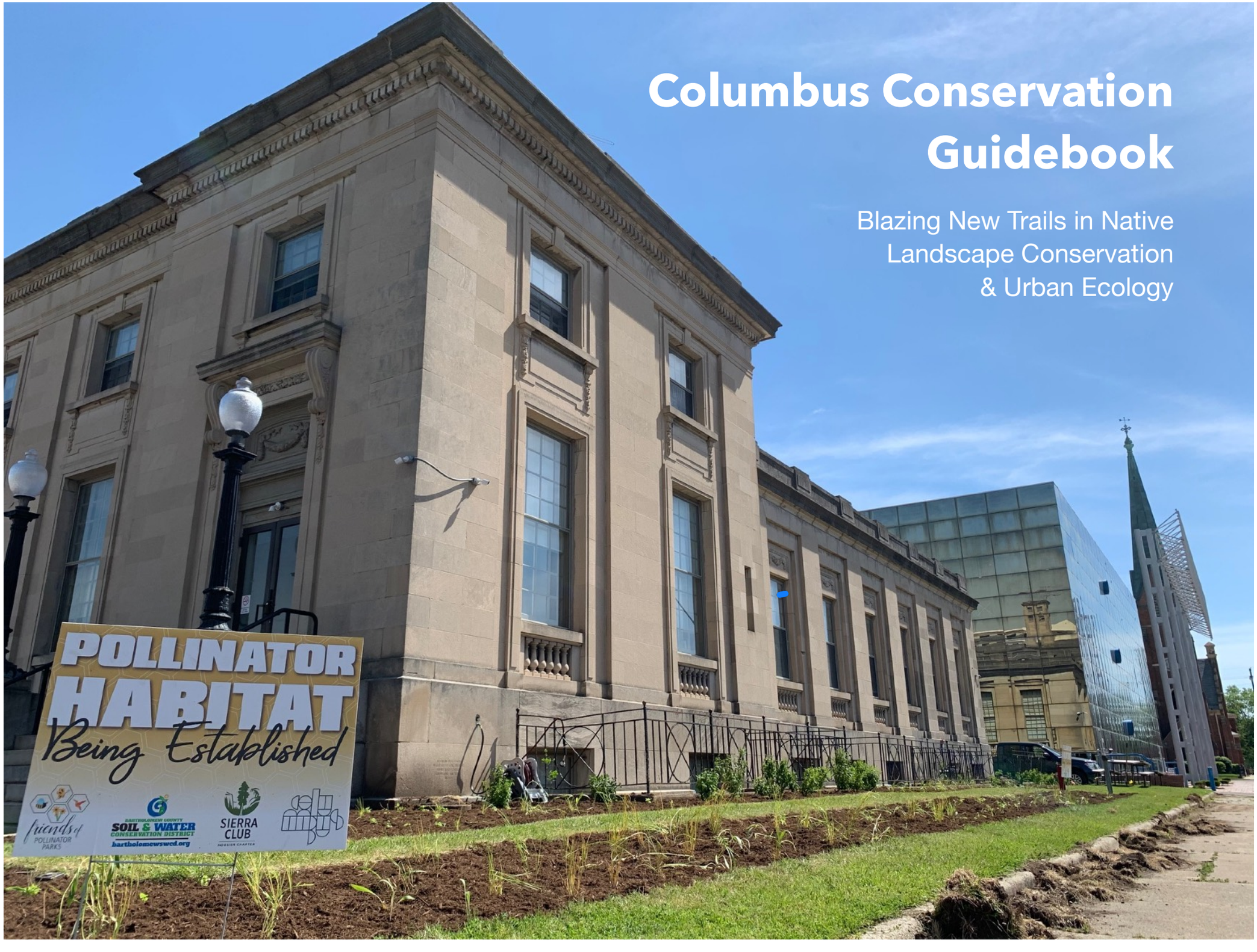
Columbus Conservation Guidebook

Blazing New Trails in Native Landscape Conservation & Urban Ecology



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Version 1

We would like to make the contents of this report available to groups working towards conservation. If you belong to a community group or non-profit organization and would be interested to use the material, please contact:
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- Supports Bee City USA initiatives and the development of local public pollinator parks in the communities where we work.

Contents

Papilio polyxenes, black swallowtail, on *Zizia aurea*, Golden Alexanders © C. Palmer

Executive Summary

Research from around the world and across species indicates a very clear trend - biodiversity is in steep decline. An estimated 1 million animal and plant species are now threatened with extinction, many within decades, and the rate of global species extinction is accelerating.

This loss of biodiversity affects us all - without functioning ecosystems, we lose the vital ecosystem services which support life. Humans are completely dependent on the ecosystem functions and services provided by plants and animals. The loss of functioning ecosystems impacts not only our quality of life, but also threatens the very existence of life on Earth.

Globally, ecosystem services such as crop pollination, water purification, flood protection and carbon sequestration have been valued at over a hundred trillion US dollars per year. The economic costs of biodiversity loss are immense.

Plants, and native plants in particular, are the foundation of ecosystems on which life depends. Native plant communities support a great deal more biodiversity than introduced plants, and conserving and increasing native plant populations is critical for maintaining biodiversity.

Conserving existing native plant habitat, using native plants in landscaping and adopting ecologically sustainable landscape management practices will be key.

This guidebook highlights the considerable conservation efforts that have been made in the City of Columbus and the excellent local groups working to make a difference. Recommended policy changes and community level actions which will lead to increased conservation success are laid out.

Additionally, guided by the latest scientific research and linking with the ethos of the Homegrown National Park™ initiative - a grassroots call-to-action to regenerate biodiversity and ecosystem function by planting native plants and creating new ecological networks - the guidebook lays out clear steps to help individuals contribute to conservation.

There are inextricable links between biodiversity, climate resilience, sustainable development and environmental justice, and this guidebook is intended to be supplemental to the ongoing work addressing climate change and sustainable development in Columbus.

Columbus is in a fortunate position with strong leadership support for sustainable development. Environmental justice should be made a key focus of ongoing and future city-wide strategic planning. Ensuring that all people feel safe, welcomed and valued as contributors to conservation efforts should be a priority.

Ongoing conservation initiatives in Columbus include:

Bee City USA

In September 2021, Columbus became the first city in Indiana to be awarded the status of Bee City USA® . The Columbus Pollinator Committee is currently working towards Bee Campus USA certifications.

Columbus Pollinator Park at Blackwell Park

In 2019, the Pollinator Committee began the restoration of a native plant habitat in Blackwell Park. A Cooperative Invasive Species Management Area (CISMA), the Blazing Stars CISMA, has been formed and a three-year CISMA management plan created to systemically control invasive species.

AirPark Columbus & the Pollinator Path from Blackwell Park

With the support of several community organizations, AirPark Columbus is establishing a Pollinator Path that will be certified by the Indiana Wildlife Federation to connect Blackwell Park to the new Native Plant Meadow adjacent to Columbus Community Garden. A new framework plan and site design for the campus by GGN seek to restore a connection to the historical landscape of the site through native planting and habitat creation.

Fresh Start Landscape Project

The project is a partnership between Friends of Pollinator Parks (FOPP) and Volunteers of America (VOA). Utilizing a grant from the Duke Energy Foundation, FOPP hired Loci Creative, a Columbus-based landscape architecture firm, to design a 100% native plant design for the property.

Bicentennial Tree Planting Project

In the spring of 2021, the Noon Rotary Club committed to a tree planting fund with the goal of planting 200 trees to celebrate the bicentennial. Fundraising led to contributions from local churches, nonprofit organizations, the Sierra Club, Columbus & Bartholomew County Parks departments, the DNR Urban Forestry program and Duke Energy. Overall, $30,000 was committed to the budget; well over 200 native trees will be planted.

Pleasant Grove

In 2008, the Pleasant Grove neighborhood was the epicenter of a devastating 100-year flood. An ambitious approved park plan and Cummins property enhancement is currently on hold as a fundraising plan is determined.

10 Steps to Ecological Landscapes

1. Identify and remove invasive species.
Identifying and removing invasive species is a critical first step and a key priority.

2. Shrink the lawn.
The goal is to reduce the area of ecologically desolate turf-grass by at least 50%.

3. Plant native plants.
Include keystone genera, plant for specialists, increase diversity and consider phenology.

4. Be generous with your plantings.
Plantings should include more than 70% native plant biomass to support wildlife populations.

5. Source mindfully.
Where possible, choose straight species over cultivars and source neonicotinoid-free.

6. Echo native plant communities and consider landscape design.
Careful landscape design and choosing the native species to best suit site conditions will help to make habitats both ecologically valuable and enjoyable.

7. Build a conservation hardscape.
One of the biggest sources of insect decline - but one of the easiest to rectify - is light pollution.

8. Create caterpillar pupation sites under trees.
Create caterpillar pupation sites under your trees and leave the leaves!

9. Adopt ecological maintenance practices and avoid chemical use.
Reduce mowed areas, follow ecologically sensitive mowing schedules and leave plants intact to provide overwintering habitat and nest sites. Avoid prophylactic chemical use and treatment without documented need.

10. Network with neighbors, educate civic associations and broaden the reach.
The high level of civic engagement and current environmental projects indicate that Columbus is in an excellent position to make a really significant impact. Ensuring that there are no barriers to accessing educational materials and that these are as inclusive as possible should be a priority.

10 Policy Recommendations for Columbus

1. Pass native plant ordinances.
2. Update weed and vegetation control ordinances.
3. Tighten restrictions on invasive plant use.
4. Designate no mow zones and adopt reduced mowing schedules.
5. Address light pollution in city ordinances.
6. Require window well covers.
7. Reduce chemical use in all public areas.
8. Re-examine city landscaping and maintenance practices.
9. Explore policy options to encourage adoption of best practices.
10. Legislate for an ongoing commitment to conservation and sustainability.

Monarda fistulosa, wild bergamot © C. Palmer

Pycnanthemum verticillatum var. pilosum, hairy mountain mint © C. Palmer

10 Ways to Demonstrate, Educate & Celebrate - Influencing Behavior Beyond Policy

In addition to policy changes, behavior change can be effectively encouraged through positive reinforcement of good conservation practices and increased access to educational and financial resources.

1. Prioritize inclusivity.
2. Showcase demonstration areas.
3. Highlight the financial benefits.
4. Consider signage to highlight and educate.
5. Coordinate with partners.
6. Focus on invasives.
7. Educate to reduce chemical use.
8. Engage the schools.
9. Incentivize best practice.
10. Highlight action & celebrate Columbus' heritage.

Introduction

Partners in Columbus are proud to share that they have received official designation as the first Bee City USA in Indiana. This document highlights this and other excellent conservation initiatives and partnerships in the City.

The City of Columbus has a very high level of civic engagement, excellent existing conservation projects, strong leadership support for sustainable development and a heritage of world class architecture and public art. Bringing those elements together to support the design and implementation of outstanding ecological landscapes, the City of Columbus could be uniquely placed to become a leader in the fields of conservation, climate resilience, sustainable development and environmental justice.

This document considers both potential policy and behavioral changes; it is intended to be supplemental to existing work addressing climate change and sustainable development, and to aid coordination between stakeholders.

Ensuring that the conservation of biodiversity and environmental justice are key considerations of city and strategic planning, and that there is coordination between local environmental partners, the Parks Department Master Plan, the Envision Columbus Downtown Strategic Development Plan and Cummins' PLANET 2050 initiatives will be key.

The aim of this report is to provide a clear rationale and simple steps for individuals, businesses, community groups and municipal planners to make better landscaping decisions, adopt sustainable practices and maximize the ecological value of landscapes at the City and County level.

All people have a valuable and vital role to play in the conservation of biodiversity and the well being of our shared world. The overarching goal is for all people in Columbus to be able to access functional healthy ecosystems, to feel safe and welcomed doing so, and to feel valued as stakeholders and contributors to the conservation of these spaces and all the life that shares them. Our hope is that this guidebook can help to support this goal.

Eutrochium maculatum, Joe Pye weed © C. Palmer

Part I. The Value of Healthy Habitats

Archilochus colubris, Ruby-throated Hummingbird © C. Palmer

Biodiversity & Ecosystem Function

Biodiversity in Decline

Research from a very broad geographic range and across different species indicates a very clear trend - biodiversity is in steep decline.

Lobelia siphilitica, great blue lobelia © C. Palmer

"Biodiversity is the totality of all inherited variation in the life forms of Earth, of which we are one species. We study and save it to our great benefit. We ignore and degrade it to our great peril."

E.O. Wilson

A global assessment published in 2019 found that biodiversity is declining faster than at any time in human history (IPBES, 2019). This assessment, with more than 350 contributing authors, analyzed more than 15,000 scientific publications as well as a large body of indigenous and local knowledge and covered all regions of the world. The assessment found that around 1 million animal and plant species are now threatened with extinction, many within decades; the current rate of global species extinction is tens to hundreds of times higher than the average over the last 10 million years, and, very worryingly, the rate is accelerating (IPBES, 2019).

A 2020 report by the World Wide Fund For Nature found that global populations of mammals, birds, amphibians, reptiles and fish have suffered an average two-thirds decline in less than half a century, with an alarming average drop of 68% since 1970 (WWF, 2020).

In terms of sheer numbers, diversity, biomass and importance to functioning ecosystems, insects eclipse all other forms of animal life on Earth (Forister et al., 2019). Insect abundance, biomass, species richness and range size are all declining (Wagner et al., 2021) . The number of insects has been reduced 45% since 1974 (Dirzo et al., 2014), while reported rates of annual decline in abundance are estimated to be around 1 to 2% (Wagner et al., 2021). Available evidence supports a tentative estimate of 10% of insect species being threatened with extinction (IPBES, 2019).

Insects are vital to life as we know it. They pollinate 90% of all flowering plants, and are the primary means by which energy is transferred from plants to most other animals in food webs. They also play major roles in the critical processes of decomposition and nutrient cycling.

Meanwhile, a 2019 assessment found staggering losses in the North American bird population, with an estimated net loss of 2.9 billion breeding adults since 1970 (Rosenberg et al., 2019). Devastating losses were found among birds in every biome (Rosenberg et al., 2019).

The Value of Ecosystems

Agastache scrophulariifolia, purple giant hyssop © C. Palmer

Biodiversity affects us all.

A reduction in genetic diversity affects species' potential for adaptation, ongoing evolution and survival; this is becoming even more critical as fragile populations face increased pressures from climate change and loss of habitat through rapid development. Loss of individuals is in itself a tragedy, and loss of abundance of individuals can lead to species extinctions. Loss of each unique and intrinsically valuable species is irreparable, and each species lost increases the risk of cascading effects - with the loss of interdependent species and the breakdown and loss of entire ecosystems.

Ecosystems are incredibly complex; we have limited understanding of even the most well studied species interactions, and there are countless others that we have little to no knowledge at all of; we just don't know where the 'breaking point' for ecosystems are. When we lose biodiversity, we destabilize these systems and risk their collapse. Without functioning ecosystems, we lose the vital ecosystem services which support life - such as the provision of oxygen, food and fresh water (See Appendix II, p 39).

Without functioning ecosystems, we lose the vital ecosystem services which support life.

For many, the conservation of other species is in itself a strong enough argument for action, but even for those who perhaps aren't as concerned with conservation of other species, we can also look at it from a very anthropocentric view. The loss of functioning ecosystems impacts not only our quality of life, but also threatens the very existence of life on Earth. Humans are completely dependent on the ecosystem functions and services provided by plants and animals.

Loss of biodiversity and loss of ecosystem services can affect food and water supply and the results can be financially devastating. Flooding, soil erosion of farm land and loss of pollination services can directly impact crop growth. Land degradation has already reduced the productivity of 23% of the global land surface; over 75% of global food crop types rely on animal pollination, and up to $577 billion in annual global crops are at risk due to pollinator loss (IPBES, 2019).

Globally, ecosystem services such as crop pollination, water purification, flood protection and carbon sequestration have been valued at an estimated $125-140 trillion per year, i.e. more than one and a half times the size of global GDP (OECD, 2019). Quantifying the loss of recreational and spiritual benefits of natural areas is exceptionally difficult, but the immense value of these benefits need to be recognized.

The economic costs of biodiversity loss are extremely high - the OECD reports that between 1997 and 2011, the world lost an estimated $4-20 trillion per year in ecosystem services owing to land-cover change and $6-11 trillion per year from land degradation (OECD, 2019).

"The health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide."

IPBES Chair, Sir Robert Watson

The Critical Role of Native Plants

Plants, and native plants in particular, are
the foundation of ecosystems on which life depends.

Zizia aurea, Golden Alexanders © C. Palmer

"Habitat is rapidly being converted from coevolved native ecosystems into novel assemblages of plants and animals, making the conversion of native plant communities into plant assemblages dominated by non-native species one of the most ubiquitous threats to biodiversity today."

(Tallamy et al., 2020)

Native plant communities support a great deal more
biodiversity than introduced plants.

The greater biodiversity supported by native plant communities is primarily due to specialized relationships that have evolved between plants and insects, with host specificity driven by phylogenetic history, plant defences, and ecological experience within specific environments (Tallamy et al., 2021).

The great majority of insects are diet or host-plant specialists, meaning that they can only eat or live on plants that they have developed a relationship with through evolutionary time (Forister et al., 2015). Host range expansions are exceptions, which means more species cannot use non-natives for growth and reproduction than can, and the largest guild of insect herbivores (mandibulate insects) is both the most vulnerable to non-native plants and the most valuable to insectivores (Tallamy et al., 2021).

Additionally, while some insects attempt to reproduce on non-native plants, these attempts can become ecological traps when the use of novel hosts results in mortality or reduced fitness - studies indicate that female insects may be induced to lay eggs on non-native plants that do not support successful larval development (Tallamy et al., 2021).

This host specificity has consequences throughout the ecosystem. For example, a 2018 study found that there were 68% fewer caterpillar species and 91% fewer caterpillars, and that there was 96% less caterpillar biomass in study areas with introduced plants compared to native hedgerows (Richard et al., 2018).

Caterpillars are one of the most important food sources for many wildlife species and the reduction in caterpillar numbers impacts food availability; another study found that suburban yards dominated by introduced plants were 60% less likely to have breeding chickadees compared to primarily native landscapes (Narango et al., 2018).

While non-native plants can provide some ecosystem functions, there is almost always a loss in biodiversity when they are used in place of native plants.

Conserving existing native plant habitat, using native plants in landscaping and adopting ecologically sustainable landscape management practices are key ways that each one of us can make a difference. In this guidebook, we highlight the efforts that have been made to this end in the City of Columbus, and give recommendations for how you can contribute to conservation..

Sustainable Futures

Linking Biodiversity, Climate Resilience, Sustainable Development & Environmental Justice

This guidebook is intended to be supplemental to the ongoing work addressing climate change and sustainable development in Columbus.

Baptisia australis, blue wild indigo © C. Palmer

"Biodiversity protection is fundamental to achieving food security, poverty reduction and more inclusive and equitable development."

(OECD, 2019)

There are inextricable links between biodiversity loss and climate change (IPBES, 2019). Conservation and protection of Indiana's diverse native species should be a central component of climate change preparation. Genetic variation enabling adaptation is key to species survival as conditions change. Restoration and protection of habitat, supporting biodiversity to maintain ecosystem stability and increasing population numbers will all be critical.

In addition to recognizing the impacts of climate change on Indiana's native species, the link between conservation and climate resilience should be stressed. The role of native plant communities and healthy wetlands, forests and grasslands in helping to mitigate impacts from climate change, and the economic and qualitative benefits of this, should be recognized. As our climate changes, the importance of maintaining urban green infrastructure to support economic, environmental and health benefits to cities in Indiana will likely increase (Reynolds et al., 2018).

Damage to ecosystems undermines efforts to reduce poverty and hunger, and to promote more sustainable development (IPBES, 2019). Environmental justice should be a key focus of city-wide strategic planning.

Columbus is in a fortunate position with strong leadership support for sustainable development, and conservation being a consideration of the Parks Department Master Plan for 2017 - 2021. Ensuring that the conservation of biodiversity and environmental justice are central considerations of both the Envision Columbus Downtown Strategic Development Plan and the Parks Department Master Plan for 2022 - 2026 will be vital.

Coordination between local environmental partners, Columbus Parks and Recreation Department, Envision Columbus and Cummins' PLANET 2050 initiatives could enable the City of Columbus to be a leader in the fields of conservation, climate resilience, sustainable development and environmental justice.

Part II. Recommendations

Danaus plexippus, Monarch butterfly pupation on *Pycnanthemum verticillatum var. pilosum,* hairy mountain mint © C. Palmer

10 Steps to Ecological Landscapes

These recommendations are based on those detailed in Chapter 11 of *Nature's Best Hope* by Dr. Douglas W. Tallamy, tailored for Columbus.

1. Identify & Remove Invasive Species

Identifying and removing invasive species is a critical first step and a key priority.

- Prioritize removing species covered under the Terrestrial Plant Rule & those species designated as invasive by the Invasive Plant Advisory Committee, and do not buy or plant these species going forward (See Appendix III, p 40).

- Significant progress has been made by the Bartholomew County's "Blazing Stars" Cooperative Invasive Species Management Area (CISMA) and this remains an area for urgent and continued focus.

- Continued and close coordination between the Indiana Invasive Species Council, State of Indiana Cooperative Invasives Management (SICIM), their Indiana Invasives Initiative, the Blazing Stars CISMA and city agencies will be of great value. City-wide recognition and dissemination of the Blazing Stars CISMA's efforts and events (such as Weed Wrangles) will be key.

- SICIM, IISC, INPS and The Nature Conservancy provide excellent resources. The availability of land surveys for property owners and the potential to train to become a surveyor, plus resources for financial assistance for invasive plant removal could be further highlighted to Columbus residents.

2. Shrink the Lawn

The goal is to reduce the area of ecologically desolate turf-grass by at least 50%.

- Aim to reduce the amount of area under lawn, and replace it with native plantings. While 50% of lawn reduction is the goal, even small patches of habitat are important (Forister et al, 2019) and any efforts to convert lawn to native plant habitat is encouraged.

- The Homegrown National Park™ Call to Action is aiming for 20 million acres of native plantings in the US, representing the area of approximately 50% of the green lawns of privately-owned properties in the nation. Properties can be registered free-of-charge on the Homegrown National Park™ interactive map, signage and resources can be freely downloaded and efforts shared on social media with #onthemap.

photo courtesy of Eric R. Riddle

3. Plant Native Plants

Include keystone genera, plant for specialists, increase diversity & consider phenology.

- Native plants support a great deal more biodiversity than introduced plants; conservation of existing native plant habitat as well as their increased use in landscaped areas is critically important. Aim to use native plant species in landscaping wherever possible.

- Recent research highlights that not all native plants are equivalent in terms of their contributions of energy flow through food webs and their support of interaction diversity (Narango et al, 2020).

- When choosing native plants, aim to include these keystone genera, as well as considering planting for specialist insects, increasing the diversity of native plantings and trying to ensure resources for as long as possible over the growing season. (See Appendix IV, p 41)

Pycnanthemum verticillatum var. pilosum, hairy mountain mint © C. Palmer

Physostegia virginiana, obedient plant © C. Palmer

4. Be Generous with Your Plantings

Plantings should include more than 70% native plant biomass to support wildlife populations.

- Research suggests that plantings should at a minimum include at least 70% native plants by biomass. The research indicates that this is a threshold level below which the probability of sustaining some local bird populations plummets to zero (Narango et al., 2018).

- Meanwhile, a recent review found evidence that non-native plants, both invasive species and widely used ornamental plants, should be considered a threat to insect populations (Tallamy et al., 2021).

5. Source Mindfully

Where possible, choose straight species over cultivars & source neonicotinoid-free.

- Due to differences in their impacts on ecosystem function, biodiversity and gene flow, choosing straight native species is an ecologically safer option than nativars (see Appendix V, p 43). Where space or aesthetics might initially indicate a nativar of a particular species might be a good option, consider alternative straight native species - the landscaping section of the INPS website and the IWF Plant Finder Tool are both excellent resources to help with this.

- Neonicotinoids, a particularly prevalent class of systemic insecticides, are routinely used by some commercial suppliers to treat plants and seeds. As neonicotinoids are absorbed into the plant they can be present in pollen and nectar, making them toxic to pollinators (see Appendix VI, p 44). The potentially long-lasting presence of neonicotinoids in plants makes it possible for these chemicals to harm pollinators even when the initial application is made months before the bloom period. Actively source plants and seeds that have not been treated with neonicotinoids.

Agastache scrophulariifolia, purple giant hyssop © C. Palmer

6. Echo Native Plant Communities & Consider Landscape Design

Careful landscape design and choosing the native species to best suit site conditions will help to make habitats both ecologically valuable and enjoyable.

- Where possible, echo native plant communities - assess what plant community a property or area resembles (such as woodland, water's edge or prairie) together with the conditions (soil, light, aspect, moisture level).

- Using design tools and management can help to give a more formal or cared for look to areas of native landscaping, for example: use distinct edges for a formal setting; mow paths through natural areas and place seats or garden sculpture to show an area is cared for; use larger groups of one species for impact and structure; repeat patterns, color and combinations of plants and use plant labels and signs. Techniques such as cutting back taller perennials in early summer for shorter stature and cutting back after flowering to promote fresh growth can also be very effective.

- Consider time and resources available for maintenance. Adding native trees and shrubs to landscapes can be an excellent way to greatly increase the ecological value of a habitat while keeping maintenance time and costs very low.

- Incorporating the latest scientific research into planting plans and landscaping decisions wherever possible can maximize the ecological value of plantings. For example, a 2020 study found that the layout of gardens strongly influences the extent to which milkweed plants are found and used by monarchs (Baker & Potter, 2019). Another recent study found that *Asclepias incarnata* and *Asclepias tuberosa* appear to be the most cost-effective milkweed species to include in seed mixes (Lukens et al., 2020).

- Considering the results of these and other studies when designing and planning landscapes can maximize contributions to conservation.

7. Build a Conservation Hardscape

One of the biggest sources of insect decline - but one of the easiest to rectify - is light pollution.

- Replace all outdoor light bulbs with yellow LEDs and use motion sensors on all security lights to reduce moth mortality and reduce carbon footprint (Tallamy, 2019).

- Where possible, and for all new lights, shades should be fitted that direct the light down - both increasing effectiveness of the lighting and reducing the impact on insects (Tallamy, 2019).

- Other small but effective steps include installing window well covers to prevent small creatures from becoming trapped; installing small water features with bubblers for wildlife; and using smaller, dispersed bee houses and leaving logs and stems intact and in situ in place of using bee “hotels” to reduce predation and disease (Tallamy, 2019).

Echinacea pallida, pale purple coneflower © C. Palmer

8. Create Caterpillar Pupation Sites Under Trees

Create caterpillar pupation sites under your trees & leave the leaves!

- The vast majority of caterpillars do not pupate on their host plants; most drop to the ground to find pupation sites in leaf litter or under the soil. Where the area under trees is compacted, mortality can be high (Tallamy, 2019). Plant a layered canopy and ground cover beneath trees wherever possible.

- Fallen leaves not only act as an excellent mulch, they also provide overwintering habitat for many insects. Leave leaf litter on beds and around the base of trees to increase habitat (in addition to reducing carbon emissions from leaf blowers and saving money on purchased mulch). Fallen logs should also be left in situ under trees where this can be safely done. The Xerces Society have detailed information on the #LeaveTheLeaves campaign.

9. Adopt Ecological Maintenance Practices & Avoid Chemical Use

Reduce mowed areas, follow ecologically sensitive mowing schedules and leave plants intact to provide overwintering habitat and nest sites. Avoid prophylactic chemical use and treatment without documented need.

- Delay initial spring mowing as long as possible to avoid killing caterpillars and other overwintering creatures that are emerging; consider adopting “No-Mow May”; wherever possible, adopt less frequent mowing regimes and no-mow zones.

- When mowing is required, set mower heights as high as possible, ideally above 4 inches. To reduce wildlife mortality, avoid mowing in the evenings, use a mowing pattern that starts in the middle and moves out and set power tools going for a few minutes prior to use to allow wildlife a chance to flee.

- Leave plants intact over winter to provide food, overwintering habitat, and nest sites. Heather Holm advises cutting back spent stems at varying heights (6, 12 and 24 inches) in the spring to create habitat for bees as they emerge from the ground; leaving some stems fully intact until the end of April or early May before trimming will create habitat for those species that are later to emerge. Stems that are left for nests should remain intact throughout that year and not removed before the following spring; ideally they should be left indefinitely.

- Avoid all prophylactic chemical use. For mosquito control, consider more effective alternatives to pyrethroid pesticides, such as mosquito dunks and frequent disposal of standing water (Tallamy, 2019).

- Avoid plants treated with neonicotinoids and pyrethroid pesticides (see Appendix VI, p 44).

- Avoid or reduce fertiliser use. Use native plantings around pond and water edges wherever possible.

- Advocate for increased education on plant-insect interactions, alternatives to pesticides and the impacts of chemical use.

Monarda bradburiana, Bradbury’s beebalm © C. Palmer

10. Network with Neighbors, Educate Civic Associations & Broaden the Reach.

The high level of civic engagement and current environmental projects indicate that Columbus is in an excellent position to make a really significant impact. Ensuring that there are no barriers to education and that all people feel safe, welcomed and valued as contributors to conservation should be a priority.

- Encourage networking and information sharing. Consider highlighting the financial benefits and cost savings associated with an ecologically sensitive approach to landscaping with HOA and local civic associations (see Appendix VIII, p 46).

- Register native plantings on the Homegrown National Park™ map and celebrate them through certification schemes such as through IWF and INPS. Wildlife-certified yards have the potential to contribute to city-scale heterogeneity and potentially mitigate the ecological homogenization of residential landscapes (Lehman et al., 2021).

- Connect with school teachers and youth club leaders. Coordination with the Columbus North Environmental Club is an exciting example. Additionally, other clubs and classes may have the potential to expand the reach and make efforts more inclusive - including photography, journalism / media and art classes. Connecting with these students could both enhance conservation efforts and engage the wider community.

- Actively seek to engage as large and diverse a community as possible. Have key materials translated into Spanish and other languages used by local communities.

- Pitch concepts and educational messages at a range of levels to increase inclusivity and provide access to educational materials for people with disabilities. Consider sensory gardens using native plants, and include native plants with scent, texture and sound in community plantings.

- Thoughtfully consider cultural and traditional uses of native plants and the importance of food security to communities.

- Partner with programs (such as INPS’s Letha’s Fund) which may help facilitate access for broader audiences. Consider opportunities and materials to help people participate without economic barriers - initiate and participate in local native plant and seed swaps and giveaways; set up a Little Free Seed Library (see Bartholomew County’s Cleo’s Seed Share) or become part of an INPS Native Seed Community.

10 Policy Recommendations for Columbus

1. Pass native plant ordinances.

- Mandate the use of native plants in landscaping around municipal buildings, in parks, medians, verges and all other common areas, and in all new developments. These would ideally require 100% and at a minimum 70% native plants. All new trees and shrubs planted on city property and in new developments should be required to be native species.

- Require a 50% reduction in maintained turf-grass areas wherever possible on city properties and a less than 50% area of maintained turf-grass in all new developments, around municipal buildings, in parks, medians, verges and common areas.

- Planting plans should include members of keystone genera and consider the diversity of native plants in order to maximize conservation benefits. The latest scientific research should be incorporated into planting plans wherever possible to enhance ecological value.

- Native planting zones around all retention ponds should be required on city properties and in all new developments.

- In all city managed areas, provenance of seed and plants used should be carefully considered. Plants and seeds should be free from neonicotinoids; should be of local genotype where possible and straight native species (as opposed to cultivars) should be used unless there is specific need (such as disease resistance).

- Lists of permitted plant species for new developments should be compiled - the City of Bloomington development ordinances provide a good model (see Appendix VII, p 45).

2. Update weed and vegetation control ordinances.

- Ensure that they support and do not prevent the use of native plants (for example due to height restrictions).

3. Tighten restrictions on invasive plant use.

- In addition to the plants covered in the Terrestrial Plant Rule, all species designated as invasive by the Invasive Plant Advisory Committee should be prohibited in municipal areas and new developments, and strongly discouraged in all areas. Efforts to remove existing invasive plants should be actively supported.

- The current Columbus Zoning and Subdivision Regulations do address invasive plant use, and this is commendable - a number of plants are listed as non-qualifying plants under the points system, in Table 8.2 of General Landscaping Standards. It would be excellent to see this list expanded to include all species designated as invasive by the Invasive Plant Advisory Committee, and for stronger language to be used. Ideally their use should be prohibited; if this is not possible, their use could be more strongly discouraged through having a negative value in the current landscaping points system.

4. Designate no mow zones & adopt reduced mowing schedules.

- Designate no mow zones in appropriate areas and adopt reduced mowing schedules as widely as possible throughout the city - both to benefit wildlife and to reduce maintenance costs. Ideally this should be combined with educational signage and media outreach

Tradescantia ohiensis, Ohio spiderwort © C. Palmer

5. Address light pollution in city ordinances.

- All town outdoor lights should be replaced with yellow LED bulbs when they are due for replacement, and all new lights on town property and in new developments should be required to be yellow LEDs. Motion sensors should be fitted on all security lights to reduce moth mortality (and reduce carbon footprint). Where possible, and for all new lights, shades should be fitted that direct the light down to both increase effectiveness of the lighting and reduce the impact on insects (Tallamy, 2019).

- Bloomington's Unified Development Ordinances Section 20.04.090 Outdoor Lighting is fairly comprehensive and includes the following: "*The lighting standards are intended to encourage lighting practices and systems that conserve energy and resources; minimize light pollution … and to minimize disturbance to sensitive plants and animals*".

6. Require window well covers.

- These should be required on all city and new properties to reduce wildlife mortality.

Liatris pycnostachya, prairie blazingstar © C. Palmer

7. Reduce chemical use in all public areas.

- Prophylactic chemical use and treatment without documented need on town property should be prohibited; fertilizer use on town-maintained properties should be stopped or significantly reduced. At a very minimum this should be applied to particularly sensitive areas (for example in Bloomington's Unified Development Ordinances, "*Any use of pesticides, herbicides, or fertilizers is prohibited within the [karst conservancy] easement area*", p226).

8. Re-examine city landscaping and maintenance practices.

- Ensure that practices include the latest research supporting conservation. This should include, but not be limited to: consideration of wildlife in setting mower blade heights and mowing times; best practices for maintenance of areas around trees and best practices for maintaining overwintering habitat. Additionally, best practices for tree planting and maintenance - including correct mulching and avoidance of accidental girdling - should be followed. Education regarding best practices should be provided to all landscaping staff and contractors.

9. Explore policy options to encourage adoption of best practices.

- Encourage adoption of best practices by businesses, the school district, neighborhoods and residents, including potentially financial assistance, in addition to providing access to information and resources.

10. Legislate for an ongoing commitment to conservation and sustainability.

- Ensure long-term meaningful change. The Envision Columbus Downtown Strategic Development Plan is commendable; extending this strategic development plan to ensure that the conservation of biodiversity is included as a key consideration is important. This comprehensive environmental strategic plan should be drawn up, circulated for stakeholder and expert review and made public for residents. Assessment of implementation and review of the plan should ideally be required on a scheduled, regular basis.

10 Ways to Demonstrate, Educate & Celebrate - Influencing Behavior Beyond Policy.

In addition to policy changes, behavior change can be effectively encouraged through positive reinforcement of good conservation practices and increased access to educational and financial resources.

1. Prioritize Inclusivity.

- Ensuring that there are no barriers to accessing educational materials and that they are as inclusive as possible should be a priority. Welcoming as large and diverse an audience as possible to access educational material is key to successful conservation and addressing environmental injustice.

- Ensuring that all people feel safe, welcomed and valued as contributors to conservation should be a central focus.

2. Showcase Demonstration Areas.

- Columbus has some excellent areas of native planting on larger scales with educational signage (for example at Blackwell Park). Increased signage and media focus could enhance their impact and educational value. Further support for the efforts of groups such as the Columbus Pollinator Committee and Blazing Stars CISMA is essential.

- In addition, identifying areas that could be used for demonstration of residential scale native plantings and supporting demonstration gardens would be excellent.

3. Highlight the Financial Benefits.

- Providing educational resources and opportunities for residents and businesses to learn about the potentially significant financial advantages associated with adopting best conservation practices is key.

4. Consider Signage to Highlight and Educate.

- There are a number of non-profit organizations that can provide excellent signage for those committing to ecologically sustainable practices (including the Indiana Wildlife Federation, Indiana Native Plant Society, the Homegrown National Park and the Xerces Society, among others).

- Columbus could highlight these programs and / or consider Columbus-specific signage, given to groups or residents who adopt best conservation practices and primarily use native plants in their landscaping. There could be different levels of adoption, and city media attention on those participating.

5. Coordinate with Partners.

- A great deal of work is already being done on these issues in Indiana; coordinating closely and fostering partnerships is key to accessing expertise while reducing costs. INPS, IWF, the Indianapolis Office of Land Stewardship, Indiana SWCDs and Purdue University among others have extensive educational material freely available online. Columbus could provide links to these resources on city media and could consider hosting a virtual meeting to bring representatives of these groups together to help in conservation strategic planning.

- Columbus already has a very impressive network of partner organizations working together, and with the city (please see these partnerships highlighted in Part III).

- Both fostering these relationships and partnering with additional organizations will be important, and stand to bring benefits to Columbus residents (for example IWF provides educational programming (such as Monarch butterfly tagging) and educational signage for Certified Trails and Habitats, while INPS have biodiversity and educational grants available).

6. Focus on Invasives.

- Close coordination with the Indiana Invasive Species Council, State of Indiana Cooperative Invasives Management (SICIM) and the Indiana Invasives Initiative should be fostered.

- The newly formed Bartholomew County Blazing Stars CISMA and the Weed Wrangles hosted in Columbus to date are excellent. Continued support for, and wide recognition of, the work of the Blazing Stars CISMA will be extremely valuable.

7. Educate to Reduce Chemical Use.

- Efforts should be made to educate residents on plant-insect interactions, options to reduce chemical use and alternatives to pesticides.

8. Engage the Schools.

- Further engaging Columbus schools and students, with an emphasis on older, middle and high school age students in addition to the younger age group who have typically been the focus of environmental programs, will be important. Consider science and environmental students (as with the work in partnership with the Columbus North Environment Club), and also those involved in the arts and media programs at the schools. Consider models used in other towns, such as Carmel's Carmel Green's 'Teen Micro Grant' program and 'Promise Project' as potential models.

9. Incentivize Best Practices.

- Businesses, schools, community buildings and neighborhoods could be encouraged to adopt best practices with incentives, including being highlighted in city and social media and being supplied with signage to advertise their commitment.

10. Highlight Action & Celebrate Columbus' Heritage.

- Celebrate the many excellent environmental achievements and efforts already happening in Columbus on city social media, including its position as the first (and, at the time of writing, only) Bee City in Indiana. Perhaps residents could nominate individuals and community efforts they feel have made a contribution?

- Columbus is in an extraordinary position with its history, world class architecture and public art. Bringing those elements together to design and implement outstanding ecological landscapes could be an excellent focus.

- Residents and neighborhoods could be encouraged to share photos and videos of native plant landscaping and the wildlife it supports for virtual tours and social media posts. A city wildlife and native plant photo competition could be considered, and further coordination between arts and environmental groups to support similar initiatives encouraged.

Part III. Highlighting Columbus

Echinacea pallida, pale purple coneflower © C. Palmer

Bee City, USA

Bee City USA® and Bee Campus USA work to galvanize communities to sustain pollinators, in particular the more than 3,600 species of native bees in this country, by increasing the abundance of native plants, providing nest sites, and reducing the use of pesticides. Bee City USA and Bee Campus USA are initiatives of the Xerces Society for Invertebrate Conservation.

On 22 Sep 2021, Columbus became the first city in Indiana to be awarded the status of Bee City USA® . The Pollinator Committee is currently working towards Bee Campus USA certifications.

Bee City USA and Bee Campus USA are initiatives of the Xerces Society to bring people together to make their communities better places for pollinators, through creating and enhancing habitat, reducing pesticide use and impacts, and outreach and education.

The Columbus Pollinator Committee's goals for Bee City USA affiliation included:

- Drive local awareness and support of pollinators and the benefits they provide
- Provide volunteer opportunities for people who love gardening and ecological diversity
- Show support of environmental stewardship to appeal to students, creatives, and young professionals (retainment & recruitment tool)
- Convert some areas of the city that can be more easily maintained as pollinator sites
- Bring together existing nature focused groups and individuals in our community for collaborative work
- Good pollinator health is an indicator of ecosystem health in general
- Demonstrate how creative people can get involved and make a difference in our community
- Natural expansion of the Columbus Pollinator Committee work over the past 3 years
- Affirm the initiatives already in the Columbus Parks Department plan

The focus for 2022 will be on development of the Pollinator Path, and supporting the work around the Ivy Tech college campus. Over the next 2-4 years, the goal is for the city to convert more mowed areas into pollinator meadow, expanding the pilot project currently being undertaken at the airport.

Current Conservation Initiatives

Columbus Pollinator Park at Blackwell Park

Columbus Parks and Recreation was awarded an Indiana Office of Community and Rural Affairs grant in 2020. The money was used for improving the trail system at Blackwell Park, installing educational signs about native flora and fauna. Later in 2020, the Bartholomew County Public Library installed a Story Walk™ on the People Trail by the new native plant beds.

In 2021, The Nature Conservancy approached the Columbus Pollinator Committee about starting a local Cooperative Invasive Species Management Area (CISMA). The Blazing Stars CISMA was created in Bartholomew County and Blackwell Park was chosen as one of the primary sites for invasive removal. Through the course of the year, three Weed Wrangles™ were organized to begin removing the callery pear, honeysuckle, multiflora rose, and other invasive species from the eight acre focus area.

A three-year CISMA management plan has been created to systemically control the invasives and further beautify the park.

In spring 2019, the Columbus Pollinator Committee began the restoration of a native plant habitat in Blackwell Park.

The original meadow was poorly maintained and invasive species were taking over the area. The Tree Seedling Nursery in Vallonia, IN and the Winding Water Group of the local Sierra Club donated native plants to the project, and over 1,000 plants were dug up and transplanted in a large native plant bed installed parallel to the People Trail at Blackwell Park.

In fall 2019, a second bed was created with potted native plants donated by the Landmark Columbus Foundation, following the close of the 2019 Exhibit Columbus native plant installation at the Bartholomew County Public Library.

Volunteer day at Blackwell Park
photo courtesy of Eric R. Riddle

Mayor Lienhoop, ceremonial planting during June's National Pollinator Week
photo courtesy of Eric R. Riddle

AirPark Columbus & the Pollinator Path from Blackwell Park to a New Native Plant Meadow

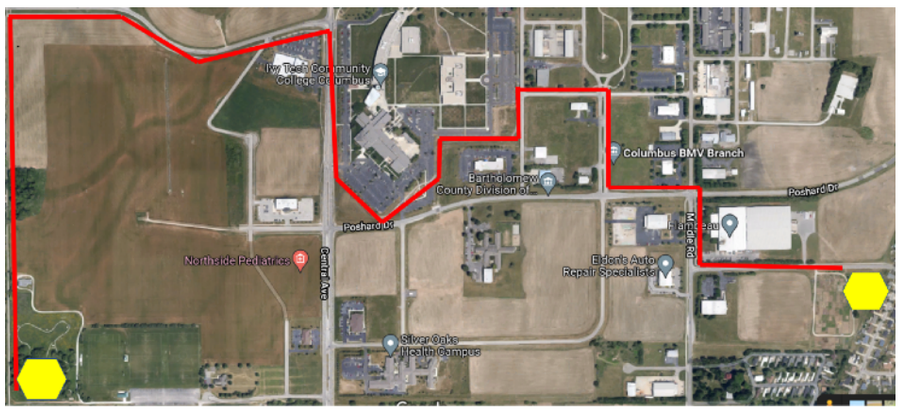
Blazing Stars at Blackwell Park
photo courtesy of Eric R. Riddle

With the support of several community organizations, AirPark Columbus is establishing a Pollinator Path that will be certified by the Indiana Wildlife Federation to connect Blackwell Park to the new Native Plant Meadow adjacent to Columbus Community Garden.

In February 2022, on the 40th anniversary of the Columbus Community Garden, the new Native Plant Meadow was seeded in the acre next to the historic gardens.

The Meadow project was led by Sycamore Land Trust, Bartholomew County Soil & Water, and The Nature Conservancy who advised on soil preparation and seed selection. AirPark Columbus owns the land and leased the acre to Bartholomew County Soil and Water for $1 per year.

The Pollinator Path activates the current Columbus People Trail; beautifying the local Ivy Tech and IUPUC Campuses, People Trail, and local businesses with native plants, rain gardens, wildlife shelters, and educational signage. The local Sierra Club Winding Waters Group will be leading plant selection for new native plant beds on multiple sites along the path.



The AirPark Columbus College Campus has recently completed a visioning process to establish a guiding landscape framework plan for future development on the site. Within that framework plan are goals for the campus to connect to its natural history through the use of native vegetation reflecting the site's historical condition, reduce the amount of lawn present and improve habitat through native plantings, and extend potential habitat connections by suggesting green corridor improvements along adjacent streets and sidewalks.

A site design for the southwest corner of campus along Central Avenue and Poshard Drive will be the initial implementation of the framework plan. The design focuses on the removal of an existing building and associated parking and in its place introducing native woodland and meadow plantings intertwined with winding pathways that frame a nature-play area.

AirPark Columbus
College Campus

Fresh Start Landscape Project

Fresh Start Recovery Center after planting installation. May 2021
photo courtesy of Eric R. Riddle

The Fresh Start landscape project is a partnership between Friends of Pollinator Parks (FOPP) and Volunteers of America (VOA).

VOA is the national nonprofit that manages the Fresh Start Recovery Center, an addiction treatment recovery home for women at 7th and Washington Streets. Landmark Columbus Foundation helped facilitate the partnership and wrote a grant, which supported the project.

FOPP chose to partner with VOA because of the property's visible location in downtown Columbus, relatively large lawn, and opportunity to partner with the women served by the nonprofit to both benefit from and participate in the maintenance of the native landscape.

Utilizing a $5,000 grant from the Duke Energy Foundation, FOPP hired Loci Creative, a Columbus-based landscape architecture firm, to design a 100% native plant design for the property. Plants were sourced from Woody's Warehouse (Lizton, IN) and Spence Nursery (Muncie, IN). During United Way's National Day of Caring in May, 2021 volunteers from around the Columbus community planted over 1000 plugs, a dogwood tree, and native hydrangeas.

Fresh Start planting, May 2021
photo courtesy of Eric R. Riddle

Volunteers from Columbus Regional Health at Fresh Start, May 2021
photo courtesy of Eric R. Riddle

Ongoing maintenance of the site is led in continued partnership between FOPP and VOA. The opportunity to work with the women and staff is enriching the educational experience of the beauty of landscaping with native plants.

Bicentennial Tree Planting Project

First bicentennial tree planted at Breeding Farm with local South Central Indiana Master Gardeners, September 11 2021
photo courtesy of Eric R. Riddle

Bartholomew County celebrated its 200th anniversary in 2021.

In the spring of 2021, the local Noon Rotary Club committed $1,000 to a tree planting fund with the goal of planting 200 trees to celebrate the bicentennial. Fundraising led to contributions from local churches, nonprofit organizations including the Sierra Club, and Columbus & Bartholomew County Parks departments. The DNR Urban Forestry program provided a $7,420 grant and Duke Energy became the lead funder through a $10,000 donation. Overall, $30,000 was committed to the budget.

Planting began on September 11 with the planting of Indiana's state tree; the Tulip Poplar at Breeding Farm. Two city parks each received 20 trees. The largest event was a 43 bald cypress tree planting at Columbus East High School on November 1. Two other schools also received trees.

Bicentennial tree planting at Columbus East High School. Nov 1, 2021
photo courtesy of Eric R. Riddle

A second round of tree planting is planned for Spring 2022 with an effort to plant multiple trees at all parks managed by the Bartholomew County parks department. Well over 200 trees will be planted as a way to celebrate the bicentennial, and all trees selected are native to Indiana.

Pleasant Grove

Apple harvest from Pleasant Grove Orchard, August 30, 2021
photo courtesy of Eric R. Riddle

In 2008, the Pleasant Grove neighborhood, southeast of the Central Ave and 7th St intersection, was the epicenter of a devastating 100-year flood.

FEMA's maximum $28,800 grant was not nearly enough to repair the buildings. Because of the overwhelming damage, over 40 homes in the two blocks east of Cummins Tech Center were levelled and turned into city-owned greenspace through the FEMA Property Acquisition Program. Today, the empty lots are a stark reminder of the devastating flood.

A "Puddles to Parks" project was completed in 2011 when students from Lincoln Elementary planted a small orchard on the south end of Pleasant Grove St. Apples are picked annually at the orchard in the fall and donated to local food banks.

The much larger 2.5 acre portion north of the orchard was the development focus of the Pleasant Grove Steering Committee in 2016-2019. Working with local landscape architecture firm Loci Creative, the committee planned a park that focuses on large sections of native wildflowers, paved walking trails, an outdoor education area, and a flood memorial sculpture area. The committee successfully received approval from the Columbus Planning Commission, Indiana Department of Homeland Security, and Federal Emergency Management Area (FEMA).

A separate plan for a mural and native plant landscape installation across the street from Pleasant Grove on Cummins property was developed by Loci Creative in partnership with the Columbus Arts Council.

The ambitious approved park plan and Cummins property enhancement is currently on hold as a fundraising plan is determined.

The Columbus Pollinator Committee is composed of many members from the original Pleasant Grove Steering Committee who are gaining experience in understanding native plant installation and maintenance through their work at Blackwell Park and the AirPark Meadow project.

Local Environmental Partners

Columbus Pollinator Committee

The Columbus Pollinator Committee is a group dedicated to sharing information and learning about how to create landscapes, gardens and parks that promote native plants and support pollinator species. They are actively working to build parks, gardens and landscapes in Columbus, Indiana. Join their facebook group - Friends of Pollinator Parks - to learn more about upcoming events and to find out how you can participate in their projects within the Columbus parks system and beyond.

Vision of the Columbus Pollinator Committee:

- Partners with with local secondary schools to create education events at Pollinator Park sites
- Partners with local colleges to become Bee Campus USA sites
- Enhances the BCPL Seed Library
- Builds community awareness and support for pollinators and the natural environment
- Resource to private individuals that may want to establish private pollinator habitats
- Provides natural recreation opportunities that the entire community can enjoy
- Finds ways to celebrate our local achievements along the way to promote, maintain, and create native plantings in Columbus, IN.

Blazing Stars CISMA

SICIM | State of Indiana Cooperative Invasives Management

Bartholomew County's "Blazing Stars" Cooperative Invasive Species Management Area (CISMA) is a newly formed organization with a mission to partner with and educate community members to manage invasive species for the improvement of Bartholomew County's natural habitat. In August 2021 the Blazing Stars CISMA received the Weed Wrangler award at the State of Indiana Cooperative Invasives Management (SICIM) Conference. Many local organizations are supporting the CISMA, inlcuding: Sycamore Land Trust, The Nature Conservancy, Sierra Club, Columbus Parks and Recreation, Columbus AirPark, Purdue Extension, Soil and Water Conservation District of Bartholomew County, and Friends of Pollinator Parks.

SIERRA CLUB HOOSIER CHAPTER

The Hoosier Chapter of the Sierra Club has more than 10,000 members. Local Sierra Club groups are active in different parts of the state, working on conservation-related issues, sponsoring outdoor activities, and educating members on issues. The Greater Columbus (Winding Waters) Sierra Club group has been instrumental in progressing conservation projects in Columbus. The annual "Bring Back Butterflies and Bees" native plant sale, that began in 2018 with the Sierra Club Winding Waters Group in partnership with Spence Nursery of Muncie, IN has brought in thousands of native plants to Bartholomew County over the past five years.

The Columbus Recreation and Parks Department connect the people of our community through the power of nature, wellness, and creativity.

Bartholomew County Public Library

Bartholomew County Public Library has been an active supporter of environmental projects in Columbus, including establishing Cleo's Seed Share in 2019 and supporting the Blackwell Park Storywalk.

Columbus North Environmental Club

The Columbus North High School Environmental Club have a mission to promote environmental friendliness in their school by taking on green projects and spreading awareness among students and faculty.

Sycamore Land Trust

Sycamore Land Trust is a 501c3 nonprofit conservation organization that has been protecting land, restoring habitat, and connecting people to nature in southern Indiana since 1990. Sycamore owns and cares for 121 protected properties and maintains trails on 13 preserves for free public use. Tangeman Woods and Touch the Earth in western Bartholomew County are Sycamore Land Trust properties with easily accessible public trails.

Ivy Tech Community College

Ivy Tech offers many programs through their various schools of study that are aligned with employer needs. Their students are sought out for good-paying careers by some of the top companies in Indiana. Their state-of-the-art facilities and equipment give you hands-on, relevant experience that make you career-ready right away.

Bartholomew County Soil & Water Conservation District

The Bartholomew County Soil and Water Conservation District mission is to provide the public information about soil, water and related natural resource conservation; identify and prioritize local soil and water resource concerns; and connect land users to sources of education, technical and financial assistance to implement conservation practices and technologies.

Purdue University Extension - Bartholomew County

Purdue Extension educators, specialists, and volunteers provide the link between Land Grant research and Indiana citizens. Purdue University Extension - Bartholomew County provides research-based information that enhances lives and livelihoods. The South Central Indiana Master Gardener Association is supervised by Extension office.

Indiana Wildlife Federation

Since 1938, the Indiana Wildlife Federation (IWF) has worked to promote the conservation, sound management, and sustainable use of Indiana's wildlife and wildlife habitat through education, advocacy, and action. IWF is a nonprofit, grass-roots affiliate of the National Wildlife Federation. Working on behalf of Indiana's hunters, anglers, gardeners, conservationists, and outdoor enthusiasts, IWF advocates for commonsense conservation practices that will protect the future of wildlife and wildlife habitats in Indiana.

The Nature Conservancy

Founded in the U.S. through grassroots action in 1951, The Nature Conservancy has grown to become one of the most effective and wide-reaching environmental organizations in the world. Their mission is to conserve the lands and waters on which all life depends. The Nature Conservancy's Indiana chapter is committed to diversity and inclusion.

Indiana Native Plant Society

The mission of the Indiana Native Plant Society (INPS) is to promote the appreciation, preservation, scientific study, and use of plants native to Indiana. Founded in 1993, the statewide organization and seven regional chapters offer informational programs, member get-togethers, plant rescues, invasives removals, youth education, and outreach activities such as hikes, garden tours, and plant sales. The active South Central Chapter covers Bartholomew County.

The Bartholomew County Parks and Recreation department seeks to enhance the quality of life and the environment; to acquire, conserve, and protect natural resources; and to provide leisure time opportunities for the benefit of Bartholomew County's present and future citizens.

Homegrown National Park ™

"We are learning how to convert at least half of the area now in lawn to attractive landscapes packed from the ground to the canopy with plants that will sustain complex food webs, store carbon, manage our watersheds, rebuild our soils and support a diversity of pollinators and natural enemies. In other words, we are learning how to create landscapes that contribute to rather than degrade local ecosystem function."

Dr. Douglas Tallamy

Homegrown National Park™ is a grassroots call-to-action to regenerate biodiversity and ecosystem function by planting native plants and creating new ecological networks.

With his writing and the excellent Homegrown National Park™ concept, Dr. Douglas Tallamy takes the teachings of E.O. Wilson and others and looks at how we can achieve their goals within the constraints of the world we find ourselves in.

Looking at the situation as it is today where, for example, in the US so much of the land is under private ownership or management, Dr. Tallamy doesn't diminish the critical role of public preserves, but argues that, on their own, they will not be enough to sustain biodiversity.

He argues that we need to find ways for nature to thrive in human-dominated landscapes. In doing so, he expands both the opportunity and the responsibility for this 'necessary task of restoring ecological function to the land' to all of us and provides a framework for how this can realistically be done.

The Homegrown National Park™ is catalysing a collective effort of individual homeowners, property owners, land managers, farmers, and anyone with some soil to plant in…to start a new HABITAT™ by planting native plants and removing most invasive plants. It is the largest cooperative conservation project ever conceived or attempted.

The initial goal is 20 million acres of native plantings in the U.S., an area that represents approximately ½ of the green lawns of privately-owned properties.

The aim is to provide the ecological networks that connect preserved habitat fragments with one another, sustainably enlarging populations of plants and animals.

Key to the call-to-action is the Homegrown National Park™ interactive map. The map is a community-based visual that will show each person's individual contribution to planting native, and will gauge the success of reaching the goal of 20 million acres of native planting in the United States. Registering your native plantings is free and easy!

https://homegrownnationalpark.org/

#onthemap.

Part IV. Resources

Pycnanthemum verticillatum var.pilosum, hairy mountain mint © C. Palmer

INPS Landscaping with Natives Initiative

Indiana Native Plant Society

Building on the Homegrown National Park™ concept as a platform, the initiative aims to bridge the disconnect between gardening, landscaping and ecology, enabling people with any level of experience to contribute to conservation efforts through the use of native plants in their landscaping.

Currently, much of the information available on native plants is focussed on individual species and assumes a level of knowledge that excludes many home gardeners and municipal planners. Both the lack of easily accessible information and the lack of availability of the plants themselves mean that native plants are often only used by enthusiasts who specifically seek them out. Additionally, knowledge and availability often limit native plant use to prairie-type settings, despite the enormous diversity of Indiana's native plant species.

The Indiana Native Plant Society (INPS) & Indiana Wildlife Federation (IWF) are working together to provide accessible, comprehensive information so that all people can successfully incorporate native plants into a wide variety of urban, suburban and rural landscapes.

- The Science Explained - Detailed scientific, accessible information on native plants their ecological importance.
- A Digital Education Series - A series of short videos guiding through the steps of why and how to use native plants in landscaping.
- Species Information - Species profiles, including consideration of both ecological and horticultural information.
- Growing Native Plants from Seed - A comprehensive guide to propagating native plants from seed.
- Garden Designs - Sample garden plans for different conditions; plant combination ideas; photos and video virtual tours of mature native plant gardens.
- Community Gardens - In partnership with SWCDs and Purdue Extension, helping to provide technical assistance and information for community gardens, specifically: edible natives; native companion plants for vegetable gardens; native pollinator gardens, and advice on avoiding and reducing chemical use.
- Respecting Indigenous Knowledge - Working to better understand indigenous ethnobotanical uses of native plants and plants that are important to indigenous peoples.
- Material for HOA Boards - Content that residents can present to their HOA boards, along with sample HOA newsletter content.
- For Municipalities - Resources for municipal leaders, with advice on ordinances and legislative changes that can reduce environmental impacts of municipal areas.
- Answers to Common Questions - FAQs on landscaping with native plants and advice on common problems and obstacles.
- Availability & Economics - How and where to buy native plants, including information on available resources and grants.

Heliopsis helianthoides, early sunflower © C Palmer

All of this material will be freely available at
https://indiananativeplants.org/landscaping/
Any questions or feedback will be gladly received
at landscape@indiananativeplants.org.

Indiana Wildlife Federation & National Wildlife Federation

Indiana Wildlife Federation Native Plants Finder

The Indiana Native Plants Finder enables users to search an extensive database of Indiana native trees, shrubs, ferns, vines, grasses, and nectar plants found in natural spaces and native gardens.

This database was made possible by a collaboration with Indiana Native Plant Society (INPS). This excellent plant finder combines ecological data with landscaping information, enabling users to filter results by light and water levels, color, bloom period, pollinators and plant height. All of the species listed in this tool are native to Indiana.

INDIANA WILDLIFE FEDERATION

Indiana Native Plant Society

NWF Native Plant Finder

NWF have developed an excellent plant finder tool in collaboration with Dr Tallamy.

Users can put in their zip code and search for the highest value genera to Lepidoptera in their area. The results rank the top genera in each category, flowers and grasses; trees & shrubs for your zip code.

https://www.nwf.org/NativePlantFinder/.

NWF Native Plant Challenge

The National Wildlife Federation are calling on cities to adopt three policy changes in their Native Plant Challenge

1. Pass native plant ordinances - ideally to mandate 100% use of native plants on all town properties and in new developments.
2. Update weed and vegetation control ordinances - to ensure that ordinances support wildlife-friendly landscaping while also ensuring public safety.
3. Designate no-mow zones - both to benefit wildlife and to save money through reduced maintenance costs; ideally combined with educational signage and media outreach to educate the public about the benefits to both wildlife and people.

Excellent examples and further details can be found on the NWF website.

NWF Community Wildlife Habitat Program

The National Wildlife Federation's Community Wildlife Habitat program partners with cities, towns, counties, neighborhoods, and communities to become healthier, greener, and more wildlife-friendly.

Community Wildlife Habitats garden and landscape with wildlife in mind, promote the use of native trees and plants, work to reduce or eliminate the use of pesticides and chemicals, and integrate wildlife-friendly practices into sustainability plans and park master plans. Through this program, communities can enhance and restore islands and corridors of wildlife habitat in urban and suburban areas nationwide, while at the same time connecting to existing work around climate resiliency, community resiliency, urban forestry, water conservation, beautification, and more.

Online Resources

Native Plant Information & Plant Finders

Indiana Native Plant Society (INPS) https://indiananativeplants.org/

INPS YouTube Channel https://www.youtube.com/channel/UC4uXb_c2U5DdzwQ4zfzD1Xg

Buy Indiana Natives Directory www.BuyIndianaNatives.org

Indiana Wildlife Federation (IWF) Native Plant Finder Tool https://indianawildlife.org/education/native-plants-finder/#

Biota of North America Program (BONAP) http://www.bonap.org/

Homegrown National Park https://homegrownnationalpark.org/

National Wildlife Federation (NWF) plant finder tool https://www.nwf.org/NativePlantFinder/

Heather Holm, plant lists for supporting native bees and wasps www.pollinatorsnativeplants.com

Xerces Society Pollinator Friendly Plant Lists https://xerces.org/pollinator-conservation/pollinator-friendly-plant-lists

Xerces Society habitat assessment guides https://www.xerces.org/publications/habitat-assessment-guides/habitat-assessment-guide-for-pollinators-in-yards-gardens

DNR Endangered, Threatened and Extirpated Plants of Indiana https://www.in.gov/dnr/nature-preserves/files/np-etrplants.pdf

Xerces Society region specific guides https://xerces.org/publications/plant-lists

Asclepias incarnata, swamp milkweed © C Palmer

Invasive Species Information

Terrestrial Plant Rule https://www.in.gov/dnr/files/ep-terrestrial_plant_rule.pdf

Invasive Plant Advisory Committee https://www.entm.purdue.edu/iisc/pdf/IISC_Plant_List_by_group.pdf

Pocket Guide to Regulated Plants https://indiananativeplants.org/invasive-plants/2019-terrestrial-invasive-plant-rule/

Indiana Invasive Species Council https://www.entm.purdue.edu/iisc/

Southern Indiana Cooperative Invasives Management http://www.sicim.info/

Reducing Pesticides

Pesticide Impacts Database https://www.pesticideimpacts.org/

Xerces Society - Neonicotinoids https://xerces.org/sites/default/files/2018-05/16-009_02_XercesSoc_Protecting-Bees-From- Neonicotinoids-in-Your-Garden_web.pdf.

Policy & Ordinances

The Sustainable Development Code https://sustainablecitycode.org/brief/require-use-of-native-plants-vegetation-8/

City of Bloomington Unified Development Ordinance https://bloomington.in.gov/sites/default/files/2020-04/Bloomington%20UDO_04-18-2020_final.pdf

Site Preparation & Planting

INPS Native Seed Communities https://indiananativeplants.org/growing-native-plants-from-seed/

Xerces Society Site Preparation Guidelines https://www.xerces.org/publications/guidelines/organic-site-preparation-for-wildflower-establishment

Xerces Society Site Preparation https://www.xerces.org/publications/fact-sheets/organic-site-preparation-methods-comparative-overview

Xerces Society Interseeding Wildflowers https://xerces.org/sites/default/files/publications/18-021_01_Interseeding-Wildflowers-Grasslands-Guide_web.pdf

University of Minnesota Land Management for Pollinators Guide https://ncipmhort.dl8.umn.edu/sites/ncipmhort.cfans.umn.edu/files/files/media/best_practices_for_open_spaces_1.pdf

Zizia aurea, Golden Alexander © C. Palmer

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Appendix I

Addressing the Biodiversity Crisis - Protect & Preserve

Essentially, biodiversity is the variety of life in a given place.

Primary ways to measure biodiversity include:

- Species Richness - the total number of species within the area.
- Genetic Diversity - the variety of genetic information within a population, species, assemblage, or community.
- Endemic Species - the species that occur in the area and nowhere else.
- Ecosystem Diversity - the total number of ecosystems in the area.

Pycnanthemum verticillatum var.pilosum, hairy mountain mint & *Ratibida pinnata*, gray headed coneflower © C. Palmer

The UN Convention on Biological Diversity (CBD) Draft Global Biodiversity Framework:

Developed to guide actions worldwide through 2030, to preserve and protect nature and its essential services to people, the framework includes 21 targets for 2030. Key targets include:

- At least 30% of global land and sea areas are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area based conservation measures, and integrated into the wider landscapes and seascapes.
- A 50% or greater reduction in the rate of introduction of invasive alien species, and controls or eradication of such species to eliminate or reduce their impacts.
- Reducing nutrients lost to the environment by at least half, and pesticides by at least two thirds, and eliminating the discharge of plastic waste.

In his wonderful Half Earth theory, E.O. Wilson argued that time is running short and we need to act quickly to stabilize the biosphere. He puts forward the argument that by saving – setting aside as a natural reserve – half the Earth, we could stabilize 80% of its species. This is an amazing goal, and something that it is wonderful to strive towards.

There is a growing understanding that the biodiversity crisis needs to be addressed at a global level and with the same urgency as the climate crisis. The UN Convention on Biological Diversity (CBD) Draft Global Biodiversity Framework comprises 21 targets and 10 ‘milestones’ proposed for 2030, en route to ‘living in harmony with nature’ by 2050.

Key targets include, among other things, conserving and protecting at least 30% of Earth’s lands and oceans by 2030 - a global conservation initiative known as 30 by 30.

Unfortunately, the US is one of a very small handful of countries that is not a signatory to the Convention on Biological Diversity.

Appendix II

A brief note on the terms - Ecosystems, Ecosystem Services & Nature's Contributions to People

Ecosystems

An ecosystem can be defined as a community of different species which are interdependent on each other, together with their non-living environment.

Ecosystem Services

Ecosystem services are the conditions, processes and outputs of ecosystems that sustain and fulfill human life, or, more simply, the benefits people obtain from ecosystems. Some ecosystem services are absolutely vital for human life, such as the provision of oxygen, food and fresh water, while others enhance our quality of life.

The UN-sponsored Millennium Ecosystem Assessment identified four major categories of ecosystem services:

- Supporting Services - underlying natural processes such as nutrient cycling, soil formation and primary production. These services are fundamental for sustaining life on Earth.
- Provisioning Services - any type of benefit to people that can be extracted from nature, such as food, fresh water, wood and fiber, and fuel.
- Regulating Services - benefits provided by ecosystem processes that moderate natural phenomena, such as pollination, decomposition, water purification, flood and erosion control, disease regulation, climate regulation and carbon storage.
- Cultural Services - non-material benefits that contribute to the development and cultural advancement of people, including aesthetic, spiritual, education and recreational benefits.

Nature's Contributions to People

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is a joint global effort by governments, academia, and civil society to assess and promote knowledge of Earth's biodiversity and ecosystems and their contribution to human societies in order to inform policy formulation.

One of the key elements of the IPBES conceptual framework is the notion of nature's contributions to people (NCP), which builds on the Ecosystem Services concept popularized by the Millennium Ecosystem Assessment (MA) (Diaz et al. 2018).

Nature's Contributions to People (NCP) is defined as 'all the contributions, both positive and negative, of living nature (i.e. diversity of organisms, ecosystems, and their associated ecological and evolutionary processes) to the quality of life for people' (IPBES, 2019).

The NCP approach builds on the concept of Ecosystem Services, but differs in several key ways. It recognizes the central and pervasive role that culture plays in defining all links between people and nature, and elevates, emphasizes, and operationalizes the role of indigenous and local knowledge in understanding nature's contribution to people (Diaz et al, 2018).

The NCP approach acknowledges a broader range of knowledge systems and stakeholders, including indigenous knowledge. With greater inclusiveness than the Ecosystem Services concept, NCP may offer a stronger framework for policy changes (Diaz et al., 2018).

"Nature and its vital contributions to people, which together embody biodiversity and ecosystem functions and services, are deteriorating worldwide…"

Key message of the Global Assessment Report on Biodiversity and Ecosystem Services

Appendix III

Invasive Species

Hedera helix, common ivy © C. Palmer

Invasive species are defined as non-native species whose introduction causes or may cause economic or environmental harm or harm to human health.

Invasive species are one of the greatest threats to natural habitats, and are responsible for degrading and destroying thousands of acres of natural plant communities in Indiana alone. They outcompete and displace native plants, eliminate food and cover for wildlife, and threaten rare plant and animal species. Overall, they significantly reduce native plant diversity, abundance and fitness (Lehan et al., 2013).

Control efforts for these invasive species cost Indiana taxpayers hundreds of thousands of dollars each year. Nationally, invasive plants cost many millions of dollars per year to control (Lehan et al., 2013).

Invasive plants in the United States have been introduced primarily through the ornamental plant trade (Lehan et al., 2013). In some areas of Indiana, it as been estimated that over 80% percent of invasive woody species— like Asian bush honeysuckle, privet, and burning bush—come from landscape plantings (MC-Iris.org).

Despite efforts at regulation, research has found that 61% of 1285 plant species identified as invasive in the US remain available through the plant trade nationally, including 50% of state-regulated species and 20% of federal noxious weeds; vendors offering invasive plants were located in all lower 48 states (Beaury et al., 2021).

Removing & Controlling Invasives

- Identifying and removing invasive species is a critical step and a key priority. All species covered under the Terrestrial Plant Rule & those species designated as invasive by the Invasive Plant Advisory Committee should be removed.

- Significant progress has been made by the Bartholomew County's Blazing Stars CISMA and this remains an area for urgent and continued focus. Both SICIM and IISC provide excellent resources. The availability of land surveys for property owners and the potential to train to become a surveyor, plus resources for financial assistance for invasive plant removal could be highlighted to Columbus residents.

Preventing Further Introductions

- Tightening city ordinances so that in addition to the plants covered in the Terrestrial Plant Rule, all species designated as invasive by the Invasive Plant Advisory Committee are prohibited in municipal areas and new developments, and discouraged in all areas, would be an excellent step forward.

- The link between plants used in home landscaping and invasive species in parks, agricultural and natural areas, and both the economic and environmental costs of invasive species should be highlighted. Education about invasive plants and the Terrestrial Plant Rule, for example through access to copies of the 'Pocket Guide to Regulated Plants' at the library and other public access areas, should be encouraged.

- INPS provide online information on native alternatives to commonly used invasive species and a directory of horticultural businesses committed to being invasive-free.

Appendix IV

Choosing Native Plants - Keystone Genera, Planting for Specialists, Increasing Diversity & Considering Phenology

"The loss of a keystone species is like a drill accidentally striking a power line. It causes lights to go out all over".

E.O. Wilson

Eutrochium maculatum, Joe Pye weed © C. Palmer

Recent research indicates that a few genera are critical for local ecosystems, going 'above and beyond' in terms of ecological productivity.

Plant diversity overall should be increased, with the intentional inclusion of these keystone plants.

I. Include Keystone Genera

Specialisation is key to why native plants are so vital for maintaining biodiversity and ecosystem stability. The great majority of insects are diet or host-plant specialists, meaning that they can only eat or live on plants that they have developed a relationship with through evolutionary time (Forister et al., 2015). Recent research highlights that not all native plants are equivalent in terms of their contributions of energy flow through food webs and their support of interaction diversity.

For example, a 2020 study which included over 12,000 butterfly and moth species and more than 2000 native plant genera (Narango et al, 2020) found:

- On average across counties sampled in the US, 14% of local plant genera supported more than 90% of Lepidopteran diversity ((Narango et al, 2020).
- Keystone genera support orders of magnitude more Lepidopteran species than the majority of other local plant genera.
- Planting these keystone native plants will have a disproportionately large impact on restoring biodiversity through the trophic levels and help to create the most productive landscapes possible.
- In 84% of counties in which they occur in North America, an oak is most powerful plant to plant.

Additionally, data from a 2021 study suggest that bird foraging is non-random, reflecting preferences for keystone tree species which host large numbers of caterpillar species and thus are more rewarding (Piel et al., 2021). This research highlights that planting, restoring, and protecting these keystone tree species in both natural and human-dominated landscapes is important for both bird and insect populations (Piel et al., 2021).

The top 10 woody plant genera for supporting host plant - Lepidoptera interaction networks:

- *Quercus* (Oaks)
- *Salix* (Willows)
- *Prunus* (Cherries, Plums, Peaches)
- *Pinus* (Pines)
- *Populus* (Poplars, Aspens, and Cottonwoods)
- *Betula* (Birch)
- *Vaccinium* (Cranberry, Blueberry)
- *Carya* (Hickory)
- *Acer* (Maples)
- *Malus* (Apples, Crabapples)

The top 10 herbaceous plant genera for supporting host plant - Lepidoptera interaction networks in Columbus, Indiana:

- *Solidago* (goldenrods)
- *Helianthus* (sunflowers)
- *Fragaria* (strawberry)
- *Eupatorium* (bonesets and Joe Pye Weeds)
- *Viola* (violets)
- *Geranium* (geranium)
- *Sium* (water parsnip)
- *Hibiscus* (hibiscus, rose mallow)
- *Panicum* (panic grass, maiden cane)
- *Vernonia* (ironweed)

https://www.nwf.org/NativePlantFinder

II. Plant For Specialists & Increase Diversity

- Many native bees and other insects specialize on a particular plant family or genus when gathering pollen; less commonly, some appear to specialize on a single species (such as the Passionflower Bee, *Anthemurgus passiflorae,* which is reliant on *Passiflora lutea*)

- Planting for specialists can greatly increase the biodiversity supported by the habitat, as both specialist and generalist species can be supported.

- Increasing diversity at the family level in particular increases the potential support for as many specialists as possible, and may have a significant positive impact on populations that specialize on less commonly used plants.

- The Biota of North America Program (BONAP) North American Plant Atlas (NAPA) has very comprehensive US County-Level Species Maps, enabling searches by family or genus for plant species native to a particular US county - http://www.bonap.org/

- It is also an important consideration to prioritize some of the less common species or those that are of conservation concern in Indiana to support the wildlife that depends on the fragile remaining populations - the DNR have good lists of species of conservation concern on their website.

Including plants from the genera that typically support the most specialists together with the greatest diversity of native plants - particularly at the family level - is a really strong strategy for increasing the ecological value of a landscape.

Cercis canadensis, eastern redbud © C. Palmer

Try to ensure continuous bloom time and resources for as long as possible over the growing season. Include plants that have a long bloom time, plants that provide floral resources early in spring or late in the fall, and those that provide nesting and sheltering sites.

III. Consider Flowering Phenology

- In addition to including plants that support high numbers of Lepidoptera and those that support specialist pollinators, ensuring floral and other resources for as long as possible through the year is vitally important.

- Including plants that have a long bloom time, provide floral resources particularly early or late in the season, and those that provide nesting and sheltering sites is key.

- Where planting is limited, plants that combine these elements can make the most impact.

- The Indiana Wildlife Federation Native Plant Finder is an excellent tool for filtering native plant species by bloom time - https://indianawildlife.org.

- The Xerces Society provide excellent information on endangered pollinators, and on planting for pollinators.

- Heather Holm terms plants that play an important role in providing food, shelter and nesting sites the “Power House Plants”, and her website - pollinatorsnativeplants.com - has excellent free downloadable plant lists and resources, particularly for native bees and wasps.

Appendix V

The Case for Choosing Straight Species.

Rudbeckia subtomentosa, sweet coneflower © C. Palmer

While nativars may be more attractive for some gardeners for aesthetic reasons, they can have ecological costs.

1. Pollination and Herbivory: nativars can impact ecosystem function and biodiversity. Many nativars have been selected primarily for ornamental traits, and research indicates that not all nativars are ecologically equivalent substitutions for the native species (White, 2016a).

    - Their ecological roles can be altered by selection for flower size, abundance, color, shape or phenology, which can affect the quantity, quality and accessibility of pollen and nectar (White, 2016a).

    - Selection for traits such as leaf color can alter plant chemistry, potentially making the plant unrecognizable as a host and / or deterring herbivory.

    - Even where the trait being selected for may not appear to be ecologically significant, we are still learning about cues that may be important for wildlife - for example a June 2020 paper indicates hummingbirds can discriminate various non-spectral colors, including UV, and that these are likely vital in foraging (Stoddard et al., 2020).

    - Additionally, hybridization may uncouple trait combinations that influence pollinator foraging (White, 2016a).

2. Genetic Pollution & Lack of Genetic Variation: for fragile native plant populations, both of these are a potential concern.

    - Unintended hybridization can lead to gene flow from nativars into wild populations. As well as potentially affecting ecosystem services, this can affect native population survival and potentially contribute to species extinction (Byrne et al, 2011).

    - Where nativars have been selected for vigor, hybridization is also concerning and may affect competitive interactions and community structure (White, 2016a).

    - Many nativars are propagated clonally and so have no genetic variation (Narango et al., 2019). Genetic diversity found within native plant populations is critical for their adaptability and ongoing evolution, particularly in the face of climate change and increased development. Open-pollinated, seed grown ‘selections’ of natives are preferable to nativars produced vegetatively, but information on nativar provenance is not always easily available (White, 2016a).

Appendix VI

Reducing Chemical Use

Neonicotinoids, a particularly prevalent class of systemic insecticides, are routinely used by some commercial suppliers.

Neonicotinoids can impact many benign and beneficial insects, and have impacts through the trophic levels. Residue levels on ornamental plants have been found to far exceed lethal concentrations for honey bees and bumble bees, while research also indicates that neonicotinoids can lead to changes in foraging behavior, reduced predator avoidance, delayed development and reduced reproduction in bees even at very low residue levels (Hopwood et al., 2016).

A 2017 study found neonicotinoids dramatically reduced egg-laying by queen bumblebees, which were 26% less likely to lay eggs after being exposed to it; modelling the impacts of a 26% reduction in colony founding on population dynamics dramatically increased the likelihood of population extinction (Baron et al., 2017)

Because they are systemic chemicals absorbed into the plant, neonicotinoids can be present in pollen and nectar, making them toxic to pollinators that feed on them. The potentially long-lasting presence of neonicotinoids in plants makes it possible for these chemicals to harm pollinators even when the initial application is made months before the bloom period.

All buyers should be encouraged to use their buying power to influence the supply chain by asking suppliers about neonicotinoid treatments and provenance of plant material. The Xerces Society and the IPI Database have excellent, very detailed information on this topic

Zizia aurea, Golden Alexander © C. Palmer

Herbivory by native insects will typically not kill a healthy plant. Evidence of herbivory indicates that a plant is, in fact, contributing to the ecosystem and should be welcomed - it does not indicate the need for insecticide use.

In a stable ecosystem with sufficient biodiversity, insect levels are kept largely in check by natural predators (and parasitoids), including many of the birds that are such a welcome sight in gardens.

Prophylactic chemical use and treatment without documented need should be avoided.

Pyrethroid pesticides, widely used in mosquito control, are a serious concern. Mosquito fogging kills insects indiscriminately and the pyrethroid pesticides typically used can be highly toxic to bees. Research indicates that some pyrethroid insecticides may have toxic effects in humans, affecting fertility, the immune system, cardiovascular and hepatic metabolism and enzymatic activity (Chrustek et al., 2018).

As a safer, cheaper and more effective alternative, Dr Tallamy advocates the use of mosquito dunks - commercially available tablets containing larvicide. Frequent disposal of even small amounts of standing water can also be very effective for mosquito management on smaller properties.

Native planting around pond edges provides habitat for natural predators of mosquitos and mosquito larvae (such as dragonflies, damselflies, birds and bats), and can greatly help to reduce mosquito populations.

Fertilizer use is also unnecessary in areas of native planting, and high nitrogen soils may actually favor non-native and invasive species (Tallamy, 2019). Given the pollution associated with fertilizer run-off into waterways, in addition to purchase and application costs, fertilizer use should be avoided as much as possible.

The complex root systems of native plants play a key role in soil health and in the hydrologic cycle, helping to reduce run off into waterways and improve water quality. With the combination of this important role and their contribution to mosquito control, native plants should be planted around all retention and ornamental ponds. As an added benefit, geese will typically not congregate around ponds that are edged with tall vegetation, and native planting around ponds is an extremely effective and economic goose deterrent.

Appendix VII

City of Bloomington - Unified Development Ordinances

The City of Bloomington updated their Unified Development Ordinances in 2020 and have included some excellent language, particularly with regards to vegetation requirements (considering both invasive and native plant use) - this could be a good model to emulate.

In particular the following sections are of interest:

- 20.04.080 - Landscaping, Buffering, and Fences (section starting at 168 (176 of PDF): "…*Additionally, the standards are intended to foster an aesthetically pleasing development that will protect and improve Bloomington's biodiversity and the ecological services provided by native species and ecosystems*."
- In this section under 'Plant Material Standards' both invasive plant species and species diversity is considered.
- Also, excellently, the ordinances have "*Permitted Plant Species - All plant material shall be selected from this Section 20.04.080(d). Substitutions to the list shall be submitted to the City Planning and Transportation Department for approval*" (page 179). Tables list:
    - Street Trees (Table 04-14: Permitted Street Tree, page 180)
    - Interior Trees (Table 04-14: Permitted Street Tree, page 181)
    - Shrubs, Bushes, and Hedges (Table 04-16: Permitted Shrubs, Bushes and Hedges, page 182)
    - Herbacaceous Perennial Plants (Table 04-17: Permitted Herbaceous Perennial Plant Species, p183-185)

All of these plant species are native, and most would be species that could also be recommended for Columbus.

Additionally, the document contains lists of Prohibited Plant Species (Table 04-18: Prohibited Plant Species, page 185 - 188) - this is incredibly important given the enormous financial and environmental impacts of invasive species. Ideally, in addition to plants covered in the Terrestrial Plant Rule, all species designated as invasive by the Invasive Plant Advisory Committee should also be prohibited in municipal areas and new developments, and discouraged in all areas.

The development ordinances contain thoughtful language under the Environment section (20.04.030) (such as in 20.05: Subdivision Standards (beginning page 227) - "Protect the natural environment by promoting the use of good design, landscape architecture, and civil engineering to preserve and enhance natural topographic features, watercourses, drainage ways, floodplains, native vegetation, and trees and to control erosion and minimize runoff") and with regards to native and invasive species.

Rudbeckia triloba, Brown-eyed Susan © C. Palmer

Appendix VIII

Examining the Financial Benefits: The Ridgefield Nature Park.

The Ridgefield subdivision in Fishers provides an excellent example of some of the many benefits associated with ecologically sensitive planning. Due to the high costs of turf grass maintenance, in 2006 a large portion of the mowed turf grass area in the subdivision was converted to a 6.5 acre nature park consisting of native warm season grasses, forbs, trees, and shrubs. Due to the environmental benefits associated with native habitat, cost share funding was received (in part from the Hamilton County Soil & Water Conservation District and the DNR); the initial cost to the neighborhood to plant the habitat was less than the annual maintenance cost to care for the turf grass.

After maintenance expenses, the neighborhood saved $58,608 through year-end 2016.

Other benefits to the residents have included:

- Healthier Retention Ponds: A 2015 study found that nitrates were 59% lower, phosphates 17% lower, dissolved oxygen 49% higher, and water clarity 57% better in the one-acre pond in the nature park than in a ‘standard’ pond located elsewhere in the neighborhood.
- Less Algal Growth: Due to the reduced pollutants in the pond, algal growth on the Nature Park pond has greatly reduced. As a result, algae control is only completed on an as needed basis, saving the neighborhood further costs.
- Discouraging Geese: With the shoreline vegetation, geese have not visited the Nature Park pond since the conversion.
- Erosion Prevention: The neighborhood pond was plagued by erosion prior to the conversion as the shallow root turf grass did not slow down the runoff of water down the steep banks of the pond nor hold the soil in place. Since the establishment of the Nature Park, erosion has been completely eliminated.
- Increased Wildlife: The native plants included in the Nature Park provide critical wildlife habitat. As a result, the Nature Park as well as the neighborhood have experienced a significant increase in wildlife, including butterflies, bees and hummingbirds.

Adiantum pedatum, Northern maidenhair fern © C. Palmer

Appendix IX

The Indianapolis Office of Land Stewardship: A Model for Conservation

The Indianapolis Office of Land Stewardship, housed under the Department of Public Works and partnering with the Department of Parks and Recreation, offers an excellent example.

Managing over 1,900 acres of natural area across 37 park properties and over 100,000 square feet of City rain gardens that assist in filtering stormwater runoff, Land Stewardship holds a leadership role by preserving critical wildlife habitats, providing passive recreational opportunities, protecting air quality and addressing stormwater issues. Efforts like these helped Indianapolis earn a Top 10 City for Wildlife designation from the National Wildlife Federation in 2015, 2018 and 2019. The Office of Land Stewardship was honored with an Outstanding Institution Advancing Sustainability award by the City of Indianapolis in 2019. In their excellent document outlining strategy they highlight the following efforts:

1. Stormwater

- Conversion of agricultural fields and turf grass to native woodlands and wetlands, which naturally manage large volumes of stormwater, and protection of natural areas performing this task, in particular natural wetlands.
- Green infrastructure elements such as rain gardens and bioswales to divert rainwater from storm sewers and waterways. Water running off buildings and streets carries a great deal of contaminants, which are flushed into waterways and city drinking water sources; the more stormwater soaks into the ground, the cleaner the city's waterways and drinking water.
- Promotion of naturalized stream buffers and undeveloped flood plains, reducing flooding and improving water quality.

2. Climate Resiliency

- Older forests are carbon sinks, sequestering nearly 5 times as much carbon as turf grass; wetlands and floodplains may be even more effective. Conversion of turf grass and agricultural areas to native flora reduces emissions from gas-powered maintenance. The nearly 720 acres transitioned from turf or agriculture to native woodlands, prairies, and wetlands is estimated to amount to roughly 1.2- 2.8 million pounds of carbon that is no longer entering the atmosphere every year.
- Improving air quality - forested areas on Land Stewardship properties are estimated to absorb around 5,292 tons of carbon dioxide every year and 420 tons of air pollutants. Forests, wetlands, and prairies also provide clean air and help cool the environment; trees in particular lower the ambient air temperature.

3. Pollinator Protection & Managed Pollinator Habitat

- Protecting valuable pollinator habitat; converting fallow landscapes to species rich pollinator plantings and enhancing edge habitat with native flora

4. Species of Special Concern

- Much of the conversion of landscapes to native flora and protecting remaining natural areas is aimed at preserving conditions for Indiana's species of special concern to survive, including the Kirtland's snake, Henslow's sparrow, Northern leopard frog, and American ginseng.

5. Invasive Species Control

- This is central to Land Stewardship's work, as invasive species impact species of special concern, pollinators and water quality.

As part of their Call-to-Action, Land Stewardship are asking people to use native plants in their own landscaping, and to control invasive species on their own property.

The Native Planting Area program recognizes residents who use primarily native plantings in their residential landscapes with program designation signage. Registration for the program is free.

Interestingly, they do note that while the City of Indianapolis encourages the use of native planting areas, since many native planting areas have vegetation over 12" tall, it is important to fill out and submit the form to avoid a weed citation. This highlights further the importance of ensuring Columbus' ordinances are supportive of native plantings.

Helenium autumnale, common sneezeweed © C. Palmer

Echinacea purpurea, purple coneflower © C. Palmer

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