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Front Cover: Red-spotted Toad (*Anaxyrus punctatus*) by Travis W. Taggart.

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Collinsorum

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MESSAGE FROM THE PRESIDENT-ELECT

An issue of Collinsorum always looks sharp and is filled with useful and interesting information. Our old friend Joe Collins made it look easy. So do Curtis Schmidt and Travis Taggart. I can assure you, preparing an issue is a time-consuming task adorned with many fine details that demand attention. As president, I want to make the work of assembling and disseminating these issues easier. I also want to maintain space for both peer-reviewed articles on all things herpetology, as identified by having an Abstract, and for non-reviewed material. This combination of material adds to the journal its charm and usefulness to a broad group of people.

Beginning with 2015, we will aim for four issues annually. Each will be announced on CNAH and presented online. At the end of 2015, all four issues will be printed and sent as a single 2015 volume to each member. This way, each issue is immediately accessible online and subsequently presented in hard copy for personal libraries.

Three cheers to the KHS editorial team and to one and all of the KHS!

Walt

THE KANSAS HERPETOLOGICAL SOCIETY 41st ANNUAL MEETING

Herpetologists swarmed the streets of Manhattan, Kansas from November 7th–9th, 2014 as they gathered for the 41st Annual Meeting of the Kansas Herpetological Society (KHS). Kansas State University (KSU) was the host for this year's meeting where KHS members were privileged to hear a vast assortment of scientific presentations from herpetologists, students, and citizen scientists. Attendees traveled via airplane, car, and van from all over Kansas and the United States.

The pre-meeting social gathering was held Friday evening, November 7th, at The Little Apple Brewing Company in Manhattan. Sustenance, beverages and conversation abounded while old friends and new friends reunited after a year's hiatus. After dinner the celebration continued well into the early morning hours at one of the local lodging establishments. A few hours later the meeting officially began at KSU's Ackert Hall where a welcome and opening remarks were presented by KHS President **Daniel D. Fogell**. After a brief welcome to the University by KHS Secretary and KSU Professor **Eva A. Horne**, meeting-goers were treated to the first oral presentation of the meeting - *Results of the KDWPT 5-Year Review of Threatened and Endangered Species* presented by **David Bender**. This presentation was followed by a *Herpetofaunal Survey of Quivira National Wildlife Refuge* presented by **Jeffrey T. Seim** and *The Tarnished Penny: An Insight into Occupancy Modeling of Herpetofauna on a Refuge-based Scale* from **Kasandra A. Brown**.

After a short coffee and snack break the second scientific paper session of the meeting commenced with back-to-back talks by **George Pisani**: *Ecology and Niche Modeling of Redbelly and Smooth Earth Snakes in Eastern Kansas* and *Snakes and Snails, and Puppy Dog Tails: Calcium Flow in High-quality Deciduous Forest and a Potential Model for Redbelly Snake Ecology.* After George was finished answering questions, Session Moderator and KHS President **Dan Fogell** introduced the Keynote Speaker for the meeting – **Dr. Michael Lannoo**. Mike is a Professor of Anatomy and Cell Biology at Indiana University School of Medicine in Terre Haute. He is also a prolific author of scientific papers and books with an emphasis on amphibian conservation. His keynote address – *Do Amphibians Have the Emotional and Economic Clout to Save Amphibians?* – provided attendees with some insight into the near impossibility of obtaining funding specifically for amphibian conservation efforts. But Mike's message was not all doom and gloom. He also enlightened listeners by describing how landscape-level conservation is often easier to accomplish as well as more financially productive. And so by default, if you conserve the landscape you conserve the amphibians, and amphibian conservation will often be accomplished by default. His words were very well received and throughout the day Mike was swarmed by meeting-goers asking questions and sharing in his experiences. Following Mike's talk was the annual KHS Group Photograph, facilitated and taken by CNAH Director and KHS Past President **Travis Taggart**, followed by lunch.

Upon returning from lunch members were treated to the third scientific paper session which included the following talks: **Eva Gann** – *Reintroduction Ecology of Alligator Snapping Turtles (*Macrochelys temminckii*) on the Kansas/Oklahoma Border*; **Emma Pauly-Hubbard** – *Why Do Prairie Ring-necked Snakes Aggregate?*; **Ashley Messner** – *Energy Allocation After Caudal Autotomy in Great Plains Skink*, Plestiodon obsoletus; **Maya McElfish** - *Behavioral Responses of Two Salamander Species to the Herbicide Atrazine*; **Daniel D. Fogell** – *Show Me the Way Home: Identifying Timber*

Rattlesnake Dens in Southeast Nebraska; and **Walter E. Meshaka, Jr.** – *A Preliminary Survey of the Herpetofauna of Three Mile Island in South-Central Pennsylvania*. Throughout the day Saturday there was a live animal exhibit where native Kansas amphibians, reptiles and turtles were available for viewing and photographing. KHS members **Christopher Visser, Dexter Mardis**, and KHS President **Dan Fogell** all brought some animals for visitors to see. Additionally, bookseller **Eric Thiss** of Zoo Book Sales presented his usual impressive collection of herpetological books as well as some herp wear for sale to KHS meeting attendees. T-shirts commemorating the 41st Annual KHS Meeting depicting an in situ Timber Rattlesnake (*Crotalus horridus*) were available at the registration desk. The design was constructed in part by CNAH Director **Travis Taggart**.

Following the Saturday afternoon presentations members were treated to a Kansas Herpetofauna Identification Quiz. After the success of last year's quiz KHS President **Dan Fogell** decided to once again test members' knowledge of native Kansas amphibians, reptiles and turtles. This year's quiz had a slightly modified theme in that all photos in the running slide show were of close-up sections of animal patterns or body parts rather than the entire animals themselves. Those with high scores were able to choose from a variety of prizes donated by **Travis Taggart** and **Dan Fogell**. Members **Ryan Shofner** and **Chris McMartin** were neck-and-neck but Ryan beat out Chris by a half a point with only three wrong answers. Third place was shared by **Dexter Mardis** and **John Lokke**.

To wrap up the day's meeting activities members attended the KHS business meeting, which included elections for officers as well as the annual awards ceremony. First up was the presentation of awards, presented by KHS President and Awards Committee Chairperson **Dan Fogell**. The first award, the *Henry S. Fitch-Dwight R. Platt Award for Excellence in Field Herpetology*, was presented to **Travis Taggart** of Fort Hays State University. Travis received a $200.00 Honorarium, however in an act of unsuspected and inexplicable benevolence, he immediately donated the award back to the Fitch-Platt Award fund. The next award – the *Howard K. Gloyd-Edward Harrison Taylor Scholarship* – was granted to **David Penning**, a PhD student at the University of Louisiana at Lafayette. David received a stipend of $300.00. The *Alan H. Kamb Grant for Research on Kansas Snakes* was presented along with a $300.00 stipend to **Christopher Visser** of Lincoln, Nebraska. The final award of the day…the S*uzanne L. & Joseph T. Collins Award for Excellence in Kansas Herpetology*…was awarded to **Walter Meshaka** of the State Museum of Pennsylvania in Harrisburg, PA. Walter received the Collins Award for his manuscript titled *Reproductive Characteristics and Sexual Maturation of the Eastern Collared Lizard,* Crotaphytus collaris *(Say, 1823), at the Northern Edge of its Geographic Range* (Collinsorum Volume 1(2/3), September 2012) which he co-authored with **Stanley E. Trauth, Katherine M. Talbott,** and **Curtis J. Schmidt**. Walter was caught completely unaware and appeared somewhat shocked when he received a commemorative plaque and a check for $1,000.00, however let there be no doubt…he is quite deserving of this prestigious award.

Next up was the election of officers. The nominating committee suggested **Eric Kessler** (Kansas City, Missouri) for the President-Elect position, and the membership unanimously voted him in. Also elected were **David Oldham** (Pittsburg State University) for Treasurer and **Eva Horne** (Kansas State University) for Secretary – both of whom are currently serving in those positions. **Walter Meshaka** will take over as KHS President on January 1st, 2015. **Dan Fogell** (Southeast Community College, Lincoln, Nebraska) will continue to participate in KHS Executive Council decisions in the role of immediate Past-President. Following elections and business discussions, the meeting was adjourned and members were free to find food and beverages at the restaurants of their choice.

As tradition dictates, Saturday evening was reserved for the annual KHS Auction. This year's event was held at the Konza Prairie Biological Station Meeting Hall, and auctioneers **Eric Thiss** and **Walter Meshaka** had the place roaring with bids and laughter. The third of the "Three Amigos" – **Dan Fogell** – was granted an excused absence from auctioneering duties due to all of the stressful tasks he had to accomplish throughout the day ensuring that the meeting and auction ran smoothly. In an attempt to mix up the traditional activities, a silent auction was held in conjunction with the live auction. As usual there were many fine items to bid on, including previously worn t-shirts, books, herpetological paraphernalia and knickknacks, and a couple of premium items that solicited quite high bidding activity. One such item was a beautiful cross stitch depiction of a Speckled Rattlesnake which was hand-made by KHS Secretary **Eva Horne**, but the highlight of the auction was a hand-sewn quilt made of past and present KHS meeting t-shirts. Donated by **Travis Taggart** and made by his mother (**Germaine Taggart**), the quilt sold for more than $300.00! Other items of note included several rare natural history prints donated by **Ted Leonard**. One remarkable item was a framed print depicting a variety of hand-colored salamanders, including a siren, an amphiuma, a grotto salamander, and a fire salamander. The valuable and gorgeous print will now adorn the office walls of our keynote speaker – **Mike Lannoo** – who won the bid for a fraction of the print's value. While auction-goers were bidding and snacking inside the meeting hall, gremlins and hoodlums roamed the parking lot and removed license plates to be sold at the auction. One such plate –

KHS 42nd Annual Meeting Group Photograph

Nebraska license plate V1PERS – sparked a bidding war between **Dan Fogell** (the owner of the plate) and **Ryan Shofner**. In an attempt to prove a point, Fogell stopped bidding and allowed Shofner to win the item. But later in the evening while Shofner topped off his beverage, one of Fogell's many disciples opportunistically absconded with the unattended plate, returning it to Fogell at no cost. Point proven. As auction activities wrapped up, many members returned back to the central lodging facility and continued the banter in the lobby – well into the early morning hours…again. The auction brought in more than $2,500.00 for the KHS.

On Sunday morning the second day of paper sessions commenced. The first of the day included the following speakers and topics: **Daniel Martin** – *Opportunities to Help Test Volunteer-Based, Standardized Surveys for Reptiles in the Great Plains*; **Dylan W. Maag** – *Prey Procurement and Strike Behavior in Selected Venomous Snakes of the Family: Crotalidae*; **Dylan Tegtmeier** – *Toxicology: The Effects of Road Salt Caused Salinity on Tadpole Mortality*; **Carolyn Reiland-Smith** – *Possible Tail Regeneration Variation in* Hemidactylus; **David Penning** – *Hail to the King: Constriction Pressures in two Colubrid Snakes*; and **Steven Bostwick** – *Population Survey, Seasonal Movement Tracking, and Microhabitat Dependences of the Western variant of Timber Rattlesnake* Crotalus horridus *in Madison County, Iowa*. After a brief coffee, snack, and bathroom break, the second session of the day and final session of the meeting offered the following speakers: **Pablo R. Delis** – *The Herpetofauna of Wallops Island: A Case Study of A Community Under Threat*; **Daniel F. Hughes** – *Nesting Activity and Nest Temperature of Three Turtle Species in the Northern Allegheny Mountains*; **Katie Talbott** – *Disease Ecology of Free-living Anurans in a Suburban Zoological Park*, and finally, **Andrew Coleman** – *Sound Production in the Small-mouthed Salamander*.

As members packed up their belongings and prepared to return to their homelands, KHS Awards Committee Chairman **Dan Fogell** presented the final award of the weekend: the George Toland Award. The 2014 *George Toland Award for Ecological Research on North American Herpetofauna* was presented to **Maya McElfish** of Emporia State University. Maya's outstanding presentation on the *Behavioral Responses of Two Salamander Species to the Herbicide Atrazine* was relevant to the subject matter of the award, showed excellent scientific design and analysis, and was delivered professionally. In recent years student presentations at KHS meetings have not only increased in number but also in caliber. Choosing a qualified student presentation is never an issue…but choosing the best has become a difficult task. Kudos to the KHS Awards Committee for taking the time to observe all student presentations to select a winter. As the 41st Annual Meeting of the Kansas Herpetological Society came to a close, President **Dan Fogell** thanked **Eva Horne** for her efforts with meeting venue logistics and **Travis Taggart** for his assistance with a number of meeting-oriented tasks as well as several other members whose help and talents keep the Society and the meetings running smoothly from year-to-year. Finally, Fogell wished everyone safe travels home and President-Elect **Walter Meshaka** invited all to come out to Hays, Kansas November 6th-8th, 2015 for the 42nd Annual Meeting of the Kansas Herpetological Society.

Dan Fogell
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Lincoln, Nebraska 68520
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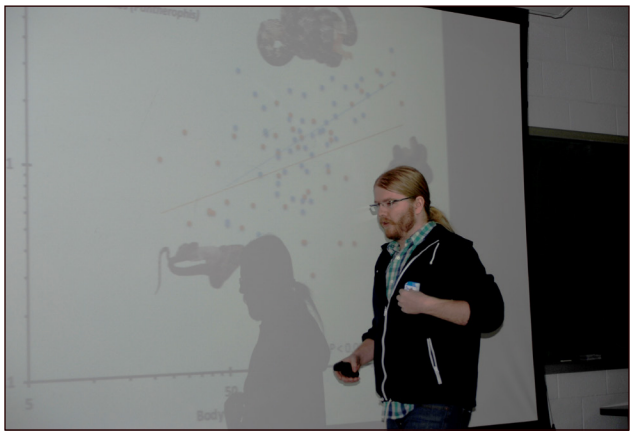
Eva Gann talks about her research tracking re-introduced Alligator Snapping Turtles on the Kansas-Oklahoma border.



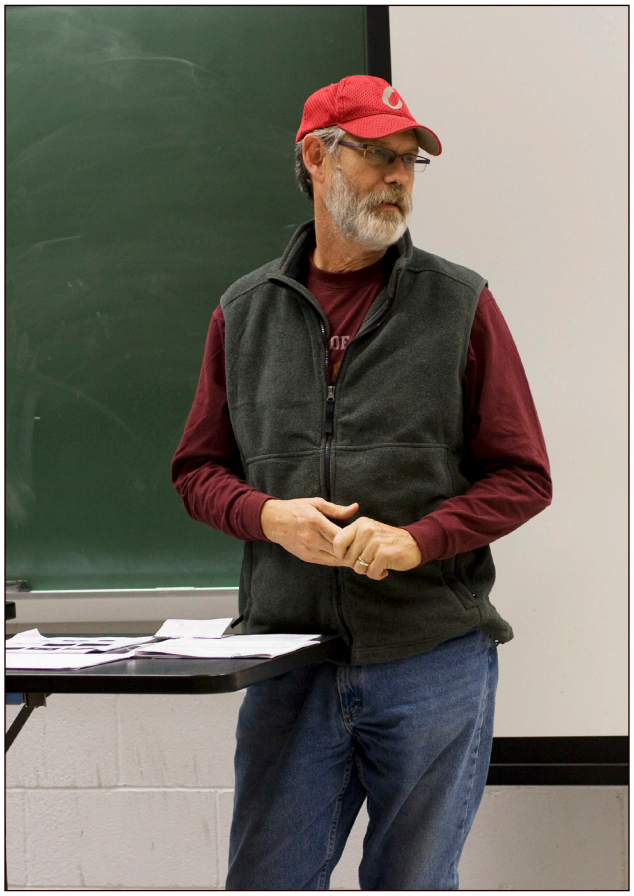
David Penning discusses how kingsnakes overpower and ingest other snakes. “Hail to the King!”

Dan Fogell presents Chris Visser with the Kamb Grant

Stan Roth, Dan Johnson, and Mike Caron ponder what life would be like without the KHS.

Chris McMartin and Ryan Shofner pause for a photo amid their discussion of Australian herps.

The KHS Annual Meeting brings together friends from several states. Pictured are Walter Meshaka and Pablo Delis (Pennsylvania), Suzanne Collins (Kansas), and Dan Fogell (Nebraska).



KHS Treasurer David Oldham reports on the solid fiscal state of the KHS during the business Meeting.

Emma Trewhitt proudly displays her new rattlesnake she picked up at the auction.

John and Jill Locke entertained the auction crowd by generating herpetological masterpieces; some of which were donated to the auction while the paint was still wet.

Dan Fogell and Michael Lannoo proudly display the catch of the auction, a pair of herp-oriented bottles of beer.

Jennifer Mittlehauser and Mary Kate Baldwin enjoying the KHS Auction.

Eva Gann, Travis Lyon, David Penning, and Melissa Schindler await the next auction item.

Evan Thiss displays the amazing quilt that Germaine Taggart made out of KHS t-shirts. The quilt was auctioned for over $300.

KHS President-Elect, Walter Meshaka auctions off a pair of Dan Fogell's undeshorts. Pretty sure the KHS lost money on this item.

Sara Shofner displays some auction items unknowingly donated by Dan Fogell.

Jeff Seim boasts his new prints, while Andrew Karlin sulks in jealousy.

Mark Ellis was highly disappointed when he discovered that his new jug was empty.

Carolyn Reiland-Smith admires the amazing cross-stitch Speckled Rattlesnake won by Josh Mead. Eva Horne's cross-stitch creations fetch top dollar every year.

Andrew Coleman and Maya McElfish enjoy a new frog mobile. Some budding future herpetologist is going to love this!

KHS 2015 Field Trips

Spring
Russell County
24-26 April 2015
Summer
Harvey/Reno
17-19 July 2015
Fall
Washington
2-4 October 2015

The
KHS 42nd Annual Meeting
will be held at

Sternberg Museum of Natural History/
Fort Hays State University,
Hays, Kansas

6-8 November 2015

NOTES

Recent Scientific and Standard English Name Changes Effecting the Kansas Herpetofauna

Continual advancements in our understanding of herpetofaunal evolutionary relationships and the concomitant changes in scientific names have led to many proposed changes since the publication of Collins, Collins, and Taggart (2010. Amphibians, Reptiles, and Turtles of Kansas. Eagle Mountain Publishing. 312 pp.) (CCT).

Standardized English names continue to become stabilized (Crother, ed. 2012. Scientific and Standard English names of Amphibians and Reptiles of North America North of Mexico, with comments regarding confidence in our understanding. SSAR Herpetological Circular No. 39) which has led to several changes among them as well.

CCT followed the English names standardized by The Center for North American Herpetology (CNAH). In 2012 CNAH ceased producing a names list, in part to reduce the potential confusion among available and competing English names. Most of the English name changes are the result of simply combining words (e.g. Water Snake to Watersnake) or hyphenating two or more modifying words treated as adjectives (e.g. Smallmouth Salamander to Small-mouthed Salamander). Notice that as proper nouns, standardized English names are always capitalized; at a minimum, this practice will help a reader distinguish a “green frog” from the Green Frog. Other changes are more substantial (e.g. Bullfrog to American Bullfrog or especially, Prairie Kingsnake to Yellow-bellied Kingsnake).

It should be noted that you are not bound to use any particular scientific name change. Rather, you should evalute the underlying evolutionary hypotheses and use the scientific name that you can defend. Standardized English names however, are independent of science (e.g. the English name Great Plains Rat Snake does not change because it is moved from the genus *Elaphe* to *Pantherophis)*. The purpose of standardized English names are to facilitate communication outside of science by their repeated and consistent usage.

Frogs

***Anaxyrus debilis,* Chihuahuan Green Toad** - Standard English name in CCT was Green Toad.

***Gastrophryne carolinensis,* Eastern Narrow-mouthed Toad** - Standard English name in CCT was Eastern Narrowmouth Toad.

***Gastrophryne olivacea,* Western Narrow-mouthed Toad** - Standard English name in CCT was Great Plains Narrowmouth Toad.

***Lithobates catesbeianus,* American Bullfrog** - Standard English name in CCT was Bullfrog.

***Lithobates clamitans,* Green Frog** - Standard English name in CCT was Bronze Frog.

Salamanders

***Ambystoma mavortium,* Western Tiger Salamander** - Standard English name in CCT was Barred Tiger Salamander.

***Ambystoma texanum,* Small-mouthed Salamander** - Standard English name in CCT was Smallmouth Salamander.

***Eurycea longicauda,* Long-tailed Salamander** - Standard English name in CCT was Longtail Salamander.

***Necturus maculosus,* Mudpuppy** - Standard English and scientific name in CCT was Red River Mudpuppy, *Necturus louisianensis*. The SSAR salamander specialist group placed this taxon back into *Necturus maculosus*.

Turtles

***Chelydra serpentina,* Snapping Turtle** - Standard English name in CCT was Common Snapping Turtle.

***Chrysemys picta,* Painted Turtle** - Standard English name in CCT was Northern Painted Turtle.

***Graptemys geographica,* Northern Map Turtle** - Standard English name in CCT was Common Map Turtle.

***Pseudemys concinna,* River Cooter** - Standard English name in CCT was Eastern River Cooter.

***Sternotherus odoratus,* Eastern Musk Turtle** - Standard English name in CCT was Common Musk Turtle.

***Terrapene triunguis,* Three-toed Box Turtle** - Standard English and scientific name in CCT was Eastern Box Turtle, *Terrapene carolina*. This species was broken out by Martin et al. (2013. Sequence-based molecular phylogenetics and phylogeography of the American Box Turtles (*Terrapene* spp.) with support from DNA barcoding. Molecular Phylogenetics and Evolution 68: 119–134)

***Trachemys scripta,* Pond Slider** - Standard English name in CCT was Slider.

Lizards

***Holbrookia maculata,* Common Lesser Earless Lizard** - Standard English name in CCT was Lesser Earless Lizard.

***Ophisaurus attenuatus,* Slender Glass Lizard** - Standard English name in CCT was Western Slender Glass Lizard.

***Plestiodon fasciatus,* Common Five-lined Skink** - Standard English name in CCT was Five-lined Skink.

***Plestiodon laticeps,* Broad-headed Skink** - Standard English name in CCT was Broadhead Skink.

***Plestiodon septentrionalis,* Prairie Skink** - The Southern Prairie Skink, *Plestiodon obtusirostris* of CCT is considered a subspecies.

***Sceloporus thayeri*, Prairie Lizard** - Listed as *Sceloporus consobrinus* in CCT. Leache and Reeder (2002. Systematic Biology, 51(1): 44-68) revised this group, but did not sample close enough to the type locality of *S. thayeri* (Baird and Girard, 1852) to associate the name with either of the putative lineages in the vicinity (*S. cowlesi* (Lowe and Norris, 1956) and *S. consobrinus* (Baird and Girard, 183)). Subsequently, Dixon and Hibbitts (2013. Amphibians and Reptiles of Texas: With Keys, Taxonomic Synopses, Bibliography, and Distribution Maps. Third Edition.) illustrated that *S. cowlesi* was restricted to west Texas and the range of the eastern lineage contains the type localities of both *S. consobrinus* and *S. thayeri*. Dixon and Hibbitts (2013) used *S. consobrinus,* however *S. thayeri* has priority.

***Scincella lateralis,* Little Brown Skink** - Standard English name in CCT was Ground Skink.

Snakes

***Agkistrodon contortrix,* Eastern Copperhead** and ***Agkistrodon laticinctus,* Broad-banded Copperhead** - Standard English and scientific name in CCT was Copperhead, *Agkistrodon contortrix.* Burbrink Guiher. (2014. Zoological Journal of the Linnean Society, 2014. 1-22) broke the former polytypic *Agkistrodon contortrix* into two species, both of which occur throughout its range in Kansas.

***Agkistrodon piscivorus,* Northern Cottonmouth** - Standard English and scientific name in CCT was Cottonmouth. Burbrink and Guiher. (2014. Zoological Journal of the Linnean Society, 2014. 1-22) broke the former poly-typic *Agkistrodon piscivorus* into two species, of which one has been recorded from extreme Southeast Kansas.

***Arizona elegans,* Glossy Snake** - Standard English name in CCT was Eastern Glossy Snake.

***Coluber constrictor,* North American Racer** - Standard English name in CCT was Eastern Racer

***Coluber flagellum,* Coachwhip** - The Coachwhip, *Masticophis flagellum* of CCT was transferred to the genus *Coluber*.

***Diadophis punctatus,* Ring-necked Snake** - Standard English name in CCT was Ringneck Snake.

***Haldea striatula,* Rough Earthsnake** - Standard English and scientific name in CCT was Rough Earth Snake, *Virginia striatula*. McVay and Carstens (2013. Molecular Phylogenetics and Evolution 68(2013):425–431) resurrected the genus *Haldea* (Baird and Girard, 1853) for the formerly recognized *Virginia striatula*.

***Heterodon nasicus,* Plains Hog-nosed Snake** - Standard English name in CCT was Western Hognose Snake.

***Heterodon platirhinos,* Eastern Hog-nosed Snake** - Standard English name in CCT was Eastern Hognose Snake.

***Hypsiglena jani,* Chihuahuan Night Snake** - Standard English name in CCT was Chihuahuan Nightsnake.

***Lampropeltis calligaster,* Yellow-bellied Kingsnake** - Standard English name in CCT was Prairie Kingsnake.

***Lampropeltis gentilis,* Western Milksnake** - Standard English name in CCT was Milk Snake. Ruane et al. (2014.Systematic Biology 63(2):231–250) split the former wide-ranging polytypic species *Lampropeltis triangulum* into seven different species. Only one of which (*Lampropeltis gentilis*) is definitely known to occur in Kansas. The Eastern Milksnake may occur in Cherokee County, KS.

***Nerodia erythrogaster,* Plain-bellied Watersnake** - Standard English name in CCT was Plainbelly Water Snake

***Nerodia rhombifer,* Diamond-backed Watersnake** - Standard English name in CCT was Diamondback Water Snake.

***Nerodia sipedon,* Common Watersnake** - Standard English name in CCT was Northern Water Snake.

***Opheodrys aestivus,* Rough Greensnake** - Standard English name in CCT was Rough Green Snake.

***Opheodrys vernalis,* Smooth Greensnake** - Standard English name in CCT was Smooth Green Snake.

***Pantherophis emoryi,* Great Plains Ratsnake** - Standard English name in CCT was Great Plains Rat Snake.

***Pantherophis obsoletus,* Western Ratsnake** - Standard English name in CCT was Western Rat Snake.

***Pituophis catenifer,* Gophersnake** - Standard English name in CCT was Gopher Snake.

***Rena dissecta,* New Mexico Threadsnake** - Standard English name in CCT was New Mexico Blind Snake.

***Rhinocheilus lecontei,* Long-nosed Snake** - Standard English name in CCT was Longnose Snake.

***Sistrurus tergeminus,* Western Massasauga** - Standard English and scientific names in CCT was

Massasauga, *Sistrurus catenatus*.

***Sonora semiannulata*, Western Groundsnake** - Standard English name in CCT was Ground Snake.

***Tantilla gracilis,* Flat-headed Snake** - Standard English name in CCT was Flathead Snake

***Tantilla nigriceps,* Plains Black-headed Snake** - Standard English name in CCT was Plains Blackhead Snake.

***Storeria dekayi,* Dekay's Brownsnake** - Standard English name in CCT was Brown Snake.

***Storeria occipitomaculata,* Red-bellied Snake** - Standard English name in CCT was Redbelly Snake.

***Thamnophis marcianus,* Checkered Gartersnake** - Standard English name in CCT was Checkered Garter Snake.

***Thamnophis proximus,* Western Ribbonsnake** - Standard English name in CCT was Western Ribbon Snake.

***Thamnophis radix ,* Plains Gartersnake** - Standard English name in CCT was Plains Garter Snake.

***Thamnophis sirtalis,* Common Gartersnake** - Standard English name in CCT was Common Garter Snake.

***Virginia valeriae,* Smooth Earthsnake** - Standard English name in CCT was Smooth Earth Snake.

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KHS 2014 Spring Field Trip to Barber County

The KHS met at Barber County State Lake in Barber County 18-20 April 2014. Counts took place on private property northwest of Sun City (Saturday AM [37.413049°, -98.963579°] and Sunday AM[37.398823°, -98.983262°]) and near Aetna Saturday PM (37.008838°, -98.968140°). There were 292 individuals of 43 species discovered by the 125 participants. A special thanks to Ken Brunson, and the private landowners for allowing us access to their properties.

Frogs
- Great Plains Toad....5
- Red-spotted Toad....1
- Woodhouse's Toad....6
- Blanchard's Cricket Frog....30
- Boreal Chorus Frog....3
- Western Narrow-mouthed Toad....12
- Plains Leopard Frog....2
- American Bullfrog....4
- Plains Spadefoot....2

Salamanders
- Western Tiger Salamander....3

Turtles
- Snapping Turtle....1
- Ornate Box Turtle....5
- Pond Slider....3
- Yellow Mud Turtle....1
- Spiny Softshell....2

Lizards
- Slender Glass Lizard....4
- Eastern Collared Lizard....26
- Common Lesser Earless Lizard....2
- Texas Horned Lizard....12
- Prairie Lizard....16
- Great Plains Skink....7
- Prairie Skink....4
- Little Brown Skink....4
- Six-lined Racerunner....14

Snakes
- North American Racer....4
- Coachwhip....7
- Yellow-bellied Kingsnake....4
- Speckled Kingsnake....1
- Great Plains Ratsnake....2
- Western Ratsnake....4
- Gophersnake....3
- Long-nosed Snake....2
- Western Groundsnake....47
- Plains Black-headed Snake....4
- Prairie Rattlesnake....3
- Western Massasauga....8
- Ring-necked Snake....16
- Chihuahuan Night Snake....8
- New Mexico Threadsnake....2
- Plain-bellied Watersnake....1
- Dekay's Brownsnake....2
- Western Ribbonsnake....3
- Lined Snake....2

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KHS 2014 Summer Field Trip to Morton County and adjacent Colorado, New Mexico, and Oklahoma

The KHS convened at the Cimarron National Grassland in Morton County on 25-27 July 2014. Counts took place in Kansas (Morton County), Oklahoma (Texas and Cimarron counties), Colorado (Baca County), and New Mexico (Union County). There were 1029+ individuals of 28 species discovered by the 39 participants.

Frogs
- Great Plains Toad (KS, CO, NM, OK) 43
- Chihuahuan Green Toad (CO, NM, OK) .....180+
- Red-spotted Toad (NM, OK).....16
- Woodhouse's Toad (KS, CO, NM, OK) .....200+
- New Mexico Spadefoot (CO, NM, OK).....23
- Plains Spadefoot (KS, CO, NM, OK).....64

Salamanders
- Western Tiger Salamander (KS, OK) .....300+

Turtles
- Pond Slider (KS) 8
- Ornate Box Turtle (KS, CO, OK) 19
- Yellow Mud Turtle (KS, OK).....9

Lizards
- Common Lesser Earless Lizard (KS, OK).....7
- Eastern Collared Lizard (OK) 5
- Texas Horned Lizard (KS, OK).....24
- Prairie Lizard (KS, OK).....5
- Great Plains Skink (OK) 4
- Six-lined Racerunner (KS, OK) 35

Snakes
- Glossy Snake (KS, CO, NM, OK).....14
- North American Racer (KS, OK) 4
- Coachwhip (KS, OK) 11
- Western Milksnake (OK) 1
- Gophersnake (KS, OK) 17
- Long-nosed Snake (KS, OK).....9
- Plains Black-headed Snake (OK).....1
- Prairie Rattlesnake (KS, CO, NM, OK) 19
- Plains Hog-nosed Snake (KS, OK) 2
- Lined Snake (OK).....4
- New Mexico Threadsnake (OK) 3
- Plains Gartersnake (KS) 2

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KHS 2014 Spring Field Trip to Woodson County

The KHS met at Woodson State Fishing Lake and Wildlife Area in Woodson County 26-28 September 2014. Counts took place in southwest Woodson County. There were 220 individuals of 34 species discovered by the 103 participants.

Frogs
- American Toad 3
- Blanchard's Cricket Frog 34
- Gray Treefrog complex.....3
- Western Narrow-mouthed Toad 5
- Plains Leopard Frog.....1
- American Bullfrog.....4
- Southern Leopard Frog 15

Salamanders
- Small-mouthed Salamander.....10

Turtles
- Snapping Turtle 1
- Painted Turtle 6
- False Map Turtle 3
- Ornate Box Turtle 2
- Three-toed Box Turtle 13
- Pond Slider.....7
- Spiny Softshell 1

Lizards
- Slender Glass Lizard.....1
- Common Five-lined Skink 3
- Great Plains Skink.....3
- Little Brown Skink.....27
- Six-lined Racerunner.....6

Snakes
- North American Racer.....4
- Yellow-bellied Kingsnake.....1
- Western Milksnake.....1
- Rough Greensnake 11
- Western Ratsnake.....6
- Gophersnake.....2
- Broad-banded Copperhead.....8
- Western Massasauga 3
- Ring-necked Snake.....7
- Plain-bellied Watersnake.....15
- Diamond-backed Watersnake 8
- Common Watersnake.....2
- Western Ribbonsnake.....3
- Common Gartersnake.....1

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Reconfirmation of the Plains Spadefoot (*Spea bombifrons*) at the Fort Riley Military Reservation

In 1993, the Kansas Biological Survey (KBS) conducted the first systematic herpetofaunal survey of the Fort Riley Military Reservation, which yielded 39 reptile and amphibian species at the base (Busby et al. 1994). Since 2002, the Directorate of Public Works (Environmental Division) at Fort Riley have conducted annual herpetofaunal counts and have yielded reptile and amphibian species at the base not seen during the 1993 KBS survey (Suleiman 2003; Suleiman 2005). However, one amphibian species, the Plains Spadefoot (*Spea bombifrons*), that was documented at Fort Riley during the 1993 KBS survey, wasn't seen or heard again at the base until 2012.

Plains Spadefoot: 1993 Fort Riley records – A total of three Plains Spadefoot individuals were found at Fort Riley during the 1993 KBS survey. On 16 May 1993, two adults were found under a rock in a flooded area. On 16 June 1993, a single metamorph was found. All three sightings occurred in the Backstop Ridge area (Training Areas 20 and 21) at Fort Riley. No breeding choruses were heard during these sightings (Busby et al. 1994).

Plains Spadefoot: 2012 Fort Riley reconfirmation – For my graduate thesis research at Emporia State University, I conducted a large-scale herpetofaunal survey of Fort Riley from March – September 2012, with special focus on the Plains Spadefoot and Western Hognose Snake (*Heterodon nasicus*). A total of three adult Plains Spadefoots were found during my survey. The first sighting occurred on 21 June 2012 at 23:15. The second and third sightings occurred on 22 June 2012 between 23:23 – 23:34 (Figure 1). All sightings occurred in a small wetland located behind Sietz Elementary School in Camp Forsyth (Figure 2). Breeding choruses were heard during these sightings (Pence 2013).

Discussion

The Plains Spadefoot was reconfirmed at Fort Riley during my 2012 survey and was most recently seen again at Fort Riley on 20 May 2013 in Camp Forsyth during a nocturnal amphibian call survey conducted by the Fort Riley Environmental Division (pers. comm.: Fort Riley Environmental Division). All sightings occurred in the wetland located behind Sietz Elementary School in Camp Forsyth (Pence 2013). The open sand prairie located south of the wetland contains sandy soil that is preferred by the Plains Spadefoot (Collins, Collins, and Taggart 2010) and is likely where this species burrowed during dry conditions. On 20 June 2012, the FRMR received an estimated two inches of precipitation (pers. comm: Fort Riley Environmental Division) which likely stimulated Plains Spadefoot breeding activity. At Fort Riley, the natural rarity of the soil type preferred by Plains Spadefoots makes this species highly localized at the installation (Pence 2013). The increased urbanization in the Camp Funston and Camp Forsyth areas is likely contributing to the decline in suitable habitat for the Plains Spadefoot. Also, because of the 2012 drought, there was likely not enough precipitation to bring more Plains Spadefoots to the surface during that summer.

Future Plains Spadefoot surveys at Fort Riley should be focused in the Camp Funston and Camp Forsyth areas. These are the only open areas at Fort Riley where the soil type preferred by Plains Spadefoots is present (Busby, Collins and Suleiman 2005). The Plains Spadefoot is a fossorial and nocturnal species and only emerges from the ground after heavy rainfall (Hoyt 1960), which means surveys should be conducted after heavy precipitation occurs. Because most Plains

Figure 1. A Plains Spadefoot (*Spea bombifrons*) chorusing in the wetland in Figure 2.

Figure 2. A small wetland located behind Sietz Elementary School in Camp Forsyth.

Spadefoot breeding choruses in Kansas have been recorded between 22:00 – 03:00 (Collins, Collins and Taggart 2010), an extension in the amount of time spent in amphibian call surveys should be considered. Dipnetting for Plains Spadefoot tadpoles should also be considered, but could be difficult because the tadpole stage of this species is known to be as short as nine days (Busby, Collins and Suleiman 2005). Since Camp Funston and Camp Forsyth are two of the main urban areas at Fort Riley, public education on how to identify the Plains Spadefoot (sight and sound) and the ideal conditions for this species could help yield more sightings in the future.

Acknowledgements

I thank the staff of the Fort Riley Environmental Division (Shawn Stratton, Mike Houck, Tom Duckworth, Frank Rottinghaus, Brian Monser, Brett Parsons, Josh Pease, Steve Wahle, Derek Moon, Megan Smith, David Myers, and Steve Huebner) for logistical support and all their hard work helping me in the field. I thank Shawn White of the GIS department at Fort Riley for his help in mapping out survey and specimen locations at the installation. I thank Dr. William Busby of the Kansas Biological Survey for providing me with the original 1993 Fort Riley herpetological survey data and his great advice. I thank Dr. William Jensen of Emporia State University for additional field supplies. I thank my major advisor (Dr. John R. Schrock), scientific committee (Dr. Brent Thomas and Dr. Lynnette Sievert), and Greg Sievert at Emporia State University for their advice and guidance. I thank the Institutional Animal Care and Use Committee (IACUC) at Emporia State University for approval of my research protocols (ESU-PROTOCOL-11-019). I give special thanks to the Kansas Department of Wildlife, Parks, and Tourism for a scientific collection permit (#SC-077-2012) and financial assistance through the Chickadee Checkoff Small Grants program (KDWPT Project #CC-2012-06).

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Shedding Aggregations of Timber Rattlesnakes (*Crotalus horridus*)

Introduction

Timber Rattlesnakes (*Crotalus horridus*) in southeastern Minnesota hibernate in dens associated with crevices in rock outcrops in “goat prairies” on south- or southwest-facing slopes of bluffs. During individual years, they first appear from late April to mid-May and are last observed from mid-September to early October (Cochran, 2008; Cochran, unpublished data). Gravid females remain at dens or in nearby rocky habitat, whereas males and nongravid females move away from the slopes to forage. The frequency of Timber Rattlesnakes as “nuisance snakes” in residential and agricultural areas typically increases sharply in early July (Cochran, 2008; Cochran, in review).

Ashton (1999) described shedding aggregations of *Crotalus viridus concolor* in Wyoming and speculated about their potential benefits. He defined snakes that occurred within 5 m of each other as aggregated. The purpose of the present account is to report evidence for shedding aggregations in Timber Rattlesnakes.

Methods

Observations were made on south- and southwest-facing slopes of bluffs in Winona and Houston counties in southeastern Minnesota, the same bluffs monitored by Cochran (2008). Because the Timber Rattlesnake is a threatened species in Minnesota, precise locations are not included here. During surveys on each bluff, the presence of Timber Rattlesnakes and shed skins were noted at each ledge or den opening. Snakes were not handled, which may lead to greater wariness at dens and basking sites and make them more difficult to observe (Brown, 1992, 1993), but that meant that exact counts were not always possible and that it was not possible to determine the sex of individual snakes.

Results

Winona County – Observations were made at two den openings, referred to herein as the Main Ledge and Accessory Den. At the Main Ledge in 2004, five snakes and no sheds were present on 16 May, 7-8 snakes and three sheds on 29 June (two snakes appeared to be in pre-shed condition), 4-5 snakes and seven additional sheds on 2 July, and six snakes and no sheds on 20 July. At the same site in 2009, six snakes were present on 31 May 2009 and 10 snakes and nine sheds on 7 July.

At the Accessory Den, three adults were present on 16 June 2008 and three sheds but no snakes were observed on 25 June. At the same site in 2010, two snakes were present on 5 June and two sheds but no snakes on 1 July.

Houston County – One site observed on the Houston County bluff in 2007 (Figures 1-3) consisted of a rock ledge and a slab rock 3 m away that was leaning against the slope at a steep angle. Of four snakes present on 4 June, three were in pre-shed condition with milky eyes. Six snakes and two sheds were present on 13 June. Five additional sheds were present on 21 June, and four snakes were behind the rock slab. One shed and four snakes were observed on 3 July; by 10 July, only one snake was apparent. On 16 June 2012, seven snakes were present at this site (five in the vicinity of the tilted slab) along with nine sheds; all snakes appeared to have shed recently.

Farther upslope on the Houston County bluff at another ledge with a leaning rock slab, two sheds observed on 19 July 2007 were not present on 10 July. On 16 June 2012, eight snakes, all newly shed, were present at this site, and three sheds were clustered approximately 8 m downslope (Figure 4). On this date, several solitary snakes and several solitary sheds were observed on the Houston County bluff.

DISCUSSION

My observations are consistent with the possibility that some adult Timber Rattlesnakes aggregate during late spring and early summer until shedding occurs within a short period of time, followed by dispersal. In some cases, I found groups of sheds that appeared to be of roughly the same age, but the sites were not visited frequently enough to establish how closely in time they were produced. However, in both Winona and Houston county sites, multiple sheds appeared at sites within intervals of 8 days or less.

Shedding aggregations were reported for *C. viridus concolor* by Ashton (1999). Because snakes at his study site did not appear to hibernate communally, he believed that they aggregated specifically to shed and not simply as a result of their recent egress from hibernacula. In contrast, on both the Winona and Houston county bluffs, some groups of sheds occurred near openings where Timber Rattlesnakes emerge from hibernacula (e.g., the Main Ledge and Accessory Ledge in Winona County), and where, in some cases (e.g., the Main Ledge), gravid females may remain all season and give birth in late summer (Cochran, 2008). Similarly, some previous studies (Galligan and Dunson, 1979; Brown et al., 1982) have indicated that at least some Timber Rattlesnakes remain in the vicinity of dens until after they have shed. However, in the present study, some aggregated Timber Rattlesnakes had moved from ledges with underground access to sites without such access (e.g., the tilted rock slabs).

If shedding by Timber Rattlesnakes in early summer

Figure 1. Two Timber Rattlesnake sheds at a site on the Houston County bluff, 21 June 2007.

Figure 2. Three Timber Rattlesnakes in an aggregation behind a tilted rock slab on the Houston County bluff, 21 June 2007. An additional snake was concealed behind the rock.

is more or less synchronous, it may help explain why they don't appear in great numbers at lower elevations until early July (Cochran, 2008; Cochran, in review). However, because sheds at any given site did not necessarily all appear on the same date, my observations are consistent with the likelihood that there is some degree of "turnover" within shedding aggregations, with snakes entering and leaving aggregations asynchronously. It would be helpful to monitor putative shedding aggregations more continuously than I was able to do, and strategically placed remote cameras (Cochran and Schmitt, 2009) may prove useful for this purpose.

Ashton (1999) suggested that the potential advantages conferred by shedding aggregations include increased protection from predators, decreased heat loss, and decrease water loss. These potential benefits may also accrue to aggregating Timber rattlesnakes. Moreover, in light of what is known about the genetic structuring of Timber Rattlesnake populations with respect to hibernacula (Clark et al., 2008; Clark et al., 2012), it is possible that at least some individuals within shedding aggregations are more closely related to each other than random, and, if so, indirect selection might favor this behavior.

Further studies of Timber Rattlesnake social behavior are warranted. A greater understanding of aggregations is especially critical in light of the potential emergence of the fungal pathogen *Chrysosporium* sp. as a source of mortality in Minnesota populations (Smith et al., 2013).

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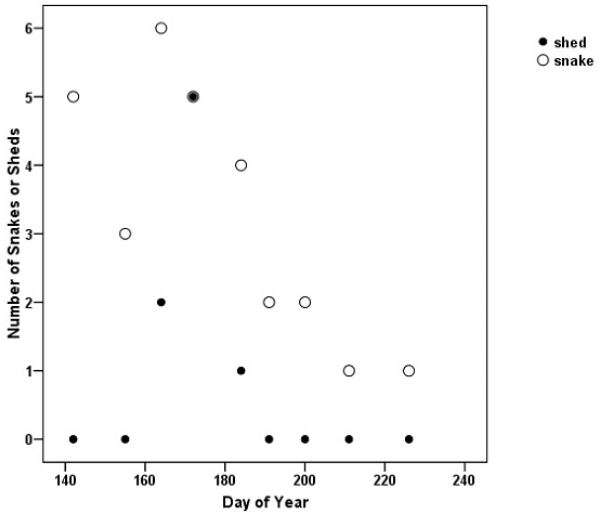

Figure 3. An example of a shedding aggregation of Timber Rattlesnakes at a site on the Houston County bluff in 2007. Number of Timber Rattlesnakes (open circles) and sheds (solid dots) observed at the site versus day of year. For reference, day 200 is 19 July.

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Prairie Ring-necked Snake *Diadophis punctatus arnyi* Captive Care

Introduction

Prairie Ring-necked Snakes (*Diadophis punctatus arnyi*) are small (up to 28.1 cm SVL) snakes common in prairies, woodlands, and rocky areas of Kansas (Fitch 1975, Collins et al. 2010). However, because they are difficult to keep in captivity they are rarely used in laboratory experiments (Fitch 1975). Henderson (1979) collected 32 *D. p. arnyi* and housed them in a laboratory setting, but only one survived to 210 days. The snakes were difficult to feed; only 36% of his snakes would eat, and he found that neither force-feeding nor transference to simulated natural settings induced the snakes to start eating. Additionally, *D. p. arnyi* develops blisters if the substrate is too wet, but has problems shedding if the captive area is too dry (Fitch 1975, Henderson 1979). For my ongoing research, one objective was to determine how to keep these snakes healthy long term.

Housing – I collected 20 adult *D. p. arnyi* from Atchison County, Kansas, on 8 September 2012 and 32 adults from Chase County, Kansas, between 14 April and 13 May 2013. Seven snakes were still alive from the Atchison Co. group when they were released 17 May 2014 (kept 621 days), and 19 snakes from the Chase Co. group were still alive when they were released 8 May 2014 (kept 389 days). The Atchison Co. group was housed in a tank 93.5 x 36.5 x 52.5 cm that was glass on one side, wood on the other three sides, and had a wood floor and ceiling. The snakes were housed on a dry unfertilized potting soil substrate about 2 cm thick with dry leaves covering the soil. There was an assortment of cover objects in the tank, including broken clay pots, small flat rocks, bark pieces, and PVC pipe halves. The Chase Co. population was split into groups of 17 and 15 and housed separately so the snakes would have more room in the tanks. Each group was housed in a plastic 79 x 32 x 27 cm container with the same substrate conditions as the Atchison Co. group. The cover objects in these tanks were whole bricks, flat rocks, and bark pieces. I initially housed the Atchison Co. group with a moistened local soil substrate, but several of the snakes developed persistent blisters and I changed to a dry local soil substrate. Henderson (1979) noted that if his snakes were not transferred to a dry substrate after they developed blisters, they usually died within 2 or 3 weeks. The blisters disappeared within a few weeks of changing to a dry soil substrate. Later, I found that the snakes were less likely to attempt escape if they were housed with a dry potting soil substrate, perhaps because it is easier for them to move through the potting soil than the dried local soil, which may allow them to feel more secure.

All tanks had 40 W incandescent lights on a timer that allowed light from 07:00 to 19:00 CDT and CST, and the room temperature was kept at 25C. All tanks had 2 shallow water bowls that were changed daily and 2 cotton socks that were kept moist in opposite corners of the tank. Snakes that appeared thin were isolated from the group to monitor their condition more closely. The isolation tank was a plastic container 40.5 x 28 x 14.5 cm with a dry potting soil substrate 2 cm thick, a cotton sock, a shallow water bowl, a piece of bark, and dry leaves.

Feeding Rate – Diadophis p. arnyi feeds almost exclusively on earthworms, especially *Allolobophora caliginosa* (Fitch 1975). To feed the snakes, I put earthworms on top of the moistened socks, and the snakes were allowed to forage. Before feeding, I made sure there were no earthworms, snakes, or snake eggs in the socks, remoistened the socks, and returned them to the tank. I put the earthworms directly on the soil at first, but after changing to a dry substrate the socks served as a refuge for the earthworms. Henderson (1979) found that *D. p. arnyi* feeds equally during the day and night, and Blanchard et al. (1979) found similar results with *D. p. edwardsii*. I usually fed the snakes every 1-3 days, but occasionally they went up to 4 days without being fed. Feeding rate data for the Atchison Co. group were collected over 199 days between 1 October and 30 November 2012, and between 29 January and 17 June 2013. Between 30 November 2012 and 29 January 2013, the Atchison Co. group was in hibernation, and no earthworms were given to the snakes. Feeding data for the Chase Co. group were collected over 63 days between 15 April and 17 June 2013.

The Atchison Co. group ate about one earthworm every two days and the Chase Co. group ate about one earthworm every three days. Because I fed snakes in groups, I was unable to determine which snakes had eaten or whether some snakes ate more than others. In both groups, the snakes initially only ate a few earthworms about every 5 days, but the snakes' consumption increased the longer they were held in captivity. The Atchison Co. group was initially fed without the socks; I put the earthworms directly on the moistened soil. The Atchison Co. group ate more earthworms after I changed the method of feeding, but the snakes may have become habituated to captivity and more willing to eat. I was eventually able to feed some individuals of the Atchison Co. group directly from forceps. The Chase Co. group, which was collected later, was fed with the same method I

used to feed the Atchison Co. group after I changed the method of feeding the snakes.

Mortality Rate – Several of the *D. p. arnyi* I kept in the laboratory died; most of them died within 100 days of the end of hibernation (Fig. 1). I was unable to determine the cause of any of the deaths. Some died suddenly, but most of the snakes that died visibly lost weight prior to death. All of the snakes that were put in the isolation tank by themselves refused to eat and died. I later put an additional, healthy snake in the isolation tank when I noticed an underweight snake, and some of the underweight snakes that were kept with a healthy snake started eating again and recovered.

Conclusion

Fitch (1975) noted that *D. p. arnyi* eats one earthworm about once every eight days, but the *D. p. arnyi* I kept in captivity ate considerably more. The Chase Co. group was collected during the breeding season, so one explanation for the snakes initially eating very little could be that breeding affected their behavior (Gregory et al. 1999). I found that keeping the substrate dry and using a few moistened cotton socks reduced the number of blisters while allowing the snakes to moisten their skin for shedding, if they needed to loosen their skin, and providing a suitable microhabitat for the earthworm prey. The snakes appeared to become habituated to captivity because they stopped attempting to escape, especially when I provided dry leaves to use as additional cover to the cover objects. However, the snakes still appeared stressed if disturbed, so if keeping *D. p. arnyi* for experimentation I recommend minimal contact.

Because it is so abundant in Kansas, *D. p. arnyi* can be collected easily for laboratory experiments without extirpating it. The snakes are easily stressed and need certain conditions to thrive. They require at least 2 cm of dry soil that they can move through such as potting soil, a number of cover objects such as bark pieces or broken clay pots, leaves covering the bare spots of soil to provide additional cover, moist pieces of cloth such as cotton socks that the snakes can use to dampen their skin during their shed cycle as well as providing refuge for earthworm prey, and a constant water source. If these conditions are met, it is possible to keep *D. p. arnyi* in captivity long-term.

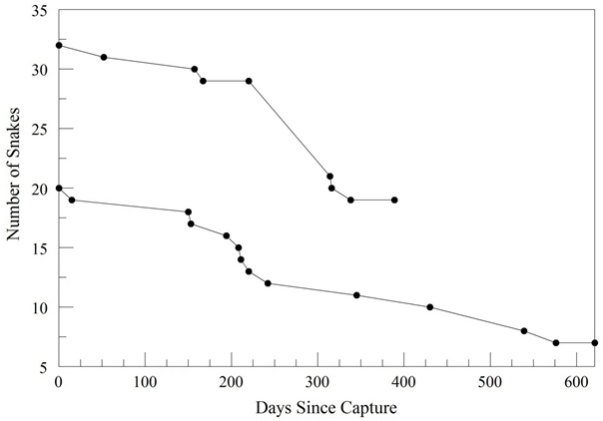

Figure 1. *Diadophis punctatus arnyi* mortality rate in captivity. The data from the Atchison and Chase county groups have been separated.

Acknowledgements

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The Red-eared Slider, *Trachemys scripta elegans* (Wied, 1838), found in Westmoreland County, Pennsylvania

The Red-eared Slider, *Trachemys scripta elegans* (Wied, 1838), is an aquatic emydid turtle native to much of the central United States (Conant and Collins, 1998). It has been reported in other states outside of its native range but its status in many of these sites is poorly known (Conant and Collins, 1998; Somma et al., 2013). Here, we provide the first vouchered published record of the Red-eared Slider in Pennsylvania.

An adult female (21 cm carapace length, 20 cm plastron length) was captured by DFH in conjunction with an aquatic turtle mark-recapture project in a shallow pond (40.17156302°, -79.273906°; elev. = 390 m) in Rector, Westmoreland County, Pennsylvania on 18 July 2013. The turtle was identified by Pablo R. Delis and was deposited in the State Museum of Pennsylvania (SMP-H6620). Upon dissection, the female was found to contain six *corpora lutea* ranging 4.8-7.9 mm, indicating production of an earlier clutch. In addition to luteal scars, the female also contained 51 ovarian follicles at various sizes > 3.0 mm in diameter (Figure 1). Six follicles measured 19.6-22.2 mm, and the next putative follicle size-class ranged 18.1-18.8 mm (n = 8). This was a potentially highly fecund individual. We do not know the length of time this turtle has been in the wild or the point of its escape or release. However, we do know that this female had laid at least six eggs someplace during 2013, and based on the size distribution of her follicles, she probably would have produced one more clutch before fall. The status of this species in the Rector area remains unknown, and to that end, this capture should serve to underscore the potential danger of release or escape of even just one adult female of what is a potentially highly fecund and long-lived species (Ernst et al., 1994).

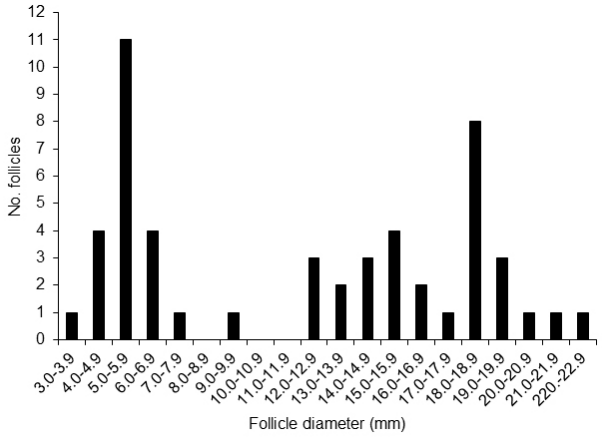

Figure 1. Distribution of ovarian follicle sizes from a single female Red-eared Slider (*Trachemys scripta elegans*) collected on 18 July 2013 from a pond in Rector, Westmoreland County, Pennsylvania.

Acknowledgments

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The Defensive Behaviors of Dekay's Brownsnake, *Storeria dekayi*: An Illustrated Review of a Diverse Repertoire

Dekay's Brownsnake, *Storeria dekayi* is a small (total length up to 492 mm) natricine snake that is relatively common in eastern North America (Conant and Collins 1998). It may be found in various habitats, including fields, meadows, and ecotonal areas, and also thrives at urban sites where an abundance of non-native slugs and earthworms are present (Gray 2013a; 2014a). One of the most common descriptions of this snake includes the word inoffensive, or a variation of the phrase "seldom or never attempts to bite". The enemies of Dekay's Brownsnake are many and include frogs, snakes, birds, and mammals (Ernst and Ernst 2003). Humans may intentionally or inadvertently kill Dekay's Brownsnakes. Despite the ubiquity of Dekay's Brownsnake, it is secretive and not readily observed unless sought after under logs, flat rocks, or debris. Once this little serpent is exposed, it may perform any number of defensive behaviors. Defensive behaviors may be classified into two categories, passive or active. Passive defense, such as crypsis or concealment operates regardless of whether or not a potential predator is nearby, and decreases the likelihood of an encounter (Edmunds 1974). While active defenses such as flight, death-feigning, bluffing, and attack are invoked only after a potential predator has been detected or made contact, and functions to increase the prey's chances of survival during an encounter (Edmunds 1974). Fleeing beneath a cover object is active defense, while remaining there after a potential predator has left, is passive (Cloudsley-Thompson 1994).

It is the purpose of this paper to summarize the defensive strategies of Dekay's Brownsnake in an effort to increase the reader's appreciation for this often overlooked serpent. In addition to my own observations, I reviewed 27 references and my own personal observations for descriptions of the defensive behaviors of Dekay's Brownsnakes. From these sources, the relative prevalence of each behavior is noted.

Crypsis and Concealment – The first line of defense of many snakes is to remain undetected. This may be accomplished by crypsis (i. e., camouflage) or concealment in a secure refuge. In Dekay's Brownsnake, the dorsal pattern of earthy tan to brown tones may help it to blend in with its surroundings, especially when dried vegetation is present (Figure 1). When initially exposed, Dekay's Brownsnake may stay motionless (Krulikoski 2004) in an effort to remain inconspicuous. During spring, I have frequently found Dekay's Brownsnakes concealed beneath clumps of dry grasses. Such behavior likely allows the snakes to bask while not being exposed to avian and other potential predators. Many predators are attracted by movement, including Racers, *Coluber constrictor* which are known to prey on Dekay's Brownsnake (Ernst and Ernst 2003). Anachoresis is the term used to describe the phenomenon in which animals live or extensively use crevices or holes. Many snakes are anachoretic and can be found beneath a log, rock, board, or other debris. Dekay's Brownsnake is more anachoretic during the day than at night, at which time it hunts for nocturnal slugs and earthworms. Concealment beneath a cover object may provide protection during inactive periods of rest and sleep when the animal is not so alert and capable of taking evasive action (Edmunds 1974). Concealment, however, does not offer protection from all predators. For example, while taking refuge beneath a board may prevent predation by a bird, it may not protect a Dekay's Brownsnake from shrews or ophiophagous snakes (e. g., Milksnakes, *Lampropeltis triangulum*) which frequently occupy these sites (Figure 2). Crypsis and concealment as a defensive strategy by Dekay's Brownsnake is not often discussed in the sources used in this review (Table 1).

On several occasions during late spring and early summer, I have found Dekay's Brownsnakes beneath cover in proximity to ants (Figure 3). In my limited experience (three observations), the ants appeared to be oblivious to the snakes in all cases. Perhaps the ants do not recognize live Dekay's Brownsnakes as a threat or food. Ants do feed on dead snakes, including Dekay's Brownsnakes as well as their shed skins (Gray 2005). The overlapping keratinized scales of Dekay's Brownsnakes should offer protection from bites by smaller species of ants. It is known that Dekay's Brownsnakes use ant nests to hibernate during winter (Pisani 2009). Might it be possible that during the active season Dekay's Brownsnakes gain some protection against certain predators by abiding with or near ants? Some snakes (Leptotyphlopidae) that feed on ant pupae produce chemicals that protect them from being attacked by the ants (Vitt and Caldwell 2009); such a defense has not been described for Dekay's Brownsnakes.

Aggregation – Dekay's Brownsnakes aggregate during the active season beneath cover objects in groups of up to 12 snakes (Noble and Clausen 1936; Gray 2013b). There is safety in numbers, and aggregating may reduce the likelihood of any one snake in a group from being preyed upon. Aggregating behavior may occur for many other reasons however, such as increased mating opportunities, reduced water loss, and in response to concentrations of prey (Gray 2013b); it

Table 1. Defensive behaviors of Dekay's Brownsnake, *Storeria dekayi* reported in select references (n = 27), and observed by me.

Defensive Behavior	Sources
Crypsis or concealment	X
Death-feigning	2, 14, 16, 18, 22
Flattening	1, 3, 4, 7, 8, 10, 12, 13, 16, 17, 19, 20, 22, 23, 25, X
Fleeing	7, 13, 16, X
Gaping	X
Head-hiding	2, 16, 22, X
Inflate or puffing up	3, X
Inoffensive	5, 7, 9, 10, 11, 12, 13, 15, 17, 19, 21, 23, 24, 25,26, 27, X
Lip-curling or flaring	12, X
Musking /smearing feces	2, 3, 6, 7, 8, 10, 11, 13, 16, 17, 18, 19, 20, 22, 23, 25, X
Remain still	13, X
Strike posture	3, 10, 12, 13, 18, X
Striking	1, 3, 12, 18, 22, X
Twisting or thrashing	3, 11, 17, X

Sources: *1*. Ashton and Ashton 1981; *2*. Ballinger et al. 2010; *3*. Bartlett 1987; *4*. Bartlett 2001; *5*. Bishop 1927; *6*. Collins et al. 2010; *7*. Conant 1938; *8*. Conant and Collins 1998; *9*. Fowler 1907; *10*. Harding 1997; *11*. Holman 2012; *12*. Hulse et al 2001; *13*. Krulikoski 2004; *14*. Liner 1977; Logier 1958; *16*. Mason and Hill 2008; *17*. McCauley 1945; *18*. Miller 2013; *19*. Oldfield and Moriarty 1994; *20*. Palmer and Braswell 1995; *21*. Pope 1964; *22*. Rowell 2012; *23*. Schmidt and Davis 1941; *24*. Trauth et al. 2004; *25*. Vogt 1981; *26*. Froom 1972; *27*. Mount 1975; *X*. This study.

is for this reason I chose not to include aggregation in Table 1. The benefit of aggregation behavior in increasing survivorship of individual Dekay's Brownsnakes is an area in need of study.

Fleeing – When the above tactics fail and the snake is noticed by a potential predator, what next? Fleeing is an option and is the choice of many snakes. Locomotor ability, like many other attributes of ectotherms, is dependent on temperature. Locomotor velocities of neonatal Dekay's Brownsnakes increased significantly with temperature (Gerald and Claussen 2007). Maximal crawling speed of *Thamnophis elegans* is strongly temperature dependent (Peterson et al. 1993). During fleeing, a snake's sudden change in direction may confuse a potential predator (Heckrotte 1967). Several studies have demonstrated that at lower temperatures gartersnakes exhibit more aggressive defensive behaviors rather than attempting to flee (Fitch 1965; Heckrotte 1967; Arnold and Bennett 1984). This was supposedly the result of the negative effect of lower temperatures on crawling speeds and the futility of direct escape (Heckrotte 1967). In contrast, Schieffelin and de Queiroz (1991) demonstrated that Eastern Gartersnakes were less aggressive at lower temperatures (10°C) than at higher temperatures (20-30°C). They further noted that at lower temperatures, a snake's movements are slowed to such an extent that aggressive striking is not an effective defense. It has been my experience that Dekay's Brownsnakes and Eastern Gartersnakes more readily attempt to flee when air and soil temperatures are warmer. Fleeing was mentioned in three references (Table 1), and has been observed by me numerous times.

Head-hiding – Head- hiding involves covering the head with coils of the body and tail (Figure 4). Hayes (1987) suggested that head-hiding is a secondary escape method used only when fleeing is not possible. Such behavior diverts attention from the vital head to the more expendable tail. Dekay's Brownsnake may hide its head beneath body coils if touched. Head-hiding is

Figure 1. Dekay's Brownsnake, *Storeria dekayi* (left center) concealed beneath dried vegetation.

Figure 2. The Milksnake, *Lampropeltis triangulum* is a known predator of snakes and is often found beneath cover objects with Dekay's Brownsnake, *Storeria dekayi*.

Figure 3. Dekay's Brownsnake, *Storeria dekayi* found in proximity to ants tending eggs and pupae.

Figure 4. Dekay's Brownsnake, *Storeria dekayi* exhibiting head-hiding behavior.

Figure 5. Dekay's Brownsnake, *Storeria dekayi* with body dorsoventrally flattened.

Figure 6. Dekay's Brownsnake, *Storeria dekayi* with body puffed up and in a defensive posture. Also note that the supralabials are slightly curled.

Figure 7. A cold Dekay's Brownsnake, *Storeria dekayi* (body temperature -0.6°C) dorsoventrally flattening its body in response to handling.

Figure 8. Red-bellied Snake, *Storeria occipitomaculata* exhibiting lip-curling behavior.

Figure 9. Red-bellied Snake, *Storeria occipitomaculata* attacking a Milky Slug, *Deroceras reticulatum*. Note how the labial scales are curled as to prevent contact with the sticky slug.

Figure 10. Dekay's Brownsnake, *Storeria dekayi* exhibiting gaping behavior while in a defensive posture. Note that the supralabials are somewhat flared.

Figure 11. Dekay's Brownsnake, *Storeria dekayi* striking at camera lens.

Figure 12. Dekay's Brownsnake, *Storeria dekayi* in the process of smearing musk on itself.

Figure 13. Dekay's Brownsnake, *Storeria dekayi* regurgitating a slug during handling.

usually accompanied by the release of feces and anal gland secretions, which makes the snake unpalatable to some predators. Head-hiding was mentioned in three references (Table 1), and has been observed by me on numerous occasions.

Flattening and puffing up – Tactile cues have been shown to be important in the rapid change in behavior of many snakes once touched or picked up (Peterson et al. 1993). If touched, Dekay's Brownsnake may suddenly flatten dorsoventrally while assuming a strike posture (Figure 5). This flattening makes the snake appear larger than it is, and exposes a checkered pattern that is otherwise somewhat hidden. The lower profile may also make the snake harder to grasp. In some geckos (e. g., *Ptychozoon* and *Uroplatus* spp.) a dorsoventrally flattened body and tail reduces any lateral shadow, thus obscuring the delineation between the lizard and the background (Edmunds 1974). Perhaps this occurs with Dekay's Brownsnakes as well. I have had at least one Dekay's Brownsnake puff up in addition to flattening (Figure 6). The sudden display may cause surprised hesitation on the part of a potential predator, giving the snake a moment to escape (Parker and Grandison 1977). I have witnessed people not accustomed to handling snakes flinch in response to such displays. Flattening may be accompanied by gaping and striking, behaviors which may make the snake look more intimidating. Bartlett (1987) noted that as a child, such displays as flattening accompanied by coiling and striking frightened him. Temperature plays a role in determining the extent additional anti-predator behaviors will accompany flattening. If very cold, Dekay's Brownsnakes may flatten and sway from side to side when handled (Gray 2014b), as did one juvenile found 1 April 2013 (Figure 7). This individual had a body temperature of -0.6°C. It seems unlikely that the above displays would deter some larger predators such as a cat or raccoon. Perhaps these displays are used effectively against inexperienced predators, such as a juvenile raccoon, just learning to fend for itself. Small mammals might also be intimidated by flattening and striking, although shrews are known to consume Dekay's Brownsnakes. Interactions between potential predators and Dekay's Brownsnakes are sparse and observations of such encounters would be of great interest. If a defensive behavior works just one time, it may have meaningful adaptive value for that individual snake. Flattening appears to be a commonly observed defensive behavior of Dekay's Brownsnake (Table 1); while puffing up is rarely mentioned in the references used in this review.

Lip-curling – In this behavior the supralabial scales are curled upward, exposing the teeth, and in some instances, the snake rubs against the skin of the restraining hand. The curling of the supralabials (Figure 8) is more commonly exhibited by the closely related Red-bellied Snake, *Storeria occipitomaculata* (do Amaral 1999; Busby and Pisani 2012); however, it has also been reported for Dekay's Brownsnake (Hulse et al. 2001). In Dekay's Brownsnake the extent of lip-flaring is not as extreme as that of the Red-bellied Snake (Figure 6). In a study of this behavior in the Red-bellied Snake, do Amaral (1999) noted that the two posterior-most teeth on each maxilla are more robust than the others and are equipped with well-developed distal carina (i. e. a thin and sharp blade-like ridge). He further noted that during the lip-curling display, the maxillary bone is protracted outwardly and rotated, causing the posterior teeth of the maxillary bone to protrude from the snake's mouth in a spur-like manner. In addition to these cranial changes, a slightly viscous clear secretion, possibly from Duvernoy's glands, fills the mouth just after the display begins (do Amaral 1999). Both Red-bellied Snakes and Dekay's Brownsnakes feed on slugs, which may exude large amounts of sticky mucus, and it is for this reason that Gans (1975) suggested that these snakes curl their lips during feeding (Figure 9). Johnson and Stark (2013) provide an image of a Dekay's Brownsnake with its upper labials curled while feeding on a slug. Since lip-curling was so common and easy to evoke in Red-bellied Snakes, do Amaral (1999) thought that the behavior must be an efficient and effective deterrent against some potential predators. A good majority of predators grasp their prey in their mouths, in proximity to their eyes. While a Dekay's Brownsnake scraping its teeth against the skin of a person's hand might be futile, scraping them across the eye or nose of a much smaller predator might elicit the release of the snake. Incidentally, the same is likely true of the tail spines of Wormsnakes (*Carphophis* spp.) and Mudsnakes and Rainbow Snakes (*Farancia* spp.). If a tail spine were to be pressed into an eye, the action may elicit a predator to release the snake. These behaviors must be effective in deterring some predators; otherwise, why would they persist? Lip-curling is apparently rarely observed, it is mentioned in only one of the references used in this review (Table 1). I have observed slightly curled lips in a Dekay's Brownsnake during gaping behavior (Figure 10).

Gaping – Gaping involves opening the mouth and displaying the teeth or internal lining of the mouth. This behavior is well known in the venomous Cottonmouth, *Agkistrodon piscivorus*, which displays the white inner lining of its mouth as a warning, signaling that the snake is dangerous (Ernst and Zug 1996). Dekay's Brownsnake is not a dangerously venomous snake, although the behavior does make it look more threatening than it is (Figure 10). Gaping by Dekay's Brownsnakes may be accompanied by flattening, assuming a defensive posture, and by striking (Figure

11). Gaping was not mentioned in any of the references used for this review, but has been observed by me on several occasions (Table 1).

Death-feigning – Death-feigning (letisimulation or thanatosis) usually requires an initial tactile stimulus, and presumably works by damping a potential predator's interest (Gehlbach 1970; Ernst and Zug 1996). Some predators, including cats will continue to attack prey that show active movements (Edmunds 1974). Therefore, thanatosis may cause these predators to relax their attention, giving the prey a chance to escape. Ruxton et al (2004) suggest that death-feigning can be effective for single prey individuals, if the predator concerned has evolved to release prey quickly, because it often encounters prey in groups. Quick release of non-struggling prey by such predators in these situations can aid in making multiple kills. Death-feigning behavior in some snakes is often preceded by erratic activity (e. g. writhing and thrashing) and succeeded by a cautious recovery involving tongue-flicking (Gehlbach 1970). Dekay's Brownsnakes observed exhibiting this behavior by Hayes (1987) became flaccid, and refused to move or turn over when placed on their backs. Liner (1977) noted that upon touching a Dekay's Brownsnake, it writhed, became kinked with the appearance of being desiccated and turned on its back. He further noted that if turned over, the snake made no effort to roll on its back. With handling the Dekay's Brownsnake made no response or discharge of musk. I have not witnessed death-feigning in Dekay's Brownsnake and the behavior seems relatively uncommon (Table 1). It has been observed in the closely related Red-bellied Snake (Linzey and Clifford 1981). Gehlbach (1970) suggested that since death-feigning does not occur without following erratic activity and may be released by this behavior its evolution is comparatively recent. Five references noted death-feigning as a defensive behavior of Dekay's Brownsnake (Table 1).

Musking and defecation – This appears to be one of the more commonly reported defensive behaviors of Dekay's Brownsnake (Table 1), and is induced by touching or handling the snake. Smearing musk and or feces on their bodies or on potential predators make the snake unpalatable either by a nasty taste or foul smell. Incidentally, juvenile Milksnakes appear to be unaffected by this defensive strategy as they frequently consume Dekay's Brownsnakes (Ernst and Ernst 2003; Gray 2014a). Musking may accompany other behaviors such as head hiding (Figure 12), twisting and thrashing about, and struggling (McCauley 1945; Bartlett 1987; Holman 2012). Occasionally Dekay's Brownsnakes will regurgitate recently eaten prey (Figure 13) while being handled (Gray 2013a). I am not aware of observations of Dekay's Brownsnakes disgorging a recent meal during a predator-prey interaction in the wild. If it does occur, such behavior might repulse a predator, as it does some humans. Regurgitating a recently consumed prey might distract a predator by offering it an alternative meal.

Several factors may influence the defensive repertoire of a given population of snakes, so that not all behaviors known to be utilized by a species will occur at every site. For example, a lack of predators at a site may alter the resident snake population's defense strategy. Barnes et al. (2006) noted that Maritime Gartersnakes on Georges Island, Nova Scotia were likely less aggressive than their mainland counterparts as a result of reduced predation. Nocturnal activity may have evolved in some snakes to minimize the risk of avian predation (Webb and Whiting 2005). It may seem surprising that such a repertoire of defenses is reported for Dekay's Brownsnake. However, one must realize that smaller snakes potentially have more predators than larger snakes. Therefore, whereas a single defensive behavior may be needed by a large snake to deal with one or a few predators, a small snake, like Dekay's Brownsnake may need many more to deal with a plethora of predators. Also, certain circumstances may require different defensive strategies. For instance, when cold fleeing may not be an option for a snake, and therefore intimidation by flattening and striking may be more successful. Several snake species adopt specific defenses against particular predators. For example, rattlesnakes assume a defensive posture known as body bridging when exposed to king snakes, *Lampropeltis* spp. (Weldon 1982). The rattlesnake places its head on the ground, arches the middle of its body and uses the loop to deliver a vigorous slapping blow to the king snake (Bellairs 1970). Likewise, some of the defensive behaviors of Dekay's Brownsnake may be predator-specific and used only against a single species of predator. Observations of defensive behaviors by Dekay's Brownsnakes against a predator in the wild are uncommon (Gray 2014a). Furthermore, the majority of descriptions of these behaviors involve a snake's response to human handling, which is usually gentle and does not cause injury to the snake. It is likely that Dekay's Brownsnakes may behave differently when grasped by the sharp claws, teeth, or talons of a predator. Much more study is needed to determine how Dekay's Brownsnakes react to various potential predators, including humans, and determine if differences in behaviors toward them exist. If only we could see the defensive behaviors of Dekay's Brownsnake through the eyes of its potential predators. Many of the proposed benefits of the defensive behaviors described above also need more detailed study to determine if they are indeed beneficial; hopefully, this brief review will stimulate further research.

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ARTICLES

Observations on the Diet of the Wood Turtle (*Glyptemys insculpta*) in Northeastern Wisconsin and on Its Potential Role as a Seed Disperser

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Abstract. — *Wood Turtles (*Glyptemys insculpta*) at a site in northeastern Wisconsin consumed fruits of several plant species in addition to mushrooms, earthworms, snails, and insects. Germination trials to assess whether seeds of two native plant species were capable of surviving the Wood Turtle digestive process were inconclusive because neither control seeds nor experimental seeds germinated. However, some seeds of two non-native plant species, Tomato and Bittersweet Nightshade, did germinate after recovery from turtle feces. Germination success for Tomato seeds that had passed through a Wood Turtle was not significantly different from that observed for control seeds, but germination success for Bittersweet Nightshade after passing through a turtle was significantly lower than for controls.*

INTRODUCTION

Turtles have been identified as dispersers of seeds in several geographic areas (e.g., Rick and Bowman, 1961; Cobo and Andreu, 1988; Moll and Jansen, 1995; Varela and Bucher, 2002; Blake et al., 2012). In the eastern United States, the Box Turtle (*Terrapene carolina*) was identified by Rust and Roth (1981) as a disperser of Mayapple (*Podophyllum peltatum*) seeds, and additional species with seeds capable of germinating after passage through Box Turtles were reported by Braun and Brooks (1987). In some species, consumption by Box Turtles reduces the time it takes seeds to germinate or increases germination success (Rust and Roth, 1981; Braun and Brooks, 1987).

Mayapple occurs in some areas, such as Wisconsin, where Box Turtles are not present. In some locations, it co-occurs with the Wood Turtle (*Glyptemys insculpta*), an omnivorous species that may spend extensive parts of the year in terrestrial habitat and that is known to consume the fruits of some species of plants (Ernst and Lovich, 2009 and references therein).

During a study of Wood Turtle ecology in Brown County, Wisconsin (Cochran et al., 2014), we were able to collect field data on diet of turtles collected in terrestrial habitat, and we conducted experiments to assess whether seeds can survive passage through the Wood Turtle's digestive tract. We conducted the experiments with two native species, Mayapple and blackberry (*Rubus* sp.), and two non-native species, Tomato (*Lycopersicon esculentum*) and Bittersweet Nightshade (*Solanum dulcamara*). Tomato seeds were used because they are readily available commercially, they have been used in previous research on seed dispersal by turtles (Rick and Bowman 1961), and they provide a basis for comparison with results obtained for native species. Bittersweet Nightshade was added after our trials with native species proved inconclusive. It is an invasive exotic species in the same family as Tomato (Solanaceae) and has bright red berries, The distribution of Bittersweet Nightshade in Brown County includes our study site.

METHODS

We collected dietary data during a field study on a population of Wood Turtles along a small, shallow river in Brown County, Wisconsin (Cochran et al., 2014). The exact location is not provided because of the threatened status of this species. The area around the stretch of river inhabited by the turtles included lowland forest of White Cedar (*Thuja occidentalis*) and Hemlock (*Tsuga canadensis*), upland forest of Sugar Maple (*Acer saccharum*) and Beech (*Fagus grandifolia*), and grassy clearings. Outlying areas were used for agriculture (primarily corn).

Samples analyzed for food items were obtained during July, August, and September and included

seven stomach samples obtained by flushing (Legler, 1977) and 11 fecal samples obtained when turtles were held overnight for processing. In seven cases, paired stomach and fecal samples were obtained for the same individuals. Caputo and Vogt (2008) recommended that both types of samples be used to provide a more comprehensive assessment of diet. Each sample was preserved in 70 % ethanol until it was processed beneath a microscope.

Greenhouse germination experiments using natural lighting were conducted with seeds recovered either from feces of wild turtles held temporarily in captivity or from a captive Wood Turtle obtained from a local wildlife rehabilitation facility (the captive turtle proved more reliable at readily eating fruits). General procedures included treatment of seeds with a 0.5 % sodium hypochlorite solution to inhibit fungal growth (Braun and Brooks, 1987), provision of a cold treatment of at least 30 days for native or naturalized species other than Tomato, use of sterile potting soil, and randomization of the positions of pots with respect to various treatments. Fisher's Exact Test was used to compare between groups with respect to the relative numbers of seeds that did or did not germinate. Because experiments with Mayapple and blackberry resulted in no germination either among seeds that had passed through a turtle or in control seeds, these trials will not be discussed further.

An initial experiment was conducted with commercially obtained Tomato seeds. Seeds were fed to the turtle by embedding them in an "artificial fruit" of banana pulp (15-26 seeds per feeding). Additional seeds were placed in a glass vial and held in the turtle's enclosure as a control. Seeds that remained uneaten in the banana pulp the morning after a feeding were retained as a second control. Each Tomato seed in the turtle's feces was removed with forceps and planted in a separate pot with a seed from each of the two control groups.

A second set of experiments were conducted with seeds of Bittersweet Nightshade collected in September in Brown County, Wisconsin. Seeds from six fruits were divided into two groups. Half of the seeds from each fruit were planted immediately (two seeds/pot). The other half of the seeds from each fruit were wrapped in moist paper toweling, placed in a covered Petri dish and refrigerated at 4.5° C for 30 days, then planted in the greenhouse (two seeds/pot). Three berries were fed to the turtle on 6 October. Ten seeds recovered from the turtle's feces on 29 October were planted in the greenhouse (two seeds per pot).

RESULTS

Actual observations of Wood Turtles feeding in the field were limited to two food types: dewberries (*Rubus* sp.) and mulberries (*Morus* sp.). Several radiotagged turtles moved into grassy clearings and spent several weeks beneath the cover of dewberry plants, in some cases arriving before the berries were ripe and eating green berries. Four turtles were found on one occasion feeding on White Mulberries (*M. alba*) beneath a single isolated tree in an area where turtles were not otherwise observed. In addition to direct observations of feeding, one turtle found at the edge of a dewberry patch had berry stains around its mouth, and another turtle was found with fragments of mushroom about its mouth.

Seeds of *Rubus* spp. (dewberry or blackberry) were found in six fecal samples; mulberry seeds were found in five. Seeds of other plants found in Wood Turtles included grape (*Vitis* sp.) in three fecal samples, sumac (*Rhus* sp.) in one fecal sample, *Prunus* sp. (probably Black Cherry, *P. serotina*) in one fecal sample, quackgrass (*Elytrigia* sp.) in one fecal sample, and ryegrass (*Festuca* sp.) in one stomach sample. A radiotagged turtle that had spent at least one week in a cornfield in an area where Whitetail Deer had knocked down corn plants contained abundant corn seeds in both its stomach and feces (see Castellano and Behler, 2003).

In addition to fruits and seeds, Wood Turtles consumed mushrooms (eight fecal and five stomach samples), which sometimes formed the bulk of individual samples, earthworms (~ 35 individuals in one stomach sample), snails and slugs (six fecal and three stomach samples), and insects (fragments in nine fecal and five stomach samples). Insect prey included at least one dipteran, one bee, two lepidopteran larvae, and eight beetles; a carrion beetle (*Nicrophorus* sp.) in one fecal sample may be evidence of scavenging (McAlpine et al., 2007). White Cedar leaves were found in five fecal and one stomach sample, and fragments of leaves or grasses were found in nine fecal and five stomach samples. Plant material was often present in trace amounts and may have been ingested incidentally to other food items, but it sometimes occurred in volumes up to ~2 cc. Nonfood items included five small pebbles in one fecal sample and a piece of clear plastic ~ 3 cm^2 in another.

A comparison of paired fecal and stomach samples collected from the same individual turtles at the same time (excluding fragments of leaves or grasses) suggested that the former tended to contain a greater variety of food types (paired-t = 2.589, d.f. = 6, p = 0.042). Most seeds were found only in fecal samples, and earthworms occurred only in a stomach sample.

In the germination test using Tomato seeds, seeds took from two to four days to pass through the turtle. Most (26/34) seeds recovered from the turtle's feces germinated. Two seeds that did not germinate appeared to have been physically softened during passage through the turtle. Germination rates of control seeds (30/34) and uneaten seeds removed from the banana

pulp (32/34) were slightly higher than for seeds that had passed through the turtle, but differences among groups were not statistically significant.

In the germination tests involving Bittersweet Nightshade seeds, 55 of 60 seeds planted directly and 50 of 60 seeds subjected to a period of chilling germinated, an indication that chilling did not affect germination rate (p = 0.269). Bittersweet Nightshade seeds were first recovered from the turtle's feces 23 days after the berries were fed to the turtle. Four of 10 seeds that had passed through the turtle germinated. This result was significantly different from the relative numbers of uneaten seeds that did or did not germinate when planted directly (p = 0.001) or when planted after chilling (p = 0.007). Analysis of variance ($F_{2,106}$ = 21.903, p = 0.000) indicated that mean germination times varied among seeds planted directly (7.73 days. SE = 0.16 day, range: 7-12 days), chilled seeds (9.06 days, SE = 0.66 day, range: 7-25 days), and seeds that passed through a turtle (19.00 days, SE = 1.00 day, range: 18-22 days). Post-hoc comparisons that did not depend on homogeneous variances (Levene test, p = 0.001) indicated that the mean germination time for the seeds fed to a turtle was significantly different from the means for the other two groups.

DISCUSSION

The results of the germination trial with commercial Tomato seeds are similar to those of Rick and Bowman (1961), who fed Galápagos Tortoises (*Chelonoidis porteri*) wild and commercial Tomato seeds. Both types of seeds germinated after passage through tortoises, but the commercial Tomato seeds germinated at a lower rate than uneaten controls. Bittersweet Nightshade, which is in the same family as Tomato, also displayed reduced germination success after passage through Wood Turtles (as well as longer germination times), although our sample size was small.

Although Ernst (2001) reported that Wood Turtles at a Pennsylvania site consumed only animal food, they are known to eat plant material, including fruits, at other locations (see review by Ernst and Lovich, 2009). Wood Turtles at our Brown County study site consumed fruits and seeds of several species, including some taxa (*Prunus, Rubus*) found in the scats of Gopher Tortoises (*Gopherus polyphemus*) in Georgia (Birkhead et al., 2005) and some taxa (*Morus*, *Prunus*, *Vitis*) shown by Braun and Brooks (1987) to be capable of surviving passage through the digestive tracts of Box Turtles. Although we were not successful at germinating the seeds of the two native plant species used in our trials, Braun and Brooks (1987) were also unsuccessful with blackberry, and we have demonstrated that at least some plant species produce seeds capable of germinating after passing through Wood Turtle digestive tracts. Bittersweet Nightshade, although a non-native plant, does occur at our Brown County study site.

The distance a Wood Turtle might disperse a seed would be affected by the time it takes to pass through its digestive tract and the distance moved by the turtle during that time. The digestive period may be affected by such factors as temperature (Sadehayobi et al., 2011) and the frequency of feeding, but our casual observations are consistent with previous reports (e.g., Rick and Bowman, 1961, Braun and Brooks, 1987) that it may take days or weeks for seeds to appear in turtle feces. Some of the radiotagged turtles we followed were sedentary for long periods of time (e.g., during the fruiting season for dewberries), but individual turtles sometimes made movements as long as 236 m in a single day. The turtle we observed in the cornfield moved from there 172 m and across the river to a blackberry patch within a 24-hour period. Thus, Wood Turtles have the potential to disperse some seeds long distances across the landscape, at least by the criterion (> 100 m) used by Cain et al. (2000).

Although we were unable to continue our investigation of Wood Turtle feeding ecology beyond the work described here, it is hoped that future studies will address the potential role of this species as a seed disperser. We anticipate that larger samples of stomach and fecal contents would have revealed additional plant species with fruits consumed by this species. Additional germination trials using seeds of native species would also be desirable, although it may be inevitable that turtles disperse seeds of non-native plants as well as those of native species (e.g., Blake et al. 2012). Our experiments were narrowly focused on the question of whether some combination of mechanical and chemical action in the turtle gut affects germination; it would be ideal if future trials also included an assessment of germination by seeds deposited in unconsumed fruit (Samuels and Levey, 2005). Finally, it may be desirable to elaborate the details of interactions between Wood Turtles and the individual plant species they disperse. We offer two examples suggested by the present study: (1) What are the effects on each species of Wood Turtles consuming unripe dewberries? (2) How do chemicals in fruits such as Bittersweet Nightshade affect the digestive process (Cippolini and Levey, 1997)?

ACKNOWLEDGMENTS

This research was conducted under Permit 229 from the Bureau of Endangered Resources of the Wisconsin Department of Natural Resources. Our field work was partially funded by grants from the Chicago Herpetological Society and the Saint Norbert College Student-Faculty Endowment Fund. We thank the many people who assisted with field work, germination trials, or care of captive Wood Turtles, including Andrew

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Fourth and Final Update!

UNIVERSITY OF KANSAS SSAR MEETING

THURSDAY, JULY 30 – MONDAY, AUGUST 3, 2015

Society for the Study of Amphibians and Reptiles

co-sponsored by Partners in Amphibian and Reptile Conservation (PARC)

together with the herpetological societies of Kansas, Missouri, and Arkansas, the Center for North American Herpetology, *and the* International Society for the History and Bibliography of Herpetology

• For registration and full conference details, visit SSAR2015.ku.edu •

Transportation, Parking and Housing

The Kansas City International Airport is one hour northeast of Lawrence. Shuttle options include vans. See list at www.flykci.com/direction/shuttle/Index.htm.

Ample free parking within a 3-block radius of conference activities will be available in surrounding university lots and nearby streets.

A wide variety of housing options are available ranging from low-cost dormitory rooms that can be shared to local hotels and motels. Options include:

- Springhill Suites by Marriott (downtown)
- The Oread Hotel (1 block away): $149–169
- Holidome (2 miles away): $80 for up to four people including breakfast
- On-campus dormitory housing: $40–$60

•

Registration Fees (Deadline June 30th)

Student members*	US $160
Regular members	$295
Seniors (retired / over 70) (membership not required)	$160
Non-members	$375
Late surcharge for all after June 30	$50

*For this meeting, student members of SSAR, HL, ASIH, and other international, national, and regional herpetological societies are eligible for the SSAR student member rate, but they must provide written evidence of their membership (statement from society officer, student's advisor, or other authority).

•

Deadlines for Presenters (May 15th)

Abstracts for all papers (oral and poster) are due to the conference organizer by May 15th. These should include title, author or authors, and address (both postal and email). Full details on format for abstracts and posters as well as available projection facilities may be found on the SSAR 2015 meeting website: SSAR2015.ku.edu.

•

Meeting website (available March 15)

Visit SSAR2015.ku.edu for the day-by-day meeting schedule, registration, airport shuttle, parking, accommodations, meals, special events, tours, juried prizes, auction donations, committee meetings, socials and other activities associated with this meeting.

SSAR will hold its 2015 meeting on the beautiful and centrally located campus of the University of Kansas in Lawrence. All scientific sessions will be held in the Kansas Union, which is adjacent to the KU Biodiversity Institute and Natural History Museum, the setting of more than a century of research and graduate education in herpetology. The intimate campus setting will facilitate personal and friendly interactions while moderating fees for registration and lodging.

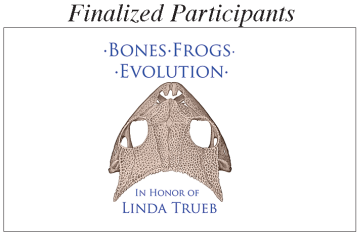
This unique campus format meeting will include oral and poster presentations, silent and live auctions, vendor displays, student social, symposia, and special lectures provided by David Hillis (Keynote), Harry W. Greene (Plenary), and Miguel Vences (President's Travelogue).

Conference activity highlights include:

- Redesigned audiovisual shows arranged by David Dennis and Eric Juterbock
- Reception honoring distinguished senior herpetologists, allowing students to interact personally with luminaries in the field
- The Herpetological Quiz, arranged by the graduate students at UT Arlington and KU, with prizes for winners
- Guided tours of herpetological collections and newly renovated laboratories in the Biodiversity Institute
- Tour of the Fitch Reservation (*see photo on next page*) at the KU Biological Fieldstation and Reserves, led by George Pisani
- Special presentation for the International Society for the History and Bibliography of Herpetology featuring author Sally Haines of the KU Spencer Research Library
- Display of live Kansas herps with photographic set-ups

SYMPOSIA UPDATES

Finalized Participants



Bones, Frogs, and Evolution

Organized by David Blackburn, Anne Maglia, and David Cannatella

This event will celebrate the exceptionally productive 40 years of scholarship of Linda Trueb and will include presentations by Ana Maria Baez, David Blackburn, David Cannatella, Luis Coloma, Eli Greenbaum, Juan Guayasamin, Anne Maglia, Dave McLeod, Greg Pregill, Chris Sheil, Helio de Silva, Erik Wild, and Marvalee Wake. Introduction by Leonard Krishtalka and summary by William Duellman.

•

Frontiers in Integrative Organismal Biology: Herpetological Horizons

Organized by Rich Glor and Rafe Brown

This event will bring together a group of exceptionally research-active herpetologists working at the forefront of evolution-related fields, using amphibians and reptiles as study systems. Topics include speciation, adaptive radiation, convergence, phenotypic evolution, and the evolution of development—all through the lens of genomic approaches to understanding evolution of amphibians and reptiles. Participants include Frank Burbrink, Todd Castoe, Ben Evans, Matt Fujita, Luke Harmon, Ryan Kerney, Adam Leaché, Emily Lemmon, Jim McGuire, Rachael Mueller, Dan Rabosky, Erica Rosenblum, Robert Thompson, John Wiens, and Kelly Zamudio. Summary by David Wake.

continued on next page

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. Figures and photographs submitted with manuscripts are welcome, but must be sized appropriately by authors for this journal's column sizes (i.e., 19.5 or 39 picas wide). Particular attention should be paid to reduction of text on the figures.

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.

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.

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.

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