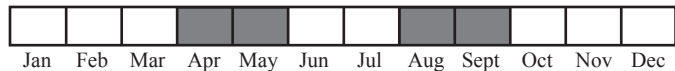


Best Survey Period



Status: Federal candidate species, state special concern

Global and state rank: G3G4T3Q/S3S4

Family: Viperidae (pit vipers and vipers)

Taxonomic comments: Prior to 2011, the eastern massasauga (*Sistrurus catenatus catenatus*) was recognized as one of three subspecies including the western massasauga (*Sistrurus catenatus tergeminus*) and desert massasauga (*Sistrurus catenatus edwardsii*) (Gloyd 1940, Minton 1983, Conant and Collins 1991). In 2011, results from a genetic analysis of the subspecies within the *Sistrurus* genus as well as morphological differences and non-overlapping distributions between the eastern massasauga and the other two subspecies provided strong evidence that the eastern massasauga is distinct from the western and desert massasaugas, and should be elevated to full species status (i.e., *Sistrurus catenatus*, Kubatko et al. 2011). Based on this information, the U.S. Fish and Wildlife Service (USFWS) now recognizes the eastern massasauga as a distinct species (USFWS 2011). However, this change has not been widely adopted or recognized yet.

Range: The eastern massasauga’s range extends from southern Ontario and western New York west through Michigan and southern Wisconsin to southeastern

Minnesota and eastern Iowa and south to southern Illinois, central Indiana, southern Ohio, and northwestern Pennsylvania (Conant and Collins 1991, Harding 1997). The species’ range had previously included Missouri (Conant and Collins 1991, Szymanski 1998), but a study in 2011 found that extant populations in central and northwestern Missouri are genetically more similar to and should be classified as western massasaugas instead of eastern massasaugas (Gibbs et al. 2011). Eastern massasaugas may have occurred historically in eastern Missouri but are now extinct from this part of the state (Szymanski 1998, Gibbs et al. 2011). Eastern massasaugas are also likely extirpated from Minnesota (Szymanski 1998).

State distribution: Michigan appears to be the last stronghold for this species in the U.S. based on the number of extant populations in the state compared to other states within its range. Eastern massasaugas occur throughout Michigan’s Lower Peninsula. Massasauga reports or occurrences appear to cluster in several regions across the Lower Peninsula, indicating areas in the state where they may be concentrated (Legge and Rabe 1994). These areas include Oakland, Livingston, Jackson and Washtenaw counties in southeast Michigan; Allegan, Barry, Berrien, Cass, Kalamazoo and Van Buren counties in southwest Michigan; and in Iosco, Alcona, Alpena, Crawford, Kalkaska, Montmorency, and



Presque Isle counties in northeast Michigan (Michigan Natural Features Inventory (MNFI) 2012). While a number of historical occurrences of this species have not reconfirmed within the last 20-30 years, recent surveys have identified at least 90 extant occurrences in the state including several new county records (MNFI 2012). The species has not been reconfirmed though in Wayne and Huron counties since the mid-1800's and early 1900's (MNFI 2012). It is important to note that a statewide, systematic field survey for this species has not been conducted. Massasaugas are also highly cryptic and difficult to find in their natural habitats. Thus, massasaugas may still be present in areas that lack recent reports, and may occur in new areas in which the species has not been documented.

Recognition: The massasauga is a medium-sized, thick-bodied snake. Adult lengths range from about 18 to 39.5 inches (45 - 100 cm), and average length is about 24 inches (60 cm) (Harding 1997). It has a distinctive color pattern of **dark brown, light-edged saddle- or figure eight-shaped blotches** down the back, with two or three additional rows of **dark brown spots along the sides** and **alternating dark and light bands along the tail**. The **background color** of the snake is **gray, gray-brown or light brown**. Some individuals, however, can be melanistic and look almost entirely black without any obvious patterning. The **belly** or underside of the snake is **dark gray or black**. The massasauga is a rattlesnake, and therefore has a **blunt-tipped, segmented, yellow-gray rattle** at the end of its tail. It has a **triangular-shaped head** (i.e., widens at the back of the head and narrows at the neck) with nine large scales on the top of the head, **vertical slit-shaped pupils**, and **large, heat-sensing pits or openings** between the nostrils and



Melanistic Massasauga Photo by Julie Oakes

the eyes. A black stripe extends from each eye down the side of the head. The scales are keeled (i.e., have a raised ridge), and the anal plate (i.e., enlarged scale partly covering the anal opening) is divided into two parts. It is the only **venomous** snake found in the state. Newborn massasaugas, or neonates, range in length from 7 to 10 inches (18-25 cm), and look similar to adults except are generally lighter in color (Harding 1997). They only have a single button at the end of their tails when they are born, and are unable to produce the sound of a rattle.

Several snakes in Michigan are frequently mistaken for eastern massasaugas. These include the eastern fox snake (*Pantherophis gloydi*, state threatened), northern water snake (*Nerodia sipedon sipedon*), eastern milk snake (*Lampropeltis triangulum triangulum*) and eastern hog-nosed snake (*Heterodon platirhinos*). Young gray ratsnakes (formerly black ratsnakes) (*Pantherophis spiloides*) and young blue racers (*Coluber constrictor foxii*) also can look similar to massasaugas. These snakes have a similar pattern of dark blotches on the back, but they usually have a lighter background color. They also lack the rattle, head shape, and pupil shape of the massasauga. Eastern fox snakes generally have a more slender and longer body than the massasauga (total adult lengths of 35 – 67 in/90 - 170 cm), a solid yellow-colored head, and irregular rows of dark squares or spots on a yellowish background (Harding 1997). The eastern milk snake is thin-bodied, has a Y- or V-shaped mark on the top of its head or neck, and smooth scales. The eastern hog-nosed snake is medium-sized, thick-bodied snake like the massasauga but it has an upturned snout, and flattens and spreads its neck out like a cobra and/or flips over onto its back and pretends it's dead when threatened. The northern water snake has a cream-colored belly with



Photo by Matthew Heumann



crescent-shaped markings. Several of these snakes often will mimic the eastern massasauga and vibrate their tails when threatened, which can produce a buzzing sound similar to the massasauga's rattle if the snake is in dry leaf litter.

Best survey time: Massasaugas typically are active between April and late October (Seigel 1986), and can be seen anytime during the active period. Massasaugas also have been observed earlier and later in the year (mid- to late March and November/December) during periods of warm weather. The best time to survey for this species is in the spring (April - May) when snakes emerge from their hibernacula and move to their summer activity areas (Casper et al. 2001). Other survey windows include mid- to late summer (August to early September) when gravid females are basking and giving birth (Szymanski 1998, Casper et al. 2001), and in the fall (September to early to mid-October) when snakes are moving back to their hibernacula or overwintering sites (Seigel 1986, Johnson 1995, Szymanski 1998).

The recommended survey method is visual searches (Casper et al. 2001). Optimal weather conditions for visual surveys include greater than 50% cloud cover, less than 15 mph wind speed, and air temperatures between 50 and 80° F (Casper et al. 2001). Warm, cloudy days and cool, sunny days seem to provide good conditions for observing massasaugas. Although daily activity cycles vary among populations, Seigel (1986) found that during the spring and fall, massasaugas tend to be most active during the warmest parts of the day (e.g., 1200 – 1600 h). During the summer, they tend to be more active early in the morning and in the late afternoon or evening when temperatures are cooler, and may even become nocturnal. Drift fences with funnel traps and cover boards also have been utilized and have been successful at finding massasaugas in some locations (Casper et al. 2001, Hileman personal communication).

Habitat: Eastern massasaugas utilize a variety of wetland habitats, including bogs, fens, peatlands, shrub carr/thickets, wet meadows, emergent marshes, moist grasslands, wet prairies, floodplain forests, and forested swamps (Reinert and Kodrich 1982, Hallock 1991, Weatherhead and Prior 1992, Johnson 1995, Harding 1997, Johnson et al. 2000, Ernst and Ernst 2003, Harvey and Weatherhead 2006, Marshall et al. 2006, Moore and Gillingham 2006). Populations in southern Michigan are typically associated with open or early to mid-successional wetlands, while those in

northern Michigan are often associated with lowland coniferous forests, such as cedar swamps, in addition to open wetlands (Legge and Rabe 1999, Bissell 2006, Moore and Gillingham 2006, Smith 2009, Bailey 2010, DeGregorio et al. 2011). Massasaugas also utilize drier, upland sites, ranging from prairies, savannas, barrens, and old fields to upland forests and forest openings (Reinert and Kodrich 1982, Harding 1997, Szymanski 1998, Johnson et al. 2000, Bissell 2006, Bailey 2010, DeGregorio et al. 2011). Massasaugas use upland habitats for foraging, basking, giving birth to young, and dispersal. In general, structural characteristics of a site appear to be more important than vegetative composition for determining habitat suitability for massasaugas (Beltz 1992). Known massasauga sites appear to be characterized by the following: (1) open, sunny areas intermixed with shaded areas, presumably for thermoregulation; (2) presence of the water table near the surface for hibernation; and (3) favorable juxtaposition of wetland and upland areas for seasonal use (Beltz 1992, Szymanski 1998, Johnson et al. 2000).

Massasaugas in Michigan were previously thought to hibernate or overwinter primarily in wetlands, but recent research has found that massasaugas also hibernate along the edge or in the transition zone between wetlands and uplands and in uplands adjacent to wetlands (Bissell 2006, Smith 2009). Massasaugas usually hibernate in crayfish or small mammal burrows, old stumps, and root systems of dead and live trees and shrubs (Johnson and Menzies 1993, Moore 2004, Bissell 2006, Smith 2009). The presence of water that does not freeze is critical to hibernaculum suitability (Johnson 1995).

Ecology: Massasaugas usually are active from mid-March or April to October or early November (Ernst and Ernst 2003). Spring emergence typically starts in mid-late March and early April as groundwater levels rise and ground temperature approaches air temperature (Harding 1997, Szymanski 1998). Snakes begin to emerge from hibernacula when there is a soil temperature inversion in which soil temperature near the surface is warmer than that deeper underground (Smith 2009). Massasaugas spend most of the time in the spring basking on elevated sites, such as sedge and grass hummocks, clumps of dead vegetation, muskrat and beaver lodges, or woody debris. Individuals may spend up to several weeks in the wetlands near their hibernation sites before moving to their summer habitats (Johnson 1995). This seasonal shift in habitat



use appears to vary regionally and among populations (Szymanski 1998). In some populations, only the gravid females dispersed to drier uplands to have their young while the males and non-gravid females remained in the wetlands (King 1997), or the gravid females also stayed and gave birth in the wetlands (Moore 2004). In other populations, males, non-gravid females, and gravid females utilized both wetland and upland habitats (Bissell 2006, Kingsbury personal communication).

Mating occurs in the spring, summer and fall (Reinert 1981, Vogt 1981, Harding 1997). The gestation period is, on average, about 100 days (Ernst and Ernst 2003). The females give birth to litters of 8 to 20 live young in burrows, stumps, logs, or other woody debris in open upland or wetland habitats from late July to early October, with most born in August (Vogt 1981, Harding 1997, Ernst and Ernst 2003). The live young are born enclosed in a thin egg sac from which they emerge upon birth (i.e., ovoviviparous). Female massasaugas reach sexual maturity at three or four years of age, and reproduce biennially or annually in some populations in Michigan and other states (Reinert 1981, Seigel 1986, Harding 1997, Ernst and Ernst 2003, Bissell 2006). In some populations, gravid females have been found to return to the same site or general area to give birth during subsequent years.

Massasauga home ranges and movement distances can be quite variable. Average home ranges have been reported from as small as 2.5 acres (1 ha) in Pennsylvania (Reinert and Kodrich 1982) to 62 acres (25 ha) in northern Ontario (Weatherhead and Prior 1992) and 64 acres (26 ha) in New York (Johnson 2000). In Michigan, average home ranges have been reported from about 3 acres (1.3 ha) (Moore and Gillingham 2006), 5 acres (2 ha) (Sage 2005), and 7 acres (2.8 ha) (Bissell 2006) in southern Michigan to 41 acres (16.7 ha) at a site in north-central Michigan (DeGregorio et al. 2011). Reported maximum movements have ranged from 0.1 mile in southern Michigan (Hallock 1991) and 0.6 mi in northern Michigan (DeGregorio et al. 2011) to 2 miles in Wisconsin (King 1997). Male massasaugas usually have larger home ranges than non-gravid females which, in turn, have larger home ranges than gravid, or pregnant, females (Weatherhead and Prior 1992, King 1997, Bissell 2006, DeGregorio et al. 2011). Male massasaugas also generally move longer distances than the females (Bissell 2006, DeGregorio et al. 2011), although gravid females migrate the longest distances from their hibernation sites to their summer range (King 1999, Ernst and Ernst 2003). Neonates, or recently born snakes, have the

shortest home ranges and move smaller distances per day and per season (King 1999). Eastern massasaugas are not territorial as individual home ranges overlap within a population, but males will engage in non-lethal combat for mates (Ernst and Ernst 2003, Moore 2004). Massasaugas are good swimmers and can readily disperse through water (Ernst and Ernst 2003).

Massasaugas feed primarily on small mammals such as voles (*Microtus* spp), shrews (*Blarina* spp. and *Sorex* spp.), and mice (*Zapus* spp. and *Peromyscus* spp.) (Keenlyne and Beer 1973, Seigel 1986, Hallock 1991, Holycross and Mackessy 2002, Shepard et al. 2004). They also will consume snakes and occasionally birds, frogs, and lizards (Keenlyne and Beer 1973, Seigel 1986, Hallock 1991, Ernst and Ernst 2003). Young massasaugas feed primarily on small mammals and snakes (Keenlyne and Beer 1973, Seigel 1986, Shepard et al. 2004). Natural predators for the massasauga include hawks, turkeys, large wading birds, skunks, raccoons, weasels, foxes, and coyotes (Minton 1972, Vogt 1981, Ernst and Ernst 2003). Massasaugas also are commonly killed by humans.

When they are threatened, massasaugas will typically remain motionless, relying on their cryptic coloration to blend into their surroundings. They sound their rattle when alarmed but will occasionally strike without rattling when surprised. Although the temperaments of individual snakes vary widely, this species is generally considered unaggressive. It is unusual for a massasauga to strike unless it is directly disturbed (Johnson and Menzies 1993). Bites to humans are rare, and typically occur when snakes are handled or people come in direct contact with snakes (e.g., stepping on a snake). Although the venom is highly toxic, fatalities are very uncommon because the species' short fangs can inject only a small volume of venom (Klauber 1972). Venom, which is primarily used to kill and digest prey, also takes a lot of energy to produce. As a result, many snake bites contain little to no venom (referred to as dry bites). Most people fully recover from a massasauga bite with prompt and appropriate medical attention.

Starting in late August or September, massasaugas move from their summer habitats back to their hibernation sites. Individuals have been found to return to the same hibernation site or area or even the same burrow or structure year after year (Prior 1991, Smith 2009). This species tends to hibernate singly or in small groups of 2 or 3 up to 7 individuals ((Johnson and Menzies 1993, Smith 2009). Massasaugas also have been observed overwintering with other species



(e.g., garter snakes (*Thamnophis sirtalis*)) (Smith 2009). Ingress or entry into hibernation sites in the fall is triggered by a soil temperature inversion in which the soil temperatures at the surface are now cooler than soil temperatures deeper underground (Smith 2009). Hibernation sites are located below the frost line, usually at least 12 inches (30 cm) below ground, often close to groundwater level (Smith 2009). The snakes hibernate partially submerged in water to prevent from freezing and desiccation, insulate against sudden temperature changes, and potentially respire through their skin by getting oxygen from the water which requires less energy than hibernating in air (Costanzo 1989, Smith 2009). The snakes move up and down within the hibernation sites following the frost line as the temperature rises and falls throughout the winter.

Conservation/management: Eastern massasaugas were once common across its range, but have declined drastically since the mid-1970's (Szymanski 1998). Rangewide, approximately 40 percent of the counties in which eastern massasaugas have been documented no longer support the species (Szymanski 1998). The eastern massasauga now primarily occurs in small, isolated populations, and has been listed as endangered or threatened in every state or province in which it occurs except for Michigan where it is designated as a species of special concern. The eastern massasauga also was listed as a federal candidate species by the U.S. Fish and Wildlife Service in 1999, which means that it may be listed as federally threatened or endangered under the Endangered Species Act in the future.

The greatest threats to eastern massasauga populations are habitat loss and degradation due to human activities, including the draining of wetlands for agriculture, residential development, roads and pollution (Szymanski 1998). In addition to the loss of wetlands, essential upland habitat has been destroyed and fragmented. Vegetative succession also has reduced habitat availability (Beltz 1992, Johnson 1995). Current land use practices, hydrological changes and fire suppression have altered or eliminated the natural disturbance regimes necessary for maintaining the early successional structure with which massasaugas are associated (Szymanski 1998). Vehicle-caused mortality and injury also pose a significant threat to populations as suitable habitat becomes fragmented by roads (Szymanski 1998). Roads also have been found to pose a barrier to movement for massasaugas (Kingsbury personal communication).

Overcollection for commercial, recreational, scientific, or educational purposes has greatly reduced massasauga numbers at many sites, particularly collection for the pet trade and bounty hunting in states other than Michigan (Szymanski 1998). The lack of uniform protection for the massasauga across its range can create loopholes for illegal take and trade (Szymanski 1998), and lead to increased collecting pressure in states where take is not prohibited. Indiscriminant persecution by humans also has contributed to this species' decline. In Michigan, the eastern massasauga is protected under the Director's Order No. DFI-166.98, Regulations on the Take of Reptiles and Amphibians, which is administered by the Michigan Department of Natural Resources' Fisheries Bureau. It is unlawful to take an eastern massasauga from the wild except as authorized under a permit from the Director (legislated by Act 165 of the Public Acts of 1929, as amended, Sec.302.1c (1) and 302.1c (2) of the Michigan Compiled Laws). Public land managers and the general public should be informed that this species is protected and should not be collected or harmed. Any suspected illegal collection of eastern massasaugas should be reported to local authorities, conservation officers or wildlife biologists.

Management and protection of suitable wetland and associated upland habitats are critical for conservation of the eastern massasauga. Where populations are concentrated on public lands, land management efforts should consider and implement strategies to maintain and restore massasauga habitat where appropriate and minimize adverse impacts to the species whenever possible. For instance, potential adverse impacts of land management practices such as timber harvesting, mowing, or prescribed burning can be avoided or



Photo by Joseph Sage



minimized if these activities are conducted in late fall, winter, or early spring (i.e., November through early March) when the snakes are hibernating. Hydrological alterations such as winter drawdowns should be conducted prior to the initiation of hibernation to reduce the potential for causing winter mortality due to desiccation or freezing (Szymanski 1998). Extended flooding during the active season also can be detrimental to populations. Viable massasauga populations in the state should be identified and targeted for long-term conservation and management efforts. Finally, education and outreach should be conducted to raise public awareness and understanding of the biology, ecology and value of the eastern massasauga to reduce direct harm to individual snakes.

Research needs: While recent sightings and information on the distribution of the species have been compiled (Legge and Rabe 1994), additional surveys and monitoring are needed to assess and determine the status and viability of the species and individual populations in the state. Additional work is needed to obtain long-term data on selected populations to identify healthy or viable massasauga populations. Efforts also are needed to determine the number and locations of populations that should be managed and protected, and the resources needed to sustain these populations and massasaugas in perpetuity in Michigan. A reliable and efficient protocol or methodology for surveying and monitoring this species and estimating population size needs to be developed. Continued research and monitoring are needed to improve our understanding of the specific biology and ecology of Michigan massasaugas, particularly in northern Michigan, as well as potential impacts of various management practices. The genetic diversity of extant populations needs to be monitored and assessed over time. Effective methods to educate the public about how to co-exist with massasaugas also need to be researched and implemented.

Related abstracts: Mitchell's satyr butterfly, spotted turtle, Blanchard's cricket frog, eastern fox snake, Kirtland's snake, wood turtle, Blanding's turtle, eastern box turtle, small white lady's-slipper, mat muhly, Hill's thistle, Allegheny plum, red-legged spittlebug, swamp metalmark, Poweshiek skipperling, Karner blue, blazing star borer, bog, prairie fen, coastal fen, coastal plain marsh, dry northern forest, dry-mesic northern forest, dry-mesic prairie, dry-mesic southern forest, floodplain

forest, hardwood-conifer swamp, mesic prairie, mesic sand prairie, northern fen, northern hardwood swamp, northern shrub thicket, northern wet meadow, oak barrens, oak openings, oak-pine barrens, patterned fen, pine barrens, poor conifer swamp, poor fen, rich conifer swamp, rich tamarack swamp, southern hardwood swamp, southern wet meadow, wet prairie, wet-mesic prairie, wet-mesic sand prairie.

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