

Engaging Residents with Local Pest Management and Conservation Goals

Vatsal Parikh
July 25, 2024



Project Team

CLC Fellow



Vatsal Parikh

Graduate Student, University of Michigan

Mentor



Justin Gish

Sustainability Planner, City of
Kalamazoo

Technical Advisor



Dr. Laura Iles

Director, North Central Integrated
Pest Management Center

KALAMAZOO

Mosquito spraying halted in Kalamazoo, Portage by opt-out requests

Updated: Sep. 29, 2019, 9:55 p.m. | Published: Sep. 29, 2019, 5:21 p.m.



A plane from Ovid-based AI's Aerial Spraying provides aerial mosquito-killing treatment over a wooded area in Saginaw Township on Tuesday, April 18, 2017. Jeff Schrier | MLive.com file

MICHIGAN

EEE virus in Michigan: Kalamazoo County opts out of pesticide spraying program



[Kristen Jordan Shamus](#)

Detroit Free Press

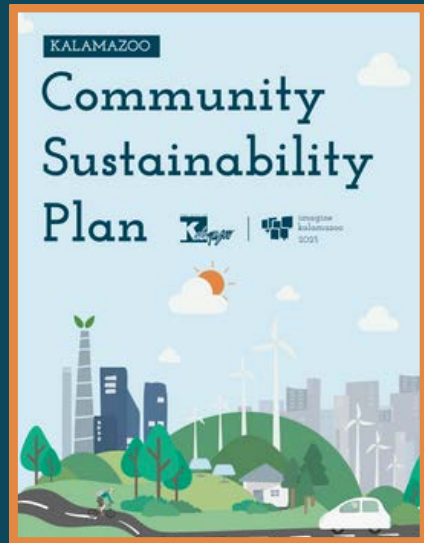
Published 8:44 p.m. ET Oct. 1, 2019 | Updated 7:53 p.m. ET Oct. 1, 2019



EEE [Play](#) facts about the mosquito-borne Triple E infection
The mosquito-borne virus is known as Eastern equine encephalitis, EEE, and Triple E. Humans and animals can get infected. [Grace Pateras, USA TODAY](#)

More than 128,000 acres of land in Berrien, Cass, St. Joseph and Van Buren counties were treated with pesticides Monday as Michigan began its aerial spraying program to kill mosquitoes with hopes of stopping the spread of [Eastern equine encephalitis](#).

The state is experiencing its worst-ever outbreak of the mosquito-borne virus, according to the [Michigan Department of Health and Human Services](#). As of Tuesday, 15 counties — Newaygo, Montcalm, Kent, Allegan, Barry, Livingston, Genesee, Lapeer, Van Buren, Kalamazoo, Calhoun, Jackson, Berrien, Cass and St. Joseph — were considered high-risk for EEE, and have confirmed human or animal cases.



Aligning Goals with the Community Sustainability Plan

Strategic Vision Alignment

Strategic Vision Goals	SP	CC	TP	ER	SC	YD	CN	SD	EV	GG
Goal 7: Protect the natural environment for urban resilience										
Goal 8: Support a healthy & resilient community										
Goal 9: Support systems for local food on multiple scales										
Goal 10: Reduce waste & support market for waste recovery										

The matrix shows how the Community Sustainability Plan aligns with the City's Strategic Vision Goals.

1) Address vector-borne disease to support a healthy and resilient community

2) Use environmental education to increase public awareness of the ecological systems related to pest management

3) Build on community engagement to improve urban habitat quality for threatened local wildlife associated with pest management

Goal: Protect the natural environment for urban resilience

Equitably Increase the Tree Canopy across the City

ACTIONS:

- Use the street tree inventory to update the City's forestry management plan
- Plant more trees

FEASIBILITY: Horizon

Actionable Aspirational

CITY ROLE: Act Connect Advocate

TIMELINE: Short Mid Long Extended

COST: \$ \$ \$ \$ \$

Create Opportunities for People to Interact with Nature and Improve Biodiversity

ACTIONS:

- Manage City-owned natural areas for better ecosystem health
- Update zoning ordinance to support more biodiversity
- Increase job training and market opportunities for native landscaping
- Collaborate on environmental education and stewardship

FEASIBILITY: Horizon

Actionable Aspirational

CITY ROLE: Act Connect Advocate

TIMELINE: Short Mid Long Extended

COST: \$ \$ \$ \$ \$

Design a built environment more integrated with wildlife

ACTIONS:

- Develop an inclusive process for the public to gain understanding on wildlife and ecosystem concerns
- Monitor wildlife-related data to understand risks and set action levels
- Partner to implement and advocate best practices for urban wildlife protection

FEASIBILITY: Priority to Launch

Actionable Aspirational

CITY ROLE: Act Connect Advocate

TIMELINE: Short Mid Long Extended

COST: \$ \$ \$ \$ \$

Collaborate regionally for better water quality in rivers, lakes, and streams

ACTIONS:

- Work with partners to implement watershed management plans, best management practices

FEASIBILITY: Horizon

Actionable Aspirational

CITY ROLE: Act Connect Advocate

TIMELINE: Short Mid Long Extended

COST: \$ \$ \$ \$ \$

Connecting the Dots with Systems Thinking

Systems Considerations of Mosquito Management

Human activities have indirect effects on mosquito abundance. While insecticides can help reduce mosquito abundance upon application, long-term mosquito management is more effective when approached comprehensively. To steward a mosquito-resilient ecosystem in your community, consider practicing Integrated Pest Management and participating in local habitat restoration efforts for natural mosquito predators.



Pesticides

Mosquito adulticides such as organophosphates and pyrethroids have broad-spectrum toxicity and can kill non-target organisms including pollinators and other federally endangered insects. They can have notably wide-reaching effects when they run off into waterways.

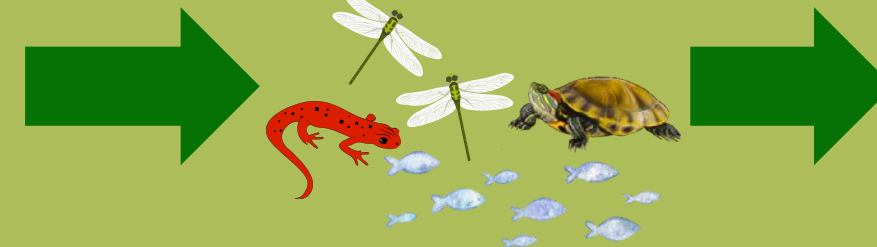


Litter

Mosquitoes can breed in very small pools of water. When items such as old tires, buckets, or litter collect water, they can become breeding grounds for mosquitoes, particularly because they lack natural predators.

Larval Predation in Aquatic Habitat

Aquatic organisms such as dragonflies, fish, amphibians, and turtles can help control mosquito populations by consuming larvae or adults, during different stages of their life cycle. While wetlands do have standing water, those with diverse ecological communities can have minimal mosquito production. However, insecticide or fertilizer runoff into wetlands can harm these organisms through toxicity or the creation of eutrophic conditions.



Adult Mosquito Predation in Terrestrial Systems

Many species of birds and bats prey on pests, including mosquitoes. Did you know that annually bats provide billions of dollars of agricultural benefits in the United States by reducing crop damage and need for pesticide application? Some Michigan species such as the purple martin and the little brown bat are known to include mosquitoes in their diets. They won't eliminate mosquitoes on their own, but together natural predators play an important role in controlling adult mosquitoes.

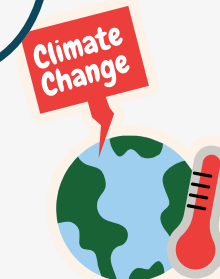
Habitat Degradation

Habitat loss is a leading threat to bats and birds in the United States. Habitat loss can come in different forms such as the clearing of trees which removes available roosting sites, development that fragments available habitat, or pollution that reduces survival of species in an area.



Climate Change

Warming climates can contribute to extended and more active mosquito seasons. Climate change can also cause more droughts and severe storms. Did you know that both of these conditions can drive mosquito breeding by increasing pools of standing water?



Direct Impact Goal: Integrated Pest Management

What is IPM?

Integrated Pest Management is a science-based approach that combines a variety of techniques. By studying their life cycles and how pests interact with the environment, IPM professionals can manage pests with the most current methods to improve management, lower costs, and reduce risks to people and the environment.

IPM tools include:

- Alter surroundings
- Add beneficial insects/organisms
- Grow plants that resist pests
- Disrupt development of pest
- Prevention of pest problem developing
- Disrupt insect behaviors
- Use pesticides

3 PREVENT

Some pest problems can be prevented by using resistant plants, planting early, rotating crops, using barriers against climbing pests, sanitation, and sealing cracks in buildings.

4 ACTION

IPM uses multiple tools to reduce pests below an economically damaging level. A careful selection of preventive and curative treatments will reduce reliance on any one tactic and increase likelihood of success.

5 MONITOR

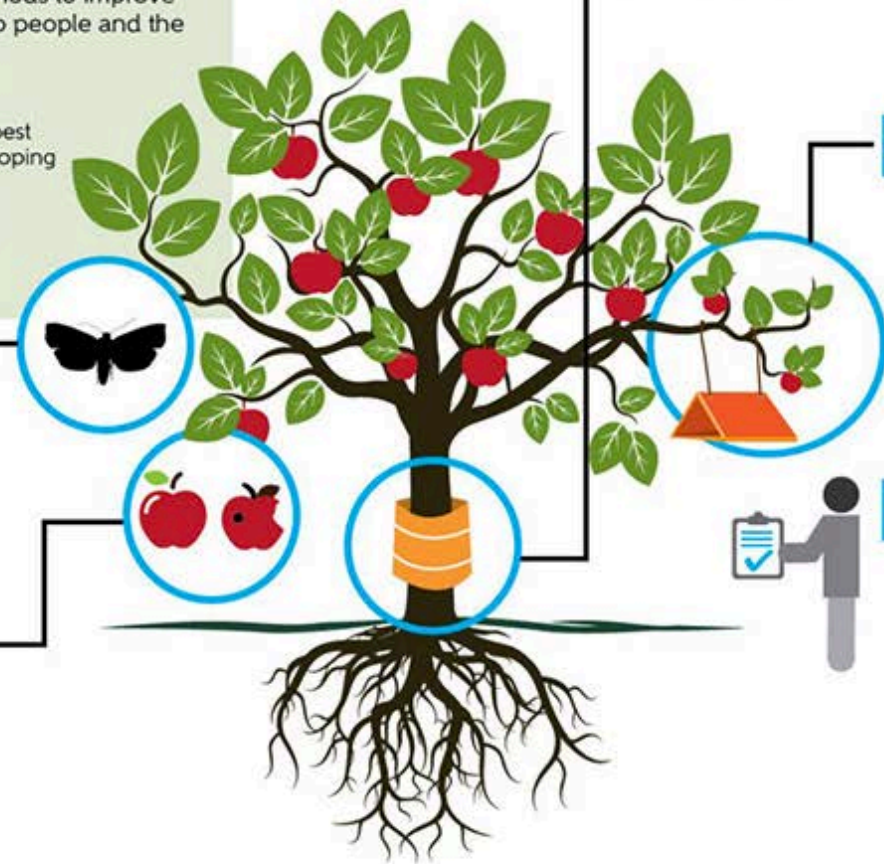
Continue to monitor the pest population. If it remains low or decreases, further treatments may not be necessary, but if it increases and exceeds the action threshold, another IPM tool should be used.

1 IDENTIFY/MONITOR

Determine the causal agent and its abundance (contact your local extension agent for help).

2 EVALUATE

The results from monitoring will help to answer the questions: Is the pest causing damage? Do we need to act? As pest numbers increase toward the economic threshold further treatments may be necessary.



WHERE CAN YOU PRACTICE IPM?



Buildings and Homes:

Inspect, identify pests, keep pests out, clean to deny pests food and water, vacuum, trap, or use low-risk pesticides.



Farms:

Check for pests/pest damage regularly, identify accurately, choose pest-resistant plant varieties, encourage/introduce beneficial insects, time planting to avoid pests, and if needed use low-risk pesticides.



Managed Natural Systems:

Identify the pest and use management options that have minimal risks to pollinators, humans, and pets.

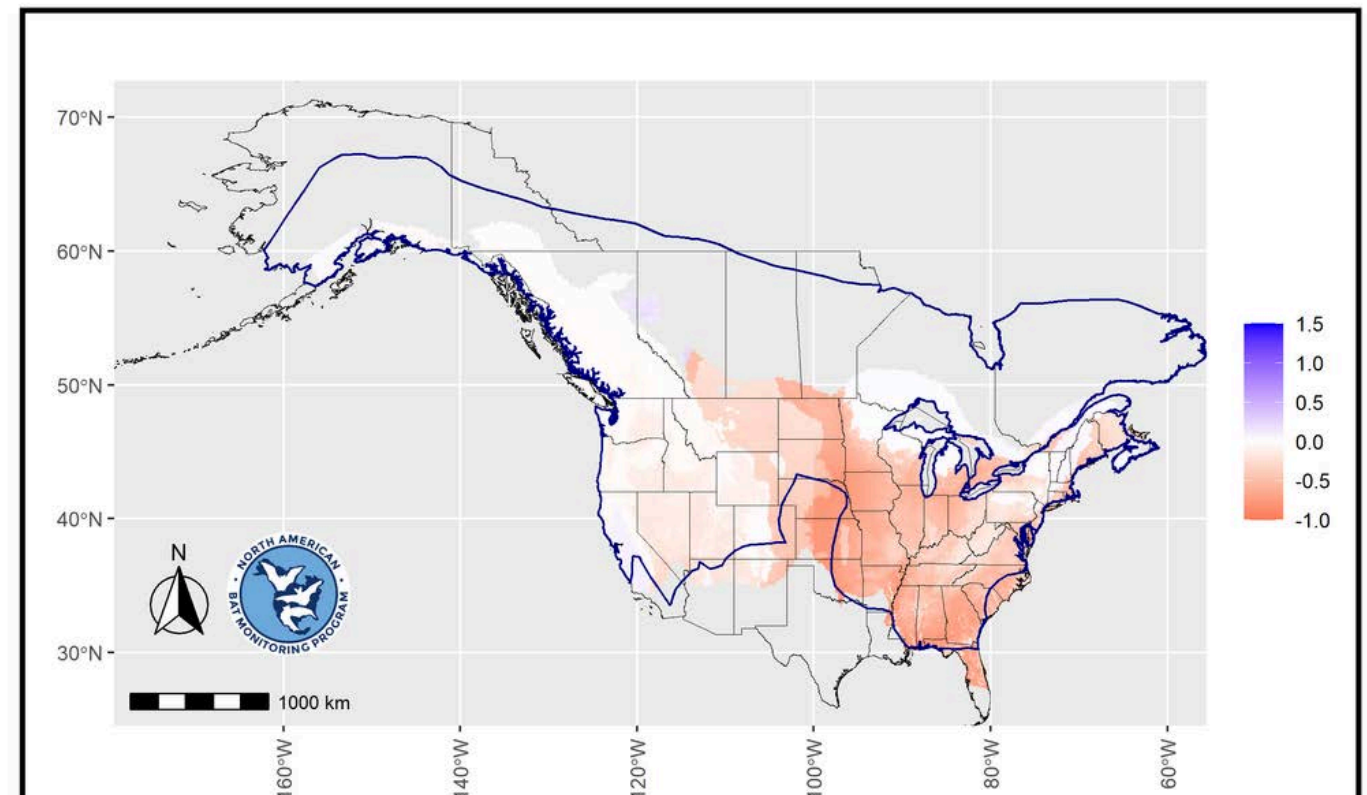


The Entomological Society of America is the largest organization in the world serving the needs of entomologists and other insect scientists. ESA stands as a resource for policymakers and the general public who seek to understand the importance and diversity of earth's most diverse life form— insects. Learn more at www.entsoc.org.



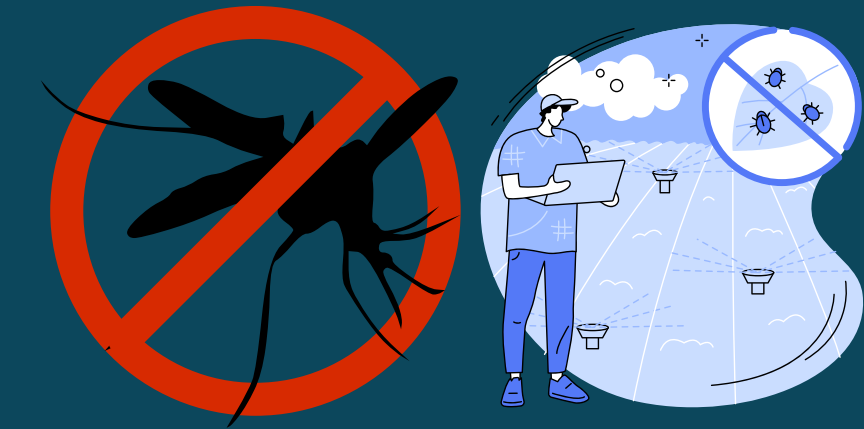
Local Wildlife Concern: Bat Population Declines

Species	Status Variable	Latest Map	Total Change (2016-19)	Total Change (2012-19)	Total Change (2010-19)	Change Map
 <i>Myotis Lucifugus</i>	Summer Occupancy		-11.5% (CRI = -18.0% to -4.3%)	-19.8% (CRI = -27.2% to -11.7%)	-21.0% (CRI = -29.7% to -11.6%)	
	Summer Abundance	In Development	In Development	In Development	In Development	In Development
	Winter Abundance	In Development	In Development	In Development	In Development	In Development
	Winter Occupancy	In Development	In Development	In Development	In Development	In Development



The total change rate in mean grid cell occupancies (color bar) for *Myotis lucifugus* (MYLU) between 2010 and 2019 (9yr_total_change) for all NABat grid cells in the modeled species range based on site-level covariates for each grid cell and year. This is depicted against the reference range map (blue polygon; National Atlas of the United States, 2011) and borders of U.S. states and Canadian provinces/territories. For visualization purposes, the upper bound of the scalebar is truncated at 1.5 (150%) and corresponds to values of 1.5 and above, while the lower bound is naturally bounded at -1 (-100%).

Stages of Resident Engagement



Household IPM

Expand use of proactive and sustainable practices to reduce mosquito abundance.

01



Supporting Ecosystem Services

Improve habitat diversity across residential spaces to support healthier aquatic systems and natural pest predators.

02

The Umbrella Species

Bat conservation will serve as an umbrella tool to promote education and action towards the other public health and ecosystem resilience goals.



Bat Conservation Program

Run programming to involve residents in supporting imperiled bat species. Focus on city-wide planning for habitat restoration and artificial roost construction. Leverage conservation engagement to communicate importance of employing the other strategies against mosquito-borne disease.

03



Deliverable 1: Program Guidebook

- Plan for how cities in Michigan can plan the phases of the program
- Public-facing educational materials

Deliverable 2: Bat Habitat Suitability Mapping

- Habitat suitability maps created for conservation planning
- Enable other cities to reproduce mapping:
 - Downloadable ZIP file with GIS models
 - Detailed tutorial on how models are created (located in guidebook)



ENGAGING RESIDENTS WITH LOCAL PEST MANAGEMENT AND CONSERVATION GOALS

VATSAL PARIKH
CLC FELLOW
JUSTIN GISH
MENTOR
DR. LAURA ILES
TECHNICAL ADVISOR

2024 CATALYST LEADERSHIP CIRCLE FELLOWSHIP

THE CITY OF Kalamazoo

GRAHAM SUSTAINABILITY INSTITUTE
UNIVERSITY OF MICHIGAN

EGLE MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

CATALYST COMMUNITIES

This material is based upon work supported by the Department of Energy and the Michigan Energy Office (MEO) under Award Number EE0008653 as part of the Catalyst Communities program. Find this document and more about the CLC Fellowship that supported this project at graham.umich.edu/clcf.

Spatial Planning for Bat Conservation

Spatial planning goals for bat conservation

- **Habitat** - Identify existing areas that are high quality habitat for bats. Natural landscapes in these areas can be prioritized for bat-oriented conservation and ecological restoration.
- **Bat Box Sites** - Identify highest habitat quality areas where bat boxes can feasibly be placed and are likely to achieve occupancy.

Ideal landscape characteristics of quality habitat and bat box installation sites

- **Habitat** - Each bat species has different habitat requirements, but broadly Michigan's bats prefer to roost in areas with access to forest and permanent water bodies / wetlands. They also thrive better in areas away from concentrated urban development which may contain light pollution and impervious surfaces that limit prey availability.
- **Bat Box Sites** - Although forests provide necessary **habitat for bats**, occupancy of bat boxes within forests is low because they already contain diverse roost options. Similarly, bat box installation and maintenance is not practical directly within wetlands and water bodies due to the lack of access to stable soil for mounting. A goal of installing bat boxes is to supplement existing habitat, so installation should be prioritized at sites that are not directly within these features.

Methods: A tool you can download and use for your own analysis

- We have created a Habitat Suitability Model for bats on ArcGIS Pro. This model accepts land cover feature data for a given county in Michigan. Then after running the model steps, it will create raster files indicating habitat suitability scores at locations across the county, which can then be used for planning.
- A ZIP file containing the ArcGIS project file with the model, the necessary file structure, and the data inputs and outputs associated with the Kalamazoo analysis is available as another deliverable on this project's page within <https://graham.umich.edu/projects>.
- The following pages will explain how to acquire the necessary data to provide to the model. They will also explain how the model was created and how to configure each step. The easiest way to use the model is to download the ZIP file and plug in your data. However, you can also use the guide to try and recreate it

Inputs:

- County and City boundaries
- Land Cover data

Tool:

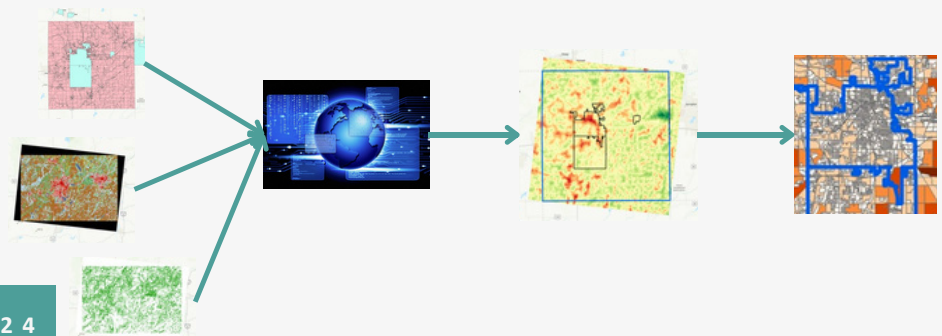
- ZIP file with ArcGIS models

Outputs:

- Habitat Suitability Maps

Analysis:

- Group data for local planning



2 4

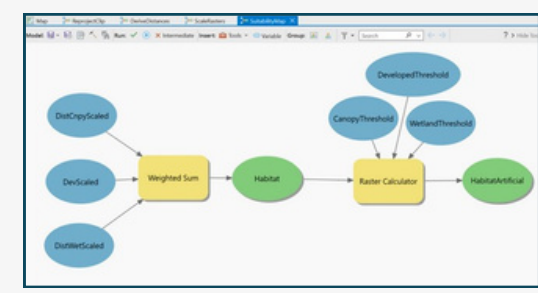
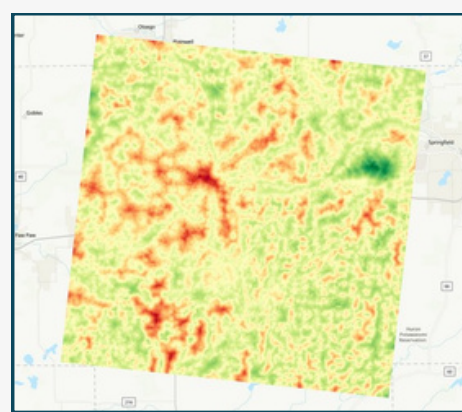
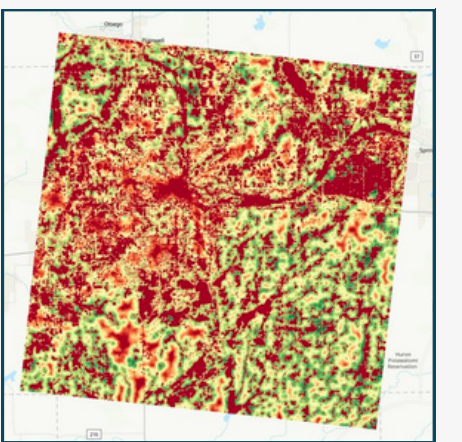
Download and Run the Models

Run Model 4: SuitabilityMap

Run the model. It will compute a weighted sum and create the result rasters:

- "Habitat" - raster where values are scores for bat habitat suitability
- "HabitatArtificial" - raster where values are scores for places where bat boxes installation can be pursued according to our prioritization guidelines.

Refresh the geodatabases and see the computed files now created. These final files can be utilized for map making and further analysis.

Suitability.gdb

- Habitat
- HabitatArtificial

Value

2.98875

0.768439

Public Facing Materials in Guidebook

Integrated Pest Management



STAY PROTECTED AGAINST MOSQUITOES

INTEGRATED PEST MANAGEMENT

Mosquito-borne diseases, are emerging public health concerns. Minimizing human and livestock exposure to mosquito bites is critical to reducing cases of Eastern Equine Encephalitis, West Nile Virus, and other vector-borne diseases in Michigan. While insecticides can provide temporary relief from mosquito abundance, when used in isolation their effects can be temporary. They can also have ecological consequences. The EPA and CDC recommend Integrated Pest Management, which is a scientifically-proven framework that first targets natural processes within pest lifecycles. Public adoption of preventative measures is necessary for community-wide integrated mosquito management.



ELIMINATE BREEDING HABITAT

Mosquitoes can rapidly breed in small pools of standing water. Common items within which water can collect include buckets, litter, rain gutters, old tires, plastic covers, and toys. Remove these items from outdoor spaces exposed to rain. In fixtures meant to hold water — such as bird baths, fountains, wading pools, or rain barrels — replace water weekly. Swimming pools should be treated and circulating.

STRUCTURAL BARRIERS

Physical barriers can reduce the likelihood of indoor mosquito bites. Effective strategies include installing window and door screens, covering gaps in walls, and covering baby carriers and beds with mosquito nets. Using fans during outdoor gatherings can also help blow away mosquitoes from the area.

LARVAL STAGE CONTROL

Mosquitoes are most concentrated and accessible during their larval stage. "Mosquito dunk" tablets containing EPA-registered strains of Bti (Bacillus thuringiensis - a naturally occurring bacterium found in soils) can be effective larvicides. Bti produces spores that target mosquitoes rather than other species. Add water and straw (or leaves) to a bucket to attract mosquitoes. After 2-4 days, add a mosquito dunk to the bucket. Make sure to follow the product label! These traps can last up to a month and should then be poured out and replaced.

ADULT STAGE CONTROL

There are many misconceptions surrounding the use of insecticides in mosquito control. In a residential setting, sprays and outdoor foggers lack extensive study and are only effective in reducing mosquito presence briefly after application. Focusing on the previous steps is recommended. If utilizing pesticides, consult a professional and only apply EPA-registered products per their label instructions.



BITE PROTECTION

- Mosquitoes are most active in Michigan during the summer months and can be populous near permanent water bodies.
- Minimize exposed skin by wearing long-sleeved shirts, pants, and head nets to help reduce bites.
- Applying EPA-registered mosquito repellents in accordance to label directions can also safely and effectively protect against bites.



INSERT QR CODE HERE



STAY PROTECTED AGAINST TICKS

INTEGRATED PEST MANAGEMENT

Cases of tick-borne illnesses, such as Lyme Disease, are increasing in the United States due to a variety of factors. Tick distribution can expand due to climate change and land use patterns that increase their activity and ability to occupy new habitats. The EPA recommends Integrated Pest Management strategies that aim to minimize human-tick interaction by comprehensively utilizing tick monitoring, preventative strategies, and tick control. Public engagement with preventative strategies is a key step in this process.

LANDSCAPING PRACTICES

Knowing where ticks may exist in your yard can help guide how you interface with them. Ticks are often found in leaf litter, brush, and weeds at the edge of a lawn. Create a 9-foot buffer zone between such areas and places utilized for recreation. Around frequented areas:

- Apply 3 foot wide mulch barrier along forest edge
- Remove leaf litter, brush and weeds
- Keep grass mowed (less than 3 inches)
- Keep vegetation trimmed near edge of lawn



IMAGE SOURCE: <https://www.epa.gov/sites/default/files/2014-11/documents/tick-safety-in-schools.pdf>

REDUCE TICK TRANSPORT

Ticks can also be transported on common host animals such as deer, chipmunks, and ticks. Try to remove wood piles and other similar structures that mice may seek shelter in. Further, consider restricting deer accessibility to to gardens and frequented spaces. This can include the use of fencing around vegetable gardens (ideally 8 foot in height). Deer resistant plants can also be used to deter deer from select areas.

REPLACING INVASIVE PLANTS

Studies have found that several species of invasive plants can harbor high tick densities. Consider replacing Honeysuckle and Japanese Barberry with native plants. Areas abundant in Honeysuckle may have 10 times greater risk of tick exposure, whereas plots abundant with Japanese Barberry may have up to 60% greater tick exposure!



INSERT QR CODE HERE

BITE PROTECTION

- In Michigan ticks are most active between early May and November. They are commonly found in forests and grassy areas.
- When entering tick habitat, wear long-sleeved shirts, pants, and boots. Tuck shirts into pants and pants into long socks to seal points of entry. Wear light-colored clothing for easy tick checks.
- DEET based repellents can be used on self while, permethrin-based repellents can be used on clothing. Always apply in accordance to label directions!
- To remove ticks, grasp them with tweezers close to the skin and steadily pull upwards. Sanitize the site with soap and water or rubbing alcohol.
- DO NOT crush ticks with your hands. Instead flush them down the toilet or dispose in a sealed bag.
- If bitten, consider bringing the tick in a sealed bag to a medical professional. Identification of the tick can assist medical diagnosis.



LEARN MORE: [WWW.CDC.GOV/TICKS](http://www.cdc.gov/ticks)

Ecosystem Services for Mosquito Management

ECOSYSTEM SERVICES FOR MOSQUITO MANAGEMENT

SUPPORTING NATURAL PREDATORS

After female mosquitoes lay eggs in standing water, larvae hatch and leave the water as adults within 10-14 days. As adults, mosquitoes can disperse several miles away from breeding grounds. It is during their larval stage that they are most concentrated and immobile. In Michigan, healthy aquatic systems can include a variety of larval predators such as dragonfly and damselfly nymphs, aquatic beetles, fish, amphibians, and turtles. Additionally many species of dragonflies, birds, and bats consume large quantities of pest insects and are known to include mosquitoes in their diets. None of these species will singlehandedly eliminate mosquitoes, but collectively their presence in and around ponds, wetlands, and other water bodies can help to limit the quantity of mosquitoes reaching adulthood. Aquatic habitat degradation from pesticide and nutrient runoff threatens populations of many aquatic species in Michigan. Salamanders and other amphibians for example, are particularly sensitive due to the permeability of their skin. Some of these species, such as the Hine's Emerald Dragonfly, are listed as federally endangered. Community support of habitat for native mosquito predators can both contribute to local resilience against mosquito abundance and help provide important conservation value for these at-risk species. At a household level, efforts to support natural predators of mosquitoes ultimately involve planning around water and creating habitat heterogeneity. Collectively, these efforts can act as an umbrella to support many other local species.

ENHANCEMENTS TO ARTIFICIAL PONDS

Permanent fixtures of standing water, such as artificial ponds, can be breeding grounds for mosquitoes if stagnant. However, ponds can also provide needed habitat for wetland-dependent species. If you already have an artificial pond, or would like to create one, consider creating adjacent dragonfly habitat. Mosquito breeding in ponds can be limited by installing small waterfalls to keep the water moving. If ponds do not connect to other waterways, native fish such as fathead minnows can also be added to consume mosquito larvae. For a comprehensive guide, follow the QR code and review the linked guide to creating and maintaining dragonfly habitat.



RAIN GARDENS

On the other hand, if you have a problem with rainwater collecting into standing pools, consider building a rain garden. Rain gardens help water from poorly drained areas infiltrate into the ground while also filtering pollutants that may instead run off into waterways. Rain gardens preferably utilize deep-rooted native plants, which can also provide habitat to mosquito predators and pollinators. For a guide to constructing a rain garden, follow the QR code.

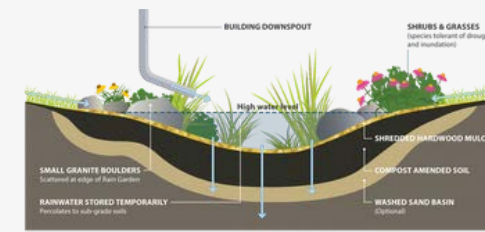


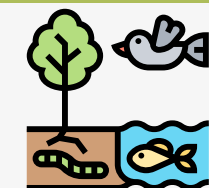
IMAGE SOURCE: <https://trca.ca/news/complete-guide-building-maintaining-rain-garden/>



INSERT QR CODE HERE

HOW TO CHOOSE?

While water systems and habitat heterogeneity closely interact with natural mosquito management processes, their quality also drives other environmental benefits. These benefits can include providing pollinator habitat, reducing need for pesticides and fertilizers, to preventing nonpoint source pollution loads from reaching waterways. There are many small ways to make an impact so consider your interests and tailor these strategies to for your goals - whether those are adding aesthetic value to your home or learning more about your local flora and fauna!



HABITAT DIVERSIFICATION

Habitat heterogeneity is an important factor that can drive species richness in a landscape. Compared to plain lawns, mixtures of native plants and kinds of vegetation, can provide food and shelter for a more balanced variety of invertebrates, while also being more resilient to local pests and reducing the need for chemical treatments. Similarly features such as trees in different phases of their growth and decay cycles can provide a variety of nesting and roosting options for birds and bats. Structures such as bird houses and bat boxes can also help increase roost habitat diversity.



INSERT QR CODE HERE

Public Facing Materials (continued)

Local Bats in Kalamazoo



LOCAL BATS IN KALAMAZOO

Find more resources about bat safety and ways to effectively participate in bat conservation on our website:

INSERT QR CODE HERE

➤➤➤ DID YOU KNOW?

Bats provide important pest management, pollination, and seed dispersal services across around the world. Estimates suggest that in the United States, insectivorous bats provide save the agricultural system over 3 billion dollars by reducing crop damage and pesticide applications!

Bat species in Michigan, all of which are insectivorous, include the following species:

- Big Brown Bat
- Hoary Bat
- Eastern Red Bat
- Silver-haired Bat
- Little Brown Bat
- Indiana Bat
- Northern Long-Eared Bat
- Evening Bat
- Tricolored Bat



Of the above, acoustic surveys from shared to the Midwest Bat Hub have identified the 5 underlined species (in order of detection quantity) at monitoring sites around Kalamazoo. While the Little Brown Bat is now rarely found around Kalamazoo, it is one of the primary species that includes mosquitoes in their diets.

POPULATION DECLINES

A variety of factors have led to steep population declines in bats across Michigan. White-Nose Syndrome (WNS) is a fungal disease that was introduced to the United States in recent decades. While it does not affect humans, the condition irritates bats during their hibernation, leading them to wake up and exhaust needed the energy stores they need to survive winter conditions. Species such as the little brown bat, that roost in social groups have been some of the most affected with up to 90% mortality rates in affected colonies.

Emerging threats such as WNS make bats particularly vulnerable to habitat loss and other pressures. Habitat restoration, preservation of corridors, and the provisioning of alternative roost (such as bat boxes) can help bat populations withstand these stressors.

➤➤➤ COEXISTENCE AND MISCONCEPTIONS

There are many reasonable fears and misconceptions about bats, particularly around roosting in buildings and spread of rabies.

- Many bats naturally roost in tree cavities and other similar structures because they provide stable temperatures and protection from predators. Loss of natural roost options can drive bats to seek shelter in roofs and cellars that provide some of the same benefits. Taking preventative measures to seal openings in houses and installation of bat boxes can help reduce human exposure to bats.
 - If bats are found roosting in your home, exclude and relocate them humanely by calling a trained bat rehabilitator.
- While rabies rates amongst bats are low, medical care should be urgently sought for direct human contact with a bat. Recognizing the signs of an infected bats contact are key to avoiding exposure.
 - Bats that are unusually active during daylight, or are grounded may have rabies. Do not approach these animals and call animal control.
 - Providing alternative habitat again is key to reducing human-bat contact.

Taking proactive measures to bat-proof buildings and provide alternative habitat can help communities reduce health risk while benefiting from the ecosystem services that bats provide.

➤➤➤ HOW TO HELP LOCAL BATS



Keep pet cats indoors. Cats can hunt bats using their night vision and ability to hear high frequency sounds made by bats.



Turn off outdoor lights. Lights can disturb how bats hunt and can limit their ability to catch night flying insects.

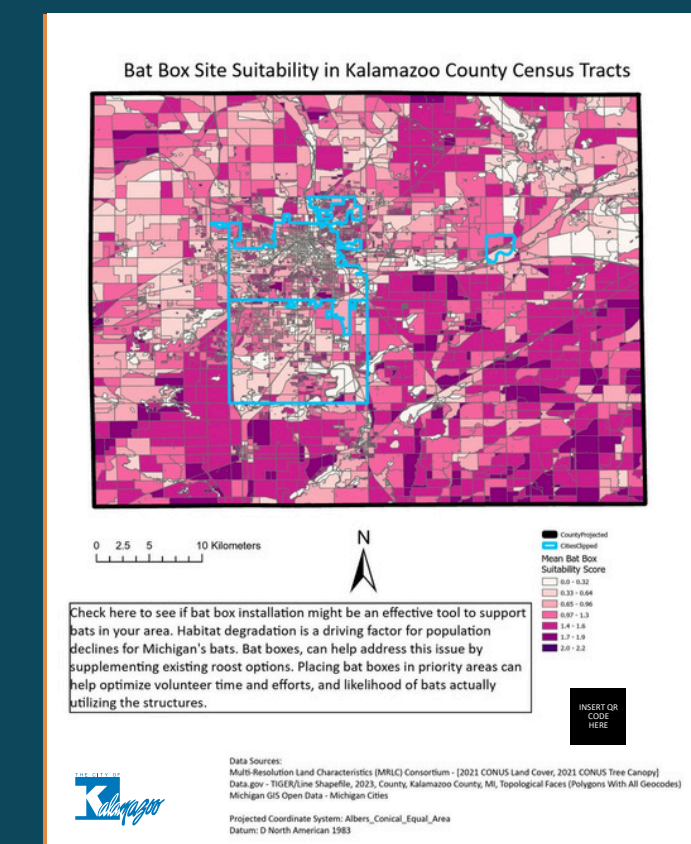
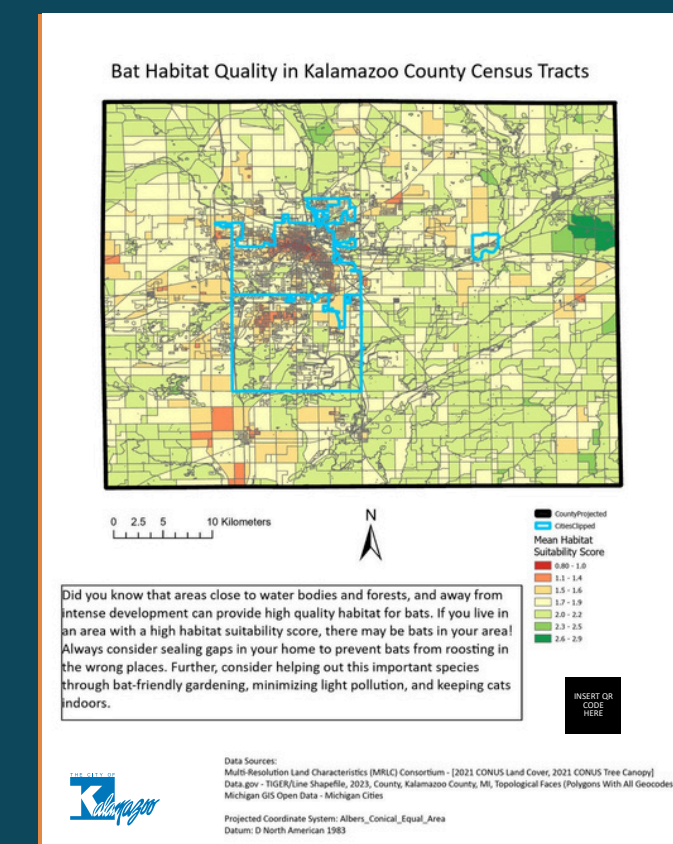
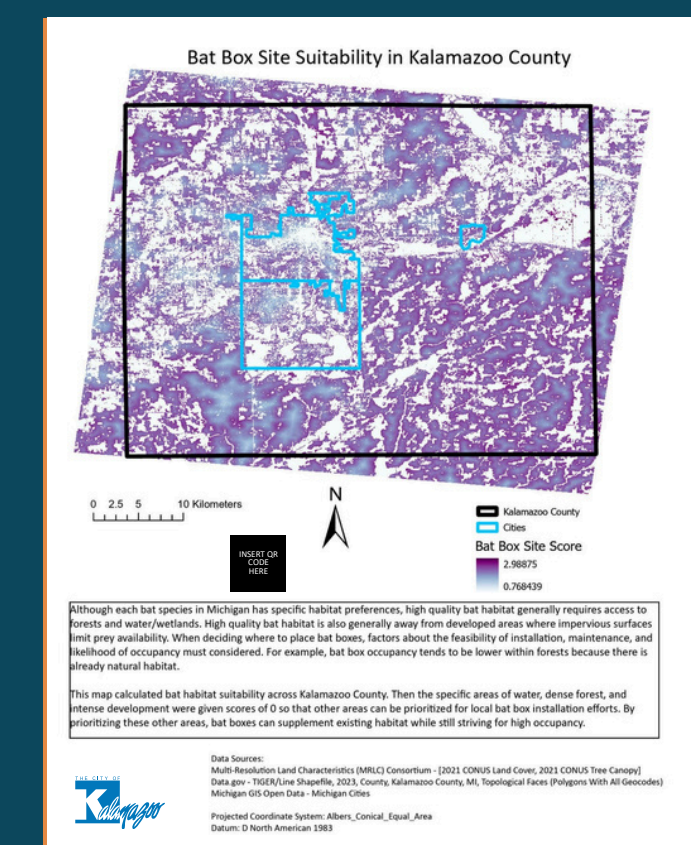
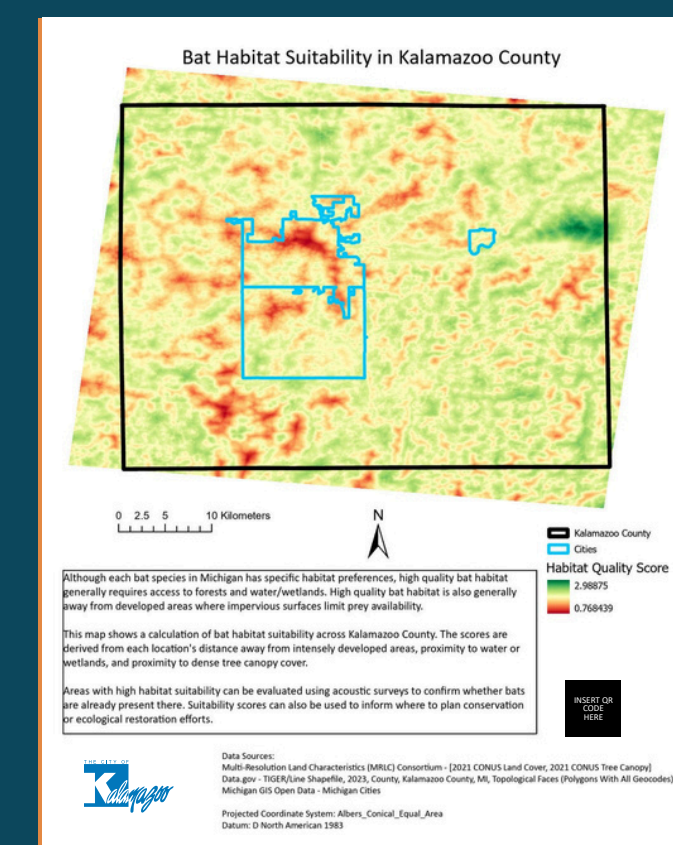


Plant a bat-friendly garden! The presence of fragrant or light-colored flowers, native plants, and trees at different stages of their growth cycle can provide bats alternative habitat and food. These strategies can also support a variety of other native species.



Install bat boxes. Join the City of Kalamazoo's efforts to improve habitat availability for bats. Make sure to follow our recommended guides regarding construction materials, placement, and maintenance. Also read carefully about including vents to reduce overheating risk. It can take time, sometimes years, before bats move in. Observe and be patient!

Bat Habitat and Artificial Roost Suitability Mapping



Q & A?

Special thanks to:

Graham Sustainability Institute:

- Sarah Lee (fellowship coordinator)
- CLCF Cohort
- Graham Institute Staff

Project Team:

- Justin Gish (Sustainability Coordinator, City of Kalamazoo)
- Dr. Laura Iles (North Central Integrated Pest Management Center)
- Alexa Hempel (Community Sustainability Liaison, City of Kalamazoo)

Additional Guidance:

- Dr. Maarten Vonhof (Western Michigan University)
- Beth Keith (Kalamazoo Valley Community College)
- Kalamazoo County Health Department

