



# MASSACHUSETTS

 Pollinator Protection Plan

**PREPARED BY:**

Aplary Program Working Group  
Division of Crop & Pest Services

**AVAILABLE ONLINE AT:**

[mass.gov/eea/agencies/agr/farm-products/aplary](http://mass.gov/eea/agencies/agr/farm-products/aplary)

**CONTACT:**

Kim Skym  
Chief Aplary Inspector  
Division of Crop & Pest Services  
[Kim.Skym@state.ma.us](mailto:Kim.Skym@state.ma.us)



Division of Crop and Pest Services

## TABLE OF CONTENTS

Letter from the Commissioner of Agriculture .....	3
The Importance of Pollinators .....	4
Historical and Current Status of Pollinators .....	5
A. Managed and Wild Bees .....	5
B. Other Wild Pollinators .....	8
The Pollinator Protection Plan (PPP) .....	8
The Role of the Massachusetts Department of Agricultural Resources (MDAR) .....	11
A. Apiary Program .....	11
B. Pesticide Enforcement Program .....	12
Best Management Practices and Actions to Benefit Pollinators .....	13
A. Beekeepers .....	13
B. Pesticide Applicators .....	15
C. Land Managers and Farmers .....	17
D. Nurseries and Landscapers .....	20
E. Homeowners and Gardeners .....	21
Future Actions and Improvements .....	24
Acknowledgements .....	25
References and Photo Credits .....	26
Appendix A: Performance Metrics .....	30

THE COMMONWEALTH OF MASSACHUSETTS  
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS



Department of Agricultural Resources  
101 University Drive, Suite C-4, Amherst, MA 01002  
413-548-1905 fax: 413-548-1901 www.mass.gov/agr



CHARLES D. BAKER  
Governor

KARYN E. POLITO  
Lt. Governor

MATTHEW A. BEATON  
Secretary

JOHN LEBEAUX  
Commissioner

Agriculture is a vital part of life in Massachusetts, providing our state with valuable commodities, land preservation, employment opportunities, and economic growth. Currently home to 7,755 farms consisting of 523,000 acres of operating farmland, Massachusetts is a key Northeastern U.S producer of crops, such as our native cranberry. Over 45% of agricultural commodities in our state rely on our rich diversity of pollinators for crop pollination. Over the past decade, populations of pollinators nationwide have been experiencing significant challenges in their ability to survive and flourish. Given the diversity of stressors affecting pollinators, there is a need to effectively evaluate, sustain and enhance their populations.

The Department has taken the direction to states contained in President Obama's 2014 Memorandum *Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators* seriously and developed this *Massachusetts Pollinator Protection Plan*. This plan is designed to improve the overall health of pollinator populations by providing stakeholders with a set of voluntary guidelines that facilitate communication, collaboration and recommendations of best management practices. As new scientific research becomes available, this adaptive, living document will be updated to reflect these advances.

I am confident that working with the many interested and involved stakeholders, and by educating the public at-large, we will be able to provide improved support for pollinators throughout the Commonwealth.

Sincerely,

A handwritten signature in blue ink that reads "John LeBeaux".

Commissioner,  
Department of Agricultural Resources

## **THE IMPORTANCE OF POLLINATORS**

Pollinators provide critical services needed for agricultural and natural ecosystems in order to ensure the sustainability and biodiversity of our environment. This includes both managed pollinators, that have been domesticated for agricultural use and are directly managed by humans, and wild pollinators. In addition to being a part of the food chain, wild and managed pollinators are also directly responsible for the majority of pollination in plants. Without this transfer of pollen from flower to flower, there would be little opportunity for plant reproduction and subsequently for fruit and seed production.



Worldwide, it is estimated that 88% of flowering plants require a pollinator, typically an insect, for pollination<sup>1</sup>. These pollinators increase the fruit or seed set for 75% of crop plants, making them responsible for 35% of global food production<sup>2</sup>. The pollination services they provide also supply birds and mammals with approximately 25% of their diets. In the US alone, over 91 of the most prominent crops, ranging from tree nuts and fruits, berries, and many vegetables are dependent specifically on insect pollinators for reproduction<sup>3</sup>. In Massachusetts, over 45% of agricultural commodities rely on pollinators, mainly wild and managed bees, for pollination. While the economic value of both wild and managed bee pollinators in natural ecosystems is difficult to estimate, they contribute an average of \$1,200 per acre in crops, given the increase in visitation rates and subsequently greater fruit set and overall yield<sup>4</sup>. The US Department of Agriculture National Agricultural Statistics Service (NASS) recently estimated that the value of crop pollination by managed bees was \$355 million in 2015/2016 for 33 major crops<sup>5</sup>. It is also estimated that wild bees in US crops can provide \$3 billion per year in pollination services<sup>6</sup>.

Insect pollinators include a diverse group of organisms: bees, butterflies, moths, flies, beetles, and wasps. There are approximately 20,000 bee species worldwide and 4,000 in the US. Among these, the managed bee pollinator *Apis mellifera* (European honey bee) is the most utilized and universally available species<sup>7</sup>. Butterfly and moth

populations are very diverse, with 167,500 species worldwide and 12,075 in the United States<sup>8</sup>. While butterflies and moths are easily identifiable in the landscape, with most members providing pollination services, they typically only transport pollen incidentally during the collection of nectar from plants. Only a small subset of the considerably larger insect orders, such as flies (120,000 species worldwide with 19,600 species in US), beetles (350,000 species

worldwide with 23,700 species in the US), and wasps (75,000 species worldwide), actively contribute to pollination, since the majority either do not visit flowers to collect resources or actually cause damage to plants through direct feeding<sup>8</sup>. However, flies are considered to be great pollinators of some plants given their attraction to putrid odors, pale colors and pollen-producing flowers<sup>9</sup>. Members of this group serve as unique pollinators for some plants including midges with cocoa flowers, mosquitoes with bog orchids, fungus gnats with Jack-in-the-Pulpit flowers, and carrion flies with skunk cabbage<sup>9</sup>. Beetles are the first group of documented pollinators for angiosperm plants, and are still essential for these ancient plants such as Magnolia. They often eat petals and other floral parts when they visit flowers as well as defecate<sup>10</sup>. Beetles prefer to pollinate flowers that have a spicy, sweet or fermenting scent and moderate nectar/high pollen rewards<sup>10</sup>. Similar to bees, wasps are considered to be important pollinators of plants given their need to collect both pollen and nectar to sustain their high energy metabolic needs<sup>11</sup>. However, the majority of wasps are also carnivorous since they will capture other insects for food<sup>11</sup>.

Though the presence and contributions from these other insects is important, bees are still considered to be the most abundant and efficient pollinators, given their need to collect both pollen and nectar to feed developing brood and hairy bodies designed to collect and carry pollen from flower to flower<sup>7</sup>. Massachusetts has a rich diversity of wild pollinators, including an estimated 380 species of bees and 120 species of butterflies. Managed pollinators are also found in abundance in our state, with four bee species used in crop pollination: honey bees (*Apis mellifera*), bumble bees (*Bombus impatiens*), leafcutting bees (*Megachile rotundata*), and orchard bees (*Osmia lignaria*).

## **HISTORICAL AND CURRENT STATUS OF POLLINATORS**

### **A. Managed and Wild Bees**

The European honey bee, *Apis mellifera*, was introduced into the Colony of Virginia from Europe in 1622. Subsequent honey bee shipments were documented to occur from 1630-1638 to Massachusetts and it is estimated that by 1650 all New England farms had a colony. However, honey bee colonies rapidly declined after 1670 presumably due to the occurrence and widespread virulence of the bacterial pathogens American Foulbrood (AFB) and European Foulbrood (EFB). It wasn't until the creation of apiary programs, establishment of laws and regulations requiring honey bee colony inspection, and invention of the removable frame in 1852 that foulbrood outbreaks started to become less frequent. Given this, little was known about the factors causing weak or dead colonies, prior to the availability of removable frames and as such if present, diseases were able to run their course undetected. Beekeepers also during this time period traditionally harvested honey from the weakest and heaviest hives in their apiary, thus indirectly mediating diseases<sup>12</sup>. In 1891, entomologists documented the first incident of non-target impacts of agricultural pesticides on honey bees<sup>13</sup>.

From 1920-1940, honey bee populations presumably increased due to the availability of optimal forage, better climatic conditions and the Federal Honey Bee Act of 1922 that prevented the spread of tracheal mites into the US<sup>12,14</sup>. Tracheal mites were discovered in 1919

on the Isle of Wight in England and the occurrence and potential destruction from these mites were so devastating that the US responded by creating the legislation<sup>14</sup>. Unfortunately, this period of honey bee population increases are only based on hearsay since the USDA unsuccessfully attempted to collect honey bee production numbers every 10 years prior to 1943, but these data were inconsistent thus not allowing for correlations to be made in the fluctuations in colony numbers over time. However in 1944, the USDA National Agricultural Statistics Service (NASS), started recording the quantity of honey-producing colonies in the US and creating the historical data set that we compare to date. From 1945-1980, honey bee populations increased again which may have been due to the availability of antibiotics for EFB and AFB treatment<sup>12</sup>. However, in 1984 and 1987 US honey bee populations plummeted again given the introduction and detection of Tracheal and Varroa mites<sup>14</sup>. Prior to the introduction of these mites, overwintering losses of 10% were considered normal<sup>12</sup>. In 2006/2007, an alarming number of beekeepers experienced 30-90% of colony losses, much higher than historical levels, during the active bee season with symptoms that were inconsistent with any known cases of death<sup>15,16</sup>. The phenomenon became known as Colony Collapse Disorder (CCD), and is defined as a syndrome when a honey bee colony exhibits these specific criteria<sup>15</sup>:

- ❖ Little to no build-up of dead bees in the hive or at the hive entrance;
- ❖ Rapid loss of adult honey bee population despite the presence of queen, capped brood, and food reserves;
- ❖ Absence or delayed robbing of the food reserves;
- ❖ Loss not attributable to Varroa mite or Nosema loads.

Despite being considered to be a potential long term threat to honey bees, the reported cases of CCD have declined significantly from 60% of losses attributed in 2008 to not being mentioned in the latest colony loss reports<sup>15</sup>. Once CCD focused mass attention on honey bees, a closer look at the USDA NASS data showed that the number of honey-producing colonies in the US dropped 60% over 60 years, from a high of 5.9 million in 1947 to 4 million in 1970 to 3 million in



1990 and then 2.3 million in 2008<sup>12</sup>. In 2006, the Bee Informed Partnership (BIP) also started monitoring national levels of honey bee colonies from self-reported beekeeper surveys. While this data was initially set up to record winter losses in honey bee colonies, in 2010 the survey became more comprehensive by

including year-round data collection. The latest survey data from BIP indicated an increased loss level of 44% for 2015/2016, compared to 41% for 2014/2015, significantly higher than the acceptable level of 18%. The most alarming trend in these data is the increasing number of summer colony losses when honey bee colonies are supposedly building healthy populations. Locally, Massachusetts beekeepers reported an annual loss of 55.75% of honey bee colonies

over the 2015/2016 season, which is in the top 10% of states with the highest levels of loss. Massachusetts also experienced the highest level of colony losses in New England during 2015/2016<sup>17</sup>. After hearing reports of unpredictable honey bee colony losses during late summer and early fall 2015, the Massachusetts Department of Agricultural Resources (MDAR) created a state wide survey for beekeepers to report colony loss data for the 2015/2016 season. The results of this survey indicated that on average, beekeepers lost 30% of their honey bee colonies, with some counties reporting up to 41% loss. This survey data aligned more closely with the national averages.

National assessments indicate there are several health stressors involved in the decline of pollinator populations including pests, parasites and pathogens, lack of genetic diversity, habitat loss and forage degradation, poor population genetics, competition, honey bee management strategies, pesticide use and climate change<sup>15,16,17,20,21,22,23</sup>. Locally, the Massachusetts Division of Fisheries and Wildlife and its Natural Heritage and Endangered Species Program (NHESP) list habitat loss, fire suppression, introduced parasitoids and pathogens, deer browsing, off-road vehicles, and pesticides as the major threats facing pollinators<sup>18,19</sup>. While pollinator populations may be able to overcome a single one of these stressors, when a suite of these pressures overlap, evolve and interact with one another, they can place an intense pressure on pollinators.

While little data is available on wild bee abundance, given the difficulty in monitoring populations, studies have shown population declines similar to those of honey bees for many species<sup>20,23</sup>. Similar to managed bees, wild pollinator decline is linked to the degradation, fragmentation, and loss of habitat, and also to pesticides, parasitoids and pathogens<sup>20,23</sup>. A recent assessment by the International Union for Conservation of Nature's Bumblebee Specialist Group found that more than one quarter of North American bumble bee species are at risk of extinction<sup>24</sup>. The Massachusetts Division of Fisheries and Wildlife and the Natural Heritage and Endangered Species Program (NHESP), lists seven (7) species of wild bees that are of concern<sup>18,19</sup>.

While wild bees face many of the same risks as managed bees, their biology and behavior are different in that some of the universal protections put into place for managed bees often fail to address wild bee concerns. For instance, unlike honey bee colonies with thousands of workers, nearly 90% of wild bees are solitary ground nesters meaning they do not live in colonies with multiple workers<sup>7</sup>. As such, they do not have a buffer to protect future generations if the egg-laying female dies before the reproductive cycle is complete. Compared to managed bees, wild bees also have potentially different exposure routes of habitat disturbance and pesticides given their different life histories. For example, ground nesting wild bees would be subject to disturbance from tillage since it could damage their brood chambers and subsequently nest sites. Wild bees that gather mud or plant materials to construct brood cells may force immature bees to be exposed to higher quantities or levels of pesticides, given the close proximity to their developing chamber to the chemicals. These bees may also come into contact more frequently with pesticide residues from soil drenches, chemigation, and seed coatings.

## **B. Other Wild Pollinators**

Among the wild non-bee pollinators, monarch butterflies (*Danaus plexippus plexippus*) are one of the most well-known and identifiable species, given their long-distance seasonal migration and massive winter gatherings in Mexico and California. Their annual migration flight is made each fall from the northern plains of the US and Canada to the forests north of Mexico City, while some of the population also overwinters in forests along the California Coast<sup>25</sup>. The monarch population breeding areas east of the Rocky Mountains include the Central and Eastern United States and as far north as southern Canada, with the most important being the Corn Belt in the Midwestern United States<sup>26</sup>. Unfortunately, monarch butterfly populations have been in decline over the past 20 years, as citizen science counting data indicates the population has been reduced to less than 300,000 in 2015 from 1.2 million butterflies in 1997<sup>25</sup>. These estimates reveal an 80% reduction in the population in Central Mexico and 74% in California<sup>25</sup>. The most important drivers of these population declines are habitat loss, climate change, and pesticide use<sup>25,26</sup>. Habitats are not only important as overwintering sites, but also important for food resources given that they require different plants based on their life cycle: milkweed for immature growth of caterpillars in spring and summer and a variety of late blooming flowers for adults in fall. Unfortunately, monarch butterflies are not the only pollinator species in peril, given that MA NHESP currently lists nineteen (19) species of butterflies and moths and nine (9) species of beetles as endangered, threatened, or of special concern<sup>18,19</sup>.



## **THE POLLINATOR PROTECTION PLAN (PPP)**

Given the diversity of factors involved in the decline of managed bees and monarch butterflies, combined with the need to effectively evaluate, sustain and enhance these populations, there was a national memorandum issued in 2014 by President Barack Obama, followed by the release of the [National Strategy to Promote the Health of Honey Bees and Other Pollinators](#) calling on Federal Agencies to coordinate their efforts to improve managed bee pollinator health, increase monarch populations and increase pollinator habitat. The specific overarching goals of this memorandum included<sup>27</sup>:

- ❖ Honey bees: Reduce honey bee colony overwintering mortality to no more than 15% within 10 years.
- ❖ Monarch butterflies: Increase the Eastern population of the monarch butterfly to 225 million butterflies occupying an area of approximately 15 acres in the overwintering grounds in Mexico, through domestic/international actions and public-private partnerships, by 2020.
- ❖ Pollinator habitat acreage: Restore or enhance 7 million acres of land for pollinators over the next 5 years through Federal actions and public/private partnerships.



A key component of this strategy was the engagement of all states to develop independent state-level Managed Pollinator Protection Plans (MP3) that facilitate collaboration and provide a set of recommendations of practices for those key stakeholders involved in the protection of managed bee pollinators and monarch butterflies, including state agencies, beekeepers, pesticide applicators, land managers/farmers, the nursery/landscaping industry, and homeowners. However, the creation of these plans is on a state by state basis and as such flexible in content as represented by the current diversity of plan types and focus nationwide. Despite being initially centered on creating plans for managed pollinators, many states have adopted to include measures to conserve and protect non-managed, wild pollinators.

The process of drafting the Massachusetts Pollinator Protection Plan (PPP) began in November 2014, when the Massachusetts Farm Bureau established a Pollinator Stewardship Group with the purpose of constructing a draft plan for submission to MDAR. In a separate effort within the same timeframe, eight county level honey beekeeping associations also drafted their own pollinator protection plan. Both documents were then submitted to MDAR in October 2015 for consideration in crafting the state-wide pollinator plan. MDAR combined these documents, while also adhering to the State FIFRA (Federal Insecticide Fungicide Rodenticide Act) Issues Research and Evaluation Group (SFIREG) and Environmental Protection Agency (EPA) [MP3 Guidance](#), to create the first draft of this plan. That first draft was developed to provide a set of voluntary guidelines to outline the roles of states, honey beekeepers, pesticide applicators, land managers/farmers, nurseries/landscapers, and the general public in protecting managed bee pollinator health.

The initial draft plan was released for public comment on February 26<sup>th</sup>, 2016 with all comments being due on April 30<sup>th</sup>, 2016. During this time period, a total of 7 listening sessions were held all over the state, with 93 attendees providing verbal comments. A total of 2,504 written comments (hard copy and electronic) were also received during this time period, from

the following stakeholder groups: academia, a country club director, a physician, a town council member, beekeepers (hobbyist, sideliners and commercial), Beyond Pesticides, Cape Cod Cranberry Growers Association, Environment Massachusetts, farmers, Golf Course Superintendents Association of New England, GreenCape, homeowners, Irrigation Association of New England, Massachusetts Association of Landscape Professionals, Massachusetts Association of Lawn Care Professionals, Massachusetts Arborists Association, Massachusetts Audubon Society, Massachusetts Beekeepers Association (representing 3,188 members from 9 county bee organizations), Massachusetts Farm Bureau, Mosquito Squad, New England Pest Management Association, Northeast Organic Farming Association, Responsible Industry for a Sound Environment, students, The Green Industry Alliance, Toxics Action Center, University of Massachusetts-Extension and the Xerces Society.

MDAR then compiled and created a document summary of all the comments, and released it to the public on September 14<sup>th</sup>, 2016. After these comments were released, MDAR began editing and re-writing the plan to not only consider these comments, but also re-focus the content to better suit the needs of pollinators in MA. Given this, the current version of the plan has expanded beyond the federal directive to not only address many of the comments that were submitted, but also to give the document a broader focus that includes wild pollinators. The purpose of the current draft of this plan is to provide a set of Best Management Practices (BMPs) guidelines for stakeholders to reference when performing actions that could involve either managed or wild pollinators. These guidelines are not regulatory in nature, but rather a set of practices that, if performed correctly, can preventatively mitigate unintended negative impacts on pollinators and/or proactively establish hospitable conditions under which populations can thrive and become sustainable. To accomplish these goals, the plan includes a list of future projects that MDAR is working on in an effort to provide and increase the sustainability of performing the actions outlined in this document. The effectiveness and impact of this plan will be reviewed by MDAR on an annual basis by assessing a variety of performance metrics and using the [SFIREG Joint Working Committee Performance Measures for Managed Pollinator Protection Plans \(MP3\)](#) as reference. For a detailed description of these metrics, see Appendix A.



Please note that while this plan focuses on wild bees, managed bees and Monarch butterflies, all strategies listed in this document would also provide direct benefit to all other pollinator populations. This plan is a living document, and will need to be updated and changed periodically as new scientific data becomes available, in order to keep the information relevant and applicable. The collective actions and considerations of all stakeholders will ultimately determine not only the relevance of this

plan and its suggestions, but the future of pollinator populations in the Commonwealth.

## **THE ROLE OF MASSACHUSETTS DEPARTMENT OF AGRICULTURAL RESOURCES (MDAR)**

The Massachusetts Department of Agricultural Resources (MDAR) supports farms in its mission to ensure the long-term viability of agriculture in Massachusetts. Through its four divisions – Agricultural Conservation and Technical Assistance, Agricultural Markets, Animal Health, and Crop and Pest Services – MDAR strives to support, regulate and enhance the rich diversity of the Commonwealth’s agricultural community to promote economically and environmentally sound food safety and animal health measures, and fulfill agriculture’s role in energy conservation and production.

### **A. Apiary Program**

Massachusetts is home to a large and diverse beekeeping industry, with current estimates indicating the presence of 4,000-4,500 beekeepers managing 40,000-45,000 hives. In addition to pollination services that managed bees provide, honey is also an important agricultural commodity produced in the Commonwealth. MDAR’s Apiary Program was established to promote and sustain apiculture in the Commonwealth by providing support to honey beekeepers, pesticide applicators, farmers, land managers, educators, regulators and government officials. MDAR considers the Apiary Program to be an integral component of the department and will work to ensure adequate funding and staffing to provide support to honey beekeepers and other stakeholders.

The program staff consists of a full time Chief Apiary Inspector and a team of seasonal full time inspectors, with yearly contracts to service the state. Seasonal Apiary Inspectors support the Chief Apiary Inspector by performing annual health and regulatory inspections of apiaries, evaluating colonies for the presence of parasites, pathogens and pests, and providing education to stakeholders. While the program works to inspect as many colonies as possible given the staff and budget, the presence of these parameters combined with voluntary inspection requests and voluntary apiary registration processes, makes it impossible to visit every beekeeper each season. Inspection data is compiled and reported out on an annual basis. All inspectors work with county-level bee organizations, universities, other state agencies, regional inspectors and national organizations to stay updated on the needs of honey beekeepers and the health concerns facing pollinator populations.

MDAR is currently evaluating and updating the Apiary Program to determine ways that it can provide better support while also ensuring the health and sustainability of honey bee populations in the Commonwealth. Traditionally, the Apiary Program has been heavily focused on providing outreach and extension type education to honey beekeepers through the following supportive services:

- ❖ Technical assistance, continuing education, and outreach to all audiences on topics related to honey bee biology, hive management, and pollination.
- ❖ Communication with beekeepers to determine their needs.
- ❖ Keeping up to date on the status of pollinators.

- ❖ Marketing of honey and other bee products as agricultural commodities.
- ❖ Collaboration with other government agencies.
- ❖ Creation and maintenance of a state apiary to provide a portal for educational demonstrations and projects related to honey bee health.

The re-structured program will not only continue this focus, but also exercise its regulatory role by ensuring compliance of the laws and regulations pertaining to honey bees: [Chapter 128, Massachusetts General Law, Sections 32-36B](#) and [330 CMR 8.00: Apiary Inspection Regulations](#).

This regulatory role involves performing the following actions:

- ❖ Providing routine health inspections of honey bee colonies for detection, suppression and elimination of infectious diseases.
- ❖ Issuing quarantines and destruction orders for incidences of American Foulbrood.
- ❖ Conducting health inspections of imported and designated honey bee colonies for export through the detection and suppression of infectious diseases.
- ❖ Checking permits to ensure compliance of requirements for interstate movement of colonies and equipment.



colonies and equipment.

- ❖ Consulting with state and local agencies on to ensure compliance of state laws and regulations.

- ❖ Investigating bee kill incidences suspected to be due to pesticide misuse, through collaboration with the Pesticide Enforcement Program.

- ❖ Investigating other bee kill incidences to determine presence of

infectious diseases.

- ❖ Providing notification of apicultural health concerns to the public in the event of an infectious disease outbreak.

## **B. Pesticide Enforcement Program**

MDAR's Pesticide Enforcement Program is tasked with protecting the environment by providing licenses to individuals who apply pesticides, registering pesticide products used in the Commonwealth, and enforcing both federal and state pesticide laws and regulations. Pesticide Enforcement administers the provisions of the [Massachusetts Pesticide Control Act](#) and the regulations in [333 CMR 1-14](#). MDAR is also designated as the lead state agency for the enforcement of the Federal Pesticide Statute (FIFRA) by the US Environmental Protection Agency (EPA). The Pesticide Inspection Team consists of a Chief Pesticide Inspector and a team of inspectors that investigate allegations of pesticide misuse and inspect dealer establishments, pest control businesses and pesticide producer establishments. The program also acts as

support staff for the Pesticide Board, Pesticide Board Subcommittee, MDAR department heads, and the Apiary Program.

The Pesticide Enforcement Program will continue its partnership with the Apiary Program to investigate reported bee kills, using guidelines created by the Environmental Protection Agency [EPA Guidance for Inspecting Alleged Cases of Pesticide-Related Bee Incidences](#) and [Guidance for Assessing Pesticide Risks to Bees](#). All data collected on managed bee pollinator health in association with the reported bee kills will be analyzed, converted to an electronic format, and provided to the public in an annual report. This data will be reviewed to determine if there are any trends regarding pesticides and pollinator health. The program will work with the Chief Apiary Inspector to develop outreach materials and include pollinator safety information as part of any pesticide applicator training that the program participates in. MDAR will also encourage outside programs to include pollinator safety in any training provided to pesticide applicators.

## **BEST MANAGEMENT PRACTICES AND ACTIONS TO BENEFIT POLLINATORS**

### **A. Beekeepers**

Beekeepers have a larger responsibility for the overall health and welfare of managed bee colonies. This includes taking steps to ensure good bee health, proper hive husbandry, continuing education of beekeepers, and communication with land managers, farmers, pesticide applicators, and the public to mitigate pesticide risk and enhance forage. The Massachusetts Beekeeper Association [Best Management Practices for Beekeepers](#) should be used as a guideline for good husbandry practices in beekeeping. If additional support is needed, beekeepers should consider attending a bee school and/or working with a mentor to learn about beekeeping practices. Currently, there are opportunities for classroom instruction, field training, and mentoring provided by knowledgeable beekeepers to members of county beekeeping associations. For a list of the county beekeeping associations in your area visit the [Massachusetts Beekeeping Association](#) website. In addition, beekeepers must comply with Massachusetts Apiary Laws and Regulations related to honey beekeeping: [Chapter 128, Massachusetts General Law, Sections 32-36B](#) and [330 CMR 8.00-8.07: Apiary Inspection Regulations](#). Beekeepers should also check with the municipality in which the apiary is located, in case there are local ordinances that also apply.

In an effort to maximize pollinator health, beekeepers are also encouraged to consider the following practices:

- ❖ To ensure colony survival, establish your apiary in a location that provides adequate forage resources and water supply, proper environmental conditions (i.e. sun exposure, windbreak and using the proper density of colonies based on area. Refer to the BMPs listed above for density estimates, which are vital to ensuring the adequate forage resources as well as decreased conditions for disease and parasite spread. Establish and try to maintain a positive relationship with neighbors, land managers and farmers through direct communication when establishing and/or moving the apiary so that bees

are provided with the most beneficial habitat parameters and are not considered a nuisance or public safety issue.

- ❖ If supplying bees for pollination, setup a pollination contract in advance. That contract should outline at a minimum: the pollination fee, number of colonies per acre, payment schedule, bloom timeline/pollination schedule, and removal date. This ensures that both the farmer and beekeeper interests are protected. For additional information, review the [USDA Insect Pollination of Cultivated Crops](#) and sample contracts: [University of Florida Sample Pollination Contract](#), [Michigan State University Sample Pollination Contract](#)
- ❖ Learn to recognize and understand the life history, biology and management of honey bees and their common pests, parasites, and pathogens. There are several guides available from USDA [Diagnosis of Honey Bee Diseases](#) and the Pennsylvania State University Extension that can assist in learning more about these organisms:
  - [A Field Guide to Honey Bees and Their Maladies](#)
  - [A Quick Reference Guide to Honey Bee Parasites, Pests, Predators and Diseases](#)



other living organisms, and the environment. It employs a four-phase strategy: (1) Reduce conditions that favor pest populations, (2) Establish an economic threshold of how much damage can be tolerated before pest control must occur, (3) Monitor pest populations, and (4) Control pests with the most specific pest control option when the pre-established damage threshold is reached<sup>27</sup>. Along with their informative guide, the Honey Bee Health Coalition just released a series of [instructional videos](#) that demonstrates how to evaluate for Varroa mites and install treatments. Be sure to only use currently registered pesticide products for treatment, and use them according to label instructions (Remember: *The Label is the Law!*). Obtain a commercial pesticide applicator license if you are applying treatments to colonies not owned by you and in another beekeepers' apiary. If additional assistance is needed, considering contacting

- [Beekeeping Basics](#)

- ❖ Regularly inspect colonies to determine the incidence and level of common pests, parasites and pathogens. When present, incorporate Integrated Pest Management (IPM) practices for control, and evaluate pest pre/post population levels regarding treatment so that informed decisions can be made. "IPM is defined as a decision-making framework that utilizes least hazardous pest management options only when there is a demonstrated need, and takes special precautions to reduce the hazards of pest management activities to people,

the MDAR Apiary Program to request a routine [annual health inspection](#) and/or [registering your apiary](#).

- ❖ Stay up to date on new developments in honey bee husbandry so that you can practice the most effective management techniques. For example, replacing a portion of old brood comb every year is a great way to not only practice good colony hygiene but also prevent pathogen buildup in colonies. There are a few national organizations that periodically provide updated information:
  - [American Association of Professional Apiculturists](#)
  - [American Bee Journal](#)
  - [American Beekeeping Federation](#)
  - [American Honey Producers Association](#)
  - [Bee Culture Magazine](#)
  - [Beesource Beekeeping](#)
  - [Honey Bee Health Coalition](#)
  - [Project Apis m.](#)
- ❖ Support colony health by providing, when needed, supplemental feeds of sugar (dry or syrup) and pollen (fresh or protein patty) as well as providing an additional water source.
- ❖ Support colony health by adequately preparing colonies for winter by ensuring an adequate workforce, healthy queen, food stores, low pest/pathogen levels, ventilation, insulation, windbreak and mouse guard/entrance reducer to prevent pest invasion prior to the start of winter.
- ❖ Work with the local beekeeping community to encourage queen rearing of northern adapted bees, in order to increase vitality and genetics.
- ❖ Incorporate swarm management strategies into the apiary to minimize the loss of potential swarms and encourage the re-homing behavior of swarming bees to prevent a public concern.
- ❖ Be aware of agricultural production practices in your area and communicate with land managers/farmers and nursery/landscaping professionals on strategies to mitigate potential negative impacts from pesticides prior to application.
- ❖ Communicate with local nurseries to alert them to the locations of any nearby apiaries and/or colonies, so that you are kept informed about any potential pesticide applications that could impact their colonies.
- ❖ Communicate with pesticide applicators to provide location information for the apiary, or provide visible markers such as flags to clearly mark locations. Contact your local Mosquito Control Project and submit information to be included on their “No Spray” list.
- ❖ In the case of “Bee Kills” where pesticide use or an infectious disease (i.e. American Foulbrood) is suspected, report to MDAR promptly for investigation.
- ❖ Participate in state and national surveys related to hive health, so that the status of Massachusetts honey bees can be documented and tracked over time.

## **B. Pesticide Applicators**

Pesticides have the ability to negatively impact pollinators based on the type, rate, timing, and proximity to the colony of the materials used. Communication, cooperation, and education among stakeholders are the best tools to use to avoid non-target impacts of pesticides on pollinators. Information about hive locations as well as locations of agricultural commodities grown near apiaries should be shared between stakeholders, as must anticipated pesticide products to be used and timing of applications. Stakeholders must also cooperate and educate one another about their individual needs so that the best decisions can be made for mitigating negative impacts on pollinators. Given this, pesticide applicators should follow BMP's for using pesticides in a way that minimizes the risk to pollinators, such as:

- ❖ Communicate with beekeepers in the area about pesticide applications.
- ❖ Follow Integrated Pest Management (IPM). See the IPM specific information above for additional explanation.
- ❖ Reduce non-target exposure to pesticides by considering bloom periods of crops and nearby weeds, and avoiding application at those times.
- ❖ Only treat target areas.
- ❖ Do not spray or drift onto flowers/plants/trees when they are in bloom and when pollinators would be visiting them.
- ❖ When possible, apply pesticides early in the morning or later in the evening during times when pollinators are less active and/or not foraging in or near the treatment area.
- ❖ Stay current on product label changes and product reviews from EPA.
- ❖ Choose pesticide products wisely. Look for products that are listed as non-toxic, that have a low toxicity, short residual toxicity, and/or repellent properties to bees. There are several guidelines available to determine bee toxicity of pesticides:
  - EPA: [\*Guidance for Assessing Pesticide Risks to Bees, Policy Mitigating Acute Risk to Bees from Pesticide Products\*](#)
  - Michigan State University (MSU): [\*Minimizing Pesticide Risk to Bees in Fruit Crops\*](#)
  - Oregon State University (OSU): [\*How to Reduce Bee Poisoning from Pesticides\*](#)
  - The University of California Statewide Agricultural and Natural Resources Integrated Pest Management Program (UC IPM): [\*Bee Precaution Pesticide Ratings\*](#)
- ❖ Read and be familiar with BMP's created by national pest control agencies:
  - National Pest Management Association (NPMA): [\*Pollinator Protection Best Management Practices\*](#)
- ❖ When possible, use larger droplet sizes and drift reduction products.
- ❖ Learn more about pollinators including, but not limited to specific information on their life histories, biology, and distribution and occurrence in the landscape.
- ❖ Attend training sessions that offer information about the following topics:
  - Pollinators and pesticides
  - IPM
  - Drift management
  - Laws and regulations

In addition, pesticide applicators must follow the existing pesticide laws ([M.G.L.c. 132B](#)) and regulations ([333 CMR](#)), including but not limited to:

- ❖ *All persons shall use a pesticide in such a manner that there be no unreasonable adverse effect on the non-target environment. 333 CMR 13.02(5)*
- ❖ *All persons shall;*
  - *Use only methods and equipment which insure proper application of materials;*
  - *Operate in a careful manner and only when conditions are proper for controlling pests in the locality. 333 CMR 13.06*
- ❖ *All persons are prohibited from applying pesticides, which bear a warning statement on the label concerning bees, to fruit trees, alfalfa, clover or trefoil grown as field-crops while in bloom without making reasonable inquiry as to the presence of apiaries on the premises or within a 2.5 mile radius of the application site. If apiaries are found to occur within 2.5 miles of the application site, the applicator shall provide 24 hours' pre-notification to owners of the apiaries. Reasonable inquiry shall consist of obtaining a current Apiary list from the Department and checking with known agricultural establishments within a 2.5 mile radius of the application site to determine if pollinator hives are on-site. 333 CMR 13.07(2)*
- ❖ *No person shall distribute, handle, dispose of, discard, or store any pesticide or pesticide container in such a manner as to cause injury to humans, vegetation, crops, livestock, wildlife, beneficial insects, to cause damage to the environment, or to pollute or contaminate any water supply, waterway, groundwater or water body. M.G.L.c. 132B Section 6*
- ❖ *No person shall distribute any pesticide that does not conform to any requirement of its registration or permit. M.G.L.c. 132B Section 6*
- ❖ *No person shall use a registered pesticide in a manner that is inconsistent with its labeling or other restrictions imposed by the department. No person shall use a pesticide which is the subject of an experimental use permit inconsistently with the terms and conditions of said permit. M.G.L.c. 132B Section 6A*



### **C. Land Managers and Farmers**

Pollinators require flowering plants for food resources (pollen and nectar), water sources and habitat for nesting. A variety of agricultural crops are very attractive to pollinators<sup>29</sup>. Given this, land managers and farmers serve an important role in sustaining pollinators by providing these resources. Private and government agencies overseeing land also provide these resources and thus are encouraged to incorporate pollinator habitat as part of their management

regime. A variety of land types can be augmented to include suitable pollinator habitat, such as municipal and state-owned parcels, areas around public buildings, land along highways and within the highway median, land within power line right-of-ways, golf courses, cemeteries, forests, landfills, and parcels within existing agricultural landscapes such as hedge rows, field borders, waste and fallow areas. Land parcels are also important for commercial stationary and migratory beekeepers since these areas can serve as temporary or permanent apiary locations, staging yards for colony transport and forage resources for honey production. Land managers and farmers should work with beekeepers to offer land parcels for these uses and aid in selecting appropriate apiary locations. Incorporating pollinator habitat and pollinator-friendly land management practices also provides benefit to land managers and farmers, since research has shown that pollinator-dependent crops have higher visitation rates and increased yields when a diversity of pollinators are present in the landscape<sup>30,31</sup>. Crops grown for fodder also benefit from pollinators since adequate pollination is required for seed set<sup>29</sup>.

The first step in designating, designing, and/or restoring habitat for pollinators is to survey the area and determine if your goals of creating habitat can be met in the designated space. If additional funding is needed to accomplish the objectives, there are several national and state level programs available to provide financial assistance and/or incentives for incorporating, improving and/or expanding pollinator habitat:

- MA Department of Fish and Game: [MassWildlife Habitat Management Grant Program](#)
- MA Department of Conservation and Recreation: [Land and Recreation Grants and Loans, Forest Stewardship Program](#)
- Natural Resource Conservation Service (NRCS): [Conservation Stewardship Program \(CSP\), Environmental Quality Incentives Program \(EQIP\), Agricultural Conservation Easement Program \(ACEP\), Using Farm Bill Programs for Pollinator Conservation](#)
- US Department of Agriculture (USDA): [Conservation Reserve Program \(CRP\), Conservation Reserve Enhancement Program \(CREP\)](#)
- US Forest Service (USFS): [Pollinator-Friendly Best Management Practices for Federal Lands](#)

There may also be local assistance available in the form of grants, subsidies or scholarships from government or private agencies and organizations. The next step is to determine if and to what extent the landscape already has beneficial components, such as existing sources of water and natural areas. Natural areas like forests, woodlands, and wetland habitat provide not only a diversity of flowering plants, but also potential nest sites and water resources for pollinators. It is also important to either establish pollinator habitat in the vicinity of an existing water source, or to provide water (often even something simple, like a dish with rocks in the bottom, would suffice). Natural areas can also benefit agricultural land since farm fields adjacent to natural areas have higher pollinator abundance and subsequently higher crop fruit set compared to those surrounded only by farmland<sup>31,32</sup>. To provide nest sites for pollinators, it is important to leave a small area of fallow/bare soil, leaf piles, downed or dead wood, and grasses in the landscape.

After accounting for natural areas, nesting sites and water resources, incorporate pollinator-friendly plants suitable to the landscape (i.e. that grow well in that soil type, exposure to sunlight, moisture levels, etc.). Pollinators can benefit from a variety of plants, including both native and non-native species; select plant species that are appropriate for the habitat (i.e. use native species in or near conservation areas). Another important part of the process of building pollinator habitat is to select plants that provide a diversity of flower types, and a continuous supply of floral resources and bloom throughout the season. As part of any landscaping effort, it is best to consult planting lists and guidelines specific for the region, including:

- Canadian Pollination Initiative (NSERC-CANPOLIN): [Pollination in the Agricultural Landscape](#)
- NRCS: [Monarch Butterflies](#), [How Farmers Can Help Pollinators](#), [New England Pollinator Handbook](#)
- Pollinator Partnership and North American Pollinator Protection Campaign (NAPPC): [Selecting Plants for Pollinators: A Regional Guide For Farmers, Land Managers and Gardeners in the Eastern Broadleaf Forest Oceanic Province](#)
- Sustainable Agriculture Research and Education (SARE): [Managing Alternative Pollinators](#)
- UMass: [Pollinators in the Landscape I](#) and [Pollinators in the Landscape II](#)
- USDA: [Improving Forage For Native Bee Crop Pollinators](#), [Enhancing Nest Sites For Native Bee Crop Pollinators](#), [Attractiveness of Agricultural Crops to Pollinating Bees](#)
- USFS: [Plant Milkweed for Monarchs](#)
- University of Maine (UM): [Landscaping for Butterflies in Maine](#)
- Xerces Society: [Monarch Conservation](#), [Milkweeds: A Conservation Practitioners Guide](#), [Monarch Butterflies and Butterfly Larvae/Host Plants for](#)



[Eastern United States, Farming for Pollinators, Farming with Pollinators, Establishing Pollinator Meadows from Seed, Conservation Cover for Pollinators: New England Installation Guide and Job Sheet](#)

In addition to incorporating plants into the landscape, land managers and farmers can also augment management practices to create, promote or enhance pollinator habitat. These practices include the following:

- ❖ Add strips of pollinator-friendly species to field margins, or between rows.
- ❖ Plant pollinator-friendly species as cover crops or as an intercrop.
- ❖ Manage the landscape to incorporate multiple types of crops that bloom at the same time offering an array of floral resources for pollinators.
- ❖ Reduce tillage intensity to allow for more nest sites for ground nesting pollinators.
- ❖ Reduce or eliminate mowing practices to increase blooming time of flowers or allow additional plant species to flower.
- ❖ Incorporate legumes as part of fodder field management, to increase nitrogen while also providing floral resources for pollinators.
- ❖ Suppress pesticide use when not necessary. Instead, use IPM and reduced risk chemicals, if necessary. Use the guidelines listed on pages 15-16 of this guide to determine the toxicity of pesticides to bee pollinators. There are also several other guides available with more information about how to incorporate these practices:
  - North American Pollinator Protection Campaign (NAPPC): [Protecting Pollinators: How and Why Pesticide Applicators Can Help Them](#)
  - SARE: [Manage Insects on Your Farm](#)
  - University of Florida (UF): [Minimizing Honey Bee Exposure to Pesticides](#)
  - US Department of Transportation Federal Highway Administration: [Literature Review: Pollinator Habitat Enhancement and Best Management Practices in Highway Rights-of-Way, Pollinators and Roadsides: Best Management Practices for Managers and Decision Makers](#)
  - USDA: [Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators Using Integrated Pest Management and Other Conservation Practices](#)
  - Xerces Society: [Guidance to Protect Habitat From Pesticide Contamination](#)
- ❖ Work with state agencies to determine the BMPs needed for weedy, invasive plants by either timing management applications after bloom or providing replacement forage options using non-invasive plants.
- ❖ Participate in state and national surveys related to bee forage and land use, so that the status of MA landscapes as floral resources for pollinators can be documented and tracked.

#### **D. Nurseries and Landscapers**

Nurseries serve an important role in sustaining pollinator health by providing opportunities for property owners and landscapers to purchase plants that provide resources for pollinators to use for nectar and pollen foraging and as habitat. The landscaping industry has also made

strides in recent years in the development of pollinator-friendly landscaping options. Nursery owners/managers and landscapers not already doing so should consider the following:

- ❖ Provide pollinator-friendly (and weed and invasive-free) planting options (annuals, perennials, shrubs and trees) and seed mixes to property owners, and encourage the creation and/or expansion of pollinator-friendly habitat wherever possible. See the pollinator plant lists above for more information.
- ❖ When possible, provide property owners with resources to assist in creation of pollinator-friendly habitats, where planting plans encourage the use of a variety of plant species in order to attract the greatest diversity of pollinators over the course of the entire growing season.
- ❖ Apply IPM practices in planting yards, greenhouses, and retail areas to minimize potential impact of pesticide application on pollinator insects. When pesticide application is deemed necessary, choose reduced risk chemicals whenever feasible.
- ❖ Reach out to University of Massachusetts Extension and other university researchers to keep informed about the latest developments in creating pollinator habitats.
- ❖ Stay up to date with industry Best Management Practices (BMPs) as they become available:
  - Horticultural Research Institute: [Grow Wise Bee Smart: Best Management Practices for Bee Health in the Horticultural Industry](#)
- ❖ Work with local beekeepers or beekeeping groups to ensure you are aware of the locations of any nearby apiary, and that beekeepers are kept informed about any potential pesticide applications that could impact their colonies.
- ❖ Also, keep beekeepers informed about updates to pollinator gardening options and work with beekeepers on issues related to finding the most optimal plants for honey production (i.e. new plant species, research into pollinator habitat design, etc.).

#### **E. Homeowners and Gardeners**

Homeowners and gardeners can play an important part in supporting pollinators by maintaining, enhancing, and/or increasing pollinator habitat on their property. The key to thinking about pollinator habitat is considering plants that provide food, water and shelter to meet the needs of all pollinators. These plants can include both native and non-native/ornamentals, although it has been shown that gardens with native plants tend to support more diverse pollinator groups while also being drought tolerant and requiring less management than those with non-native plantings<sup>33,34,35,36</sup>. Some steps to consider:

- ❖ Select plants that fit the area, taking into account the soil type, drainage, slope, and the amount and location of sunlight throughout the day.
- ❖ Select pollinator-friendly plant species. You can familiarize yourself with common pollinator insects with an identification guide such as the Xerces Society's [Streamlined Bee Monitoring Protocol](#).
- ❖ Use the [NAPPC Pollinator Syndromes](#) and [USFS Pollinator Syndromes](#) charts to help you determine what criteria to look for in selecting plants.
- ❖ Do some research on the plants that would be best for your area. If you are interested in identifying the species of wildflowers that are already in your yard prior to making changes visit the New England Wildflower Society's Go Botany website for [keys](#).

- ❖ Your local nursery or landscaper will often have guidance on creating the best pollinator habitat on your land. To find a source for native plants, check with your local nursery or use the directory provided by Plant Native: [Native Plant List for Connecticut, Massachusetts and Rhode Island](#). If you are selecting non-native species, remember that

some cultivars have been modified and do not provide pollen and nectar, such as tulips, daffodils, petunias, and ornamental roses. Some examples of resources that provide regional native and non-native plant lists suitable for Massachusetts are:

- [BeeSmart Pollinator Gardener App](#)
- Bringing Nature Home: [Plant List for Butterflies and Moths](#)
- Massachusetts Butterfly Club: [Butterfly Gardening 101: Western Massachusetts](#)
- MSU: [Protecting and Enhancing Pollinators in Urban Landscapes](#)
- New England Wildflower Society: [State of New England's Native Plants](#)
- NRCS: [How Gardeners Can Help Pollinators](#), [Pollinator Friendly Plants for Northeast United States](#)
- OSU: [Nurturing Mason Bees in Your Backyard in Western Oregon](#)
- UMass: [Gardening to Support Pollinators](#), [Planting For Pollinators](#)
- USDA: [Massachusetts Plant Hardiness Zone Map](#)
- USFWS: [Attracting Pollinators to Your Garden](#), [Attracting Pollinators To Your Garden Using Native Plants](#), [Pollinator Plant Lists](#)
- Xerces Society: [Pollinator Plants for Northeast Region](#), [Pollinator Friendly Parks: How to Enhance Parks, Gardens, and Other Greenspaces for Native Pollinator Insects](#)



- ❖ When designing a garden or landscape around your home, make sure the plants you choose are diverse not only in the number and types of each species, but also in the timing of flowering (throughout the growing season). Design the area so that there are large sections consisting of several species of plants that all flower at the same time, with an overall array of plants flowering throughout the season. Keep in mind that many pollinator species may feed on different plants as larvae versus when they are adults.

- ❖ Your landscape should include a variety of plant types such as wildflowers, grasses, herbs, fruits, vegetables, shrubs and trees.

- ❖ Avoid invasive, noxious and weedy plants that may be harmful to other plants through overcrowding that reduces the diversity of floral resource available. Though note that if local ordinances allow, weeds such as dandelions, clover and other flowering plants in lawns can be important early season food resources for pollinators at times when other flowers are unavailable.
- ❖ Provide a water source for pollinators either in the form of a bird bath or a shallow dish with stones in the bottom to prevent drowning. If you are targeting butterflies specifically, you could also provide a salted area for adults to use in obtaining sodium by simply adding some salt to a moist area of soil.



- ❖ The majority of pollinators are considered to be central place foragers meaning that they forage very close to their nest. Taking this into account, nesting materials need to be provided in close proximity to flowering plants. However, before thinking about nesting areas, take a tour of the existing habitat and determine if it already consists of any active nests. If so, avoid disturbing them and instead incorporate these into your habitat plans. When thinking about providing nesting material for pollinators, it is important to remember that pollinators can use

a variety of above and below ground areas as nests. Providing nesting areas can be as simple as leaving some undisturbed space or as complex as installing pollinator specific boxes such as “bee hotels”. A great guide to use when constructing bee boxes has been produced by the [Xerces Society](#). If providing nest boxes, keep in mind that some types have low occupancy success rates such as those for bumble bees and others have to be very specific to meet pollinator needs, such as nest entry diameter for certain species of solitary bees. Nest boxes also have to be periodically cleaned to prevent the occurrence and spread of infectious disease. If local ordinances allow, some of the best nesting areas consist of leaving falling logs, leaf litter abandoned bird nests and mammal burrows as nesting sites for pollinators.

- ❖ If you are going to use pesticides be sure to incorporate the same IPM strategies described above. Read pesticide labels, follow label instructions carefully, and apply the materials in way that minimizes potential impact to pollinators. This includes considering the time of year and time of day for applications in order to minimize exposure to pollinators. It is also important to consider removing or mowing blooming plants that are flowering in the lawn prior to pesticide application, to mitigate the potential exposure to foraging pollinators.

After you have created the pollinator habitat on your property complete with food, water and nesting resources, consider telling others about your accomplishments, including posting signage and showing the area to your neighbors and others in the community to help spread the word on the importance of pollinator habitat. There are also several national organizations you can contribute to by collecting citizen science data on the pollinators attracted to your yard and/or getting recognition for the incorporation of pollinator habitat:

- [BeeSpotter](#)
- [Bumble Bee Watch](#)
- [eButterfly](#)
- [Monarch Watch](#)
- National Pollinator Garden Network: [Million Pollinator Garden Challenge](#)
- [Native Buzz Project](#)
- NRCS: [Pollinator Habitat Sign](#)
- [Red Admiral and Painted Lady Butterfly Research Site](#)
- [The Great Sunflower Project](#)
- Wild Ones: [Native Plant Butterfly Garden or Habitat Recognition Program](#)

## **FUTURE ACTIONS AND IMPROVEMENTS**

This plan is voluntary, not regulatory, and meant to be for educational purposes. MDAR will periodically review and modify the plan as needed to ensure that it meets the needs of stakeholders in providing the most comprehensive protection strategies for pollinators. Efforts will be made to find additional funding through grants or budgetary allocations for pollinator outreach, protection and assistance.

To better meet the needs of honey beekeepers and provide support for all pollinator species,



the MDAR Apiary Program is in the process of updating its services as well as evaluating future additional projects:

- ❖ Updated inspection request service providing options for webpage information submission in addition to the existing paper process.

- ❖ Updated webpage where stakeholders can access information related

to beekeeping, bee health, apiary laws and regulations.

- ❖ Creating a State Apiary with the purpose of providing support to beekeepers through demonstrations of beekeeping practices, hive management strategies, public outreach, and data collection on parameters related to bee health. In 2016, the first MDAR State Apiary was established on the University of Massachusetts-Amherst Agricultural Learning Center farm. It consisted of a total of 12 colonies initiated from package bees purchased in New England. The apiary was setup to mimic a standard apiary in Western Massachusetts consisting of hive stands and a bear fence. An additional State Apiary is planned for Eastern Massachusetts, with the goal of providing similar services to local beekeepers.
- ❖ Provide outreach education for honey beekeepers on topics related to honey bee biology, hive management, and pest, parasite and pathogen detection and treatment options.
- ❖ Participate in the annual National USDA Honey Bee Survey.
- ❖ Collect and analyze data on local honey bee health to better assess the population. The State Apiary can also be used to collect data assessing honey bee health.
- ❖ Launch a Varroa Mite IPM program and disperse alcohol mite wash kits to beekeepers for population monitoring throughout the season.
- ❖ Provide outreach to pesticide applicators, including the creation of pollinator safety BMPs and training programs for both the Pesticide Application Continuing Education credit courses and prep courses as well as pest control company continuing education programs.
- ❖ Research the feasibility of creating internally or incorporating one of the commercially available voluntary hive mapping programs, such as [BeeCheck](#) or [The Honey Bee and Pesticide Mapping Program](#), as a method of improving communication between beekeepers and pesticide applicators and mitigating the negative risks of pesticide exposure.
- ❖ Launch a [Bee Aware](#) program for honey beekeepers by using the model that the Mississippi Beekeepers Association implemented with success consisting of putting up distinctive black and yellow flags around honey bee colonies to note their location for alerting pesticide applicators.
- ❖ Create and distribute pollinator kits to K-12 classrooms for promoting and educating about the importance of pollinators.
- ❖ Partner with other state agencies to create a MA specific pollinator plant seed mix packet for distribution.
- ❖ Partner with other state agencies and academic institutions to determine the most optimal plants for honey production.
- ❖ Collaborate with UMass to create a Master Beekeeping educational program.
- ❖ Create a Monarch butterfly planting and release program focused on habitat and population enhancement.
- ❖ Partner with other state agencies to apply for grant funding to increase pollinator habitat and forage statewide as well as designate more existing acreage for pollinator habitat.

## **ACKNOWLEDGEMENTS**

We wish to acknowledge and thank all the stakeholders, organizations and members of the general public that was involved in the process of creating this plan. We sincerely appreciate your willingness to participate, passion for the topic and feedback for without these contributions, this plan would not have been possible.

## **REFERENCES**

1. Ollerton, J., Winfree, R., and Tarrant, S. 2011. How many flowering plants are pollinated by animals? *Oikos*, 120(3): 321-326.
2. Klein, A., Vaissière, B.E., Cane, J.H., Steffan-Dewenter, I., Cunningham, S.A., Kremen, C., and Tscharntke, T. 2007. Importance of pollinators in changing landscapes for world crops. *Proceedings of the Royal Society of London B: Biological Sciences*, 274(1608): 303-313.
3. United States Department of Agriculture (USDA). 2013. Report on the National Stakeholders Conference on Honey Bee Health. National Honey Bee Stakeholder Conference Steering Committee. Alexandria, Virginia. October 15–17, 2012. <http://www.usda.gov/documents/ReportHoneyBeeHealth.pdf> (Assessed December 1, 2016).
4. Kleijn, D., Winfree, R., Ricketts, T.H., Williams, N.M., Lee Adamson, N., Ascher, J.S., Baldi A., Batary, P., Benjamin, F., Biesmeijer, J.C., Blitzer, E.J., Bommarco, R., Bartomeus, I., Brand, M.R., Bretagnolle, V., Button, L., Cariveau, D.P., Chifflet, R., Colville, J.F., Danforth, B.N., Elle, E., Garratt, M.P.D., Herzog, F., Carvalheiro, L.G., Holzschuh, A., Howlett, B.G., Jauker, F., Jha, S., Knop, E., Krewenka, K.M., Le Feon, V., Mandelik, Y., May, E.A., Park, M.G., Henry, M., Pisanty, G., Reemer, M., Riedinger, V., Rollin, O., Rundlof, M., Sardinias, H.S., Scheper, J., Sciligo, A.R., Smith, H.G., Steffan-Dewenter, I., Isaacs, R., Thorp, R., Tscharntke, T., Verhulst, J., Viana, B.F., Vaissiere, B.E., Veldtman, R., Ward, K.L., Westphal, C., Potts, S.G., Klein, A., Kremen, C., M'Gonigle, L.K., and Rader, R. 2015. Delivery of crop pollination services is an insufficient argument for wild pollinator conservation. *Nature Communications*, 6. doi:10.1038/ncomms8414.
5. National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA). Cost of Pollination. ISSN: 2475-4315. Released December 22, 2016. <https://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=2008> (Accessed December 22, 2016).
6. Losey, J.E. and Vaughan, M. 2006. The economic value of ecological services provided by insects. *Bioscience*, 56(4):311–323.
7. Michener, C.D. 2007. *The Bees of the World*. 2nd ed. 953 pp. Baltimore, Maryland. Johns Hopkins University Press.
8. Department of Systematic Biology, National Museum of Natural History and Smithsonian Institution. Information Sheets. [https://www.si.edu/Encyclopedia\\_SI/nmnh/buginfo/bugnos.htm](https://www.si.edu/Encyclopedia_SI/nmnh/buginfo/bugnos.htm). (Accessed December 1, 2016).

9. United States Forest Service (USFS). Fly pollinators. <https://www.fs.fed.us/wildflowers/pollinators/animals/flies.shtml>. (Assessed December 1, 2016).
10. United States Forest Service (USFS). Beetle pollinators. <https://www.fs.fed.us/wildflowers/pollinators/animals/beetles.shtml>. (Assessed December 1, 2016).
11. United States Forest Service (USFS). Wasp pollinators. <https://www.fs.fed.us/wildflowers/pollinators/animals/wasps.shtml>. (Assessed December 1, 2016).
12. vanEngelsdorp, D., and Meixner, M.D. 2010. A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them. *Journal of Invertebrate Pathology*, 103:80–95.
13. Berenbaum, M.R. 2015. Does the honey bee "risk cup" runneth over? Estimating aggregate exposures for assessing pesticide risks to honey bees in agroecosystems. *Journal of Agricultural and Food Chemistry*, 64: 13-20.
14. Clemson University Cooperative Extension. Honey bee tracheal mite. 01/2000. [http://www.clemson.edu/extension/beekeepers/factsheets/honey\\_bee\\_tracheal\\_mite.html](http://www.clemson.edu/extension/beekeepers/factsheets/honey_bee_tracheal_mite.html). (Assessed December 1, 2016).
15. US Environmental Protection Agency (EPA). 2016. Pollinator Protection: Colony Collapse Disorder. <https://www.epa.gov/pollinator-protection/colony-collapse-disorder>. (Assessed December 1, 2016).
16. National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA). Honey Bee Colonies Report. ISSN: 2470-993X. Released May 12, 2016. <http://usda.mannlib.cornell.edu/usda/current/BeeColonies/BeeColonies-05-12-2016.pdf>. (Accessed December 1, 2016).
17. Steinhauer, N., Rennich, K., Lee, K., Pettis, J., Tarpy, D.R., Rangel, J., Caron, D., Sagili, R., Skinner, J.A., Wilson, M.E., Wilkes, J.T., Delaplane, K.S., Rose, R., and vanEngelsdorp, D. 2016. Colony Loss 2014-2015: Preliminary Results. Bee Informed Partnership. <https://beeinformed.org/results/colony-loss-2014-2015-preliminary-results/>
18. Massachusetts Division of Fisheries and Wildlife (DFW), Natural Heritage & Endangered Species Program (NHESP). 2015. <http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/mesa-list/list-of-rare-species-in-massachusetts.html> (Accessed December 1, 2016).
19. Massachusetts Division of Fisheries and Wildlife (DFW), Natural Heritage & Endangered Species Program (NHESP). 2015. <http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/mesa-list/non-listed-species-of-conservation-interest.html> (Accessed December 1, 2016).
20. Goulson, D., Nicholls, E., Botias, C. and Rotheray, E.L. 2015. Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. *Science*, 347(6229):1435-1444.
21. Johnson, R., and Corn, M.L. 2014. Bee Health: Background and Issues for Congress. R43191. <https://www.fas.org/sgp/crs/misc/R43191.pdf>

22. McMenamin, A.J. and Genersch, E. 2015. Honey bee colony losses and associated viruses. *Current Opinion in Insect Science*, 8:121-129.
23. National Academy of Sciences (NAS). 2007. Report on The Status of Pollinators in North America. <http://www.nap.edu/catalog/11761/status-of-pollinators-in-north-america>
24. IUCN (International Union for the Conservation of Nature). 2016. Red List of Threatened Species. ISSN 2307-8235. [www.iucnredlist.org](http://www.iucnredlist.org). (Accessed July 7, 2016).
25. Pelton, E., Jepson, S., Schultz, C., Fallon, C. and Black, S.H. 2016. State of the Monarch Butterfly overwintering sites in California. 40pp. Portland, OR. The Xerces Society for Invertebrate Conservation.
26. United States Department of Agriculture (USDA). 2015. Conservation and Management of Monarch Butterflies: A Strategic Framework. US Forest Service FS-1044. [https://www.fs.fed.us/wildflowers/pollinators/Monarch\\_Butterfly/documents/ConservationManagementMonarchButterflies.pdf](https://www.fs.fed.us/wildflowers/pollinators/Monarch_Butterfly/documents/ConservationManagementMonarchButterflies.pdf)
27. Vilsack, T. and McCarthy, G. 2015. Pollinator Health Task Force National Strategy to Promote the Health of Honey Bees and Other Pollinators. <https://www.whitehouse.gov/sites/default/files/microsites/ostp/Pollinator%20Health%20Strategy%202015.pdf>
28. United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2014. Preventing or mitigating potential negative impacts of pesticides on pollinators using integrated pest management and other conservation practices. Agronomy Technical Note No. 9. [www.xerces.org/wp-content/uploads/2014/04/NRCS\\_Pesticide\\_Risk\\_Reduction\\_TechNote.pdf](http://www.xerces.org/wp-content/uploads/2014/04/NRCS_Pesticide_Risk_Reduction_TechNote.pdf).
29. McGregor, S.E. 1976. USDA Insect Pollination of Cultivated Crop Plants. <https://www.ars.usda.gov/ARSUserFiles/20220500/OnlinePollinationHandbook.pdf>. (Assessed December 1, 2016).
30. Garibaldi, L.A., Steffan-Dewenter, I., Winfree, R., Aizen, M.A., Bommarco, R., Cunningham, S.A., Kremen, C.,Carvalho, L. G., Harder, L. D., Afik, O., Bartomeus, I., Benjamin, F., Boreux, V., Cariveau, D., Chacoff, N.P., Dudenhoffer, J.H., Freitas, B. M., Ghazoul, J., Greenleaf, S., Hipolito, J., Holzschuh, A., Howlett, B., Isaacs, R., Javorek, S.K., Kennedy, C.M., Krewenka, K.M., Krishnan, S., Mandelik, Y., Mayfield, M. M., Motzke, I., Munyuli, T., Nault, B.A., Otieno, M., Petersen, J., Pisanty, G., Potts, S. G., Rader, R., Ricketts, T.H., Rundlof, M., Seymour, C.L., Schuepp, C.,Szentgyorgyi, H., Taki, H., Tschardtke, T., Vergara, C.H., Viana, B.F., Wanger, T.C., Westphal, C., Williams, N., and Klein, A.M. 2013. Wild pollinators enhance fruit set of crops regardless of honey bee abundance. *Science*, 339(6127): 1608-1611.
31. Garibaldi L., Steffan-Dewenter, I., Kremen, C., Morales, J.M., Bommarco, R. Cunningham, S.A., Carvalho, L.G., Chacoff, N.P., Dudenhoffer, J.H., Greenleaf, S.S., Holzschuh, A. Isaacs, R., Krewenka, K., Mandelik, Y., Mayfield, M.M., Morandin, L.A., Potts, S.G., Ricketts, T.H., Szentgyorgyi, H., Viana, B.F., Westphal, C., Winfree, R., and Klein, A.M. 2011. Stability of pollination services decreases with isolation from natural areas despite honey bee visits. *Ecology Letters*, 14: 1062–72.
32. Kennedy, C.M., Lonsdorf, E., Neel, M.C., Williams, N.M., Ricketts, T.H., Winfree, R., Bommarco, R., Brittain, C., Burley, A.L., Cariveau, D., Carvalho, L.G., Chacoff, N.P., Cunningham, S.A., Danforth, B.N., Dudenhöffer, J.H., Elle, E., Gaines,

- H.R., Garibaldi, L.A., Gratton, C., Holzschuh, A., Isaacs, R., Javorek, S.K., Jha, S., Klein, A.M., Krewenka, K., Mandelik, Y., Mayfield, M.M., Morandin, L., Neame, L.A., Otieno, M., Park, M., Potts, S.G., Rundlöf, M., Saez, A., Steffan-Dewenter, I., Taki, H., Viana, B.F., Westphal, C., Wilson, J.K., Greenleaf, S.S., and Kremen, C. 2013. A global quantitative synthesis of local and landscape effects on wild bee pollinators in agroecosystems. *Ecology letters*, 16(5):584-599.
33. Tonietto, R., Fant, R., Ascher, J., Ellis, K., and Larkin, D. 2011. A comparison of bee communities of Chicago green roofs, parks and prairies. *Landscape and Urban Planning*, 103(1):102-108.
34. Frankie, G., Thorp, R.W., Schindler, M., Ertter, B., and Rizzardi, M. 2005. Ecological patterns of bees and their host ornamental flowers in two northern California cities. *Journal of the Kansas Entomological Society*, 78(3):227-246.
35. Tallamy, D., and Shropshire, K. 2009. Ranking Lepidopteran use of native versus introduced plants. *Conservation Biology*, 23(4): 941-947.
36. Burghardt, K.T., Tallamy, D.W., and Shriver, W.G. 2009. Impact of native plants on bird and butterfly biodiversity in suburban landscapes. *Conservation Biology*, 23(1):219-224.

### **PHOTO CREDITS:**

#### Cover Page:

- Bumble bee on yellow flower; Jennifer Forman-Orth, MDAR
- Swallowtail butterfly on pink flower; Jennifer Forman-Orth, MDAR
- Honey bees on comb; Kim Skyrms, MDAR

#### Page 4:

- Hoverfly on yellow flower; <https://pixabay.com/en/hover-fly-insect-close-animal-61682/>
- Bumble bee on yellow flower; <https://pixabay.com/en/bee-bumblebee-insect-yellow-flower-61639/>
- Soldier beetle on goldenrod flower; <http://ninnescahlife.wichita.edu/node/409>

Page 6: Honey bees close up; <http://maxpixel.freegreatpicture.com/Insect-Beekeeper-Nature-Bees-Honey-Bees-Close-957278>

Page 8: Monarch butterfly on milkweed flower; <http://maxpixel.freegreatpicture.com/Flower-Monarch-Butterfly-Bloom-Blossom-Insect-957784>

Page 9: Pollinator meadow of flowers; <https://pixabay.com/en/photos/wild%20flower%20meadow/>

Page 10: Ladybird beetle on blue flower; <https://pixabay.com/en/photos/ladybug/>

Page 12: Honey bee frame; Kim Skyrms, MDAR

Page 14: Honey bee brood; <https://en.wikipedia.org/wiki/Honeycomb>

Page 17: Red clover field adjacent to forest; [https://www.flickr.com/photos/forest\\_service\\_southern\\_region/23507391492](https://www.flickr.com/photos/forest_service_southern_region/23507391492)

Page 19: Wildflower meadow in Western Massachusetts; Kim Skyrms, MDAR

Page 22:

- Carder bee on pink flower; [https://en.wikipedia.org/wiki/File:Anthidium\\_February\\_2008-1.jpg](https://en.wikipedia.org/wiki/File:Anthidium_February_2008-1.jpg)
- Mining bee on pink flower; [https://commons.wikimedia.org/wiki/File:Green\\_Bee\\_from\\_the\\_Memorial\\_Rose\\_Garden\\_-\\_Flickr\\_-\\_Andrea\\_Westmoreland.jpg](https://commons.wikimedia.org/wiki/File:Green_Bee_from_the_Memorial_Rose_Garden_-_Flickr_-_Andrea_Westmoreland.jpg)
- Hoverfly on pink flower; [https://pixabay.com/p-1680534/?no\\_redirect](https://pixabay.com/p-1680534/?no_redirect)

Page 23: Pollinator habitat with sign; <https://www.flickr.com/photos/usdagov/14211811813>

Page 24: State Apiary at UMass; Kim Skyrn, MDAR

## **APPENDIX A: PERFORMANCE METRICS**

MDAR will evaluate the effectiveness and impact the plan has had on the health of pollinators using the performance metrics listed below. Key areas of interest include the educational outreach and change in behavior of stakeholder groups, reduction in exposure of bees to pesticides, methods to improve bee health including the data from the MDAR Apiary Program, and compliance of regulations related to reducing risks to bee populations. When needed, baseline data will be collected related to the performance metrics listed below to enhance and compliment current collection strategies. This combination of qualitative and quantitative data will be analyzed on an annual basis to provide a detailed assessment of the plan.

### **A. Outreach**

- Number of pollinator related inquiries via phone and email received by MDAR
- Number of pollinator specific trainings provided by MDAR
- Number of trainings that contained pollinator information provided by MDAR
- Outreach materials developed and provided by MDAR for stakeholder groups:
  - Beekeepers
  - Pesticide applicators
  - Farmers/Land managers
  - Nurseries/Landscapers
  - Homeowners/Gardeners
  - Other stakeholder groups

### **B. Behavioral Changes**

- Number of individuals (pre vs. post plan):
  - Registering honey bee apiaries
  - Requesting honey bee colony inspections
  - Requesting pollinator specific trainings
  - Requesting to be on a “No Spray List” for mosquito control applications
- New laws and/or regulations that are created

### **C. Reducing Exposure to Pesticides**

- Number of calls alleging pesticide suspected bee kills
- Number of bee kills investigated
- Number and types of pesticides found in samples

- Number of bee kills which resulted in pesticides found in samples, but inconclusive of involvement with colony death
- Number of bee kills determined to be due to pesticides

#### D. Improving Hive Health

- Apiary Inspection Program:
  - Summary of results from annual MA Hive Survey
  - Summary of results from annual USDA Honey Bee Survey
  - Beekeeper satisfaction with services provided by the Apiary Program
  - Number of inspectors
  - Amount of packages, nucleus colonies (nucs), and colonies imported into MA
  - Amount of imported nucs and colonies inspected from imported material
  - Amount of nucs and colonies exported from MA
  - Amount of exported nucs and colonies inspected from exported material
  - Number of counties and cities visited
  - Number of beekeepers visited and colonies inspected
  - Number of bee kills not related to pesticide use
  - Occurrence and amount of pests, parasites and pathogens detected:
    - Bacteria: American Foulbrood and European Foulbrood
    - Fungi: Nosema spp., Chalkbrood, Stonebrood
    - Parasites: Varroa mites, Tracheal mites
    - Pests: Wax moths, Small Hive Beetles (SHB), Mice, Bears
    - Viruses: Sacbrood Virus (SBV), Deformed Wing Virus (DWV), Chronic Bee Paralysis Virus (CBPV), Black Queen Cell Virus (BQCV), Kashmir Bee Virus (KBV), Israeli Acute Paralysis Virus (IAPV), Slow Bee Paralysis Virus (SBPV), Acute Bee Paralysis Virus (ABPV)
    - Other Issues: Colony Collapse Disorder (CCD), Idiopathic Brood Disease Syndrome (IBDS), Parasitic Mite Syndrome (PMS), Snot Brood, K-Wing
    - Invasive Species: Africanized Honey Bees
    - New pests, parasites and pathogens

#### E. Future Actions and Improvements

- Number of new projects implemented
- Number of participants in new projects
- Amount of new acreage designated and/or created for pollinator habitat statewide