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Minimizing Take of Threatened Rattlesnakes and Optimizing Project Review in SE Nebraska

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This report has been reviewed by the Nebraska Transportation Center for grammar and context, formatting, and compliance with Section 508 of the Rehabilitation Act of 1973.

Abstract

The western massasauga (*Sistrurus tergeminus*) and the timber rattlesnake (*Crotalus horridus*) are protected under Nebraska Statute 37-801-811 and listed as threatened species. These species occur in the right-of-way (ROW) along several roads in Jefferson, Gage, Pawnee, and Richardson Counties which necessitates the need for added Environmental Review (ER) from Nebraska Department of Transportation (NDOT) staff and onsite surveys prior and during maintenance and construction to roadways. This project sought to minimize ER time, staff time, and increase the knowledge of these species in southeast Nebraska by:

a) Identifying precise locations of western massasauga brumation sites;
b) Mapping travel corridors from brumation site to active (summer) sites and explore how they relate to NDOT ROW;
c) Developing standardized survey/search protocols;
d) Documenting materials used by snakes as basking and/or refuge locations;
e) Providing recommendations to avoid or minimize impacts to protected snakes for future NDOT maintenance and construction practices.

Only western massasaugas were captured during this project and were tagged with GPS and radio transmitters to elucidate their movements through NDOT ROW. Thirteen massasaugas were captured and tagged with transmitters; one individual was never recovered so we only have data for 12 snakes. Overall, the massasaugas stayed very close to their capture location and only moved into surrounding fields occasionally and we rarely noted them on NDOT materials (besides the road itself). To limit take of these species, NDOT should clear vegetation the winter before work begins, ensure water connectivity and wetlands are maintained, ensure NDOT and contractor vehicles/equipment only drive and park on the staging area – which needs to be included in the pre-construction surveys, erect signage warning drivers of snakes on the road and continue to work closely with NGPC biologists.

Chapter 1 Introduction

1.1 Background

The western massasauga (*Sistrurus tergeminus*) and the timber rattlesnake (*Crotalus horridus*) are threatened snake species in the southeast portion of Nebraska and protected under Neb. Stat. 37-801-811. A thorough review of the massasauga's life history can be found in Patten 2006 and Patten et al. 2016. Recent studies (e.g., Fogell 2011) have shown these species are using green spaces in the right-of-way along several roads in Jefferson, Gage, Pawnee, and Richardson Counties which necessitates the need for added Environmental Review from Nebraska Department of Transportation (NDOT) staff and onsite surveys prior and during maintenance and construction of roadways.

1.2 Problem Statement

Many roads managed by NDOT in southeast Nebraska contain massasauga brumation sites in their right-of-way (ROW) and/or pass through ideal wooded habitat for timber rattlesnakes. At the start of this project (2022), prior to initiation of any maintenance, repair, or improvement projects, NDOT were obligated to complete an environmental review and consult with Nebraska Game and Parks Commission (NGPC) to ensure proper avoidance protocols and conservation conditions to avoid take. These reviews and consultations add delay and costs to the project.

1.3 Objectives

a) Identify precise locations of western massasauga brumation sites;

b) Map travel corridors from brumation site to active (summer) sites and explore how they relate to NDOT ROW;

c) Develop standardized survey/search protocols.

d) Document materials used by snakes as basking and/or refuge locations;

e) Provide recommendations to avoid or minimize impacts to protected snakes for future NDOT maintenance and construction practices.

Chapter 2 Methods

Starting in July 2022 we drove highways in Jefferson, Gage, and Pawnee Counties looking for western massasauga rattlesnakes and timber rattlesnakes. We also walked through ROWs in areas of known populations of both species looking for specimens. When a rattlesnake was found it was weighed, measured, sexed, given a passive integrated transponder (PIT) tag, and, if the specimen was large enough, a dual radio/GPS transmitter was attached to its tail. The snake was then released at the site of capture.

The transmitters (Lotek PinPoint 120s) collected GPS locations every three hours and emitted a radio beacon every three days for manual tracking and transmitter recovery to download data. Using these transmitters should have allowed tracking all summer without a transmitter change; however, mating, ecdysis, and wet conditions caused several transmitters to fall off. Therefore in 2024 any specimen with a transmitter affixed was brought back to the lab if they looked close to ecdysis (e.g., cloudy scales, dull color, etc.). The specimen was kept in an aquarium with water, a rock hide, and a natural branch until ecdysis was complete (usually 2 – 3 days). Then a new transmitter was attached, and the specimen was released back into the wild.

Chapter 3 Results

Surveys were focused primarily in Jefferson, Gage, and Pawnee Counties since both species occur in these areas and the chances of finding both were increased in this area (see Figure 3.1). Highways 8, 15, 77, 99, and 103 (as well as local county roads near these highways) were the corridors we used to locate rattlesnakes. Highway 8 between Fairbury (west) and Highway 99 (east) was our primary search corridor.

A total of 13 massasaugas large enough for transmitters to be affixed were found and no timber rattlesnakes were found. Of the 13 massasaugas only one was never relocated to retrieve its data. A total of 2,119 GPS locations were collected from the 12 specimens of which 1,674 points (79%) had a high confidence of accuracy. About 15% of attempts by the transmitters did not result in a GPS location fix, likely because the snake was under heavy brush and grass or was underground.

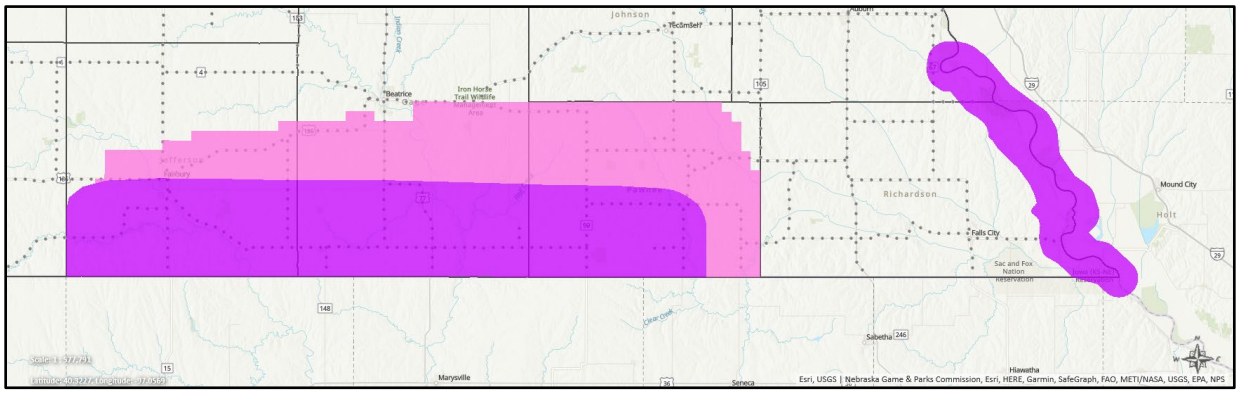

Figure 3.1 Southeast Nebraska with known range of western massasauga in pink and timber rattlesnake in purple. Nebraska Department of Roads (NDOT) highways are marked as dotted lines, while solid lines represent county boundaries.

3.1 Identify precise locations of western massasauga brumation sites

Surveys along NDOT highways resulted in only two locations of live massasaugas, each location producing several individuals for this study. Deceased massasaugas were found at other locations, but no live individuals were found at those locations despite the presence of crayfish burrows. No live timber rattlesnakes were found within the limits of this study (i.e., along or near NDOT controlled highways) though one deceased individual was found along Highway 8 during the project. Both sites were located in Pawnee County along Highway 8, within two miles of Highway 99. Exact locations have been submitted to Nebraska's Natural Heritage Program (NNHP) for inclusion in their database.

We were able to locate several crayfish burrows (used by massasaugas as brumation sites, escape cover, and for thermoregulation), some with massasaugas in or immediately adjacent to them. The majority of the crayfish burrows were located in the ditch bottom between the foreslope and backslope. Some crayfish burrows were located within the first few meters of the backslope, but this largely depended on how steep the backslope was (more incline meant fewer burrows). No crayfish burrows were found on the foreslope, likely because that area tends to be heavily compacted during road construction and becomes unusable by the crayfish. On the opposite side, the backslope offers less compact soil, but most of the backslopes were very steep in the areas where we found massasaugas and likely did not sit low enough within the water table to be a suitable habitat for crayfish burrows. The ditch bottoms have both close access to the local water table (and plenty of run-off from the roads) and non-compacted soil making the area between the fore- and backslopes the most used site for crayfish burrows. In turn, these burrows become brumation sites for western massasaugas and should be protected from future degradation and/or development (see Objective "e" below).

Identified crayfish burrow locations were recorded and are also being submitted to NNHP. Further scouting continues to find more locations and will likely continue into next year.

3.2 Map travel corridors from brumation site to active (summer) sites and explore how they relate to NDOT's ROWs

Despite our hypothesis that western massasaugas were emerging from brumation sites and using ROWs as travel corridors to larger areas for the summer, our data showed no long-distance movements from the massasaugas. They emerged in the ROWs, mated in the ROWs (as witnessed by researchers during surveys), had young in the ROWs (strongly suggested by the presence of young of the year in the ROW), and stayed most of the year in the ROW, with some individuals moving in and out of adjacent crop and grassland fields. We can confirm from this that massasaugas are using ROWs in Nebraska at all life stages and seasons, meaning ROWs are important critical habitat for this species.

Crossing the highway was a rare event; our data show massasaugas almost never crossed paved highways (see table below) and typically came right back to the side of the highway where they started from and we never saw any of the study specimens move to the other side of the highway for more than three hours. It is possible some of the GPS data points on the other side of the road are low accuracy and the snake was never on the highway or was basking on the shoulder. It should be noted that the accuracy of the transmitters used in this study likely vary from approximately 1 – 5 meters. Our data provide evidence that paved roads likely inhibit massasauga (and possibly other snake species) movements, creating a barrier; this has been noted by researchers as well (Robson and Blouin-Demers 2013).

Table 2.1 Snake ID data

Snake ID	M/F	Valid† data points collected	Distance Traveled*		Area Used		Ever on a highway?	Ever cross a highway?
			meters	feet	hectares	acres		
A	F	106	204	669.29	0.34	0.85	Yes (2)	No
B	M	384	375	1,230.31	0.33	0.82	Yes (5)	Yes (2)
C	M	204	130	426.51	4.27	10.54	Yes (1)	Yes (1)
D	F	94	79	259.19	0.23	0.57	Yes (2)	No
E	M	158	191	626.64	0.40	0.98	No	No
F✡	M	N/A	N/A	N/A	N/A	N/A	N/A	N/A
G	M	159	509	1,669.95	1.88	4.65	No	No
H	M	262	253	830.05	1.36	3.35	No	No
I	F	18	35	114.83	0.03¥	0.08¥	No	No
J	M	126	291	954.72	1.83	4.52	No	No
K	F	7	11	36.09	0.11¥	0.28¥	No	No
L	F	7	8	26.25	0.01¥	0.02¥	No	No
M	M	149	335	1,099.08	0.99¥	2.44¥	No	No

***** measured by the straight-line distance between the two furthest apart location points collected by the GPS transmitters for each snake. This is <u>not</u> a measure of how far the snake traveled, but rather an indication of how much area the snake was using. All individuals moved much further than this measure but did so in a relatively small area.

† valid data points are ones that had enough satellites to get a fix or location and had a high confidence of accuracy.

¥ small sample size, results should be interpreted with caution.

✡ Snake "F" was never relocated and therefore his data was unable to be downloaded.

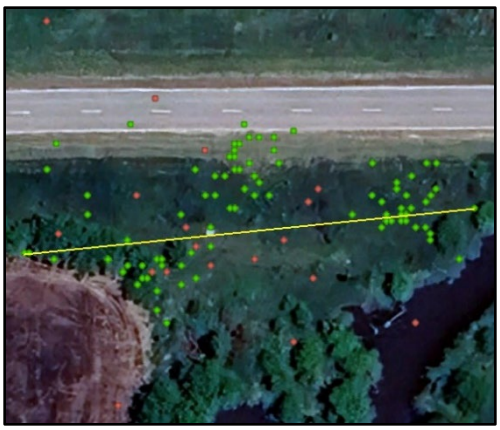

Figure 3.2 Snake D showing an example of Distance Travelled (yellow line), Valid points (green dots), and points with a low confidence are colored red.

3.3 Develop standardized survey/search protocols

See Appendix A for protocols.

3.4 Document materials used by snakes as basking and/or refuge locations

Little information was gathered on this Objective because the massasaugas did not move as much as anticipated and individual snakes were rarely near project materials (e.g., culverts, riprap, bridges, etc.). However, in July of 2023 a single massasauga was found tangled in a plastic erosion control net around a culvert along Highway 8 in Pawnee County (see Figure 3.3 below). The specimen was removed from the netting but had sustained acute scale damage and was taken back to a laboratory setting to clean his wounds and recuperate for several weeks to ensure his survival. This specimen was likely using the culvert or the surrounding substrate to initiate ecdysis and got caught in the netting. The presence of the transmitter attached to the tail likely exacerbated the entanglement and made the injuries worse.

Erosion control netting and its negative impacts to snakes are well documented (Stuart et al. 2001, Kapfer and Paloski 2011, Ebert et al. 2019) and has been discouraged for decades in any environment where snakes, especially threatened or endangered species, are likely to move

through the area. This was an unfortunate incident but a good case study illustrating how detrimental plastic erosion control netting can be for snakes and its longevity in the environment.

Figure 3.3 [top left]: a western massasauga caught in plastic erosion control netting in Pawnee County. [top right]: close up of erosion control netting caught around transmitter on snake's tail.

3.5 Provide recommendations to avoid or minimize impacts to protected snakes for future NDOT maintenance and construction practices

If possible, the work area should be burned (preferrable) or hayed/mowed as short as possible with cut vegetation removed from the area. This should be done between 1 December

and 1 March to ensure no snakes are harmed during the mowing process. Removing the vegetation will greatly increase the detection probability of any massasaugas in the work area.

To prevent harming snakes in this area, NDOT should:

a) Conduct mowing, haying, controlled burning, and/or brush removal activities in the winter when snakes are brumating;

b) Ensure water connectivity and wetlands are maintained;

c) Use caution when conducting invasive species control, including spraying herbicides;

d) Ensure NDOT and contractor vehicles/equipment only drive and park on the staging area – which needs to be included the pre-construction surveys;

e) Work closely with NGPC biologists.

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Stuart J.N., M.L. Watson, T.L. Brown, and C. Eustice. 2001. Plastic netting: an entanglement hazard to snakes and other wildlife. Herpetological Review 32:162–164.

Appendix A Survey Protocol for western massasaugas (*Sistrurus tergeminus*) and timber rattlesnakes (*Crotalus horridus*) along Right-of-Way for Nebraska Department of Transportation Projects

Prior to starting any work in the range of western massasaugas or timber rattlesnakes (both protected species in Nebraska; see range maps below) a thorough survey should be completed to ensure no snakes are in the area.

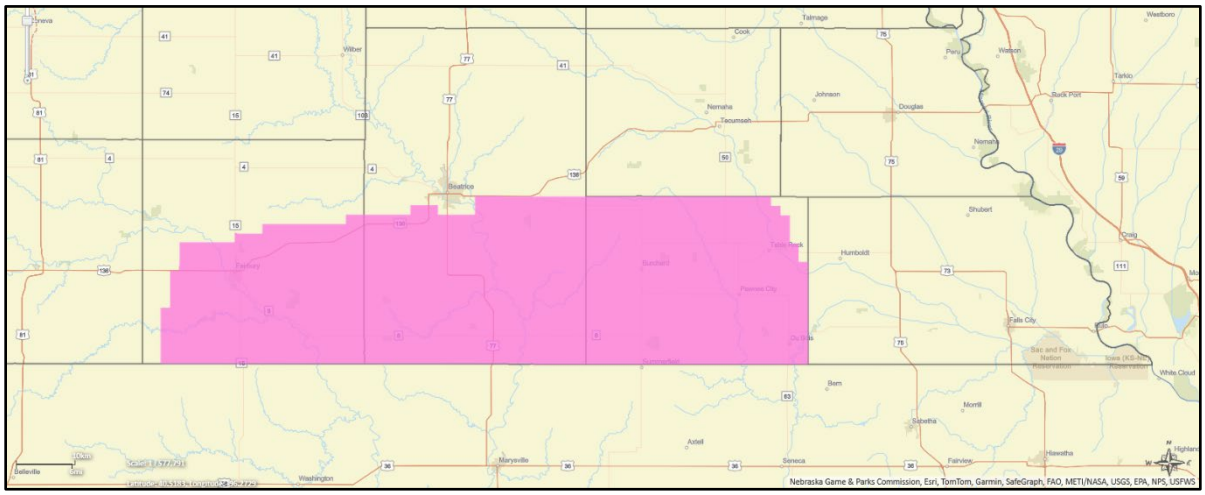

Figure A.1 Range map of western massasauga (pink polygon) in Nebraska.

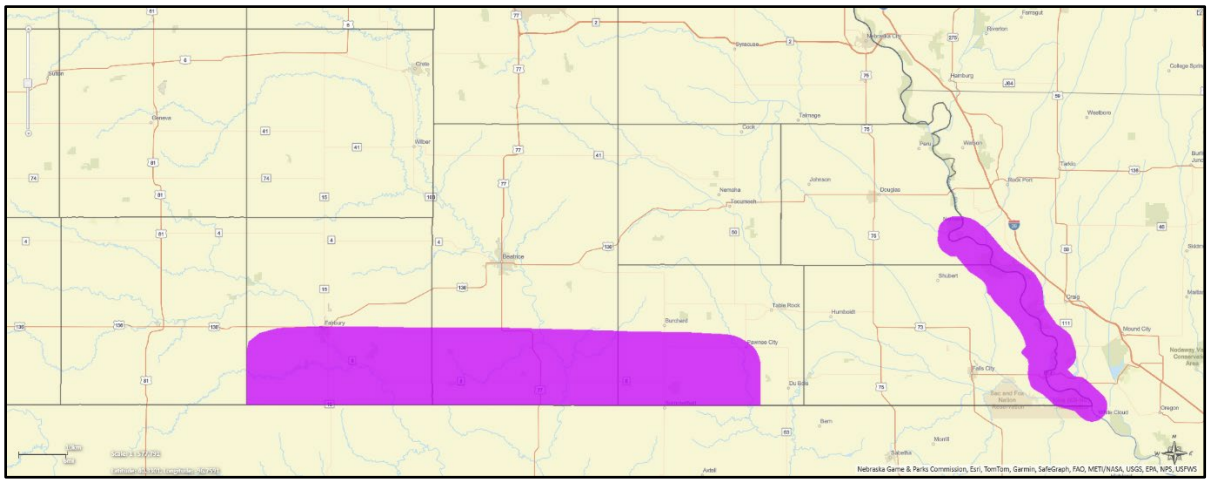

Figure A.2 Range map of timber rattlesnake (purple polygon) in Nebraska.

A.1 Materials

- Boots
- Pants
- Snake stick (with hook, preferably)
- GPS unit
- Phone and/or camera
- High visibility vest

A.2 Background and Preparation

Western massasaugas are small-bodied snakes typically between 30 and 75 centimeters (11.8 – 29.5 inches) in length and weighing less than 220 grams (7.7 ounces). The body is typically light to dark brown or grey in color with darker brown or black blotches ('heart-shaped') running the length of the body. The dorsal scales are keeled while the belly scales are smooth and are white or cream in color with an irregular pattern of dark markings. The rattle is typically very small (less than three centimeters [1.2 inches]). See Figure A.3 for an example of two different colors of western massasaugas.

Figure A.3 Western massasaugas displaying different colored markings. Both snakes were found within a kilometer (0.6 miles) of each other.

In Nebraska western massasaugas are usually active late March through early November (depending on temperatures) and are found almost exclusively near crayfish burrows which they use for escape cover, brumation (overwintering), and to find food. Therefore, areas with wetland

vegetation (e.g., cordgrass [*Spartina spp*.], cattails [*Typha spp*.], smartweed [*Persicaria bicornis*], ironweed [*Vernonia spp*.], etc.) are likely to have crayfish burrows. Even if no massasaugas are located, the presence of crayfish burrows should be documented (see Figure A.4 for an example).

As noted above, massasaugas are small-bodied snakes and they like to hide under vegetation close to the ground, especially if there is a thick layer of loose thatch that they can hide in.

Figure A.4 A crayfish burrow in the ROW in Pawnee County

Timber rattlesnakes (Figure A.5) are Nebraska's largest venomous snake, usually growing to 85 – 150 centimeters (33.5 – 59 inches) in length and weighing between 500 grams (1.1 pounds) when young and up to two kilograms (4.4 pounds) as adults. The dorsal body is light tan to dark brown in color, darkening to solid black at the tail. The body is marked with black

angled bands (‘chevron-shaped’) and a rust-colored dorsal stripe runs along the majority of the body (dorsal stripe can be difficult to see or faded in some individuals).

Timber rattlesnakes are commonly found in wooded areas where they blend in with the leaf litter and may stay in a single location for several days waiting for prey to walk by. Areas with abundant leaf litter, fallen logs, or rocky soil are prime timber rattlesnake habitats.

In spring when they emerge from brumation they may be found on south-facing rocky slopes that offer warmth, protection from predators, and close proximity to shelter until daily temperatures warm up.

Figure A.5 A timber rattlesnake sitting in dead leaves.

A note of caution: timber rattlesnakes and western massasaugas are venomous and a bite from either species is a serious injury that requires immediate medical attention. While surveying areas, do NOT pick up cover boards, logs, or other debris with your hand; use a snake stick with a hook on the end (Figure A.6) to lift objects. Boots and pants are required safety gear when looking for venomous snakes and snake chaps/gaiters can also be worn if desired.

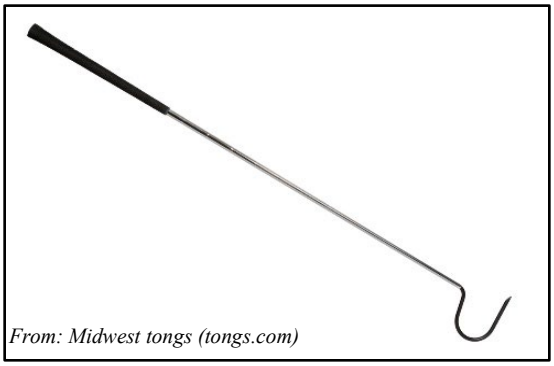

Figure A.6 Example of a snake stick with a hooked end.

Suitable Conditions for Surveying:

- Dates:
    - Massasaugas: 1 April – 31 October (may vary depending on temperatures)
    - Timber rattlesnake: 1 May – 31 October (may vary depending on temperatures)
- Temperatures:
    - Ambient temperatures should be above 60°F for at least 2 hours prior to starting surveys.
- Wind:
    - Low (<10 mph) to no wind, occasional gusts up to 20 mph are ok.
- Cloud Cover:
    - Sunny or partly cloudy are ideal.

- Precipitation:
    - Not currently raining
- Time of Day:
    - April, May, September, October: 0900 – 1700
    - June – August: 0800 – 1200; 1800 – 2000 may also be feasible if needed
- Personnel and Pattern:
    - 2 people (ideal) should walk the project and staging area at the same time in perpendicular paths to each other, each person covering the entire area
        - If only 1 person is conducting the survey, they should walk the area in one direction (e.g., east and west) and then walk the entire area again perpendicular to their original survey (i.e., north and south)
    - Each person should cover only 3 meters of ground at a time (approximately 1.5 meters on each side; see Figure A.7 below)

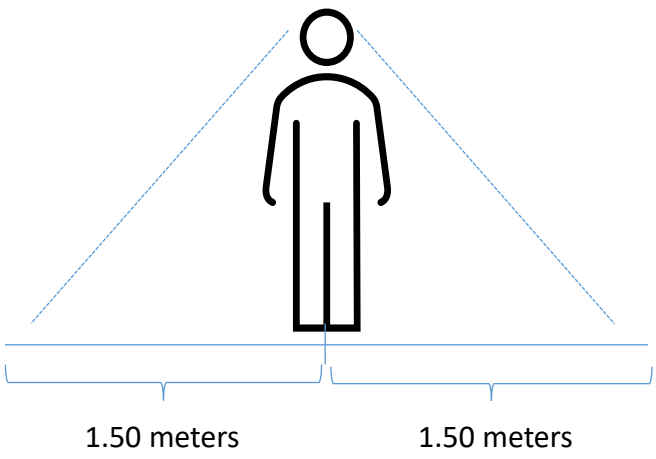

Figure A.7 Illustration of area to be covered by a single person when surveying for massasauga rattlesnakes, crayfish burrows, or timber rattlesnakes.