United States Department of the Interior
FISH AND WILDLIFE SERVICE
Chicago Ecological Services Field Office
230 South Dearborn Street, Suite 2938
Chicago, Illinois 60604

In Reply Refer To:
FWS/AES-CIFO

June 28, 2018

Memorandum

To: Assistant Regional Director, Ecological Services

From: Field Supervisor, Chicago Ecological Services Field Office, Illinois

LOUISE CLEMENCY Digitally signed by LOUISE CLEMENCY Date: 2018.06.28 15:33:41 -05'00'

Subject: Biological Opinion. Section 7 Programmatic Consultation on Actions Undertaken by the U.S. Fish and Wildlife Service Related to Habitat Management for the Eastern Massasauga Rattlesnake (*Sistrurus catenatus*)

Introduction

This biological opinion is prepared pursuant to Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C.1531 *et seq.*) (Act). This document evaluates the potential beneficial and adverse effects to the eastern massasauga rattlesnake (EMR) resulting from conservation land management actions conducted by the U.S. Fish and Wildlife Service's employees and agents, or funded by the Service through the issuance of grants or cooperative agreements pursuant to Section 6 of the Act, or though other funding mechanisms. The actions considered are intended to benefit EMR recovery, but may also result in short term adverse effects to the species through incidental take in the form of injury or mortality. The actions include land management activities, such as prescribed fire, brush cutting, mowing, herbicide application, planting, soil disking or tilling, earthmoving, and hydrological alteration, as well as providing funding (through grants or cooperative agreements) to implement habitat enhancement, restoration, or protection actions that are likely to adversely affect the EMR.

For reasons further discussed within, it is our biological opinion that the proposed actions, when conducted in accordance with the terms and conditions outlined in the document, are not likely to jeopardize the continued existence of the EMR. No critical habitat has been designated for the EMR; therefore, none will be affected.

Consultation History

Since the EMR was proposed for listing as a threatened species (U.S. Fish and Wildlife Service 2015), there have been two previous consultations. The first resulted in a Conference Opinion (USFWS 2016a) covering issuance of an Enhancement of Survival Permit (ESP) to the Michigan Department of Natural Resources and Michigan Department of Military and Veteran's Affairs, and was prepared in accordance with the regulation and

policies for Candidate conservation Agreements with Assurances (CCAA's). That CCAA (Michigan DNR 2015) was the source of some of the best management practices (BMP or BMPs) included in this Biological Opinion. The second consultation (USFWS 2017) resulted in a Conference Opinion on the issuance of Enhancement of Survival Permits to authorize research and the management of captive populations of the species.

This opinion is based on information provided in the above Conference and Biological Opinions, as well as the Species Status Assessment for the EMR (Szymanski *et al.* 2016, USFWS 2015, 2016a, b), , meetings, telephone conversations, conference calls, briefings, email correspondences, field investigations, literature, and other sources of information. A complete record of this decision is on file at the Service's Chicago Field Office, Chicago, Illinois.

Biological Opinion

Activities Proposed

Actions under consideration in this Biological Opinion are: (1) habitat enhancement, restoration, or protection activities carried out directly by the Service to benefit the EMR; (2) using the authorities of the Service to grant or direct expenditure of funds to improve habitat of the EMR through enhancement, restoration, or protection carried out primarily by, or in cooperation with States or other external partners, and (3) assisting the planning of projects, including environmental compliance reviews, that promote the conservation of EMR within its historic range in the United States (Fig. 1). Specific actions considered are detailed below.

This biological opinion applies throughout the range of the species (Fig. 1), wherever in the United States the Service's actions are intended to improve, restore, or manage habitat in ways that would provide net benefits to the species. If habitat were assumed to be occupied only because it is of suitable appearance, project site selection could be overly burdened by unnecessary implementation of BMPs, or selection of unoccupied sites might also draw limited financial and staff resources to improve EMR habitat where the species does not currently exist. Thus, during the preparation of this document, we identified a priority need to develop and distribute spatially explicit maps (showing known sites or adjacent sites with a higher likelihood of having EMR) to be made available to Service project managers who will advise, fund, or implement habitat improvements targeting the EMR. The Michigan Field Office has already completed such a "tiered" mapping system to guide Section 7 consultations in the state. Until such maps are available, individual project managers should work closely with state or local partners, or their Ecological Services Field Office to determine if a proposed project site has known occurrences of EMR.

Species Affected

Eastern massasauga rattlesnake (*Sistrurus catenatus*). Listed under the Endangered Species Act of 1973 on October 31, 2016 (U.S. Fish and Wildlife Service 2016b). Critical habitat for this species has not been designated.

Programmatic Consultation Approach

Pursuant to section 7 of the ESA, the Service must ensure that its proposed actions do not jeopardize the continued existence of any federally listed species or result in the adverse modification or destruction of designated critical habitat. In accordance with this mandate, each proposed action must undergo a section 7(a)(2) review. In the context of the potential proposed actions described here, we consider all direct actions addressed in this document and taken by the Service to enhance, restore or protect habitat for the EMR (for example, conducting habitat enhancement work, or providing technical assistance that leads directly to habitat enhancement work to benefit the EMR or EMR habitat). Similarly, we consider issuance of future recovery grants or funding agreements subject to section 7 consultation. We anticipate that activities similar to those described below will be authorized, conducted, or funded by the Service. This section 7 programmatic consultation for the U.S. Fish and Wildlife Service covers the Recovery Land Acquisition Grants Program (authorized by Section 5 of the Act), section 6 recovery grant program with states, State Fish and Wildlife (SWG) Grants, Partners for Fish and Wildlife Program agreements, and other funding

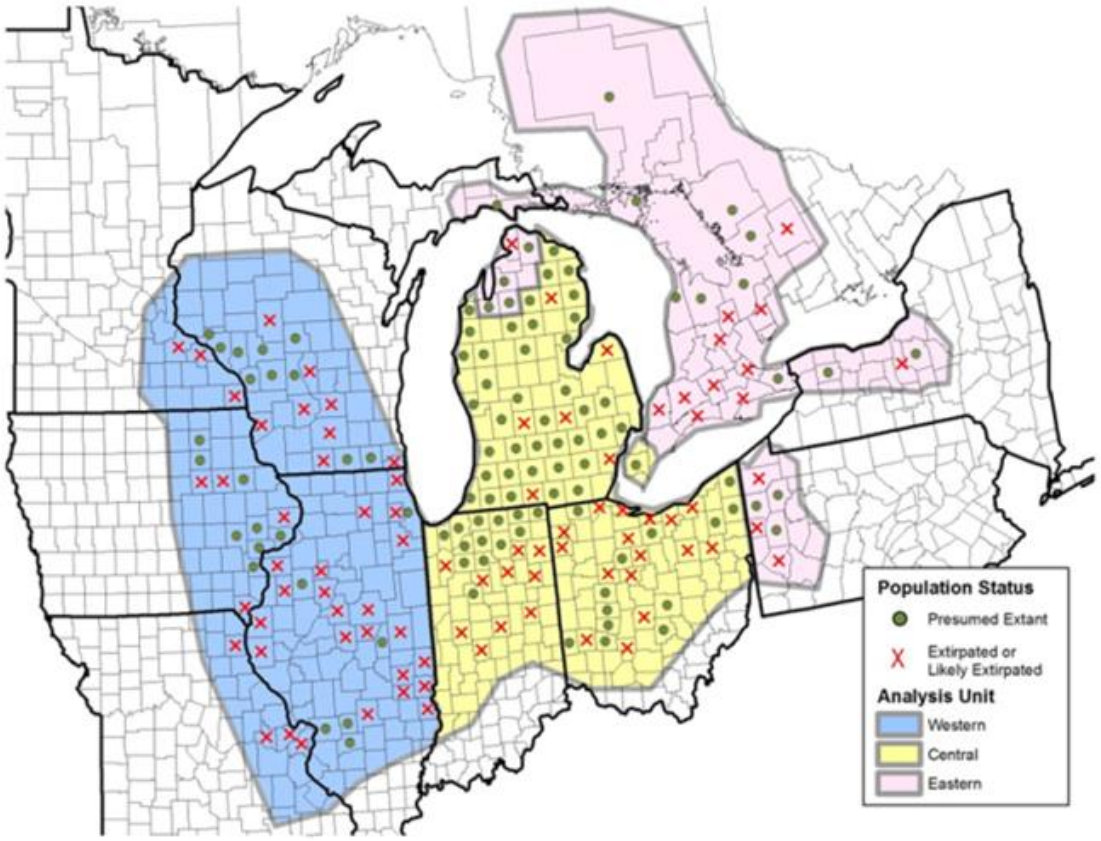

Figure 1. The geographic distribution of presumed extant (extant and unknown status) and extirpated EMR populations over the entire range and within each analysis unit (Szymanski *et al.* 2016). Solid dots represent presumed extant EMR populations. Red Xs represents extirpated or likely extirpated EMR populations.

mechanisms which the Service is authorized to implement, and that may be used to enhance, restore or protect habitat. This programmatic biological opinion includes only land management measures for the EMR either conducted, funded, or reviewed by the Service. Other recovery related activities (research and captive management) covered by issuance of Section 10(a)1(A) recovery permits are addressed in a Biological Opinion signed March 28, 2017. When funds are provided to external partners to carry out the types of management actions considered in this Biological Opinion on lands where EMR are known to occur, Service program staff should review plans and consider the BMPs provided here. When these practices are adopted into a project plan, the act of devising the plan would have an insignificant or very unlikely to lead to incidental take of the EMR. Similarly, planning and technical assistance related to the management actions, including environmental compliance reviews for funded projects that implement such actions, considered in this Biological Opinion, and provided to external partners or stakeholders by Service staff should consider the BMPs provided here.

In this biological opinion we identify BMPs, terms and conditions, which are designed to ensure that the level of incidental take from the habitat management activities is minimized to a level at which the anticipated benefits to the EMR outweigh the adverse impacts to individual EMR. Also, the BMPs are provided both to allow managers to plan projects in advance as well as to implement situationally as dictated by variable field conditions. Each future action and funding proposal will be reviewed by a project manager to ensure that: (1) the actions to be permitted or funded were contemplated in this programmatic biological opinion, (2) the appropriate recommended actions have been incorporated into the permit or project design, (3) the anticipated effect of the permit or grant is commensurate to what was anticipated in this programmatic biological opinion. If the project manager's review can ensure these criteria will be met, the project may proceed after a completed Intra-Service Section 7 Biological Evaluation Form is added to the project file (see Appendix for additional information and template "Intra-Service Section 7 Biological Evaluation Form"). We anticipate circumstances where a BMP that was planned cannot be implemented. For example walking/scanning a work area for EMR prior to work commencing may not be practical later in the season, when vegetation is too high and dense to detect EMRs. When such circumstances are encountered, they should be described and attached to the Intra-Service Section 7 Biological Evaluation Form in the project file, along with an analysis of whether the proposed action with modified BMPs can still provide a net benefit to EMR. In addition, we anticipate occasions where an action considered below is proposed, but in a scope that could make implementation of BMPs listed in this document impossible, and/or lead to a greater magnitude of take than our analysis could estimate here. Examples (see more explanation in "Effects of the Action," below) include disking, earth-moving, hydrological management and landscape-scale prescribed fires. In such circumstances where proposed habitat enhancement projects will not be implemented according to the best practices outlined below, project managers should initiate a separate consultation with the Ecological Services Field Office that covers the area where the proposed project will occur. Finally, the state of knowledge about BMPs practices to avoid and minimize incidental take of the EMR is constantly improving. As new information becomes available, we may reinitiate this consultation and periodically revise the BMPs provided by this programmatic Biological Opinion.

Description of Proposed Action

There are two general types of proposed actions: (1) habitat improvements for the EMR, including enhancement, restoration, or protection conducted under authorities of, or directly by the Services, and (2) using the Service's authorities of the Service to grant or direct expenditure of funds for enhancement or survival of the EMR through habitat enhancement, restoration, or protection carried out primarily by, or in cooperation with States or other external partners.

1) *Habitat Improvement conducted by the Service.* The Service has a number of authorities and/or programs through which we may either directly implement or assist with planning of activities that could improve habitat for the EMR, as well as other federally listed and trust species, but which, in the process could also lead to incidental take of the EMR. Examples include:

   A) Management of lands included within the National Wildlife Refuge System. At the time of listing, the EMR was known to occur or to have occurred historically at Necedah National Wildlife Refuge and at the Upper Mississippi National Wildlife and Fish Refuge, both in Wisconsin. Habitat management actions described below may be conducted periodically by Service staff that may affect EMR at these refuges if appropriate concomitant BMPs are implemented. Several other units of the National Wildlife Refuge System fall within the historic range of the EMR, though there are no current or recent records of the species occurring on those refuges. Should new information become available, actions considered in this Biological Opinion would also apply to those refuges.

   B) Providing project planning, technical assistance and implementation on non-federal land. The Service commonly provides technical and planning assistance, and also may assist with aspects of directly implementing on the ground habitat improvement projects. Examples of authorities or programs under which this may occur include the Fish and Wildlife coordination Act, the Partners for Fish and Wildlife Program, and the Great Lakes Coastal Program. Service staff providing such assistance for projects intended to benefit the EMR should consult the list of habitat management actions described below, and recommend use of appropriate concomitant BMPs as well.

2) *Issuance of funds to enhance conservation of EMR.* The Service has a number of authorities and/or programs from which it issues funds to external partners to assist them in protecting or improving wildlife habitats. Many of these could be used to directly or indirectly benefit the EMR. Service staff providing such assistance for projects intended to benefit the EMR are usually responsible for ensuring environmental compliance prior to the final award of funds. When doing so they should consult the list of habitat management actions described below, and recommend use of appropriate concomitant BMPs as well. Examples of such funding mechanisms include (but are not limited to):

   A) Recovery Land Acquisition Grants to States and Tribes. This competitive grant program provides funding to states and tribes for the acquisition of habitat in support of approved recovery goals or objectives for federally listed species. Eligible States and tribes must have entered into cooperative agreements with the

Service to conserve listed species, and are required to provide 25% of estimated project cost, or 10% when two or more states or territories implement a joint project. It has been estimated that as many as 60% of remaining EMR populations occur entirely or in part on lands under public ownership and having some degree of protection (Szymanski, 1998). However, additional opportunities to protect EMR habitat through land acquisition may arise in the future.

B) Endangered Species Conservation Fund (Section 6). Section 6 of the Act authorizes the Service to enter into cooperative agreements with any State which establishes and maintains an adequate and active program for the conservation of endangered and threatened species. Under this authority, we may provide financial assistance to any such State or Territory (hereafter, "States") for the purposes of developing conservation programs for listed species or for monitoring the status of candidate or recovered species. In order for a State program to be deemed an adequate and active program, the Service must find and reconfirm, on an annual basis, that the State program, among other things, has: (1) the authority to conserve resident endangered or threatened species of fish and wild life or plants; (2) established an acceptable conservation program, consistent with the purposes and policies of the ESA, for all resident species of fish and wildlife or plants in the State which are endangered or threatened; and has furnished a copy of such program together with all pertinent details, information, and data requested to the Service; and (3) authorization to conduct investigations to determine the status and requirement s for survival of resident species of fish and wildlife or plants. The section 6 grant review and approval process for EMR related projects is as follows. Project proposals are developed by the States in coordination with the lead field office or Regional Office, depending upon the project's location, and are evaluated based on the merits, benefits, and risks. Once proposals are selected for funding, an Intra-Service Section 7 Biological Evaluation form is completed prior to project commencement.

C) Partners for Fish and Wildlife and Coastal Programs. These two programs may provide funds on a discretionary, cooperative, and (usually) cost-share basis to assist habitat improvements with private landowners (Partners for Fish and Wildlife), NGO's (both) or (local units of government below state, and often include projects targeting habitat for federally listed species like the EMR. These are not granting programs, and require substantial involvement (for example assistance with project planning and implementation, cooperative evaluation of contractors and project progress at pre-determined milestone dates). In addition, before projects are started, Service biologists working under these programs usually prepare and evaluate projects on a case by case basis for potential effects to listed species. When applicable to projects that may affect the EMR, this Programmatic Biological Opinion should be consulted when those pre-projects evaluations occur.

D) Recovery Programs. The Service's Recovery Program (Recovery Program) works with Federal, State, tribal and non-government entities to take action to prevent the extinction of species, prepare recovery plans to ensure coordinated, effective recovery actions, and implement actions to reverse the decline of listed species and expedite those species' recovery. Recovery Program funds may be used to implement on-the-ground conservation actions.

E) State Wildlife Grants. State Wildlife Grants, also known as "SWGs" are congressionally appropriated (annually) funds available to state fish and wildlife agencies for developing and implementing programs that benefit wildlife and their habitats, including species that are not hunted or fished. Grant funds may be used to address a variety of conservation needs, such as research, fish and wildlife surveys, species restoration, habitat management, and monitoring if these actions are identified within a State's Wildlife Action Plan. These funds may also be used to update, revise, or modify a State's Plan. There are several examples of SWGs being used to fund projects to research or monitor populations of EMR, or to enhance occupied EMR habitat.

F) Other Grant or Funding Programs. Other grant programs are available that could affect the EMR. Some of these programs are ephemeral and new programs are sometimes implemented. The grant programs listed in this biological opinion are not meant to be all inclusive, but to give a general sense of the types of programs available. For example, the Service's Wildlife and Sport Fish Restoration Division transfers and administers federal grants through a variety of programs, such as federal Aid in Wildlife Restoration Grants for game species. The grant funds are often derived from State hunting and fishing excise tax. These monies are transferred to State fish and wildlife agencies for projects that enhance fish, wildlife, and habitat resources for present and future public benefit. The States use these grants, which typically account for one- fourth to one-third of their respective fish and wildlife management budgets, for work across the full spectrum of their management responsibilities. Some of these programs could directly benefit listed species including the EMR.

In addition, the Service's individual field stations may occasionally have funds that could be made available to assist with EMR habitat improvements to take place within their local service areas. Finally, the Land and Water Conservation Fund provide funds to Federal State and local governments to acquire land, water and conservation easements on land and water for the benefit of all Americans. In this biological opinion, Region 3's section 6, recovery grant programs, applicable Wildlife and Sports Fish Restoration, and other grant programs will be collectively referred to as the Service's Recovery Grant programs. Only those grant projects that are for the purpose of benefiting EMR are considered in this consultation; for other projects that may affect listed species, a separate section 7 consultation may be required.

Descriptions of Specific Habitat Management Actions

Management activities for the EMR are strongly focused on habitat enhancement (defined here as actions that would maintain or alter vegetative structure of habitat), though activities that include habitat restoration (defined here as actions that alter the physical characteristics, such as hydrology) and protection (defined here as land acquisition or acquisition of an interest in lands through conservation easements) are also considered in this Biological Opinion.

Unmanaged vegetative succession is the most commonly cited (81%) threat by species experts (Faust et. al. 2011), and is the third most common factor, occurring at 31% of sites (Szymanski et al. 2016). Individual EMRs require open, sunny areas, intermixed with shaded areas, for thermoregulation (basking sites), abundant and available prey (foraging sites), the ability to escape both temperature extremes and predators (retreat sites), presence of the water table near

the surface for hibernation (hibernation sites), and connectivity between each of these habitats (DeGregorio 2008; Marshall et al., 2006; Robillard and Johnson 2015). Habitat structure seems to be more important to the EMR than the particular plant species or soils within the habitat (Beltz 1993). Habitats preferred by EMR tend to have a generally open vegetative/shrub structure, dominated by gramminoid vegetation (sedges and grasses), where trees and shrubs are thinly distributed relative to surrounding areas (Johnson *et al.* 2000). This open vegetative structure provides the desirable thermoregulatory areas, increases prey densities for the snakes by enhancing the growth of sedges and grasses (Johnson *et al.* 2000; Robillard and Johnson 2015), and provides retreat sites. Regardless of the season, all EMR habitats include sunny and shaded areas, and vegetative structure that ranges from open to early/mid-successional canopy structure (Beltz 1993; Reinert and Kodrich 1982; Johnson *et al.* 2000). Thus, most habitat management activities evaluated below would benefit the EMR by either enhancing open, early successional habitat structure or restoring physical characteristics such as hydrology that may also influence vegetative structure.

Habitat management, planning, or technical assistance actions that may be taken by Service staff (either on or off of units of the National Wildlife Refuge System) or funded by Service programs are listed below. Each is accompanied by a list of BMPs. While the BMPs listed below may help to avoid take, most are more likely to minimize take of EMR while still allowing beneficial habitat management to occur. Also, the BMPs are provided both to allow managers to plan projects in advance as well as to implement situationally as dictated by variable field conditions.

Handling Individual EMR

Several of the actions below include BMPs that may include walking a work area to search for and remove individual EMR prior to a management treatment occurring. Briefly handling EMR in in order to remove them from situations where they may present a hazard does not require additional permission as discussed in two previous Service documents (USFWS 2016b, 2017). The most common tool used for handling venomous snakes are animal handling tongs. Older designs had no pressure release and could potentially act like scissors and crush or cut snakes in half if the handle is squeezed too tightly. Thus, the BMP for situations where habitat improvement projects may lead to handling individual EMR is:

1. When walking a work area to search for and remove individual EMR prior to a management treatment occurring, handlers shall use only modern animal handling tongs (e.g., Midwest Tongs, Inc., Gentle Giant ®; Stoney, Inc., Animal Equipment, Inc. or similar) that are engineered with pressure release springs, wide surface area jaws, and rubberized/padded coating shall be used to grab snakes encountered in the wild.

2. Any individual EMR removed from a work area shall be immediately released in adjacent habitat no greater than 200 meters form the point of capture. Briefly handling EMR in this fashion and in order to remove them from situations where they may be at risk or may present a hazard does not require additional permission as discussed in two previous Service documents (USFWS 2016b, 2017).

Planting Herbaceous or Woody Vegetation

Planting herbaceous or woody vegetation would encourage or enhance efforts to establish or reestablish desired habitat structure preferred by the EMR. Planting is most often used in

conjunction with one or more of the other treatments evaluated in this document. For example, planting may be desired after cutting/removal of invasive woody species, after disking to convert land from agricultural use to native habitat, and/or herbicide treatment. Planting select herbaceous or woody vegetation may also be used to increase diversity of a managed plant community or to ensure presence of plant species used by other Service priority wildlife that occur in EMR habitat, for example, pollinators. Planting is often done with hand tools where potential adverse effects or incidental take of EMR would be unlikely. To further minimize the risk of incidental take, the following best practices should be observed:

1. Contractors or other individuals working with hand tools in known EMR habitat shall be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

2. Contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

3. If mechanized plantings are used, individuals familiar with the EMR shall walk through the work area where planting will occur, but prior to it starting, to visually scan for and remove individual EMR that may present. Any EMR that present a hazard shall be removed from a work area shall be released on adjacent habitat not greater than 200 meters from point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

Seeding of Herbaceous or Woody Vegetation

Like planting, seeding is normally used to enhance habitat after a treatment to enhance efforts to establish or reestablish desired habitat structure preferred by the EMR. Similarly, seeding is most often used in conjunction with one or more of the other treatments evaluated in this document, for example to establish native plant species after an herbicide application to remove invasive species. Seeding usually occurs during the winter when EMR are dormant (which reduces or eliminates likelihood of incidental take, especially if the ground is frozen), though it may also take place during the active season. Seeding is more likely to use machinery ranging from light all-terrain vehicles to trucks or tractors (used to pull seed drills or devices for spreading seeds), and thus increases risk to EMR. To avoid and minimize the risk of incidental take, the following best practices should be observed as determined by field conditions or situation:

1. Avoid use of heavy machinery in EMR habitat during the species' active season. Since dates when EMR are active above ground can vary, seeding with machinery should be done within the windows provided in Table 1 (below). Managers in the southern portion of the range should be aware of unseasonably early warm periods (for example early warm weather in February) which may draw a few EMR to the surface, and avoid use of machinery in such circumstances.

2. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid seeding with heavy equipment (tractors or trucks). When seeding

is planned in these areas, use manually operated seed broadcasters, or mount seed broadcasters on small/lightweight all-terrain vehicles.

3. During periods of prolonged sub-freezing temperatures, seed when the surface soil is hard frozen. If these soil is hard frozen, light all-terrain vehicles, small trucks or tracked vehicles may be used to broadcast seed in EMR habitat.

4. If mechanized seedings are used, individuals familiar with the EMR shall walk through the work area where planting will occur, but prior to it starting, to visually scan for and remove individual EMR that may present. Any EMR that present a hazard shall be removed from a work area, and shall be released on adjacent habitat not greater than 200 meters from the point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

Cutting Woody Vegetation/Brush with Hand Tools

Tree or brush removal is used to increase, and connect the open habitat preferred by EMR. A study in western Pennsylvania similarly found that tree removal is most effective when cutting or harvesting standing timber directly adjacent to high quality EMR habitat (Kowalski 2010). Cutting of woody species is normally done to reduce canopy coverage or dominance in a plant community due to succession. While this often happens when exotic woody species (e.g., buckthorns, *Rhmanus* spp., or autumn olive, *Eleagnus ubellata*) invade more open habitats, some native species (e.g., dogwoods, *Cornus* spp., maples/box elders, *Acer* spp., cottonwoods/aspens, *Populus* spp.) may also become invasive in habitats favored by EMR. Personnel on foot using hand tools (which reduces or nearly eliminates the likelihood of incidental take of EMR) are often employed to cut brush.

To avoid and minimize the risk of incidental take, the following best practices should be observed:

1. When possible, conduct brush cutting in months when EMR are likely to be dormant (November through February in most of the range).

2. If brush cutting during the EMR active season, contractors or other individuals working with hand or power tools in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. If brush cutting during the EMR active season, contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

Cutting Woody Vegetation/Brush Using Heavy Equipment

Cutting using heavy equipment (for example tractors or other vehicles using brush cutting attachments, such as Fecon®, HYDRO-AX, Feller-Bunchers, etc.) can allow much greater areas to be covered, but also increases risk that individual EMR would be crushed during the active season or entombed (due to soil compaction) in burrows while hibernating. To avoid and minimize the risk of incidental take, the following best practices should be observed:

1. Avoid use of heavy machinery to cut brush in EMR habitat during the species' active season. Although dates when EMR are active above ground can vary, cutting brush with heavy machinery should be done within the months of November through February throughout the range of the EMR.

2. Managers in the southern portion of the range should be aware of unseasonably early warm periods (for example early warm weather in February) which may draw a few EMR to the surface.

3. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to cut brush. When brush cutting is planned in these areas, use hand tools or hand power tools.

4. Use heavy machinery to cut brush in EMR habitat only during prolonged periods of sub-freezing temperatures, when the surface soil is hard frozen. If the soil is hard frozen light all-terrain vehicles, small trucks or tracked vehicles may be used cut brush in EMR habitat.

5. Individuals familiar with the EMR shall walk through the work area where the planting will occur, but prior to it starting, to visually scan for and remove individual EMR that may be present. Any EMR that present a hazard shall be removed from a work area and released on adjacent habitat not greater than 200 meters from the point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

Mowing

Mowing is often used in conjunction with prescribed burning to setback or control encroachment by woody vegetation and other invasive plant species. In addition to its use to manage habitat, mowing can take place to manage areas used primarily by humans, for example to set back growth of invasive woody or herbaceous plant species, or to maintain roadsides, trails, picnic groves, or administrative areas in turfgrass or other short vegetative structure. By maintaining short (heights of six inches or less) grass, mowing around roadsides may also help to discourage EMR from approaching close enough that they may then attempt crossing a road, thus lessening the risk of mortality from vehicle strikes (Dr. M.J. Dreslik, personal communication to M. Redmer, 31 August 2017). Similarly, in administrative areas (e.g., campgrounds, picnic areas, or other areas where turfgrass is maintained adjacent to EMR habitat), mowing and maintaining the grass height at approximately 6 inches or less throughout the growing season should discourage EMR from entering such areas, and would have the side benefit of reducing encounters between EMR and humans using these areas.

Similar to brush cutting, mowing while EMR are dormant would reduce or eliminate likelihood of incidental take of EMR. Managers in the southern portion of the range should be aware of unseasonably early warm periods (for example early warm weather in February) which may draw a few EMR to the surface.

To avoid and minimize the risk of incidental take from mowing during the active season, the following best practices should be observed:

1. Sickle bar and disk mowers should be used because they do not create a vacuum effect which has been shown to injure or kill snakes (Durbian, 2006).

2. Mowers with a wider wheel base should be used as they will require fewer passes through the areas and reduce the probability of crushing snakes (Durbian, 2006).

3. Raise mower decks when mowing during the active season to a height no lower than 9 inches and ideally keep the mower blades above 12 inches, or if shorter turf grass in administrative areas (campgrounds, roadsides, etc.) must be maintained, do so by mowing during the hottest part of mid-day to when EMR are least likely to be present.

4. In situations where control of target invasive species (e.g., sweet clovers, *Melilotis* spp.) require mowing during the EMR active season, persons familiar with methods to safely handle venomous snakes, and carrying conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone just prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

5. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to mow. When mowing is planned in these areas, use hand tools or hand power tools.

Herbicide Application

Herbicide application is usually used to reduce or eliminate invasive vegetation from a habitat. For EMR, herbicide application would usually be used in conjunction with other actions, for example cutting invasive woody species, in order to enhance habitat by creating a more open vegetative structure. This is accomplished through applications of herbicide to the foliage of herbaceous species, the basal or cut bark of standing woody vegetation, or to the recently cut stumps or stems of invasive woody species to prevent them from clonal re-sprouting. To avoid and minimize the risk of incidental take, the following best practices should be observed:

1. When possible, conduct herbicide applications in months when EMR are likely to be dormant (see table 1, below).

2. Contractors or other individuals working during the EMR active season, and in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. Contractors or other individuals should be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

4. When possible, avoid use of heavy equipment and broadcast applications (including aerial) of herbicide in occupied EMR habitat.

5. In situations where control of target invasive species require herbicide applications using heavy equipment during the EMR active season, persons familiar with methods to safely handle venomous snakes, and carrying conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone just prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

6. Avoid using heavy equipment or other broadcast applications (e.g., aerial) in areas where known EMR hibernacula or large concentrations of crayfish burrows are known to occur in occupied EMR habitat. In these areas use hand application techniques instead.

Disking

Disking involves the use of a disk, or what is sometimes referred to as a harrow, to disturb the soil. Disking is most commonly used by natural resources managers to set back natural succession by cutting up grassy vegetation, thus preventing an area from maturing into briars, shrubs, and trees. It can eliminate or reduce a thick mat or carpet of grass, such as fescue, brome, or reed canary grass, and can also be used to encourage growth by annual plants. We recommend the following practices to avoid or minimize incidental take of EMR that may be caused by disking:

1. Disking should be minimized or avoided during the active season, or areas that are to be disked during the active season should be mowed during the inactive season to less than 15 cm (6 in) in height so that they are unattractive to snakes the following spring, and the mowing should be continued until the disking is to take place.

2. If mowing can't be done prior to disking, personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

3. Areas currently in row-crop agriculture, but to be converted to EMR habitat by disking should be continuously maintained as row-crop agriculture until such time that they may be seeded to native grasslands or similar habitat that may be beneficial to EMR.

Earthmoving

Earthmoving related to habitat improvements is most commonly done to allow construction or installation of hydrologic management structures (e.g., berms, water control structures, or ditch plugs) or removal/disablement of structures that impede wetland function (e.g., farm tiles, ditches). We recommend the following practices to avoid or minimize incidental take of EMR that may be caused by earthmoving:

1. If earthmoving is planned within occupied EMR habitat, equipment shall be offloaded from the closest point to the work zone as practicable, on a service road, parking lot etc.

2. From the offloading point, provide a short, direct route through which equipment operators can traverse to get to the work zone as quickly as possible.

3. Where the route would traverse through EMR habitat, it should be mowed in advance (see above best practices for mowing administrative areas) to a grass height of less than 6 inches to discourage EMR from using the path from the offload site to the work zone.

4. Personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

5. If the work period may be prolonged (>7 days) the work zone could be visually scanned as described above, just prior to commencing work, and a trenched-in silt fence shall be erected around the work zone to prevent re-entry by individual EMRs that are in the proximity. Once the area is scanned and found to be free of EMR, work can commence without impediment.

Earthmoving at a scale too large to permit these best management practices and that would take place in known occupied EMR habitat or in areas of known EMR hibernacula should be avoided. If earth moving in such areas is needed for a project, individual project managers should request a separate consultation with their Ecological Services Field Office.

Hydrologic Management

Managing both subsurface and surface hydrology may sometimes be necessary to enhance EMR habitat. Across its range, the EMR is associated with wetlands and often hibernates for up to six months of the year using cavities that allow access to the water table (Reinert 1978; Dr. B. Kingsbury, personal communication to M. Redmer and C. Tansy 7 March 2017) including crayfish burrows, mammal burrows, rocky crevices, rodent holes, hummocks, old stumps, rotten logs, and tree and shrub root systems (Wright 1941; Johnson 1995; Mauger and Wilson 1999, McCumber and Hay 2003; Dreslik 2005; Harvey and Weatherhead 2006; Johnson and Leopold 1998; Sage 2005). Thus, consistent hydrology at EMR sites is important to maintain conditions that support EMR over-winter survival, and the effects of drought and flood cycles are one of the most significant threats to EMR (Seigel et al. 1998, Pomara et al., 2014, Szymanski et al 2016). We thus suggest adopting the following best practices for hydrology included in the by the Michigan Department of Natural Resources in the Candidate Conservation Agreement with Assurances (Michigan DNR, 2015):

1. Water levels in managed habitat will not be drawn down during the inactive season, except for human health and safety reasons.

2. Water levels may not be raised for more than two continuous weeks during a single inactive season, except for health and safety concerns. Water levels may be raised during the active season.

3. Hydrology should be managed to ensure that EMR are able to hibernate within retreats below the water table in crayfish burrows, or other locally available cavities.

If water tables are maintained at levels higher than the opening of crayfish burrows or other cavities used by EMR for prolonged periods (greater than 5-7 days), consult with the Ecological Services office on an individual basis. Permanent flooding or drainage that results in loss of EMR habitat is not covered by this Biological Opinion.

Prescribed Fire

Historically, fire was a natural process in gramminoid dominated plant communities, including those occupied by the EMR. Fire kills or temporarily sets back the growth of woody vegetation, retards the growth of undesirable species, and rapidly stimulates the response of prairie/gramminoid species that result in vegetative structure and varied microhabitats. Prescribed fire (set by resource managers) is a common tool used to mimic the natural process. Because it suppresses woody growth (and especially of invasive species) and encourages the gramminoid/herbaceous structure preferred by EMR (Johnson *et al.* 2000, Dovčiak et al., 2013), prescribed fire is recognized as an essential tool for managing EMR habitat. However, prescribed fire, especially during the early portion of the EMR active season (when snakes are emerging and still lethargic) presents potential risk to large portions of the population (see additional discussion in "Effects of the Action, below). Studies into the wintering biology have attempted to better understand the environmental or weather conditions that trigger EMRs to emerge from hibernation, and their response to fire during the active season (Cross 2009, Cross *et al* 2015; Deslik 2005; Dreslik et. al 2011; Hileman 2016; Sage 2005). Because timing of prescribed fire in known EMR habitat is important to both managers and species experts, there has been a considerable amount of discussion among the two groups to determining best practices to allow maintenance of suitable EMR habitat while at the same time reducing risk of killing individuals. Over much of that range of the EMR, habitat may have snow cover, temperatures may be too cold, or the fuels may be too wet to carry a prescribed fire, and all of these variables may greatly limit the number of days when conditions are ideal for managers to conduct prescribed fire. While setting bounds in which to conduct prescribed fires with dates is easiest for managers to plan around, the yearly variation in weather and triggers for EMR egress have also led to an interest in better understanding the wintering biology, and specifically the ingress-egress habits of the species. Of particular note, studies into the wintering ecology of EMR have provided both a range of dates when egress occurs at different sites, as well as physical characteristics that affect egress (Smith 2009; Hileman 2016). Hileman (2016) studied factors that affected hibernation phenology at seven EMR sites across the range (Illinois N=1,Iowa N=1, Ohio N=2 and Michigan N=3), and provided a predictive model and recommended best practices to minimize risk to EMR individuals from prescribed fire. The best predictor of EMR egress in spring was in inversion of subsurface soil temperatures at the depths of 30cm and 60cm, as soil temperatures near the surface become warmer than the deeper soil temperatures. After additional review of Hileman's data, we discussed timing of burns with two EMR species experts (Dr. Bruce Kingsbury, Indiana Perdue University Ft. Wayne, personal communication to M. Redmer and C. Tansy March 7, 2017, and Dr. Richard B. King, Northern Illinois University, personal communication with M. Redmer March 8, 2017). In order to implement best practices based on Hileman's data, weather stations (including soil thermometers buried at depths of 1m, 60cm, and 30cm) at a similar latitude to individual sites where prescribed burns are to take place would need to be available for managers to check and track on a daily

basis. Where managers have access to such stations, we recommend the following as the preferred best practices to avoid or minimize incidental take of EMR from prescribed fire:

1. At least two weeks prior to anticipated start of a burn season in their area, and before burning at known EMR sites, land managers/burn bosses shall access and monitor the soil climate data at or from the nearest adequately equipped (e.g., with soil temperature probes) weather station to track and provide real-time temperatures at 1 meter, 0.6 meter, 0.3 meter depths, and at soil surface.

2. After the tenth day (cumulative) in spring when the temperature at the 0.3 meter depth has exceeded that at the 0.6 meter depth, no prescribed burn shall be conducted within in delineated wetlands known or believed to have EMR hibernacula, nor within 100 meter buffer of the delineated wetlands.

3. Land managers/burn bosses may continue to conduct prescribed burns in adjacent upland habitats beyond the 100 meter buffer for an additional two weeks/14 days following the date when wetland burns were discontinued. To avoid take of EMR dispersing into adjacent uplands, prescribed burns shall discontinued after the 14th day following the date when burns were discontinued in the wetlands as described in best practice 2, above.

If the above soil climate and science-based practices are followed, prescribed fire within EMR habitat would be unlikely to lead to incidental take of the EMR, and would likely allow an extended (over dates provided in Table 1, below) burn season. However, because adequately equipped and accessible weather stations that allow the above practices to be followed are not yet commonly available, the Service intends to work closely with state and local partners to establish a network of such stations that could be remotely accessed (e.g., by internet or cellular applications). Until such a network is available, a set of predetermined dates for planning times to use prescribed burns at EMR sites will be used as an interim measure (Table 1).

4. Timing of burns shall be determined after consulting dates in Table 1.

5. Burns may be conducted outside of these dates if the crew has soil climate data available for their latitude band, and can document it prior to igniting a fire.

6. Land managers should leave unburned areas adjacent to prescribed burns to serve as snake refugia whenever possible.

7. Prescribed burn plans will use ‘back burning’ as the primary ignition strategy. This approach will minimize entrapping snakes between flame fronts. However, the burn manager may make the judgment, during a burn treatment, that encirclement ignition or strip firing is necessary to protect human safety or property.

Table 1. Final burn dates within one-degree latitude bands across the range of the eastern massasauga rattlesnake in the United States. Example locations with known/occupied eastern massasauga rattlesnake sites nearby are provided for reference.

Latitude			
Min	Max	Final Burn Date	Example Locations
38.3	39.3	March 1	Carlyle, IL
39.3	40.3	March 7	Monticello, IL
40.3	41.3	March 13	Delong, IL; Ft. Wayne, IN; Marion, OH; Butler, PA
41.3	42.3	March 19	Cedar Rapids, IA; Chicago, IL; Cassopolis, Ann Arbor, MI; Ashtabula, OH
42.3	43.3	March 25	Delevan, Portage WI; Grand rapids, MI; Rochester, Syracuse, NY;
43.3	44.3	March 31	Nelson, WI; Ludington, MI;
44.3	45.3	April 5	Camp Grayling, MI
45.3	46.3	April 11	Bois Blanc Island, MI

8. A scientific fire behavior model, such as the United States burn model, the Canadian burn model or equivalent will be used to formulate a burn prescription for a maximum rate of spread no faster than 16 chains per hour (17.6 feet per minute) with an average targeted rate of 10 chains per hour or less (11 feet per minute), except in known hibernacula areas. A slower rate of spread may allow snakes within the burn unit adequate time to find refugia.

9. Fire breaks will be established following existing features (roads, rivers, trails…) to the greatest extent possible. Cultivation (disking or roto-tilling) of burn breaks will be minimized to the extent that human health and safety are not jeopardized. Cultivation and mowing fire breaks will be established during the inactive season to the extent possible.

As additional resources (e.g., a soil climate tracking network available to all managers) become available, or as we gather new information (e.g., mortality events) this programmatic consultation may be revised.

Status of the Species

This section presents the biological or ecological information relevant to formulating the biological opinion. The purpose is to provide the appropriate information on the species' life history, its habitat, and its range-wide distribution and conservation status for analyses in later sections. This section also considers the effects of all past human and natural activities or events that have led to the current status of the species.

The Final Rule listing the EMR as threatened under the Endangered Species Act was published in the Federal Register on September 30, 2016. A Species Status Assessment (SSA) team prepared, and continues to update, an SSA report for the EMR (Szymanski *et al.* 2016). The SSA team was composed of U.S. Fish and Wildlife Service biologists, who developed the report in consultation with other species experts. The SSA represents a compilation of the best scientific

and commercial data available concerning the status of the species, and an assessment of the impacts of past, present, and future factors (both negative and beneficial) affecting the EMR. The SSA and other materials relating to EMR listing proposal can be found on the Midwest Region website at http://www.fws.gov/midwest/Endangered/ and at http://www.regulations.gov under docket number FWS–R3–ES–2015–0145.

General Habitat Requisites

The EMR is active in the spring, summer, and fall and inactive in the winter when it hibernates. Therefore, depending on whether the snake is active or inactive determines what type of habitat is required. Active season habitat consists of thermoregulatory or *basking* sites, *retreat* sites, and *foraging* sites. Inactive season habitat consists of hibernacula, often within wetlands or in cavities that allow snakes to retreat to the upper portion of the water table (Reinert 1978).

EMR have been found in a variety of wetland habitat types across their range, including bogs, fens, shrub swamps, wet meadows, marshes, moist grasslands, wet prairies, peatlands, coniferous forests and floodplain forests (Minton 1972, Seigel 1986, Hallock 1991, Weatherhead and Prior 1992, Johnson 1995, Kingsbury 1996, Harding 1997, Sage 2005). At many locations, individual EMR may also move from wetlands to drier upland sites during certain parts of the year to forage, disperse, gestate, and even hibernate in some cases (Bissel 1006, Johnson 1995, King 1997, Reinert and Kodrich 1982, Seigel 1986, Weatherhead and Prior 1992). Suitable upland habitat types range from forest edges and openings, savannahs and prairies to meadows, old fields and some agricultural lands.

During the active season, EMR need highly intermixed and interspersed opportunities to bask and retreat from sun, hide from predators, attack prey without a chase, find mates, and travel to and from hibernacula seasonally through corridors that lack potentially lethal barriers such as roads.

During the winter months EMR occupy hibernacula. These hibernation sites can occur in wetland, wetland edges, wet prairie, closed canopy forests with mossy substrates (DeGregorio 2008), wet grassland, and sedge meadow (Mauger and Wilson 1999). Across its range, EMRs have been reported to hibernate for up to six months of the year. Crayfish burrows are commonly used over much of the range, though mammal burrows, rocky crevices, rodent holes, hummocks, old stumps, rotten logs, and tree and shrub root systems are also used, (Dreslik 2005, Harvey and Weatherhead 2006, Johnson 1995, Johnson and Leopold 1998, Mauger and Wilson 1999, McCumber and Hay 2003, Sage 2005, Wright 1941) as may be any cavity that reaches the water table (Reinert 1978; Dr. B. Kingsbury, personal communication to M. Redmer and C. Tansy March 7, 2017). Hibernacula may be either dispersed, with individual EMR emerging from dormancy across large areas (for example, areas of >20ha in southwest Michigan, M. Redmer, personal observation) or communal or concentrated, with numbers of individual EMR emerging from adjacent burrows in high densities (for example areas of <2ha at hibernacula in southern and northeastern Illinois, and <1ha in southwest Michigan, M. Redmer, personal observation). While communal hibernacula are difficult to find and delineate, when they are found they should be noted by land managers because a large percentage of the EMR in a population may use them. Thus knowing where communal hibernacula occur is beneficial to

planning actions or timing of actions in a way that allows avoiding or minimizing adverse effects to the EMR that use them.

While EMR may use the burrows of more than one species of burrowing crayfish, the burrows of one species (the devil crayfish, *Cambarus diogenes*) in which EMR commonly hibernate are known to reach depths of up to 5m below the surface, though usually depth is associated with actual depth of the water table (Grow and Merchant, 1980). Consistent hydrology at winter hibernacula sites is important in maintaining conditions that support EMR over-winter survival. To survive the winter, each individual EMR requires a suitable hibernation site which is critical to avoid lethally low temperatures and reduce the risk of desiccation (Reinert and Kodrich 1982). Consequently, hibernation sites must provide insulated and moist subterranean spaces below the frost line where individuals can avoid freezing and dehydration (Sage 2005). Most EMRs will either return to the same hibernacula annually (Johnson *et al.* 2000) or to an area within roughly 100 m (328 ft) of their previous hibernation site (Sage 2005; Harvey and Weatherhead 2006).

Requirement for Connectivity Between Microhabitats
EMR need corridors between microhabitats (basking sites, retreat sites, and foraging areas) and between seasonal habitats. EMRs can traverse corridors most successfully (reduced likelihood of mortality) between habitats when there are no barriers such as roads, rivers, or anything that can act as a barrier to snake movement. The absence of roads is an important criterion because roads are a strong barrier to EMR movement due to road mortality (Choquette 2011, Shepard et al, 2008a,b) or road avoidance behavior.

Connectivity between the active season (summer) habitat and inactive season (winter) habitat is crucial for population sustainability. Similarly, when temperatures shift the snakes must have the unimpeded ability to either access or retreat to a particular (summer or winter) habitat.

Habitat Requirements for Successful Reproduction
Males may use chemical cues to simultaneously trail and pursue individual females during the mating season (Johnson 1989). Because mature male EMRs often occur in higher numbers than receptive females, competition for mates can be intense. Male EMR may exhibit prolonged periods of mate searching, longer daily movements, and defensive female polygyny during the mating season (Jellen 2005; Johnson 2000). During their searches for receptive females, the extensive movements of male EMR may be even greater in areas with marginal habitat, or at the peripheries of the species range (DeGregorio et al., 2011). Greater movements increase risk of exposure to predators or mortality while crossing barriers (such as roads, trails, or utility rights of way).

Thermoregulation is so important to gravid female EMR that they spend the majority of the gestation period within open-canopy areas (Reinert and Kodrich 1982). This type of habitat has significantly higher mean soil temperature than early to mid-successional wetlands (Foster *et al.* 2009). Depending on the location of the population, gestation habitat of gravid female EMRs could be rock outcroppings, open grassland, shoreline, sedge meadow, barrens, or any suitable land characteristic that provides the snake the ability to thermoregulate and avoid predators.

Usually gravid females will remain near their winter hibernacula until parturition in late July or early August and then move to other foraging locations (Marshall *et al.* 2006; Johnson 1995). Foster *et al.* (2009) identified "the importance of accessible early/mid-successional upland areas adjacent to wetlands for the reproductive success of *S. c. catenatus*. This vegetation type apparently provides gravid females with favorable thermal conditions, which ultimately may enhance *S. c. catenatus* productivity." Local gestation sites may be used by several females in a given season and appear to be used by the same individuals in successive breeding years. While at their chosen gestation sites, gravid female snakes generally engage exclusively in basking behavior, forfeiting opportunities for other essential behaviors such as feeding (Keenlyne and Beer 1973; Marshall *et al.* 2006; Weatherhead and Prior 1992). Since gravid females feed very little, if at all, it appears that they maintain themselves on reserved body energy (fat) throughout their pregnancies (Keenlyne and Beer 1973). In the fall, gravid females continue to thermoregulate more than males or non-gravid female snakes, despite giving birth in late summer (Harvey and Weatherhead 2011).

Rangewide distribution and abundance

The EMR historically occupied sections of western New York, western Pennsylvania, southeastern Ontario, the upper and lower peninsulas of Michigan, the northern two thirds of Ohio and Indiana, the northern three quarters of Illinois, the southern half of Wisconsin, extreme southeast Minnesota, east central Missouri, and the eastern third of Iowa. The limits of the current range of the EMR are similar to the historical range; however, the geographic distribution of extant localities has been restricted by the loss of the populations from much of the area within the boundaries of that range (Szymanski *et al.* 2016) (Fig. 1).

Threats

The most prominent threats include: habitat loss and fragmentation through development and vegetative succession; mortality of individuals as a result of roads, hydrologic alteration resulting in drought or flooding; persecution; collection; and post-emergent prescribed fire, mowing, and disking. Disease is a relatively recent threat with still unknown consequences. The effects of threats on extinction risk to EMR populations were included in model evaluations by Faust et al. (2011), while the Species Status Assessment (Szymanski et al., 2016) considered the total number of sites range wide where specific threats were reported.

Habitat Loss and fragmentation

The effects of past, widespread wetland loss continue to impact EMR populations. Development and agricultural practices continue to cause habitat loss, although to a lesser degree than in the past. Habitat loss increases the distance between populations and can isolate seasonally used habitats within individual populations, can restrict gene flow, and other effects of small population dynamics, as well as increase exposure to sources of mortality.

In addition, urban encroachment has disrupted the natural disturbance processes (such as hydrological cycles and fire frequency), and subsequently, changes in habitat structure and vegetative composition have occurred. Prolonged flood conditions may make wetlands too deep for use by EMR, while prolonged drought conditions may affect crayfish populations and thus reduce the number of suitable hibernacula (crayfish burrows) available for EMR.

Vegetative Succession
Woody succession, especially by introduced species such as Eurasian buckthorn, that results in EMR's preferred gramminoid (grasses, sedges, and rushes) dominated habitat becoming too shaded may reduce or eliminate these sites as suitable places for EMR to bask and thermoregulate. Unmanaged vegetative succession is the most commonly cited (81%) threat by species experts (Faust et. al. 2011), and is the third most common factor occurring at 31% of sites (Szymanski et al. 2016).

Post-emergent land management practices (prescribed fire, mowing, and disking)
The dependence of EMR on early to mid-successional stage gramminoid (grasses, sedges, and rushes) dominated plant communities necessitates that these communities be managed in a manner that controls woody species from dominating them. One of the most commonly used management techniques for this is prescribed fire, since it is a relatively inexpensive technique and mimics the natural fire processes that would have regulated these plant communities prior to European settlement. However, although EMR likely evolved in these fire dependent communities, direct mortality of EMR can result from exposure to fire if burning occurs when the snakes are out of their hibernacula (post-emergent fire) (Cross 2009; Cross *et al.* 2015; Dreslik 2005; Dreslik *et al*. 2011**).** In Missouri, Durbian (2006) observed the mortality of 8 western massasauga rattlesnakes on a 16.6 ha (41 ac) prairie after a burn conducted on April 18, 2000.

Mowing is another strategy often used in conjunction with prescribed burning, to control woody vegetation and invasive species encroachment. Durbian and Lenhoff (2004) postulated that pre-burn mowing may potentially reduce fire related mortality of EMRs and other snake species by negatively modifying the occupied habitat forcing the snakes to leave the area or seek refuge below ground. Durbian (2006) subsequently found that pre-burn mowing at a height of 20 cm (8 in) resulted in the direct mortality of 3 of 7 radio-marked EMRs (*in* Szymanski *et al.* 2016). After the burn, 3 unmarked individuals in the burned area were killed by the fire itself indicating that a number of EMRs did not leave the site after mowing as hypothesized by Durbian and Lenhoff (2004). Durbian (2006) concluded that mowing prior to burning results in additional direct mortality to EMRs beyond that incurred by prescribed burning and advises to conduct burns while EMRs are hibernating until methods that effectively reduce mortality while achieving the treatment objectives are identified (Durbian 2006).

Road Mortality
EMR are more sedentary than other snakes and they also move more slowly which increases the probability of being killed while crossing roads (Andrews and Gibbons 2005), and snakes in general are more often intentionally struck by motorists (Ashley et al. 2007). Road mortality is potentially one of the most significant non-natural causes of mortality to this species (Baker et al 2016).

Hydrologic alteration resulting in drought or artificial flooding
Individual populations of EMR often occur in riparian areas, wet prairies, or other places that are prone to fluctuations in hydrology. While EMRs are to a degree adapted to natural hydrological fluctuation, altered flood and drought cycles, or naturally occurring floods and droughts can have effects on EMR or the burrowing crayfish they rely upon for hibernacula. Prolonged flood

conditions in a Missouri population of the western massasauga (*Sistrurus tergeminus*) led to changes in population and reproductive characteristics as well as an immediate effect on body condition (Seigel et al., 1999). Conversely, prolonged drought or drawdown conditions may affect water table and burrowing crayfish populations and thus reduce the number of suitable hibernacula (crayfish burrows) available for EMR.

Persecution / Collection

Persecution and collection of EMR are documented threats (Szymanski *et al.* 2016), with several populations having been collected beyond a recoverable threshold. Generally, people have a negative view of snakes and snake encounters frequently result in snake mortality. Poaching and the illegal collection of snakes for the pet trade is also a factor that contributes to the species decline. In Wisconsin, illegal collecting has been documented despite many years of legal protection (Christiansen 1993, Wisconsin Department of Natural Resources 2011). An Indiana Department of Natural Resources law enforcement investigation in 1998 uncovered a well-organized multi-state effort to lauder State Protected reptiles species (including EMR). The investigation concluded with the indictment of 40 defendants. Another investigation of illegal reptile trafficking concluding in 2009 uncovered a shipment of EMR collected at a single location in Canada, and that were then smuggled into the United States in violation of laws in both nations (USFWS 2010).

Disease

Snake fungal disease (SFD) is an emerging and significant threat to EMR populations (Allender *et al.* 2011). Recently, a growing number of snakes have been found in the U.S. with severe and often fatal fungal infections. The number of species of snakes with documented or suspected cases of the disease, and the geographic area the disease has been found, continues to increase annually. A causative agent, *Ophidiomyces ophidiicola* (formerly *Chrysosporium ophidiicola*) was first described from an Eastern Rat Snake (*Pantherophis obsoletus*) in Georgia (Rajeev *et al.* 2009). Five individuals from three sites in Michigan tested positive for SFD in 2013 and 2014 and two EMR were confirmed to be infected in 2015 in the Grayling area. Both died within a few weeks of capture. In the wake of the devastating impacts on amphibians due to Chytrid beginning in 1996 (caused by the fungus *Batrachochytrium dendrobatidis*) (Longcore *et al.* 1999), and White Nose Syndrome (caused by the fungus *Pseudogymnoascus destructans*) on bats beginning in 2005 (Gargas *et al.* 2009), there may be genuine cause for concern that the emerging fungal disease in snakes could have a significant impact on EMR populations.

Climate change

Climate change is one of several factors believed to be actively leading to declines in reptile populations (Gibbons *et al.* 2000). The EMR scored Highly Vulnerable to climate change in an analysis using the NatureServe Climate Change Vulnerability Index tool (Hoving *et al.* 2013). Poor dispersal ability, landscape barriers, and drought sensitivity all contributed to the highly vulnerable score (Hoving, unpublished). Another assessment modeled demographic rates under past and future climate scenarios. They found that past climate change explained the observed recent range contraction, and suggested that the range contraction would continue. Only populations in northern Michigan and Ontario were likely to persist to mid-century (Pomara *et al.* 2014). While these studies suggest that EMR populations in southern Michigan are not viable,

there is some uncertainty about this prediction. Although additional models suggest drying in southern Michigan, nearly as many models suggest a wetter climate.

Conclusion
In assessing the occurrence of these threats or risk factors, Szymanski *et al.* (2016) found that 94% of EMR populations have at least one risk factor currently affecting the site. Habitat loss or modification is the most common risk factor occurring at 55% of the sites with 3% of these sites at risk of total habitat loss. The second most common risk factor is fragmentation which occurs at 49% of the sites. Unmanaged vegetative succession is the most commonly cited (81%) threat by species experts (Faust et. al. 2011), and is the third most common factor occurring at 31% of sites (Szymanski et al. 2016).

Among the other factors considered, road mortality occurs at 20%, collection or persecution occurs at 17%, water fluctuation at 7 %, and pre or post-emergent fire at less than 1% of sites (Szymanski *et al.* 2016). The risk factors most likely to push a population to quasi-extirpation within 25 years (high magnitude risk factors) are late-stage vegetative succession, high habitat fragmentation, moderate habitat fragmentation, total habitat loss, and moderate habitat loss or modification.

Environmental Baseline Conditions

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area; the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation; and the impact of state and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action.

Historically and rangewide there were 558 known EMR populations. Currently, 266 of these are known to be extant, 211 are extirpated or likely extirpated, and 84 are of uncertain status (Szymanski *et al.* 2016). The EMR Species Status Assessment (Szymanski *et al.* 2016) grouped the current number of extant rangewide EMR populations (263) with the current number of EMR populations of unknown status (84) and considered these populations in total as currently being "presumed extant". Therefore the total number of currently presumed extant EMR populations is 347 (263 + 84) (Table 1). The EMR has been extirpated from Minnesota and Missouri and from counties in every state across the range, and the Canadian Province of Ontario (Fig. 1). The range of the EMR is divided into three analysis units (western analysis unit (WAU), central analysis unit (CAU), and eastern analysis unit (EAU)) (Fig. 1). These three geographic "analysis units" correspond to broad scale genetic differences across the EMR range and represent areas of unique adaptive diversity. The EMR occupied spatial extent rangewide has declined by a northeasterly contraction in the range and by the loss of area occupied within each analysis unit. Overall, there has been more than 41% reduction in the extent of occurrence rangewide. This loss has not been uniform, with most of this decline occurring in the WAU (70% reduction in the extent of occurrence). However, losses of 33% and 26% in the CAU and EAU, respectively, are notable as well (Table 2). Of those rangewide populations presumed extant, 139 (40%) are presumed to be quasi-extirpated while 105 (30%) are presumed to be demographically,

genetically, and physiologically (DGP) robust (Redford *et al.* 2011). Of these, 105 presumed DGP robust populations, only 53 EMR populations range-wide are considered to be self-sustaining (Szymanski *et al.* 2016; Table 3). The greatest decline has occurred in the western analysis unit where only one population (of 20 presumed extant) is considered to be self-sustaining (Szymanski *et al.* 2016). In the central analysis, only 47 populations are considered to be self-sustaining, while the eastern analysis unit has only six self-sustaining populations (Szymanski *et al.* 2016).

Table 2. The number of EMR populations by status within each analysis unit and rangewide. WAU = Western Analysis Unit, CAU = Central Analysis Unit, EAU = Eastern Analysis Unit (from Szymanski et al. 2016)

	Analysis Unit		
Status	WAU	CAU	EAU
Extant	18	189	56
Likely Extirpated	15	19	9
Extirpated	37	75	56
Unknown	2	67	15
Rangewide	72	350	136

Table 3. The percent of range falling within each analysis unit and the percent reduction in EoO from historical to present day. WAU = Western Analysis Unit, CAU = Central Analysis Unit, EAU = Eastern Analysis Unit, RW = Rangewide (from Szymanski et al. 2016)

	% Range within AU		
Analysis Unit	Historical	Current	% Reduction
WAU	27%	14%	70%
CAU	37%	42%	33%
EAU	35%	44%	26%
RW			41%

Effects of the Action

In this biological opinion, the Service anticipates conducting or guiding habitat improvements, or issuing funds through grants or cooperative agreements, to improve or protect EMR habitats.

Although the proposed actions are intended to have overall positive effects on the conservation status of the EMR, incidental take of EMR from unintentional harm, harassment, injury, or mortality is expected to occur occasionally from the habitat management actions evaluated in this Biological Opinion. Incidental take is take that occurs accidentally during the performance of an otherwise lawful activity (e.g., unintentionally injuring EMR while conducting habitat

management activities). "Harm," as defined by the Service includes significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. "Harass" is defined by the Service as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

The following BMPs, terms and conditions, are designed to ensure that the level of incidental take from the habitat management activities is minimized to a level at which the anticipated benefits to the EMR have a net beneficial effect on population persistence to outweigh the adverse impacts to individual EMR. The BMPs are based on our review of research publications and gray literature titles relating to habitat improvement practices and their potential to result in incidental take of individual EMRs, and the effects (both beneficial and adverse) of habitat improvement on EMR persistence.

Handling Individual EMR

Several of the actions below include BMPs that may include walking a work area to search for and remove individual EMR prior to a management treatment occurring. Because the EMR is venomous, efficient and safe handling of EMRs usually requires use of animal handling tongs be used. Older models often had no way to relieve pressure on the animal, and once it was seized, if the handler gripped to tightly a snake could be crushed or even cut in two. Many modern animal handling tongs (e.g., Midwest Tongs, Inc., Gentle Giant ®; Stoney, Inc., Animal Equipment, Inc. or similar) that are engineered with pressure release springs, wide surface area jaws, and rubberized/padded coating should be used to grab snakes encountered in the wild. These designs ensure a secure grip while minimizing or even eliminating the risk of injury caused by crushing or cutting snakes when they are seized with the tongs. Briefly handling EMR in this fashion and in order to remove them from situations where they may present a hazard does not require additional permission as discussed in two previous Service documents (USFWS 2016b, 2017). We anticipate that land management actions rangewide will result in handling of EMR when they are encountered in a work area or present a hazard. However, we anticipate that this will happen at a much lower frequency than would happen during field studies when individual EMR are targeted for capture. We estimate that 20 or fewer EMR will be captured and handled annually in the implementation of actions considered in this Biological Opinion. Based on this, if precautions are taken to carefully handle EMR (using methods described above) we estimate that one or fewer per year will be injured or killed due to precautionary handling.

Planting Herbaceous or Woody Vegetation

Planting is usually done in the spring, when rainfall is predictable and sufficient to allow root development. Planting herbaceous plugs or whips of woody species in spring could take place in areas of bare soil and that are not immediately attractive to EMR, or on areas already vegetated and thus potentially attractive to, or providing habitat to active EMR. Planting is usually done by personnel working on foot or using hand tools such as trowels or augers during the growing season, though sometimes mechanical plantings may also be used. If EMR are active and present in the habitat when these activities take place, there is minimal risk that personnel (working on foot) could crush an EMR by stepping on it. However, on a scale of acres human footfalls represent a very small area and chance that this will happen. During hundreds of hours conducting field surveys for EMRs at occupied sites in several states since 2001, the Service lead

Biologist for the species has never knowingly stepped on one (M. Redmer, personal observation through October, 2017). We estimate that Service implemented or funded habitat improvements including planting or seeding of herbaceous vegetation by hand/on foot to directly benefit EMR habitat would be less than or equal to 50 acres, annually. When personnel conducting a planting are instructed to observe BMPs listed above (including watching for/being alert to them) as they walk through habitat to plant vegetation, we believe that the likelihood of causing injury or death to EMR by stepping on them is extremely unlikely, and this activity is not likely to adversely affect the species.

There is a higher risk that machinery (wheeled or tracked) working in the field could crush individual snakes. The BMP for this type of planting is for personnel to walk the work area prior to machinery entering the field and visually scan for and remove any EMR encountered in the work area. However, not all snakes may be detected, and at a pace needed to efficiently operate a wheeled or tracked vehicle used to do plantings, there is increased risk that some EMR will be crushed by the vehicles. Because two sets of wheels or two sets of (wider) tracks (on vehicles that presumably move faster than workers on foot), also increase the risk of crushing EMR over that estimated by personnel on foot. We estimate that Service implemented or funded habitat improvements including planting or seeding of herbaceous vegetation by hand/on foot to directly benefit EMR habitat would be less than or equal to 100 acres, annually. When personnel conducting the planting with machinery are instructed to observe BMPs listed above as they plant herbaceous or woody vegetation, incidental take caused by EMR being crushed by machinery is estimated be five or fewer per year, rangewide.

Direct seeding

Seeding to establish prairie, wetland, or other gramminoid dominated habitats is often done with light machinery (for example tractors or all-terrain vehicles pulling seed spreaders or drills) in winter over frozen and/or bare soil, when EMR are dormant. However, exceptions occur and seeding is sometimes done during the growing season. We estimate that Service implemented or funded habitat improvements including planting or seeding of herbaceous vegetation by hand/on foot to directly benefit EMR habitat would be less than or equal to 50 acres annually, and using machinery would be less than or equal to 100 acres, annually. For both types of seeding we estimate incidental take caused to be similar to that caused by planting by hand (one or fewer per year) or with machinery (five or fewer per year, rangewide).

Cutting Woody Vegetation/Brush

Increasing patch size of open gramminoid dominated habitats and connectivity between EMR habitats where invasive woody species have fragmented them increases the potential to support larger EMR populations. The value of smaller patches of EMR habitat tends to decrease as they become more isolated (Johnson 2000; Szymanski, et al 2016), possibly because individual snakes can have substantial spatial demands, and spatial ecology of this species is also quite variable across its range (DeGregorio, et al 2011; Moore and Gillingham 2006; Weatherhead and Prior, 1992). Cutting is often performed both with hand/power tools such as chainsaws by persons on foot (and thus presenting minimal risk to EMR), but in some cases larger tracked or wheeled vehicles equipped with brush mowing or cutting attachments (e.g., Fecon®, HYDRO-AX, Feller-Bunchers, etc.) are used. These vehicles allow greater areas to be covered, but in turn increase risk of crushing individual EMR or entombing them in subsurface refugia unless done at a time when the ground is hard frozen. We estimate that Service implemented or funded habitat

improvements including cutting of woody vegetation or brush by hand/on foot to directly benefit EMR habitat would be less than or equal to 25 acres annually, and using machinery would be less than or equal to 100 acres, annually. For cutting woody vegetation or brush by hand, we estimate incidental take caused to be similar to that caused by planting by hand (one or fewer per year). However, because cutting woody vegetation or brush using machinery often takes place in winter, we estimate higher take due to mortality or injury (because of potential to compact soil or crush openings of crayfish burrows with hibernating EMR) of up to ten EMR per year, rangewide.

Mowing

Mowing can have adverse effects on EMR by crushing them under the tires of the mower or by killing them with mower blades (Durbian and Lenhoff 2004; Durbian 2006). Mowing in EMR habitat should be avoided during the species active season (Durbian 2006). For some woody invasive species, mowing may be effective during the winter. This is not always possible because treating some high-priority invasive species must take place during the growing season. For example sweet clovers (*Melilotis* spp.) are often controlled by mowing in early summer prior to completion of annual flowing. Thus, mowing for habitat management can take place year round, though it is most common during the growing season (when snakes such as the EMR are active above ground). In a study on the effects of mowing and fire on the related western massasauga, Durbian (2006), Durbian reported 3 of 7 radiotelemetered massasaugas were killed by the mower within a 16.6 ha (41 acres) patch, or one killed per 13.6 acres. This represents the best available estimate of EMR mortality per acre resulting from mowing. The acreage that will be mowed by the Service, or as a direct result of Service action (including funding) to benefit grasslands or other occupied EMR habitat throughout the species range is estimated to be 150 acres or less annually. Thus we estimate incidental take of up to approximately 9 EMR per year will occur as a result of mowing by, or funded by the Service, but this number may be considerably lower if the BMPs suggested in this document are implemented.

In addition to its use to manage habitat, mowing can take place to manage areas used primarily by humans, for example to set back growth of invasive woody or herbaceous plant species, or to maintain roadsides, trails, picnic groves, or administrative areas in turfgrass or other short vegetative structure, which may require more frequent mowing. However, by maintaining short (heights of six inches or less) grass, mowing around roadsides may also help to discourage EMR from approaching close enough that they may then attempt crossing a road, thus lessening the risk of mortality from vehicle strikes (Dr. M.J. Dreslik, personal communication to M. Redmer, 31 August 2017). We have no accurate measure of the average amount of maintenance mowing in administrative areas that is funded by or undertaken by the Service adjacent to occupied EMR habitat. However, because this practice is likely to help offset some road mortality, or deter EMR from other situations where they may be at risk of being killed by humans, we consider it to have a net benefit to the species, and is essentially a BMP.

Herbicide Application

In gramminoid-dominated habitats preferred by EMR, herbicide application reduces or eliminates invasive herbaceous and woody vegetation from a habitat. Because the Service has no information related to the direct effects that common herbicides (e.g., Glyphosate) used in habitat restoration may have on the EMR, we urge managers to use caution when applying these in known EMR habitat. In cases where herbicide application is done by personnel on foot hand

operated applicators (e.g., backpack sprayers) or application techniques (e.g., wicking or rubber glove application), workers can easily avoid harming individual EMR by watching where they apply herbicide. Broadcast applications (e.g., from booms pulled behind equipment or from aerial platforms) are also used when widespread coverage is required, for example to prepare an old field for seeding of native species, or to efficiently cover large patches of invasive plants. In cases where herbicide is broadcast, the likelihood that herbicide drift could land on an EMR would increase. However, because there are no available data on the direct effects of herbicide (e.g., from drift that may land on a snake) on EMR, and we thus cannot estimate resulting take. However, use of machinery (e.g., tractors) to broadcast herbicides during the active season of the EMR would increase the likelihood that individual snakes would be injured or crushed. We estimate that acreage and take resulting from injury or mortality caused while applying herbicides by hand or with heavy equipment would be similar to that expected from planting or seeding done by personnel on foot (<50 acres, incidental take would be highly unlikely (we estimate one or fewer per year), or with machinery such as wheeled or tracked vehicles (<100 acres, five or fewer per year, rangewide), and is thus not likely to adversely affect the species.

Disking

Disking requires use of larger tractors that could crush EMR if they are present, and the disks themselves could lead to direct mortality of EMR by cutting them, turning them under the soil, or by cutting off exits from underground refugia (e.g., crayfish burrows). While there is little known about direct effects of disking and field plowing on burrowing crayfishes, if done when EMR are hibernating these practices would likely kill some snakes in their burrows. This is known to happen to the crayfish frog, *Lithobates areolatus*, another grassland species that occupies crayfish burrows (Wright and Wright, 1995). In addition, strips that were disked within a wildlife management area occupied by a population of crayfish frogs remained devoid of burrows for up to four years following the time the strips were disked (Dr. M.J. Lannoo, personal communication to M. Redmer, January 13, 2017). Thus, it is similarly assumed that disking in areas with EMR hibernacula could result in loss of a significant part of the population.

If disking is necessary in areas with EMR and their hibernacula are present, individual project managers should request consultation with their Ecological Services Field Office. However, since disking may be used to allow continued cultivation prior to conversion to habitat, or following cessation of cultivation so that an area can be seeded to restoring unoccupied grassland habitat that may be beneficial to EMR, there may be times when it is prescribed for use in or adjacent to occupied EMR habitat. If this occurs, there is still some chance that individual EMR could be killed by crushing or by being disked up with the soil. We estimate that acreage take resulting from injury or mortality caused from disking in areas adjacent to known EMR habitat would occur at a rate similar to that expected from brush cutting with machinery (such as wheeled or tracked vehicles), but that acreage of disking in EMR habitat to be lower (less than 50 acres per year rangewide), and take resulting from injury or mortality from disking to be five or fewer per year, rangewide.

Earthmoving

Earthmoving usually involves use of heavy, wheeled or tracked equipment and thus may pose a crushing risk when used in areas where EMR are present, and may also alter the contour or upper soil horizons within their habitat. At the scale of most habitat projects that may be proposed within EMR habitat, earthmoving often occurs on a localized basis. Thus, while earthmoving

may alter a significant amount of habitat (for example through creating a low a berm to impound water or expand moist soil areas, or to disable farm tile that alters hydrology in EMR habitat), the work zones themselves may be small enough to allow measures to minimize or avoid incidental take to EMR (see "Description of the Action," above). If earthmoving is necessary when EMR may be hibernating, and is proposed in areas with EMR and their hibernacula are present, individual project managers should request consultation with their Ecological Services Field Office. However, if earthmoving can take place during the active season, and BMPs for this action are implemented, take would be less likely than if earthmoving occurs when snakes are hibernating. We also estimate that projects involving earthmoving would affect 25 or fewer acres per year, rangewide. Thus, we estimate that take resulting from injury or mortality caused from earthmoving in areas with EMR, or adjacent to occupied EMR habitat would result in a similar rate as expected brush cutting, or disking with machinery such as or wheeled or tracked vehicles, but the lesser area affected would result in five fewer EMR taken per year, rangewide.

Hydrologic Management

Extreme fluctuations in the water table may negatively affect body condition the following active season, cause early emergence, or direct mortality (Harvey and Weatherhead 2006; Johnson et al. 2000; Kingsbury 2002, Seigel et al 1999, Smith 2009) when the snakes are underwater hibernating. The water in the hibernacula protects the snakes from dehydration and freezing, thus dropping the levels in the winter leaves the snakes vulnerable to both (Kingsbury 2002; Michigan DNR 2015; Moore and Gillingham 2006; Smith 2009). Draining removes the heat sink capabilities of the water and weakens the thermal link to warmer areas further underground (Michigan DNR, 2015). Flooding that leads to water levels that prevent hibernating EMR from being able to reach the water's surface to breathe can lead to individuals either drowning, or exiting hibernacula prematurely (Dr. M. Dreslik, personal communication to M. Redmer, 29 August, 2017). This has also been reported in *Lithobates areolatus* (a frog that lives and hibernates in crayfish burrows) when ice forms at the top of the burrows, preventing the frogs from breathing (Heemeyer and Lannoo 2011, Lannoo and Stiles, 2017). Hydrologic management to return or modify the physical characteristics of wetland soils within EMR habitat may be necessary in some circumstances to ensure the success of other actions that lead to habitat enhancement. Consistent hydrology at EMR sites is important to maintain conditions that support EMR over-winter survival. In areas where hydrology is managed for other wildlife (waterfowl attraction for example) but where EMR are known to occur, maintaining existing flood-drawdown cycles may be sufficient if it is known that EMR have persisted through those management cycles. Similarly, if mechanisms (e.g., water controls structures, valves installed in farm tile networks) are in place, these may be used to the benefit of populations of both burrowing crayfishes and EMR by holding water and maintaining more hydrated soils than may be otherwise possible in times of drought. Thus, in areas where EMR are known to hibernate, if hydrology can be managed EMR should be taken into consideration when annual hydrology management plans are devised. Maintaining a high water table, but not one where the openings of crayfish burrows are submerged during the dormant season (generally November through February in the southern part of the EMR's range, and November through early April in the northern part of the EMR range) should be a goal at sites where EMR occur. Where hydrological management will result in levels that are higher than the openings to crayfish burrows or other potential EMR hibernacula, a high amount of take is likely, and individual project managers should request consultation with their Ecological Services Field Office.

However, hydrological management may be valuable to maintaining either the very shallow wetlands, or high water tables needed by crayfish and massasaugas that hibernate in crayfish burrow, this practice may also be beneficial to EMR. When wetlands are managed this way, there is still some chance that individual EMR could be killed by crushing or by being disked up with the soil, or from events (such as heavy rain or rapid snow melt) beyond the control of the manager. We estimate that acreage affected by actual work to construct water controls structures in EMR habitat would affect up to 25 acres per year. Thus take resulting from injury or mortality caused from actual work to construct low berms, to install other water control structures (for example "AgriDrain" or other underground valves), or to disable field tiles in areas adjacent to or having known EMR habitat would be similar to that expected from brush cutting, or earth moving (five or fewer per year, rangewide).

Prescribed Fire

While prescribed fire is an essential tool for managing EMR habitat (Johnson *et al.* 2000, Dovčiak et al., 2013), direct mortality of the EMR can result from exposure to fire if burning occurs when the snakes are out of their hibernacula (post-emergent fire) (Cross 2009, Cross *et al.* 2015, Dreslik 2005, Dreslik *et al*. 2011, Durbian 2006)**.**

The primary consideration in using prescribed fire to manage habitat occupied by EMR in a way that avoids or minimizes the risk of incidental take is timing to avoid periods when most of an EMR population is active in the habitat to be burned. In general, most EMR in a population will enter (ingress) hibernacula between October (in the northern part of the range) and early November (in the southern part of the range) and emerge (egress) from their hibernacula from between early March (in the southern part of the range) until as late as early May (in the northern part of the range). However, across the range of the EMR, ingress into hibernation, and especially egress from hibernation may vary greatly from year to year depending on when and how rapidly spring temperatures rise, and local thaws progress.

While EMR that egress in the spring may re-enter burrows for short periods of time to avoid early season cold periods, this behavior is not predictable, and it should not be presumed that prescribed fires can be ignited during cold period that follow a period of egress. In March 2007, following unseasonably warm temperatures (several consecutive days in excess of 27°C) EMR were monitored at two sites in Illinois after emerging 2-3 weeks earlier than observed during previous years. At the first site during a subsequent period of cold weather in April, one radiotelemetered EMR was observed to stay on the surface, sheltering under dead vegetation rather than re-entering a hibernaculum. The snake survived several days when low air temperatures dropped to ca. -4°C and during which time >9.6cm (4 inches) of snow covered the top of its shelter (M. Redmer, personal observation, March and April 2007). At the other Illinois site, land managers assumed that the same period of cold weather caused EMR to return to their hibernacula, and ignited a prescribed fire. During a 6.9 hectare (17 acres) prescribed fire in April 2008, two EMRs were killed in Illinois (Dreslik et al., 2011; Eric Smith, Illinois Department of Natural Resources, personal communication February 2, 2018). In a study on the effects of mowing and fire on the closely related western massasauga, Durbian (2006) reported three massasaugas killed by prescribed fire within an 8 ha (19.8 acre) patch, or one killed per 6.6 acres. Both cases represent mortality rates that occurred after egress from hibernation had begun, and thus make the best available estimate of EMR mortality per acre resulting from

burning. Based on the best currently available data, if the BMPs recommended in this document are followed (either by using prescribed dates or actual soil climate data) prescribed fire would likely be less than would be unlikely to lead to incidental take of the EMR when soil climate data are unavailable for guiding burn dates. The acreage that will be burned as a direct result of Service action (including funding) to benefit grasslands or other occupied EMR habitat throughout the species range is estimated to be 200 acres or less annually. Thus we estimate that, rangewide up to approximately 30 EMR per year would be killed or harmed as a result of burning during the active season. However, this number may be considerably lower, or close to zero if the BMPs (either based on timing or soil climate do avoid burning in the active season) suggested in this document are implemented. If those BMPs cannot be followed, individual project managers should request consultation with their Ecological Services Field Office.

Summary of Effects of the Proposed Action

The effects due to the proposed actions, discussed above, may result in harassment, reduced fitness, injury, and mortality of individual EMRs. However, the proposed habitat enhancement actions will be conducted using BMPs designed to ensure that the level of incidental take from the habitat management activities is minimized to a level at which the net benefit to the EMR from habitat improvement will outweigh the adverse impacts to individual EMR.

Cumulative Effects

Cumulative effects include the effects of future state, local, or private actions that will not be subject to section 7 consultation in the areas being considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not being considered in this Biological Opinion, since they would require a separate consultation pursuant to section 7(a)(2) of the ESA, as amended. We have not analyzed the additional cumulative effects of future state, local, or private actions in this Biological Opinions because the net effect of the proposed action in intended to be beneficial to the species, and this net benefit would not be altered by the effects of other actions.

Conclusion

Regulations define "jeopardize the continued existence of a species" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." After reviewing the current status of EMR, the environmental baseline for the action area, the effects of the proposed actions, and the cumulative effects, we conclude that the proposed action is not likely to reduce reproduction, numbers, or distribution of EMR to such an extent as to reduce appreciably the likelihood of survival and recovery of the species. Some incidental take of EMR is expected as a result of actions to improve or protect the habitat of the EMR, however, the proposed actions will provide significant benefits for the species. It is the Service's biological opinion that the proposed action will not jeopardize the continued existence of EMRs.

Incidental Take Statement

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take[1] of endangered and threatened species, respectively, without special exemption. Harm and harass are both further defined by regulation.[2] Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary and must be undertaken by the Service for the exemption in section 7(o)(2) to apply. The Service has a continuing duty to regulate the activity covered by this ITS. If the Service (1) fails to assume and implement the terms and conditions as part of the proposed action the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Service must document the progress of the action and its impact on the species as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Amount or Extent of Take Anticipated

This is a programmatic Biological Opinion, and will outline the amount of take anticipated for each category of proposed action without identifying the total amount of acres anticipated to be treated. Individual consultations using the attached "Intra-Service Section 7 Biological Evaluation Form" template will report project by project take estimates using the "Anticipated Take Table."

For most conservation land management activities that are reasonably certain to result in incidental take, we will express the amount or extent of take in terms of surrogates. It is appropriate to use surrogates to describe the extent of incidental in an ITS as long as 1) the ITS describes the causal link between the surrogate and the take of the listed species; 2) the ITS describes why it is not practical to express the amount or extent of anticipated take or to monitor take-related impacts in terms of individuals of the listed species; and, 3) the ITS sets a clear standard for determining when the level of anticipated take of the listed species has been exceeded. These descriptions are provided in the attached "Anticipated Take Table" template and in the "reinitiation of consultation" narrative.

Projects evaluated under this programmatic Biological Opinion and reported on the attached Intra-Service Section 7 Biological Evaluation Form template will also report actual take from project implementation using the attached "Observed Take Table."

Table 4 (below) provides an illustration of potential take levels that may be associated with possible habitat restoration acreages. We attempted to estimate the number of acres where the contemplated habitat management actions would take place, annually, at or adjacent to known occupied EMR habitat. Due to the difficulty in estimating future acreages of habitat

[1] Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct.

[2] See 50 Code of Federal Regulations 17.3.

Table 4 Estimated acreage of habitat enhancement actions (through both direct project implementation or indirect implementation, e.g., by technical assistance or funding of projects) intended to have direct benefits to the species and associated annual take (mortality or injury of eastern massasauga rattlesnakes).

Action	Estimated Acreage	Estimated Annual Take
Handling/removing snakes from work areas	N/A	≤1/unlikely
Planting herbaceous/woody plants		
On foot/by hand	≤50	≤1/unlikely
Using machinery	≤100	≤5
Direct seeding		
On foot/by hand	≤50	≤1/unlikely
Using machinery	≤100	≤5
Cutting woody vegetation/brush		
On foot/by hand	≤25	<1/unlikely
Using machinery	≤100	≤10
Mowing		
For habitat management	≤150	9
Of administrative areas	Unknown	unlikely
Herbicide application		
On foot/by hand	<50	<1/unlikely
Using machinery	≤100	≤5
Disking	≤50	≤5
Earthmoving	≤25	≤5
Hydrologic management	≤25	≤5
Prescribed Fire	≤200	≤30*
Planning and Technical Assistance	Included in above estimates	Included in above estimates
USFWS Funding Mechanisms	Included in above estimates	Included in above estimates
TOTAL	-**	83*

*If BMPs for prescribed fire are implemented, this number could be considerably lower.

improvement projects that may be conducted or funded by the Service, the acreages (and related take resulting from mortality or injury) below represent what we believe to over-estimate annual land management treatments potentially conducted or funded by the Service.

Typically, reinitiation of consultation is triggered when authorized take levels are exceeded. This Biological Opinion analyzes take that occurs incidental to actions designed to result in a net benefit to the EMR through improvement of the species habitat. Higher numbers of individual "take" in this case would be expected to indicate a greater amount of habitat managed, and resulting increase in net benefit in the species' condition. Therefore, setting a simple numeric

threshold for total "take" does not in this case provide the intended safeguard of preventing harm to a species by identifying a trigger to reinitiate consultation when take, and therefore impact to the species, exceeds the level anticipated in the effects analysis. We propose an alternative metric or "trigger" that is more relevant to this Biological Opinion.

The habitat management "Terms, Conditions, and Best Practices" described below have been designed to keep levels of individual take of EMR below a level that, combined with the increase in habitat quality for EMR, results in a net conservation benefit to the species. It is important, therefore, to be able to identify whether our assumptions are proven wrong, and whether take resulting from any of the proposed management actions may occur at levels that change the net impact to EMR from positive to negative. We will reinitiate consultation if, during the course of an action, high levels of incidental take (here defined as mortality of ten [10] or more individual EMR from any single treatment or during a single treatment period) are detected. This level of incidental take would indicate that we underestimated potential take resulting from the action and would represent new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. Upon learning of an event leading to a high level of incidental take, the project officer(s), either from the Service or cooperating state/local agency or organization, must immediately inform the appropriate Ecological Services Field Office, and/or the EMR lead office. The project officer(s) should provide an explanation of the causes of the taking and review with the applicable Ecological Services Field Office(s) the need for possible modification of the reasonable and prudent measures.

When dead EMR that may have been killed in the course of implementing a habitat improvement for, or funded by, the Service are found in the field, Service project managers or partners shall contact the Ecological Services Field Office that covers the project area to report such mortality within five (5) business days of discovery.

Reasonable and Prudent Measures

To track acres of EMR habitat managed and observed take of EMR, the incidental take that occurs shall be recorded upon project completion and reported to the Service using the attached "Observed Take Table." Accurate and timely reporting of incidental take that occurs as a result of the proposed action will help to validate the ongoing accuracy of the analysis conducted in that biological opinion.

The Service believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize impacts of incidental take of eastern massasauga:

1. Ensure that proposed activities will result in the maximum benefit to the species and least possible levels of direct and incidental take necessary to accomplish beneficial management and recovery objectives.

2. When possible, monitor the extent of take occurring due to habitat management actions carried out under the Service's authority or through the Service's authorities to provide funding to external partners to assist with habitat management actions that may be beneficial to the species when efforts are taken to avoid and minimize adverse effects and incidental take (reasonable parties: permit holder/grantee and Service). In addition to completing an Intra-

Service Section 7 evaluation (template for EMR appended for individual project managers) prior to initiating the project, also complete the tables (also appended below) indicating what treatment(s) were used and at what acreages as a surrogate for estimating incidental take as a result of the project.

Terms and Conditions, and Best Practices

The Chicago Field Office (or all Field offices) will help ensure that any proposed management activities use the most recent information available for the EMR.

Unless identified below as a "recommended" practice, the Service must comply with the following terms and conditions, which carry out the reasonable and prudent measures, described below and outline the required reporting/monitoring requirements. These terms and conditions are non-discretionary.

A. Handling Individual EMR

1. When walking a work area to search for and remove individual EMR prior to a management treatment occurring, handlers shall use only modern animal handling tongs (e.g., Midwest Tongs, Inc., Gentle Giant ®; Stoney, Inc., Animal Equipment, Inc. or similar) that are engineered with pressure release springs, wide surface area jaws, and rubberized/padded coating shall be used to grab snakes encountered in the wild.

2. Any individual EMR removed from a work area shall be immediately released in adjacent habitat no greater than 200 meters form the point of capture. Briefly handling EMR in this fashion and in order to remove them from situations where they may be at risk or may present a hazard does not require additional permission as discussed in two previous Service documents (USFWS 2016b, 2017).

B. Planting Herbaceous or Woody Vegetation

1. Recommended: Contractors or other individuals working with hand tools in known EMR habitat shall be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

2. Recommended: Contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

3. If mechanized plantings are used, individuals familiar with the EMR shall walk through the work area where planting will occur, but prior to it starting, to visually scan for individual EMR, any EMR encountered that may present a hazard shall be removed from a work area. Such EMR shall be immediately released on adjacent habitat not greater than 200 meters from point of capture. Moving EMR from such situations does not require a permit (see USFWS 2016c, 2017).

C. *Seeding Herbaceous or Woody Vegetation*

1. Recommended: Avoid use of heavy machinery in EMR habitat during the species' active season. Since dates when EMR are active above ground can vary, seeding with machinery should be done within the windows provided in Table 1 (above). Managers in the southern portion of the range should be aware of unseasonably early warm periods (for example early warm weather in February) which may draw a few EMR to the surface, and exercise caution in such circumstances.

2. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid seeding with heavy equipment (tractors or trucks). When seeding is planned in these areas, use manually operated seed broadcasters, or mount seed broadcasters on small/lightweight all-terrain vehicles.

3. Recommended: During periods of prolonged sub-freezing temperatures, seed when the surface soil is hard frozen. If these soil is hard frozen, light all-terrain vehicles, small trucks or tracked vehicles may be used to broadcast seed in EMR habitat.

4. If mechanized planting is used, individuals familiar with the EMR shall walk through the work area where planting will occur, but prior to it starting, to visually scan for and remove individual EMR that may present. Any EMR that present a hazard shall be removed from a work area, and shall be released on adjacent habitat not greater than 200 meters from the point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

D. Cutting Woody Vegetation/Brush with Hand Tools

1. Recommended: When possible, brush cutting should be conducted in months when EMR are likely to be dormant (November through February in most of the range).

2. Recommended: If brush cutting during the EMR active season, contractors or other individuals working with hand or power tools in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. Recommended: If brush cutting during the EMR active season, contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

E. Cutting Woody Vegetation/Brush Using Heavy Equipment

1. Avoid use of heavy machinery to cut brush in EMR habitat during the species' active season. Although dates when EMR are active above ground can vary, it is recommended that brush cutting with heavy machinery should be confined to the months of November through February (or when ground is hard frozen) throughout the range of the EMR.

2. Recommended: Managers in the southern portion of the range should be aware of unseasonably early warm periods during the usual dormant season (for example early warm weather in February) which may draw a few EMR to the surface, and avoid use of heavy machinery at such times.

3. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to cut brush. When brush cutting is planned in these areas, hand or power tools shall be used instead.

4. Use heavy machinery to cut brush in EMR habitat only during prolonged periods f sub-freezing temperatures, when the surface soil is hard frozen. If the soil is hard frozen light all-terrain vehicles, small trucks or tracked vehicles may be used cut brush in EMR habitat.

5. Individuals familiar with the EMR shall walk through the work area where the planting will occur, but prior to it starting, to visually scan for and remove individual EMR that may be present. Any EMR that present a hazard shall be removed from a work area and released on adjacent habitat not greater than 200 meters from the point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

F. Mowing

1. Avoid use of heavy machinery to mow in EMR habitat during the species' active season. Since dates when EMR are active above ground can vary, consult "Prescribed Fire" section and/or Table 1 (above) before mowing with heavy machinery.

2. Recommended: Sickle bar and disk mowers should be used because they do not create a vacuum effect which has been shown to injure or kill snakes (Durbian, 2006).

3. Recommended: Mowers with a wider wheel base should be used as they will require fewer passes through the areas and reduce the probability of crushing snakes (Durbian, 2006).

4. Raise mower decks when mowing during the active season to a height no lower than 9 inches and ideally keep the mower blades above 12 inches, or if shorter turf grass in administrative areas (campgrounds, roadsides, etc.) must be maintained, do so by mowing during the hottest part of mid-day when EMR are least likely to be present.

5. In situations where control of target invasive species (e.g., sweet clovers, *Melilotis* spp.) require mowing during the EMR active season, persons familiar with methods to safely handle venomous snakes, and carrying conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone just prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

6. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to mow. When mowing is planned in these areas, use hand tools or hand power tools.

7. Recommended: When administrative areas (e.g., campgrounds, roadsides, picnic areas, or other areas where turfgrass is maintained adjacent to EMR habitat), regular mowing and maintaining the grass height at approximately 6 inches or less throughout the growing season should discourage EMR from entering such areas, and would provide a net benefit of reducing encounters between EMR and humans using these areas.

G. Herbicide Application

1. Recommended: When possible (e.g., with woody species), conduct herbicide applications in months when EMR are likely to be dormant (see Table 1).

2. Recommended: Contractors or other individuals working during the EMR active season, and in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. Recommended: Contractors or other individuals should be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

4. Recommended: Avoid use of heavy equipment and broadcast applications (including aerial) of herbicide in occupied EMR habitat.

5. When heavy equipment or broadcast applications must be used in areas known to be occupied by EMR, follow the same seasonal guidelines provided for practices listed above to avoid soil compaction or crushing EMR.

6. Avoid using heavy equipment or other broadcast applications (e.g., aerial) in areas where known EMR hibernacula or large concentrations of crayfish burrows are known to occur in occupied EMR habitat. In these areas use hand application techniques instead.

7. In situations where control of target invasive species require herbicide applications using heavy equipment during the EMR active season, persons familiar with methods to safely handle venomous snakes, shall conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

8. Avoid using heavy equipment or other broadcast applications (e.g., aerial) in areas where known EMR hibernacula or large concentrations of crayfish burrows are known to occur in occupied EMR habitat. In these areas use hand application techniques instead.

H. Disking

1. Disking should be minimized or avoided during the active season, or areas that are to be disked during the active season should be mowed during the inactive season to less than 15 cm (6 in) in height so that they are unattractive to snakes the following spring, and the mowing should be continued until the disking is to take place.

2. If mowing can't be done prior to disking, personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

3. Areas currently in row-crop agriculture, but to be converted to EMR habitat by disking should be continuously maintained as row-crop agriculture until such time that they may be seeded to native grasslands or similar habitat that may be beneficial to EMR.

I. Earthmoving

1. If earthmoving is planned within occupied EMR habitat, equipment shall be offloaded from the closest point to the work zone as practicable, on a service road, parking lot etc.

2. From the offloading point, provide a short, direct route through which equipment operators can traverse to get to the work zone as quickly as possible.

3. Where the route would traverse through EMR habitat, it should be mowed in advance (see above best practices for mowing administrative areas) to a grass height of less than 6 inches to discourage EMR from using the path from the offload site to the work zone.

4. Personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

5. Recommended: If the work period may be prolonged (>7 days) the work zone could be visually scanned as described above, just prior to commencing work, and a trenched-in silt fence shall be erected around the work zone to prevent re-entry by individual EMRs that are in the proximity. Once the area is scanned and found to be free of EMR, work can commence without impediment.

J. Hydrologic Management

1. Water levels in managed habitat shall not be drawn down during the inactive season, except for human health and safety reasons.

2. Water levels may not be raised for more than two continuous weeks during a single inactive season, except for health and safety concerns. Water levels may be raised during the active season.

3. Hydrology should be managed to ensure that EMR are able to hibernate within retreat into the water table in crayfish burrows, or other locally available cavities.

K. Prescribed Fire: (Recommended/Preferred Practice) When Weather/Soil Climate Stations are Available

1. At least two weeks prior to anticipated start of a burn season in their area, and before burning at known EMR sites, land managers/burn bosses shall access and monitor the soil climate data at or from the nearest adequately equipped (e.g., with soil temperature probes) weather station to track and provide real-time temperatures at 1 meter, 0.6 meter, 0.3 meter depths, and at soil surface.

2. After the tenth day (cumulative) in spring when the temperature at the 0.3 meter depth has exceeded that at the 0.6 meter depth, no prescribed burn shall be conducted within in delineated wetlands known or believed to have EMR hibernacula, nor within 100 meter buffer of the delineated wetlands.

3. Land managers/burn bosses may continue to conduct prescribed burns in adjacent upland habitats beyond the 100 meter buffer for an additional two weeks/14 days following the date when wetland burns were discontinued. To avoid take of EMR dispersing into adjacent uplands, prescribed burns shall discontinued after the 14th day following the date when burns were discontinued in the wetlands as described in best practice 2, above.

If the above soil climate and science-based practices are followed, prescribed fire within EMR habitat would be unlikely to lead to incidental take of the EMR, and would likely allow an extended (over dates provided in Table 1, below) burn season in most years. However, because adequately equipped and accessible weather stations that allow the above practices to be followed are not yet commonly available, the Service intends to work closely with state and local partners to establish a network of such stations that could be remotely accessed (e.g., by internet or cellular applications). Until such a network is available, a set of predetermined dates for planning times to use prescribed burns at EMR sites may be used as an interim measure (Table 1).

Prescribed Fire: When Weather/Soil Climate Stations are Not Available

4. Timing of burns shall be determined after consulting dates in Table 1.

5. Burns may be conducted outside of these dates if the crew has soil climate data available for their latitude band, and can document it prior to igniting a fire.

6. Recommended: leave unburned areas adjacent to prescribed burns to serve as snake refugia whenever possible.

7. Prescribed burn plans will use back burning as the primary ignition strategy. The approach will minimize entrapping snakes between flame fronts. However, the burn manager may make the judgement during a burn treatment, that encirclement ignition or strip firing is necessary to protect human safety or property.

8. A scientific fire behavior model, such as the United States burn model, the Canadian burn model or equivalent shall be used to formulate a burn prescription for a maximum rate of spread no faster than 16 chains per hour (17.6 feet per minute) with an average targeted rate 10 chains per hour or less (11 feet per minute), except in known hibernacula areas. A slower rate of spread may allow snakes within the burn unit adequate time to find refugia.

9. Fire shall will be established following existing features (such as roads, streams, and trails) to the extent possible. Cultivation (disking or rototilling) of burn breaks will be minimized to the extent that human health and safety are not jeopardized. Cultivation and mowing fire breaks will be established during the inactive season to the extent possible.

Reinitiation – Closing

This concludes the Biological Opinion for Federally Listed EMR (*Sistrurus catenatus*) in relation to impacts of proposed habitat management actions of the Service that are intended to benefit EMR recovery, but which may also result in short term adverse effects to the species through incidental take in the form of injury or mortality. The actions include land management activities, such as prescribed fire, planting, brush cutting, mowing, herbicide application, soil disking or tilling, earthmoving, and hydrological alteration, as well as providing funding (through grants or cooperative agreements) and technical assistance to help plan or implement habitat enhancement, restoration, or protection that may adversely affect the EMR.

In this Biological Opinion, incidental take of EMR would be a result of implementation of habitat management and restoration activities that could result in injury or mortality of individual EMRs. Incidental take is expected in the form of harassment, injury, or mortality by actions incidental to the proposed/funded actions. However, we have not attempted to estimate total numbers of EMRs that may be injured or perish due to potential habitat management and restoration activities because that number will depend on the total acreage of habitat managed each year, which depends on unpredictable future Federal and State government budgets that provide the majority of habitat management funding. In addition, level of take from habitat management activities will vary by site conditions and population density at each site, and the total number of EMR that may be anticipated to be taken as a result of habitat management and restoration activities is not an informative number for conservation of the species. Incidental take would occur as a result of, and be proportional to, activities with a net conservation benefit since the improvements would be expected to increase the likelihood of survival for the EMR populations in the managed habitats.

The habitat management "Terms, Conditions, and Best Practices" described in this document have been designed to keep levels of individual take of EMR below a level that, combined with the increase in habitat quality for EMR, results in a net conservation benefit to the species. If, during the course of the action, high levels of incidental take (here defined as ten [10] or more individual EMR from any single treatment or during a single treatment period) are detected, this would represent new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. Upon learning of an event leading to a high level of incidental take, the project officer(s), either from the Service or cooperating state/local agency or organization, must immediately inform the appropriate Ecological Services Field Office, and/or the EMR lead office. The project officer(s) should provide an explanation of the causes of the taking and review with the applicable Ecological Services Field Office(s) the need for possible modification of the reasonable and prudent measures.

This concludes formal consultation on the actions outlined in the request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary. Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species is listed or c1itical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

References

Allender, M.C., M. Dreslik, S. Wylie, C. Phillips, D. Wylie, C. Maddox, M.A. Delaney, and M. J. Kinsel. 2011. An unusual mortality event associated with *Chrysosporium* in Eastern Massasauga Rattlesnakes (*Sistrurus catenatus catenatus*). Emerging Infectious Diseases 17: 2383–2384.

Andrews, K.M. and J.W. Gibbons. 2005. How do highways influence snake movement? Behavioral responses to roads and vehicles. Copeia 2005: 772-782.

Ashley, E., A. Kosloski, and S. Petrie. 2007. Incidence of intentional vehicle-reptile collisions. Human Dimensions of Wildlife 12:137-143.

Baker, S.J. 2016. Life and death in a corn desert oasis: reproduction, mortality, genetic diversity, and viability of Illinois' last eastern massasauga population. Ph.D. Dissertation, University of Illinois at Urbana-Champaign. 131p.

Baker, S.J., M.J. Dreslik, D.B. Wylie, and C.A. Phillips. 2016. Sources of mortality in endangered Eastern Massasauga (*Sistrurus catenatus*) in Illinois. Herpetological Conservation and Biology 11: 335-343.

Beltz, E. 1993. Distribution and status of the eastern massasauga rattlesnake, *Sistrurus catenatus catenatus* (Rafinesque, 1818), in the United States and Canada. 26-31.

Bielema, B.J. 1973. The eastern massasauga (*Sistrurus catenatus catenatus*) in west-central Illinois. MS Thesis, Western Illinois University, Macomb, Illinois. 80p.

Bissell, K.M. 2006. Modeling habitat ecology and population viability of the eastern massasauga rattlesnake in southwestern lower Michigan. MS Thesis, Michigan State University, East Lansing. 124p.

Choquette, J.D. 2011. Reconnecting rattlers: identifying potential connectivity for an urban population of eastern massasauga rattlesnakes. MS Thesis, The University of Guelph, Ottawa, Canada. 98p.

Christiansen, J.L. 1993. Survey for New Populations of the Eastern Massasauga Rattlesnake, *Sistrurus catenatus catenatus* in Eastern Iowa. Final Report submitted to Iowa Department of Natural Resources. 38p.

Cross, M.D. 2009. Responses of the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) to prescribed fire. MS Thesis CentralMichigan University. 41p.

Cross, M.D., K.V. Root, C.J. Mehne, J. McGowan-Stinski, D. Pearsall, and J.C. Gillingham. 2015. Multi-scale Responses of Eastern Massasauga Rattlesnakes (*Sistrurus catenatus*) to Prescribed Fire. The American Midland Natualist, 173(2): 346-362.

DeGregorio, B.A. 2008. Response of the eastern massasauga rattlesnake (*Sistrurus c. catenatus*) to clearcutting. MS Thesis, Purdue University, Ft. Wayne, Indiana. 61p.

DeGregorio, B.A., J.V. Manning, N. Bieser, and B.A. Kingsbury. 2011. The Spatial Ecology of the Eastern Massasauga (*Sistrurus c. catenatus*) in Northern Michigan. Herpetologica, 67: 71-79.

Dovčiak, M., P.A. Osborne, D.A. Patrick, and J.P. Gibbs. 2013. Conservation potential of prescribed fire for maintaining habitats and populations of an endangered rattlesnake *Sistrurus c. catenatus*. Endangered Species research 22: 51-60.

Dreslik, M.J. 2005. Ecology of the eastern massasauga (*Sistrurus catenatus catenatus*) from Carlyle Lake, Clinton County, Illinois. Ph.D. Dissertation, University of Illinois at Urbana Champaign. 353p.

Dreslik, M.J., R.B. King, J.M. Earnhardt, and R.A. Christoffel. 2011. Illinois species recovery plan for the eastern massasauga (*Sistrurus catenatus catenatus*). Unpublished agency draft. 45p.

Dreslik, M.J., C.A. Philips, and D.B. Shepard. 2003. Thermal and Behavioral relationships in the Eastern Massasauga Rattlesnake, *Sistrurus c. catenatus*. The Illinois Department of Natural Resources Non-Game Wildlife Fund Small Projects.

Durbian, F.E. 2006. Effects of Mowing and Summer Burning on the Massasauga (*Sistrurus catenatus*). Am. Midl. Nat. 155: 329-334.

Durbian, F.E., R.S. King, T. Crabill, H. Lambert-Doherty, and R.A. Seigel. 2008. Massasauga home range patterns in the Midwest. Journal of Wildlife Management 72: 754-759.

Durbian, F.E., L. Lenhoff. 2004. Potential Effects of Mowing Prior to Summer Burning on the Eastern Massasauga (*Sistrurus c. catenatus*) at Squaw Creek National Wildlife Refuge, Holt County, Missouri, USA. Trans. Mo. Acad. Sci., 38: 21-25.

Faust, L., J. Szymanski, and M. Redmer. 2011. Range wide extinction risk modeling for the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*). Unpublished report, Lincoln Park Zoo and U.S. Fish and Wildlife Service. 66p.

Foster, M.A., K.M. Bissell, H. Campa III, and T.M. Harrison. 2009. The influence of reproductive status on thermal ecology and vegetation use of female Eastern Massasauga Rattlesnakes (*Sistrurus catenatus catenatus*) in southwestern Michigan. Herpetological Conservation and Biology 41: 48-54.

Gargas, A., Trest, M., Christensen, M., Volk, T.J., and Blehert, D. 2009. *Geomyces destructans* sp. nov., associated with Bat White-Nose Syndrome. Mycotaxon. 108: 147-154.

Gibbons, J.W., Scott, D.E., Ryan, T.J., Buhlmann, K.A., Tuberville, T.D., Metts, B.S., Greene, J.L., Mills, T., Leiden, Y., Poppy, S., and Winne, C.T. 2000. "The global decline of reptiles, deja vu amphibians". BioScience 50(8): 653–666.

Grow, L., and H. Merchant. 1980. The burrow habit of the crayfish, *Cambarus diogenes* (Girard). American Midland Naturalist 103: 231-237.

Hallock, L.A. 1991. Habitat utilization, diet and behavior of the Eastern Massasauga (*Sistrurus catenatus*) in southern Michigan. MS Thesis, Michigan State University. 40p.

Harding, J.H. 1997. Amphibians and reptiles of the Great Lakes Region. University of Michigan Press. Ann Arbor, Michigan. 378p.

Harvey, D.S., and P.J. Weatherhead. 2006. A test of the hierarchical model of habitat selection using eastern massasauga rattlesnakes (*Sistrurus c. catenatus*). Biological Conservation 130: 206-216.

Harvey, D.S., and P.J. Weatherhead. 2011. Thermal ecology of massasauga rattlesnakes (*Sistrurus catenatus*) near their northern range limit. Canadian Journal of Zoology 89: 60-68.

Heemeyer, J.L. and M.J. Lannoo. 2011. *Lithobates areolatus circulosus* (northern crawfish frog) Winterkill. Herpetological Review 42: 261-262.

Hileman, E.T. 2016. Filling in the gaps in demography, phenology, and life history of the eastern massasauga rattlesnake (*Sistrurus catenatus*). Ph.D. Dissertation, Northern Illinois University.

Hoving, C.L., Y. Lee, P.J. Badra, and B.J. Klatt. 2013. Changing Climate, Changing Wildlife: a Vulnerability Assessment of 400 Species of Greatest Conservation Need and Game Species in Michigan. Wildlife Division Report No. 3564. Lansing, Michigan. 82p.

Jellen, B.C. 2005. The continued decline of the eastern massasauga (*Sistrurus c. catenatus*) in Pennsylvania. Unpublished report, Western Pennsylvania Conservancy. 118p.

Johnson, B. 1989. Combat and courtship of the eastern massasauga rattlesnake: comparison of field and captive behavior. Combat IHS proceedings 71-78p.

Johnson, G. 1995. Spatial ecology, habitat preferences, and habitat management of the eastern massasauga, Sistrurus c. catenatus, in a New York transition peatland. Ph.D. Dissertation, State University of New York, Syracuse, New York. xvii + 140p.

Johnson, G. 2000. Spatial ecology of the eastern massasauga (*Sistrurus c. catenatus*) in a new York peatland. Journal of Herpetology 34: 186-192.

Johnson, G., B. Kingsbury, R. King, C. Parent, R. Seigel, and J. Szymanski. 2000. The Eastern Massasauga Rattlesnake: A Handbook for Land Managers. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. 52p.

Johnson, G. and D.J. Leopold. 1998. Habitat management for the eastern massasauga in a central New York peatland. Journal of Wildlife Management 62: 84-97.

Johnson, K.E. 2015. MDNR Early Detection and Response Program: Environmental Assessment of treatment methods for controlling aquatic invasive species. Michigan Department of Natural Resources Wildlife Division Early Detection and Response Program.

Keenlyne, K.D., and J.R. Beer. 1973. Food habits of *Sistrurus catenatus catenatus*. Journal of Herpetology 7: 382–384.

King, R.S. 1997. Preliminary findings of a habitat use and movement patterns study of the eastern massasauga rattlesnake in Wisconsin. Unpub. report to the U.S. Fish and Wildlife Service, Green Bay, Wisconsin. 32p.

Kingsbury, B.A. 1996. Status of the eastern massasauga, *Sistrurus c. catenatus*, in Indiana with management recommendations for recovery. Proceedings of the Indiana Academy of Sciences 105: 195-205.

Kingsbury, B.A. 2002. R9 conservation approach for the eastern massasauga (*Sistrurus c. catenatus*) on the Huron-Manistee National Forests. Unpublished report (to the United States Forest Service), Indiana-Purdue University, Ft. Wayne, Indiana. 71p.

Kowalski, M.J. 2007. Movements and Habitat Usage by the Eastern Massauga in Pennsylvania. Technical report submitted to the Pennsylvania Fish and Boat Commission.

Kowalski, M.J. 2010. Recommendations for land management in Pennsylvania specific to the protection of eastern massasauga habitats and populations. Unpublished report, Western Pennsylvania Conservancy. 9p.

Lannoo, M.J., and R.M. Stiles. 2017 Effects of short term climate variation on a long-lived frog. Copeia 105: 726-733.

Longcore, J.E., A.P. Pessier, and D.K. Nichols. 1999. *Batrachochytrium dendrobatidis* gen. et sp. nov., a chytrid pathogenic to amphibians. Mycologia 91: 219-227.

Marshall, J.C., J. Manning, and B. Kingsbury. 2006. Movement and macrohabitat selection of the eastern massasauga in fen habitat. Herpetologica 62: 141-150.

Mauger, D. and T.P. Wilson. 1999. Population characteristics and seasonal activity of *Sistrurus catenatus catenatus* in Will County, Illinois: Implications for management and monitoring. p. 110-124, In: Johnson, B., and M. Wright (Eds.), Second International symposium and workshop on the conservation of the eastern massasauga rattlesnake, *Sistrurus catenatus catenatus*: population and habitat management issues in urban, bog, prairie, and forested ecosystems. Toronto Zoo.

McCumber, E. and R. Hay. 2003. Eastern massasauga rattlesnake status survey and telemetry study lower Chippewa River, Buffalo Co., Wi. Unpublished report (to USFWS), Wisconsin Department of Natural Resources. 7p.

Michigan Department of Natural Resources 2015. Candidate Conservation Agreement with Assurances for the Eastern Massasauga Rattlesnake *Sistrurus catenatus* in Michigan. 39p + Appendices.

Minton, S.A., Jr. 1972. Amphibians and Reptiles of Indiana. Indiana Academy of Science, Indianapolis. 315-319p.

Moore, J.A. and J.C. Gillingham. 2006. Spatial ecology and multi-scale habitat selection by a threatened rattlesnake: the eastern massasauga (*Sistrurus catenatus catenatus*). Copeia 2006: 742-751.

Ohio Department of Natural Resources. 2006. Eastern massasauga rattlesnake (*Sistrurus c. catenatus*) candidate conservation agreement with assurances for rome State Nature Preserve, Ashtabula County, Ohio. 14p.

Pomara, L.Y., O.E. Ledee, K.J. Martin, and B. Zuckerberg. 2014. Demographic consequences of climate change and land cover help explain a history of extirpations and range contractions in a declining snake species. Global Change Biology 20: 2087-2099.

Rajeev, S., D.A Sutton, B.L. Wickes, D.L. Miller, D. Giri, M. Van Meter, E.H. Thompson, M.G. Rinaldi, A.M. Romanelli, J.F. Cano, and J. Guarro. 2009. Isolation and Characterzation of a New Fungal Species, *Chrysosporium ophiodiicola*, from a Mycotic Granuloma of a Black Rat Snake (*Elaphe obsoleta obsoleta*). Journal of Clinical Microbiology 47(4): 1264-1268.

Reinert, H.K. 1978. The ecology and morphological variation of the Massasauga rattlesnake (*Sistrurus catenatus*). Unpubl. M.S. Thesis. Clarion State Coll., Clarion Pennsylvania. 173p.

Reinert, H.K. and W.R. Kodrich. 1982. Movements and Habitat Utilization by the Massasauga, Sistrurus catenatus catenatus. Journal of Herpetology 16: 162-171.

Robillard, A., B. Johnson. 2015. Edge Effects on Eastern Massasauga Rattlesnakes Basking in Managed Habitat. Northeastern Naturalist 22: 200-208.

Sage, J.R. 2005. Spatial ecology, habitat utilization, and hibernation ecology of the eastern massasauga (*Sistrurus catenatus catenatus*) in a disturbed landscape. MS Thesis, Purdue University, Ft. Wayne, Indiana. 93p.

Seigel, R.A. 1986. Ecology and conservation of an endangered rattlesnake, *Sistrurus catenatus*, in Missouri, USA. Biological Conservation 35: 333-346.

Seigel, R.A., C.A. Sheil, and J.S. Doody. 1998. Changes in a population of the endangered rattlesnake *Sistrurus catenatus* following a severe flood. Biological Conservation 83: 127-131.

Shepard, D.B., A.R. Kuhns, M.J. Dreslik, and C.A. Phillips. 2008a. Roads as barriers to animal movement in fragmented landscapes. Animal Conservation 11: 288-296.

Shepard, D.B., A.R. Kuhns, M.J. Dreslik, and C.A. Phillips. 2008b. Reptile roads mortality around an oasis in the Illinois corn desert with emphasis on the endangered eastern massasauga. Copeia 2008: 350-359.

Smith, C.S. 2009. Hibernation of the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) in northern Michigan. MS Thesis Purdue University, Ft. Wayne, Indiana. 44p.

Smith, D., D. Williams, G. Houseal, and K. Henderson. 2010. The Tallgrass Prairie Center Guide to Prairie Restoration in the Upper Midwest. University of Iowa Press, Ames. 304p.

Szymanski, J. 1998. *Sistrurus c. catenatus* rangewide status assessment. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

Szymanski, J., C. Pollack, L. Ragan, M. Redmer, L. Clemency, K. Voorhies, and J. Jaka. 2016. Species Status Assessment for the Eastern Massasauga Rattlesnake (*Sistrurus catenatus*) July 2016 (v2).

U.S. Fish and Wildlife Service. 2010b. Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) candidate conservation agreement with assurances for the Lower Chippewa Bottoms, Buffalo and Pepin counties, Wisconsin. 24p. + iv.

U.S. Fish and Wildlife Service. 2015. Endangered and threatened wildlife and plants: threatened species status proposed for the eastern massasauga rattlesnake. Federal Register 80(189): 58688-58701.

U.S. Fish and Wildlife Service. 2016a. Conference opinion on the enhancement of survival permit to the Michigan Departments of Natural Resources and Military and Veterans Affairs for the eastern massasauga rattlesnake (*Catenatus sistrurus* [sic.]). East Lansing Field Office. 48p.

U.S. Fish and Wildlife Service. 2016b. Endangered and threatened wildlife and plants: threatened species status for the eastern massasauga rattlesnake. Federal Register 81(190): 67193-67214.

U.S. Fish and Wildlife Service. 2017. Section 7 Programmatic Consultation on Issuance of Section 10(a)(1(A) Scientific Take Permits and Providing Funding Pursuant to Endangered Species Grants for the Eastern Massasauga Rattlesnake (*Sistrurus catenatus*). Chicago Field Office, 56p.

Weatherhead, P.J. and K.A. Prior. 1992. Preliminary observations of habitat use and movements of the eastern massasauga rattlesnake (*Sistrurus c. catenatus*). Journal of Herpetology 26: 447-452.

Wisconsin Department of Natural Resources. 2013. Eastern Massasauga (*Sistrurus catenatus*) Species Guidance. Bureau of Natural Heritage Conservation, Wisconsin Department of Natural Resources, Madison, Wisconsin. PUB-ER-713.

Wright, B.A. 1941. Habit and habitat studies of the massasauga rattlesnake (*Sistrurus catenatus catenatus* Raf.) in northeastern Illinois. American Midland Naturalist 25: 659-672.

Wright, A.H., and A.A. Wright. 1995. Handbook of Frogs and Toads of the United States and Canada. Comstock Publishing Associates (Reissue of original 1949 edition).

Appendix.
The following Intraservice Section 7 form is provided as a template for use prior to, and when evaluating effects to the Eastern Massasauga of any Service project intended to take place at sites with known habitat for the species, and intended at least in part for its benefit.

Intra-Service Section 7 Biological Evaluation Form

Region 3

Originating Person: Date Submitted:

Telephone Number:

Email:

For assistance with section 7 reviews, go to Region 3's Section 7 Technical Assistance website: http://www.fws.gov/midwest/endangered/section7/s7process/.

I. **Service Program and Geographic Area or Station Name**:

II. L**ocation**: Location of the project including County, State and TSR (township, section & range):

III. **Species/Critical Habitat**: List federally-listed, proposed, and candidate species or designated or proposed critical habitat that may occur within the action area:

Eastern massasauga rattlesnake (*Sistrurus catenatus*); No critical habitat has been designated for eastern massasauga

IV. **Project Description:** Describe the proposed project or action, including all conservation elements. If referencing other documents, prepare an executive summary. Include map and photos of site, if possible. (Attach additional pages as needed):

[Where eastern massasauga rattlesnakes may be present, indicate yes/no regarding whether the project will comply with the following terms and conditions from the programmatic biological opinion. If "no" is selected, insert additional descriptions of other BMPs or measures that will be implemented to avoid or minimize risk of incidental take to the EMR

and how you anticipate they will affect "take" of the EMR for that category of action. Enter estimated acres for each action category.

(Delete any categories of actions below that are not part of your project description.)

Yes/No		*Project Actions*
		A. Handling Individual EMR
_____		1. When walking a work area to search for and remove individual EMR prior to a management treatment occurring, handlers shall use only modern animal handling tongs (e.g., Midwest Tongs, Inc., Gentle Giant ®; Stoney, Inc., Animal Equipment, Inc. or similar) that are engineered with pressure release springs, wide surface area jaws, and rubberized/padded coating shall be used to grab snakes encountered in the wild.
_____		2. Any individual EMR removed from a work area shall be immediately released in adjacent habitat no greater than 200 meters form the point of capture. Briefly handling EMR in this fashion and in order to remove them from situations where they may be at risk or may present a hazard does not require additional permission as discussed in two previous Service documents (USFWS 2016b, 2017).
		ESTIMATED ACREAGE: <u>Not Applicable</u>
		B. Planting Herbaceous or Woody Vegetation
_____		1. Contractors or other individuals working with hand tools in known EMR habitat shall be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.
_____		2. Contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.
_____		3. If mechanized plantings are used, individuals familiar with the EMR shall walk through the work area where planting will occur, but prior to it starting, to visually scan for individual EMR, any EMR encountered that may present a hazard shall be removed from a work area. Such EMR shall be immediately released on adjacent habitat not greater than 200 meters from point of capture. Moving

EMR from such situations does not require a permit (see USFWS 2016c, 2017).

ESTIMATED ACREAGE:_____

C. *Seeding Herbaceous or Woody Vegetation*

_____ 1. Avoid use of heavy machinery in EMR habitat during the species' active season. Since dates when EMR are active above ground can vary, seeding with machinery should be done within the windows provided in Table 1 of the Biological Opinion completed in June 2018. Managers in the southern portion of the range should be aware of unseasonably early warm periods (for example early warm weather in February) which may draw a few EMR to the surface, and exercise caution in such circumstances.

_____ 2. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid seeding with heavy equipment (tractors or trucks). When seeding is planned in these areas, use manually operated seed broadcasters, or mount seed broadcasters on small/lightweight all-terrain vehicles.

_____ 3. It is recommended that project managers be aware of periods of prolonged sub-freezing temperatures, and seed when the surface soil is hard frozen. If these soil is hard frozen, light all-terrain vehicles, small trucks or tracked vehicles may be used to broadcast seed in EMR habitat.

_____ 4. If mechanized planting is used, individuals familiar with the EMR shall walk through the work area where planting will occur, but prior to it starting, to visually scan for and remove individual EMR that may present. Any EMR that present a hazard shall be removed from a work area, and shall be released on adjacent habitat not greater than 200 meters from the point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

ESTIMATED ACREAGE:_____

D. Cutting Woody Vegetation/Brush with Hand Tools

_____ 1. When possible, it is recommended that brush cutting should be conducted in months when EMR are likely to be dormant (November through February in most of the range).

2. If brush cutting during the EMR active season, it is recommended that contractors or other individuals working with hand or power tools in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. If brush cutting during the EMR active season, contractors or other individuals shall be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

E. Cutting Woody Vegetation/Brush Using Heavy Equipment

1. Avoid use of heavy machinery to cut brush in EMR habitat during the species' active season. Although dates when EMR are active above ground can vary, it is recommended that brush with heavy machinery should be confined to the months of November through February (or when ground is hard frozen) throughout the range of the EMR.

2. Managers in the southern portion of the range should be aware of unseasonably early warm periods (for example early warm weather in February) which may draw a few EMR to the surface, and avoid use of heavy machinery at such times.

3. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to cut brush. When brush cutting is planned in these areas, hand or power tools shall be used instead.

4. Use heavy machinery to cut brush in EMR habitat only during prolonged periods of sub-freezing temperatures, when the surface soil is hard frozen. If the soil is hard frozen light all-terrain vehicles, small trucks or tracked vehicles may be used cut brush in EMR habitat.

5. Individuals familiar with the EMR shall walk through the work area where the planting will occur, but prior to it starting, to visually scan for and remove individual EMR that may be present. Any EMR that present a hazard shall be removed from a work area and released on adjacent habitat not greater than 200 meters from the point of capture. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

ESTIMATED ACREAGE: _____

F. Mowing

1. Avoid use of heavy machinery to mow in EMR habitat during the species' active season. Since dates when EMR are active above ground can vary, consult "Prescribed Fire" section and/or Table 1 of the Biological Opinion (completed June 2018) before mowing with heavy machinery.

2. It is recommended that sickle bar and disk mowers should be used because they do not create a vacuum effect which has been shown to injure or kill snakes (Durbian, 2006).

3. Mowers with a wider wheel base should be used as they will require fewer passes through the areas and reduce the probability of crushing snakes (Durbian, 2006).

4. Raise mower decks when mowing during the active season to a height no lower than 9 inches and ideally keep the mower blades above 12 inches, or if shorter turf grass in administrative areas (campgrounds, roadsides, etc.) must be maintained, do so by mowing during the hottest part of mid-day when EMR are least likely to be present.

5. In situations where control of target invasive species (e.g., sweet clovers, *Melilotis* spp.) require mowing during the EMR active season, persons familiar with methods to safely handle venomous snakes, and carrying conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone just prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

6. In areas where known EMR hibernacula, or concentrations of crayfish burrows occur within known EMR habitat, avoid using heavy equipment (tractors or trucks) to mow. When mowing is planned in these areas, use hand tools or hand power tools.

7. When administrative areas (e.g., campgrounds, roadsides, picnic areas, or other areas where turfgrass is maintained adjacent to EMR habitat), mowing and maintaining the grass height at approximately 6 inches or less throughout the growing season should discourage EMR from entering such areas, and would

provide a net benefit of reducing encounters between EMR and humans using these areas.

ESTIMATED ACREAGE: _____

G. Herbicide Application

1. When possible (e.g., with woody species), conduct herbicide applications in months when EMR are likely to be dormant (see Table 1).

2. Contractors or other individuals working during the EMR active season, and in known EMR habitat should be made aware of the species presence prior to commencing work, and trained to identify this or other species of snakes on site that may be of similar appearance.

3. Contractors or other individuals should be instructed on how to avoid encounters with the species, and to not harm or kill individual EMR they encounter.

4. Avoid use of heavy equipment and broadcast applications (including aerial) of herbicide in occupied EMR habitat.

5. When heavy equipment or broadcast applications must be used in areas known to be occupied by EMR, follow the same seasonal guidelines provided for practices listed above to avoid soil compaction or crushing EMR.

6. Avoid using heavy equipment or other broadcast applications (e.g., aerial) in areas where known EMR hibernacula or large concentrations of crayfish burrows are known to occur in occupied EMR habitat. In these areas use hand application techniques instead.

7. In situations where control of target invasive species require herbicide applications using heavy equipment during the EMR active season, persons familiar with methods to safely handle venomous snakes, shall conduct a "walk through" to search for and remove EMR a short distance (generally <200m, and into adjacent habitat) from the work zone prior to mowing. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

8. Avoid using heavy equipment or other broadcast applications (e.g., aerial) in areas where known EMR hibernacula or large

concentrations of crayfish burrows are known to occur in occupied EMR habitat. In these areas use hand application techniques instead.

ESTIMATED ACREAGE: _____

H. Disking

1. Disking should be minimized or avoided during the active season, or areas that are to be disked during the active season should be mowed during the inactive season to less than 15 cm (6 in) in height so that they are unattractive to snakes the following spring, and the mowing should be continued until the disking is to take place.

2. If mowing can't be done prior to disking, personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

3. Areas currently in row-crop agriculture, but to be converted to EMR habitat by disking should be continuously maintained as row-crop agriculture until such time that they may be seeded to native grasslands or similar habitat that may be beneficial to EMR.

ESTIMATED ACREAGE: _____

I. Earthmoving

1. If earthmoving is planned within occupied EMR habitat, equipment shall be offloaded from the closest point to the work zone as practicable, on a service road, parking lot etc.

2. From the offloading point, provide a short, direct route through which equipment operators can traverse to get to the work zone as quickly as possible.

3. Where the route would traverse through EMR habitat, it should be mowed in advance (see above best practices for mowing administrative areas) to a grass height of less than 6 inches to discourage EMR from using the path from the offload site to the work zone.

4. Personnel familiar with EMR should walk the work zone prior to work commencing, to visually scan for and remove any EMR found where heavy equipment will drive. Any EMR found could be relocated a short distance (generally <200m, and into adjacent habitat) from the work zone. Moving EMR from such hazardous situations does not require a permit (see US Fish and Wildlife Service 2016c, 2017).

5. If the work period may be prolonged (>7 days) the work zone could be visually scanned as described above, just prior to commencing work, and a trenched-in silt fence shall be erected around the work zone to prevent re-entry by individual EMRs that are in the proximity. Once the area is scanned and found to be free of EMR, work can commence without impediment.

ESTIMATED ACREAGE: _____

J. Hydrologic Management

1. Water levels in managed habitat shall not be drawn down during the inactive season, except for human health and safety reasons.

2. Water levels may not be raised for more than two continuous weeks during a single inactive season, except for health and safety concerns. Water levels may be raised during the active season.

3. Hydrology should be managed to ensure that EMR are able to hibernate within retreat into the water table in crayfish burrows, or other locally available cavities.

ESTIMATED ACREAGE: _____

Prescribed Fire: When Weather/Soil Climate Stations are Available

1. At least two weeks prior to anticipated start of a burn season in their area, and before burning at known EMR sites, land managers/burn bosses shall access and monitor the soil climate data at or from the nearest adequately equipped (e.g., with soil temperature probes) weather station to track and provide real-time temperatures at 1 meter, 0.6 meter, 0.3 meter depths, and at soil surface.

2. After the tenth day (cumulative) in spring when the temperature at the 0.3 meter depth has exceeded that at the 0.6 meter depth, no prescribed burn shall be conducted within in delineated wetlands known or believed to have EMR hibernacula, nor within 100 meter buffer of the delineated wetlands.

3. Land managers/burn bosses may continue to conduct prescribed burns in adjacent upland habitats beyond the 100 meter buffer for an additional two weeks/14 days following the date when wetland burns were discontinued. To avoid take of EMR dispersing into adjacent uplands, prescribed burns shall discontinued after the 14th day following the date when burns were discontinued in the wetlands as described in best practice 2, above.

If the above soil climate and science-based practices are followed, prescribed fire within EMR habitat would be unlikely to lead to incidental take of the EMR, and would likely allow an extended (over dates provided in Table 1, in the June 2018 Biological Opinion) burn season. However, because adequately equipped and accessible weather stations that allow the above practices to be followed are not yet commonly available, the Service intends to work closely with state and local partners to establish a network of such stations that could be remotely accessed (e.g., by internet or cellular applications). Until such a network is available, a set of predetermined dates for planning times to use prescribed burns at EMR sites will be used as an interim measure (see Table 1 of the June 2018 Biological Opinion).

L. Prescribed Fire: When Weather/Soil Climate Stations are Not Available

1. Timing of burns shall be determined after consulting dates in Table 1 of the Biological Opinion Completed June 2018.

2. Burns may be conducted outside of these dates if the crew has soil climate data available for their latitude band, and can document it prior to igniting a fire.

3. It is recommended that land managers should leave unburned areas adjacent to prescribed burns to serve as snake refugia whenever possible.

4. Prescribed burn plans will use back burning as the primary ignition strategy. The approach will minimize entrapping snakes between flame fronts. However, the burn manager may make the judgement during a burn treatment, that encirclement

_____		ignition or strip firing is necessary to protect human safety or property. 5. A scientific fire behavior model, such as the United States burn model, the Canadian burn model or equivalent shall be used to formulate a burn prescription for a maximum rate of spread no faster than 16 chains per hour (17.6 feet per minute) with an average targeted rate 10 chains per hour or less (11 feet per minute), except in known hibernacula areas. A slower rate of spread may allow snakes within the burn unit adequate time to find refugia. 6. Fire shall will be established following existing features (such as roads, streams, and trails) to the extent possible. Cultivation (disking or rototilling) of burn breaks will be minimized to the extent that human health and safety are not jeopardized. Cultivation and mowing fire breaks will be established during the inactive season to the extent possible. ESTIMATED ACREAGE: _____
_____		

Incidental Take Statement

The measures described above are non-discretionary and must be undertaken by the Service for the exemption in section 7(o)(2) to apply. The Service has a continuing duty to regulate the activity covered by this ITS. If the Service (1) fails to assume and implement the terms and conditions as part of the proposed action the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the Service must document the progress of the action and its impact on the species as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Amount or Extent of Take Anticipated

For any activities that will be implemented as part of the action described above in this intra-Service consultation form, enter the appropriate information in the Amount or Extent of Incidental Take Anticipated column.

ANTICIPATED TAKE TABLE. Activities that are reasonably certain to result in the incidental take of eastern massasauga (EMR) when implemented by the U.S. Fish and Wildlife Service or its agents as described in the programmatic biological opinion. Insert "n/a" for any activity that is not applicable to the proposed project; for relevant activities that are reasonably likely to result in incidental take, describe the amount or extent of incidental take anticipated using either the number of individual EMR (search and removal of EMRs) or the surrogate (acres).

Activity (Forms of Take)	Surrogate or Metric	Amount or Extent of Incidental Take Anticipated	Causal Link for Surrogate and Why it is Impractical to Monitor Take-Related Impacts in Terms of Individuals
Search for and removal of EMRs prior to a management treatments (Pursuit and Capture)	Number of EMR pursued and captured		n/a, number recorded should be actual number of snakes suspected to have been injured or killed as a direct result of handling prior to a habitat management action.
Use of Machinery to Plant Herbaceous or Woody Plants (Harm or Kill)	Acres planted with machinery		The likelihood or number of individual EMRs harmed or killed will be related directly to the extent of the area planted or seeded. Harm or death of EMRs due to these activities will have a low likelihood of detection.
Direct Seeding Using Machinery (Harm or Kill)	Acres of EMR habitat seeded with machinery		
Cutting Brush/Woody Vegetation using Machinery (Harm or Kill)	Acres of EMR habitat affected by cutting of woody vegetation using wheeled/tracked machinery		The likelihood or number of individual EMRs harmed or killed will be related directly to the extent of the area subject to cutting of brush or woody vegetation with machinery. Harm or death of EMRs due to these activities will have a low likelihood of detection.
Mowing for Habitat Management of Administrative Areas (Harm or Kill)	Acres of EMR habitat mowed		The likelihood or number of individual EMRs harmed or killed will be related directly to the extent of the area mowed. Harm or death of EMRs that occurs due to mowing will have a low likelihood of detection.
Herbicide Application Using Machinery (Harm or Kill)	Acres of EMR habitat treated using machinery		EMR exposure to herbicides is unlikely to be detected, as are cases when EMRs are harmed or killed due to exposure to machinery used. An unknown proportion of the affected EMRs will be detected.
Disking (Harm or Kill)	Acres of EMR habitat disked		The likelihood or number of individual EMRs harmed or killed will be related directly to the extent of the area disked. Harm or death of EMRs due to disking will have a low likelihood of detection.
Earthmoving (Harm or Kill)	Acres of EMR habitat exposed to earthmoving		The number of EMRs harmed or killed due to earthmoving will likely be related directly to the extent of the area exposed to this activity. Harm or death of EMRs due to earthmoving will have a low likelihood of detection.
Hydrologic Management (Harm or Kill)	Acres of EMR habitat exposed to construction of berms/water control structures, or disabling tiles		The number of EMRs harmed or killed due to construction of low berms, or other water control structures, or to disable field tiles will likely be related to the area exposed to this activity. Harm or death of EMRs due to these activities will have a low likelihood of detection.

Effect of the Take

In the accompanying biological opinion, the Service determined that, because the action is designed with conservation measures that maintain the incidental take at a level where the net impact to the species is beneficial, this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures/ Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Service must comply with the following reasonable and prudent measure.

Reasonable and Prudent Measure #1 - To ensure that the anticipated level of incidental take is not exceeded; the incidental take that occurs shall be recorded upon project completion and reported to the Service. Please use attached "OBSERVED TAKE TABLE" below.

B. Determination: Determine the anticipated effects of the proposed project on species and critical habitats listed in item III. Check all applicable boxes and list the species (or attach a list) associated with each determination**. For assistance with making appropriate Section 7 determinations, go to Region 3's Section 7 Technical Assistance website:**
http://www.fws.gov/midwest/endangered/section7/s7process/

Determination

No Effect: This determination is appropriate when the proposed project will not directly or indirectly affect (neither negatively nor beneficially) individuals of listed/proposed/candidate species or designated/proposed critical habitat of such species. No concurrence from ESFO required. _____

May Affect but Not Likely to Adversely Affect: This determination is appropriate when the proposed project is likely to cause insignificant, discountable, or wholly beneficial effects to individuals and designated critical habitat. Concurrence from ESFO required. _____

May Affect and Likely to Adversely Affect: This determination is appropriate when the proposed project is likely to adversely impact individuals of listed species or designated critical habitat of such species. Concurrence from ESFO required. _____

Not Likely to Jeopardize candidate or proposed species/critical habitat:

This determination is appropriate when the proposed project is not expected to jeopardize the continued existence of a species proposed for listing or a candidate species, or adversely modify an area proposed for designation as critical habitat. Concurrence from ESFO required. _____

Likely to Jeopardize candidate or proposed species/critical habitat:

This determination is appropriate when the proposed project is reasonably expected to jeopardize the continued existence of a species proposed for listing or a candidate species, or adversely modify an area proposed for designation as critical habitat. Concurrence from ESFO required. _____

Signature _____ Date _____

[Supervisor at originating station]

Reviewing Ecological Services Office Evaluation (check all that apply):

A. **Concurrence _____** **Nonconcurrence _____**

Explanation for nonconcurrence:

B. Formal consultation required _____

List species or critical habitat unit

C. Conference required _____

List species or critical habitat unit

Name of Reviewing ES Office _____

Signature

Date

_____ _____

O:\TE\S7\FORMS\R3intra-s7_form.wpd\28 June 2018

JSzymanski\19 June 2002

OBSERVED TAKE TABLE. Format for reporting the amount of incidental take that occurred as a result of project implementation.

Name of Project –

Activity (Forms of Take]	Surrogate or Metric	Resulting Amount or Extent of Incidental Take[3]
Search and removal of EMRs prior to a management treatments (Pursuit and Capture)	Number of EMR pursued and captured	
Use of Machinery to Plant Herbaceous or Woody Plants (Harm or Kill)	Acres planted with machinery	
Direct Seeding Using Machinery (Harm or Kill)	Acres seeded with machinery	
Cutting Brush or Woody Vegetation using Machinery (Harm or Kill)	Acres affected by cutting of brush or other woody vegetation with the use of wheeled or tracked machinery	
Mowing for Habitat Management of Administrative Areas (Harm or Kill)	Acres mowed	
Herbicide Application Using Machinery (Harm or Kill)	Acres treated using machinery	
Disking (Harm or Kill)	Acres disked	
Earthmoving (Harm or Kill)	Acres exposed to earthmoving	
Hydrologic Management (Harm or Kill	Acres exposed to construction of low berms, installation of other water control structures, or to disable field tiles	

[3] Insert "n/a" for any activity that is not applicable to the proposed project; for relevant activities that are reasonably likely to result in incidental take, describes the amount or extent of incidental take anticipated using either the number of individual eastern massasauga (search and removal of EMRs) or the relevant surrogate.