

# Conserving the Eastern Massasauga Rattlesnake at the Matthaei Botanical Gardens

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## **Background**

The Eastern Massasauga Rattlesnake (EMR) is labeled as a species of special concern by the DNR and is listed as “threatened” under the Endangered Species Act (“Eastern Massasauga Rattlesnake,” 2019). The EMR is considered a keystone species because hawks and other predators rely on the snakes as prey while the snakes also keep native vole populations in check (“Eastern Massasauga Rattlesnake” MBGNA). The EMR is the only venomous snake in Michigan and has several populations in other Great Lakes states (Parrish, 2012). These snakes inhabit prairie fens in southern Michigan and utilize nearby wetland spaces. In lowland, wetland habitats crawfish create burrows that the snakes then utilize for winter hibernation. There have been multiple surveys conducted by the Ecological Consulting Group to understand the ecological impacts on the EMR at the specific sites where EMR are found at Matthaei Botanical Gardens (MBG).

Past reports created by the Ecological Consulting Group, expert testimony from MBG staff, and scientific articles have guided us in our proposed management plan. We will examine how the use of GIS software and thermal imaging technology can be used in order to identify and track the EMR population in order to conserve the species at MBG. We also identify the threat of vehicles for the EMR and how to mitigate their damage. Additionally, the threat of encroaching woody plants will be addressed and management for this threat will be proposed. We will also propose how research should be conducted on invasive crawfish, climate change, and snake fungal disease as these may have future negative impacts on the EMR.

### **Assessment of the Issues Faced by the EMR**

The EMR faces several key issues presented in a report in 2012 by Parrish. The EMR is a threatened species and the true population size located at the MBG is largely unknown. This lack of information presents several key issues, one being the lack of population measures makes it difficult to monitor and preserve the population. Another issue facing the EMR is the encroachment of woody vegetation, such as the increasing prevalence of invasive woody plant species such as buckthorn and honeysuckle. Buckthorn and other woody plants pose a hazard to the EMR's preferred habitat: prairie in the summers and wetland habitats in the winters for hibernation (Hallock, 1990). Many snake species exhibit extirpation and declines in habitats that are being reforested (Smith & Stephens, 2003) The EMR hibernates in wetlands and thus this ecosystem is key to their survival; therefore, wetland degradation is inherently harmful to the species. Several Eastern Massasauga Rattlesnakes have been observed in a field of invasive Eurasian bluegrass near the parking lot at MBG and do not mind it due to its multiple uses: a hiding place, a nest site, for thermoregulation, and for foraging (Anton, 2015). Several other issues the EMR faces include human fear and snake fungal disease (although the fungal disease is not currently present at the Matthaei Botanical Gardens). Human fear also can lead to both accidental and purposeful removal of the snakes. Misperception and mischaracterization of the snake as "dangerous" can lead to intentional killings of the snake. Roads at the MBG are also of great threat to the snakes with road mortality found to be high (Hallock, 1990).

### **Goals of Envisioned Restoration**

As the EMR is a threatened species, one key goal of the monitoring plan is to obtain a successful population count. A representative at MBG estimated the population to be



approximately 50 based on consultant reports and personal experience. Approximately 50 maintains a strong population size and prevents genetic depression in the short term; thus, if the population of the EMR is near 50 it will be considered a stable population for the time being (Greipsson 2011). This information will be reported through surveys and translated through GIS software in order to create a map detailing population size, density, location, and other factors. The population will be surveyed every 2 years; in order to ensure subsequent, successful population counts, the staff at MBGNA need to guarantee that The Ecological Consulting Group, LLC will take population counts during spring emergence (i.e., April-mid-June) of the EMR every two years (due to their biennial reproduction). Because The Ecological Consulting Group is an independent organization, it is the responsibility of MBGNA to communicate with them at the necessary time to do the EMR population counts. A successful, consistent population count for 6 years or more (at least 3 surveys) will be regarded as a successful measure.

In order to promote education and preserve the population, signs should be placed at both entrances to the park. Six signs will be placed in total. Snake deaths and run-over snakes can be reported through MBG's survey. If accidental snake deaths are reduced by 75% in the next few years, this will be considered a successful measure. Additionally, in order to advance community education, signage will be posted in nearby neighborhoods. Flyers and brochures will also be passed out in nearby neighborhoods (see Appendix B). If this literature and media are sufficiently distributed to all communities within a 2-mile radius of MBG within a year, this measure will be considered successful.

A species distribution map of the EMR will be created. This will combine information presented by visitors, staff, consultants, and other individuals submitted through the survey. The

map will be created through GIS software and will compile multiple sources of data into one easily accessible resource. The survey will ask for several key pieces of information including the location of snake, approximate size, presence of disease, and more. This will help to define exactly which habitat should be carefully protected and where the snakes reside. When the information is successfully collaborated and combined into one mapping software that is easily accessible, this goal will be regarded as a success.

Continued removal of buckthorn and honeysuckle among prairie edges is necessary (Anton, 2015). The EMR sunbathes and hunts in open prairie environments (Parrish, 2012). The encroachment of invasive woody plants limits their range of movement places pressure upon finding their prey population and reduces overall habitat for necessary activities (such as sunbathing). In order to successfully reduce the number of woody invasives present this population should be artificially managed; the invasives need to be removed. We suggest involving more interns or work-study students in the removal of these invasive species. This removal among and in prairies should occur during the winter season, while the massasaugas are hibernating in the wetlands to prevent disturbance. Some brush piles should be left near wetland edges, however, to provide shelter and thermoregulation for the snakes (Anton, 2015).

#### *Removing Woody Plants*

Protecting the EMR habitat from woody invasive plants will be considered a success if the current suitable habitats remain a consistent size and invasive species such as buckthorn and honeysuckle are reduced by a significant portion, to be decided at MBG's discretion. This will be qualified as a standard of success as reducing invasive species helps to retain adequate

sunbathing locations (given the MBG workforce and volunteer/intern availability and resources this project remains feasible), and helps to stabilize population size.

#### *Outreach to Neighbors*

Surrounding community members should be taken into consideration since they along with visitors can have encounters with the massasaugas from the Matthaei Botanical Gardens. We suggest handing out brochures (see Appendix B) to surrounding community members that include the importance of the massasauga species (see Background section above), a statement that they are a federally endangered species, and what to do if one encounters a massasauga (see Parrish, 2012).

#### *Conserving Species: Signage*

The EMR is a classic ectotherm and has been observed sunning themselves on the blacktop of the road and parking lot. However, this has resulted in individuals being run over and killed. One method to prevent the snakes from being killed is to add signs in the parking lot and nearby roads. A simple sign such as those used for turtle crossings could give drivers enough notice to slow down and spare the snakes.

### **Monitoring Plan**

Continual assessment of the plant species, vegetation cover, and sunlight reaching the ground within the areas the EMR resides in on Matthaei property is necessary to ensure that woody vegetation is not encroaching. Areas where the EMR has commonly been found, including the grassy area behind the guest parking lot, Sam Graham Trail, prairie areas throughout the property, and the north wetlands wet meadow needs to be continuously assessed by natural areas managers and interns to see if woody plants, both invasive and native, are

starting to infiltrate prairie or wetland habitats currently holding EMR populations. Photographs should be taken each growing season of each site that woody plant removal was done in order to assess if they woody plants are being kept at bay and to ensure that sunbathing sites continue to exist. Water quality as well should continue to be monitored in regards to crawfish conservation and thus crawfish burrows for massasauga viability to hibernate and survive through the winter (Anton, 2015).

### **Methods**

#### *Mechanical woody vegetation removal and mapping*

We suggest using brush cutters and hand saws for woody vegetation removal during the growing season (spring/summer) in order to minimize harm to emerging snakes (Parrish, 2012). Brush hogging should only be utilized during winter at sites where large snake populations are found because they are hibernating in lowland areas during this season. If a large volume of volunteers are allowed to utilize hand saws, a significant number of woody plants can be removed in the area. Additionally, we suggest taking photographs of the sites before and after invasive species removal to provide tangible evidence of the reduction of invasive woody plants at the specified sites. These photographs could be put into the Invasive Shrub Management GIS Map (Appendix C, Map 2) as well as the acreage of removal, similar to the GIS map for prescribed burns (Appendix C, Map 1). Inputting acreage, time taken to remove invasives, and how many workers or volunteers were used can help to create numeric metrics in the future for how many invasive plants should be removed. This data would help to prevent further spread of invasive species to the habitat currently occupied by the EMR, including the grassy area behind

the guest parking lot, Sam Graham Trail, prairie areas throughout the property, and the north wetlands wet meadow.

#### *Test genetic diversity*

Although massasauga populations at the Matthaei Botanical Gardens currently are considered to be at a healthy population size, we suggest that genetic diversity of the population be tested through molted skin collection or capture and sampling DNA from the snakes to find if there is any possible inbreeding among them. If genetic diversity is found to be low, this could threaten the viability of the future massasauga population; considerations to deal with this issue then should be made.

#### *Thermal Vision*

Previous population counts of the EMR have relied on visual inspection. However, the EMR is an ambush predator that relies on natural camouflage. EMR offspring are born live, meaning that they do not hatch from eggs (Parrish, 2012). Thus, the neophytes are small, camouflaged, and difficult to observe. Their habitats often consist of dense underbrush which is also not conducive to a visual search. As an alternative to a visual count, we propose the use of thermal imaging technology. As the snakes are ectotherms, it would be possible to identify the snakes after the sun has set and their bodies retain the warmth they have absorbed through sunning themselves. It is also possible that the snakes' cold temperature would show on the thermal software early in the day before the snake has warmed but after the sun has heated the land. The technology required is known as a FLIR imager and has had great success in Southern Florida ("Thermal imaging," 2009). Here researchers have used thermal imaging in order to identify invasive pythons in the Florida Everglades.

We have reports on the EMR from the Ecological Consulting Group who surveyed areas at Matthaei Botanical Gardens in 2010, 2012, and 2014. Additionally, the Natural Areas Data Resources page from the MBGNA website provides burn data, invasive shrub removal data, and more. We have found information about EMR biology and ecology via the Michigan Natural Features Inventory, the DNR of Michigan, the MBGNA website, and a MBGNA presentation (Parrish, 2012). Several news articles and other research databases have explored the emerging possibility of using thermal imaging technology to identify snake populations.

### *GIS*

Matthaei Botanical Gardens should use GIS software in order to map the habitat of the EMR at the gardens. By mapping population density, location, and sightings, the software can be used to aid in the conservation of the EMR. This data will also aid in conserving the EMR habitat and assisting in the preservation of this habitat. The creation of a species distribution map would be beneficial for consolidating all information concerning EMR regarding their population size, habitat type, vegetation index, and more. Therefore, when one views this GIS map, they can see what areas of the Matthaei Botanical Gardens contain the EMR, how many are in a specific area, which habitat type that particular area is, and the vegetation found there. Currently, there is a GIS map that includes reports of the EMR from individuals (including workers and visitors; see Appendix C Maps 3 & 4) that were logged using Survey123, but this is a very new program implemented at MBGNA. Therefore, we are proposing blending reports from Survey123 and prior and future population counts from the environmental consulting group to create a holistic GIS map that shows where snakes are found. Then, other layers that include other environmental aspects can be included to highlight ideal EMR habitats at the Matthaei Botanical Gardens.

*Distributing literature*

In order to educate neighbors of the MGB property about the EMR in a noninvasive but relevant way, brochures with information about the EMR should be distributed to neighborhoods and neighboring houses. The distribution can be done by interns during the summer. The brochures could also be mailed to MBGNA members, which is especially relevant since these are people who clearly frequent the property and are more likely to encounter the EMR. Docents could also distribute brochures during tours of the property, and brochures could be available at the front desk. Again, an example of the brochure (Appendix B) is provided.

*Snake Crossing Signage*

Staff at the botanical gardens have reported finding dead EMR's on the service drive and entrance drive. Mike Palmer reported on October 10th in 2019 using the Survey123 reporting tool that a snake was run over "just south of the Matthaei Trail crosswalk." This is a problem cited by Natural Areas Manager, Steven Parrish, as well. Often, cars travel faster than the 10mph speed limit set in place by MBGNA when entering the property, and the EMR can easily blend into the road. To alleviate this issue and make drivers acutely aware of the threatened species potentially crossing the road, MBGNA should implement signs along the service drive and entrance drive in each direction, and on the two parking pay stations to warn visitors (see Appendix A). A study conducted in Utah found that only 2% of animal-vehicle collisions (AVC) occurred within the recognition distance of a road sign warning of animal crossing, and saw less AVCs on roads that had warning signs (Khalilikhah & Heaslip, 2017). Therefore, on a small road like those at MBG, a warning sign is likely to be effective in reducing snake deaths. The goal is



to have drivers slow down and be mindful of possible snakes on the road, and the pay station signs will serve to reinforce the message.

### **Future Research/Prevention**

#### *Crawfish*

The EMR hibernates and overwinters in crawfish burrows (Anton, 2015). This hibernation consists of a vertical hole, in which the body of the snake rests beneath the water table and the snake head rests above water. The presence of larger, invasive species of crawfish have been observed at MBG, and there is an inquiry that their burrows may not be suitable hibernacula for the EMR. One of the crawfish at MBG, the Digger crawfish, is a native keystone species whose burrows provide hibernacula for the EMR (Anton, 2010); thus, it is crucial to understand if competition from the invasive Rusty crawfish will pose a significant threat to the native crawfish.

#### *Snake Fungal Disease*

Future research can explore snake fungal disease, *Ophidiomyces ophiodiicola* (Allender, 2011). As this disease has not affected the population of the EMR at the MBG and is an emerging contagion in Michigan, very little current data exists. Future research can explore the fungus and its effects along with possible methods of prevention. These methods of prevention can include proper techniques for handling the snake and proper decontamination protocol. In case the snake fungal disease ever enters into the population at the gardens, there should be contact information for a veterinarian. Additionally, a small snake quarantine center could be created or built somewhere at the Matthaei Botanical Gardens. Also, as surveys are done every

two years for the massasaugas at the gardens, it should be noted down if any signs of the fungus are noticed.

### *Climate Change*

As climate change continues to occur there are multiple opportunities for the impact to be observed upon the EMR. Increased temperatures may allow for earlier parturition rates in female snakes that permit longer foraging time for them and neonates before hibernation, but this comes at the risk of increased risk for predation (Johnson, Gibbs, Shoemaker, and Cohen, 2016). Additionally, as temperatures change and precipitation patterns change, nearby wetlands will be affected. pH and thus macroinvertebrate diversity may change and consequently affect crawfish. Floodplains and key habitat such as Fleming Creek may be negatively impacted by expected changes in precipitation, including an increase in severe precipitation events. As the EMR hibernates in these habitats, change in the scope of wetlands can negatively impact EMR populations. Climate change could potentially impact prey populations for the EMR as well, such as the prairie vole, and can also impact the EMRs' predators' populations, such as the red-tailed hawk, thus influencing trophic-level interactions. Moreover, if temperatures become unfavorable to massasaugas, they may start to migrate north and eventually out of protected habitat at the MBG. Overall, climate change is predicted to impact both the habitat of the EMR and the massasauga itself.

### **Acknowledgments**

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improving MBGNA's GIS maps for future invasive plant removal and mapping of EMR populations. She designed the sign and brochure. All three contributors gave creative ideas, dedication to the topic, and passion for conservation and restoration.

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## Appendices

### *Appendix A: EMR Crossing Sign*



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*Sign:* An example of a road sign that could be used by MGBNA on their botanical garden property entryways. It includes an image of the EMR, a warning, and a brief explanation of why the species is important to watch for. The U.S. Fish and Wildlife Service logo is included to articulate their governance over the Endangered Species Act that federally protects the EMR.

*Appendix B: Brochure about the EMR for Neighbors*



The brochure features a background image of a snake's head and body, with a focus on the distinctive black and white diamond-shaped patterns on its head. The text is arranged in several sections: a central mission and vision statement, a top right section about the snake's status in Michigan, and a bottom left section encouraging a change in perspective. Logos for the U.S. Fish & Wildlife Service and the Michigan Department of Natural Resources are at the bottom right.

## ABOUT MBG

**Mission:**  
Promoting environmental enjoyment, stewardship and sustainability through education, research and interaction with the natural world.

**Vision:**  
We will be the center for rich and diverse nature-based experiences for the University of Michigan and its surrounding communities. We will provide exceptionally beautiful gardens and natural areas for enjoyment. We will train a new generation of environmental leaders in sustainability, conservation and ecological restoration and engage research that deepens our understanding of plants, ecology, and the role of nature in our lives.

## THE EASTERN MASSASAUGA RATTLESNAKE

**Michigan's only venomous snake has one fear: us**

**Most people are scared of snakes, but have you thought about how scared they are of us?**

**FEDERALLY AND STATE PROTECTED**

**SEE THE WORLD FROM A SNAKE'S PERSPECTIVE**

<https://mbgna.umich.edu/about/mission/>





The Eastern massasauga rattlesnake is an important predator in Michigan ecosystems.

These snakes help control rodent populations and are important food sources for other rodent predators, like the fox and hawk. Protecting the EMR means getting a free exterminator for rodent pests! They're also a keystone species, which means they have a large impact on the ecosystems they live in, and their extinction would have negative effects for plants and animals in that ecosystem.

## THE IMPORTANCE OF THE EMR

Source: <https://mbgna.umich.edu/education/eastern-massasauga-rattlesnake/>

*Use the EMR reporting tool if you spot one! Type this into your phone or computer:  
<https://tinyurl.com/EMRreport>*

## WHAT TO DO IF YOU SPOT ONE

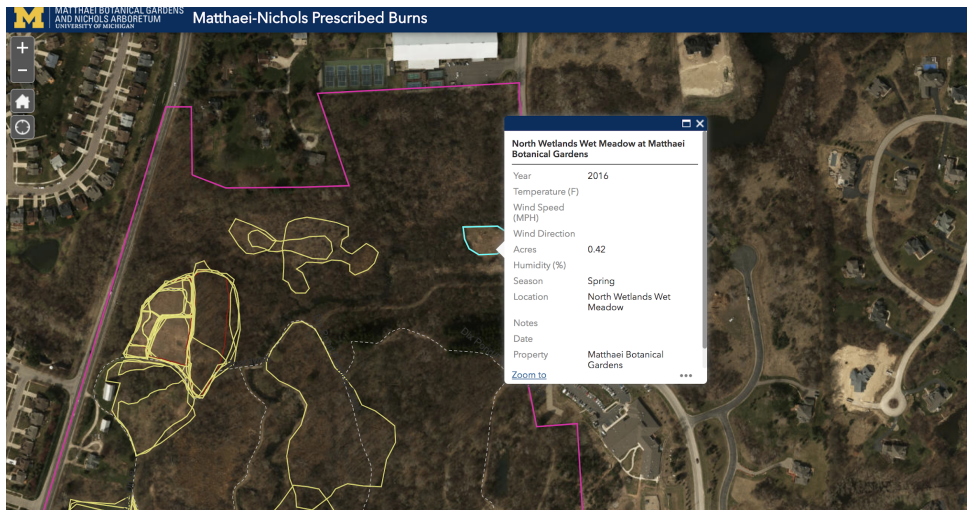
Again, the EMR is more afraid of you and would prefer not to be disturbed. The only snake bites that occur happen to those who wander into snake habitat without proper footwear or do not give the EMR the distance and respect it needs. At the Botanical Gardens and surround native ecosystems nearby, stay on trails with close toed shoes (they can't bite through them!) If bitten, call 911 and stay calm. Half of the snake bites are actually dry and have no venom.



*Brochure:* Brochure to distribute to nearby community members who encounter massasaugas



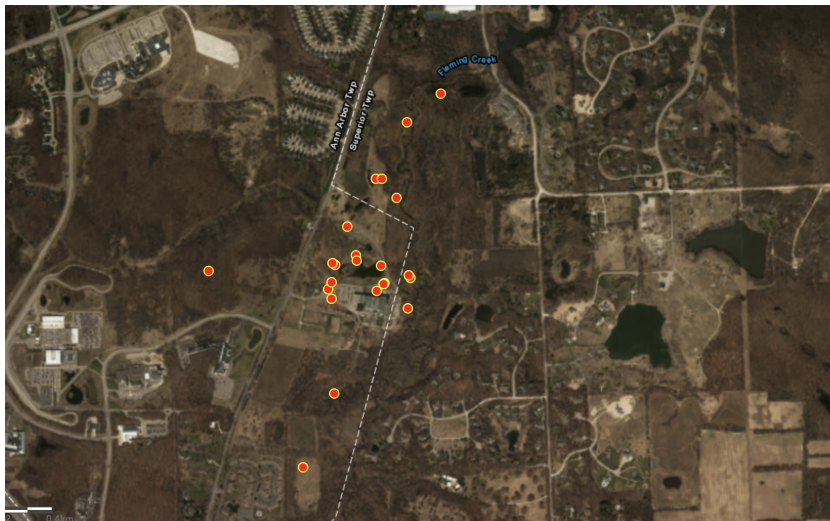
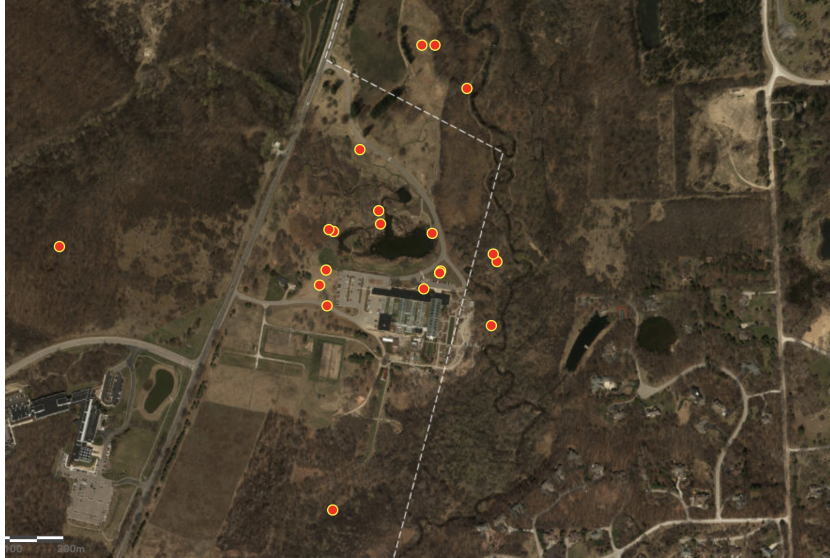
### Appendix C: GIS Maps



*Map 1 (above):* A prescribed burn conducted in 2016 on the North Wetlands Wet Meadow, a habitat where the EMR has been sighted



*Map 2 (above):* Areas around Willow Pond, including prairie and wetland areas, where invasive shrub management has been conducted. Green areas have been brush-hogged and orange areas have been manually cut, and often they are treated with herbicide after. Around Willow Pond and the nearby prairie and wetland habitats are habitats where the EMR have been found.



*Maps 3 & 4 (above):* Locations of reports of the EMR made by visitors, interns, and staff using Survey123. Each dot represents a sighting of an EMR, dead or alive, and has information about size, significant characteristics, life status, and a picture, if available.