

CHAPTER 5

RECOMMENDATIONS FOR RESEARCH, POLICY AND COMMUNICATION

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These recommendations have been developed with input from the Pennsylvania Pollinator Protection Plan (P4) Task Force and Advisory Board, and from Pennsylvania stakeholders and members of the public who submitted suggestions on the P4 during an open comment period in Fall 2017. These recommendations are based on the diverse experiences, expertise, and perspectives of these groups, and from reviewing strategies developed by other states with similar opportunities and challenges as Pennsylvania. These recommendations are intended to provide a broad framework in which to consider and improve pollinator health in Pennsylvania, and can be used by a variety of communities and stakeholder groups at multiple levels, from local to state-wide.

RECOMMENDATIONS FOR RESEARCH

1. Improve baseline information on wild pollinator populations in agricultural and non-agricultural systems. Aside from managed honey bee colonies, we have little information about the status and trends of other pollinators (wild bees, butterflies, moths, flies, etc) in Pennsylvania. Developing this baseline information can include aggregating information from historical records, developing a streamlined and continuous monitoring system, and providing an accessible online portal to obtain records and disseminate information.

In Pennsylvania, pollinators in agricultural systems are well monitored, but other areas of the state, but other areas of the state are woefully under-surveyed. Furthermore, the monitoring methods do not consider abundances of colonies (the reproductive unit) for social species, although methods to accomplish this are well developed for some species, and could be developed for additional social species. Comprehensive and accessible information on the population trends of pollinator species and communities is critical to better understanding the status of pollinator populations in Pennsylvania, identifying factors that undermine the health of these populations, and determining where and how resources should be allocated to best support pollinator populations. This goal could potentially be coupled with “communications” recommendations below, to create a trained citizen-scientist network to aid in performing and supporting these surveys (see “recommendations for communication” point 6 below).

2. Develop science-based, metrics and methods for assessing and improving pollinator habitat. Many of the guidelines for improving forage and habitat are fairly generalized, and do not necessarily provide clear criteria for where best to focus efforts on improving habitat (for example, which locations would benefit most from habitat restoration practices in terms of overall increases in pollinator

abundance and diversity, and which locations should be targeted to support specific pollinator species), which restoration practices will best support pollinator populations (which will vary depending on the goals of the restoration, for example, to support the most diverse pollinator communities or support the most important agricultural pollinators) and how to best determine if habitat restoration efforts have been successful (for example, identify easy-to-measure, short-term metrics that effectively predict longer-term, community-scale changes). For agricultural systems, these guidelines should include considerations of using cover crops, altering crop harvest patterns (such as letting some of a crop typically harvested in a vegetative stage progress to a flowering stage), or other farm-level management practices as a means of improving pollinator habitat.

Moreover, while these guidelines are usually designed for a fairly small scale (individual gardens or farms), they should be expanded to better understand how to most effectively create and manage pollinator habitat in natural areas, roadsides and rights of way, and urban areas.

3. Improve understanding of the nutritional ecology of pollinators. Multiple studies have shown that pollen from different plants can have vastly different nutritional profiles. Pollen from different plants may have different amino acids, different ratios of protein, carbohydrate and fats, and different ease of digestion (see Chapter 2, Best Practices for Forage and Habitat). A better understanding of both the nutritional needs of different pollinator species and the nutrition provided by Pennsylvania plant species would allow the development of improved practices for restoring or creating pollinator habitat.

4. Understand the role of climate change on pollinators and pollinator food sources. With its diverse landscape, Pennsylvania hosts a range of microclimates and types of ecosystems. More research is needed on how climate change will impact pollinators (both stationary and migratory populations) and their food sources. Natural habitats, public lands, riparian zones, and rights of way can play an important role as habitat and corridors for pollinators as they respond to climate change. Best management practices can help attract and sustain pollinators as they move through these habitats.

5. Identify the pollinator species or pollinator communities that most efficiently pollinate agricultural crops and support natural ecosystems. Multiple studies have demonstrated that wild bees serve as better pollinators for some crops than managed honey bees, while other studies have demon-

strated that wild bees and honey bees together provide the best pollination services. However, we know little about which bees – or combination of bees – serve as the best pollinators for many Pennsylvania crops.

6. Determine the optimal distribution and densities of managed bees to support stakeholders' requirements. Currently, recommendations for the numbers of managed bees (including honey bee colonies, bumble bee colonies, *Osmia* bees) needed to optimize pollination services for different crops are not well-defined and are likely over-estimated. Moreover, the extent to which Pennsylvania growers can meet their pollination needs from the ecosystems services of wild bee communities is not well understood. Similarly, there are no clear guidelines that beekeepers can use to assess the number of bee colonies that can be successfully supported – and produce large honey crops – by a given landscape.

7. Evaluate the impact of pesticide use (particularly herbicides) on pollinator habitat and forage quality. Studies have demonstrated that herbicides can reduce growth, flowering, and resource quality of important pollinator plants, if they come in contact with these plants through leaching or drift or when they are deliberately oversprayed (see Chapter 3, Best Practices for Pesticide Use). With the expanded use of auxinic herbicides, the risk of non-target plant injury, particularly broadleaf plants, is greatly increased. The indirect effects of herbicide damage on pollinator-supporting plant species poses a serious threat to the provisioning capacity of intentional pollinator plantings as well as the floral abundance and food quality of naturally occurring plants. These issues may arise in agricultural, urban, suburban and natural landscapes, as well as on roadsides and rights of way.

8. Evaluate the impact of pesticide type, application procedure and surrounding landscape conditions (such as soil type) on pesticide residue levels and persistence in the pollen and nectar of adjacent flowering plants, soil, and water. Increasingly, data suggests that pollinators are exposed to pesticides (insecticide, fungicides, herbicides, and additional ingredients in pesticide formulations) while foraging on flowering plants that are not directly targeted by a pesticide application, but are simply adjacent to a treated crop or area. Better understanding how pesticides move through the landscape and are incorporated into growing plants will allow for the development of more targeted and precise pesticide application protocols in agricultural, natural, and urban areas, and roadsides and rights of way.

RECOMMENDATIONS FOR POLICY

1. Obtain information on management practices from registered beekeepers. During the registration process, surveying beekeepers on their management practices and overwintering survival outcomes would generate an outstanding data set which could be used to determine which practices and landscape conditions are most successful in supporting healthy honey bee colonies.

2. Consider requiring pesticide applicators to contact registered apiaries within vicinity of pesticide application. It is currently only recommended, but not required, that applicators contact registered apiaries. However, given the size and diversity of agricultural systems in Pennsylvania, any such requirement would need to be developed in a manner that is manageable for pesticide applicators and useful for beekeepers. For more information, see Chapter 3, Best Practices for Pesticide Use.

3. Develop methods to better document pesticide use in Pennsylvania. Mitigating pollinator exposure to pesticides requires a solid understanding of where and when pesticides are applied. While national pesticide surveys provide rough estimates of pesticide use in agricultural systems in Pennsylvania, these surveys leave out many crops and do not provide any information on pesticide use in other landscapes. These surveys also do not describe when pesticides are applied during the growing season, a key factor influencing pollinator exposure. Pennsylvania could launch its own pesticide reporting program, similar to the one **currently used in California**. Note, however, that the Pennsylvania landscape is much more diverse than California, and pesticides are applied in smaller-scale operations. Thus, careful planning would be needed to develop a reporting system that does not overburden pesticide applicators, growers, land managers, etc.

4. Create incentives for seed producers to provide a diverse array of options for growers, including seeds that are not coated with neonicotinoids. Data from Pennsylvania (see Chapter 3, Best Practices for Pesticide Use) have demonstrated that neonicotinoid seed treatments on soybeans can actually lead to reduced yield, but growers have few options when they are purchasing their seeds.

5. Establish an affordable lab service at PA Department of Agriculture or Penn State University that beekeepers and growers (in Pennsylvania and nationally) could utilize to evaluate bee health. Bee health evaluations can include measuring virus and pesticide loads in managed bees, the diversity and abundance of the wild bee community in a particular location, and/or the number of wild colonies providing pollination services. Pathogens and pesticides are considered major factors underpinning bee declines, but measuring levels of these stressors requires sophisticated molecular and chemical approaches which are out of reach of beekeepers. Research has documented that wild bee populations are providing much of the pollination services in PA apples and pumpkins, and may also be doing the same in blueberries, strawberries, and other crops. Currently, growers have access to services for analyzing the status of multiple soil health metrics, and plant nutrients such as petiole tests, and water quality. A comparable service could be designed for growers wishing to evaluate populations of wild bee species in their farm-scape. For bumble bees, this might take the form of an annual collection and PCR analyses to estimate colony abundance. For other species, this may include a structured measure of visitation rates.

6. Expand incentive programs for conserving pollinators to lands beyond the farm, at spatial scales relevant to those pollinator species that visit the crop. Currently, USDA-NRCS programs (such as EQIP, CSP & WHIP) can cost share the development of pollinator habitat on farms and forests. But adjacent land, owned by a different farmer, could also help provide pollinator habitat. Incentivizing these cost-share programs so they are designed at the landscape scale (across farms) could benefit multiple growers, and would better support pollination services at smaller-scale operations.

RECOMMENDATIONS FOR COMMUNICATION AND COLLABORATION

1. Develop an annual meeting of Pennsylvania Pollinator Protection Plan Task Force and Advisory Board members. This meeting will facilitate communication, resource sharing, the development of new collaborations, and ensure that the P4 is regularly updated to reflect current information, opportunities and challenges.

2. Develop a series of short videos highlighting aspects of the Pennsylvania Pollinator Protection Plan and disseminate these through social media. These videos could be linked to short surveys and questionnaires to evaluate impact of these videos, and help identify sections of the P4 that could be adjusted to more effectively communicate information.

3. Develop training modules for specific aspects of the P4 that can be used by and address the needs of different stakeholder communities.

These modules can address individual chapters or chapter sections, such as creating pollinator habitat, managing pesticide use, or keeping bees in different types of landscape. These modules can be very targeted (eg, improving the public's ability to read and understand pesticide use and toxicity labels) or broad. These training modules could be required for certain groups (such as pesticide applicators, or individuals who are receiving support from programs to develop pollinator habitat on their lands).

4. In the same way the P4 itself was created, utilize the P4 partnership to help coordinate and facilitate participation of scientists, policymakers, concerned citizens, and others in the development and implementation of future research, conservation, and planning efforts.

For example, the Northeast Fish and Wildlife Diversity Technical Committee is developing a monarch conservation strategy on behalf of the Northeast Association of Fish and Wildlife Agencies (to be completed by February 23, 2018). They are seeking assistance from stakeholders in each state in the Northeast to share existing information on monarch conservation efforts, and to help develop strategies to address gaps in those efforts as needed. The P4 partnership includes individuals with the information, expertise, and connections needed to inform future local and regional efforts to support pollinators.

Additionally, this group should collaborate with the Pennsylvania Biological Survey to develop a white paper that discusses the status of 'orphan taxa' in Pennsylvania. Orphan taxa are species that have fallen through gaps in the state code and lack state agency oversight regarding their status and management. Orphan taxa include many pollinating insects such as native butterflies, moths, bees, wasps, beetles, flies, etc. This paper can investigate the many implications of having orphan taxa (e.g., fiscal, environmental and human health, etc.) and suggest strategies to advance research, conservation, and management of this large and diverse group of overlooked species.

5. Develop resources that individuals can use to better identify pollinator species and pollinator plants in Pennsylvania. These can include a checklist of Pennsylvania bees and key pollinator plants, and accessible online resources (including modifications to existing resources such as Discover Life).

6. Organize citizen-scientists to help monitor pollinator populations in Pennsylvania. With sufficient training, informational resources and organizational support, Pennsylvania citizens can become important contributors to a long-term plan to monitor pollinator populations in the state (see research recommendation #1).

7. Develop a group that supports individuals who manage non-*Apis* bee species, such as bumble bees or *Osmia* bees. The Pennsylvania State Beekeepers Association (PSBA) provides valuable information and support for individuals who manage honey bee colonies, and can advocate effectively for honey bee health in Pennsylvania. With a growing interest in managing non-*Apis* bee species, a similar group could be developed, or the PSBA could be expanded to include these other managed bees.

8. Promote the Pennsylvania State Wildlife Action Plan. The conservation status of pollinators and other invertebrates were evaluated for this plan, which was updated in 2015. The invertebrate assessment report can be found in Appendices 1.1 and 1.2 (Pages 76-149), [which is available online](#). There are urgent conservation and management issues that need to be addressed to 'keep common species common', conserve species of global and regional importance, maintain PA-rare species, and reduce knowledge gaps to better assess the conservation status of species.

9. Highlight and celebrate the diversity of pollinators in Pennsylvania, and our efforts to support them. These efforts can include photo contests of pollinators, monthly news articles featuring local citizens (including growers) whose efforts support pollinators, pollinator-themed scavenger hunts for K-12 students, and so forth. The development of pollinator gardens in regions with high visibility (such as state and municipal buildings) can also help promote understanding of pollinators and pollinator conservation.

10. Develop a rating system to help growers effectively communicate their efforts to support pollinators to consumers. This rating system or alternative communication strategy can be developed for different crops, types of growers, markets, and consumers. This rating system should be developed by a consortium of researchers, extension specialists, growers, and retailers.

RECOMMENDATIONS FOR ASSESSMENT

Below are suggestions for assessing the effectiveness of the P4 in terms of reaching a broad audience in Pennsylvania and encouraging more individuals and organizations to actively participate in supporting pollinator populations. Participation may take many forms, including obtaining improved information, working with existing groups that support and advocate for pollinators, and implementing changes in backyards, farms, businesses, communities, or regions. The P4 could be considered effective if we could demonstrate:

1. Increased number of participants in the PA State Beekeepers Association, and/or an equivalent managed non-Apis bee organization. The PSBA provides valuable information, resources and guidance for individuals managing honey bee colonies, which can support both beekeepers and their bees. Establishing an equivalent group for managed non-Apis bees would similarly support this growing beekeeper group in Pennsylvania.

2. Increased average honey bee colony overwintering survival. This information is generated annually from the PA State Beekeepers Association Annual Survey and the Bee Informed Partnership's annual Management and Loss Surveys. The 2016-2017 winter loss rate in Pennsylvania was ~50%. The target for the US National Strategy to Promote the Health of Honey Bees and Other Pollinators is to reduce losses to 15% by 2025.

3. Increased numbers of certified PA Pollinator Gardens through the PSU Master Gardeners Program. The certified PA Pollinator Garden program provides critical information for individuals wishing to create pollinator habitat in their backyards or businesses, and sets criteria to evaluate the effectiveness of these practices.

4. Increased acres of pollinator habitat in public and wild lands.

5. Increased numbers of people taking training modules developed to disseminate information from PA Pollinator Protection Plan.

6. Increased "pollinator literacy" of individuals viewing informational videos developed about the P4. See "recommendations for communication" point 2. Pollinator literacy can be evaluated via short questionnaires or surveys of individuals watching these videos on social media.

7. Increased numbers of people viewing and downloading the PA Pollinator Protection Plan.

CONCLUSIONS AND FUTURE DIRECTIONS

The development of the Pennsylvania Pollinator Protection Plan (P4) brought together individuals representing 28 state and national organizations and stakeholder groups, establishing a strong network that can be leveraged to address ongoing and arising issues in pollinator health in Pennsylvania. The P4 is a comprehensive, information-rich, and living document that provides recommendations for best practices to support pollinator populations – and the diverse communities and stakeholders that value and depend on them – throughout the state. The best practices outlined in the P4 were developed to ensure that the incredible diversity of Pennsylvania’s pollinator species and their ecosystem services are appreciated, promoted, and protected across the different landscapes of Pennsylvania. This recommendations section represents the input of a diverse community of individuals, and is intended to serve as a framework for using the P4 as a platform for supporting the pollinators and people of Pennsylvania.