

ISSN 1540-773X

Collinsorum

THE NEWSLETTER/JOURNAL OF THE KANSAS HERPETOLOGICAL SOCIETY

Volume 6, Number 2-3

September 2017



1974-2017



Published by the Kansas Herpetological Society
<http://www.cnah.org/khs>

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Front Cover: Ring-necked Snake
(*Diadophis punctatus*) by Tiffany A. Jehle

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KHS Annual Meeting & Presentation Registration

Available On-line
cnah.org/khs

Registrations being accepted now!

You can now pay your 2017 dues On-line...

Visit the KHS Website
cnah.org/khs

...now, and never miss out!

KHS BUSINESS

KHS Annual Meeting Call for Papers, Posters, and Auction Items

The **44TH ANNUAL MEETING OF THE KANSAS HERPETOLOGICAL SOCIETY** will be held 3-5 November 2017 at Friends University, 2100 University Avenue, Wichita, KS 67213. Scientific paper sessions and general meeting activities will be held at Friends University while the annual KHS Auction and associated festivities will be held at the Sedgwick County Zoo, 5555 Zoo Blvd, Wichita, KS 67212. Effective immediately, the Society is accepting titles for talks to be presented at the meeting.

Looking for an alternative to costly national herpetological meetings held in large cities with way too many herpetological registrants (and where you only have a cash bar)? Try the KHS. Regional meetings are the future and great venues for graduate students. The KHS annual meeting provides an opportunity for herpetologists and other like-minded individuals interested in amphibians and reptiles to come together for scientific lectures and friendly intellectual discussion. There is ample opportunity for socializing in a collegial and supportive atmosphere. Meeting registration is only \$15.00.

This year's keynote speaker is **Dr. Ann Stengle**. Dr. Stengle has been studying endangered snake species in Massachusetts since 2007 (Eastern Ratsnakes and Copperheads) and Timber Rattlesnakes across the state since 2009. Her Bachelor's degree and PhD are from University of Massachusetts, Amherst in Organismic and Evolutionary Biology. She also have an associates in veterinary technology from Holyoke Community College. Dr. Stengle's recent work has focused on radiotelemetry of the largest timber population in MA, looking at effects of Snake Fungal Disease on movement patterns and habitat selection, in addition to population genetics of the entire New England region. Currently she is the New England Rattlesnake Geneticist, employed by the Orianna Society, and the Coordinator for the USFW SWG grant "Conserving SGCN snakes threatened by an emerging fungal skin disease." Dr. Stengle also teaches Chemistry at Holyoke Community College.

Herpetologists at all levels of expertise are encouraged and urged to give scientific paper presentations. An award and stipend of \$200 (The George Toland Award for Ecological Research on North American Herpetofauna) will be presented for an outstanding student presentation at the

end of the meeting, so students are strongly encouraged to participate. The \$100 Meshaka Award for best poster will also be awarded. Additionally, the Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology, a \$1,000 prize. Being an odd numbered year, the Collins Award will be awarded for the best photograph portraying or be based on those species native to Kansas. The KHS is looking for striking images of Kansas herpetofauna that depict interesting behavior or include portraits of species in a natural habitat or setting.

The annual fund-raising **AUCTION** held at the Sedgwick County Zoo on Saturday evening. KHS will provide FREE BEER, SOFT DRINKS, and SNACKS. Please bring herpetological items for the auction. Hold them and bring them to the auction site Saturday evening. We count on you to bring items about amphibians, or reptiles and other stuff oriented to herpetology. PLEASE DO NOT BRING LIVING OR DEAD ANIMALS. No specimens or body parts of herpetofauna will be sold at auction.

For more information (including lodging options), or to register as an attendee or presenter, please visit the KHS website.

Hotel:

Best Western Plus West Wichita Airport.
3800 Kellogg Dr, Wichita, KS 67213
(316) 945-4100

A block of rooms containing both single king and double queen layouts has been reserved at a group rate of \$89.99 per night. Register before October 20 to get the discount.

**Don't miss an issue!
Pay your 2017 dues On-line...**

cnah.org/khs

... or by mail to the KHS Secretary

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The KHS Fall Field Trip to be held at Kanopolis State Park

The Rockwell Area at scenic Kanopolis State Park will serve as the base campground for the KHS Fall 2017 Field Trip. Field trip activities will take place from Friday evening 29 September through Sunday morning 1 October.

Our goal will be to better determine the status of the Western Diamond-backed Rattlesnake in the canyons northeast of the Reservoir. Western Diamond-backed Rattlesnakes have been documented irregularly since the mid-1990s, with 5 occurrences documented last year and another this Spring by members of a University of Kansas Biodiversity Institute field trip.

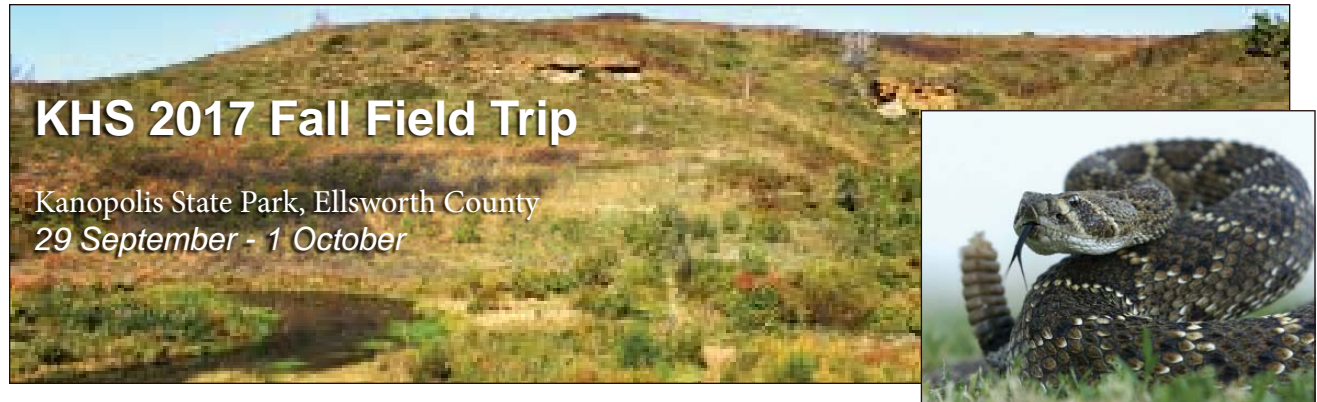
Participants will also visit additional areas near the Reservoir that have not been herpetologi-

cally explored yet.

Signs will be posted near the campsite on Friday afternoon. A vehicle permit is required to enter Kanopolis State Park and a camping permit to camp. Cabins are available for rent. More information can be found at: <http://ksoutdoors.com/State-Parks/Locations/Kanopolis>

The group will meet at the campsite at 9am on Sunday to receive direction and head out for the first group excursion. If you wish to take part, please bring gloves, sunscreen, and sturdy shoes.

Please direct any questions to KHS Field Trip Chairman (contact info, inside the front cover).



Plan now to attend the **KHS 44th Annual Meeting**

4-5 November 2017
Wichita, Kansas



Paper sessions/Keynote - Friends University



Auction - Sedgwick County Zoo

Proposed Amendments to the KHS By-laws

ARTICLE I. Membership

Section 1. Membership shall be open to all persons who shall make formal application to the Secretary and pay the prescribed dues.

ARTICLE II. Officers of the Society

Section 1. The Officers of the Society shall be of two kinds, elective and appointive.

(a) The elective officers shall be President, President-elect, Secretary, Treasurer, and the Immediate Past-president.

(b) The appointed officers shall be the **Editor Publications Director** and the Historian.

Section 2. No one individual may hold two or more ~~elective~~ **executive** offices concurrently.

Section 3. The terms of office for all officers of the Society shall be for one year.

Section 4. The duties of the elective officers shall be as follows:

(a) The President shall preside at meetings of the Society and its officers, shall be nominal head of the Society, shall rule on questions of procedure that may arise, and shall appoint standing and ad hoc committees as needed. **The President is tasked with planning and organizing the Annual Meeting in the year of their Presidency.**

(b) The President-elect shall fulfill the duties of the President when the latter is absent, and shall succeed the President at the termination of the latter's term. The President-elect shall also assume the presidency should that office become vacant during a term.

(c) The Secretary shall maintain the records of the Society and officers, including all moneys received, collect the annual dues and deposit fund into the society's designated account(s), maintain the membership roster, ~~provide mailing labels to the Editor of the Society,~~ and notify the membership of pertinent business. **The Secretary shall provide minutes of each meeting to the Publications Director for the forthcoming issue of Collinsorum.**

(d) The Treasurer shall keep financial records and accounts of the Society, be responsible for all moneys disbursed, and prepare and submit all financial reports required by the business of the Society. The Treasurer shall make a financial report to the membership at the general meetings, this report is to be published in the **first March** issue of the ~~Journal of Kansas Herpetology~~ **Collinsorum** ~~is during the year following the general meeting.~~

(e) The Immediate Past-president shall serve

as a member of the executive committee of the society.

Section 5.

(a) The duties of the **Editor Publications Director** of the Society shall be as follows: The **Editor Publications Director** shall be responsible for all phases of Society publications. The **Editor Publications Director** may appoint staff members for assistance as needed. Inasmuch as ~~the Journal of Kansas Herpetology~~ **Collinsorum** is the principal mechanism for written communication to the membership, the **Editor Publications Director** is obligated to publish all communications of the Society and its officers on a first priority basis and to include, as space permits, other items consonant with the stated objectives of the Society. The **Editor Publications Director** shall report annually to the officers of the Society. **Collinsorum will be published in March, June, September, and December of each year.**

(b) The Historian of the Society shall compile all Society publications and other pertinent records and make provisions for permanent archival storage of those records. The Historian shall report annually to the officers of the Society.

(c) The duties of the Field Trip Chairperson are to plan and organize the Society's field trips.

ARTICLE III. The Executive Council of the Society

Section 1. The Executive Council of the Society shall consist of the President, President-elect, Secretary, Treasurer, immediate Past-president, **Editor Publications Director**, and Historian.

Section 2. The Executive Council shall be empowered to manage the affairs of the society and to designate all appointive officers for terms of one year.

Section 3. The Executive Council shall fill any vacancy occurring among officers, except that of President, by an appointment for the unexpired term.

Section 4. The Executive Council shall be responsible for all publications of the Society and shall set such policy as is needed to coordinate the contents of the various media so as to further the stated objectives of the Society and to insure the availability and distribution of Society materials.

ARTICLE IV. Election of Officers

Section 1. The President shall appoint three members of the Society to serve as a nominat-

ing committee, to include not more than one member of the current Executive Council.

Section 2. The Nominating Committee shall present a slate of at least one candidate for each office to be filled. The slate must be presented at the general meeting, at which time nominations may be made by the membership.

Section 3. The Nominating Committee, or a member of the Society proposing a nominee, shall obtain the assent of the candidate to serve if elected.

Section 4. The slate of nominations shall be circulated to the entire membership by the Secretary via **Collinsorum** not later than one month before the general meeting.

Section 5. Voting shall take place at the general meeting of the Society and shall be conducted by secret ballot. The Secretary shall receive and count the votes. The results of the election shall be communicated to the membership via ~~the Journal of Kansas Herpetology~~ **Collinsorum**.

Section 6. The Secretary shall inform the elected candidates of their election. Newly elected persons will take office at the beginning of the next calendar year following the date of the general meeting election.

ARTICLE V. Meetings

Section 1. The Society shall hold a general meeting annually at a time and place set by the Executive Council of the Society. Not more than 18 months shall elapse between meetings.

Section 2. The membership shall be informed in writing of the time and place of the general meeting not later than two months prior to the opening of the meeting.

Section 3. The membership assembled at the general meeting shall elect the Society officers for the coming year.

Section 4. Special meetings may be called by vote of the majority of the Executive Council, or on a petition of a quorum of the membership. The time and place of such special meetings must be announced to the membership at least two weeks prior to the meeting.

Section 5. One-tenth of the membership will constitute a quorum to petition for a special meeting.

Section 6. All meetings shall be conducted under Robert's Rules of Order.

ARTICLE VI. Meetings of the Executive Council of the Society

Section 1. The Executive Council of the Society shall meet at least once a year on the occasion of the general meeting of the Society. The Executive Council will also meet at least

once no later than ~~one month~~ **March 1 to set the agenda for the year. The agenda for the year, as set by the Executive Council, will be published in the March edition of Collinsorum.**

Section 2. Any meeting of the Executive Council shall be open to attendance by interested members of the Society as observers, unless the Executive Council moves for executive session.

Section 3. A simple majority of the Executive Council shall constitute a quorum.

Section 4. A majority of those present and voting shall be necessary to pass any motion.

Section 5. The meeting shall be conducted according to Robert's Rules of Order.

Section 6. Special meetings of the Executive Council may be called by the President, or by a majority of same.

ARTICLE VII. Dues

Section 1. The Executive Council shall be authorized to establish such dues as are compatible with the financial status of the Society.

Section 2. A member in arrears for payment of dues for a period of three months after conclusion of the current membership year shall be dropped from the role after due notice from the Secretary.

ARTICLE VIII. Fiscal Year

Section 1. The fiscal year of the Society shall embrace the period of 1 January through 31 December of the same year.

ARTICLE IX. Amendment of the Bylaws

Section 1. Amendments may be proposed to the Executive Council by petition to the Secretary by ten or more members of the Society.

Section 2. Proposed amendments must be submitted in writing to the Secretary at least three months before the general meeting at which they are to be discussed.

Section 3. Such amendments shall be submitted in writing by the Secretary to the general membership at least two months prior to the general meeting at which time they are to be discussed.

Section 4. To be approved, an amendment must receive a positive vote by two-thirds of those voting at the general meeting.

Section 5. Any adopted amendment shall become an integral part of the Bylaws. The Secretary shall add them to copies of the Bylaws and distribute the amended Bylaws to the members of the Executive Council of the Society and to any interested members.

Dexter Mardis,
KHS President

Results of the 2017 KHS Spring Field Trip to Elk County, Kansas

The 154 registered participants that braved the damp and cool weather to take part in the KHS 2017 Spring Field Trip held in Elk County over the weekend of 21-23 April, were rewarded with spectacular scenery, new friendships, and a lot of herps.

The participants visited four local ranches and tallied 1,526 individual frogs, salamanders, lizards, turtles, and snakes representing 37 species. The sites visited were the Palmer Ranch (PR), Youngmeyer Ranch (YR), Roby Ranch (RR), and Ferrell Ranch (FR). The habitat varied little among the sites but diversity did (Table 1). The entire area is characterized by Flint Hills hillsides banded with limestone rocks of various thicknesses. Each site was dissected by one or more wooded streams.

Significant counts were recorded for Flat-headed Snakes (436 individuals), Great Plains Skinks (305 individuals), Speckled Kingsnakes (46 individuals), Western Milksnakes (46 individuals), and Eastern Collared Lizards (178 individuals) during the combined group outings.

Saturday morning the group met at the campsite (field north of the Beaumont Hotel) just before 9am. Following a few instructions and the group photo, they caravanned south to the first two sites. The group split up between the Palmer Ranch (north) and the adjacent Youngmeyer Ranch (south). The Palmer Ranch yielded a higher diversity (27 species to 24 on YR) while the Youngmeyer Ranch produced more individuals (401 to 301 on PR).

The group met back on the road between the ranches at noon and compared their counts. The only Small-mouthed Salamander observed during the field trip was found under a small rock near a pond on the PR and the only Snapping Turtle was also observed nearby. Other notable finds on PR were 102 Flat-headed Snakes, 6 Plain-bellied Watersnakes, and 13 Speckled Kingsnakes. Significant counts for YM that morning were 125 Flat-headed Snakes, 125 Great Plains Skinks, 16 Ornate Box Turtles, and 19 North American Racers.

The group reassembled at 1:20 pm Saturday and again headed southeast, this time to the Roby Ranch. The significant feature of RR was a large central watershed lake and an extensive wooded stream below and above it. The group remained on site until 5:00 pm and recorded 369 individuals of 25 species.

Sunday morning, those that remained, gath-

ered at the campsite, and soon headed off to the Ferrell Ranch. By the time they reached the ranch headquarters, the sky was clearing and the temperature was rising. The group uncovered 455 individuals of 34 species between 9:30 AM and noon. The FR tally included the only specimens of the Gray Treefrog complex, American Bullfrog, Texas Horned Lizard, Six-lined Racerunner, and Coachwhip observed over the weekend.

The KHS wishes to thank the ranch managers/land owners of each ranch for allowing us to hike around peering under rocks. Luke Westerman and Dexter Mardis were especially helpful in getting us access to YM and FR respectively.

PARTICIPANTS THAT SIGNED IN: Jordyn Alford, Carl Junction, MO; Liz Ang, Overland Park, KS; Mary Kate Baldwin, Topeka, KS; Jacob Basler, St. Mary, KS; Rachel Bechtold, Pittsburg, KS; Don Becker, Cedar Rapids, IA; Ashmika Behere, Overland Park, KS; John Bellah, Chicago, IL; Mira Bhagat, Overland Park, KS; Mariah Bickle, Overland Park, KS; Mary Blackwell, Olathe, KS; Steve Blackwell, Olathe, KS; Anthony Bostwick, Des Moines, IA; Steven Bostwick, Des Moines, IA; Nichole Brown, Wichita, KS; Ken Brunson, Pratt, KS; LeeAnn Brunson, Pratt, KS; Nick Burgmeier, Corydon, IN; Andy Burr, Salina, KS; Caitlin Burr, Salina, KS; Calley Burr, Salina, KS; Cody Burr, Salina, KS; Mike Caron, Freedom, ME; Dan Carpenter, Derby, KS; Shelbi Carpenter, Wichita, KS; Tony Chananikorn, Kansas City, KS; Cameron Cobb, Overland Park, KS; Suzanne Collins, Lawrence, KS; Megan Corrigan, Pittsburg, KS; Hebersain Crautro, Kansas City, KS; Savannah Crisp, Overland Park, KS; Mia Davis, Salina, KS; Nate Davis, Salina, KS; Noah Davis, Salina, KS; Nicholas Edge, Shawnee, KS; Emmy Engasser, Wichita, KS; Kyle Engasser, Wichita, KS; Cody Farra, Dodge City, KS; Colton Farra, Dodge City, KS; Jon Farra, Dodge City, KS; Marisa Farra, Dodge City, KS; Pete Ferrell, Beaumont, KS; Dan Fogell, Omaha, NE; Lou Forster, Wichita, KS; Andy George, Pittsburg, KS; Fabio Giacomelli, Pittsburg, KS; Jill Hagler, Carbondale, IL; Oliver Halon, Emporia, KS; Jefferey Haug, Overland Park, KS; Mayah Haug, Overland Park, KS; Hallie Heed, Overland Park, KS; Travis Heging, Wichita, KS; Brandon Hein, Wichita, KS; Allie Hicks, McPherson, KS; Jamie Hicks, McPherson, KS; Ryan Hicks, McPherson,

Specimens observed during the KHS Spring Field Trip held 21-23 April 2017 on four ranches in Elk County, Kansas

	SatAM Palmer	SatAM Youngmeyer	SatPM Roby	SunAM Ferrell	Species Total
FROGS					
American Toad	3	2	1	16	22
Blanchard's Cricket Frog	4	4	19	41	68
Gray Treefrog complex				1	1
Boreal Chorus Frog			20	15	35
Western Narrow-mouthed Toad	4	6	8	9	27
Plains Leopard Frog	2		2	2	6
American Bullfrog				2	2
SALAMANDERS					
Small-mouthed Salamander	1				1
TURTLES					
Snapping Turtle	2				2
Painted Turtle	1	1		3	5
Ornate Box Turtle	6	16	25	13	60
Three-toed Box Turtle				1	1
Pond Slider				1	1
LIZARDS					
Slender Glass Lizard	5	5	9	4	23
Eastern Collared Lizard	47	53	29	49	178
Texas Horned Lizard				2	2
Great Plains Skink	62	125	66	52	305
Little Brown Skink	2		7	1	10
Six-lined Racerunner				2	2
SNAKES					
North American Racer	6	19	17	13	55
Coachwhip				4	4
Rough Greensnake	1	2	3		6
Prairie Kingsnake	2	1	4	6	13
Western Milksnake	6	5	16	19	46
Speckled Kingsnake	13	8	10	15	46
Great Plains Ratsnake	4	5	5	11	25
Western Ratsnake	1	1	1	3	6
Gophersnake	2	1	1	2	6
Western Massasauga		2	1	1	4
Ring-necked Snake	3	6	22	27	58
Flat-headed Snake	102	125	92	117	436
Plain-bellied Watersnake	6	2		5	13
Common Watersnake	1	5		2	8
Dekay's Brownsnake			1	2	3
Western Ribbonsnake	6	5	3	6	20
Common Gartersnake	2	1	2	1	6
Lined Snake	7	1	5	7	20
Total individuals	301	401	369	455	1526
# Species	27	24	25	34	37

KS; Hannah Hoetmer, Wichita, KS; Niall Horton, Augusta, KS; Joe Htun, Kansas City, KS; Allison Hullinger, Conway Springs, KS; Adaira Hutto, Winfield, KS; Joe Hutto, Winfield, KS; Katelin Hutto, Winfield, KS; Paxon Hutto, Winfield, KS; Sylvie Hutto, Winfield, KS; Amelia Jaeger, Hays, KS; Tiffany Jehle, Wichita, KS; Dan Johnson, Kansas City, MO; Hunter Johnson, Longmont, CO; Melissa Johnson, Longmont, CO; Nancy Johnson, Kansas City, MO; Casey Kelly, Lawrence, KS; Dan Keyler, Minneapolis, MN; Jenny Keyler, Minneapolis, MN; Michael Kill, Burden, KS; Brayden Kilmer, Wichita, KS; Brian Kilmer, Wichita, KS; Joey Kippenberger, Wichita, KS; Kelly Kluthe, Lawrence, KS; Jessica Kriszciokaitis, Wichita, KS; Jesus Lopex, Kansas City, KS; Mariah Lopez, Wichita, KS; Dexter Mardis, Wichita, KS; Elijah McCoy, Valley Center, KS; Sean McMullen, Morrison, CO; Tameren McMullen, Emporia, KS; Katie McMurry, Pittsburg, KS; Michelle Melekian, Omaha, NE; Tyler Melekian, Omaha, NE; Justin Michels, Pekin, IL; Larry L. Miller, Wakarusa, KS; Steve Mossberg, Wichita, KS; Baxter Moulden, Slater, IA; Ethan Moulden, Slater, IA; Max Moulden, Slater, IA; Mia Moulden, Slater, IA; Nate Nelson, Wichita, KS; Herman Nonnenmacher, Pittsburg, KS; Arin O'Conner, Emporia, KS; David Oldham, Oswego, KS; Robin Oldham, Oswego, KS; Chriss Ollig, Overland Park, KS; Jonathan Orozoco, Kansas City, KS; Kurt Parker, Mission, KS; Jaclyn Perry, Overland Park, KS; Mike Pingleton, Champaign, IL;

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TRAVIS W. TAGGART, 3000 Sternberg Drive, Hays, Kansas 67601



Group photo courtesy Larry L. Miller.

KHS HERP COUNTS

Herp Count: Northeast Barton County

On 9 April 2017 we conducted herpetological field work in northeastern Barton County, Kansas (38.694432°, -98.535791°; WGS84). From 1:30 to 2:00 pm we looked under rocks and other cover on adjacent rocky hillsides. The temperature was 83°F and the sky was mostly cloudy. We had hoped to discover a Western Ratsnake; known from the area by a single specimen collected just south of Wilson (Russell County) in 2003. Anecdotal reports of Western Groundsnakes in the area were not confirmed. Participants were Sarah, Jess, Meg, and Travis Taggart and Trace Jacobs. Verifier was Travis W. Taggart.

The following species were observed:

- Western Narrow-mouthed Toad 1
- Western Milksnakes 6
- Eastern Collared Lizard 18
- Ring-necked Snake..... 67
- Great Plains Skink 7
- Boreal Chorus Frog..... 100+
- Lined Snake 14
- Totals 7 species 213 specimens

TRAVIS W. TAGGART, 3000 Sternberg Drive, Hays, Kansas 67601

Herp Count: Southeast Ellis County

We conducted herpetological field work in southeastern Ellis County, Kansas (38.719776°, -99.225282°; WGS84) on 23 April 2017. From 1:30 to 3:30 pm we looked under rocks and other cover on adjacent rocky hillsides. The temperature hovered right around 70 degrees F. Participants were Curtis Schmidt, Avery Schmidt, and Kali Boroughs. Verifier was Curtis Schmidt.

The following species were observed:

- Western Narrow-mouthed Toad 14
- Eastern Collared Lizard 4
- Texas Horned Lizard 1
- Great Plains Skink 1
- Six-lined Racerunner 2
- Ring-necked Snake..... +/- 100
- Lined Snake 1
- Western Milksnake 4
- Speckled Kingsnake..... 5

Totals 9 species 132 specimens

CURTIS J. SCHMIDT, 3000 Sternberg Drive, Hays, Kansas 67601

Herp Count: Clark County State Lake

On 21 May 2017 we conducted herpetological field work below the dam at Clark County State Fishing Lake, Kansas (37.378116°, -99.776932°; WGS84). From 10:30am to noon we looked under rocks on adjacent rocky hillsides. The temperature was 84°F and the sky was mostly sunny. Participants were Jess and Travis Taggart and Beau Brogden. Verifier was Travis W. Taggart.

The following species were observed:

- Red-spotted Toad 1
- Prairie Lizard 15
- Ring-necked Snake..... 12
- Western Groundsnake..... 6
- North American Racer 2
- Coachwhip 1
- Chihuahuan Night Snake 3
- Speckled Kingsnake..... 5
- Western Milksnake 1
- Lined Snake 3
- Prairie Rattlesnake 1
- Totals 7 species 213 specimens

TRAVIS W. TAGGART, 3000 Sternberg Drive, Hays, Kansas 67601



Jess Taggart (L) and Beau Brogden (R) show off a Coachwhip they turned up under a large rock at Clark State Fishing Lake. Photo by Travis W. Taggart.

Observations of the Population Ecology of Three-Toed Box Turtles in Small, Urban Forest Fragments

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ABSTRACT

While there is ever-increasing research on the effects of urbanization of Eastern Box Turtles (*Terrapene carolina carolina*), little information is present on the ecology of the more westerly occurring Three-toed Box Turtle (*T. c. triunguis*) living within city boundaries. As part of an 18-month undergraduate-led project, we studied the population structure and home range size of Three-toed Box Turtles at two woodland fragments in Jefferson City, Missouri. Using both mark-recapture techniques and radio telemetry we determined that both density and home range for each fragment was possibly constrained by fragment size. Female turtles had lower survivorship than males, and older age classes were male biased. All turtles used residential properties frequently, as the properties may subsidize food and water requirements for the turtles.

INTRODUCTION

Urbanization is responsible for habitat loss and population declines in many species due to fragmentation and conversion of natural lands to residential or industrial land uses (Berry, 1990; Mitchell and Brown, 2008). While urbanization has been implicated in declines, limited research on turtles in developed landscapes had been conducted (Budischak et al., 2006). An increasing focus on urban populations of the Eastern Box Turtle *Terrapene carolina carolina* is allowing researchers to establish some generalities concerning the ecology of the species in developed landscapes. Survival is similar to values reported for wild populations (Brisbin et al., 2008) and density is dependent upon habitat fragment size (Ferebee and Henry, 2008; Nazdrowicz et al., 2008; West and Lukowski, 2016). There is a trend towards male biased sex ratios in some populations (Nazdrowicz et al., 2008; West and Lukowski, 2016). Males have been reported to move more than females (Iglay et al., 2007). Seasonally though, females may be more active as they attempt to find suitable nesting sites. Kipp (2007) reported that females made long distance movements to find suitable nesting sites and Brisban et al. (2008) stated that females were more commonly observed crossing streets

than males. Lack of suitable nesting sites may be a limiting factor in urban environments, with females experiencing an increased risk in mortality (Kipp, 2007; Brisban et al., 2008).

While an ever-increasing amount of work has focused on urban populations of the Eastern Box Turtle, little research has focused on the more westerly occurring sub-species, the Three-toed Box Turtle *T. c. triunguis*, in either wild or urban settings. As part of a hands-on learning experience, undergraduate students at Lincoln University in Jefferson City, MO, USA sought to study the demography and movement patterns of Three-toed Box Turtles in a highly fragmented urban environment.

METHODS

Lincoln University (LU), Jefferson City, Missouri is bordered to the south and west by wooded residential neighborhoods. Our study sites consisted of two woodland fragments owned by LU and were located within this residential/ woodland matrix (Figure 1). The smallest site (Dickinson) occupies 7.4 ha of a 10.2 ha plot. Vegetation within the Dickinson site is predominately hardwoods, with large patches of invasive Bush Honeysuckle (*Lonicera* sp.). Roughly half the site consists of a greenhouse, small field,

Table 1. Sex ratios of Three-toed Box Turtles on woodland habitat fragments in Jefferson City, MO.

	Males:Females	χ^2	<i>P</i>	df
Dickinson	11:7	0.889	0.348	1
Hill	23:18	0.610	0.434	1
Pooled	34:25	1.373	0.241	1
Pooled 20+ Annuli	9:3	3.000	0.083	1

and parking lot. The larger Hill site was a 14.7 ha plot located within a larger 25.8 ha fragment. Bush Honeysuckle encroachment on the Hill site was not as extensive as on Dickinson, but a dense stand of Red Cedar (*Juniperus virginiana*) is present within the center of the plot.

Turtles were encountered during foot searches of each site, or serendipitously while conducting radio telemetry. For each turtle encountered we recorded sex, mid-line carapace length (MCL), plastron length (PL), height, and mass. We also recorded any damage observed, or signs of attempted predation (teeth and chew marks). All individuals were given a unique mark by notching marginal scutes with a triangular file. Annuli was counted on the 3rd and 4th costal scutes to determine size-age relationships. While annuli have not been validated for Three-toed Box Turtles we felt the data acquired, even with some deviation, would provide information in regards to age at maturity. We calculated population size using the Chapman modification of the Lincoln-Peterson population estimator for small sample sizes (Seber, 1982), using summer of 2011 as a mark period and the summer of 2012 as the recapture period. We calculated apparent survivorship and recapture probability using Cormack-Jolly-Seber models in



Figure 1. Aerial photograph of the two urban Three-toed Box Turtle study sites in Jefferson City, Missouri. The checked line denotes the perimeter of the Dickinson Site, and the solid line the Hill Site.

Table 2. Apparent survivorship (ϕ) and recapture probability (*p*) \pm 1 standard error for Three-toed Box Turtles on woodland habitat fragments in Jefferson City, MO.

	ϕ	<i>P</i>
Male	1.00 \pm 0.12	0.08 \pm 0.04
Female	0.77 \pm 0.67	0.12 \pm 0.16
All Turtles	1.00 \pm 0.01	0.08 \pm 0.04

Program MARK assuming constant survival and recapture rates (Lebreton et al., 1992).

A subset of adult turtles was fitted with Holohil R1-2B transmitters (Holohil Systems Ltd., Ontario Canada). We attached the transmitters to the 1st costal scute with quick setting gel epoxy (Figure 2). Turtles were typically located twice monthly during the active season and monthly during the winter. At each turtle location, we recorded canopy cover using a concave forestry densiometer (Lemmon, 1957) at waist height. We also noted whether the turtle was in the open or buried under vegetation at the time the location was recorded. We then calculated minimum convex polygon (MCP) home ranges for each turtle. Mean home range sizes were compared between sexes and sites using t-tests with $\alpha = 0.05$.

RESULTS

We made 82 captures of 59 individual box turtles (34 males, 25 females, and 3 unknown sex juveniles) between 19 April 2011 and 2 August 2012. We captured more males than females, although the difference was not significant (Table 1). The population estimate for the Hill site (34 \pm 14.7; 2.3 turtles/ha) was nearly twice that of the smaller Dickinson site (18.2 \pm 5.4; 2.5 turtles/ha), although densities were nearly identical. Due to small sample sizes, we pooled all turtles from both sites to calculate survivorship and recapture



Figure 2. Transmitter placement on Three-toed Box Turtles at two sites in Jefferson City, MO.

Table 3. Means comparisons between sexes of morphometric variables collected for Three-toed Box Turtles on woodland habitat fragments in Jefferson City, MO. Shell measurements are in mm and mass in g (± 1 SE).

	Male	Female	<i>t</i>	<i>P</i>
Carapace Length	141 \pm 9	144 \pm 12	-0.215	0.830
Plastron Length	133 \pm 1	129 \pm 5	0.826	0.411
Shell Height	67 \pm 1	70 \pm 2	-1.270	0.208
Mass	484 \pm 14	501 \pm 24	-0.594	0.554

probabilities. Recapture probabilities were low, and survivorship was high, 1.00 \pm 0.01 for both sexes pooled (Table 2). Survivorship was lower for females than males.

We could identify and count to 20 annuli before the annuli became too crowded to differentiate between growth lines, or the shell to worn to observe annuli (Figure 3). Older age classes were male biased (Table 1). There was no significant difference in morphometric measurements between male and female turtles (Table 3).

We affixed radio transmitters to 10 males and 10 females between 21 March 2012 and 22 October 2013. Five turtles (2 males: 3 females) were lost soon after being outfitted with transmitters, so were excluded from analyses. We tracked turtles for an average of 563 days (range 514-580 days) and obtained an average of 24 locations per turtle (range 16-32 locations). Minimum convex polygon home ranges were nearly three times larger on the Hill site (1.59 ha \pm 0.44) than on the smaller Dickinson site (0.46 \pm 0.08). There was not a difference in home range size between males and females on the Dickinson site, but males had significantly larger home ranges than females on the Hill site (Table 4). Males from the Hill site had significantly larger home ranges than males from the Dickinson site (Table 4). There was not a dif-

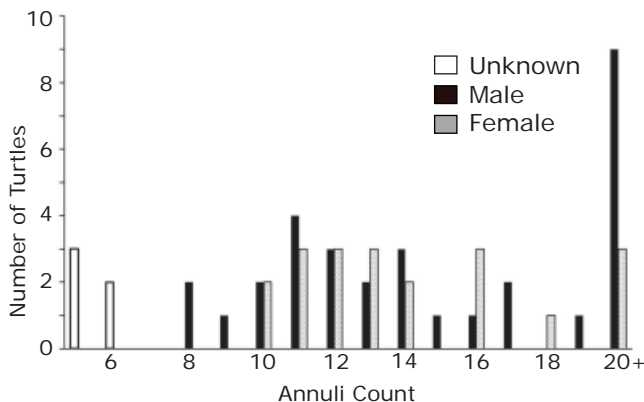


Figure 3. Age frequency distributions by sex based on annuli counts for Three-toed Box Turtles at two sites in Jefferson City, MO.

Table 4. Mean Home Range Size comparisons between sites and sexes for Three-toed Box Turtles on woodland habitat fragments in Jefferson City, MO. Home range sizes are reported in ha (± 1 SE).

	Male	Female	<i>t</i>	<i>P</i>
Dickinson	0.44 \pm 0.15	0.49 \pm 0.27	2.91	0.29
Hill	2.29 \pm 1.29	0.89 \pm 0.82	-1.69	0.09

	Dickinson	Hill	<i>t</i>	<i>P</i>
Male	0.44 \pm 0.15	2.29 \pm 1.29	-2.41	0.03
Female	0.49 \pm 0.27	0.89 \pm 0.82	-0.80	0.22

ference in female home range sizes between the two sites (Table 4).

Mean canopy cover at tortoise locations was 79% \pm 32%. We located turtles on private property 85 different times. One turtle overwintered on a private residence. There were 247 locations on LU property and turtles were observed under cover (partially buried under leaves) 181 times. Of the 66 observations of turtles in the open, we observed turtles mating on 7 occasions, between 1 April and 30 May. One mating observation was also made on 8 October. Hibernating turtles were typically found beneath 150-200 mm of leaf litter.

No marked or telemetered turtles were observed moving between sites. Two female road mortalities were observed near the Hill site during this study. Neither carcasses showed evidence of notching, so most likely represented unmarked individuals. Eight turtles (3 males: 5 females) exhibited chew marks consistent with mesocarnivores on their carapaces.

DISCUSSION

While the study was short (18 months), the data collected elucidates important information concerning the ecology of Three-toed Box Turtles in urban environments. Habitat use mirrored what is known



Figure 4. A Three-toed Box Turtles resting in a "form" on 27 March 2012 at the Dickinson site, Jefferson City, MO.

for wild populations. Both Eastern Box Turtles and Three-toed Box Turtles inhabit mesic forests with relatively closed canopy, sparse understory, and well defined leaf litter (Dodd, 2001). Turtles spend a considerable time amount of time sleeping or avoiding unfavorable conditions under a thin layer of leaf litter, also called a “form” (Stickel, 1950). Many observations for telemetered animals were individuals resting under a thin layer of leaves at sites with dense canopy cover (Figure 4). Turtles on the Dickinson site were typically located within or near dense stands of Bush Honeysuckle. Three-toed Box Turtles then are quite cryptic, which contributes to their low encounter rates. Serendipitous encounters of active turtles typically occurred during warmer spring or fall months. Relative humidity is thought to greatly influence activity patterns (Reagan, 1974), and mate searching, courtship, and mating can take place anytime during the active season during suitable conditions (Dodd, 2001). We observed mating activity in April, May, and October (Figure 5). Dolbeer (1970) reported hibernating turtles resting 6-7 cm under thick mats of leaf litter. We made similar observations of our hibernating turtles.

While suitable habitat is present within our urban woodplots, the small fragmented size and proximity to roads and residential developments may hinder population persistence. Home range sizes were constrained by fragment size, at least for males, and population densities were also constrained by fragment size and much lower than for wild populations. Population densities for wild Three-toed Box Turtles in Missouri ranged from 18.4-26.9/ha (Schwartz et al., 1984). Population densities for wild populations of the nominate Eastern Box Turtle ranged from 2.7-22.7/ha across their range (Dodd, 2001). Nazdrowicz et al. (2008) reported similar low densities, 0.81-3.62/ha depending on fragment size, for Eastern Box Turtles in Delaware.



Figure 5. A telemetered female and unmarked male observed copulating on 1 April 2012, on the Dickinson site, Jefferson City, MO.

Turtles at our sites may be reliant upon residential locations for meeting nutritional and nesting requirements. Donaldson and Echternacht (2005) reported uneven home range use by Eastern Box Turtles in Tennessee, where a disproportionate amount of time was spent near wet areas. Four of our telemetered turtles frequented one particular residence during their active season. A landscaping pond was maintained on the residence, and the homeowner reported to us that he regularly fed the local box turtles commercial dog food. Box turtles will also use urban gardens as food sources as well (Budischak et al., 2006).

Preferred nesting sites, at least for Eastern Box Turtles are sites with open canopy or forest edge (Congello, 1978; Kipp, 2007). Within urban habitats, these open canopy sites are most likely to be found along boundaries with residences and road edges. Females will make long movements, 445-774 m, outside of their normal home ranges to find suitable nesting habitat (Stickel, 1950; Kipp, 2007). Males typically move more (Iglay et al., 2007) but females tend to have higher encounter rates as they search out these more open habitats (Brisbin et al., 2008). In our study, males on the larger Hill site did have larger home ranges than females, but female encounter rates were slightly higher than that of males. This increase in encounter rates is thought to lead to an increase in female mortality, as it brings them closer to roads and increases exposure to predation (Brisbin et al., 2008). Females did exhibit lower survival in our study population. Movements related to locating suitable nest sites does lead to increased female mortality across a suite of aquatic and semi-aquatic turtles (Aresco, 2005; Gibbs and Steen, 2005). Turtles on site did exhibit signs of attempted predation, and Raccoons (*Procyon lotor*) and domestic dogs (*Canis lupus familiaris*) were present on site. Increased movements while nesting may increase exposure of female box turtles to predation. Increased predation of females due to increased pre-nesting foraging has also been observed in *Gopherus morafkai* (Riedle et al., 2010). This skew towards a male biased population could be due to increased female mortality, resulting from nesting movements.

Regardless of cause of mortality, elevated mortality rates in females do raise concerns for the long-term viability of these populations. A population viability analysis of Florida Box Turtles (*Terrapene carolina bauri*) reports that annual losses > 3.8% results in declining populations (Dodd et al., 2016). If one considers the loss of the two road kill females observed during this study, that would be equal to

5.8% of the Hill site population. Sustained losses at this level would put these urban populations at jeopardy.

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Common Gartersnake (*Thamnophis sirtalis*) Mortality likely Resulting from Cold Exposure Following Late Winter Hibernaculum Emergence

Milder winters are thought to be a consequence of global climate change, triggering phenological changes in a myriad of biota (McCarty 2001; Walther 2002; Skelly et al. 2007; Körner and Basler 2010). Reptiles are thought to be one of the most susceptible life forms and are declining globally as they fail to adapt to climactic conditions as fast as they are changing (Araújo et al. 2006; Bickford et al. 2010). Unseasonably warm winters throughout central Nebraska have recently been implicated in bringing the Red-bellied Snake (*Storeria occipitomaculata*) out of brumation early, before spring arrives (Tye et al. 2017). In January 2016, a sustained warm period drove three Eastern Racers (*Coluber constrictor*) out of their hibernaculum near the Platte River and an ensuing drop in temperature to those more normally observed in January resulted in their demise (Wiese et al. 2016).

On 10 March 2017, one adult (Figure 1) and one juvenile (Figure 2) Common Gartersnake (*Thamnophis sirtalis*) were observed dead on the northwest corner of the Crane Trust Visitor's Center (40.796085° N, 98.493181° W; WGS84) in Hall County, Nebraska. The sexes and sizes of the snakes were not assessed. The carcasses were located on landscaping rock abutting the building's stone foundation, a known hibernacula for both *C. constrictor* and *T. sirtalis*. The two *T. sirtalis* were found on their backs with no markings indicating that they were killed by a predat

tor and neither specimen appeared desiccated, suggesting that the deaths were recent (Figure 1, 2). Though the date of death is unclear, the snake bodies were not observed throughout the first two weeks of February.

In 2017, the second warmest February was recorded globally, with local temperatures reaching a peak of 25 °C on 21 February (NOAA 2017). This high temperature was followed by a cold snap 3 days later with temperatures as low as -9 °C. Additionally, the first week of March 2017 had temperatures averaging 12 °C, peaking on 6 March at 25 °C. Low temperatures stayed above the lethal threshold of -5.5 °C documented for *T. sirtalis* (Churchill and Storey 1992) until the morning of 10 March when temperatures dropped to -8 °C. It is uncertain which cold snap resulted in the death of these two snakes. *T. sirtalis* is known to have one of the longest active, and shortest brumation periods of all snake species in the central Great Plains (Fitch 1965), and emerge from brumation as early as mid-late February in Kansas and Missouri (Sexton and Bramble 1994; Ballinger 2010) and early March in Nebraska (Fogell 2010). *T. sirtalis* activity and emergence has been linked to changes in soil temperature in some studies (Wittier et al. 1987; Lutterschmidt et al. 2006). Late winter emergence may expose *T. sirtalis* to a potentially significant mortality risk, as temperatures retain the potential to drop well



Figure 1. Adult *T. sirtalis* found in landscaping rocks at the Crane Trust Nature and Visitor's Center 10 March 2017.



Figure 2. Juvenile *T. sirtalis* found in landscaping rocks at the Crane Trust Nature and Visitor's Center 10 March 2017.

below their lethal threshold during this time of year in Nebraska. Fogell (2010) notes that *T. sirtalis* can be active during every month of the year in Nebraska, suggesting that they are the most cold-adapted snake species in the state. Evidence that *T. sirtalis* is susceptible to fatal freezing during early emergence suggests other snake species employing temperature-based cues to emerge from brumation may also face mortality risks associated with early emergence.

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About the Kansas Herpetological Society

The KHS is a non-profit organization established in 1974 and designed to encourage education and dissemination of scientific information through the facilities of the Society; to encourage conservation of wildlife in general and of the herpetofauna of Kansas in particular; and to achieve closer cooperation and understanding between herpetologists, so that they may work together in common cause. All interested persons are invited to become members of the Society. Membership dues per calendar year are \$15.00 (U.S., Regular), \$20.00 (outside North America, Regular), and \$20.00 (Contributing) payable to the KHS. Send all dues to: KHS Secretary, (address inside the front cover)

KHS Meetings

The KHS holds an annual meeting in the fall of each year. The meeting is, minimally, a two day event with lectures and presentations by herpetologists. All interested individuals are invited to make presentations. The annual meeting is also the time of the Saturday night social and fund-raising auction.

Field Trips

The KHS hosts three field trips each year, one each in the spring, summer, and fall. Field trips are an enjoyable educational experience for everyone, and also serve to broaden our collective understanding of the distribution and abundance of the amphibians, reptiles, and turtles in Kansas. All interested persons are invited to attend.

Editorial Policy

Collinsorum, currently issued quarterly (March, June, September, and December), publishes all society business.

Submission of Manuscripts

As space allows, *Collinsorum* publishes all manner of news, notes, and articles. Priority of publishing is given to submissions of Kansas herpetological subjects and by KHS members; however all submissions are welcome. The ultimate decision concerning the publication of a manuscript is at the discretion of the Editor. Manuscripts should be submitted to the Editor in an electronic format whenever possible. Those manuscripts submitted in hard copy may be delayed in date of publication. Manuscripts should be submitted to the Editor no later than the 1st of the month prior to the month of issuance. All manuscripts become the sole possession of the Society, and will not be returned unless arrangements are made with the Editor.

Reprints & Artwork

Collinsorum publishes original peer-reviewed submissions under the Articles and Notes sections. Upon review, acceptance, and publication, Portable Document File (PDF) copies are provided gratis to the author on request.

Societal Awards, Grants, and Recognitions

Distinguished Life Members

Individuals selected as Distinguished Life Members are chosen by the KHS Executive Council based on their distinguished published research papers on Kansas herpetology.

Bronze Salamander Award

Established in 1987, this Award is presented to those individuals whose efforts and dedication to the Kansas Herpetological Society go far beyond the normal bounds. The recipients of this Award have given exemplary service to the KHS, and are presented with an elegant bronze sculpture of a Barred Tiger Salamander.

The Howard K. Gloyd - Edward H. Taylor Scholarship

Established in 1993, The Gloyd-Taylor Scholarship is presented annually by the Kansas Herpetological Society to an outstanding herpetology student. The scholarship is a minimum of \$300.00 and is awarded on the basis of potential for contributing to the science of herpetology. Students from grade school through university are eligible.

The Alan H. Kamb Grant for Research on Kansas Snakes

KHS members only are eligible to apply for The Alan H. Kamb Grant for Research on Kansas Snakes, which was established in 2001. The recipient of the grant will be selected by the KHS Awards Committee. A minimum award of \$300 is given annually. Research results (in whole or in part) must be submitted for publication in *Collinsorum*.

The Henry S. Fitch - Dwight R. Platt Award for Excellence in Field Herpetology

KHS members only are eligible to apply for The Henry S. Fitch - Dwight R. Platt Award for Excellence in Field Herpetology, which was established in 2010. The recipient of the grant will be selected by the KHS Awards Committee. The award will be given annually when sufficient funds have been raised to establish a trust.

The George Toland Award for Ecological Research on North American Herpetofauna

This CNAH Award was established in 2008 in recognition of the scientific career of George Fredrick Toland, whose life-long interest in herpetology was passed on to so many of his students. The recipient of this award will be selected by the KHS Awards Committee. A minimum award of \$200 is given annually at the end of the KHS meeting. Research results (in whole or in part) must be submitted for publication in *Collinsorum*.

The Suzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology

This CNAH Award was established by Westar Energy in 1998 in recognition of the achievements of Suzanne L. Collins and Joseph T. Collins. In even years, the Award is bestowed upon an individual who, in the preceding two calendar years, had published a paper of academic excellence on native species of Kansas amphibians, reptiles, and/or turtles, and in odd years, the Award is given to an individual who, in a juried competition, took the best photograph of a Kansas amphibian, reptile, or turtle. The Collins Award is minimally \$1,000.00, and is neither a grant nor a scholarship. No nominations or applications can be made for it.

KANSAS HERPETOLOGICAL SOCIETY
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