

Eastern Massasauga (*Sistrurus catenatus*) Species Guidance

Family: Viperidae – the pit vipers

State Status: [Endangered](#) (1975)

State Rank: [S1](#)

Federal Status: [Threatened](#) (2016)

Global Rank: [G3G4T3Q](#)

Wildlife Action Plan

Mean Risk Score: [4.7](#)

Wildlife Action Plan Area

Importance Score: [2](#)



Counties with documented locations of eastern massasaugas in Wisconsin. Source: Natural Heritage Inventory Database, February 2013



Rori Paloski, Wisconsin DNR

Species Information

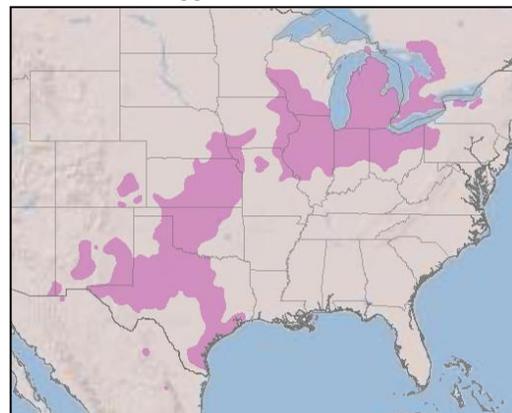
General Description: The eastern massasauga is a relatively short, heavy-bodied snake with a total adult length of 51-82 cm (20-32 in). Massasaugas possess large, distinct, saddle-shaped or oblong blotches along their backs, sometimes outlined with a thin white or yellowish margin, and smaller blotches between the large blotches along their sides. The blotches are typically dark brown to blackish, occasionally light chocolate or reddish brown, and overlaid on a light gray background. The head is heavily patterned, with thick brown bands running from the eye to the back corner of the mouth and heat sensing pits between the eye and nostril. Juvenile massasaugas look similar to adults, but have a yellow or green tipped tail and may only have one rattle segment called a button. Scales are keeled, the anal plate is undivided, and like most snake species, males have relatively longer tails than females. This snake's tail is tipped with an obvious rattle, and its pupils are elliptical.

Similar Species: The only other rattlesnake species native to Wisconsin is the timber rattlesnake (*Crotalus horridus*), but the two are easily distinguishable by several characteristics. Adult timber rattlesnakes are much larger than adult massasaugas and possess black or dark brown bands rather than blotches. Timber rattlesnakes have a solid yellowish head and black tail as opposed to the massasauga's patterned head and tail. These two rattlesnakes also occupy very different habitats; the timber rattlesnake is primarily an upland species, and the massasauga is more often associated with wetland habitats. The common watersnake (*Nerodia sipedon*) is often found in similar habitats as the massasauga and occasionally mistaken for a venomous species. The watersnake, however, is generally darker than the massasauga, lacks a rattle, and appears mostly brown or olive when dry and patterned with alternating thick reddish-brown and thin gray bands when wet. Many of the larger non-venomous snakes in Wisconsin are considered rattlesnake mimics because they vibrate their tail in response to a perceived threat, and are often mistaken for rattlesnakes. Juvenile eastern foxsnakes have very similar patterning to massasaugas, but venomous species have a tail tipped with an obvious rattle and elliptical pupils, whereas all non-venomous species in Wisconsin possess round pupils.

Associated Species: Species associated with the eastern massasauga are wetland-dwelling species and include predators (e.g., fish, American bullfrogs [*Lithobates catesbeianus*], turtles, North American racers [*Coluber constrictor*], loggerhead shrikes [*Lanius ludovicianus*], large hawks, owls, large wading birds, carnivorous mammals) and prey (e.g., short-tailed shrews, masked shrews, voles, mice, birds, DeKay's brownsnakes [*Storeria dekayi*], common gartersnakes [*Thamnophis sirtalis*], American toads [*Anaxyrus americanus*], and spring peepers [*Pseudacris crucifer*]).

State Distribution and Abundance: Massasaugas historically occurred throughout southern and west-central Wisconsin, but were aggressively persecuted in the 19th and 20th centuries and now are limited to several isolated wetlands. Distribution information for this species may not reflect its full extent in Wisconsin because many areas of the state have not been thoroughly surveyed.

Global Distribution and Abundance: Eastern massasaugas – the only subspecies found in Wisconsin - range west from western New York, western Pennsylvania, and southern Ontario to eastern Iowa and Missouri, and extreme southeastern Minnesota. There are two other subspecies (the western massasauga; *Sistrurus*



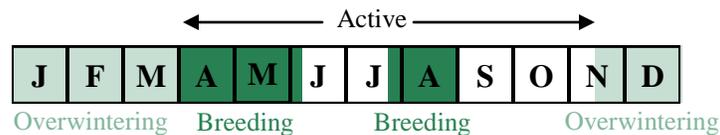
Global range map for the Massasauga. (NatureServe 2013)

catenatus tergeminus, and the desert massasauga; *Sistrurus catenatus edwardsii*) that make up the rest of the massasauga's range.

Diet: Massasaugas are primarily diurnal ambush predators that wait motionless for unsuspecting prey, but some active foraging may occur (Ernst and Ernst 2003). Small mammals make up the bulk of their diet (Weatherhead et al. 2009). Keenlyne and Beer (1973b) reported that a single species of vole (*Microtus pennsylvanicus*) constituted over 85% of the diet of Wisconsin individuals, and only 5% of stomach contents contained cold-blooded prey. Weatherhead et al. (2009) reported that mammals made up 97% of the massasauga diet in Ohio and 88% in Ontario, and anurans (frogs and toads) were rarely eaten. The total percentage of mammals in the diet will be reflective of the prey type in the area (Weatherhead et al. 2009), and studies from other locations have found that a larger proportion of the massasauga's diet may consist of cold-blooded vertebrates (as reviewed by Ernst and Ernst 2003). Juveniles have been found to prey primarily on other snakes and small mammals (Shepard et al. 2004).

Reproductive Cycle: Breeding may occur in the spring and then in the late summer or fall (Vogt 1981, Ernst and Ernst 2003), and females may exhibit an annual or biennial reproductive cycle (Reinert 1981, Seigel 1986, Ernst and Ernst 2003). McCumber (pers. comm.) noted most breeding activity over a four year period was restricted to late July and August in a Wisconsin population. Similar observations have been made in Iowa (VanDeWalle 2005a). When late-summer or early-fall breeding occurs, females may hold sperm over winter to give birth to their ovoviviparous (live bearing) young the following year (Ernst and Ernst 2003). Throughout the species' range, parturition dates typically vary from late July to early October, and most births occur in August (Keenlyne and Beer 1973a, Ernst and Ernst 2003). Birthing "rookeries" may be located under over-hanging rocks, along train tracks (J. Kapfer pers. obs.), in or under fallen logs, and in mammal burrows (Vogt 1981). Ernst and Ernst (2003) report the average clutch size of this species to be eight individuals, while VanDeWalle (2005a) clutch sizes of five and six in Iowa. Wisconsin litter sizes vary from five to 20, and older snakes produce more offspring (Harding 1997). Neonates average approximately 22 cm long and weigh roughly eight to nine grams (Ernst and Ernst 2003).

Ecology: Eastern massasaugas emerge from winter dormancy as spring floods occur (Vogt 1981, Ernst and Ernst 2003). Soil temperatures at 15-cm soil depth in open-canopy wetlands during emergence in Wisconsin typically exceed 10° C (Casper et al. 2008). Pennsylvania massasaugas initially prefer low poorly drained habitats when they emerge from overwintering, then favor thickly vegetated moist habitats from May to early June, and move into drier, more sparse habitats during parturition and foraging as waters recede (July-August) (Reinert and Kodrich 1982).



Massasaugas have highly variable home range sizes that appear to be dictated by numerous factors such as geographic location, habitat quality, habitat fragmentation, and snake density. At two sites in Iowa, VanDeWalle (2005a) reported mean convex polygon home ranges of non-gravid females to be 14.3 acres and 74.6 acres. Durbian et al. (2008) found a fair amount of variation in home range size from convex polygons measured at three sites in Missouri (257.7 acres, 329.6 acres, and 249.1 acres) and two sites in Wisconsin (75.9 acres and 1330.7 acres). Moore and Gillingham (2006) reported average movement rates of nearly 7 m per day in Michigan and convex polygon home range estimations averaging 3.19 acres. Jellen and Kowalski (2007) found that newly hatched massasaugas move frequently before winter dormancy, but their estimated mean areas of activity (0.89 acres) and movement rates (5.3 m/d) were small.

VanDeWalle (2005a) found that individuals in Iowa typically migrate back to overwintering locations in early to mid-October, but cooler than normal temperatures in late summer may drive snakes back to overwintering locations several weeks early. Annual and geographic variation in dates of emergence and overwintering is driven by seasonal weather. Overwintering locations include crayfish burrows, small mammal burrows, old stumps, rotten logs and moist poorly drained habitats (Maple 1968, Ernst and Ernst 2003). In Ohio, massasaugas were found to be able to hold their body temperatures above environmental temperatures for 45 minutes (Ernst and Ernst 2003) and by overwintering in moist, poorly drained habitats are able to avoid lethally low temperatures and desiccation (Maple 1968).

Massasaugas do not always rattle to make their presence known, and may only rattle at the last instant; the rattling sound is also somewhat quiet, and resembles the buzz of an insect (Vogt 1981).

Natural Community Associations (WDNR 2005, WDNR 2009):

Significant: [alder thicket](#), [calcareous fen](#), [dry prairie](#), [dry-mesic prairie](#), [emergent marsh](#), [ephemeral pond](#), [floodplain forest](#), [mesic prairie](#), [oak barrens](#), [open bog](#), [pine barrens](#), [sand prairie](#), [shrub carr](#), [southern sedge meadow](#), [wet prairie](#), [wet-mesic prairie](#)

Moderate: Southern hardwood swamp

Minimal: none

Habitat: Massasaugas generally use open-canopy wetland and upland vegetation types left by glacial retreat (Reinert and Kodrich 1982, Cook 1993, Ernst and Ernst 2003). The specific type of lowland habitat preferred varies considerably with geographic location, but preferred habitats typically possess similar structural characteristics. Various studies have shown massasaugas to be particularly associated with emergent wetlands. Marshall et al. (2006), for example, reports that undeveloped shoreline associated with a small open water body was preferred, followed by cattail stands and sedge tussock wetlands, but agricultural areas were avoided. VanDeWalle (2005a) found that massasaugas in Iowa used dense reed canary grass less frequently than wet prairies and were often found in roadside ditch wetlands. Massasaugas in Michigan and Wisconsin prefer emergent wetlands, shrub wetlands, and lowland hardwood habitats, and avoid upland hardwood and disturbed habitats (McCumber and Hay 2002, Moore and Gillingham 2006). Massasaugas in Michigan have been found in high herbaceous cover interspersed with moderate dead herbaceous cover (Bailey et al. 2012), and in Wisconsin are primarily restricted to open-canopy or shrub wetlands imbedded within river-bottom forests (Vogt 1981, McCumber and Hay 2002). Harding (1997) indicates that lowland habitats are used from fall through late spring and well-drained upland habitats (e.g., shrubby fields, grasslands, pastures and hayfields) are selected during the summer. Encroachment of tall shrubs is a limiting factor for thermoregulation sites (Shoemaker and Gibbs 2012).

Telemetry studies of massasaugas throughout their range demonstrate that habitat use at the microhabitat scale is more important than at the macro habitat or landscape scale (McCumber and Hay 2002, Harvey and Weatherhead 2006a). Harvey and Weatherhead (2006a) found that microhabitat selection differs based on whether snakes were males, gravid females, or non-gravid females. For example, gravid females preferred open-canopy locations with high amounts of rock cover that were close to retreat sites. Males and non-gravid females selected locations with greater canopy closure and less rock cover, and located slightly further from retreat sites. The presence of escape cover, regardless of landscape-level habitat type, was an important component of habitat selection for this species.

Overwintering habitat varies depending on geographic location. Massasaugas are often reported to overwinter in crayfish burrows, but they also use small mammal burrows (Vogt 1981, McCumber and Hay 2000, VanDeWalle 2005a). Harvey and Weatherhead (2006b) found that massasaugas in Ontario overwintered in old root systems, rodent burrows and rock crevices in forested habitat. These snakes did not always return to exactly the same overwintering location over multiple years, but 70% were found to overwinter in the same general vicinity (i.e., at the previous overwintering location or within 100 m). This study also reported a 20% mortality rate for overwintering massasaugas.

Threats: As with most snakes, particularly rattlesnakes, human-related mortality (e.g., direct killing, road mortality, and habitat destruction) is a great threat to this species (Weatherhead and Prior 1992, Dreslik 2005). VanDeWalle (2005a) found that 47% of the mortality observed in radio-tagged individuals was due to road mortality. Shepard et al. (2008) also reported substantial road mortality at an Illinois site. Illegal collecting of massasaugas for the pet trade, management practices, and habitat fragmentation are also a threat to this species. Research on the potential impacts of two common habitat management practices (mowing with blades at 10-15 cm from ground and summer burning) determined that both resulted in substantial massasauga mortality (Durbian 2006).

In several Wisconsin massasauga populations, the alteration of hydrology (e.g., the lowering of pool levels just before or during winter months) appears to have played a role in this species' decline. Damming of rivers and streams has inundated massasauga habitat and raised the water table in adjacent wetlands, resulting in the loss of suitable habitat and population carrying capacity (Reinert and Bushar 1992). Dams have also affected sedimentation patterns, resulting in the filling of braided channels and backwaters and increases in the duration of flooding (J. Wetzel pers. comm.). Flooding has been shown to cause significant short-term mortality (Siegel and Sheil 1994, R. Hay pers. obs.) and could become a major factor for this species if flooding frequency and duration increases.

Climate Change Impacts: Anticipated changes in storm frequency and intensity (WICCI 2011), peak water levels, and other waterway characteristics may create a shift to deeper wetland types with increased flooding duration in low-lying areas and higher initial water levels in ephemeral ponds. These changes may cause significant short-term mortality (Siegel and Sheil 1994, R. Hay pers. obs.). A warmer climate may also reduce soil moisture through increased evaporation and transpiration (WICCI 2011). A lack of soil moisture could prove to be detrimental to overwintering sites and pose a threat of desiccation or increased travel to find suitable overwinter habitat. Increased flooding and a warmer/drier climate may also open new suitable habitat for the eastern massasauga and offset some negative effects, but the species' restricted distribution in the state (see the "State Distribution and Abundance" section) and limited adaptive capacity (limited migration ability) may prevent colonization of new areas.

Survey Guidelines: Persons handling massasaugas must possess a valid [Endangered and Threatened Species Permit](#) and should take care when handling venomous snakes. If surveys are being conducted for regulatory purposes, survey protocols and surveyor qualifications must first be approved by the Endangered Resources Review Program (see *Contact Information*). The U.S. Fish and Wildlife Service's suggested survey protocol for this species indicates that visual encounter surveys (VES) for a minimum of 10 years are the most effective means to determine presence (Casper et al. 2008). This protocol must be followed when conducting surveys for regulatory purposes. This protocol suggests focusing on suitable habitat under optimal conditions (e.g., > 50% cloud cover, < 15 mph breeze, and temperatures from 50-80 F) in the morning or evening. Cloudy and cool days, especially in late spring and summer, usually cause the snakes to bask in exposed microhabitats (e.g., small areas of dead vegetation, debris piles) and, therefore, improve

snake detection probability. Surveys should focus on the likely spring emergence period and, if possible, immediately after controlled burns. In Wisconsin, some massasauga populations migrate from open-canopy meadows to shrub-carr or lowland hardwoods to overwinter, and therefore early post-emergence spring surveys are less productive. Therefore, the window for surveys should run from early May through mid-June under the above conditions, unless a pre-emergence burn has just been conducted. A second survey window occurs in late July through mid-August when females are in late in the gestation period and giving birth. Surveys can be conducted on sunny days if they are conducted during morning hours and prior to temperatures exceeding 75° F or in the evenings within 1.5 hours of sunset.

Non-regulatory surveys focusing on habitat may exhibit a bias if relying only on VES captures (Weatherhead and Prior 1992). Weatherhead and Prior (1992) reported that habitat where snakes were captured via VES was drastically different from habitat used by snakes located using telemetry. In a telemetry study in Ohio, Weatherhead et al. (2009) caught and radio collared most snakes via cover boards. When using cover boards, place 5 to 10 boards in suitable habitat (see “Habitat” section above) March through September. For the massasauga, upland habitat is recommended to provide a warm, protected, dry habitat under the board ideal for basking under cover (Shoemaker and Gibbs 2010, R. Hay pers. comm.). Check the boards several times per week during appropriate weather conditions.

Summarize results, including survey dates, times, weather conditions, number of detections, detection locations, and behavioral data and submit via the WDNR online report: <<http://dnr.wi.gov>, keyword "rare animal field report form">.

Management Guidelines

The following guidelines describe actions that will help maintain or enhance habitat for the species. These actions are not mandatory unless required by a permit, authorization or approval.

This section provides guidance for maintaining, restoring and enhancing habitat for the eastern massasauga. The habitat management goal for this species is long-term preservation of open-canopy wetlands connected to open-canopy uplands.

Habitat management should be considered at two levels:

1. Reduce or eliminate forest cover and dense brush to open up the landscape.
2. Manage herbaceous vegetation to promote a canopy that matures at about 0.5-1.0 m in height. Massasaugas appear to select for these low canopy areas in relation to the availability of this micro-type (Johnson and Breisch 1993).

Upland Habitat: Management should strive to enlarge and/or connect smaller openings when snakes are inactive (November 1-March 31). Small-scale manipulations (e.g., maintaining high cover of live herbaceous growth interspersed with moderate standing dead herbaceous cover and relatively few tall trees and shrubs) coupled with small burn areas (e.g., 0.75-30 acres) may promote favorable conditions for thermoregulation, and provide snakes a gradient of early-successional conditions (Bailey et al. 2012). It is very important to retain downed woody debris (e.g., trunks and tops) on-site, especially if the site is dominated by taller canopy herbaceous vegetation. For habitat restoration, select native broad-leafed herbaceous vegetation and sedges over grasses (Hay 1993). Low-growing shrubs are also preferable to taller shrubs. Shoemaker and Gibbs (2010) report that vegetation management should be conducted at small spatial scales to achieve benefits (both economical and functional) and general management should focus on larger spatial scales.

Wetland Habitat: Massasaugas use a variety of open-canopy wetland habitats. Natural succession and tall invasive herbaceous vegetation (e.g., reed canary grass [*Phalaris arundinacea*] and giant reed grass [*Phragmites sp.*]) can reduce habitat suitability and force snakes into remaining smaller areas. Maintaining wetland habitat may involve thinning and/or removing woody vegetation. Wetland maintenance may also involve reducing dense cattail (*Typha sp.*) beds and/or stands of exotic species (e.g., reed canary grass, purple loosestrife [*Lythrum salicaria*], giant reed grass) so that they account for 50% or (preferably) less of the wetland. Sustaining viable crayfish populations will likely increase carrying capacity by providing more cover and overwintering locations. Reducing pool and reservoir levels during the summer months can result in the restoration of suitable habitat for the snake. Pool levels should not be reduced during the fall and winter months because doing so can kill a population overwintering in the area.

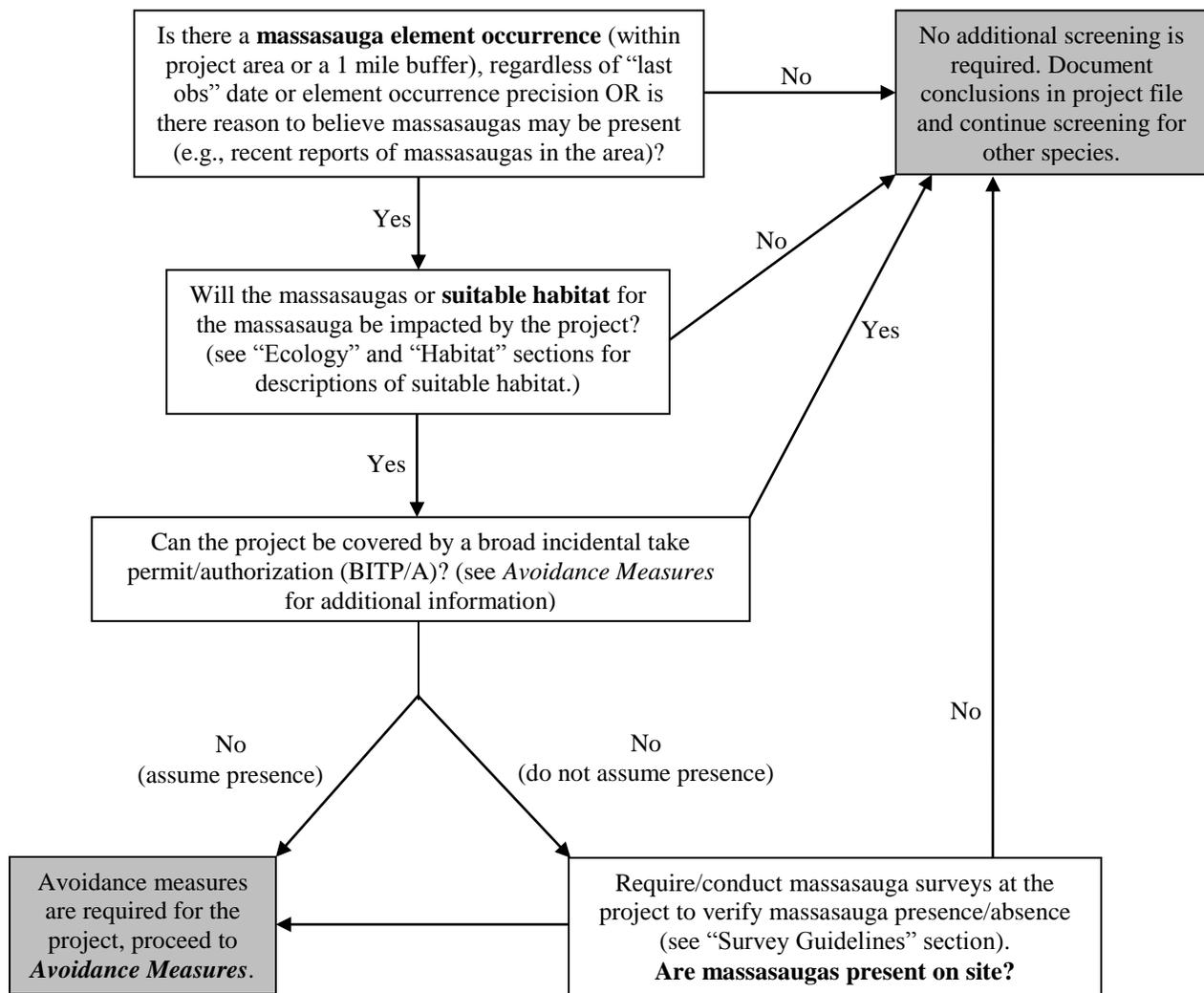
General Habitat: Low-canopy herbaceous vegetation is especially important to massasaugas (Johnson 1995) and appears to be critical for gestating females that require higher temperatures prior to giving birth, especially where large woody debris and debris piles are absent (Hay and McCumber pers. obs). If early successional uplands and wetlands are limiting, then carefully applied treatments (e.g., mowing, burning, woody species removal) should positively affect populations by creating or improving habitat (Johnson et al. 2000); management is permitted according to the [Grassland and Savanna Management Protocol](#) (WDNR 2011). Prescribed burns in suitable wetlands and uplands, during the massasauga’s active season have caused significant mortality and should be strictly avoided (Erwin and Stasiak 1979, Seigel 1986).

Plastic netting without independent movement of strands can easily entrap snakes and other wildlife moving through the area, and cause dehydration, desiccation, and eventually mortality (Kapfer and Paloski 2011). If erosion matting (also known as an erosion control blanket, erosion mat or erosion mesh netting) is used, use the following matting (or something similar): North American Green S75BN, S150BN, SC150BN or C125BN. Netting that contains biodegradable thread with the “leno” or “gauze” weave (contains strands that are able to move independently) has the least impact on wildlife.

Screening Procedures

The following procedures must be followed by DNR staff reviewing proposed projects for potential impacts to the species.

Follow the “Conducting Endangered Resources Reviews: A Step-by-Step Guide for Wisconsin DNR Staff” document (summarized below) to determine if eastern massasaugas will be impacted by a project (WDNR 2012):



Avoidance Measures

The following measures are specific actions typically required by DNR to avoid take (mortality) of state endangered or threatened species per Wisconsin's Endangered Species Law (s. 29.604, Wis. Stats.). These guidelines are typically not mandatory for non-listed species (e.g., special concern species) unless required by a permit, authorization or approval.

According to Wisconsin's Endangered Species Law (s. 29.604, Wis. Stats.), it is illegal to take, transport, possess, process, or sell any wild animal on the Wisconsin Endangered and Threatened Species List (ch. NR 27, Wis. Admin. Code). Take of an animal is defined as shooting, shooting at, pursuing, hunting, catching or killing.

If *Screening Procedures* above indicate that avoidance measures are required for a project, follow the measures below. If you have not yet read through *Screening Procedures*, please review them first to determine if avoidance measures are necessary for the project.

1. The simplest and preferred method to avoid take of eastern massasaugas is to avoid directly impacting individuals, known massasauga locations, or areas of suitable habitat (described above in the "Ecology" and "Habitat" sections and in *Screening Procedures*).
2. If suitable habitat cannot be avoided, follow these time-of-year restrictions to avoid take:
 - Conduct work in non-overwintering areas (uplands) during the snake's inactive season (typically November 16 - March 30).
 - Install snake exclusion fencing according to the [Amphibian and Reptile Exclusion Fencing Protocols](#) in non-overwintering areas (uplands) during the snakes' inactive season (typically November 16 - March 30). Work can then be conducted within the fenced area at any time of year as long as the fencing is maintained.
3. If impacts cannot be avoided but the No/Low Impact Broad Incidental Take Permit/Authorization (BITP/A; <http://dnr.wi.gov/topic/ERReview/ITNoLowImpact.html>) can be followed, the project is covered for any unintentional take that may occur.
4. If impacts cannot be avoided during restoration or management activities, but the Grassland and Savanna Protocols can be followed (<http://dnr.wi.gov/topic/ERReview/ItGrasslands.html>), the project is covered for any unintentional take that may occur.
5. If eastern massasauga impacts cannot be avoided or covered by the No/Low Impact BITP/A or Grassland and Savanna Protocols, please contact the Natural Heritage Conservation Incidental Take Coordinator (see *Contact Information*) to discuss possible project-specific avoidance measures. If take cannot be avoided, an [Incidental Take Permit or Authorization](#) is necessary.

Additional Information

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Linked Websites

- Incidental Take Permit and Authorization: <<http://dnr.wi.gov>, key word “incidental take overview”>
- Natural Communities of Wisconsin: <<http://dnr.wi.gov>, key word “natural communities”>
- Rare Animal Field Report Form: <<http://dnr.wi.gov>, key word “rare animal field report form”>
- Wisconsin Endangered and Threatened Species: <<http://dnr.wi.gov>, key word “endangered resources”>
- Wisconsin Endangered and Threatened Species Permit: <<http://dnr.wi.gov>, key word “endangered species permit”>
- Wisconsin Initiative on Climate Change Impacts: <<http://www.wicci.wisc.edu/>>
- Wisconsin Natural Heritage Working List: <<http://dnr.wi.gov>, key word “Natural Heritage Working List”>
- Wisconsin’s Wildlife Action Plan: <<http://dnr.wi.gov>, key word “Wildlife Action Plan”>

Funding

- USFWS State Wildlife Grants Program: <<http://wsfrprograms.fws.gov/subpages/grantprograms/swg/swg.htm>>
- Sadie Nolan Amphibian and Reptile Education and Conservation Memorial Fund
- Wisconsin Natural Heritage Conservation Fund

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