Inventory and Monitoring of Two State-listed Snakes (Kirtland's Water Snake and the Eastern Massasauga) in Piatt County, Illinois

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INTRODUCTION

At the time of European settlement, the Eastern Massasauga Rattlesnake, *Sistrurus catenatus catenatus*, (EMR) was distributed throughout the northern two-thirds of Illinois. Early inhabitants of the state reported seeing up to 20 or more EMR in one season (Hay, 1893). The habitat conversion that followed settlement, such as draining of prairie marshes and intensive agriculture may have contributed to the EMR's decline. As early as 1866, the EMR was noted as declining (Atkinson and Netting, 1927). In 1994 the EMR was listed as an endangered species in Illinois (Herkert, 1994) and is now a candidate for listing at the federal level (USFWS, 1999). The persecution of the EMR by the unenlightened, uninformed human population has lead to only a few widely scattered populations remaining. Smith (1961) stated that there were 25 extant populations of the EMR at that time. Recent studies have found that only two to three of the previous 25 remain (Beltz, 1992). One of these occurs at Allerton Park, near Monticello, Illinois.

The Kirtlands snake, *Clonophis kirlandii*, (KS) also abundant at the time of settlement has suffered serious declines over the past century. The KS is distributed through the middle one-third to the northeast corner of Illinois (Phillips *et al.,* 1999). Garman (1892) stated that tiling, ditching and cultivation of the soil have nearly destroyed its habitat. The KS is listed as threatened in Illinois and Ohio and endangered in Indiana and Michigan. The KS is offered no protection at the federal level. A total of 70 historical localities are known in Illinois; a 1985 survey found individuals in only 20 of these sites (Wilsmann and Sellers, 1988). One of these localities is Allerton Park, near Monticello, Illinois. Between June, 1991 and May, 1993, 33 historic locations were surveyed and KS were encountered at only two, Effingham and Lake Sangchris (Bavetz, 1994).

The objectives of this study were to 1) determine the status of the EMR and KS at Allerton Park through visual encounter searches, 2) estimate home range size and determine habitat utilization of the EMR, 3) determine the composition of other snake species at Allerton Park and 4) offer management recommendations for improving site quality.

MATERIALS AND METHODS

Study Organisms

Eastern massasauga rattlesnake: The EMR has a range that includes the states of Illinois, Indiana, Iowa, Michigan, Missouri, New York, Ohio, Pennsylvania, Wisconsin, and across the Canadian border into the province of Ontario. Preferred habitat of the EMR ranges from lowland forest and grasslands in the midwestern United States and western Great Lakes to mixed deciduous/coniferous forest in Ontario to peat bogs in New York (Wright, 1941; Smith, 1961; Reinert and Kodrich, 1982; Seigel, 1986; Weatherhead and Prior, 1992; Johnson and Leopold, 1998). The EMR has four activity periods. Emergence (egress) begins when the snake leaves its hibernacula to thermoregulate adjacent to the entrance, occurring late March to mid-April and ending when the snake leaves the vicinity of the hibernacula. The primary activity period begins when the snake moves to its foraging area and ends when the snake moves back to the vicinity of its

hibernacula area, approximately mid-October. Entrance (ingress) involves the snake locating a suitable burrow. The snake may shuttle between several crayfish burrows until a suitable one is found concluding this period. Winter dormancy ends the season for the EMR. During this period, the snake remains underground, in the burrow, until mid-March to mid-April. The primary activity period is punctuated by mating season, mid-July through August.

Kirtland's snake: The KS range includes the states of Ohio, Indiana, extreme southern Michigan and extreme northern Kentucky. A disjunct population occurs in western Pennsylvania and northeastern Missouri. The KS historically occurred in open habitats (Conant 1943). This includes wet grasslands, margins of streams, lakes, swamps and meadowlands. Present habitat consists mainly of open low grassy areas at the margins of creeks, ponds or ditches (Bavetz 1994). Populations at the periphery of the range occur in relatively open woods while those in the core are more commonly found in urban or floodplain habitats (Conant 1943). Life history information is lacking on the KS, but what little exists states that the KS is very secretive and most likely nocturnal, possibly aestivating during the hotter part of the summer (Conant 1943, Smith 1961).

Study Site

Allerton Park, located SW of Monticello Il, was donated to the University of Illinois by Robert Henry Allerton in 1946 for use as an educational and research center (Plate 1). The park's 1500 acres contain woodland, riparian and prairie areas of such high quality they have been designated a National Natural Landmark. We searched for snakes at three study sites: Prairie Restoration, Bennett Property, and Old Rt. 47. The Prairie Restoration and Bennett property are reclaimed agriculture fields. The Prairie is managed for grassland habitat while the west portion of the Bennett Property (Plate 2) is in the early stages of upland forest restoration, and the east portion is left fallow as grassland habitat. Old Rt. 47 (Plate 3) is a 40 meter wide power line and abandoned railroad right of way on the north side of Allerton Park that, until 2004, had not been managed for any specific habitat type. It is currently owned by Heartland Pathways, a non-profit conservation organization.

Survey Methods

Snakes were collected using visual encounter surveys throughout the activity season (mid-May to mid-September). Surveyors walked areas at each site checking under cover objects such as logs, grass clumps, and debris. Alternating halves of the Prairie Restoration are burned every year. The burned area was searched more intensively due to higher detection probabilities in areas where vegetative cover has been removed.

Captured snakes were individually marked by implanting passive integrated transponder (PIT) tags subdermally. Scale clipping (Brown and Parker 1976) was used to mark individuals too small for PIT tags. EMRs were also marked by painting rattle segments with unique patterns to allow identification of recapture without handling. All EMR were photographed and had their saddle descriptions recorded as a precautionary measure in the event the previous marking methods failed. All snakes were sexed by cloacal probing and weighed to the nearest gram with a Pesola spring scale. Snout vent length (SVL) was

obtained using the average of three measures within 0.5 cm with a flexible tape. Tail length was determined by measuring to the nearest 0.5 cm with a ruler. For the EMR we also recorded the number of rattle segments and subcaudal scales. A blood sample was taken from each EMR for future genetic work. Catch per unit effort was also calculated.

For VES snakes, recorded environmental variables were amount of cloud cover and presence/intensity of precipitation, shaded air temperature (to the nearest 0.1 ºC), relative humidity and max wind speed were determined with a Kestrel 3000. Substrate temperature ~1cm below the surface (to the nearest 0.5 ºC) using a Fieldpiece digital thermometer. All snake locations (sightings or captures) were recorded with a Garmin GPS 3 Plus unit, using map coordinates in UTM-NAD 83.

Telemetry Methods

Temperature sensitive radio-transmitters were surgically implanted into EMRs by Dr. Julia Whittington at the University of Illinois Wildlife Medical Clinic. Snakes were located every other day during the early activity season (late March thru mid-July), every day during the breeding season (mid-July through August), and every other day after the breeding season until winter dormancy. During winter dormancy, snakes were checked two to three times monthly. Each time a snake was located, pulse interval in seconds, behavioral observations (rattling or not rattling; coiled or straightened out; moving or not moving; whether it was in shade, partial sun, or full sun; and in burrow or not) and environmental characteristics listed above were recorded. In addition, at each snake location we recorded an initial GPS reading and the following habitat measurements: canopy cover using a concave spherical densiometer, distance to the nearest road, and distance to the nearest wooded edge. Within a 500 m radius, we measured the distance to the nearest tree (DBH $\geq$ 7.5 cm) and shrub in the NW, NE, SE, and SW quadrants. I made all distance measurements to the nearest meter using a laser range finder or tape. I scaled the distance to woodland edge as negative values for measurements within woodland boundaries and positive values for measurements outside woodland boundaries. When I did not have direct line of sight, I calculated the road and edge measurements using Arc-View data layers with the Nearest Feature (Jenness, Ent.) extension. I reduced shrub and tree measurements to mean distances by averaging over the four quadrants. To minimize GPS error I recorded a second GPS location during habitat analysis and averaged the two. Individual snake locations were considered unique only if they were greater than one meter from a previous location. Home range was calculated with the use of minimum convex polygon (MCP) and 95, 75, 50% Kernel density isopleths, descriptive movement statistics will be calculated. For habitat use, I delineated each snake's habitat by buffering all unique locations by the snake's single largest movement. I classified the area within the outer most boundary of all buffers as available habitat. I then divided the available habitat into macrohabitats by habitat type (agriculture, canopy, mowed grass, prairie and road). Macrohabitat preference was determined by calculating the proportion of locations in a particular habitat type. Microhabitat was classified by the environmental habitat variables described earlier. I recaptured all radio-implanted snakes two times per season (spring and before ingress in September) to record morphological variables. Home range and movement analyses were performed using ARC-View 3.2. All other data were analyzed using Microsoft Excel.

RESULTS

Surveys

Prairie Restoration

The south side of the prairie was burned on 9 April 2007. Two juvenile EMRs, one male one female were killed during the burn. Above average snowfall in February and March delayed attempts to burn at a more favorable, earlier date. The ten days preceding the burn, temperatures exceeded 27°C (80°F), followed by a three-day cold snap were the low temperatures fell to -4°C (26°F). These two snakes were the unfortunate few who did not locate a burrow and get underground to avoid the cold temperature.

The prairie restoration was searched for 69.6 man-hrs with the effort concentrated in the burned area. A single, dead, EMR was encountered. The skull of the snake appeared to have been crushed. A 350 m drift fence with 48 funnel traps (half on each side) was erected along the firebreak the length of the prairie. The traps were checked daily from March 26 to October 3. One new adult male EMR and one new KS were encountered in the funnel traps on the un-burned side of the fence. Appropriate morphological measurements were taken and a PIT tag was injected into the EMR, while the KS received a scale clip.

Coverboards (n=10) were checked once per week. No EMRs or KSs were encountered under boards.

Other snake species encountered included *Lampropeltis calligaster* (n = 8), *Thamnophis sirtalis* (n = 6), *Coluber constrictor* (n = 7) and *Heterodon platirhinos* (n = 4), *Elaphe vulpina* (n=7), *Elaphe obsoleta* (n=1).

Old Rt. 47

No burning took place in 2007. Searching was impeded by vegetation and detection probability suffered. A total of 20.4 man-hrs of effort was spent searching with no EMR encounters. Four separate stretches of drift fence, each approximately 40 m long, were erected perpendicular to the long-axis of the ROW at irregular intervals. Three funnel traps were placed along each side of each fence (6 traps total). The traps were checked daily from July 20, 2007 to October 4, 2007. No EMRs or KSs were encountered in the funnel traps.

Cover boards were not checked for the presence of EMRs at Rt. 47.

No other snake species were encountered.

Bennett Property

Because no prescribed burns were conducted at this site, ground vegetation was very dense, making searching difficult. A total of 19.3 man-hrs of effort were spent searching this site with no EMR or KS encounters.

Coverboards (n=30) were checked once per week. No EMRs or KSs were encountered under boards.

Other snake species encountered were *Storeria dekayi* (n = 15), *Thamnophis sirtalis* (n=7) and *Elaphe vulpina* (n = 2).

Telemetry

On July 12, a radio-transmitter was surgically implanted into the male EMR (#035). Following a five-day recovery period, the snake was released on July 17. The snake was tracked daily from its release until it entered hibernation on October 22.

Movement
Average distance moved between unique locations for 035 was 83.9 meters. The EMR exhibited periods of inactivity lasting up to three days. The snake's largest movement was 441 meters (Table 2). Large movements such as this are normal for males during the mating season (Phillips et al. 2001; 2002). Snake 035 was not observed mating.

Home Range
The minimum convex polygon (MCP) for snake #035 was 10.3ha and 95, 75, 50% Kernel's were 6.86, 1.09, 0.61 ha (Table 1).

Macrohabitat
A large proportion (43 out of 44) of locations were in prairie habitat. The second ranked habitat type was forest and is represented by a single location.

Microhabitat
Snake #035 was on average 125.65 meters from a road, 134.9 meters from an agricultural field (Table 2). On average 035 used microhabitats within 24.0 meters of a tree, 1.2 meters of a shrub and average distance to tree and shrub were 34.56 meters and 2.02 meters (Table 2).

RECOMMENDATIONS

At the Prairie Restoration, increasing the level of search effort and continuing to burn while the snakes are still in hibernacula will aid in encountering new EMRs and recapturing known snakes. Recaptures are important for estimating population size and survivorship.

At Old Rt. 47, there are numerous burrows for hibernacula. Furthermore, with the reduction in the scope of mowing and removal of exotic invasive plant species the site is

improving. Prescribed burns should continue to progress east and west in order to determine the total occurrence of EMRs in the strip.

At the Bennett property, the retention pond dam should be repaired to restore the aquatic habitat required for amphibian reproduction. Increasing the local soil moisture would be beneficial for both the KS and EMR. Crayfish would increase in the area providing possible EMR with hibernacula and provide the KS with its preferred habitat type. Overall, it is recommended that agricultural lands adjacent to Allerton Park be restored to natural prairie habitats through conservation easements or outright purchase.

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Table 1: Amount of habitat used and proportion of habitat used relative to available habitat area (m^2) using 95, 75, and 50% kernel density isopleths (KDI), and minimum convex polygon (MCP), average distance moved per unique location, total distance moved during tracking period and maximum distance moved, for *S. c. catenatus* radio-located at Allerton Park, Piatt County, Illinois.

	KDI(ha)											
Snake	**95**	**%**	**75**	**%**	**50**	**%**	**MCP**	**%**	**Ava. Hab.**	**Avg. Dist.**	**Total Dist.**	**Max**
035	6.87	5.4	1.1	0.9	0.61	0.5	10.30	8.1	127.67	83.9	2349	441

Table 2: Means for habitat measurements of radio-located *S. c. catenatus* at Allerton Park, Piatt County, Illinois.

Snake	Nearest Tree	Nearest Shrub	Mean Dist. Tree	Mean Dist. Shrub	Road	Agriculture	Wooded Edge
035	24.00	1.20	34.56	2.02	125.65	134.90	44.67

PLATES

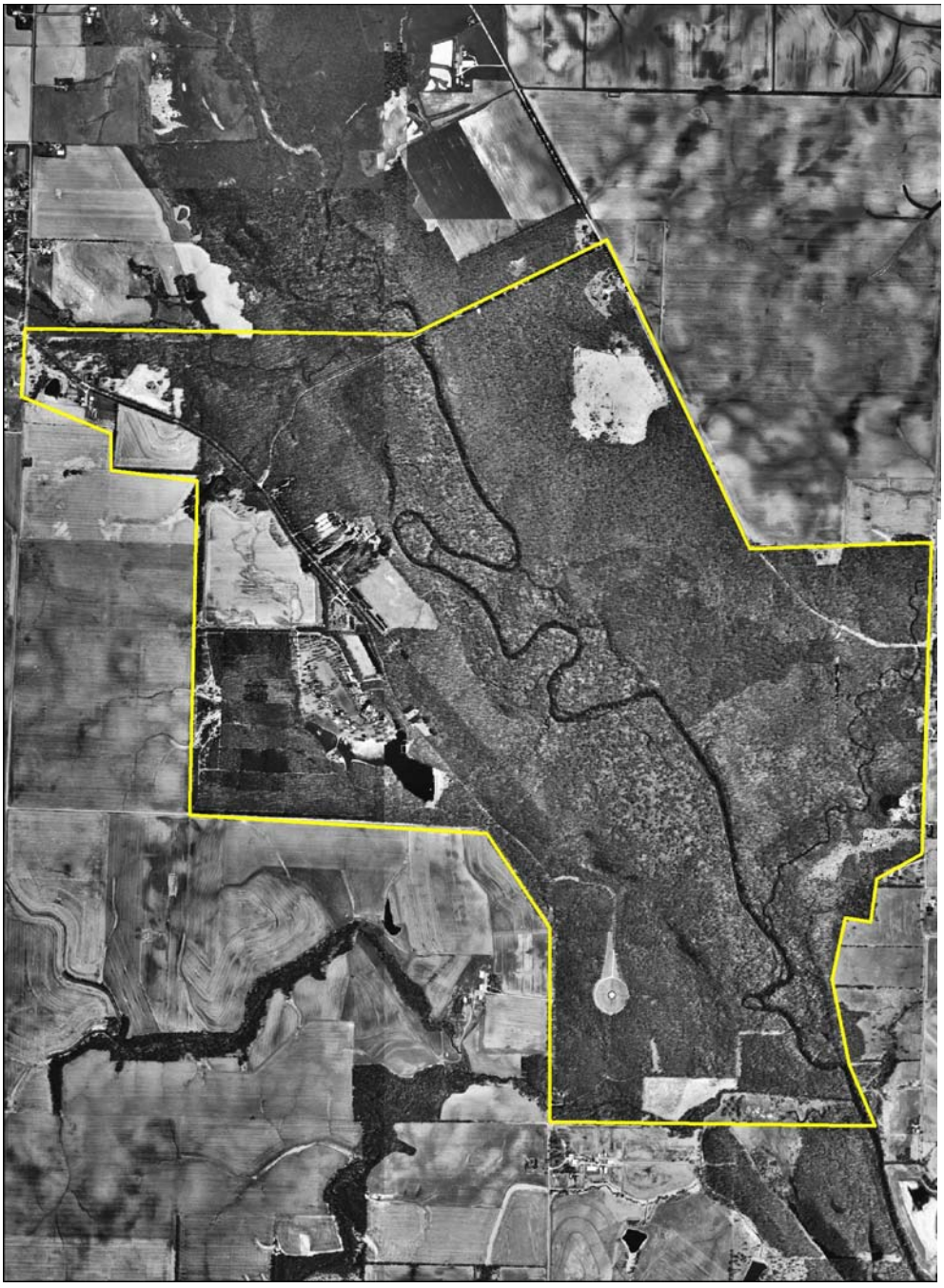

Plate 1: Aerial photo of Allerton Park (Outlined in yellow)

Plate 2: Aerial photo of Bennett property (outlined in yellow)

Plate 3: Aerial photograph of Old Rt. 47 (outlined in blue)