A Survey of Two Rarely-Seen Northeast Kansas Snakes

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INTRODUCTION

The Redbelly Snake (*Storeria occipitomaculata*) and the Smooth Earth Snake (*Virginia valeriae*) are two of the least commonly encountered snakes in Kansas. The true nature of their scarcity is masked by aspects of their biology; they are small (neither species attains a total length greater than 15 inches and are typically less than 8 inches), they are secretive and thus not often encountered in the open, and the bulk of their range in Kansas occupies a relatively small footprint along the state's eastern border (Collins and Collins 1993; Taggart et al. 2008).

An examination of the fossil record (Holman 2000) and the current range of both species (Conant and Collins, 1998) illustrates that while *Storeria* sp. and *Virginia* sp. were always small in stature and therefore probably secretive; at some point in the past 1.5 to 0.01 million years, both were probably found throughout Kansas. Climatic changes (precipitation and temperature) and the resulting alteration of hydrology, vegetation, and soils gradually made most of Kansas inhospitable for these two snakes. Except for a few residual pockets of suitable habitat, they were pushed off the Great Plains. This is best evidenced by examining the isolated yet thriving remnant populations of *S. occipitomaculata* in the Black Hills of South Dakota and Wyoming (Baxter and Stone, 1985; Ballinger et al., 2000; Collins et al., 2005), the Platte River floodplain of central Nebraska (Hudson, 1942; Lynch, 1985), and quite possibly in Phillips County, Kansas (Taggart et al., 2008). Along with the presence of fossil *Storeria* from places such as Meade County in southwest Kansas, these records allude to the natural progression and retraction in the ranges of all species. The current rate of change isn't climatic for these two serpents in Kansas. It is due to habitat alteration, which is outpacing the natural progression by fragmenting populations and initiating local extinctions.

Northeast Kansas (Figure 1) is the most populous and fastest growing region in the state. In large part, this is due to growth in the major metropolitan areas of greater Kansas City, Leavenworth, Lawrence, and Topeka.

Population growth in northeast Kansas exceeds rates of other like-sized regions in the state. During the period of 1990 through 2000, US Census records show that all but two of the fifteen counties in this region grew in population size. In Johnson County alone, 10,000 new residents are added each year, accounting for 55% of all population growth in Kansas during that time. Wyandotte County lost 2.6 % of its population in that time; however its population density is still the greatest in the state at 1,402.9 persons per square mile. As a whole, the northeast Kansas region has the greatest human population density of any like-sized region in the state.

The region is comprised of glaciated plains to the north of the Kansas River, and Osage Cuestas to the south. The entire region consists of gently undulating terrain with rocky, wooded ravines below meadows, cultivated fields, or urban sprawl. Principle drainages within the region are the Missouri, Kansas, Marais des Cygnes, Wakarusa, and Delaware rivers. Lesser tributaries include Stranger, Pottawatomie, Big Sugar, Bull, and Hundred and Ten Mile creeks.

Northeast Kansas is home to both *S. occipitomaculata* and *Virginia valeriae* (Figure 2). The paucity of information concerning the biology of these snakes, coupled with the rapidly expanding human population in northeastern Kansas, necessitates the need for an evaluation of current mitigation attempts. Additionally, there is a pressing need to better understand the habitat requirements for these snakes in northeastern Kansas. Fraser (2000) summarized many reasons for the protection of species at the edge of their range, including patterns of species collapse, historical importance of peripheral species in recovery planning, and genetic, evolutionary, and biodiversity considerations.

Both species have been formally designated as Threatened Species in Kansas pursuant of the Kansas Nongame and Endangered Species Conservation Act of 1975. This Act directs the Kansas Department of Wildlife and Parks to identify and act upon conservation measures for listed species. This includes the issuance of special action permits for activities that directly affect the individual organisms or impact their habitats. The action permits generally follow an environmental review and are designed to mitigate the negative affects of the proposed activity in the designated critical habitat of the listed species though avoidance, minimization, or compensation. Both the Redbelly Snake and Smooth Earth Snake have Designated Critical Habitat in the fifteen county study area. Designated Critical Habitat for the Redbelly Snake consists of all woodland habitats within Douglas, Jefferson, Johnson, Leavenworth and Wyandotte counties. Designated Critical Habitat for the Smooth Earth Snake consists of all suitable woodland habitats within Jefferson, Johnson, Leavenworth, Linn, Miami and Wyandotte counties. Currently, new construction or expansion of commercial and urban expansion necessitating the acquisition of state permits generally requires that the proposed area be evaluated with respect for its potential habitat suitability for both species of snakes. The Kansas Department of Wildlife and Parks has developed a form (Appendix I) to be used by their personnel or herpetological consultants to measure the impact (calculated in Habitat Units) of the proposed construction on the critical habitat of these two snake species. KDWP then uses those measurements to initiate the mitigation of those critical habitats affected. Mitigation may include one or more of the following: halting the proposed activity, movement of the proposed activity to an area with a lesser impact, the protection of land elsewhere, or contributing monetarily.

The objectives for this study were twofold:

The first was to identify areas or habitats in the study region to give the best direction for protective attention. To adequately protect a species, the community and ecosystem to which it belongs must itself be protected from drastic alterations. This is best accomplished by identifying the habitat conditions (both micro and macro) in which the species lives. In as much as so little is known of habitat requirements of *V. valeria*e and *S. occipitomaculata* in Kansas, any information toward this objective is particularly valuable.

The second objective is to assess the current mitigation measures for protecting the Northern Redbelly Snake and Rough Earth Snake in the study region. There is a need to evaluate those procedures already in place with regard to the alteration of critical habitat for these species. Meeting these objectives will allow biologists, regulators, and developers to better support our efforts to protect these taxa.

MATERIALS AND METHODS

Late in 2005, all previous localities in which *V. valeriae* and *S. occipitomaculata* had been observed within Kansas (voucher and literature records) were visited to determine a baseline of the habitat types these species utilized in the state. Particular attention was paid to the cover afforded by trees, shrubs and herbs, and grasses, as well as surface cover such as rocks or logs.

Additionally, literature reviews were conducted to determine what habitats these snakes occupied in other parts of their range. Also, other information that would help in delineating suitable habitat (e.g. dietary data) was extracted as well. When reported, information concerning the effects of urban sprawl in other states was noted as well.

Sampling took place from March through November of 2006 and 2007. Inventory efforts relied primarily on the tried and proven methods of obtaining specimens of these species. Throughout the entire study funnel traps (Clarke 1966; Fitch 1999) were used extensively and often checked and maintained by myself and project volunteers to maximize the time they remained open. The funnel traps were placed at various spots throughout the study area and were moved frequently (Appendix II).

Road cruising was employed during the late evenings, at night, and during the early mornings. This method is widely used and has been successful for both of the target species (especially *Storeria occipitomaculata*) in the past.

By day, we relied on turning natural cover in an attempt to discover these snakes. Using this method, rocks, logs, bark, and loose natural material are moved to reveal what may be hidden beneath. Emphasis was placed on sampling diverse types of natural cover in various habitats (deep woods, woodland edge, open prairie, etc.) At every survey site in which leaves had accumulated covering the forest floor, a leaf rake was used to quickly gather up all of the surface detritus in a ten foot diameter area forming a mound of leaves and grass surrounded by bare earth. The leaves in the mound were slowly pulled away to occasionally reveal snakes hiding within and under them.

When surface cover was lacking (i.e. no rocks or logs) or was not easily turned (i.e. thick thatch) artificial cover was utilized and checked daily. Types of artificial cover utilized in this study included plywood sheets of various sizes (generally larger than 1 square meter) and corrugated metal roofing (tin) cut into 1 or 2 square meter pieces.

Drift fence/pitfalls were used at several sites during this study. These trap arrays have proven successful in capturing both of the target species elsewhere (Fitzgerald and Nilon 1994; Willison and Dorcas 2004).

RESULTS

Without exception the literature from state sources (Appendix V) pertaining to the habits and habitat of *S. occipitomaculata* and *V. valeriae* are consistent despite the size of their respective ranges (each roughly one-half of the eastern United States). Both species are seldom encountered and generally considered rare (due to their secretive nature, not anticipated low populations sizes). Anecdotal observations such as Anderson's (1965) concerning the difficulty in finding *V. valeriae* are common: "In Jackson County [which abuts Johnson County, Kansas] 30 years of intensive field work has revealed only five individuals." When they are found it is usually under cover objects such as boards, rocks, bark, logs, or leaf litter. Due to the secretive nature of these species, our historic understanding of their distribution is more a reflection of where herpetologists spend their time collecting than where they actually occur.

The diets listed for the two species were also very similar. The two species prey on slugs, snails, earthworms, and other soft-bodied invertebrates. No source cited an overwhelming preference for a particular prey item for either species.

Habitat associations from historic observations of *S. occipitomaculata* and *V. valeriae* varied extensively within each species. With few exceptions, neither snake was ever taken far from wooded areas; however, *S. occipitomaculata* was found in much closer proximity (often in the wooded areas themselves) while *V. valeriae* was more frequently observed at the woodland edge. While both *S. occipitomaculata* and *V. valeriae* make use of upland and lowland areas, *V. valeriae* was observed most frequently on the upland sections and *S. occipitomaculata* in the lower and wetter regions. Seldom were they ever found syntopically.

Table 1 lists those snakes discovered utilizing the various techniques discussed above. It was not possible to quantify the amount of time or effort expended in any single collecting technique due to the considerable overlap of techniques used at any one site. Figure 3 summarizes those records collected during this study and Appendix

III and Appendix IV summarize all the known records for *S. occipitomaculata* and *V. valeriae* respectively, in Kansas.

More than and 1,000 miles of northeast Kansas roadways were driven for over 600 hours during the course of the study. Neither of the two study species was collected by road cruising, although this method has yielded specimens of each prior to this study. At total of 149 specimens of 16 other species of snakes were observed during the study.

While no *S. occipitomaculata* were collected under artificial cover, 65 observations of *V. valeriae* were made using this technique. Most of these (62; 27 captures and 35 recaptures) were associated with a small woodland edged pasture in southeastern Jefferson County that abuts the Fitch Natural History Reservation (University of Kansas) through the efforts of George Pisani (Kansas Biological Survey, Lawrence). It should be noted that attempts were made to duplicate his results at several other sites within the study area without success. The number of snakes observed at this site is brought into greater perspective considering that in over 50 years of extensive surveying on the Natural History Reservation, Dr. Henry S. Fitch only observed a single specimen of *V. valeriae* (Fitch 1999). Across all taxa, the use of artificial cover led to the discovery of 117 individuals of eleven species of snake.

A total of two *S. occipitomaculata* and two *V. valeriae* were observed under natural cover. Natural cover consisted primarily of rocks and logs. However, traditionally unnatural objects such as concrete or railroad ties were grouped in this category when it deemed they had been abandoned long enough to have become naturalized in the landscape. A total of 239 individuals from 16 different species of snakes were observed under natural cover during this study.

During the course of this study, funnel traps were used extensively as they were easy to transport, set up, and take down. No *S. occipitomaculata* or *V. valeriae* were collected in the funnel traps, and overall only 22 specimens of seven species of snakes were taken by this method during the study.

Leaf-raking yielded two individuals each of *S. occipitomaculata* and *V. valeriae*. All four of those animals were collected in Jefferson County. Elsewhere, leaf-raking led to the observations of 32 specimens of five species of snakes.

The drift fence/ pitfall trap arrays produced 15 individuals of eight species of snakes. No *S. occipitomaculata* or *V. valeriae* were observed in these arrays.

DISCUSSION

Assessment of stated objectives

In light of our recent findings, the current mitigation measures for protecting the *S. occipitomaculata* and *V. valeriae* in the study area are in need of review.

The Critical Habitat Evaluation Form (Appendix II) is a great tool in that it allows the consulting herpetologist to evaluate the habitat using fairly unambiguous (yet subjective) criteria. The form can then be taken by the regulatory agency and used to illustrate their concerns and recommendations to the developer. Particular changes however, are needed to address the new information acquired during this study with respect to the habitat requirements for these species in Kansas. Their is also a need to recognize that while these taxa are similar in many regards, they differ in many important aspects of their biology and thus should be treated separately.

S. occipitomaculata is more of a generalist and so its list of potential indicators is long and varied. In many areas it reaches its peak abundance in wetlands and so certain indicators useful to delineating wetlands or Waters of the US (e.g. hydric soils and the presence of hydrophytes) may be adopted. In this sense, many populations will be afforded concomitant federal protection under Section 404 of the Clean Water

Act. This species also occupies dense upland forest, using both rocks and leaf litter as shelters. Key indicators here will be vegetative (presence of large trees [particularly Oak-Hickory]) and the presence of cover (limestone, leaf litter, or downed logs). The presence of food items can generally be assumed to exist as the diet of this snake is sufficiently broad. Snails or earthworms make up only a portion of the prey base as many other soft bodied invertebrates are consumed when available. Compared to *V. valeriae*, *S. occipitomaculata* utilizes woodland edge and open prairie less frequently. However, it does make use of this habitat, especially when a thick layer of thatch is present. Possible, indicators for woodland edge and open habitats would be the proximity to upland or riparian forests and the density of the grass cover at ground level (perhaps by the thickness measured in centimeters or by the amount of bare ground showing in a given area).

Critical habitat for *S. occipitomaculata* currently includes five counties within the study area. It should be expanded to include Anderson, Atchison, Franklin, Miami, Linn, and Shawnee counties within the study area and Bourbon County outside the study area.

V. valeriae is primarily a grassland and woodland edge species, showing no affinity to wetland areas or deep woods. The availability of cover objects such as surface rocks, outcrops, leaf litter, and fallen logs are not a requisite for this species, and only a thick layer of thatch in which to move about is necessary. When available, cover objects are often used, but they are certainly not a requirement. Unfortunately, this aspect of their biology makes them difficult to sample by conventional means.

Indicators that are appropriate to use in delineating the habitat of *V. valeriae*, are the proximity to woodland edge (generally not found more than 400 meters away [although this may be an artifact of collecting]) and the density of dead grass cover at ground level. Again, attempting to detect the presence of food items is probably meaningless, as in addition to its primary diet of earthworms, other soft bodied invertebrates are readily consumed.

Critical habitat for *V. valeriae* currently includes six counties within the study area. It should be expanded to include Anderson, Atchison, Douglas, Franklin, Jackson, Shawnee counties.

Under the current system (Appendix II) the indicators are tallied (possible total points range of 0 to 30) and converted to a habitat value (essentially reducing each point by a third). There appears to be no biological reasoning behind the conversion of total points to a habitat value. Also, because the ten current indicators are so diverse, the Habitat Value scores are a poor comparative measure, especially at the lower end of the scale.

Habitat Values are then multiplied by the acreage to be impacted, yielding Habitat Units which is the measure taken and used by the regulatory agency. It would be beneficial to all parties if the herpetological consultant was instructed to delineate contiguous areas of site that contained similar values for principal indicators. As the tract size increases the consultant will find that the indicators are seldom distributed equally across the landscape and a site might reasonably contain areas of both prime (Habitat Values of 7.00 to 10.00) and marginal (Habitat Values of 0.33 to 3.00). To produce an accurate and fair delineation to all parties, these should be broken out whenever possible.

With respect to the potential alteration and development of delineated habitat for these two snakes, complete avoidance of the habitat and a modest buffer is the only way to negate potential impacts. When this is not possible, minimization of the habitat alteration can be achieved by restricting development to those areas of the project site that contain the smallest calculated Habitat Values. However, it will be important to account for the low vagility of these snakes and attempt to minimize the amount of population fragmentation. It is important to maintain sufficiently large blocks of habitat that remain connected in some manner (i.e. a buffered right of way or a buffered riparian corridor).

When complete avoidance is inevitable, compensation should be required. It is not possible to apply an objective monetary value to a Habitat Unit, as there is no amount of money or land set aside elsewhere that will bring these species back once their habitat is removed. Likely, this will have to be achieved through discourse between the regulator and the developers to settle on an amenable arrangement.

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Table 1. Snakes observed or collected during this project. Survey types are discussed in the Methods section and listed as follows: RC = Road cruising; AC = Artificial Cover; NC = Natural Cover; FT = Funnel Traps; LR = Leaf/ Thatch Raking; = DF = Drift Fence/ Pitfalls.

Colubridae	RC	AC	NC	FT	LR	DF
Coluber constrictor	32	13	17	1	0	2
Lampropeltis calligaster	5	1	3	0	0	0
Lampropeltis getula	1	2	4	0	0	0
Lampropeltis triangulum	2	0	17	1	0	1
Opheodrys aestivus	2	0	0	0	0	0
Scotophis obsoletus	13	19	1	1	0	1
Pituophis catenifer	2	0	0	0	0	0
Tantilla gracilis	0	0	2	0	0	0
Crotalidae						
Agkistrodon contortrix	11	16	14	1	0	3
Crotalus horridus	7	8	3	0	0	1
Sistrurus catenatus	1	0	1	0	0	0
Dipsadidae						
Carphophis vermis	0	2	23	4	9	0
Diadophis punctatus	4	25	144	6	12	2
Natricidae						
Nerodia sipedon	2	0	0	0	0	1
Regina grahamii	1	0	0	0	0	0
Storeria dekayi	42	2	3	8	7	4
Storeria occipitomaculata	0	0	2	0	2	0
Thamnophis proximus	2	0	1	0	0	0
Thamnophis sirtalis	22	8	2	0	0	0
Virginia valeriae	0	65	2	0	2	0

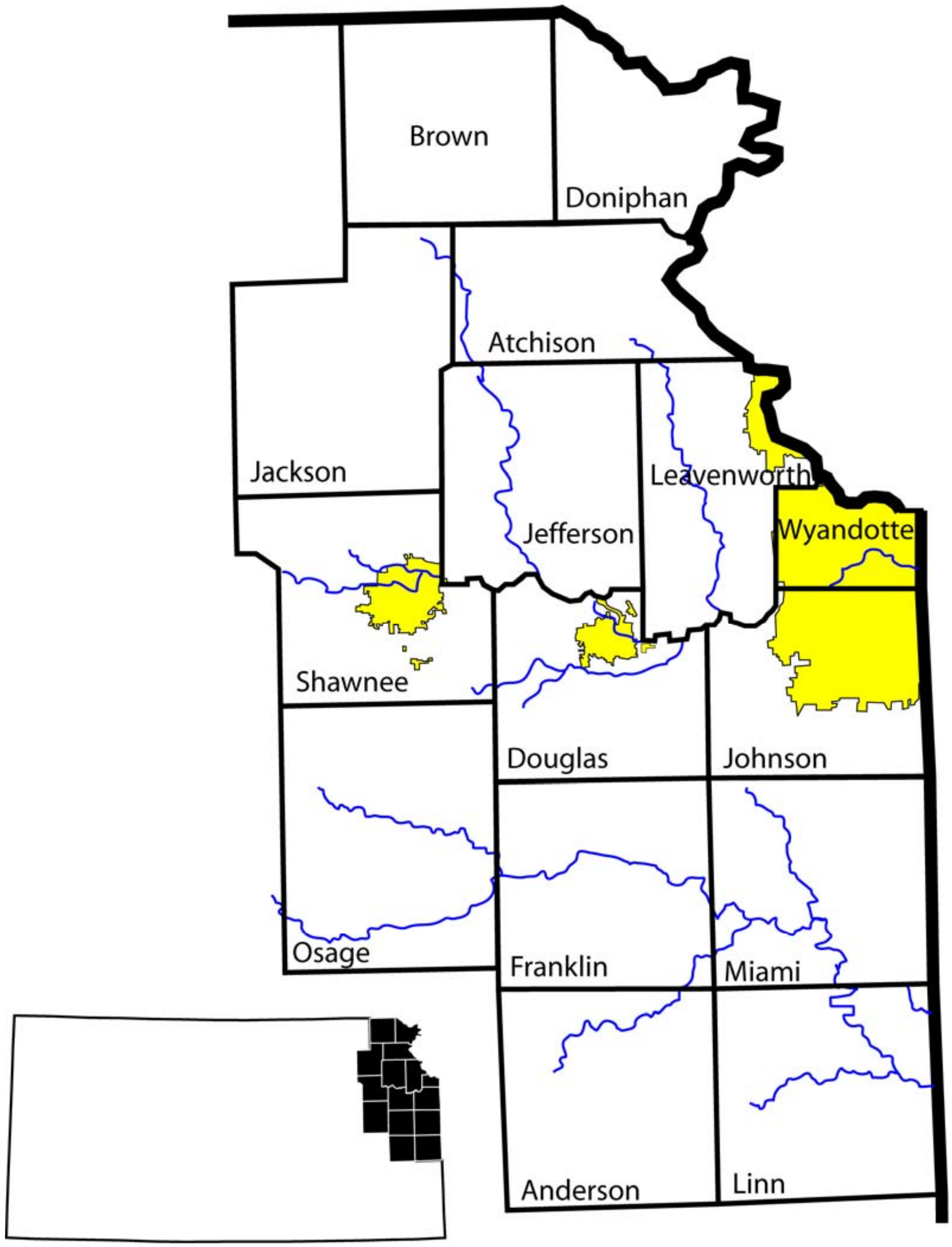

Figure 1. Base map of the study area in northeast Kansas showing the major metropolitan areas (in yellow; from west to east Topeka, Lawrence, Leavenworth, and greater Kansas City) and the county names referred to in the text.

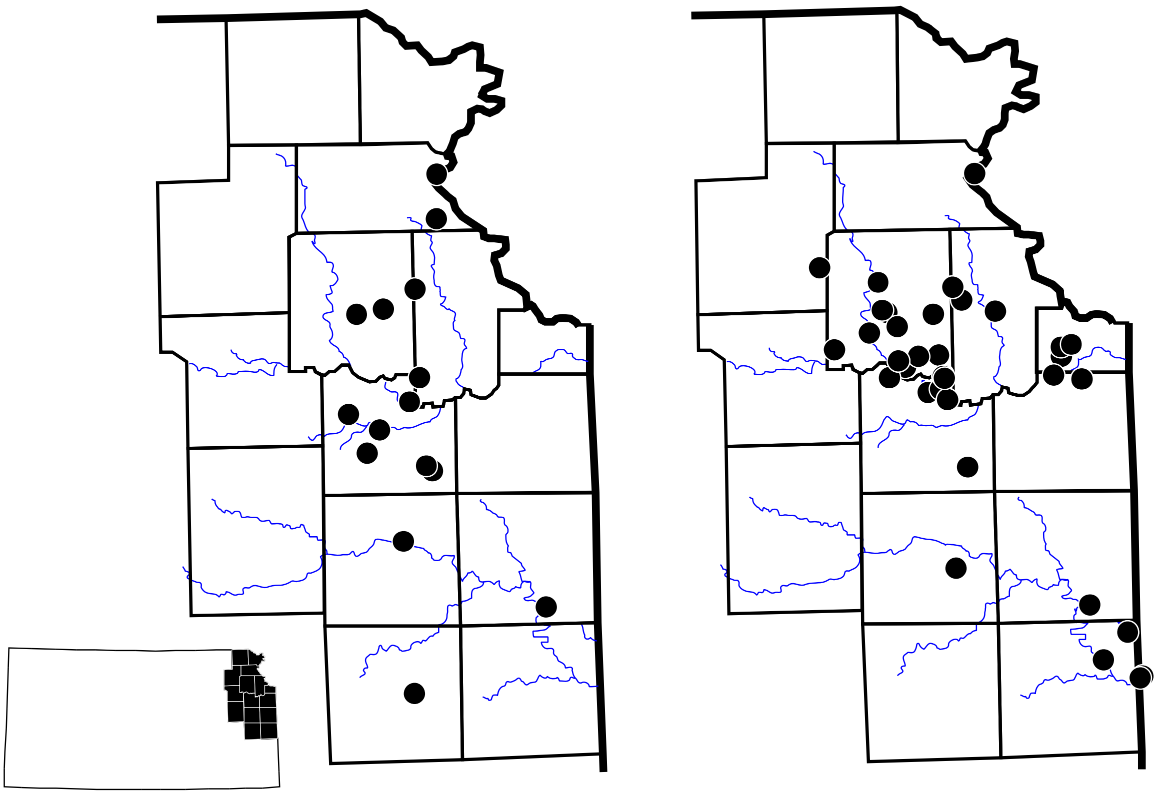

Figure 2. The distribution *Storeria occipitomaculata* (left) and *Virginia valeriae* (right) in the northeast Kansas prior to this study.

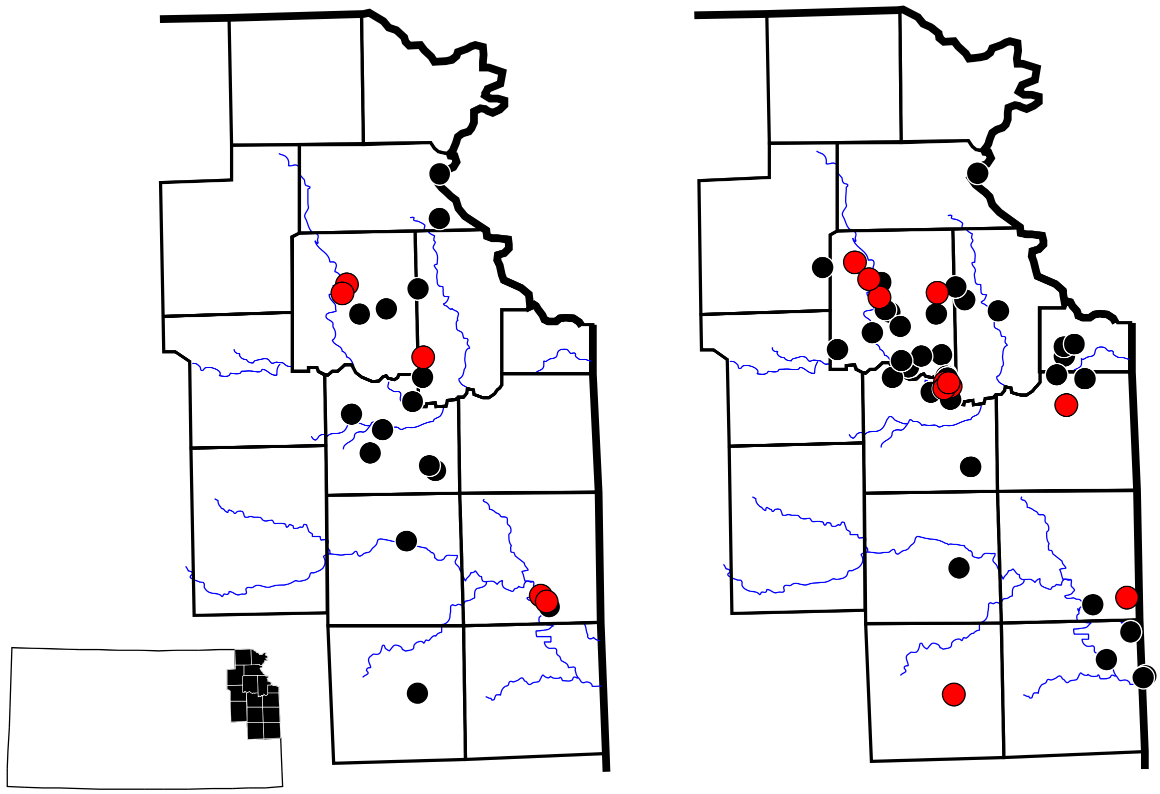

Figure 3. The distribution *Storeria occipitomaculata* (left) and *Virginia valeriae* (right) in the northeast Kansas following this study. Prior localities are indicated by the black dots, localities discovered through the course of this study are shown in red.

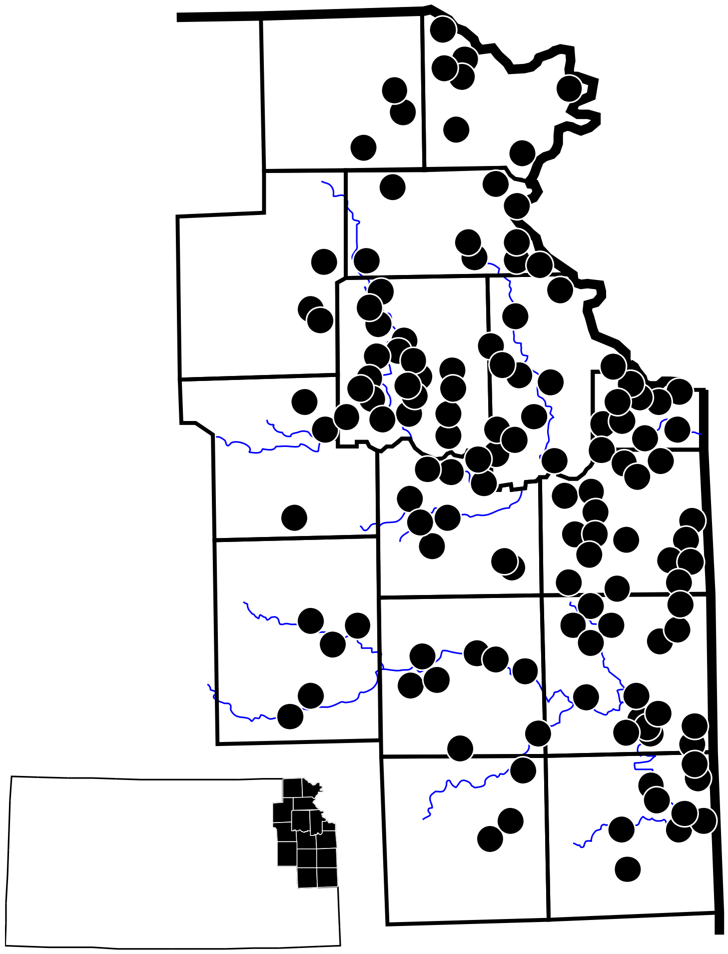

Figure 4. Map of northeast Kansas depicting those sites surveyed for S. occipitomaculata or V. valeriae during the course of this project. Coordinates for each is given in Appendix III. When possible, localities within close proximity to one another are given a single dot.

APPENDIX I

Critical habitat evaluation form

Redbelly (*Storeria occipitomaculata*) & Smooth Earth (*Virginia valeriae*) snakes

Date: ______________________________ County: ____________________

Project: ____

Project sponsor: ____

Evaluator (s): ____

Legal: ____________/4 Sec: ____________ T: ______________ R: __________

<u>Preferred habitats:</u>

Redbelly: prefer deeply wooded regions near rivers and lakes, sandstone woods, wooded hillsides, hillsides near streams, steep slopes of forested hills, moist areas, moist woodlands, woodlands with dense leaf litter, lowlands, forest edge, open fields, the vicinity of old dilapidated farm buildings, and woodlands which remain damp throughout the year. They are usually discovered on damp ground beneath leaf litter, leaf mold, or pine needles mixed with dead leaves; equally as often they are found under flat rocks, logs, rotten logs, boards, and other surface debris.

Smooth Earth: prefer open sandstone woods, rocky hillsides in moist woodlands, deciduous forests, wooded urban areas, woodland edge situations, open brushy woodlands without a continuous leaf canopy, and abandoned fields. They are frequently found in thick piles of dead leaves, or beneath leaf litter, flat rocks, logs, and other surface debris, most often near forest-edge or on hillsides with sparse tree cover.

Photos by Suzanne L. Collins, Center for North American Herpetology

Critical habitat: Mature oak-hickory woodland

Protocol:
1. Conduct a visual assessment of the project area and evaluate the following parameters:

Habitat Indicator	**Absent (0)**	**Sparse (1)**	**Common (2)**	**Abundant (3)**	**TOTAL**
Vegetation (Oak-Hickory)					
Abundance					
(DBH>18")					
Rock outcrop					
Surface lime/sand stone					
Leaf litter					
Deadfall					
Perennial water					
Terrestrial Snails (casings)					
Non-vascular plants & fungi					
Earthworms					
TOTAL	+	+	+	+	=

Conversion Table: Convert Total Points to a scale of 0-10

Total Points	**Habitat Value**	**Total Points**	**Habitat Value**
1	0.33	**16**	5.33
2	0.67	**17**	5.67
3	1.00	**18**	6.00
4	1.33	**19**	6.33
5	1.67	**20**	6.67
6	2.00	**21**	7.00
7	2.33	**22**	7.33
8	2.67	**23**	7.67
9	3.00	**24**	8.00
10	3.33	**25**	8.33
11	3.67	**26**	8.67
12	4.00	**27**	9.00
13	4.33	**28**	9.33
14	4.67	**29**	9.67
15	5.00	**30**	10.00

Habitat Value = ___________

2. Review project plans, maps, etc. to deliniate acres of impact

3. Multiply acres X Habitat Value = Habitat Units

_______________ X ___________________ = ____________________HUs

APPENDIX II

Coordinates of 185 survey sites sampled during this study. Those localities associated with road-cruising activities are not listed. Survey types are discussed in the Methods section and listed as follows: AC = Artificial Cover; NC = Natural Cover; FT = Funnel Traps; LR = Leaf/Thatch Raking; = DF = Drift Fence/Pitfalls. When possible, localities within close proximity to one another are given a single coordinate. Datum is NAD83/WGS84.

Anderson County

N38.18463°, W95.25432° .... FT, NC

N38.19131°, W95.20313° ....AC, NC, FT

N38.36653°, W95.15337° .... FT, NC

Atchison County

N39.63714°, W95.17627° ....AC, NC, FT, LR, DF

N39.59063°, W95.09999° .... NC, LR, DR

N39.48611°, W95.10070° ....AC, NC, FT

N39.44665°, W95.14224° .... FT, NC

N39.44935°, W95.02811° ....FT, LR

N39.45237°, W95.19077° ....AC, NC, FT

N39.47879°, W95.20722° .... FT, NC

N39.63682°, W95.44966° .... NC, LR, DR

N39.44553°, W95.51279° .... FT

Brown County

N39.67629°, W95.51259° ....NC

N39.84562°, W95.37199° ....AC, NC, FT

N39.79358°, W95.37391° ....AC, NC, FT

Doniphan County

N39.97930°, W95.30030° ....AC, NC, FT

N39.97516°, W95.31542° .... NC, LR, DR

N39.92456°, W95.23756° ....FT, LR

N39.91930°, W95.23880° ....AC, NC, FT

N39.91453°, W95.27090° .... FT

Douglas County

N38.93038°, W95.36639° ....AC, NC, FT

N38.91001°, W95.32613° .... FT, NC

N38.88105°, W95.39754° ....FT, LR

N38.96046°, W95.45661° ....AC, NC, FT

N38.84110°, W95.37752° ....NC

N38.82487°, W95.38480° .... FT, NC

N38.80004°, W95.16510 ° .... FT, NC

N38.79909°, W95.14366° ....NC

N38.81405°, W95.20536° ....NC

N39.02937°, W95.33645° .... NC, LR, DR

N39.03080°, W95.37104° ....NC

N38.97956°, W95.24076° .... FT, NC

N39.03494°, W95.20698° ....AC, NC, FT

N39.03971°, W95.25250° ....FT, LR

N39.03970°, W95.19960° ....FT, LR

N39.03173°, W95.20355° ....AC, NC, FT

N39.00524°, W95.18875° ....AC, NC, FT

Franklin County

N38.39661°, W95.43355° ....NC

N38.40807°, W95.07346° ....AC, NC, FT

N38.57867°, W95.10037° ....NC

N38.58026°, W95.14649° .... NC, LR, DR

N38.61321°, W95.20698° .... FT, NC

N38.58010°, W95.38743° ....NC

N38.54637°, W95.43416 ....AC, NC, FT

N38.62085°, W95.44609 ....NC

Jackson County

N39.46097°, W95.65804° .... FT, NC

N39.32999°, W95.60906° .... NC, LR, DR

Jefferson County

N39.39102°, W95.48767° .... FT, NC

N39.41529°, W95.50517° .... FT

N39.38983°, W95.55476° .... LR

N39.40368°, W95.50947° .... NC, LR, DR

N39.28336°, W95.44062° ....FT, LR

N39.30023°, W95.41172° .... FT, NC

N39.21000°, W95.41213° ....AC, NC, FT

N39.19249°, W95.41029° ....NC

N39.20602°, W95.39185° ....AC, NC, FT

N39.18024°, W95.41480° .... FT, NC

N39.26952°, W95.48078° .... NC, LR, DR

N39.25822°, W95.46234° ....NC

N39.18501°, W95.48222° ....FT, LR

N39.18485°, W95.43959° ....FT, LR

N39.10910°, W95.42320° .... NC, LR

N39.11881°, W95.46459° ....AC, NC, FT

N39.12183°, W95.39103° .... NC, LR

N39.13575°, W95.40606° .... LR

N39.21369°, W95.42011° .... LR

N39.19615°, W95.36705° .... NC, LR, DR

N39.15573°, W95.49820° .... FT, NC

N39.10751°, W95.32013° .... NC, LR

N39.13297°, W95.32832° .... FT, NC

N39.15668°, W95.32648 ....AC, NC, FT

N39.22989°, W95.29164° ....NC

N39.16607°, W95.27771° ....FT, LR

N39.17499°, W95.30885° .... NC, LR, DR

N39.10958°, W95.29287° ....NC

N39.08173°, W95.28242° .... FT, NC

N39.14427°, W95.29984° ....AC, NC, FT

N39.13631°, W95.24348° ....FT, LR

N39.05945°, W95.21439° ....AC, NC, FT

N39.04688°, W95.20988° .... NC, LR, DR

Johnson County

N39.03303°, W94.76581° .... FT, NC

N39.04512°, W94.74251° ....NC

N38.99038°, W94.79891° .... NC, LR, DR

N38.97701°, W94.80749° ....AC, NC, FT

N38.97335°, W94.81198° ....FT, LR

N38.96937°, W94.81014° .... NC, LR, DR

N38.94518°, W94.80013° ....AC, NC, FT

N38.96619°, W94.81444° ....AC, NC, FT

N38.99372°, W94.82506° ....NC

N38.95839°, W94.84876° ....FT, LR

N38.94248°, W94.88391° .... FT, NC

N39.00550°, W94.80258° ....AC, NC, FT

N38.89807°, W94.84897° .... NC, LR

N38.94295°, W94.88513° .... NC, LR

N38.92258°, W94.91742° .... FT, NC

N38.95473°, W94.91476° ....AC, NC, FT

N38.95505°, W94.92865° ....FT, LR

N38.95234°, W94.89903° ....AC, NC, FT

N38.92322°, W94.88145° ....NC

N38.91049°, W94.86245° .... FT, NC

N38.87802°, W94.86756° .... FT, NC

N38.87595°, W94.87696° .... NC, LR, DR

N38.88391°, W94.87655° .... NC, LR

N38.94894°, W94.88187° ....NC

N38.94459°, W94.82216° ....AC, NC, FT

N38.96078°, W94.79609° .... NC, LR

N38.96221°, W94.84271° .... FT, NC

N38.78365°, W94.67494° ....FT, LR

N38.80991°, W94.62872° ....AC, NC, FT

N38.80641°, W94.64012° ....AC, NC, FT

N38.79431°, W94.72218° .... FT, NC

N38.82662°, W94.66944° .... NC, LR, DR

N38.81357°, W94.63809° .... FT, NC

N38.81405°, W94.63320° ....NC

N38.83028°, W94.62974° .... FT, NC

N38.73638°, W94.67799° .... NC, LR, DR

N38.75373°, W94.86267° ....AC, NC, FT

Leavenworth County

N39.12072°, W95.15598° ....FT, LR

N39.07329°, W95.17504° ....AC, NC, FT

N39.10639°, W95.10783° ....NC

N39.10496°, W95.16992° .... NC, LR, DR

N39.04910°, W95.01191° .... FT, NC

N39.14348°, W95.02576° ....AC, NC, FT

N39.21700°, W95.07707° .... FT, NC

N39.36325°, W95.11494° ....AC, NC, FT

N39.29116°, W95.16116° ....FT, LR

N39.39429°, W95.00010° .... NC, LR, DR

N39.21429°, W94.84007° .... NC, LR

Linn County

N38.37720°, W94.64115° ....FT, LR

N38.33996°, W94.63569° .... NC, LR, DR

N38.23938°, W94.62031° .... NC, LR, DR

N38.24335°, W94.63791° .... FT, NC

N38.24654°, W94.65693° ....NC

N38.26866°, W94.72854° ....NC

N38.28457°, W94.75504° ....AC, NC, FT

N38.22728°, W94.85377° ....NC

N38.15630°, W94.80339° .... FT, NC

Miami County

N38.67161°, W94.89606° ....NC

N38.63580°, W94.88486° ....AC, NC, FT

N38.72142°, W94.95572° ....FT, LR

N38.68960°, W94.96773° .... NC, LR, DR

N38.51947°, W94.91000° .... FT, NC

N38.40998°, W94.79267° ....NC

N38.39884°, W94.79004° ....AC, NC, FT

N38.45247°, W94.79186° ....AC, NC, FT

N38.42542°, W94.78883° .... NC, LR, DR

N38.42176°, W94.78519° .... NC, LR

N38.43910°, W94.73987° ....FT, LR

N38.41030°, W94.85336° .... FT, NC

N38.39518°, W94.76010° .... FT, NC

N38.40425°, W94.64783° ....AC, NC, FT

Osage County

N38.67718°, W95.56242° .... FT, NC

N38.65522°, W95.59701° ....AC, NC, FT

N38.68816°, W95.61845° .... FT, NC

N38.67177°, W95.68521° ....FT, LR

N38.53475°, W95.80093° .... NC, LR, DR

N38.47459°, W95.86384° ....NC

Shawnee County

N39.19053°, W95.66028° ....NC, LR, DR, FT

N39.09144°, W95.60068° ....AC, NC, FT

N39.09175°, W95.60885° ....FT, LR

N38.89155°, W95.69380° .... FT

Wyandotte County

N39.15891°°, W94.81604 °...FT, LR

N39.16385°°, W94.77532° ....AC, NC, FT

N39.17101°°, W94.77003° .... NC, LR

N39.15939°, W94.78448° .... NC, LR, DR

N39.16878°, W94.78469° ....AC, NC, FT

N39.13106°, W94.79482° .... FT, NC

N39.07186°, W94.83957° .... FT, NC

N39.07488°, W94.85407° ....AC, NC, FT

N39.08045°, W94.85264° ....AC, NC, FT

N39.07396°, W94.86075° .... NC, LR

N39.06340°, W94.87147° ....NC

N39.08481°, W94.86457° .... NC, LR, DR

N39.11081°, W94.87109° ....FT, LR

N39.14395°, W94.88431° ....AC, NC, FT

N39.11642°, W94.88043° .... FT, NC

N39.15875°, W94.87451° ....AC, NC, FT

N39.16400°, W94.69511° ....AC, NC, FT

N39.16560°, W94.72147° ....FT, LR

N39.16496°, W94.74170° .... NC, LR, DR

N39.16687°, W94.75968° ....FT, LR

N39.15541°, W94.67325° .... NC, LR, DR

N39.16976°, W94.69151° .... FT, NC

N39.10172°, W94.66342° ....NC

N39.06470°, W94.73904° .... FT, NC

APPENDIX III

Records of *Storeria occipitomaculata* from Kansas

ANDERSON -- KU 3582. (38.2118° N, 95.2481° W), 4 mi S Garnett, 25 Jun 1927: *ATCHISON* -- KU 129470. (39.4468° N, 95.1272° W), 9 mi S Atchison, 27 April 1968; KU 179037. (39.5631° N, 95.1214° W), Atchison, 28 April 1978: *CHEROKEE* -- MHP 8839. (37.03025° N, 94.66735° W), 9 June 2004; UIMNH 33069, No locality; KU 155322. (37.0445° N, 94.6274° W), ca Galena, 16 March 1974; KU 192181. (37.0253° N, 94.6211° W), just S Shafer Farm, Sec 1, T35S, R25E, 20 March 1982; KU 192182. (37.1286° N, 94.6251° W), NE jct Turkey Creek & Spring River, Sec 36, T33S, R25E, 10 April 1982; KU 192183. (37.1286° N, 94.6251° W), NE jct Turkey Creek & Spring River, Sec 36, T33S, R25E, 4/10/1982; KU 192184. (37.0283° N, 94.6228° W), ca Shafer Farm, Sec 1, T35S, R25E, 22 May 1982; KU 221512. (37.0523° N, 94.6363° W), Schermerhorn Cave, just outside twilight zone, 23 March 1993; KU 222228. (37.1743° N, 95.0071° W), 0.1 mi W Hallowell, 4/30/1994; KU 23690. (37.0198° N, 94.62° W), 5.5 mi E Baxter Springs, 24 Apr 1948; KU 8503, ca Joplin, 1928; Per. Obs. (37.04384° N, 94.64169° W), Schermerhorn Park, 30 September 2005; Lit. rec. 37.02651° N, 94.61958° W), 19 March 1982; Lit. rec. (37.1321° N, 94.62058° W), 10 April 1982: CRAWFORD -- KU 224646. (37.6469° N, 94.8119° W), center of SW 1/4 Sec 32, T27S, R24E, 7 October 1997: *DOUGLAS* -- KU 146972. (38.8403° N, 95.3806° W), Lone Star Lake, 29 March 1972, Joseph T. Collins; KU 155397. (38.9431° N, 95.4381° W), ca 2 mi S, 1 mi E Stull, 9 July 1974, Al Kamb; KU 3581. (38.9001° N, 95.3371° W), 7.5 mi SW Lawrence, 27 May 1927; KU 56085. (38.790375° N, 95.166387° W), 1.5 mi NE Baldwin, 1 May 1960; KU 7661. (38.97167° N, 95.235° W), W of Lawrence, 1 April 1930; KU 88033. (38.803994° N, 95.18611° W), 2 mi N Baldwin, 6 November 1964; FMNH 11145, No locality, 24 April 1930: *FRANKLIN* -- UMMZ 66981, No locality, 3 May 1925; UMMZ 66982, No locality, 1 May 1927; MVZ 14886. (38.6138° N, 95.2675° W), Ottawa, 5/1/1927, Howard K. Gloyd (#62); MVZ 14886. (38.6087° N, 95.2685° W), Ottawa, 1927; KU 55176, No locality, 9 May 1926; KU 55177, No locality, 9 May 1926; KU 55178, No locality, 9 May 1926; FMNH 18135, No locality, 3 May 1925: *JEFFERSON* -- KU 139975, No locality, N of KU Natural History Reservation, 17 March 1971; KU 154041. (39.21528° N, 95.3125° W), W Oskaloosa on Ks Rt 92 at Stoney Crest Camp, 5/5/1973; KU 155396. (39.265103° N, 95.205621° W), 5.5 mi N McLouth, Scatter Creek, 21 Sep 1974; KU 179038. (39.20306° N, 95.40194° W), Camp Jayhawk, July 1978; KU 8431, No locality, Spring 1928; Lit. rec. (39.06223° N, 95.19127° W), 27 May 1978, From Fitch 1999; MHP 13905, (39.13575° N, 95.406056° W), 28 May 2008; ; MHP 13906, (39.213694° N, 95.420111° W), 28 May 2008; : *MIAMI* -- KU 28750. (38.4282° N, 94.8067° W), Murray Lake, 1950; CHAS 5277, No locality, 24 March 1928; MHP 13818, (38.40260° N, 94.76862° W), 6 October 2007; MHP 13819, (38.40358° N, 94.78233° W), 6 October 2007: *PHILLIPS* -- AMNH 3380, (39.9494° N, 99.5356° W), Long Island, 25 September 1884.

APPENDIX IV

Records of *Virginia valeriae* from Kansas.

ANDERSON -- Per. Obs. (38.18402° N, 95.25456° W), 16 May 2003; *ATCHISON* -- KU 189272. (39.5631° N, 95.1214° W), Atchison, April 1981: *DOUGLAS* -- KU 177018, (38.7951° N, 95.1743° W), 4 May 1965; KU 7550, (38.9996° N, 95.2563° W), 5 April 1930; KU 7663, (38.9924° N, 95.2987° W), 1 April 1930; FMNH 11141. (38.9717° N, 95.235° W), Lawrence, 24 April 1930; FMNH 11142. (38.9717° N, 95.235° W), Lawrence, 24 April 1930; CM 58729. (39.0283° N, 95.2419° W), Midland, 6/18/1972; AMNH 44932. (39.0361° N, 95.2464° W), 5 mi. N Lawrence, 13 May 1931; AMNH 44932. (39.0361° N, 95.2464° W), 5 mi. N Lawrence; Lit. rec. (39.03845° N, 95.19083° W), 18 April 1954, From Fitch 1999; Lit. rec. (39.03074° N, 95.19334° W), 5/27/1978, From Fitch 1999; Lit. rec. (39.03723° N, 95.19522° W), 24 May 1964: *FRANKLIN* -- KU 203989, (38.5323° N, 95.2227° W), 8 km S & 4 km E Ottawa, Sec 32, T17S, R20E, 21 Sep 1985; KU 203990. (38.5323° N, 95.2227° W), 8 km S & 4 km E Ottawa, Sec 32, T17S, R20E, 21 Sep 1985; KU 224648. (39.3273° N, 95.6458° W), Sec 29, T85, R16E, 8/23/1997: *JEFFERSON* -- MHP 12128. (39.0447° N, 95.20612° W), 9 June 2005; MHP 9663, (39.21287° N, 95.44212° W), NE4 Sec. 6, T10S, R18E, 10 September 2004; UIMNH 38949. (39.0886° N, 95.2591° W), 7 1/2 mi. N Lawrence; LACM 103510. (39.062774° N, 95.36984° W), 6 mi. N, 2 mi. W Williamstown, 28 April 1949; KU 140294. N of KU Natural History Reservation, 17 April 1971; KU 148529. (39.0862° N, 95.32624° W), 1.9 mi N jct US Rts 24 & 59 on 59, 9/12/1972; KU 155323. (39.07583° N, 95.39306° W), ca Perry Reservoir along Ks Rt 4, 20 April 1974; KU 155324. (39.07583° N, 95.39306° W), ca Perry Reservoir along Ks Rt 4, 4/20/1974; KU 155402. (39.265103° N, 95.205621° W), 5.5 mi N McLouth, Scatter Creek, -- Sep 1974; KU 177023. (39.26492° N, 95.206606° W), 8.8 km N McLouth at Scatter Creek, April 1968; KU 188983. (39.20277° N, 95.427225° W), 4.8 km SE Ozawkie, 4

August 1956; KU 192253. (39.285589° N, 95.45288° W), ca Perry Lake dam, 30 April 1982; KU 204790. (39.1655° N, 95.3938° W), Sec 22, T10S, R18E, 11 April 1986; KU 218779. (39.1509° N, 95.4868° W), Sec 26, T10S, R17E, 6 April 1991; KU 52263. (39.195812° N, 95.273526° W), 3.5 mi S, 3.5 mi W McLouth, 18 April 1955; MHP 13907, (39.213361° N, 95.41950° W), 28 May 2008; Pers. Obs. (39.04785° N, 95.20984° W), 28 March 2008; Pers. Obs. (39.04785° N, 95.20984° W), 25 March 2008; Pers. Obs. (39.04518° N, 95.21034° W), 25 March 2008; Pers. Obs. (39.04785° N, 95.20964° W), 10 November 2007; Pers. Obs. (39.04773° N, 95.20936° W), 10 November 2007; Pers. Obs. (39.04676° N, 95.21044° W), 8 November 2007; Pers. Obs. (39.04785° N, 95.20964° W), 8 November 2007; Pers. Obs. (39.04676° N, 95.21044° W), 28 October 2007; Pers. Obs. (39.04676° N, 95.21044° W), 18 October 2007; Pers. Obs. (39.04661° N, 95.21078° W), 1 October 2007; Pers. Obs. (39.04661° N, 95.21078° W), 29 September 2007; Pers. Obs. (39.04714° N, 95.21029° W), 14 June 2007; Pers. Obs. (39.04676° N, 95.21044° W), 22 May 2007; Pers. Obs. (39.04714° N, 95.21029° W), 8 May 2007; Pers. Obs. (39.04714° N, 95.21029° W), 5 May 2007; Pers. Obs. (39.04663° N, 95.21071° W), 3 May 2007; Pers. Obs. (39.04712° N, 95.21018° W), 29 April 2007; Pers. Obs. (39.04712° N, 95.21018° W), 28 April 2007; Pers. Obs. (39.04676° N, 95.21044° W), 28 April 2007; Pers. Obs. (39.04712° N, 95.21018° W), 24 April 2007; Pers. Obs. (39.04544° N, 95.21062° W), 24 April 2007; Pers. Obs. (39.04753° N, 95.2105° W), 19 April 2007; Pers. Obs. (39.04753° N, 95.2105° W), 17 April 2007; Pers. Obs. (39.04715° N, 95.2101° W), 3 April 2007; Pers. Obs. (39.04558° N, 95.21058° W), 3 April 2007; Pers. Obs. (39.04612° N, 95.21041° W), 3 April 2007; Pers. Obs. (39.04761° N, 95.20994° W), 3 April 2007; Pers. Obs. (39.04753° N, 95.2105° W), 2 April 2007; Pers. Obs. (39.04773° N, 95.20936° W), 2 April 2007; Pers. Obs. (39.04714° N, 95.21029° W), 1 April 2007; Pers. Obs. (39.04753° N, 95.2105° W), 1 April 2007; Pers. Obs. (39.04612° N, 95.21041° W), 1 April 2007;

Pers. Obs. (39.04773° N, 95.20936° W), 29 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 29 March 2007; Pers. Obs. (39.04558° N, 95.21058° W), 29 March 2007; Pers. Obs. (39.0473° N, 95.20907° W), 29 March 2007; Pers. Obs. (39.04558° N, 95.21058° W), 29 March 2007; Pers. Obs. (39.0473° N, 95.20907° W), 27 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 27 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 27 March 2007; Pers. Obs. (39.04509° N, 95.21075° W), 26 March 2007; Pers. Obs. (39.04676° N, 95.21044° W), 26 March 2007; Pers. Obs. (39.0473° N, 95.20907° W), 26 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 25 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 25 March 2007; Pers. Obs. (39.0473° N, 95.20907° W), 25 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 24 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 24 March 2007; Pers. Obs. (39.04676° N, 95.21044° W), 23 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 23 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 23 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 22 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 22 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 21 March 2007; Pers. Obs. (39.04676° N, 95.21044° W), 21 March 2007; Pers. Obs. (39.04714° N, 95.21029° W), 21 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 19 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 19 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 19 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 18 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 17 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 17 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 16 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 16 March 2007; Pers. Obs. (39.04712° N, 95.21041° W), 16 March 2007; Pers. Obs. (39.04552° N, 95.21016° W), 16 March 2007; Pers. Obs. (39.04753° N, 95.2105° W), 14 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 14 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 13 March 2007; Pers. Obs. (39.04661° N, 95.21078° W), 11 March

2007; Pers. Obs. (39.04661° N, 95.21078° W), 10 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 10 March 2007; Pers. Obs. (39.04773° N, 95.20936° W), 28 November 2006; Pers. Obs. (39.04718° N, 95.20967° W), 30 September 2006; : *JOHNSON* -- MHP 13222. (38.948° N, 94.80074° W), 5/2/2006; UIMNH 32948. (39.0165° N, 94.7882° W), 3 mi. W Shawnee; KU 291131. (39.02861023° N, 94.88083649° W), Sec 12, T12S, R24E, 15 May 2001; KU 291181. (39.02856° N, 94.880674° W), Sec. 12, T12S, R24E; FMNH 98565. (39.0165° N, 94.7882° W), 3 mi. W of Shawnee: *LEAVENWORTH* -- KU 220719. (39.1993° N, 95.0674° W), NW1/4 Sec 10, T10S, R21E, 10 May 1992; KU 7344. (39.2307° N, 95.1771° W), 20 mi N Lawrence, 23 April 1930; KU 7345. (39.2307° N, 95.1771° W), 20 mi N Lawrence, 23 April 1930: *LINN* -- MHP 8079. (38.2345° N, 94.6305° W), SEC11, T21S, R25E, 26 April 1998; KU 192254. (38.3546° N, 94.6667° W), Linn County Park ca LaCygne Lake, T19S, R25E, 08 May 1982; KU 192255. (38.3546° N, 94.6667° W), Linn County Park near La Cygne Lake, T19S, R25E, 08 May 1982; KU 222266. (38.2842° N, 94.7486° W), Marais des Cygnes Wildlife Management Area, NW 1/4 Sec 27, T20S, R24E, 17 April 1994; KU 288639. (38.2393° N, 94.6225° W), Sec 11, T21S, R25E, 26 March 1998: *MIAMI* -- KU 223467. (38.4285° N, 94.787° W), Miami County State Fishing Lake, E edge Secs 5&6, T19S, R24E, 4/28/1996; Per. Obs. (38.49409° N, 94.67883° W), 3/31/2006: *SHAWNEE* -- KU 192256. (39.1097° N, 95.6044° W), Sec 9, T11S, R16E, 09 May 1982; KU 220720. (39.1097° N, 95.6044° W), Sec 11, T11S, R16E, 14 October 1992: *WYANDOTTE* -- KU 188984. (39.0907° N, 94.8462° W), 4.8 km NE Bonner Springs, May 1956; KU 188985. (39.0771° N, 94.8533° W), Camp Naish, 10 August 1959; KU 207060. (39.1018° N, 94.8531° W), E edge Bonner Springs, 0.8 km S Kansas turnpike on 118 Street, 24 June 1987; KU 289722. (39.1078° N, 94.8185° W), W4, Sec.12, T11S, R23E; within Kansas City city limits on NW corner at jct. of I-70 & I-435 (N facing outcrop on SW side of Turkey Creek), 28 March 2000; KU 289722. (39.1094° N, 94.8069° W), 15 May 2000;

APPENDIX V

Literature from which habitat data was collected from other states within the range of *S. occipitomaculata* and *V. valeriae*.

Alabama
Reference(s): Mount, 1980.

Arkansas
Reference(s): Trauth et al. 2004.

Connecticut
Reference(s): DeGraaf et al. 1983, Hulse et al. 2001

Delaware
Reference(s): White and White 2002.

Florida
Reference(s): Ashton and Ashton, 1988

Georgia
Reference(s): Jensen et al. 2008.

Illinois
Reference(s): Pope 1944; Smith 1961; Phillips et al. 1999

Indiana
Reference(s): Minton 2001

Iowa
Reference(s): Christiansen and Bailey 1990

Kansas
Reference(s): Cragin 1880; Gloyd 1928; Tihen 1937; Smith, 1950; Brumwell 1951;Smith 1956; Fitch 1963; Collins, 1982; Fitzgerald and Nilon 1993; Collins and Collins 1993; Fitzgerald and Nilon 1994; Irwin and Collins 1994; Ahrens Fitch 1993, Fitch 1999; 1997; Taggart et al. 2008

Kentucky
Reference(s): Collins 1962; Barbour 1971

Louisiana
Reference(s): Dundee and Rossman 1989; Boundy 1997.

Maine
Reference(s): DeGraaf et al. 1983; Hunter et al. 1992; Hulse et al. 2001

Maryland
Reference(s): White and White 2002

Massachusetts
Reference(s): Hulse et al. 2001

Michigan
Reference(s): Holman et al. 1999.

Minnesota
Reference(s): Oldfield and Moriarty 1994

Missouri
Reference(s): Greene and Wakeman 1962; Anderson 1965; Johnson 2000;

Nebraska
Reference(s): Hudson 1942; Lynch, J. D. 1985

New Hampshire
Reference(s): DeGraaf et al. 1983; Hulse et al. 2001

New Jersey
Reference(s): Hulse et al. 2001

New York
Reference(s): Hulse et al. 2001; Gibbs et al. 2007

North Carolina
Reference(s): Martof et al. 1980; Palmer and Braswell 1995; Willson and Dorcas 2004

Ohio
Reference(s): Conant 1938; Conant 1951.

Oklahoma
Reference(s): Webb 1970; Black and Sievert. 1989; Sievert, and Sievert 1993; Sievertand Sievert 2005

Pennsylvania
Reference(s): Hulse et al. 2001.

Rhode Island
Reference(s): DeGraaf et al. 1983; Hulse et al. 2001

South Carolina
Reference(s): Martof et al. 1980.

South Dakota
Reference(s): Over 1946; Ballinger et al. 2000; Collins et al. 2005

Texas
Reference(s): Ford et al. 1991; Werler and Dixon 2000; Dixon 2000

Vermont
Reference(s): DeGraaf et al. 1983, Hulse et al. 2001

Virginia

Reference(s): Martof et al. 1980; Mitchell 1994; White and White. 2002; Linzey and Clifford 2002

West Virginia
Reference(s): Green and Pauley 1987.

Wisconsin
Reference(s): Casper 1996; Christoffel et al. 2000

Wyoming
Reference(s): Baxter and Stone 1985