

# **43<sup>rd</sup> International Herpetological Symposium**



**July 21-24, 2021  
Rodeo, New Mexico  
& Virtual**



This year, 2021, marks the 43rd anniversary of the *International Herpetological Symposium*. The first annual symposium on *Captive Propagation and Husbandry of Reptiles and Amphibians* was held in July 1976, at Hood College in Fredrick, Maryland. The *International Herpetological Symposium* (IHS) evolved from this meeting. The primary purpose of the IHS is to provide a forum for the dissemination of information and results of such research pertaining to the natural history, conservation biology, and captive management and propagation of amphibians and reptiles. Each year the IHS is held in a different location hosted by a zoological, herpetological, or herpetocultural institution. This year, IHS is proud to partner with the Chiricahua Desert Museum in New Mexico who remain dedicated to the preservation of reptiles and amphibians and public outreach.

Unlike most herpetological societies or associations, IHS does not have a voting membership, but an electoral body. That body consists of the volunteer members of the Board of Directors, the Advisory Council, and chairs of various committees. Zoologists, herpetologists, and private herpetoculturists are all involved in organizing the annual symposia. These meetings and programs are largely supported by the generosity of our donors and sponsors, to whom we are eternally grateful. If YOU would like to get involved in IHS, please speak to any officer.

Our last meeting of the IHS was in 2019 in Belize. Like most other organizations, IHS was heavily impacted by the Covid-19 pandemic, and sadly we had to postpone our 2020 Atlanta meeting until summer of 2022. For this year, 2021, we wanted to be safe and host a semi-remote meeting in an outdoor venue, and there is no better spot for this than *the Chiricahua Desert Museum* in Rodeo, New Mexico. Here we can host a mostly outdoor meeting for local attendees and still offer an virtual option for those joining us from their homes. IHS is forever grateful to Bob Ashley, Sheri Ashley, Chuck Smith, Chelsea Smith, and the rest of the CDM staff for all their assistance with putting on this dynamic conference. We would also like to thank our fantastic symposia speakers joining us in person and remotely from across the globe as well as our major sponsors, **Timberline** and **ZooMed Industries** - We would not be where we are today without you. Please support all of our sponsors whenever you are able.

Over the years, an increasing number of people with varied interests in herpetology have attended IHS meetings, and this curious mix has allowed IHS to develop its “unique” flavor. Although IHS is often visualized as an organization with an interesting blend of academia and herpetoculture, the types of people who attend the meetings far exceed those bounds. Progressive programs such as the *Junior Herpetologist Award* and *Collegiate Speed Session* have also opened the doors to the next generation of reptile and amphibian enthusiasts and conservationists.

The 43<sup>rd</sup> meeting marks my fourth full year as President of this wonderful organization. My tenure has been extended for a third term due to the pandemic by the Executive Committee. I have been busy working on the next two meetings and am excited to see them through. I gave my first public presentation at an IHS in my early 20's; I recall feeling nervous, but the welcoming IHS board and attendees made it easy. At that same meeting, I met a soon to become employer and mentor who played a significant role in both my career and life. You never know what opportunities may present themselves at an IHS meeting. I am honored to have the opportunity to work with such a multi-talented and highly dedicated group of volunteers as we continue to move forward. For our old friends, we thank you for your continued support, and for those who are joining us for the first time, we welcome you. We look forward to seeing you at these annual gatherings for many years to come.

To our friends near and far, welcome to Rodeo!

Jennifer Stabile  
President  
*International Herpetological Symposium*



## Time Zone for Presentations and Events: Rodeo, New Mexico MOUNTAIN TIME (MT)

### July 21 WEDNESDAY

7:00pm-10:00pm **IHS Ice Breaker and Registration**

Join us for a socially distanced event outside. Complimentary Pre-packaged snacks, water, tea, coffee, and beer. Bagged meals available for purchase.

### July 22 THURSDAY

9:00am-9:10am **OPENING REMARKS: IHS President, Jennifer Stabile**

9:10am-9:40am **Andrew Durso, Ph.D. Florida Gulf Coast University**  
*Remote* **“That’s Not a Copperhead Either! (Mis-)Identification of Snakes in a Citizen Science Challenge”**

Snake species identification can be challenging for both experts and laypeople. We asked participants to select which of the 38 species of snakes native to North Carolina were shown in photos of varying difficulty, and collected information about their experience and self-assessment of expertise in snake identification, as well as some demographic information. We provided county-level locality information and gave immediate feedback on whether or not the response was correct. Fifteen of the 153 participants identified all 1000 photos over 14 days, and the three most accurate (98-99% correct) won a field guide. The average non-herping participant identified 37% of images correctly, increasing to 65% for the average participant who went herping regularly. Those that reported regularly going herping on their own or organizing a herping trip with friends that are equally serious about it experienced the largest performance increase of any measured demographic, including age, years living in North Carolina, self-assessment of experience or accuracy, participation in herpetoculture, and even work as a professional herpetologist. Rough Greensnakes, Eastern Coralsnakes, Pigmy Rattlesnakes, and Eastern Kingsnakes were correctly identified >90% of the time, whereas Banded Watersnakes were correctly identified just 53% of the time. Copperheads and Ratsnakes were guessed more often than other species. I will present other intriguing patterns in the data and discuss what I think they might mean for snake ID education.

9:40am-10:10am **Mark Mandica, M.S., Tobias Landberg Ph.D. The Amphibian Foundation**  
*Remote* **“New Routes into Herpetology: The Amphibian Foundation’s Conservation Research Bridge Program”**

Bolstered by a diverse partner base and focused on critical multi-agency collaborative conservation, the Amphibian Foundation (Atlanta, GA) has grown in many ways in the five years since it was founded. Last year, we launched a new conservation career development program with the goal of expanding the reach of our training and conservation missions.



**July 22 THURSDAY continued**

The Conservation Research Bridge Program admitted 5 students over the past year which substantially improved our ability to conduct research such as survey habitat for imperiled amphibian species throughout the Southeast. Students receive contextualized instruction, career development opportunities, and transition services with specialized training in animal husbandry, field work, guided research, formal classes, creative expression, and outreach. The program curriculum includes an expansion of our previous high priority conservation targets such as Frosted Flatwoods Salamanders, Gopher Frogs, and Striped Newts, plus the addition of new projects focused on Pigeon Mountain and Blue-spot Salamanders. New long-term urban ecology research projects were designed to meet the career goals of the students including monthly herpetological surveys, a creek litter and clean-up project, and a turtle population study. The program has generated new revenues through tuition, scholarships to increase inclusion and diversity, and was awarded three grants. The program built new and strengthened existing public and private partnerships with local, state, and federal organizations. Within this dynamic and collaborative framework, this innovative new program integrates hands-on experiential learning and career development in a mentored research setting and has increased our ability to achieve our institutional goals.

10:10am-10:40am  
*In-person*

**Rachel Pikstein, M.S.**

**Grand Canyon University**

**“Studying Morphological Selection in a Grand Invasion; How Tegu Lizards Can Teach Lessons in Evolution, Ectotherm Adaption, & Conservation”**

Exponentially detrimental to the ecosystems they establish in, invasive species often place a heavy burden on regional economies to manage their various impacts. However, these exotic species offer remarkable opportunities to assess short-time speciation, using newly established populations with rapid reproduction rates. This study compared black and white tegu lizards, *Salvator merianae* (previously *Tupinambis merianae*), from invasive populations in southern Florida and captive-bred specimens across the United States, in order to investigate divergences from an ecological evolutionary perspective. We sampled twelve morphological variables on all captive and invasive specimens, including five established scale counts for determining squamate classification, and two new scale count parameters developed by this work. Subocular and supralabial scale counts differed significantly between the two populations, suggesting that the invasive population is functioning as a result of the founder effect, with unique selection pressures resulting in greater scale abundance. Genetic analysis is planned for end of 2021, with the 1<sup>st</sup> publication following. Results aim to develop new models for measuring evolutionary change, using highly successful colonizing species that are simultaneously expanding their introduced geographic ranges, while being subject to intense eradication efforts.

10:40am-11:00am

**COFFEE BREAK (complimentary)**



July 22 THURSDAY continued

11:00am-11:30am  
Remote

**Sarah Goodnight**

**“Effects of *Halipegus* spp. parasite infection on vocalizations and dispersal of the green tree frog *Hyla cinerea*”**

**East Carolina University**

IHS Grant Winner (2019)

*Halipegus occidualis*, a parasitic worm, lives in the mouths of several species of frog across North America and often occurs at high infection loads (sometimes reaching 40+ worms per frog). However, no study has addressed the consequences of *Halipegus* infection on male frog calling ability. *Hyla cinerea*, the green tree frog, is a well-studied model for calling behavior and is commonly infected with *Halipegus* in the wild. Single, calling male frogs in eastern North Carolina were recorded in the field then captured by hand, and all visible parasites in the mouth were counted. Calls were analyzed using Raven Pro software, specifically focused on certain call characteristics (e.g., frequency and duration) previously established as important for female choice. Interestingly, moderately infected males (6-7 worms) seemed to have the highest quality calls when compared to both uninfected (0 worms) or highly infected (10+ worms) individuals. Call playback experiments were then conducted to determine if these differences in call characteristics caused by the presence of parasites affected female preference. Females preferred the calls of uninfected to heavily infected male frogs but preferred moderately infected male calls over uninfected male calls, corroborating the previous acoustic analysis. Thus, there appears to be a tradeoff between the benefits of consuming prey—the source of the parasite—and risk of disease. Highly infected frogs with a reduced ability to attract mates may be forced to spend more time in breeding pools trying to attract a mate, where they transmit *Halipegus* to the next host in the life cycle (freshwater snails). Therefore, I will be conducting a mark-recapture and tracking study to determine if infected male frogs do in fact display different dispersal patterns than uninfected frogs across the breeding season. Interfering with the communication systems of frog hosts may not only impact frogs’ reproductive success and fitness, but also facilitate the spread of the parasite itself.

11:30am-11:50am  
Remote

**Ellen Bronson, med. vet., Dipl. ACZM**

**“Pharmacokinetics of single and multi-dose transdermal itraconazole in the liver and skin of the Panamanian golden frog (*Atelopus zeteki*)”**

**Maryland Zoo Baltimore**

IHS Grant Winner (2016)

Itraconazole is an antifungal drug used to treat chytridiomycosis caused by *Batrachochytrium dendrobatidis* (Bd), one of the leading causes of global amphibian species’ decline. In the current study, experimental frogs were split into two groups, A and B. Frogs in Group A were exposed to a single 0.01% itraconazole bath for 10 min, and ventral skin and liver were analyzed at various time points from 1-84 h. Group B frogs were divided further and exposed to itraconazole in six combinations of concentration (0.01% or 0.001%) and time (5, 10, or 15 min) over 10 days of treatment, as well as a saline vehicle control and an untreated control. Tissue concentrations were quantified via high performance liquid chromatography. Following a one-time dose, itraconazole concentrations remained high and did not decrease for the entire 84 hr measured. At 0.01% itraconazole, an additional five minutes of exposure (5 vs. 10 min) resulted in



**July 22 THURSDAY continued**

3.8 times higher skin concentration and 4.2 times higher concentration in the liver. Frogs exposed at the lower concentration (0.001%) for either 10 or 15 min resulted in comparable skin and liver concentrations and appear to reach steady state, likely representing an acceptable regimen daily at the low dose or every 3-4 days at the higher dose, but definitive dosing could not be determined. At the examined doses, there was no histologic evidence of hepatic toxicity. This is the first study to examine the effects of itraconazole on hepatic tissue and the first multi-dose antifungal pharmacokinetic study in an amphibian.

11:50am-12:10pm

**Dr. Shailendra Singh, Arunima Singh**

**Turtle Survival Alliance: India/ Wildlife Conservation Society**

*Remote*

**“Imparting River Reptile Conservation Education at Kukrail Gharial Rehabilitation Centre, India”**

**IHS Grant Winner (2014)**

There are a number of myths and misbeliefs associated with the reptiles among the young children in developing countries such as India. A dedicated Guided Nature Tour (KGNT) was designed to raise awareness about reptilians (as turtles, crocodilians and snakes) in the region at a UPFD/TSA joint conservation project during 2014-2015. With support from IHS, in the initial phase we registered and invited urban school groups to the Kukrail Gharial Rehabilitation Centre, a centre of conservation activities in Lucknow city in Northern India. The program included activities such as Nature Walk, Interactive Games, Know-Your-reptiles, Show-and- Tell etc with clear conservation messaging, which helped them move past their fears and trepidation about the reptiles. In 2015, we provided guided tours to 1124 school students from 17 schools, above the age of 10. It was challenging to bring school groups to the centre initially as it was distantly located from the main town. Gradually through advertising as well as presentations at the schools we were able to convince various teachers. In 2014, 365 students from 6 different schools participated in KGNT whereas in 2015 our reach increased with the participation of 759 students from 11 different schools. We were successful in connecting with youth of various age groups and socio-economic strata and engage them to the natural-world and consolidated their understanding about nature's little unsung heroes. In 2016 we further expanded this to our nearest field sites running turtle and gharial conservation projects along Ghaghra River and involved village schools through a dedicated 'Cluster level education program'. This program provided further opportunity to bring kids from local communities to see and experience our conservation work firsthand at Kukrail and Lucknow Zoo. Our engagement with both urban and rural students gave us an insight of understanding perceptions of these two diverse groups. The coloured posters about gharial and turtles were shown to understand the knowledge and perception of students about these species. Average awareness about aquatic wildlife was observed to be higher in the students from rural areas in comparison to the urban community. The comparative analysis of response suggests rural students have had encountered these species thus are more aware about it. Among all the activities conducted, the show and tell program was the most interactive as it gave hands-on wildlife experience for urbanites in and around Lucknow, where children can get close to a turtle, see the feeding and other activities of gharial and learn about a snake (python).





*July 22 THURSDAY continued*

12:10pm-1:40pm      **LUNCH (on your own)**

1:40pm-2:00pm  
*Remote*

**Hiral Naik**

**Save The Snakes**

**“Assessing human-snake conflict in Hoedspruit using education tools to create awareness”**

**IHS Grant Winner (2020)**

Assessing human-snake conflict in Hoedspruit using education tools to create awareness  
Human-snake conflict is an increasingly common problem around the world, stemming from a lack of education about snakes. As human encroachment increases in many areas, the likelihood of human-snake conflict also increases. To reduce human-snake conflict, education about venomous and non-venomous snakes is necessary. The Hoedspruit area is predominantly rural with increasingly more development taking place. A diversity of venomous and non-venomous snakes is found in the area and are often encountered and killed. To create a better relationship between snakes and humans in the area, our goal has been to mitigate human-snake conflict through effective education tools and mentorship, particularly in schools. We visited various schools in Hoedspruit, conducted pre-talk surveys, an interactive presentation, and a snake demonstration. The learners had a range a different attitude towards snakes, including many that fear and/or hate snakes. However, almost all learners would like to learn about snakes. Through our continuing engagement with learners in and around Hoedspruit, we believe that we can reduce the fear of snakes significantly. As we continue to grow our initiative, we hope to create a mentorship programme where learners that love snakes will mentor learners in the surrounding rural communities.

2:00pm- 2:20pm  
*In-person*

**Sheri Ashley**

**Chiricahua Desert Museum/E.C.O.**

**“The Chiricahua Desert Museum History and Beginnings”**

The Chiricahua Desert Museum opened to the public on April 1, 2009. To date, the Museum displays over 60 species of wildlife, including among the rarest and most endangered species native to the Chihuahuan Desert. Our art gallery showcases the works of many well-known and respected artists, including original paintings from the celebrated wildlife artist, Tell Hicks. Many of Tell's prints are available in our gift shop and online. The gallery also displays the largest collection of herpetological art in the world, representing a diverse array of media--- sculpture, jewelry, pottery, and original oil, acrylic and sketched works. Our wildlife and botanical garden provides ample opportunity to intimately observe and photograph native wildlife in natural settings. The garden is open to everyone for a leisurely stroll, an afternoon of bird watching, or some quiet time among the desert's wild inhabitants.



July 22 THURSDAY continued

2:20pm-2:45pm  
Remote

**Adam G. Clause, Ph.D.**  
"Helping dragons and people: Discovery of a remarkable new lizard species facilitates applied conservation "

**Natural History Museum of Los Angeles County**  
IHS Grant Winner (2018)

Describing species is foundational to understanding the diversification of the Tree of Life. When a new species is an endangered conservation flagship, taxonomists can further enhance the impact of their work through community engagement. We showcase this intersection of taxonomy and conservation using a striking, imperiled new species of arboreal alligator lizard (genus *Abronia*) endemic to the La Sepultura Biosphere Reserve, Chiapas, Mexico. Beginning in 2018, our international team joined with local partners to formally describe this 30<sup>th</sup> member of the genus. Concurrently, we implemented a multifaceted outreach program. This included dissemination of interpretive posters, presentations to the ejido (community) that supports the only known populations of the species, a training session for the Reserve biological monitors and rangers, and a public talk in the capital of Chiapas covered by state/national media. Our outreach emphasized the economic promise of this iconic *Abronia* for drawing visitors to the Reserve and to the ejido's ecotourism center. Balanced against this benefit is the illegal international pet trade in *Abronia*, which led us to share anti-poaching strategies when engaging with local stakeholders. Our project highlights how taxonomists who study threatened, commercially valuable animals can directly address these conservation issues at the grassroots.

2:45pm- 3:00pm  
Remote

**Kyle Miller Hesed**  
"Population biology of the Red-backed Salamander (*Plethodon cinereus*) at a site in Maryland"  
IHS Grant Winner (2013)

**Hesston College**

In order to address poorly understood aspects of the ecology of Red-backed Salamanders, I conducted a 4-y mark-recapture study of a population in Maryland, resulting in 2,745 records of 752 marked salamanders, along with a complementary genetic analysis of six microsatellite loci. In this population, males grow and mature more slowly than females, despite reaching slightly larger asymptotic sizes; they may also face greater competition for space: adult males occupy the largest home ranges and show the largest increase in home range size after the removal of conspecifics. The largest between-year movements were made by individuals as they transitioned from immaturity to maturity. Survival was approximately the same over winters and summers, and lower for males than for females; this may be an artifact of sex-biased dispersal, as the majority of encountered immature individuals were estimated to be males, with models indicating a pulse of emigration in the fall and an influx of immature males onto the study site in the spring. An FST randomization test of multilocus genotypes showed a significant male bias in dispersal. Of salamanders captured repeatedly as both immatures and adults, males moved significantly farther before maturity than females did. Together, these results provide a comprehensive assessment of sex-biased dispersal at fine spatial and temporal scales in a terrestrial ectothermic vertebrate.





**July 22 THURSDAY continued**

3:00pm-3:20pm      **COFFEE BREAK (complimentary)**

3:20pm- 3:40pm      **Warren Booth, Ph.D.**      **University of Tulsa**  
*In-person*      **“Facultative Parthenogenesis in reptiles: A Review”**

Facultative parthenogenesis, the production of offspring without the genetic contribution of a male, was once considered an anomaly, relegated to captive reptiles held in isolation for prolonged periods of time. However, in recent years, reports in reptiles have been accumulating rapidly, and with it, our understanding of this reproductive trait has advanced significantly. Here, I will provide an up-to-date review of facultative parthenogenesis in reptiles, particularly highlighting notable advances made with the aid of molecular genetic approaches.

3:40pm- 4:10pm      **Michael McFadden**      **Taronga Zoo**  
*Remote*      **“Securing the Future of Australia’s Most Threatened Amphibian Species”**

Australia has experienced severe amphibian population declines since the late 1970’s, with one third of native species currently threatened with extinction. Six species are thought to have become extinct during that time with a further seven species regarded perilously close to disappearing. Although there are a number of threats to amphibians in Australia, the primary threatening process driving population declines has been the disease chytridiomycosis.

To prevent further extinctions, a number of species have been prioritised for *ex-situ* conservation breeding programs. Since 2005, there has been a significant increase in the contribution of zoos to Australian amphibian conservation, with thirteen species now secured in insurance colonies. Taronga Zoo has been actively involved in amphibian conservation activities since the 1990’s and current holds active *ex-situ* programs for four critically endangered species, including the southern corroboree frog, northern corroboree frog, yellow-spotted bell frog and Booroolong frog. This presentation will discuss these programs and the recovery efforts being implemented.

4:10pm- 4:50pm      **María Elena Barragán-Paladines**      **Fundación Herpetológica Gustavo Orcés**  
*Remote*      **“Notes on the first breeding record of the Lesser toad-headed turtle, *Mesoclemmys gibba* (Schweigger, 1812), in captivity in Ecuador”**

The word *Mesoclemmys* comes from the Greek *mesos* which means "half" or "between", and *klemmys* which means "turtle". The “intermediate turtle” or between “*Hydraspis* and *Platemys*” (McCord et al. 2001; Lamar, 2010). In 2019, two adult specimens (Male No. 037; and a female No. 275) kept together in captivity for approximately 26 years, and a female (No. 3871) kept together with the other two specimens since 2016, showed reproductive behavior and subsequent copulation of the male with the two females. The mating resulted in three layings of 4 eggs each during the year 2020. After 230 days of incubation, only one egg hatched, constituting it in the first reproduction record of this species in Ecuador in captive conditions.



**July 22 THURSDAY continued**

This species is undoubtedly a species of Amazonian turtle of which little is known about its biology, behavior, and natural history, ecology and conservation status. An evaluation of its conservation status is urgent, so the data obtained from its reproductive behavior in captive conditions is vital for subsequent conservation programs of the species.

6:30pm-7:30pm *IHS Board Meeting (CLOSED MEETING: Board Members Only)*

8:00pm-9:00pm **Memorial for Former IHS President Ken Foose, and Barney Tomberlin  
Presented by: Bob Ashley**

**July 23 FRIDAY**

9:00am-9:40am **Heather Barrett and Jonathan Dubon** **Belize Foundation for Research &  
Environmental Education (BFREE)**  
*Remote* **“Inspiring the next generation of turtle conservationists in Belize: Education and re-wilding  
actions during a pandemic”**

Due to the rapidly declining population across its limited range of southern Mexico, northern Guatemala and Belize, the critically endangered Central American River Turtle, *Dermatemys mawii*, (locally known as Hicatee) has elicited great concern. Recognizing that the stronghold for this dwindling population is the small country of Belize, the Belize Foundation for Research and Environmental Education (BFREE) with support from the Turtle Survival Alliance, spearheaded a country-wide educational campaign to raise awareness of the species. Each year since 2017, BFREE and partners celebrate October as Hicatee Awareness Month. In response to the unique challenges and opportunities that the pandemic created, our team adapted outreach during 2020 to focus on online media while also supplying much needed materials for teachers with limited access to resources. During this remote presentation from the BFREE Field Station located in the rainforest of southern Belize, BFREE staff will highlight our educational work during the pandemic, describe the first re-wilding of captive born Hicatee turtles, and will even let you meet some of the 2021 Hicatee hatchlings.

9:40am-10:00am **Rachel Tevis** **Chiricahua Desert Museum**  
*In-person* **“Managing the Live Collections at the Chiricahua Desert Museum”**

Montane rattlesnakes are a unique group of crotalids and thus have much different requirements when successfully keeping, breeding, and rearing them. Through trial and error of a variety of husbandry techniques, this facility has had much luck with many montane species. Going over the room, individual enclosures, quarantine and raising young, you will see a noticeable difference in their basic husbandry compared to other rattlesnakes.



**July 23 Friday continued**

10:00am-10:30am     **Jerrold G. Tynes, M.S., M.Ed. & PAS**     **University of North Texas at Dallas**  
*Remote*     **“Teaching Herpetology in a Virtual Environment - Preparing our next generation of Herpetologist in the world of COVID”**

Collegiate herpetology are typically offered as 3000 or 4000 level (junior or senior) courses in Face-to-Face formats at college campuses all over the United States. These Face-to-Face formats usually include a lecture component where the professor explains concepts via the podium and a lab component where the professor or graduate assistant leads field expeditions and occasional outdoor labs to give students a hands on component. COVID-19 changed university education drastically and quickly and new teaching rules and norms had to be created to successfully educate students. Jerrod Tynes is a Lecturer at UNT Dallas and like many others, had to rethink and revamp his typical teaching approach for all of his courses including herpetology. In this presentation, he will dive into some inventive ways to educate the next generation of herpetologists.

10:30am-10:50am     **COFFEE BREAK (complimentary)**

10:50am- 11:35am     **Dave Barker**     **Vida Preciosa International, Inc.**  
*In-person*     How Not to Give a Snake Talk

11:35am- 11:50am     **Sean Sterrett**     **Monmouth University**  
*Remote*     **“SPARCnet: A geographically and intellectually distributed network focusing on population dynamics and adaptation of Red-Backed Salamander (*Plethodon cinereus*)”**  
**IHS Grant Winner (2016)**

A grand challenge for the field of conservation is to predict and develop strategies to mitigate the impacts of large-scale global change. Integrative approaches to research across many disciplines, large-geographic scales, and from the lab and field are increasingly necessary to build data sets that are informative of species responses. Additionally, these types of large-scale ecological questions can appreciably benefit from complementary community science and educational frameworks. Founded in 2013, the Salamander Population and Adaptation Research Collaborative network (SPARCnet) is a geographically- and intellectually-distributed network focusing on advancing our understanding of environmental change on the ecology of a ubiquitous woodland species, the red-backed salamander (*Plethodon cinereus*). All SPARCnet participants use a common set of sampling methods and standardized cover-board plot sampling to collect seasonal demographic data of *P. cinereus* populations through time. SPARCnet currently has 28 long-term mark-recapture and 10 long-term count sites across 14 states and provinces of the Northeastern U.S. and Southern Canada, with a diverse range of institutions involved, including nature centers, community colleges, private and public universities, and government



**July 23 Friday continued**

organizations. This research, centering on a collaborative framework, has led to multiple publications, which include critical, experimental tests of our sampling methods. Equally as important, SPARCnet has engaged educators at all levels (i.e., elementary to undergrad) and has developed teaching tools and curricula, which complement research interests. Currently, there are eight course-based undergraduate research experience (CUREs) modules that have been tested and are now being implemented in classrooms throughout the United States.

11:50am- 12:10pm  
*In-person*

**Kristina Chyn, Ph.D.**

**“Predictive roadkill models on native and endemic herpetofauna informed by community (citizen) science”**

**Texas A&M University**

**IHS Grant Winner (2016)**

Robust, spatially explicit approaches accounting for ecological drivers are needed to identify environmental correlates of roadkill and set conservation priorities. We predicted wildlife road mortality across a nationwide road network using species distribution models with environmental covariates. We applied MaxEnt to a citizen science database of > 60,000 roadkill records to predict roadkill probability. Twenty-eight environmental covariates at 50 m spatial resolution were included, such as road type and land cover composition. We focused on ecological guilds and endangered species: common venomous snakes (CVS), semiaquatic and aquatic snakes (SAS), turtles, and the Maki’s keelback snake (*Hebius miyajimae*, HM). All predictive models performed well with AUCs > 0.7. Projected roadkill risks for CVS, SAS, turtles, and HM were highest in montane regions, coastal lowlands, the southwestern coast, and parts of central Taiwan, respectively. Roadkill projection models performed well across ecological levels and scales. Road-type strongly influenced roadkill risk. As predictions and variable importance differed across guild and species models, individual models need to be produced for each group of interest. Additionally, the project emphasizes the importance of systematic collection of roadkill data, which contributes to both informing conservation action and engaging the public in wildlife education. We discovered novel findings on predicted high- and low-risk areas for groups with conservation need and produced interactive roadkill risk maps as a conservation tool for managers and practitioners. Importantly, this methodology is not limited to Taiwan; it can be applied anywhere with sufficient roadkill and environmental data and is scalable to address the ecological question of interest.

12:10pm- 1:40pm

**LUNCH (on your own)**



July 23 Friday continued

1:40pm- 2:00pm      **Michael Skibsted**      **Santa Margarita Catholic High School**  
*In-person*      **"Effects of habitat alternation and co-occurrence with introduced red-eared sliders on a Southwestern pond turtle basking site usage in a Southern California urban creek"**

Species inhabiting urban waterways face numerous threats. While virtually all water bodies are at risk of significant human modification, urban waterways are subject to a unique set of human modification practices to reduce flood risk. The large amounts of impervious surface in urbanized areas can dramatically increase storm runoff and the risk of catastrophic flooding. As a result, management agencies often implement flood and erosion control measures such as creation of drop structures, riprapping, deadwood removal, and manual modification to streamline watercourses to expedite the flow of water away from urban areas. These efforts can reduce the habitat quality for native species. We conducted 32 surveys over the course of approximately six months investigating basking behavior and basking substrate usage by native Southwestern Pond Turtles (*Emys pallida*) and non-native Red-Eared Sliders (*Trachemys scripta elegans*) in an urban creek in Orange County, California. We compare usage of basking site substrates between these two species. Results are interpreted in context of urban stream management, and the effects both heavy human modification of a creek system and introduced species can have individually, and synergistically, on Southwestern Pond Turtles. We also recommend management practices that would benefit the declining Southwestern Pond Turtles.

2:00pm- 2:40pm      **Gary Sipperley**  
*In-person*      **"Herpetoculture Pioneering"**

A historical review on the genesis of Herpetoculture. Utilizing field observation experience, breeding knowledge was gained and advanced. This included early record keeping of species growth rates, ovulation cycles, copulation observations, and shed patterns as well as improving egg incubation techniques. Efficient and safe enclosure environments were developed to manage large collections of herps. Herpetoculture advancements were shared among peers in early publications encompassing collaboration with zoological herpetologists, herpetological societies, and various world-wide private herpers.

2:40pm- 3:00pm      **Dylan Maag, M.S.**      **San Diego State University**  
*In-person*      **"Hybrid Field studies of *Crotalus viridis* X *C. scutulatus* population north of the Chiricahua Desert Museum"**

Species are mutable; individuals from clearly divergent and well-defined species can occasionally still breed and produce viable offspring in some portion of their range. In the past hybridization has been seen as an evolutionary "dead-end" for naturally evolving populations and the hybrid individuals themselves were seen as mongrels. Natural hybridization is now known to be much more common than previously realized, and hybridization has had an important role in the evolutionary history of several species, including modern humans. Because hybrid zones



**July 23 Friday continued**

represent instances where the species barrier breaks down, natural hybrid zones can give us critical insights into the processes of speciation and reproductive isolation. My research is on a natural hybrid zone between two snake species, Prairie (*Crotalus viridis*) and Mojave (*C. scutulatus*) Rattlesnakes, in Southwestern New Mexico, USA. From past research and my current efforts, we know that the hybrid snakes in this zone have many unique and intermediate characteristics when compared to the parental species: intermediate coloration and scalation, unique venom, and transgressive behaviors. With the collaboration of geneticists, my research will increase our knowledge on how behavioral variation across environmental and habitat gradients is influenced by an individual's ancestry.

3:00pm- 3:30pm  
In-person

**Stephen P. Mackessy, Ph.D.**

**University of Northern Colorado**

**"Ecology and Natural History of the Prairie Rattlesnake, *Crotalus viridis viridis*, in Northeastern Colorado"**

Animal demographic characteristics and genetic structure of populations can affect a variety of ecological processes within a species, including dispersal, mating patterns and gene flow between populations. While animal association patterns have been examined in many mammals and birds, they have not been widely examined in reptiles, and few long-term studies have looked at the demographic characteristics or genetic structure of rattlesnakes. We studied a robust population of Prairie Rattlesnakes (*Crotalus viridis viridis*) in northeastern Colorado over the last 15+ years. The Prairie Rattlesnake is still common in many places in Colorado and hibernates in communal dens with up to hundreds of individuals. Many species of rattlesnakes show high levels of den fidelity, returning to the same communal hibernaculum year after year. In this study, two den sites in Weld County, Colorado were analyzed for demographic, genetic and association patterns. Results revealed rapid growth rates of young *C. v. viridis*, sexual size dimorphism, and stable populations at both hibernacula. Hibernacula were not genetically distinct, despite the high level of fidelity to a specific hibernaculum. Prairie Rattlesnakes are one of the most widely distributed rattlesnake species in North America, and ongoing analyses are documenting variation in phenotypes associated with geographic distribution.

**\*\* Special Post-Presentation Event: Book signing with Stephen P. Mackessy "Handbook of Venoms and Toxins of Reptiles"**





**July 23 Friday continued**

6:30pm

**IHS Dinner Sponsored by the Chiricahua Desert Museum**  
**\*\*Admission to the CDM and Dinner included in registration\*\***

7:30pm-9:00pm  
*Remote*

**Special Presentation: AN EVENING WITH ROM WHITAKER**

Romulus Whitaker, is the founder of the Madras Snake Park and Madras Crocodile Bank in India. He and like-minded colleagues set up the Irula Snake-catchers Cooperative in 1978, Andamans Centre for Island Ecology in 1989 and Agumbe Rainforest Research Station in 2005. His recognitions include the Whitley Fund for Nature Award, Rolex Award for Enterprise, Sir Peter Scott Award for Conservation, Salim Ali Award for Nature Conservation, and Padma Shri Award from the Government of India. Rom co-authored is the co-author of the book "Snakes of India – the Field Guide".

*"As a snake-besotted boy growing up in New York, I was fortunate that my mother married an Indian and we moved over to India, the Land of Snakes, in 1951, when I was seven. I never entertained any aspiration other than working with reptiles, it was obviously in my genes. To combine making a living and pursuing what was seen as a weird occupation, I set up India's first reptilium, the Madras Snake Park in 1969. This led me down the path of endangered species and their conservation, tribal issues, sustainable use of wildlife and human-animal conflict. Here's my chance to share with you some of the deep fun I've been having."*

*-Romulus Whitaker, Field Herpetologist*

**July 24 SATURDAY**

9:00am-9:30am  
*In-person*

**Saunders S. Drukker** **Texas State University San Marcos**  
**"Creating a Functional Body Condition Index (BCI) for Montane Rattlesnakes (Crotalus):**  
**Development and Plans to Implement a BCI in Analyses of Habitat Dynamics, Diet, and**  
**Wildland Fire"**

In the study of biology, several metrics have been used to assess the health of populations, frequently relying on long term monitoring. However, a new method of assessing health is the creation and use of a Body Condition Index (BCI). A BCI standardizes the relationship between size of an animal and its length, and then compares it to that of other members of its species, or its population. While this method has been used for several different taxa, its use among snakes remains severely limited. This project creates a working Body Condition Index for two species of montane rattlesnakes, *Crotalus lepidus*, and *C. molossus*. This BCI is then to be used in various analyses of animal health as it relates to environmental stochastic factors.



**July 24 Saturday continued**

9:30am-9:50am  
*Remote*

**Kristen Wiley**

**Kentucky Reptile Zoo**

**“On a Mission: Thinking About Ethics in Herpetology”**

Despite improvements, it is not acceptable for facilities that house, study and use live wild animals to rest on their laurels. Maintenance of live animals creates an ethical imperative on three fronts. The first is to provide high-quality husbandry to those animals. Secondly, it is important to make use of captive animals in as many ways as possible. An animal in captivity has been lost to the wild gene pool, and that sacrifice must be justified. Lastly, it is no longer appropriate for those involved with living animals to remain isolated from the political and conservation arenas, because the very existence of the study organisms is in jeopardy from a variety of fronts. A variety of ideas and methods will be addressed to meet these challenges for a variety of stakeholders, including zoos, private breeders, researchers, and interested individuals.

9:50am-10:20am  
*In-person*

**Tim Cole**

**Rattlesnake Preservation Trust**

**“LONESTAR RATTLESNAKE DAYS: Educational and fun for the whole family without animal cruelty and poisoning our water table”**

Lone Star Rattlesnake Days is an educational/outreach event put on by the Rattlesnake Preservation Trust. The event is held at Fair Park in Dallas during the Texas State Fair. Activities include venom extraction exhibition, safe capture demonstration, live exhibits, children’s activities, related conservation groups booths, and informal talks. Educating the public about rattlesnakes is our goal.

10:20am-10:40am

**COFFEE BREAK (complimentary)**

10:40am-11:10am  
*Remote*

**Michelle E. Thompson**

**Field Museum of Natural History**

**“Recovery of amphibian and reptile communities during tropical secondary forest succession”**

Secondary forests regenerating from human disturbance are increasingly becoming a *predominant forest* type in many regions. Understanding the factors that underlie the variation in species responses during secondary succession is important for understanding community assembly and for biodiversity monitoring and management. Because species vary in ecology and behavior, the responses to ecosystem change should vary among species. I used phylogenetic occupancy models to estimate assemblage-level and species-specific responses to forest succession in chronosequence sites in two regions of Costa Rica that include pasture, secondary forest regenerating from pasture, and mature forest sites. I found that habitat type (riparian, upland), phylogeny, and species traits mediate anuran and lizard probability of occurrence and species richness in pasture and secondary forest. Riparian habitats are key ecosystem features and can provide refugia for organisms in early successional stages.



July 24 Saturday continued

11:10am-11:40am  
Remote

**Kinsey M. Brock, Ph.D.**

**University of California**

**“Evolving in isolation: population divergence in an island lizard color polymorphism”**

IHS Grant Winner (2018)

Color polymorphism is an extreme type of intraspecific variation that can drive speciation. However, few studies examine the process of morph divergence across space and through time to identify drivers of morph divergence and diversity. The Aegean wall lizard (*Podarcis erhardii*) is a color polymorphic island endemic lizard with three color morphs: orange, yellow, and white. Morph diversity in *P. erhardii* varies from island to island, making it an ideal system to test hypotheses regarding the evolution and divergence of morph types within species. I inferred an inter-island phylogeny of 46 Aegean wall lizard populations and used ancestral state reconstruction to model the evolutionary history of color polymorphism across the species' geographic distribution and tested for environmental correlates of morph diversity. Color polymorphism (orange, yellow, and white morphs) is likely the ancestral state of this species, and variation in morph diversity across the landscape is most likely the result of morph loss that happens at a much faster rate in populations than evolutionary gains of color polymorphism. I found repeated population-level loss of the same morph type and similar morph frequencies across distinct populations that experience similar environments and low levels of gene flow. I also found morph-environment associations, and that the orange morph, which was repeatedly the first morph absent from populations, is associated with cooler, wetter habitats which are decreasing with climate change. Taken together, my research suggests that population divergence in morph diversity is driven by variation in the environment.

11:40am-12:10pm  
In-person

**Justin Elden**

**St. Louis Zoo**

**“Mountain Jewels: Husbandry of Paelearctic vipers at the Saint Louis Zoo and the Armenia Conservation Breeding Center”**

The palearctic vipers of Western Asia and Eastern Europe are a diverse group of snakes with varied natural history and specialized managed care. Over the past twenty years, the Saint Louis Zoo has been a leader for its work with palearctic vipers. Along with managing and reproducing these species at the Zoo's Herpetarium we have been conducting field conservation studies in the country of Armenia with an emphasis on Armenian vipers, *Montivipera raddei*. In 2018, the Zoo and collaborators opened the Armenian Conservation Breeding Center (ACBC) in Armenia dedicated to the reproduction and ultimate repatriation of local endangered species. This facility maintains assurance colonies of endangered viper species, hosts educational outreach, and acts a holding facility for relocated animals. Here we discuss captive management strategies of these old world vipers at the Saint Louis Zoo as well as the ACBC.



**July 24 Saturday continued**

12:10pm-1:40pm      **LUNCH (on your own)**

1:40pm-3:00pm      **Collegiate Speed Session**

*Remote*

**Brooke Proffitt, "Illinois State University: Parental Behavior in *Oophaga pumilio* (Strawberry Poison Dart frog)"**

At Illinois State University we worked on developing a colony of *Oophaga pumilio* to study behavioral patterns of parental care and their offspring, through the cost of feeding and transporting tadpoles to different bromeliads. A few focal points for the project were to gather data for begging behavior in tadpoles by parental response to begging. Using tadpole survival and growth rate to determine the starting point of those begging behaviors, and to see if there was any correlation of development in behavior the tadpoles showed through action or color development. This started with fine tuning husbandry practices, food sourcing for adults, and census of tadpoles and adults once a week. Establishing a colony of species to help rear enough frogs to observe the development from tadpoles to adults then the pairing of breeding adults. Needing proper husbandry and background information on how often the females laid eggs and the males called. Study species *Oophaga pumilio*, species used for egg rearing to feed study species tadpoles were *Phyllobates vittatus*, *Ranitomeya imitator*, and *R. variabilis*. Some observations were made with these species as well. Using this lab experience I was able to observe some parental behavior in the wild (Costa Rica, La Selva Biological Station, near San Jose) during another independent student research study. Data collection and census of developing colonies was slowed due to SARS-CoV-2, not completed research but with a new associate professor was able to start the development to study these frogs' parental behaviors and tadpole begging.

*In-person*

**Calvin Schaefer, "Truman State University: Habitat Use, Home Range Size, and Movement Rates in Two Sympatric Pitvipers (Crotalinae) in Far West Texas"**

Niche partitioning, or differential resource use is a possible explanation for the coexistence of multiple species, which would theoretically be in competition. In this study, we examined two sympatric desert snakes, the eastern black-tailed rattlesnake (*Crotalus ornatus*) and western diamondback rattlesnake (*Crotalus atrox*) on Indio Mountain Research Station in Hudspeth County, Texas for evidence of partitioning along the spatial dimension of the niche. We tracked the movements of the two species using radiotelemetry and analyzed macrohabitat and microhabitat data using a combination of multivariate analysis of variance (MANOVA) and contingency table analyses. Evidence of niche partitioning along the spatial dimension of the niche exists between the two species, with *C. ornatus* showing a higher affinity for southwest facing, rocky slopes and *C. atrox* showing a relatively diverse use of all habitats with a slight preference for northeastern slopes.



July 24 Saturday continued

Remote

**Arlene Hernandez, “University of North Texas Dallas: The Efficiency of Scented Snake Bedding with Different Types of Substrates for Pest Deterrence”**

An analysis of the potency and duration of the hybrid rat snake (*Pantherophis getulla/Pantherophis obseleta*) scent, adjunct to snake bedding and various substrates offers a promising non-invasive and sustainable approach to pest deterrence. For this study, we focused primarily on small rodents commonly encountered in the North Central Texas region. Species including, but not limited to squirrels, rabbits, mice, rats, etc. These small yet problematic species cause millions of agricultural damages annually. Therefore, our research developed a premise to help prevent rodent agricultural and garden damage. Over the course of two week- and four-week periods, we combined two different types of substrates (fine coconut fibers and coconut chips), with scented snake bedding as a means of deterrence. The bedding was scented with fecal matter, skin, and urine of our hybrid rat snake species over the course of a few weeks. The rat snake, a commonly encountered predator for our target pest species, makes their scent an ample repellent. After exposure of the substrates, the scented snake bedding was placed and dispersed strategically in gardens to rely on the intrinsic instincts of these small species to evade their predators. Additionally, relying on the olfactory senses of the subject pest species to detect the predator scent given off by the scented bedding, allowed us to find the most effective substrate (fine coconut fibers or coconut chips) to deter pests based on potency and the duration of the repellence. This premise will allow local farmers, gardens, and large-scale agricultural developments some natural and non-invasive protection from pests.

In-person

**Brian Ringhiser, “West Liberty University: A Preliminary Analysis of Autecological Data for an Ongoing Study on the Northern Watersnake, *Nerodia sipedon sipedon*, in a West Virginia Stream”**

The common watersnake, *Nerodia sipedon*, is a semi-aquatic species that inhabits most waterways within the eastern United States. The vast majority of research conducted on this species concerns populations in lakes, marshes, and wetlands. Little research has been done on populations in Appalachia and small streams. The purpose of this study, which started in 2015, is to fill that void by understanding how *N. s. sipedon* persists in a second order stream within the Appalachian plateau.

In-person

**Kaleb Hill, “University of Northern Colorado: Don’t Bite the Mouth that Feeds You: Auto-Resistance in North American Pit Vipers”**

Venom is a weaponized cocktail injected by predators to subdue prey. Many predators and prey have developed resistant antibodies in their blood to combat venom. One aspect of antibody defenses often overlooked is auto-resistance, the protection from self-intoxication, cannibalism, or intraspecies competition. Toxin resistant antibodies may develop in venomous organisms from the biochemical manufacture of their own venom, but this relationship remains unknown and understanding it could lead to finding novel therapeutic benefits. North America



*July 24 Saturday continued*

contains many species of venomous pit vipers, these snakes are social animals, providing maternal care to young and are not known to bite or prey on any species of snakes. This social behavior unique to pit vipers removes the evolutionary selection pressures that are faced by predators and prey of these venomous snakes that might evolve resistance mechanisms for survival purposes. Testing auto-resistance in pit-vipers provides a model understanding of auto-resistance in venomous organisms. This research on auto-resistance in North American Pit-vipers, demonstrates the relationship between toxin production and resistance in venomous snakes, with implications towards venom evolution and medical benefits of venomous snakes.

3:00pm-3:30pm  
*Remote*

**Grant Bassett**

**Texas State University**

**“The Diet of the Rio Grande Cooter (*Pseudemys gorzugi*) in San Felipe Creek, Texas with an Isotopic Comparison to the Syntopic Red-eared Slider (*Trachemys scripta elegans*)”**

The Rio Grande Cooter (*Pseudemys gorzugi*) is an imperiled freshwater emydid turtle currently in review for listing under the USA Endangered Species Act. Little information has been published regarding the natural history of this taxon, including its dietary habits. The objective of this study was to elucidate the diet of *P. gorzugi* from San Felipe Creek, Texas and evaluate its dietary niche in relation to the syntopic red-eared slider (*Trachemys scripta elegans*). Turtles were captured by hand for collection of feces and claw tissue. Fecal matter contents were sorted to the lowest taxonomic level possible and measured volumetrically. Claw tissue and tissue from putative food items were analyzed for  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values. Trophic position and niche overlap were measured for *T. s. elegans* and *P. gorzugi*. We identify 13 novel food items in the fecal samples of *P. gorzugi* and demonstrate that *P. gorzugi* is a primarily algivorous and herbivorous turtle. Niche overlap between the two chelonian taxa was small ( $\leq 25.42\%$ ) with sliders occupying a higher trophic position than cooters. Data provided from the current study improves our understanding of how *P. gorzugi* satisfies its bioenergetic demands and may be useful for informing species and habitat management strategies.

3:30pm-4:00pm  
*In-person*

**Andrew Holycross**

**Mesa Community College/Arizona State University**

**“Snakes of Arizona: it took a village”**

Snakes of Arizona is a definitive, scholarly reference that celebrates what we know about every species of snake found in Arizona. Written for naturalists and professional biologists, resource managers, teachers and students alike, this book examines all aspects of the biology of Arizona’s snakes, as supported by a complete review of the scientific literature plus a trove of previously unpublished data and observations. One of the editors, Andrew Holycross, will share stories regarding the inspiration for this work, tales of its genesis, and illustrate how the book was built by a diverse community of collaborators.

**\*\* Special Post-Presentation Event: Book signing with Andrew Holycross “Snakes of Arizona”**





*July 24 Saturday continued*

4:00pm CLOSING REMARKS: IHS President

**\*\*\*\*\*BANQUET \*\*\*\*\***

6:00pm-11:00pm Beer at 6:00pm, Dinner served at 6:30pm

6:00pm-8:00pm Banquet Entertainment

8:00pm-11:00pm Live Auction

Additional Information:

Herping permits are needed for Arizona and New Mexico:

<https://www.azgfd.com/fishing/regulations/>

<https://www.wildlife.state.nm.us/download/enforcement/special-permits/commercial-collecting/Amphibian-Reptile-Collection-Information-Limits.pdf>

Attendees have been asked to not collect snakes found on the road on hwy-80 from CDM to I-10, Goat camp road (hwy-145), and on hwy-338 from Animas, NM to I-10 just to reduce the unlikely chance of someone unintentionally picking up one of the researcher's radio-tagged snakes.

*Special Thanks To*  
Bob and Sheri Ashley, Chiricahua Desert Museum - Local Hosts  
Erin Jackson - IHS Logo and T-Shirt Design  
Michael Smith - Author of *The Wild Lives of Reptiles and Amphibians*



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