be particularly useful when incorporated into a broader restoration strategy that includes follow-up treatment, native-seed establishment, monitoring, and repeated management where necessary. However, burn prescriptions should be developed around the ecology of the target community and invasive species rather than assuming that fire will provide uniform control; timing and fire intensity can determine whether native species are favored or whether undesirable species recover.

Equally important are partnerships with private landowners, land trusts, NGOs, academic institutions, and PBAs. Non-governmental partners such as The Nature Conservancy, Ruffed Grouse Society, and Pheasants Forever can provide outreach, landowner engagement, technical assistance, and on-the-ground implementation, particularly in fragmented landscapes where public agencies cannot achieve habitat connectivity goals alone. Universities and research institutions can support monitoring, adaptive management, and workforce development, while conservation NGOs and PBAs can help scale implementation through cooperative burning, equipment sharing, and peer-to-peer training. Together, these partnerships create a distributed, resilient prescribed fire network capable of meeting Pennsylvania's long-term SGCN conservation goals across public, private, and community-owned lands.

Statewide Prescribed Fire Goal and Objectives

Goal: Strategically use prescribed fire as a safe and effective ecosystem management tool to restore and maintain fire-adapted ecosystems, enhance habitat quality for SGCN, and reduce wildfire risk and severity supporting landscape resilience and ecological processes.

Objectives:

1. Ecosystem Health & Restoration: Restore and maintain fire-adapted ecosystems by implementing fire treatments at ecologically appropriate return intervals, generally ranging from 3-20+ years depending on habitat type and other local factors or conditions.

2. SGCN Habitat Quality & Connectivity: Prioritize prescribed fire implementation on land and habitats known to support SGCN, with an emphasis on conducting treatments on private properties that serve as buffers or connectivity corridors to public lands exhibiting high SGCN richness or abundance.

3. Hazardous Fuel Reduction: Reduce hazardous fuel loads across priority landscapes to mitigate high-severity wildfire risk, enhance ecosystem resilience, and protect both wildlife habitat and adjacent human communities.

4. Education & Outreach: Enhance and broaden landowner education and public outreach regarding prescribed fire by leveraging all appropriate communication channels and media platforms.

Monitoring and Adaptive Management

Monitoring prescribed fire in Pennsylvania will emphasize systematic evaluation of vegetation structure, species composition, and SGCN response. Key metrics should include measurements of canopy openness to assess overstory effects, quantification of shrub and sapling cover to evaluate midstory responses and assess herbaceous diversity to gauge changes in ground cover communities, as well as documentation of SGCN occupancy and relative abundance before and after fire events. When combined, these data will be used to track ecological outcomes over time and to guide adaptive management decisions, allowing adjustments to prescribed fire frequency, seasonal timing, and intensity to ensure fire regimes support desired habitat conditions and conservation objectives.

Summary

Achieving PA WAP goals and objectives, particularly for SGCN in fire-adapted habitats, will require substantial and sustained increases in prescribed fire across both public and private lands. Periodic fire has long been recognized as a critical ecological process for maintaining and restoring priority habitats and supporting SGCN as identified in prior PA WAPs (PGC-PFBC 2005, 2015). Pennsylvania's fire history, priority SGCN habitats, and fire frequency studies highlight that many natural communities such as oak-pine woodlands, savannas, grasslands, barrens, and shrublands historically experienced frequent fire disturbances. The reduction in fire disturbances coupled with changes in land management practices since the early 20th century has contributed to mesophication, habitat degradation, woody plant encroachment, and declines in species that depend on young vegetative and fire-maintained habitat conditions. Intentional and widespread fire reintroduction into these ecosystems will combat various factors leading to habitat degradation and SGCN declines.

Prescribed fire is an efficient, cost-effective, and minimally invasive tool that, when implemented strategically and at scale, can restore priority habitat, enhance ecosystem resilience by promoting native vegetation diversity, mitigate invasive plant encroachment, reduce fuel loads that enable more frequent and destructive wildfires, and improve overall habitat quality for all wildlife species. Thus, prescribed fire is essential for implementing PA WAP goals, objectives, and SGCN recovery.

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Appendix 4.4. General Conservation Actions

General Conservation Actions designed for broad implementation.
Actively manage habitat using best practices to promote favorable habitat conditions.
Avoid or minimize use of fertilizers, herbicides, pesticides and other toxins near waterways to protect water quality and Species of Greatest Conservation Need.
Avoid or minimize use of fertilizers, herbicides, pesticides and other toxins on lawns to protect water quality and Species of Greatest Conservation Need.
Clean and disinfect equipment after use to avoid spread of invasive or non-native plants and animals.
Collect habitat information to guide conservation planning and implementation.
Conduct outreach to inspire and promote Species of Greatest Conservation Need protection and habitat conservation.
Connect natural land and water habitat to support wildlife movement and aquatic organism passage.

Conserve large, contiguous forests to promote good water quality and support use of this habitat.
Conserve roosting sites for bats in old structures or buildings.
Conserve wetlands and manage water levels to provide optimal conditions for Species of Greatest Conservation Need.
Coordinate with conservation partners to properly manage habitat, inform the public, and reduce access to sensitive areas.
Create or maintain grassland habitat, particularly warm season grasses.
Encourage complex forest structure, including conifers, to support diverse wildlife populations.
Encourage grassroots and local governmental participation in established conservation programs.
Encourage grassroots and local governmental use of fish and wildlife conservation best practices.
Enroll private lands in voluntary conservation programs or establish voluntary conservation easements to provide fish and wildlife habitat for future generations.
Establish native trees, shrubs, and grasses along rivers, streams, and wetlands for erosion control and Species of Greatest Conservation Need habitat enhancement.
Gather baseline population information for species status assessments.
Install wildlife structures (e.g., bird boxes, turtle basking platforms) to support Species of Greatest Conservation Need survival and reproduction.
Keep cats safely indoors to prevent wildlife disturbance and mortality.
Leash dogs when in a natural area to prevent wildlife disturbance and potential mortality.
Manage deer for healthy and sustainable forest habitat.
Monitor species abundance and distribution over time to assess population trends.
Obey restricted area signs to give wildlife the undisturbed space needed to rest, feed, and raise young.
Participate in community science opportunities to contribute data for conservation decisions.
Plant or maintain native plants to support Species of Greatest Conservation Need.
Prevent livestock access to streams, shorelines, wetlands, and other ecologically sensitive areas.
Protect and provide native plants around seasonal (temporary) pools wherever found.
Protect native trees, shrubs, and grasses along rivers, streams, and wetlands for erosion control and Species of Greatest Conservation Need habitat enhancement.
Regularly clean and disinfect bird feeders to prevent disease transmission.
Remove non-native and invasive vegetation to minimize or avoid Species of Greatest Conservation Need population impacts.
Remove trash when visiting a natural area to prevent unnaturally drawing predators or injuring wildlife.
Turn off lights at night during peak spring and fall bird migration to prevent window collisions.