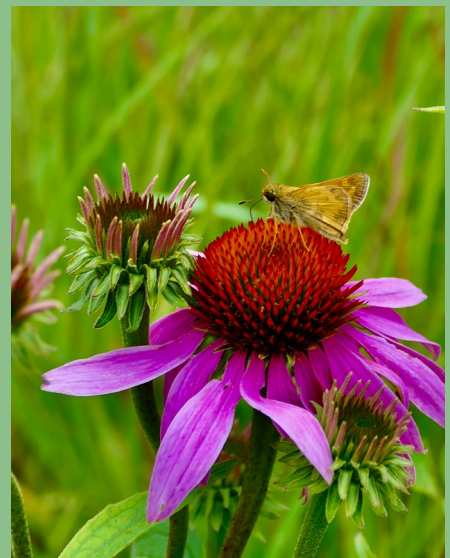


Maryland Department of Natural Resources Pollinator Habitat Plan



A blueprint for the conservation of pollinators and
pollinator habitat on the natural lands managed by the Maryland
Department of Natural Resources for the benefit of Maryland's citizens





Wes Moore, Governor
Josh Kurtz, Secretary



Maryland Department of Natural Resources
Wildlife and Heritage Service
Tawes State Office Building, E-1
580 Taylor Avenue
Annapolis, MD 21401
410-260-8540
dnr.maryland.gov

Additional Telephone Contact Information:
Toll free in Maryland: 877-620-8DNR ext. 8540
Out of state call: 410-260-8540
Text Telephone (TTY) users call via the Maryland Relay

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Introduction

Pollination is the means by which plants sexually reproduce. Much of the beauty of the natural world and the colorful glory of spring may be attributed to the process of pollination, which represents an incredible example of evolution. The flower is not only a paragon of beauty, but is also a cleverly designed portal to attract pollinator species to a plant's reproductive organs. Likewise, the many species of insects, bats, hummingbirds, and other animal species that move pollen from plant to plant have evolved over time to optimize their role in the process. Through pollination, a plant is able to mix its genes with another plant of the same species, continuing the existence of the species and ensuring another springtime bloom.

In its simplest form, pollination is copious and random. Grasses generally produce large quantities of pollen and rely upon the wind to distribute it. Since most small-grain crops (wheat, corn, rice) are grasses, much of Maryland's agriculture industry has been able to function in a landscape of decreasing pollinator diversity. In nature, pollination can become much more complex. Following hundreds of millions of years of adaptive co-evolution, sexual reproduction in plants is frequently achieved through an intermediary from the animal world. In the process of going through its daily routine, an animal – a pollinator – unwittingly plays Cupid to its plant hosts by collecting pollen. In some cases, pollinator animals pollinate thousands of plants each day. In the process of performing these procreative services, the pollinator is richly rewarded with pollen and nectar from the plants. In fact many pollinators derive virtually their entire existence from the largess of randy flora.



Sweat bee covered in pollen (TJ Gehling)

As plants and animals evolved together over time, they developed a remarkable variety of cooperative pollination adaptations. Charles Darwin observed such an adaptation. In his later years, after turning the scientific world upside-down with *On the Origin of Species by Means of Natural Selection* and *The Descent of Man*, Darwin received an unusual orchid from an admirer who was exploring Madagascar. Upon investigating the incredibly long tube between flower and nectar, Darwin remarked, "I have just received such a box full from Mr. Bateman with the astounding *Angraecum sesquipedalia* with a nectary a foot long. Good Heavens what insect can suck it?" After a few days pondering, Darwin again wrote the same correspondent: "In Madagascar there must be moths with proboscis capable of extension to a length of between 10 and 11 inches," (Darwin, 1862). Sure enough, more than a century later, a biologist in Madagascar documented a moth with an eleven-inch proboscis consuming the nectar of *A. sesquipedalian*. Such was Darwin's faith in the ingenuity of nature that he could predict the existence of an unknown – and physiologically bizarre – pollinating insect from the discovery of that unusual flower.

The natural world is rich with such wonders as Darwin's improbable giant-tongued moth – because of the co-evolutionary process of pollination, every wildflower is a love letter addressed to a pollinator species. The distinctive colors, sizes, shapes, scents, and nectar tastes produced by

specific plants entice pollinator animals to visit, thus engaging in the elaborate ritual of pollination. Although scientists since Darwin have made great discoveries in the colorful world of pollination, there remain many gaps in knowledge of the behaviors of specific plant and cooperative pollinator species. About 3,000 plant species are documented in Maryland, but the pollination processes of many of them are virtually unknown. Knowledge of Maryland's pollinating animal species is similarly lacking. There are between 25,000 and 50,000 species of insects in Maryland, but the range of that estimate alone is an indication of how little understood this populous class of animals, many of which are prodigious pollinators, remains.



Rusty patch bumblebee (Bombus affinis) queen (U.S. Geological Survey Bee Inventory and Monitoring Lab)

While the pollinator processes of a monoculture such as a corn field or pumpkin patch are fairly straightforward, the pollination requirements of a more dynamic system such as a forest or marsh are only partially understood. For the most part, native plant species must count upon the presence of native animals to meet their pollination needs. One of the most famous non-native pollinator species, the colonial honey bee, has occurred in North America only since its introduction in the 17th century. Meanwhile, approximately 430 other species of bees native to Maryland play roles in pollination that are only vaguely understood with the current level of knowledge.

In short, the current knowledge and understanding of native ecosystems barely illuminates the workings of these complex, interdependent systems. But a foundational acceptance of this complexity has produced an axiom of natural lands management: *Ecosystems function best when kept intact*. Disturbance – such as the loss of land to development, the introduction of invasive species, or the loss of key species – degrades functioning ecosystems and threatens their survival. At its heart, the struggle to maintain viable pollination processes in natural ecosystems depends on the conservation of intact and healthy forests, meadows and wetlands.

The Purpose of the Pollinator Habitat Plan

The purpose of the Maryland Department of Natural Resources' Pollinator Habitat Plan is to:

- Examine the role pollinators play in natural landscapes;
- Outline a strategy for the long term conservation of pollinators;
- Develop guidelines for the conservation of pollinator habitat; and
- Compile best management practices for the designation of Pollinator Habitat Areas

Requirements of the Pollinator Habitat Plan

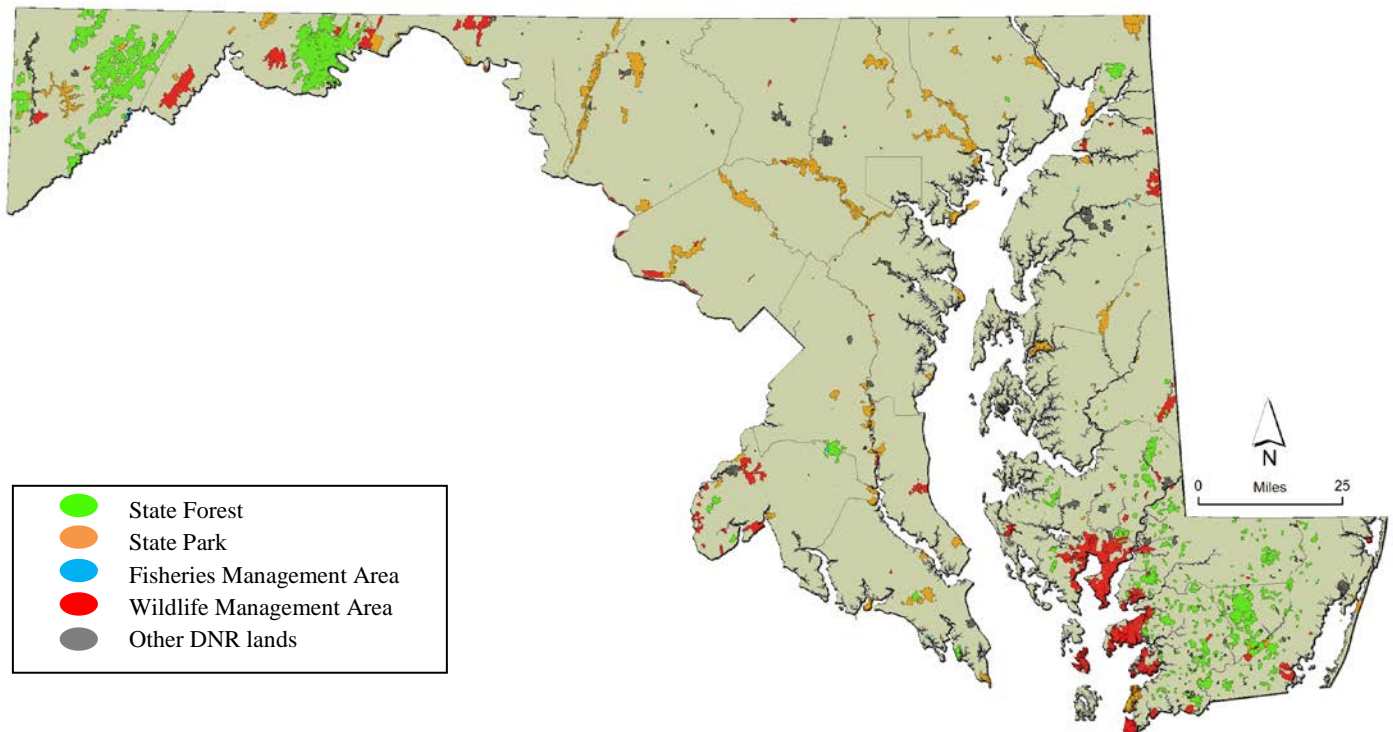
The Maryland Department of Natural Resources is required to compile a Pollinator Habitat Plan by acts of the Maryland General Assembly (Maryland Legislature) with the following characteristics:

1. The Plan must include best management practices for the designation of Pollinator Habitat Areas;
2. The Plan must be as protective of pollinators as the Department of Agriculture's Managed Pollinator Protection Plan;

3. The Plan must prohibit the use of pesticide toxic to pollinators or any neonicotinoid pesticide in Pollinator Habitat Areas;
4. The Plan must prohibit the use of seeds or plants treated with any neonicotinoid pesticide in Pollinator Habitat Areas;
5. The Plan may not allow the creation of a Pollinator Habitat Area on any productive agricultural lands; and
6. The Plan may not require any action or activity that would be in violation of some other law affecting the lands of the Pollinator Habitat Plan.

Pollinator Conservation on Maryland Department of Natural Resources Lands

The Maryland Department of Natural Resources manages about 480,000 total acres, mainly within three primary land designations: Parks, Forests and Wildlife Management Areas. Additional management types, such as Natural Environment Areas, may also be included within the jurisdiction of these. This portion of the Pollinator Plan has been divided into corresponding sections for each of the three main land management groups, since each has somewhat different management goals and methods.



Maryland Department of Natural Resources management areas by type (Maryland Department of Natural Resources)

Maryland Department of Natural Resources – State Parks

Introduction

As a land management unit within the Department of Natural Resources, the Maryland Park Service is in a unique position to play a significant role in enhancing pollinator habitat in Maryland. With the responsibility of managing a wide variety of undeveloped or lightly developed properties across the state, the Maryland Park Service can create, restore and conserve pollinator habitat, while also engaging in equally important efforts to educate the public about pollinators and the important roles they play in Maryland's diverse ecosystems.

Mission Statement

The mission of the Maryland Park Service is to *manage the natural, cultural, historical, and recreational resources on Maryland's public lands to provide for wise stewardship and enjoyment by people*. The concept of wise stewardship is based in sustainable management and in ensuring biodiversity through the conservation of all species. This stewardship concept includes pollinators and the habitat necessary for their long-term health and survival.

Goals

The goals of the Maryland Park Service are to:

- Promote, cultivate and expand public knowledge, understanding, appreciation, and support for the resources and services managed by the Maryland Park Service;
- Operate the Maryland Park Service in a manner that generates the atmosphere of teamwork, shared information, cooperation, and trust at all levels of employment;
- Manage the Maryland Park Service in a manner that ensures the maximum benefit from each dollar and hour of labor expended;
- Promote the management of natural and cultural resources to ensure their continuing benefits for present and future generations; and
- Provide diverse recreational services with an emphasis upon public safety and the provision of neat, clean, well-maintained resources.



Holding a tagged monarch butterfly (Caroline Blizzard)

Natural resources and their conservation are essential to the work of the Maryland Park Service and the service it provides to the public and park visitors. Ensuring healthy and sustainable populations of a wide variety of pollinator species is an integral part of managing natural resources for the many benefits they provide, including increasing scientific knowledge, providing for outdoor recreation, educating visitors about natural resources, enhancing the aesthetics of diverse landscapes, and promoting natural resource-based economic growth.

Acres Managed

The Maryland Park Service manages 138,270 acres of land comprising 87 land units that vary in size from about four to approximately 15,000 acres. The State Park System includes five distinct

management designations: State Parks, Natural Resources Management Areas, Natural Environment Areas, State Battlefields and Rail Trails. These lands include meadows, upland forests, tidal and nontidal wetlands, developed woodlands, shrub-scrub areas, riparian and floodplain forests, tilled agricultural lands and maintained turf recreation areas. The Maryland Park Service oversees agricultural leases on 12,000 acres of parkland. While each of the management designations includes specific land management objectives, all five encompass natural resource conservation. This means that conservation efforts directed toward pollinator habitat can potentially be appropriate, at some scale, within the boundaries of any of these land units.

Strategies to Create and Restore Pollinator Habitat

Over the last three years, the staff of the Maryland Park Service has become increasingly aware of the threats to pollinator habitat and pollinator species. This awareness was prompted by a noticeable decline in the numbers of common pollinator species, like monarch butterflies, that are present throughout public lands, as well as through media coverage of a variety of health issues affecting many pollinator species. Responding to such observations and reports, park managers, rangers, and naturalists began to educate themselves and Maryland Park Service leadership about pollinators and pollinator habitat. Staff members quickly became engaged in evaluating the problem, looking for solutions and implementing innovative strategies. These strategies have involved identifying land management practices that could be modified to improve pollinator habitat, creating and restoring pollinator habitat, and educating park visitors about pollinators and their habitats.

Several approaches to create, increase and enhance pollinator habitat have been identified. These include: 1) establishing pollinator gardens; 2) creating edge habitat for pollinators; 3) planting small-scale pollinator areas; 4) developing and implementing large-scale pollinator areas; and 5) managing utility right of way areas for pollinators. Some of these strategies are being implemented on a limited basis in 2017 to evaluate their effectiveness, and to identify optimal locations to expand pollinator habitat conservation and enhancement efforts. Opportunities to implement the larger scale measures will be identified over the next few years, and we will analyze and execute them when necessary resources become available.

Pollinator Gardens

Since 2015, approximately 15 parks have established pollinator gardens. Generally less than 1,000 square feet, these gardens are located in areas readily accessible to park staff and visitors, typically near a park's nature center, office or ranger station. While small in scale, these gardens can provide an important source of nectar during insect migration, and they provide good opportunities for park staff to educate visitors through interpretive signs or as part of educational programming. They also allow visitors to see that pollinator gardens are attractive and can be welcome landscape features in any yard.



Pollinator garden (Bill Johnson, Iowa Department of Natural Resources)

Pollinator Edge Habitat

The Maryland Park Service is examining opportunities to create pollinator edge habitat in strips of land adjacent to roads, trails or agricultural fields. Historically these areas have been maintained by regular mowing. In some cases, these areas already include food species for pollinators as well as the pollinator species themselves, so adopting “no-mow” practices is sufficient to create edge habitat. In other cases, these areas may need to be over-seeded or planted to create appropriate pollinator edge habitat.

Small-scale Pollinator Areas

Maryland Park Service employees are identifying small-scale pollinator areas that can be converted from non-productive agricultural use, mowed fields or turf. These areas are generally larger than 1,000 square feet but smaller than 2 acres. Prime candidates are areas that, because of their shape, size, or location are difficult to till (if in agricultural use) or mow, or they are not heavily used by visitors. Initial listing is done by GIS analysis by staff familiar with the park, recreational and special event use areas, and existing management and maintenance procedures. Once these areas are identified and verified as suitable from a park operations standpoint, actual site conditions can be assessed and developed to convert these areas to pollinator habitat through a multiyear effort.

Large-scale Pollinator Meadows

The creation of large scale pollinator meadows is a major effort involving land areas that exceed 2 acres. Opportunities to create these meadows exist in a variety of areas including existing mowed fields, leased agricultural fields and mowed turf areas. As most of these areas are currently vegetated with fescue or turf grass and pollinator meadows require a significant amount of effort to establish, we anticipate that establishing pollinator plants will require a multiyear effort. Most units in the Maryland Park System do not have the equipment necessary to implement a pollinator habitat planting of this scale, and the work will need to be contracted with third parties, such as local farmers.

Utility right of way Management

A fifth strategy involves active engagement with utility companies that maintain rights of way through State Park lands. In 2016, Maryland Park Service executed an agreement with Baltimore Gas and Electric Company, Inc. to identify and implement plans for specific rights of way within parks that could be converted to pollinator habitat through integrated vegetation management. Implementation of the plan began immediately with the cessation of mowing. The rights of way will be inspected regularly during the growing season to determine what, if any, herbicide application may be necessary. Limited spraying and removal of tree saplings will be conducted as necessary for meadow establishment and maintenance in accordance with pollinator-friendly protocols.

Outreach and Planning Activities

Interpretation and Programming

In addition to the strategies to restore, enhance and create pollinator habitat, the Maryland Park Service is actively engaged in efforts to educate the public about pollinator species. Many Maryland Park Service staff participated in a Xerces Society workshop in 2015, and this led to a

surge of interest in pollinators. Park naturalists have since put together exhibits and interpretive programs about pollinators. An innovative monarch butterfly program at the Deep Creek Lake Discovery Center provides hundreds of people the opportunity to learn about this amazing insect's life cycle and migration. Topical displays and interpretive programming about pollinators in most of the Park Service's 31 nature centers helps park visitors understand the important role that pollinators play in maintaining healthy ecosystems, biodiversity, and the nation's food supply. This programming educates the general public about the wide variety of pollinator species and tackles common misconceptions about pollinator species, especially highlighting that a majority of pollinator species do not sting.

Pollinator Survey

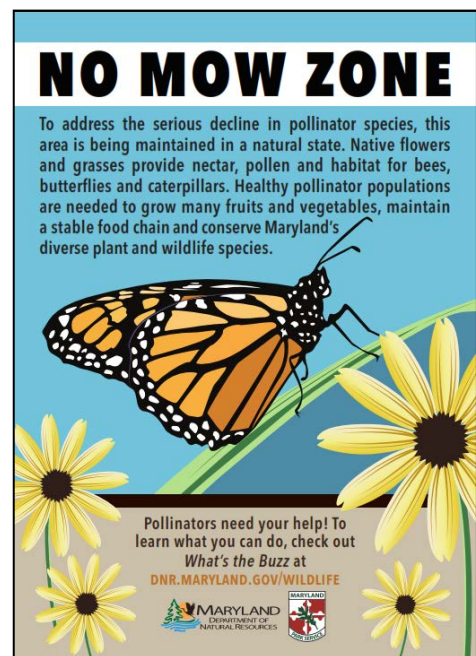
The Maryland Park Service conducted a survey of Maryland Park Service land managers in spring 2017 to collect general information about the parks' pollinator habitat enhancement efforts and to identify specific challenges and needs. An evaluation of the survey results will inform and direct pollinator efforts, projects and programs in coming years. The survey will be conducted annually to track progress.

Pollinator Habitat Signs

In order to highlight Maryland Park Service efforts to conserve and enhance pollinator habitat, as well as help park visitors understand why certain areas are no longer maintained as mowed lawn, we developed unique "No Mow" signs with information about pollinators. These attractive signs include information about the value of pollinators and a link to Maryland Department of Natural Resources' web content about pollinators. The signs are placed in park pollinator gardens, pollinator edge habitat and small-scale pollinator areas, raising awareness of the decline in pollinator species and showing park visitors the what pollinator habitat looks like. Many great pollinator plant species are attractive flowering plants that are desirable additions to lawns and gardens and are available at garden supply stores and nurseries.

Strategic Management Planning

In 2015, the Maryland Park Service embarked on a statewide initiative to update and develop strategic management plans for its properties. Each management plan is designed through a collaborative process to identify and evaluate park resources; to identify strengths, weaknesses, opportunities and threats; and to define basic objectives for the park. The planning effort includes the development of a work plan with specific tasks and projects that will further a park's goals and objectives. Conservation of pollinator habitat has been identified as an essential goal for Maryland Park properties, and opportunities to increase and enhance pollinator habitat are included in all the strategic management plans. As these plans are approved and implemented, the Park Service anticipates significant increases in the acreage of pollinator habitat within the parks.



"No Mow" sign developed to provide interpretation of pollinator habitat areas to park visitors (Maryland Park Service)

Challenges and Opportunities

In the process of planning and initiating pollinator habitat enhancement and accompanying public education, we have identified several challenges. The primary challenge is a lack of resources to properly plant and maintain pollinator habitat during the three to five years necessary to establish a healthy and self-sustaining mix of pollinator plant species. Efforts to plant pollinator meadows on a large scale are hindered by a lack of technical expertise, funding, and equipment. We expect to contract with firms that specialize in this type of planting, or include provisions for pollinator habitat creation in agricultural leases as they expire and are re-advertised for bid. Staff members have observed that even small-scale pollinator plantings take time and effort to install and maintain, particularly during spring and summer, when park visitation increases and staff are busy with other activities.

Other challenges include controlling invasive species, addressing deer browse, protecting areas from visitor impacts, and ensuring that newly established meadow areas do not detract from the park's appearance. When new pollinator areas are established, it can take three to five years before the plants become established enough to create an attractive meadow. Park visitors that are not aware of pollinator enhancement efforts can be critical of what appears to them to be a lack of mowing and maintenance.

Maryland Department of Natural Resources – State Forests

Introduction

The Maryland Forest Service's role in managing a diverse array of lands, including forested upland, wetland and riparian areas, provides the opportunity to maintain and enhance pollinator habitat across Maryland.

Mission Statement

The Forest Service restores, manages and protects Maryland's trees, forests, and forested ecosystems to sustain our natural resources and connect people to the land.

Goals

The State Forest system is managed to achieve multiple goals. Primary goals are to:

- *Protect Maryland's natural resources* – The State Forest system includes large contiguous blocks of forestland, including both uplands and wetlands, riparian areas, designated wildlands areas and other unique habitat areas. These woodlands are important habitat for many species of forest wildlife, including interior forest dwelling birds, many threatened and endangered species, and native woodland pollinator species.
- *Maintain the rural character, economy and the heritage of the state* – The State Forest system provides support to the state's primary and secondary forest products industry, which contributes \$4 billion to the state's economy and supports 10,000 jobs annually, in addition to another 40,000 induced/secondary jobs. State Forests also preserve the rural heritage of the state by keeping working forests from being fragmented by development, supporting local county governments through revenue sharing, and maintaining suitable areas for hunting and fishing contributions to the economy.

- *Maintain and enhance water quality and living resources* – The State Forest system actively protects streamside habitat areas and wetland habitats by implementing various watershed improvement and wetland creation projects aimed specifically at improving the quality of water entering the Chesapeake Bay, increasing streamside buffers and restoring native plant communities.
- *Expand opportunities for public access* – State Forests provide unique outdoor recreation experiences in undeveloped settings, including primitive camping and other resource-based activities like hunting, fishing, hiking, birding and canoeing.
- *Ensure sustainable forest management* – Sustainable forestry is a broad term for management techniques that respect the forest's full range of environmental, social, and economic values, and seek to meet today's needs without losing any of those values. Sustainable forests maintain all components (trees, shrubs, flowers, wildlife, etc.) as well as ecological processes (nutrient recycling, water and air purification, ground water recharge, etc.) so they can remain healthy and vibrant into the future. Sustainable forestry is adaptive management: a monitoring, data analysis and strategic response approach to habitat conservation. Forest managers watch and monitor the forest carefully so that, if future conditions change and the forest shows signs of stress or decline, they can take new management actions to restore sustainable conditions.

Acres Managed

The State Forest system includes five categories of lands and facilities operated in support of managing, protecting, and restoring Maryland's public and private forestlands. All of these areas are administered by the Maryland Forest Service:

- *A State Forest* is managed for multiple purposes, including water quality protection, wildlife enhancement, sustainable forest products, scenic and natural beauty, and low-intensity recreation. State Forests are generally larger acreages managed in accord with independent third-party forest certification standards established by the Sustainable Forestry Initiative (SFI) and the Forest Stewardship Council (FSC). State Forest land includes several State Wildlands and Heritage Conservation Fund sites; these acres are managed for their unique natural features and values as part of the State Forest system. There are nine State Forests encompassing 147,521 acres.
- *A Demonstration Forest* is managed to achieve the same broad purposes as a State Forest, with a specific emphasis on implementing forest management practices for demonstration purposes for the state's private woodland owners. They are generally smaller than State Forests and are not included in the state's forest certification. There are five Demonstration Forests encompassing 4,848 acres.
- *The John S. Ayton Tree Nursery* produces over 50 species of bare-root tree seedling for forest conservation plantings on private and public lands. This facility is located in Caroline County and encompasses 299 acres.
- *The Chesapeake Forest Lands* were acquired specifically to be retained as working forest lands to produce sustainable forest products and help maintain local employment, to protect traditional outdoor recreation values, and to provide other environmental values on Maryland's Eastern Shore. All uses and management of these lands are implemented

in accordance with the purposes of sustainable forestry in accord with the state's SFI-FSC forest certification. The Chesapeake Forest Lands encompass multiple parcels in the five lower counties of the Eastern Shore with a total acreage of 65,684 acres.

- **Forest Fire Tower** sites were constructed in the early part of the 20th century as part of Maryland's forest protection efforts, with the purpose of quickly detecting forest fires and reducing fire danger to the public. With the expansion of road networks and improved communications technology in the mid-1900s, several Fire Towers were converted to platforms for communications equipment. In addition, three Forest Service field offices are co-located and operated on the same site with Fire Tower locations. There are 16 of these sites encompassing 47 acres across the state.

Strategies to Create and Restore Pollinator Habitat

Pollinator habitat on State Forest lands is encouraged through active management in 1) designated areas such as the Green Ridge Special Management Area or ecologically significant areas being managed for pollinator habitat, and 2) general management zones, where regular harvesting creates a shifting mosaic of early successional habitat that is likely to provide more diverse pollinator habitat. These areas tend to support higher levels of insect diversity, including pollinators, and are important feeding areas for migratory birds and other wildlife. Maryland State Forest and Chesapeake Forest lands are dual-certified as sustainably managed through Forest Stewardship Council and Sustainable Forestry Initiative; sustainability standards include attention to biodiversity and appropriate harvesting levels, which benefit many pollinator species.



Prairie warbler with caterpillar. Pollinating species are important food sources for other animals (Nikki DeBraccio).

Outreach and Planning Activities

State Forest Annual Work Plans highlight active restoration projects such as the Green Ridge project. The conservation planting stock provided by the State Nursery provides sources of woody plant stock for restoration projects, both for public and private land. Pollinator habitat is also a component of forest stewardship plans prepared for private forest landowners.

Challenges and Opportunities

The shifting nature of some of the pollinator habitat provided on State Forest and other actively harvested forest lands is more challenging to track than is a designated area that is managed at a certain stage of succession. The existing harvest tracking system could be combined with managers' observations of forest stages to understand the locations and likely duration of pollinator habitat. Another challenge in forest management is the prevalence of invasive species. Controlling invasive plants, pests, or diseases may, in many cases, promote more diversity of native plants for pollinators and timing of control to limit impact on pollinators. A final challenge is encouraging the use of pollinator-friendly native trees and shrubs for conservation plantings. More marketing at the State Nursery would help to encourage use of native trees and shrubs for conservation plantings.

Case Study: Green Ridge State Forest Pollinator Project

A Department of Natural Resources multi-unit effort to restore native pollinator habitat is underway in western Maryland. Begun in the 2017 growing season, this project serves as a pilot to test old field restoration techniques, source genetically appropriate seed, coordinate long-term inter-unit collaboration, and most importantly, promote pollinator conservation. On newly acquired land in Green Ridge State Forest, currently fallow field will be converted to wildflower meadow in 2017-2018. Green Ridge State Forest is a documented site of high diversity for rare butterflies, and is also home to a variety of native bees. The plant list for the meadow includes species that benefit both taxa.

Green Ridge State Forest encompasses almost 48,000 acres of mixed deciduous hardwood forest in eastern Allegany County. Rather than planting more trees on old hay fields recently purchased by the state, Forest Manager Mark Beals saw an opportunity to create a different kind of habitat for wildlife. He enlisted the aid of Invertebrate Ecologist Jennifer Selfridge (Natural Heritage Program) to turn some of the land into pollinator meadow in a small-scale project. Jennifer brought together experts and interested land managers to plan the project.

The planning group met in April 2017 to define the project and identify the restoration site. They chose an area of open, formerly agricultural field of mostly tall fescue, with weedy species such as Canada thistle and common mullein also present, on a ridge above Town Creek. Roughly 2 acres of this field was delineated as the project site.

In consultation with U.S. Geological Survey bee expert Sam Droege, Selfridge created a list of native specialist pollinator bees known or likely to be present in the area. Specialist bees are bees that forage for pollen from only one plant family. The Natural Heritage Program maintains a database of the butterfly species nearby, derived in part from Selfridge's research on the forest's shale barrens. The group then compiled a list of a suite of plant species that supported one or more of those bees and butterflies. Most of the plants they chose support multiple species, but they also included plants that provide food for a single species in need of conservation.

Specialist Bee Species Supported by GRSF Pollinator Meadow			
Species	Family	Documented from:	Host plants
<i>Andrena aliciae</i>	Andrenidae		Sunflower
<i>Andrena arabis</i>			Mustard
<i>Andrena gardineri</i>			Golden ragwort
<i>Andrena simplex</i>			Asters
<i>Andrena violae</i>			Violets
<i>Andrena ziziae</i>			Golden Alexanders
<i>Panurginus potentillae</i>			Cinquefoil
<i>Melissodes denticulatus</i>	Apidae		New York ironweed
<i>Melissodes desponsus</i>			Asters, native thistle
<i>Melitoma taurea</i>		Flintstone	Morning glory
<i>Colletes latitarsis</i>	Colletidae	Cumberland	Ground cherry
<i>Megachile pugnata</i>	Megachilidae	Cumberland	Asters, sunflowers
<i>Osmia distincta</i>		Little Orleans	Beardtongue
<i>Paranthidium jugatorium</i>			Woodland sunflower
<i>Macropis ciliata</i>	Melittidae	Washington County	Loosestrife

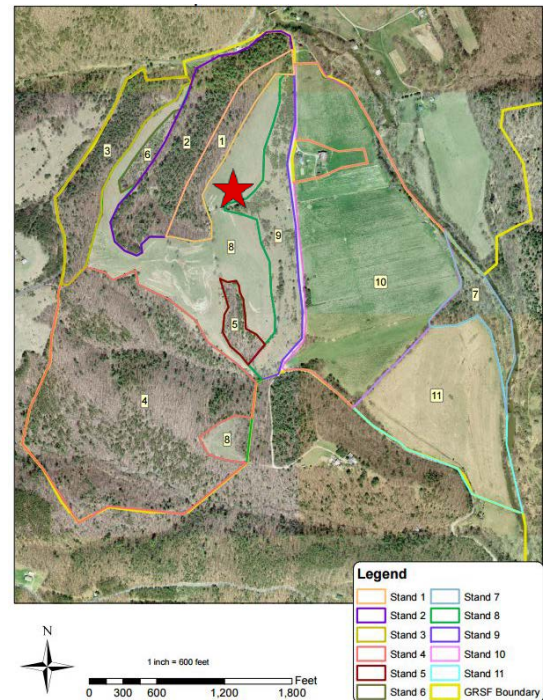
In May, the field was mapped digitally and marked out on the ground (see map). The area includes the tree line where scrub woods meets the field – an edge zone that supports a number of appropriate plant species like woodland sunflower and eastern dogwood. Meadow establishment can be done without herbicide use, but it takes years to accomplish. The team opted to prepare the site by removing existing vegetation quickly. Richard Hess, Wildlife and Heritage Service technician, treated the site with 2 percent glyphosate and an appropriate surfactant. In late summer 2017, the site will be disked and retreated, to remove any new germinants. Thereafter, we expect to need herbicides only for occasional spot treatments. Of course, no insecticides will be used.

The team analyzed the plant list to determine which species could be ordered as seed from reputable sources, particularly those supplying seed of Maryland sourced plants. The Department of Natural Resources is exploring the feasibility of supplying its units with genetically appropriate seed mixes to protect Maryland plant genetic diversity. This project provided the opportunity to gauge the difficulty of buying small quantities of seed of Maryland plant genotypes from one of the two major suppliers of restoration seed in the mid-Atlantic region.

In addition to seeding the meadow, the project team will transplant mature plants into the seeded area in clumps. Some of these will be species that are not commonly available as seed (*Viola* spp. or native morning glories) or that simply take too long to reach maturity when planted as seed (*Rhus* spp.). A study of bees of the mid-Atlantic (Fowler 2016) lists the plant families that support the highest numbers of specialist bees. The project group identified a number that are used by multiple pollinator species; these will be planted as either plants or seed, and include species of goldenrods and asters. The project team, and volunteer Master Naturalists, will scout Green Ridge State Forest and nearby public land during the summer of 2017 to locate and geotag “donor” patches of these species. In the fall, live plants will be dug from these patches and transplanted into the meadow.

The project site will be seeded and the patches planted in early fall, to allow perennial establishment before the following summer dry season. To ensure survival of the transplants, Green Ridge State Forest staff will use a water tank to water the new patches. Most of the perennial species are expected to germinate the spring after seeding.

The new meadow will be monitored for plant establishment, and a plan will be designed for reseeding or taking other action to ensure the development of a full wildflower stand. Once established, the meadow will be mowed once a year. Selfridge and/or Droege will survey the insect species that use the meadow during the bloom season. The project team plans to track pollinator species richness and abundances over time.



Map of project area, with site of project location starred (Natural Heritage Program)

Maryland Department of Natural Resources – Wildlife Management Areas

Introduction

As of 2017, Maryland's Wildlife Management Area system encompasses 61 separate areas totaling over 123,000 acres. Wildlife Management Areas are located in 18 counties and range in size from one to over 30,000 acres and support most, if not all, of the major habitat types found in Maryland.

Pollinators are critical to the health of the Wildlife Management Area system. Plants represent the link in the phototrophic system between the sun and the rest of the food chain, play critical roles in the photosynthetic and water cycles in natural systems, and make up the backbone of natural communities and habitats. Pollination is necessary for the majority of plants to reproduce, and this need makes pollinator species critical for the health and function of the entire food web.



The eastern tailed blue butterfly (Cupido comyntas) inhabits sunny, weedy, disturbed areas (U.S. Geological Survey Bee Inventory and Monitoring Lab).

The diversity of important habitats found in Maryland's Wildlife Management Areas is due, in large part, to the plants that make up these habitats. From oak forests to salt-marsh wetlands to mountainside barrens, pollinator-aided plants populate Maryland's natural areas, supporting animal species that live there. Important wildlife foods such as acorns, small grains, and fruits such as berries are all produced through pollination. Many pollinators fulfill multiple supportive roles as they are consumed by larger predators in the ecosystem. Insects provide a necessary high protein food source for wild turkey, grouse and numerous insectivorous birds; moths are an especially important food source for bats. The plant and animal assemblages found within Maryland's Wildlife Management Areas are all supported by pollinator species.

Mission Statement

To conserve and enhance diverse wildlife populations and associated habitats while providing for public enjoyment of the State's wildlife resources through hunting and other wildlife-dependent recreation.

Goals

The goals of the Wildlife Management Area System are to:

- Maintain, enhance, or protect sustainable and diverse wildlife populations;
- Create, enhance or protect appropriate habitats, natural communities and ecologically sensitive areas;

- Conserve rare, threatened, and endangered species by protecting the habitats that support them;
- With a focused emphasis on hunting, provide wildlife-dependent recreation on areas with minimal capital improvements or other development; and
- Provide a venue to educate citizens on the value and needs of wildlife and plant communities through outreach, demonstration and sound management.

A prerequisite to meeting the Mission and Goals set for the Wildlife Management Areas is to establish and administer management plans developed for each Area. To be effective, these plans must be clear and attainable while reflecting the surrounding landscape, sensitive to critical habitats and species needs, responsive to user demands, and inclusive of a variety of Department of Natural Resources land management initiatives and approaches. Wildlife Management Area plans provide direction to managers, with a focus on management priorities such as young forest habitat planning or conserving habitats for species of special concern. Goals are prescribed to create and enhance specific habitats through timber harvest and planting. Strategies for providing and improving public access and maintaining boundaries and infrastructure are also included. In order to support pollinator species, a number of Wildlife Management Area management activities aim to maintain, enhance, create, and restore pollinator habitat within Wildlife Management Area boundaries.

Management activities at Wildlife Management Areas vary with the diversity of landscapes found within them. Old-growth forests, for example, require little or no manipulation, while shallow water impoundments, successional forest, and herbaceous cover plots require more active management.

Land Protection

The funds for acquisition and management of Maryland's Wildlife Management Areas are derived almost entirely from three sources. The Maryland Department of Natural Resources' Program Open Space has provided acquisition funds since 1969. The Federal Aid in Wildlife Restoration Act administered by the U.S. Fish and Wildlife Service, and the Wildlife Management Protection Fund administered by the Maryland Department of Natural Resources provide money for both acquisition (pre-Program Open Space) and management. Activities included with the Wildlife Management Area plans must remain consistent with the guidelines set by these funding sources. In addition, the Migratory Bird Conservation Fund, administered by the U.S. Fish and Wildlife Service, is used for certain projects or purchases related to the Wildlife Management Areas.



Pollinator species on a sunflower at McKee Beshers Wildlife Management Area (Kerry Wixted)

Strategies to Create and Restore Pollinator Habitat

Habitats can be enhanced for pollinators using a variety of approaches. In addition to floral food sources, wild pollinators depend on a range of other resources. For example, the majority of Hymenoptera (an invertebrate group which includes sawflies, wasps, bees and ants) require nest sites, while Diptera (flies) and Lepidoptera (butterflies) require larval host habitat, which is often species-specific. The varied habitats represented within the Wildlife Management Area system across the landscape provide diverse native plants for native pollinators, offering not only the floral aspect in the form of flowering trees and wetland and upland plants, but also nesting and larval host habitats.

In light of advances in knowledge of pollinating species in Maryland, the state's Wildlife Management Areas are managed to facilitate the continued occurrence and health of diverse native habitats, including various wetland types, upland meadows, and forests of multiple age classes. These habitats are important for pollinator species, including native bees and butterflies. When practical and feasible, habitats are managed to provide host plants for specific species such as those listed legally by Maryland state government as Threatened, Endangered or In Need of



Ruby-throated hummingbird (Steven Kerster)

Conservation. Where known populations of these plants occur, they are protected and maintained to the extent possible. Pollinator habitat is also provided on Wildlife Management Areas through active habitat restoration. Such restoration activities involve the removal and control of invasive, non-native plants in favor of native species that are pollinator-friendly. Growth of native plants is also encouraged through natural seeding and planting practices when necessary for their establishment.

Outreach and Planning Activities

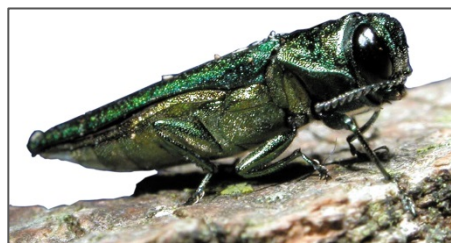
Education and outreach activities at Wildlife Management Areas allow members of the general public to observe pollinator habitat best practices in action. Suitably accessible Wildlife Management Areas where pollinator habitat is managed are used as demonstration and educational opportunity areas. Colleges and universities visit Maryland's Wildlife Management Areas routinely for classes and field tours, and incorporating good pollinator habitat into Wildlife Management Area landscapes allows these institutions to focus educational units and activities on these important habitats.

Invasive Species Management

The introduction of invasive, non-native species into North American ecosystems is one of the greatest challenges to conservation. The spread of invasive species is a major driver of the reduction in native biological diversity, as well as of the environmental degradation of natural areas. In terrestrial ecosystems, insects as a class are major contributors to the ranks of invasive species. Numerous species of invasive insects currently thrive in Maryland's forests, devastating native forest. Some examples of invasive, non-native insects in Maryland are detailed below.

Emerald Ash Borer

The emerald ash borer is regarded by many foresters as the most destructive invasive forest insect ever to have invaded North American ash forests (U.S. Forest Service 2016). This species was first identified in Michigan in 2002 and invaded Maryland in 2003. It can cause 100 percent ash mortality, a matter of critical concern in Maryland where ash is a dominant species in wetland systems critical to the Chesapeake Bay. The primary treatment for emerald ash borer is application by trunk injection or soil drench of imidacloprid, a neonicotinoid pesticide.



Emerald ash borer (National Park Service)

Hemlock Woolly Adelgid

In an early study of the oldest remaining forests in eastern North America, The Nature Conservancy discovered that deep, wet ravines dominated by eastern hemlock were bastions of surviving ancient forests. Steep, inaccessible and generally yielding low-value timber, hemlock ravines were naturally resistant to commercial exploitation. Unfortunately, these ravines proved to be highly vulnerable to the hemlock woolly adelgid, an insect pest of Asian origin that was accidentally released in British Columbia in the 1920s, spread across the continent, and arrived in Maryland forests sometime in the 1980s. Hemlock woolly adelgid is now found throughout the state and poses a critical threat to natural hemlock forest and the species that depend on these forests for survival, as well as landscape trees. Like emerald ash borer, the primary treatment for emerald ash borer is host injection of the neonicotinoid pesticide imidacloprid.

Maryland's estimated 42,000 acres of Hemlock-Northern Hardwood Forest are among the oldest and least disturbed natural communities in the state. Because pollination of eastern hemlock is wind-borne (not assisted by pollinator animals), the pesticide application methods are unlikely to harm non-target organisms. The neonicotinoid pesticide is incorporated into the plant tissue, causing harm only to insects feeding on the tree itself. The inclusion of this forest type in a Pollinator Habitat Area where neonicotinoid use is barred would open the forest to adelgid infestation, effectively removing hemlock forests from the landscape.

Gypsy Moth

The gypsy moth was intentionally imported to New England from Asia as a potential silk producer. Although the moths' escape from amateur entomologist Leopold Trouvelot's backyard was reported to the local authorities, the moths quickly infested the woods of Medford, Massachusetts. From there, the gypsy moths spread southward, reaching Maryland, and defoliating over 1 million acres since 1980 (Maryland Department of Agriculture 2008). Gypsy moth populations exhibit a roughly six to eight year expansion cycle, and continue to present threats where populations become abundant. They are of greatest ecological concern in the few old-growth oak forests that remain in Maryland. The long-term conservation of these rare natural areas will require access to pesticides that can control resurgent gypsy moth populations.

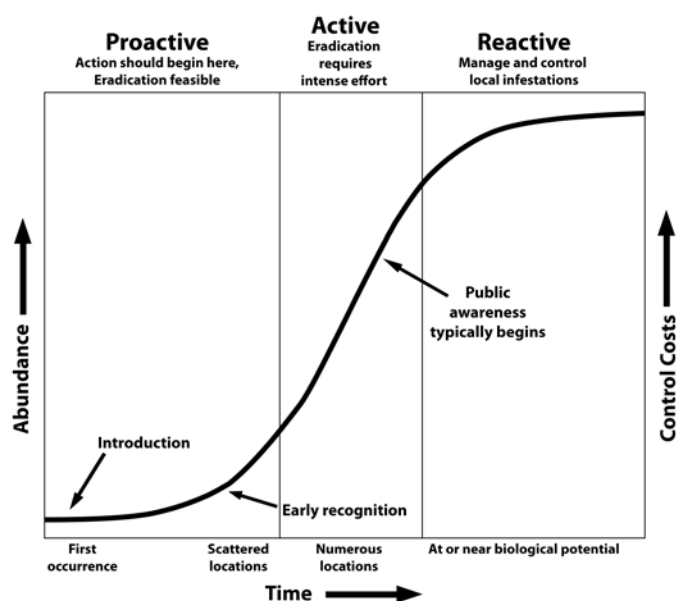
Over time, Maryland has developed pesticide strategies for gypsy moth that are increasingly narrow in their effects upon leaf-eating caterpillars. Currently, gypsy moth infestation is controlled with pesticides containing *Bacillus thuringiensis* (Bt) bacteria, which is toxic to a

broad range of pollinators. Bt and all other pesticides which have been used to control gypsy moth would be prohibited in Pollinator Habitat Area.

Other Invasive Species Issues

Numerous other insect pests, notably the Asian longhorn beetle, have become invasive in North America but have not yet made their way to Maryland. Global trade in plant material, shipping and packing materials, and fruit, vegetables, and livestock will introduce future waves of non-native insect pests. United States Department of Agriculture inspectors in the Port of Baltimore report new and potentially devastating insect species every month. Unless their inspection process is foolproof, new invaders will continue to slip through.

In any biological invasion, the time window in which the eradication of a newly established invasive species can be accomplished may be extremely limited. Invasive species can be eradicated, but action must be swift and effective, as it was in the eradication of the Chinese pond mussel in New Jersey in 2011. Maryland's successful eradication of the nutria, an invasive South American rodent, demonstrated that the eradication effort participants must have access to all of the infested area. Any islands of habitat that are untreated allow for the re-infestation of cleared areas, thwarting control or eradication efforts.



Phases of Invasive Species Invasion and Control

Invasion curve illustrating the importance of eradicating a newly established invasive species early in its establishment (Rawlins et al.)

The central paradox of the Maryland Pollinator Habitat Plan is that any area designated as a Pollinator Habitat Area could become a refuge for an invasive species. Due to the law's restrictions, Maryland Department of Natural Resources' professional land managers would be prevented from using insecticides of any sort. The law allows the use of pesticides only in the case of a threat to public health as determined by the Secretary of Health and Mental Hygiene. Therefore, designated Pollinator Habitat Areas would be the only areas within Maryland Department of Natural Resources' portfolio of over 480,000 acres in which invasive insects could not be treated with pesticides. From this perspective, Pollinator Habitat Areas – as potential refugia for non-native, invasive insects or native insects that transport invasive fungi, rusts, molds, bacteria or other non-insect invasive species and pathogens – are a profound economic and ecological liability.

Therefore, any Pollinator Habitat Areas designated by Maryland Department of Natural Resources must be in sites in which it can be made certain that no invasive insect control will ever be required.

Criteria for the Selection of Pollinator Habitat Areas on Department of Natural Resources Lands

Four critical factors must be met in order for an area to function optimally as a pollinator habitat. Such habitats must be suitable, sustainable, pesticide-free and diverse. These habitat requirements are detailed below.

Suitable

Most people think of pollinators as colonial honey bees, which, while not native to North America, are critically important to agricultural production in the United States. However, honey bees do not and cannot fulfill the diverse pollination needs of Maryland's natural ecosystems. While scientific knowledge is incomplete regarding competition between honey bees and native pollinators, research (Herbertsson et al. 2016) shows that the presence of colonial honey bees can have marked depressive effects upon native bumblebee populations and these effects probably extend to other pollinator species. The sheer density of individuals in a single honey bee hive and the hive's capacity to gather hundreds of pounds of nectar and pollen in a single season has profound effects upon native pollinators and their capacity to pollinate native plants. Based upon the current level of scientific knowledge, it would be unwise and inappropriate to allow colonial honey bees access to natural areas in which native ecosystems are expected to sustain themselves.



Seepage wetland, a habitat for many pollinator species
(Maryland Department of Natural Resources)

Pollinator habitat must be composed primarily of plants and animals that are native not only to Maryland but to the region in which they are established. In the case of most natural habitat areas, this requirement is easily attained. Intact, healthy ecosystems produce and support a sufficiently diverse and populous pollinator population to support the needs of that ecosystem. As a result, selecting pollinator habitat areas in Maryland would be relatively straightforward if it were not for the absolute restriction of the use of most pesticides in designated areas. Many Maryland natural areas and native ecosystems are threatened by invasive species, which can cause destruction to key components of those ecosystems if not for chemical control with pesticides. Therefore, the selection of legally designated Pollinator Habitat Areas must be done extremely carefully to ensure that no current or future pest that must be controlled with prohibited materials is, or will be at some future time, established in those areas.

All Department of Natural Resources lands that are in natural cover are essentially functioning pollinator habitats irrespective of designation. There is nearly unlimited opportunity to enhance native pollinator populations simply by managing and restoring the full suite of Maryland's diverse native ecosystems.

Sustainable

Individual landowners and gardeners have excellent opportunities to manage their lands for pollinator habitat through the placement of plants and habitat enhancement devices, such as nest boxes. Department of Natural Resources lands, upon which land management is planned and executed on a much larger scale, must necessarily forgo labor-intensive methods and reach instead for economies of scale.



Planting for pollinators (Howard County Library System)

Selected lands must also be appropriately targeted for the type of pollinator habitat that will remain viable in the long term. For example, very rich upland soils in areas of the state that usually support the development of mesic hardwood forest may be unsuitable for the establishment of meadows or sparse grasslands, simply because the tendency of these soils is to revert to rich woodlands. Halting succession of open meadow sown with species evolutionarily adapted to colonization may require significant extra effort to maintain – effort that might be better spent elsewhere. Conversely, sites with nutrient poor soils that are prone to periodic drought or fire might be ideal for establishment of meadows.

Moreover, Pollinator Habitat Areas on Department of Natural Resources lands must be designed to function and be maintained not with the resources available at the time of their design, but with the lowest level of resources – including personnel, equipment and materials – that are likely to be available over the lifetime of the project. Funding for the Department is variable, and while baseline funding levels are provided by federal grants, license sales and other revenues, the funding available in any given year is variable depending upon macroeconomic factors and social priorities at any given time. A realistic designer of a pollinator habitat project will use the funds available to establish a landscape design but will build the habitat to withstand a variety of ecological challenges with minimal remediation and management.

Pesticide-Free

By definition, designated Maryland Pollinator Habitat Areas must be free of any neonicotinoid pesticide or any pesticide labeled as toxic to bees or other pollinators. The birth of the modern environmental movement can be traced in great part to the discovery of the impact that broad and indiscriminate use of the pesticide DDT had upon America's wild birds and the tremendous social consequence of Rachel Carson's masterful communication of the consequences in her foundational book *Silent Spring*. Since that time, scientists have found traces of pesticides and other man-made environmental chemicals and their breakdown products in hundreds of situations involving water, wildlife and people.

Pollinators are uniquely susceptible to pesticides because they cover so much ground and often are designed by nature to pick up plant material on body hairs and carry it around. Extreme care

in the use of all pesticides on state lands is always warranted, but it is especially important in areas with diverse pollinator populations.

Diverse

The perfect pollinator habitat will contain a diverse suite of plants and animals in a stable and viable natural community. Unlike a managed crop being pollinated by colonial honey bees over a limited window of time, a natural ecosystem must provide for the year-round needs of a vast array of pollinators from wildly diverse animal groups. Bees, butterflies, moths, flies, and beetles in their innumerable forms each have unique needs and characteristics. While the lay view of a perfect pollinator habitat is generally a colorful meadow with bees flitting from flower to flower, this is actually just a place where it is easy to see adult pollinators performing their critical task.



Lassioglossum marinum (U.S. Geological Survey Bee Inventory and Monitoring Lab)

The variety of native pollinators needed to meet the reproductive needs of a diverse natural community is vast and quite beyond the scope of current scientific understanding. The life cycles of individual insects are often enchantingly complex and bizarre. Insect species have their own habitat needs for reproduction, raising their young, feeding and overwintering. Individual plants may count upon the presence of a single species for pollination, and will decline and disappear from the ecosystem if the pollinator species is lost from the system.

Given our lack of understanding of the totality of natural interspecific interactions in even the best-studied Maryland forest, swamp or marsh, the only means of managing for all species' needs is to try to stay out of the way. Functioning natural communities have much higher levels of resilience and resistance to threats than do damaged or degraded communities. Maryland Department of Natural Resources' current goal of keeping natural ecosystems intact is the best and most practical means of maintaining pollinator populations in their established native habitats.

Criteria for the Creation of Pollinator Habitat Areas on Department of Natural Resources Lands

Numerous opportunities exist for the deliberate establishment of created pollinator habitats on Department of Natural Resources lands that will function as designated Pollinator Habitat Areas. Examples of such managed areas are illustrated in the body of this report. Opportunities include managed grasslands and other managed successional habitats; wildlife openings, which already utilize pollinator-friendly practices like brush piles and snag trees; old fields and orchards; transmission lines which account for thousands of acres of Department of Natural Resources lands; and restored sites such as abandoned strip mines, gravel pits and other post-industrial lands.

Like existing natural areas, created pollinator habitats must be suitable, sustainable, pesticide-free and diverse. Created Pollinator Habitat Areas should meet the following criteria:

Diversity of plant species: Include 20 to 50 species or more, with at least at least 10 food plants.

Diversity of flowering color: Because different classes and species of pollinators are attracted to different light wavelengths, choose a diversity of flowering plants, including red, blue, purple, yellow and orange, for different light wavelengths. Choose species of at least three of these general colors.

Diversity of flowering time: Adjust the planting plan to allow for flowering periods covering the bulk of the growing season, with flowering periods of planted species covering at least 80 percent of the growing season

Snag trees or brush piles: Ensure that one or both of these features are present either at the periphery of the Pollinator Habitat Area or integrated into the site.

Bare earth: As part of the management regime or as a byproduct of site management, ensure that a small part of the Pollinator Habitat area is in bare or recently bare soil in order to accommodate ground-nesting insects.

Management plan: Develop a management plan for each site guiding the sustainable management of the site with benchmarks and a schedule of maintenance practices.

Private Land: Working with Partners

While the focus of this report is on the management of pollinators and pollinator habitat on lands overseen by the Department of Natural Resources, much of the land management that Department personnel plan, design, and implement occurs on land owned by private citizens and other organizations. A number of programs exist in Maryland to assist private landowners in managing their lands. Many private forest landowners operate in accordance with a forest stewardship plan developed by Department of Natural Resources personnel. Additionally, many private citizens have implemented wildlife habitat measures on their lands with technical guidance from Department of Natural Resources wildlife managers. And tens of thousands of acres of Maryland farmland are enrolled in programs like the Conservation Reserve Enhancement Program, a state-federal partnership that installs conservation measures to protect soil, water quality, and wildlife habitat.

Properly managed private forests, meadows, and marshlands are important to pollinators. Such private lands are often the links between larger state land units that allow wildlife to migrate through corridors of natural cover. In proximity to state lands, well-managed private lands provide equally good pollinator habitat. Private lands are a vital factor in the management of Maryland's pollinator populations because the majority of natural lands in Maryland are privately owned.

Maryland has almost 2.5 million acres of private forest land. Of this, 1.9 million acres are owned by individuals rather than industrial forestry companies. Maryland State Forest lands amount to about 150,000 acres, which is about 6 percent of Maryland's forest resources. Altogether, the Maryland Department of Natural Resources owns and manages just over 480,000 acres of Maryland's 6.2 million acres. Considering these figures, the greatest opportunity for the management of pollinator habitat lies outside the boundaries of Maryland's State Parks, Forests and Wildlife Management Areas.

Providing outreach and technical guidance to landowners is a core part of the Department of Natural Resources mission. It is critical that Department of Natural Resources programs that offer these services be maintained and strengthened in order to protect and restore pollinator habitat.

Conservation Reserve Enhancement Program

The Conservation Reserve Enhancement Program grew out of increasing recognition that wetlands and lands adjacent to streams (known as riparian areas) and other water bodies have a tremendous impact on water quality and provide critical wildlife habitat. These important conservation areas can be protected and restored in many ways. Under the Conservation Reserve Enhancement Program, landowners contract with the U.S. Department of Agriculture through their local Farm Service Agency to receive annual rental payments, plus bonuses, for taking land out of production and installing conservation practices adjacent to waterways.

Wild Acres

Maryland's Wild Acres is a voluntary program that encourages Maryland citizens to create backyard wildlife habitat to maximize wildlife benefits and highlight conservation stewardship. Backyard wildlife habitat can increase food and shelter for wildlife, control soil erosion, reduce sediment in waterways, conserve water, improve water quality, inspire stewardship and beautify the landscape. Backyard wildlife habitat can include decks, yards, large lots and everything in between. The Wild Acres program offers fact sheets informing landowners how to create food, water, and shelter resources for backyard wildlife. In addition, a quarterly publication, *HabiChat*, highlights native plants, animals and habitat-enhancing activities.

Forest Stewardship Program

Maryland's Forest Stewardship Program provides technical advice to private forest landowners. Landowners decide their primary and secondary management objectives and a Department of Natural Resources forester writes a management plan for their forest land. A well-constructed forest stewardship plan will help a landowner maintain a healthy forest with a rich and diverse pollinator component. It will also allow a forest landowner to maximize their forest land's economic potential and allow them to qualify for tax advantages available to landowners working under an approved plan.

Outdoor Education and Nature Centers

The Department operates numerous nature centers, ranger naturalist programs and other wildlife awareness programs. These programs teach the public about the importance of nature and pollinators in the forests and in privately owned backyards. A butterfly garden at a Department of Natural Resources nature center or a walk with a ranger-naturalist may be many Marylanders' first contact with wild pollinators and their critical role in our ecosystem. In order for Maryland's citizens to care about pollinators, they must be aware of these species. Environmental education, whether on Department of Natural Resources lands, in schools or via the internet, is a critical component in the conservation of Maryland pollinators.

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