

**The Effect of Urban Sprawl & Suburbanization on Eastern Massasauga Rattlesnake  
Populations in Northeastern Illinois**

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### **Abstract:**

Venomous snakes are rarely considered by humans as a major conservation concern, yet in Northeastern Illinois the indigenous eastern massasauga rattlesnake has seen a rapid decline in numbers over the last twenty years. This snake species is considered a keystone species in the prairie wetlands ecosystem in Northeastern Illinois. Looking at historical population statistics of the area's largest city, Chicago, and its various suburbs there is a visible suburbanization trend that began about fifty years back. With rising population in the suburban areas of Chicago

comes an increase in housing developments as well as an increase in urban land cover. Even with the protection of the wetlands of Illinois, all of these factors seem to be directly effecting the existing populations of eastern massasugas in Northeastern Illinois. These specialist rattlesnakes require both the prairie wetlands for hibernation, as well as adjacent dry uplands in order to survive. All in all, suburbanization and urban sprawl in the Chicago area can be correlated with the decimation of the once healthy population of eastern massasauga rattlesnakes in Northeastern Illinois.

### **Introduction:**

Specialized ecosystems contain many specialist and endemic organisms which depend heavily upon an unchanged, untouched environment. A specialized ecosystem is an environment which seems displaced in its geographic location or is found to be inconsistent with surrounding areas. Unfortunately, as we have seen with so many specialized ecosystems, they are often tampered with or even destroyed completely by expansion of human civilizations. Destruction of specialized ecosystems will certainly lead to population decreases amongst many specialist and endemic species, and in some cases will lead to extinctions or species being extirpated from the area. The Chicago metropolitan area holds within its boundaries a plethora of key specialized ecosystems, one of these ecosystems being the natural prairie wetlands of both Lake and Cook Counties. Bordering Lake Michigan, these two counties supply corresponding wetland areas near the coast of the lake. This type of ecosystem is considered specialized because the surrounding counties of Illinois do not contain such vast prairie wetland ecosystems, making these areas very unique compared to the rest of the state.

Urban sprawl and expansion of the Chicago metro area is by far the biggest threat to the preservation of Lake and Cook County's natural prairie wetlands ecosystem, and the endemic species that live there as well. While the majority of Cook County's natural prairie wetlands have already been destroyed by human development and urbanization, Lake County contains the majority of the areas prairie wetlands habitat that has been untouched by humans. Over the last twenty years new population trends have begun to surface in the Chicago area. The vast population of Chicago has begun to decrease steadily, while Lake County's population, as well

as other counties just outside the Chicago city limits, has begun to increase exponentially. With rapid human expansion occurring all over the Chicago suburbs, Lake County's natural wetlands ecosystems have begun to take a hit. Many endemic species of this area could become threatened or endangered because of this suburban development.

The eastern massasauga rattlesnake, *Sistrurus catenatus tergeminus*, has seen rapid population decline in the Chicago area in the past twenty years ("Eastern massasauga rattlesnake, "). This particular snake is one of the specialist inhabitants of Chicago's unique prairie wetland ecosystems, and has become an isolated population due to the urban development that has taken place in Northeastern Illinois. While many species that are natural to Chicago's prairie wetlands ecosystems are decreasing in population, the eastern massasauga has a distinctly devastating disadvantage that has been detrimental to its own survival. The fact that this snake is venomous to humans, and has the potential of doing great harm to humans is causing humans to kill the snake as often as possible. Throughout history humans have been known to naturally fear snakes. For thousands of years, humans have associated snakes with evil and death. It can't be denied that some snakes can be deadly to humans, yet most snakes are thought of as being man hunters but in reality they only bite when threatened. A large percentage of snakes have been studied and found to be quite docile towards non-prey and non-threatening objects. Another misconception about venomous snakes is that they always use their venom. Any herpetologist will tell you that venom is precious to a snake, taking sometimes weeks to replenish venom glands (*Toren Hill, Wildlife Prairie Park-Peoria IL*). It will, in most cases, only use venom when hunting or biting a common prey. Many venomous species, including the eastern massasauga, have been known to even give dry bites to non-prey objects that contain no venom at all (Gibbons). In recorded history, eastern massasaugas have been responsible for very few human deaths. The last recorded human death by an eastern massasauga rattlesnake bite dates back to the 1950's in Ontario, Canada (Rusz). Although they could potentially kill a human in certain cases, they are not considered to have fatal venom toxicity.

While eastern massasauga's are not responsible for many human deaths, humans, on the other hand, have killed plenty of them. Many people will often see a snake like the eastern massasauga and attempt to kill it because of its pattern or because of its distinguishing rattle.

Most snake bites actually occur when humans are attempting to kill or handle snakes. Generally, snakes will not attack a human unless they are provoked. In many cases people see a snake with a certain distinguishing pattern and automatically assume that the snake is venomous, but as with many animal species, non venomous snakes will often mimic the patterns of a venomous snake in order to scare off potential prey or competitors. It is thought that over eighty percent of snake identifications by civilians are incorrect ("Why conserve a," 1999). Snakes such as the western hognose snake, a non venomous species, are often killed because of their similar look to the eastern massasauga Rattlesnake. If people would take the time to learn about the importance of snakes in an ecosystem and their often calm natured behavior, they would possibly think differently of snakes and it may reduce the number of snakes killed by humans drastically.

Another reason why snakes like the eastern massasauga are important to have near large human populations is to help control potentially diseased rodent populations. Historically, common rats and mice have been some of the biggest detriments to human populations that the world has ever seen. Pandemics like the Black Death and other diseases such as Lyme disease are both diseases which have caused many issues for humans historically and are known to find their origins in small rodents such as rats and mice. With Lyme disease small black legged ticks are always thought to be the main cause of the bacterial illness, yet those ticks become infected with the disease from previously feeding on small rodents like mice and rats ("Timber rattlesnakes indirectly," 2013). Many snake species including the eastern massasauga frequently prey on such rodents who could potentially be carrying the Lyme disease with them. Although many people would not want sizable populations of snakes close to their homes, they do serve a large purpose in rodent control in populous areas, which in turn helps control the spread of countless bacterial diseases and pandemic outbreaks.

The eastern massasauga rattlesnake is a very important indicator species of the temperate wetlands ecosystem. Reptiles are known to be substantially less common in temperate areas and ecosystems like Northeastern Illinois. Any reptiles that naturally thrive in these temperate conditions will definitely act as a key indicator species of that particular environment. Basically it boils down to if the reptiles aren't doing well, then in all likelihood the other species' in the ecosystem are likely not doing well either. Eastern massasaugas are also an important part of the

food chain in the wetlands ecosystem. They serve as a common prey item for many predators including eagles, herons, and some mammals (Dewey, 2013).

To give some insight into just how dangerous it can be to an ecosystem to eliminate one of its main contributing species, I raise the question of rattlesnakes potentially losing their rattles all together. With more and more rattlesnakes being killed by humans because they make a rattle sound to forewarn the humans from getting to close, many of the rattlesnakes that have high functioning rattles or use their rattles a lot would be the snakes that would be getting killed by humans most often. Over time this trait would become an evolutionary disadvantage for the snake and the snakes that have low functioning rattles would become the surviving snakes. More and more rattlesnakes would be being born with low functioning rattles until eventually there would be hardly any rattles left and possibly snakes being born without rattles at all. Being that the rattle was an evolutionary trait that was meant to help the snake warn large potentially harmful animals from stepping on the snake and to keep predators from attempting to attack the snake, if it was to lose the rattling ability it could severely throw off the evolutionary cycle of the other species in the ecosystem. Whichever way you look at it, forced evolution through human disruption is something that could be very harmful in any ecosystem.

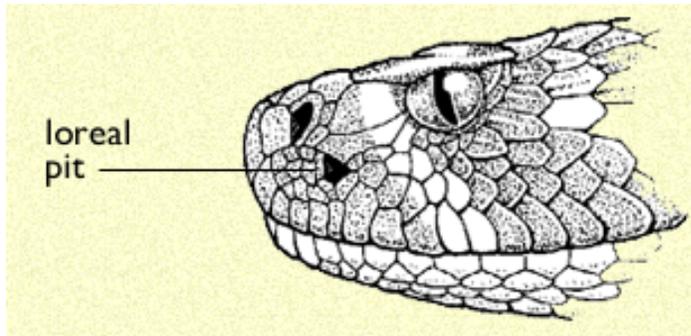
Research on the eastern massasauga rattlesnake has shown the importance and significance of the snake as well as many other types of snakes in specialized ecosystems such as the unique prairie wetlands of Northeastern Illinois. This particular snake species has nearly lost its battle against Chicago suburbanization and human development in its specialized habitat. I hope to build on the idea of expressing the importance of preserving these temperate wetlands and to show the effect of urban sprawl and human interference on these areas by mapping population increases and habitat overlapping in Lake County. I hypothesize that urban sprawl and suburbanization is directly contributing to the demise of the eastern massasauga rattlesnake and its natural habitat.

## **Literature Review:**

### **Background: Rattlesnake Morphology & Behavior:**

## *Pit Vipers*

The Eastern Massasauga Rattlesnake, as well as all Rattlesnakes, belong to a family of snakes referred to as Viperidae ("Why conserve a," 1999). The snake family Viperidae is comprised of snakes more commonly known as pit vipers. Pit vipers are known for having small pits that can sense heat. These pits are usually located beneath the eyes in pit vipers. Being able to sense heat is an adaptation that immensely benefits the survival of all pit vipers. This allows them to easily track and find warm-blooded prey like mice and rats. Being able to hunt and forage in dark conditions is also useful in that many predatory raptors and other dangerous animals will likely not be able to see the snakes as well.



**Figure 1**

## *Venom*

Along with being able to sense heat, these pit viper snakes are also highly venomous. The venom toxicity of a snake bite can vary from species to species and even from individual to individual. There is a visible correlation that shows the larger the rattlesnake the more toxic a bite can be. The reason for this is simply that the venom glands in larger snakes are larger and can store greater amounts of venom, in some cases more than 850mgs. According to the Department of Wildlife Ecology & Conservation of the University of Florida, a study was conducted comparing the venom of rattlesnakes. After milking various snakes *Crotalus adamantea*, better known as the Eastern Diamondback, was recorded to have exerted the most amount of venom. The Eastern Diamondback has also been found to be the most venomous snake drop-for-drop in the United States (Dr. Steve A. Johnson). Venom is often thought to be an infinite source in all venomous snakes, when in fact it is an entity that venomous snakes must conserve in order to use it for prey.

## *The Rattle*

While pit vipers can be found all over the world, the pit vipers in the Americas are very unique for one morphological reason. The majority of North American vipers are equipped with rattles at the end of their tails (Howard, 2005). While humans have long thought of the rattle from a rattlesnake as a behavior of aggression it is now known that rattlesnakes evolved these rattles as warning signs to frighten off potentially threatening animals. Being relatively small, well camouflaged reptiles, snakes were once easily stepped on by bison and other large bodied animals of the American continents. It is thought that the rattle was developed in order to keep large animals from stepping on snakes as well as to scare off intrigued animals without having to exert and waste venom ("Bison theory," 2005).

## *Morphology*

North American rattlesnakes share many commonalities in morphology and appearance with one another. While there is some variation in color, patterns, and size, rattlesnakes for the most part are well camouflaged reptiles that have some kind of distinguishing pattern. They can vary in size from about a foot in length to around 12 feet in length. They have very large and heavy bodies in comparison with other North American snakes (Howard, 2005). Another distinguishing characteristic of rattlesnakes is their elliptical eye pupils. Other venomous vipers have these same pupils yet many non venomous species that mimic rattlesnakes will not have these elliptical cat eye pupils. The head of rattlesnake species will often be more triangular in shape. While this morphological trait can be helpful in identifying venomous rattlesnakes, many non venomous snakes do mimic this triangular head shape as well.

## *Behavior*

While rattlesnakes are very unique snakes, they often have similar behavior characteristics and habitats that most of the common terrestrial snakes in North America have. Rattlesnakes are found in all kinds of North American habitats from deserts to mountains to subtropical forests and even temperate wetlands. Rattlesnakes are known to prefer small dark

spaces to create dens in. Rattlesnakes, as well as all snakes, are ectothermic and must utilize the rays from the sun to obtain energy. A common behavior of rattlesnakes and reptiles is sunning or basking. This behavior entails remaining motionless in open space where sunlight is plentiful. Aggression is often correlated with venomous snakes like rattlesnakes but most rattlesnakes are only aggressive when disturbed. Many rattlesnakes like the eastern massasauga Rattlesnake have been observed being seemingly docile in situations where aggression would be expected ("Behavior... a shy," 2013).

### Background: Eastern Massasauga

#### *Taxonomy & Physical Appearance*

*Sistrurus catenatus catenatus*, or the eastern massasauga rattlesnake, is one of three subspecies of massasauga rattlesnakes. The genus *Sistrurus* is comprised of three species of pygmy sized rattlesnakes. Another common name for the eastern massasauga is the Swamp Rattler. Eastern massasaugas are typically anywhere from 17 inches to 28 inches in length from mouth to tail. Although they are short in length as compared to most snakes, they are relatively thick bodied and can have somewhat of a stout look. These snakes typically weigh between 3 and 8 ounces. The eastern massasauga, like many rattlesnakes, is usually well camouflaged in its environment. The base color of their scaled body is brownish gray, accompanied by various symmetric, black blotches running down the dorsal side of the snake ("Life history notes,").

#### *Venom Toxicity*

The eastern massasauga is listed by the U.S. Fish & Wildlife Service as a venomous snake, and is one of only four venomous snakes that inhabit the Midwest region of the United States. Although a bite from an eastern massasauga has the potential to cause fatalities, they have relatively low venom toxicity as compared to other venomous snakes. In total, eastern massasauga bites have caused only two human deaths in recorded history. Both of these incidents occurred in Ontario, Canada near Georgian Bay and neither person received treatment for the bites. It has been nearly sixty years since a human has died from a eastern massasauga

bite, yet in places like Georgian Bay, Ontario snake bites occur on average four times per year (Rusz, Patrick J.). In fact, according to the Department of Wildlife & Ecology Conservation at the University of Florida, many more deaths occur in the United States from lightning strikes than by rattlesnakes all together. The venom toxicity of the eastern massasauga is widely considered the lowest of any venomous snake in North America.

Another factor to take into account when discussing the dangers of venomous snakes is the fact that it is estimated that 20-25% of all pit viper bites on non-prey targets are dry bites (Dr. Steve A. Johnson). Dry bites are snake bites that do not deliver any venom through the bite. Venom usage for venomous snakes can be controlled by a muscle near the venom gland. Many venomous snakes seem to control when exactly to use their venom on a target. It makes sense for a snake to conserve venom given that venom is necessary for hunting and digestion. Eastern massasaugas as well as many rattlesnakes have been observed delivering dry bites as warnings to large animals that got too close and were not a prey item for the snake. Using venom in situations like these would be a waste and could potentially lose them a meal in the near future.

### *Field Observations*

Being a venomous rattlesnake it is somewhat understandable to see why many people might fear eastern massasaugas yet this particular snake has been observed by many naturalists as being a docile and passive snake ("Behavior... a shy," 2013). According to the Michigan Department of Natural Resources the eastern massasauga avoids confrontations with humans and prefers to flee from an area when threatened ("Eastern massasauga rattlesnake," ). Of course, like all wild animals if, if an eastern massasauga feels trapped or is being severely disturbed by human it will defend itself and likely attempt to strike. A large percentage of eastern massasauga bites on people occur when people are attempting to pick them up. Other incidents where bites occur include cases where people have harassed the snake, or where people accidentally step on them or very close to them ("Why conserve a," 1999). In captivity eastern massasaugas are often observed being sluggish and slow moving even when being handled by a professional. While handling them in captivity still takes extreme precaution, they are observed as being much more docile than most venomous rattlers, and in most cases do not even show signs of agitation through rattling their tails (*Toren Hill, Wildlife Prairie Park-Peoria, IL.*).

Outside of docility, eastern massasaugas behave very similarly to other rattlesnakes. Eastern Massasaugas have a lifespan of about 8-12 years in the wild and can live to nearly 20 years in captivity. Mating takes place in early spring, usually around April. Females carry anywhere from 5-20 babies for around 3-4 months and give live birth, as opposed to laying eggs, in the summer. The babies are commonly born in dead logs or in abandoned burrows (Dewey, 2013). Eastern massasaugas are carnivorous, as all snakes are, and they often are found preying on small mice and voles ("Eastern massasauga rattlesnake," ). Overall the eastern massasauga is much like all the other species of rattlesnakes behaviorally, but the habitat and area in which they live in is very unique in comparison to most rattlesnakes.

### *Habitat & Range*

Many people assume all rattlesnakes live in very warm, sometimes subtropical or desert ecosystems. The eastern massasauga rattlesnake has adapted to live and survive in a much different habitat than desert or subtropical forests. The eastern massasauga inhabits the temperate wetlands ecosystem. Historically eastern massasaugas were thought to have ranged from New York up through much of Ontario and all the way to Missouri. This range area has a very seasonal and temperate climate. The area usually sustains hot humid summers, accompanied by sub-freezing, dry winters. Most snakes, and reptiles in general, are not able to survive the bitter cold of winter in this part of the world, but eastern massasaugas have evolved and adapted to hibernate in the moist wetlands of this temperate area ("Eastern massasauga rattlesnake," ).

During the winter months the eastern massasauga rattlesnake inhabits the moist swamps and various other wetlands of this temperate area. It is not uncommon amongst eastern massasaugas to have multiple unrelated snakes hibernating in the same crayfish chimney or mammal burrow during the winter. When multiple unrelated snakes share the same burrow for hibernation the space is referred to as a hibernaculum. This behavior is also seen in other rattlesnakes throughout North America, and some snakes have even been observed sharing hibernation burrows with other species of snake (Link). Once the temperature rises and spring is in full bloom the eastern massasaugas relocate from their wetlands hibernation areas to the adjacent upland dry areas close by. The eastern massasauga uses these various dry uplands for

hunting throughout the summer months. This particular snake species has a strong necessity for both the wetlands and adjacent uplands of this temperate region of North America.

This type of temperate wetland area is very unique to certain regions of the eastern massasauga vast range. The temperate wetlands areas are mostly only found bordering the Great Lakes regions of this range. While some isolated populations do also live near large river systems or natural wetlands areas, most commonly the eastern massauga inhabits wetlands that correlate with the Great Lakes. Of these temperate wetlands areas, there are two different types of wetlands in which eastern massasaugas tend to inhabit.

The first type is the temperate forested wetland. This type of wetland is often densely covered with temperate trees and shrubs while also having a tendency to sustain water on the forest floor year round. Forested wetlands are often found close to glacially scoured lakes like the Great Lakes, where the forest floor is found to be so close to the freshwater line that it often becomes infiltrated with water. Forested wetlands like these are very common in places like Michigan and Ontario near the Great Lakes. These forested temperate wetlands have been shown to be great areas to sustain sizable populations of eastern massasaugas, and as a result can be found in these areas as long as they are close enough to adjacent uplands for the important summer months.

The second type of wetland is the temperate prairie wetlands. The temperate prairie wetlands are often found to lack large populations of trees. Instead, they are often full of thick prairie grasses. Much like the forested wetlands these prairies are often in close vicinity to glacially scoured lakes, yet some of these prairie wetlands can also border large river systems like the Mississippi and Ohio River. Historically, some sizable populations of eastern massasaugas were known for frequently inhabiting the prairie wetlands of Northeastern Illinois. This area gives the eastern massasaugas the seasonal habitat change that they desperately need for survival in such temperate areas.

#### Origins of Chicago Area Wetlands:

Around 20,000 years ago, during the earth's last glacial maximum in the Pleistocene Epoch, the area that is currently known as the Chicago metropolitan area was once covered in

nearly two miles of ice by a vast ice sheet known as the Laurentide ice sheet (Ulman). This ice sheet completely covered modern day Canada and Greenland and stretched South into the Northern United States. About 10,000 years ago, near the end of the Pleistocene Epoch, large ice sheets like the Laurentide ice sheet and other large glaciers had retreated North to the Northern half of Canada and Greenland due to the natural warming of the Earth. Glacial scouring of the Earth occurred from the retreat of ice sheets and glaciers. Melt water from the glaciers began to settle in largely scoured areas creating thousands of glacially scoured lakes in the area that was once covered by the Laurentide ice sheet. Many small lakes as well as the Great Lakes of North America are evidence of a very different world during the Pleistocene Epoch.

Over the last 10,000 years the Chicago area has gone from being at the bottom of a large glacial lake called Lake Chicago to being on the banks of current day Lake Michigan. The topography of the Chicago area shows many low elevation areas just off the shore of Lake Michigan as well as many moraines that were created from glacial scouring. Over time flood events in the area have occurred and naturally the low elevation points of the area would fill up with water. The higher elevated moraines would contribute to keeping the water in the low lands by being a natural boundary for the trapped water. The temperate climate of the Chicago area and moderate precipitation levels of the area have kept the low lands wet consistently creating many permanent wetlands with adjacent moraine high lands (Carter).

#### History of Chicago Population:

Various Native American tribes such as the Potawatomi, the Illinois, and the Miami have inhabited the Chicago area. Many other tribes used Lake Michigan and other water bodies in the area as trade routes (Delgado). In the late 1700's the first permanent European residents of the Chicago area began to emerge and slowly settle the area. The city of Chicago was officially incorporated in 1837 and soon after that the most important contribution to Chicago's growth as a city was under construction. The Illinois-Michigan Canal was completed in 1848. This canal linked the Chicago River, a tributary of Lake Michigan, with the Illinois River (2009, January 1). This canal created the possibility of mass trade from Chicago and other Great Lakes cities to the cities of the Mississippi River and more importantly the link to the Atlantic Ocean. This along

with the vast railroad system which grew to be a large industry in the United States contributed greatly to the success and growth of Chicago.

The population of Chicago grew exponentially due to the mass increase in trade possibilities. In 1840 the U.S. census shows that the city of Chicago had about 4,470 people living there permanently. Ten years later in 1850 that population grew to 29,963 people, which is nearly 6 times as many people as there was in 1840 (2002, January 1). This initial spike was undoubtedly a result of the construction of the Illinois-Michigan Canal. Another ten years later the population jumped to 112,172 people. While the Illinois-Michigan Canal was the main contributor to the exponential growth of Chicago, human geography factors also pushed in large populations of people. African American slaves sought out free lives in cities like Chicago during the mid 19<sup>th</sup> Century, as well as many European immigrants who were looking for steady jobs and new lives in these kinds of big trade cities. At the turn of the century Chicago's population had increased to be over 1,600,000 people.

Over the next one-hundred years the city of Chicago continued to grow quickly. Many blue collar industry jobs and factory jobs kept such a high influx of people coming into the city up until about 1950. The maximum population of the city of Chicago to date peaked in 1950 when the population was at 3,620,962 people ("Chicago population," n.d.). At the time it was the second largest city in the United States behind only New York City. With such a dense population of people within one city Chicago became heavily urbanized with man-made structures like buildings, homes, train stations and tracks, industrial factories, and many more urban development structures. At the time people did not really have much concern about the environment and natural ecosystem of Chicago so the natural areas within the cities easily gave way to human developments. While the destruction of the natural ecosystems and landscapes of Chicago is not a good thing the urbanization was nearly all within the city limits of Chicago, so many of the surrounding areas were left relatively untouched and natural.

Over the last fifty years the city of Chicago has begun a new trend in population patterns. Slowly the population of the city has begun to decrease. In 1990 the city's population decreased below 3,000,000 people and the city had been demoted to the third largest city in the United States now behind Los Angeles ("Chicago population," n.d.). This great decrease in city

population over these years is due in large part to the loss of blue collar industrial and factory jobs. Commercialization of products may be one of the contributing factors to the loss of these types of business practices. With white collar jobs becoming more abundant and blue collar jobs disappearing rapidly the city began to harbor the poor inhabitants who were jobless or worked for low wages while the white collar wealthy workers began to spread out and suburbanize.

The once limited urbanization has since grown to cover great amounts of natural land just outside of Chicago's city limits. Recently, suburbs all over the Chicago area have seen increases in population. For example, Naperville, a Western suburb of Chicago, has seen its population grow from 12,933 in 1960 to over 130,000 people today. Lake County, the county just north of Chicago city limits, has seen a dramatic increase since 1960 as well going from 293,656 to 702,120 today (2005, January 1). The overall metropolitan area of Chicago has also grown to cover many more counties, including counties in Indiana and Wisconsin. The metropolitan area of Chicago now covers 10,857 square miles of land across 16 different counties (2011, July 18).

#### Prairie Wetlands Conservation Issues:

Illinois has always been known for being the Prairie State, yet that name hardly holds true today. In fact, according to the Illinois Natural History Survey, Illinois has around 2,000 acres of designated prairie land left from its original 22 million acres ("The tallgrass," n.d). The reason for the great loss of prairie lands in Illinois, as well as much of the Midwestern states, is because European settlers realized that the prairie soil was perfect for agricultural fields. Fortunately, of the some 2000 acres of prairie land left in Illinois, Lake and Cook County comprise nearly half of all prairie land left in Illinois. Lake and Cook County are very unique from other Illinois counties, in that they border Lake Michigan. Being so close to an immense freshwater system these prairies are actually known as prairie wetlands.

While much of Cook County's natural prairie wetlands were eradicated by urban development due to the rise of the city of Chicago, many of Lake County's natural prairie wetlands were left untouched by agriculture and urban development for several decades. Starting in the 1950's suburbanization became the new trend in Chicago as well as many large cities in the United States. Many Chicago residents began moving out to nearby suburbs in Lake

County, Du Page County, McHenry County, Will County, and Kane County. The increase of people in these areas meant the increase of homes, roads, schools, and all kinds of urban developments. Many of the people who moved from Chicago wanted larger quantities of land in beautiful locations. Of course, the ravishing prairie wetlands of Lake County were some of the popular areas to build subdivisions and neighborhoods around. Homes on or near Lake Michigan have always been some of the most popular estate choices for suburban home owners. Unfortunately, the prairie wetlands started to become urbanized and the wildlife that depended on the preservation of the natural wetlands started to decline. According to the United States Environmental Protection Agency, Illinois had lost up to 85% of its original wetlands habitat by the 1980's (1993, January 1).

**Percentage of Wetlands Acreage Lost, 1780's-1980's**



**Figure 2**

*Twenty-two states have lost at least 50 percent of their original wetlands. Seven states—Indiana, Illinois, Missouri, Kentucky, Iowa, California, and Ohio—have lost over 80 percent of their original wetlands. Since the 1970's, the most extensive losses of wetlands have been in Louisiana, Mississippi, Arkansas, Florida, South Carolina, and North Carolina.*  
 Source: Mitch and Gosselink. Wetlands. 2nd Edition, Van Nostrand Reinhold, 1993

In 1989, the United States Fish & Wildlife Service helped pass the Wetlands Conservation Act. This act stood to conserve and protect the natural wetlands of the United States, including the prairie wetlands of Northeastern Illinois. Over the last 20 years many native prairie wetlands species that were in decline like the eastern prairie fringed orchid have begun to make a comeback thanks in part to the Wetlands Conservation Act of 1989 (2014, March 26). It was originally thought that by protecting and conserving these important remaining prairie wetlands that all of the native wildlife would soon increase.

## Eastern Massasauga Conservation Issues:

While most populations in Northeastern Illinois' prairie wetlands habitat have seen some increases, the eastern massasauga rattlesnake has actually begun to rapidly decline since the 1980's. The Illinois Natural Historical Survey collected some key data showing the difference in eastern massasauga populations before 1980 and after 1980. This survey shows that after 1980 only 11 counties, in Illinois, of the 20 that were previously known to harbor populations of eastern massasaugas had evidence of existing eastern massasauga populations. Lake and Cook Counties were among the 11 counties that had evidence of eastern massasauga populations.

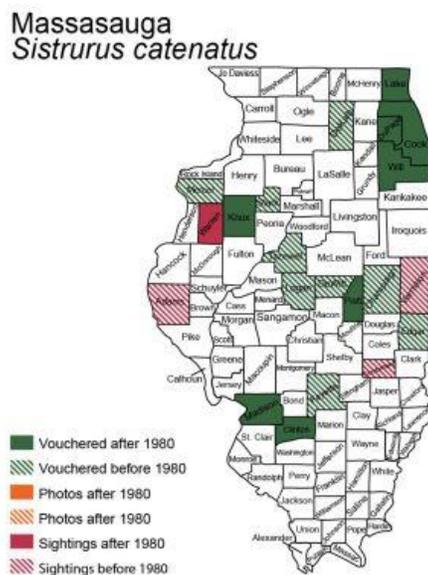


Figure 3

Over the last 20 years populations of eastern massasaugas have continued to decrease exponentially in all areas of the state, even in the protected prairie wetlands of Northeastern Illinois. In 2009, things reached crisis level for the conservation of the eastern massasauga in Northeastern Illinois. Lincoln Park Zoo, of Chicago Illinois, created an eastern massasauga recovery team. The goal of this team was to rescue the remaining eastern massasaugas from the remaining prairie wetlands habitat of Northeastern Illinois and start a breeding program aimed at reintroduction of the species in future years. In spring of 2009, only two eastern massasauga rattlesnakes were found in the various counties of Northeastern Illinois. The team thought that this time would be most effective in finding eastern massasugas because it was the time of the

year where many were expected to move from their hibernation dens in the wetlands to the dryer uplands to hunt. Of the two eastern massasugas that were recovered from the wild, there was one male and one pregnant female ("Eastern massasauga rattlesnake,").

Such a devastating decrease in a key reptile species like the eastern massasauga, even after the help of the Wetlands Conservation Act of 1989, has left many ecologists pondering the question of why this has happened. By compiling Northeastern Illinois human population data, urban land cover data, housing development data, and prairie wetlands habitat with adjacent dry uplands data, and showing quantitatively the correlations between these factors and the decline of the eastern massasauga, mistakes in conservation management can be revealed and addressed so that these mistakes are not repeated in the future.

### **Methods:**

In order to obtain the various data sets needed for the analysis of Chicago suburbanization and its effect on populations of the eastern massasauga rattlesnake, the National Historical Geographic Information System (NHGIS) database was used. NHGIS is a GIS database that was created to freely share government census data obtained since 1790 in the United States. Various shape files could easily be assembled from the information available through the NHGIS database. The three main types of data that were of interest in this particular study include; population census data of Chicago as well as Lake County, urban land cover data of Lake and Cook counties, and wetlands habitat with adjacent uplands dry habitats of Northeastern Illinois. The population census data files correspond to the specific years of 1950, 1960, 1970, 1980, 1990, 2000, and 2010 in each case.

Once datasets were found using NHGIS, data was then selected for comparison. Peculiar datasets for comparison included; population census of Chicago as well as Lake County, and urban land cover of Lake County versus wetlands habitat with adjacent upland dry habitats of Northeastern Illinois. In order to statistically analyze the population census comparisons, the Statistical Package for Social Sciences (SPSS) system was used. SPSS is a computer system that is able to quantify statistically accurate tests of data in order to show correlations as well as

significance of data. This system was accurately able to create linear regressions for the population census comparisons of Chicago, and Lake County from 1950 to 2010.

SPSS was again used to compare human population in Lake County to the estimated population of eastern massasauga rattlesnakes from the years 1990 to 2010. The estimated eastern massasauga rattlesnake population data in Lake County was gathered from the Illinois Natural History Survey website ("Massasauga research,"n.d). A linear regression was used once again for comparison and a corresponding p value was found.

Analysis of Lake County wetlands as compared to Lake County urban land cover was conducted using ArcGIS. ArcGIS is a computer system which uses layers, basemaps, and shape files to create various projections of geographic maps. Users are able to import shape files to create and assemble various types of maps. By using shape files collected from the NHGIS database, various maps could be created to help visually analyze and compare the datasets. GIS online was also used to create urban development versus wetlands and adjacent uplands maps. GIS online is an online website that works similarly to ArcGIS, but all of the datasets and information is already accessible through the website.

Data regarding the hypothesis of a potential increase in Lyme disease cases in the Chicago metropolitan area was found from previous studies. A map found on the Center for Disease Control website regarding suitable habitat for *Ixodes scapularis* was analyzed to assess the risk of Lyme disease in the Chicago metropolitan area, in particular Lake County.

## **Results:**

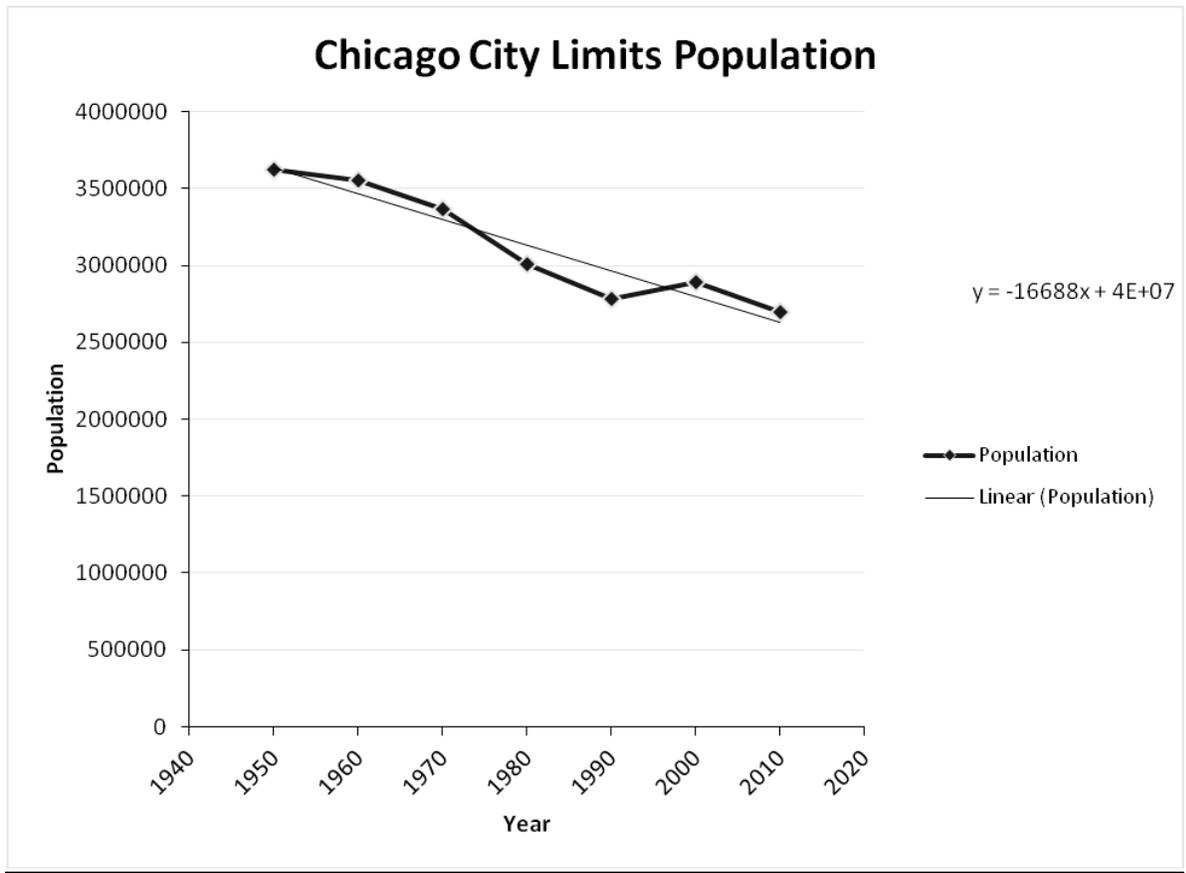
In comparing census records of the populations of Lake County, and the city limits of Chicago from the years 1950 through 2010 it is obvious that certain population trends have radically changed since the 1950's in each area. Chicago was shown to have made stern declines in population since 1950. Chicago was once growing exponentially, decade after decade until around 1950. Overall, the city has lost nearly 1 million people since 1950 and it looks like this

trend will continue in the future. Unlike the city limits of Chicago, Lake County showed to have increased exponentially in population since 1950. In 1950 the entire population of Lake County was less than 200,000 people. Sixty years later in 2010 the population has more than tripled.

For the linear regression run on Chicago human population from 1950 to 2010 the p value was shown to be 0.001. The linear regression for Lake County human population from 1950 to 2010 was shown to have a p value of 0.000002. The linear regression for the estimated eastern massasauga population of Lake County from 1990 to 2010 was shown to have a p value of 0.212. The last linear regression was run between human population of Lake County from 1990 to 2010 and estimated eastern massasauga population of Lake County from 1990 to 2010 and the corresponding p value was found to be 0.078.

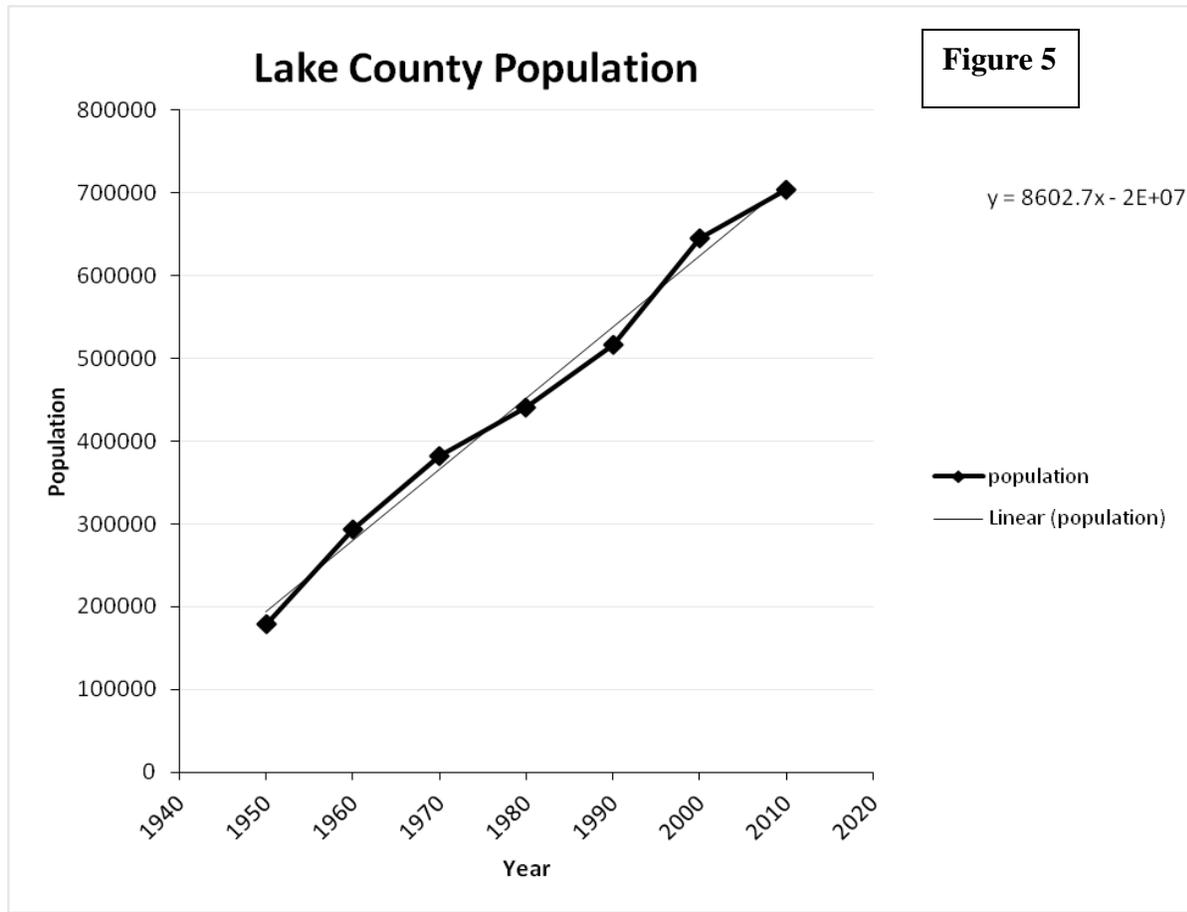
Linear Regression: Human Population Chicago 1950-2010

**Figure 4**



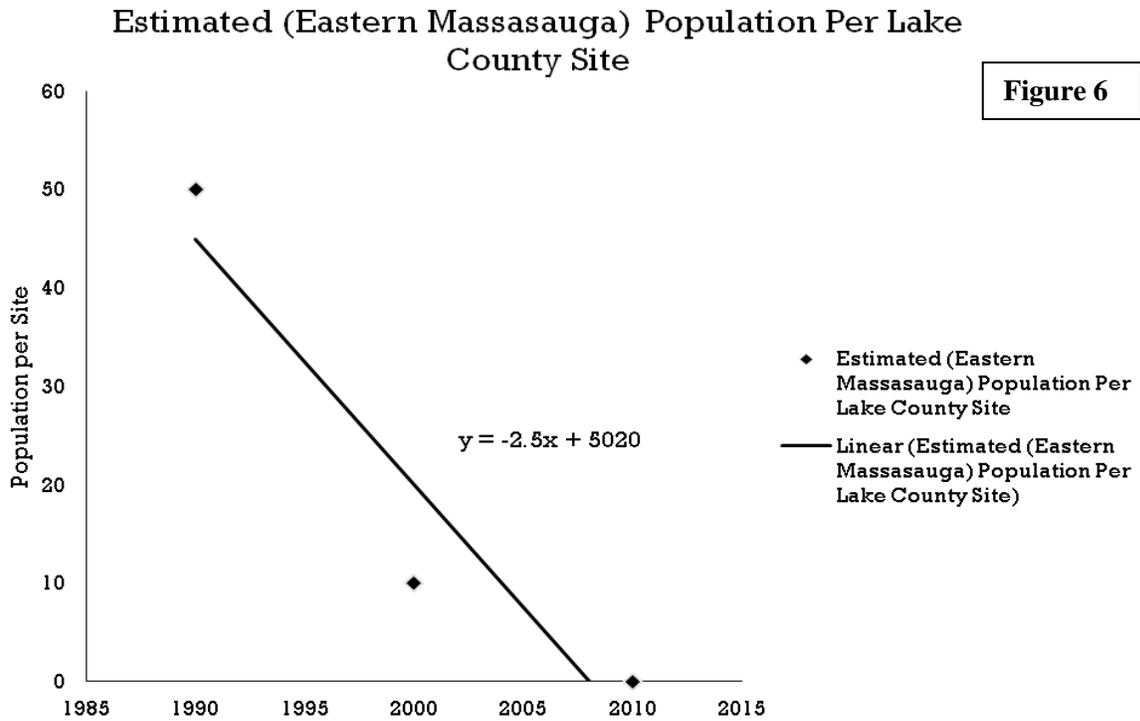
P Value = 0.001

Linear Regression: Human Population Lake County 1950-2010



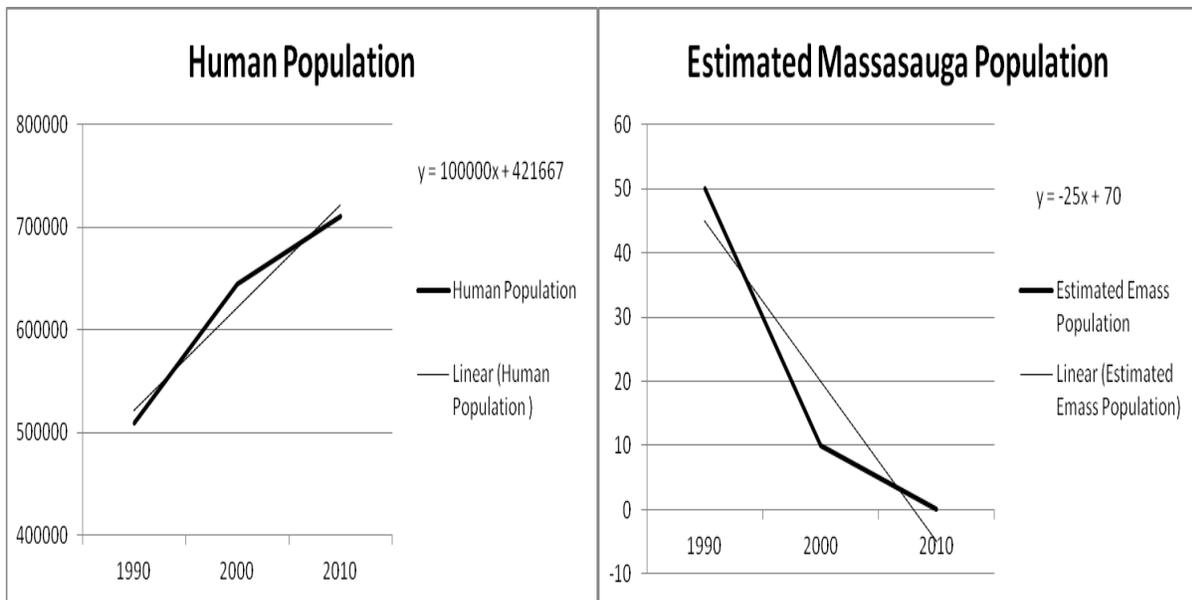
P Value = 0.000002

Linear Regression: Estimated Eastern Massasauga Population 1990-2010



P Value = 0.212

Linear Regression: Estimated Eastern Massasauga Population vs. Human Population Lake County 1990-2010 P Value = 0.078



Urban Land Cover Lake County vs. Wetlands/Adjacent Uplands Habitat Lake County

In comparing the urban land cover of Lake County to the wetlands with adjacent uplands of Lake County geographically, it is easy to see some correlations in the locations of wetlands habitat and urban land cover. The map below is of Lake County, Illinois. The blue area depicts current suitable wetlands habitat while the orange area depicts current new development/urban land cover area. In many places on each map it is evident that the wetlands themselves are mostly free of new development and urban land cover but in many cases the wetlands seem to border the new development and urban land cover areas. Based on the data shown a correlation does exist between wetlands of Lake County and urban land cover of Lake County.

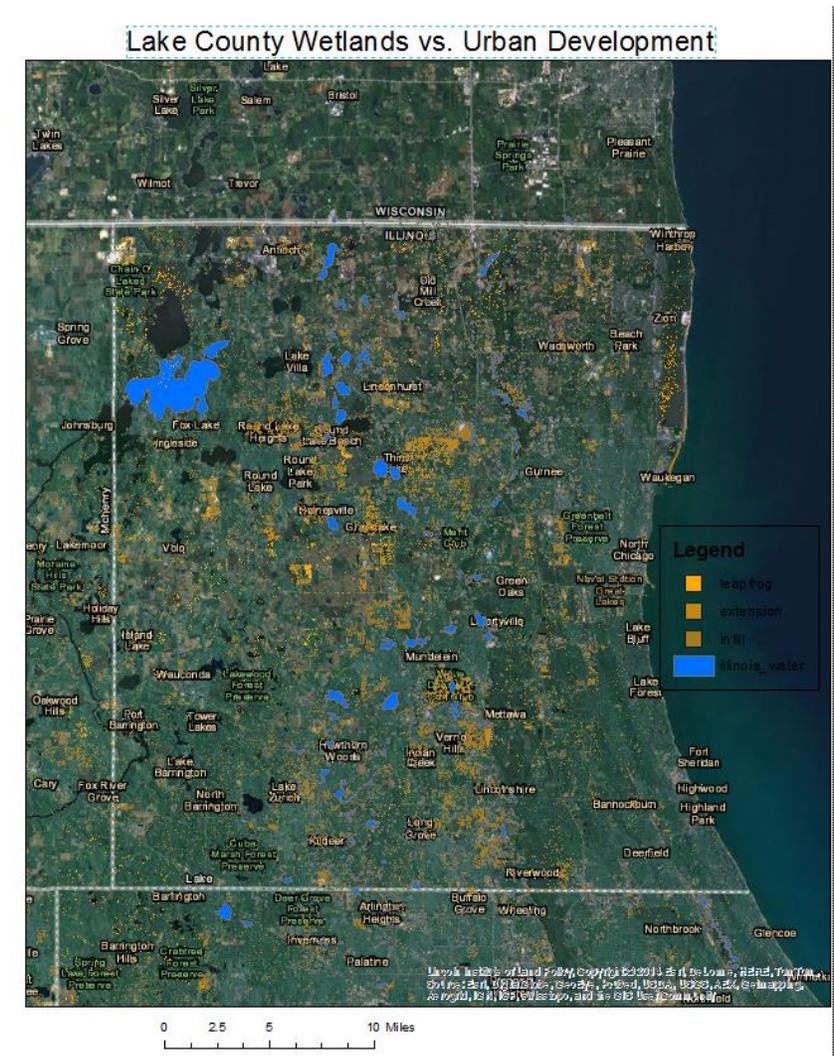
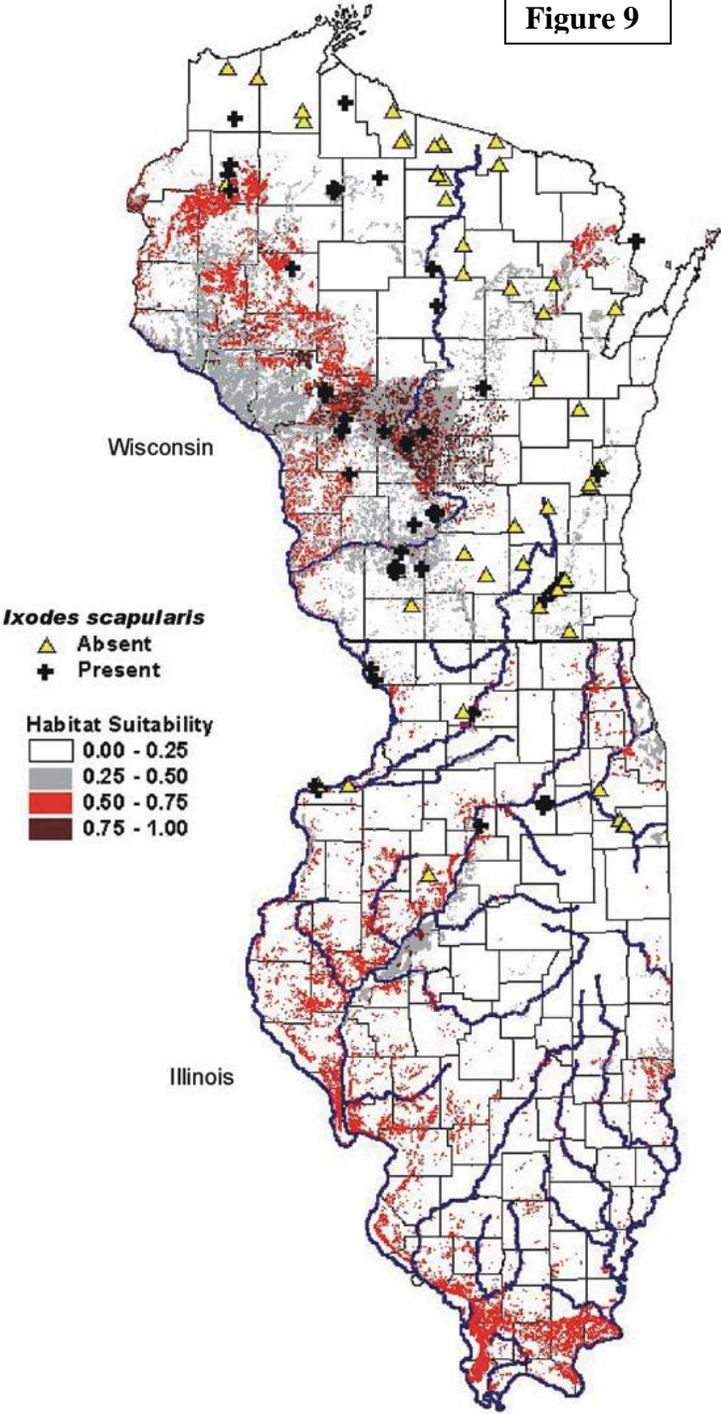


Figure 7

An alternative hypothesis correlating to the depletion of eastern massasauga rattlesnakes in Lake County is that Lyme disease could become a much larger threat to humans in the Chicago metropolitan area with the absence of eastern massasaugas. The thinking behind this hypothesis is that with less rodent predators like the eastern massasauga rattlesnake in a wetlands ecosystem, there could be an increase in rodent populations that may carry Lyme disease. With more rodents that carry Lyme disease there is potential for deer ticks to spread Lyme disease more prominently to humans in the Chicago area. In order to assess the risk of a Lyme disease epidemic in the Chicago area, information and data on the habitat suitability for *Ixodes scapularis*, or the black legged tick, was found on the Center for Disease Control website. The Center for Disease Control provided Figure 9 which accurately shows the habitat suitability of *Ixodes scapularis*. The map provided shows that populations of this black legged tick are currently absent in the counties of the Chicago area, but it does also show that many wetlands areas of Lake County have a moderate to high habitat suitability rating. Overall, the results show that there is a potential for *Ixodes scapularis* to find suitable habitat in Lake County, but currently they are not prominently found in that area.

Figure 9



("Predicting the risk," 2002)

## **Discussion:**

The original hypothesis that there is a significant suburbanization trend in the Chicago metropolitan area can be supported through the results gathered in this study. P values found through creating linear population regressions are shown to be considered significant. The other hypothesis which states that eastern massasauga populations in Lake County have declined as a result of human population increases in Lake County can also be seen to have a correlation, but it is important to note that the p value for this regression was not considered significant.

Given the evidence of rapid suburbanization in the Chicago metropolitan area, urban development in these suburban areas has obviously been on the rise as well. These various urban developments have often been located in critical habitat areas of the eastern massasauga rattlesnake. In the case of urban land cover of Northeastern Illinois, the urban land cover had a correlation between its locations and the wetlands with adjacent dry uplands habitat, where the eastern massasauga was once known to inhabit. Although many of the wetlands, themselves, have been protected since 1989, the adjacent dry uplands have often been used for urban developments such as; roads, businesses, housing units, schools, etc. The wetlands areas of the Chicago area have been relatively left untouched since the 1980's yet the uplands are often overloaded with housing developments. It makes sense for the wealthy suburbanites of Chicago to want to build large homes close to the prairie wetlands of Northeastern Illinois because these areas are often viewed as eye-popping, beautiful areas.

People may not fully understand the damage they could be causing to wildlife like the eastern massasauga when they choose to live so close or directly on their habitats. Home building companies see these wetlands areas as great opportunities to make money. By building these homes and other urban developments so close and sometimes directly on the natural prairie wetlands and adjacent dry uplands habitat of Northeastern Illinois peoples encounters with natural wildlife increase dramatically. Being that people have been known to try to eliminate venomous snakes by killing them as much as possible, it is likely that many eastern massasaugas in these Northeastern Wetlands were likely killed by local humans. When houses are built directly on the adjacent dry uplands of a prairie wetlands habitat, eastern massasaugas have no choice but to enter the nearby uplands to search for food in spring. While the eastern

massasauga is known for avoiding contact with humans, in this case they must risk being seen by humans in order to try to eat and survive.

With the inundation of human communities in wetlands areas which have seen a rapid decrease in eastern massasauga rattlesnakes, it can be inferred that the common prey items of the eastern massasauga, the vole and common prairie mouse, has seen a slight rise in its population. While rodents are seemingly physically unharmed to humans, they often can carry a devastating disease called Lyme disease. Humans can contract Lyme disease if bitten by a black legged tick that has also transmitted the bacteria from these common rodents. While no black legged tick populations have been found to currently reside in the Chicago metropolitan area, it has been shown that much of the wetlands habitat of Lake County is suitable to sustain black legged tick populations. With an increase in rodent populations in Lake County black legged ticks may find the wetlands of Lake County to be a suitable habitat in the future. This means that there exists the potential for Lyme disease cases to become more numerous in the Chicago area. Without predators like the eastern massasauga to hold rodent populations at a steady equal Lyme disease may, in fact, become a much bigger problem for people living in the Chicago area in the near future.

These studies had various limiting factors which have held the overall progress to the statistical data shown above. Further studies in this case could help further support the idea that suburbanization is contributing to the loss of eastern massasaugas in Northeastern Illinois. An up to date survey of eastern massasauga rattlesnakes in Northeastern Illinois would obviously help the studies case. Trapping of mice and voles in former eastern massasauga habitat would help show the rapid increase in rodent species since the desolation of the eastern massasauga rattlesnake. It would also be interesting in the case of this study to survey home owners, and business owners that live in the critical wetlands and adjacent dry uplands habitats of the eastern massasauga on if they have ever seen the snake around or what their general attitude is towards venomous snakes or snakes as a whole. This would help to support the idea that many eastern massasauga rattlesnakes in Northeastern Illinois have been eliminated by humans directly. These types of future studies would undoubtedly further legitimize and increase the relevance of this particular case study.

## **Conclusion:**

Based on the statistical correlations deduced from the various studies, the hypothesis that rapid suburbanization of the Chicago metropolitan area may be contributing to the decline of eastern massasauga rattlesnake populations in Northeastern Illinois can be supported. However, correlation does not entail causation, it merely shows that there is a likelihood that suburbanization of Chicago is a contributing factor to the dramatic decline of the eastern massasuga rattlesnake.

These correlations will hopefully help to open the eyes of conservation management in Illinois and around the planet. The world population is growing each day and threats to the natural wildlife of the planet are becoming more numerous along with it. In order to help conserve the natural species of the world humans need to be able to learn from past mistakes in management, as with the case of the eastern massasauga rattlesnake of Northeastern Illinois.

Suburbanization is likely a trend that will last in the United States for years to come, and with it potential destruction of natural specialized ecosystems, like the temperate prairie wetlands of Northeastern Illinois, will continue to occur unless people start to become more aware of the importance of these natural ecosystems and their inhabitants. With increasing human population it seems that the only viable solution to habitat loss for the future is education. As insignificant as it may seem, education of future and present generations is one of the few hopes for species like the eastern massasauga rattlesnake.

## **Acknowledgements:**

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