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President's Letter

Summer is now upon us with triple digit temperatures, and predictions seem to be for a decent or above average Monsoon. Pray! In spirit of this good tiding, I would like to welcome **Allison Titcomb** as our new Secretary. **Karen Watson** stepped down to attend to important matters back home in Indiana, but remains a director at large, remotely. Allison is no stranger to the THS and has been a supporter since she joined in the early years; eventually becoming President in 1998. We thank Karen for her service, and look forward to having Allison back!

This month we were able to review and select proposals for funding from our C.H. Lowe Herpetology Research Fund, and Sonoran Desert Toad Fund:

• Medina Rea, R., F.I. Valle Jiménez (advisor). Universidad de la Sierra, Moctezuma, Sonora, Mexico. **Altitude and adaptation: Hematological physiology of the Sonoran Desert Tortoise (*Gopherus morafkai*) along an aridity gradient in Sonora, Mexico.**

• Moyer, B., K. Griffis-Kyle (advisor). Texas Tech University. **Climatic drivers of amphibian reproductive phenology in Sonoran Desert tinajas.**

• Ortega Blanco, C.A., R. Lara (advisor). Instituto Politecnico de Sonora, Ciudad Obregon, Sonora, Mexico. **Design of an Edge AI bioacoustic monitoring system for the conservation of Incilius alvarius.**

• Palhoski, C. (PI). Greater Good Charities. **Microhabitat ecology of *Phrynosoma ditmarsi* in the sky islands of Sonora, Mexico.**

• Roberts, M., J. Bauder (advisor). University of Arizona. **Investigating the effects of mesquite thinning on herpetofauna communities in arid grasslands.**

• Wyman, J.A., Q. Agnew, S. Browne, J. Losos (advisor). Washington University, St. Louis. **Temperature-activity relationships in desert lizards.**

We are already beginning to plan for our **annual meeting** and **Jarchow Conservation Award on November 16th.** If you have a nomination for the Jarchow Conservation Award, please contact **Don Swann** for the requirements at *donswann3@gmail.com*. Stay tuned for more details.

If you are interested in ways to help the THS, don't hesitate to reach out. Our Board meetings are held during the first month of the quarter. Everything we do is made possible by your contributions, monetary and otherwise.

Thank you for your time,

Robert A. Villa
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ANNOUNCEMENT

Meg Davis is an MS student with Dr. Heather Bateman at ASU researching the human-tortoise connection. Their research aims at understanding what inspires someone to bring a tortoise into their life and what challenges might lead them to give one up. They are inviting all Sonoran Desert Tortoise caretakers to help explore those questions through a social survey—offering new insights into the human side of tortoise adoption and helping guide future conservation and education efforts across Arizona. Take the survey at: *asu.questionpro.com/tortoise* or scan the QR code (right). Be one of the first 250 participants and receive a $10.00 gift card upon survey completion!

ANNOUNCEMENTS

DEDICATION

ARTICLES (IN PART)

Cover Photo information: Gila monster (*Heloderma suspectum*) with aurora borealis, Maricopa County, AZ, 11 Nov 2025. Photo by Michael Ring. Our state is blessed with an abundance of unique fauna that are more reminiscent of animals found south of the border with Mexico like our monotypic genus of coral snake, jaguars, and peccaries. One such species that has captivated herpers and laypeople alike is our native species of beaded lizard, the Gila Monster. As solar flares continue to cause noticeable instances of "Northern Lights" being visible as far south as the Sonoran Desert, herping during these anomalies offers the tantalizing prospect of photographing our state's herpetofauna against the backdrop of fluorescent colored night skies.

ANNOUNCEMENT

The Tucson Herpetological Society plans to honor Robert L. Bezy in the September issue of *Sonoran Herpetologist*

Erik Enderson, Tucson Herpetological Society, Tucson, AZ; *erikenderson@icloud.com*

Dear friends and colleagues,

I am writing with very sad news. Robert L. Bezy died on June 15, 2026.

Many of you knew Bob through his work as a herpetologist, his years in the field, his writing, his museum work, his deep knowledge of Xantusiidae, or simply through the long friendships he built over decades. He meant a great deal to many people, and I know this news will be difficult for those who cared about him.

The Tucson Herpetological Society plans to honor Bob in the September issue of *Sonoran Herpetologist*, the Society's newsletter journal. I will be coordinating and curating the remembrance content for that issue, and I would like to invite those who knew Bob to contribute.

Submissions do not need to be formal articles. They may be field memories, personal reflections, accounts of his scientific influence, stories from expeditions, notes on his generosity as a colleague or mentor, photographs with captions, or anything else that helps preserve some part of who Bob was.

If you would like to contribute, please send your piece to me by July 31st. A few paragraphs are welcome. Longer remembrances are also welcome. If you have photographs, please include any available details about the date, place, people, and photographer.

Bob carried an unusual combination of scientific rigor, humor, field instinct, kindness, and devotion to the desert. My hope is that this issue will reflect not only what he accomplished, but how he affected the people who were fortunate enough to know him.

Please feel free to share this invitation with others in Bob's herpetological and field biology circle who may want to contribute.

With sadness and gratitude,

Erik Enderson
erikenderson@icloud.com

Bob abd Kit Bezy at Petrified Forest National Park

ANNOUNCEMENT

Announcing the Cecil and Carol Schwalbe Endowed Chair in Cold-Blooded Research, Teaching, and Conservation at the University of Arizona

Don E. Swann, Tucson Herpetological Society, Tucson, AZ; *donswann3@gmail.com*

Anyone who feels that reptiles and amphibians do not get the attention they truly deserve will be thrilled to learn that the University of Arizona has created the Cecil and Carol Schwalbe Endowed Chair in Cold-Blooded Research, Teaching, and Conservation. This fund was established in honor and memory of the preeminent Arizona herpetologist Cecil R. Schwalbe. An *endowed chair* is a prestigious faculty position funded by donor gifts (rather than university funds) and is considered by many to be the highest honor a university can bestow on a faculty member. In fall of 2025 the UA appointed Associate Professor Michael T. Bogan, a biologist in the School of Natural Resources and the Environment, to this position.

Fig. 1. Carol Schwalbe and the late Cecil R. Schwalbe. Photo courtesy of Carol Schwalbe.

A second fund in Cecil's honor, the Cecil and Carol Schwalbe Cold-Blooded Research Fund, supports UA students following in his footsteps in research on reptiles, amphibians, and fishes.

Cecil Schwalbe, who passed away in April 2022, was Arizona's first state herpetologist with the Arizona Game and Fish Department (AGFD). He received his Ph.D. in zoology and physiology from the University of Arizona. After many years with AGFD, he returned to UA as a biologist in the School of Natural Resources and the Environment, employed by the National Biological Survey, which later became the Biological Resources Division of the U.S. Geological Survey. In addition to his large body of academic and conservation work, especially with amphibians, Cecil's enthusiasm and dedication to conservation influenced many, many young scientists. He mentored dozens of graduate students and undergraduates, and his door was always open to members of the community who shared his love for amphibians and reptiles. A gifted public speaker, he was highly sought out by the media because of his passion for all things herpetological, as well as his sense of humor, humility, and charm. In recognition of his influence, Cecil received the Jarchow Conservation Award in 1997, the Charlie Painter Memorial Award in 2021 from Southwest Partners in Amphibian and Reptile Conservation, and the Emil W. Haury Lifetime Achievement Award from the Western National Parks Association in 2015.

Carol Schwalbe is a professor emeritus and former director of the School of Journalism at the University of Arizona. Before becoming a desert rat, she was an editor at National Geographic and an associate professor at Arizona State University's Walter Cronkite School of Journalism and Mass Communication. Like Cecil, Carol was a beloved teacher and mentor known for innovative digital teaching. She received the 2015 Scripps Howard/AEJMC Journalism Teacher of the Year Award. She continues to be active in Arizona journalism and conservation in her retirement.

Dr. Michael Bogan, the occupant of the Schwalbe Endowed Chair, has studied human interactions with riparian areas and the restoration of aquatic ecosystems his entire career. His current work is wide-ranging and

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includes conservation of the endangered Sonoyta mud turtle at Quitobaquito Springs in Organ Pipe Cactus National Monument and the Rio Sonoyta in Sonora; radio telemetry of Sonoran Mud Turtles in the Santa Cruz River in downtown Tucson; and support for high school science teachers to study turtles in the Santa Cruz. Like Cecil, Michael is often in the news, especially in spreading the word about the importance of reviving the Santa Cruz River in the heart of Tucson. Michael is especially honored and grateful to be the inaugural chair because Cecil was an invaluable mentor to him as he started his local research program in southern Arizona nearly 25 years ago.

Fig. 2. Michael T. Bogan, Associate Professor in the School of Natural Resources and the Environment at the University of Arizona and occupant of the Cecil and Carol Schwalbe Endowed Chair in Cold-Blooded Research, Teaching, and Conservation. UA photo.

The Cecil and Carol Schwalbe Cold-Blooded Research Fund has been very important for providing financial support for UA students who are on the path to become tomorrow's leaders in research and conservation. Students recently supported by this fund include Miguel Grageda, studying the Sonoyta Mud Turtle; Emma Sudbeck, studying the movement and diet of invasive American Bullfrogs; and Regan Doss, analyzing the stock structure of two native sucker fishes of the Sonoran Desert.

The Tucson Herpetological Society is proud to be associated with these UA programs. In addition to being a Jarchow Conservation Award winner, Cecil was a frequent speaker at THS, and many of his former students remain engaged in the Society today. Both the endowed chair and the scholarship fund accept donations. Interested members can visit *https://give.uafoundation.org/cecilschwalbe* for more information about the research fund and *https://give.uafoundation.org/cecil-and-carol-schwalbe* for more information about the endowed chair.

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Sonoran Herpetologist Natural History Observations

The Tucson Herpetological Society invites your contributions to our Natural History Notes section. We are particularly interested in photographs and descriptions of amphibians and reptiles involved in noteworthy or unusual behaviors in the field. Notes can feature information such as diet, predation, community structure, interspecific behavior, or unusual locations or habitat use. Please submit your observations to Howard Clark, *editor.sonoran.herp@gmail.com*. Submissions should be brief and in electronic form.

Local Research News

The *Sonoran Herpetologist* welcomes short reports for our Local Research News. We are interested in articles that can update our readers on research about amphibians and reptiles in the Sonoran Desert region. These articles need be only a few paragraphs long and do not need to include data, specific localities, or other details. The emphasis should be on how science is being applied to herpetological questions. Please submit your materials to Howard Clark, *editor.sonoran.herp@gmail.com*. Submissions should be brief and in electronic form.

Roger A. Repp—Memorial Addenda

Roy Averill-Murray

Roger was well-known for keeping incredibly detailed field notes from which he could reconstruct patterns of herp activity and distribution that few of his contemporaries could match. From this, he illustrated the value of non-invasive natural-history observation, but he also combined this with field contributions using technological tools such as radio-telemetry, the combination of which I'm sure gave him a unique perspective and insights that those who rely on one or the other lack. Personally, I always appreciated Roger's willingness and enthusiasm to talk about his observations—even better to share in the field, albeit protectively of favorite or sensitive localities. It's hard to picture herpetology in southern Arizona without imagining Roger cruising slowly down some dirt road or peering into holes in the desert.

Daniel Beck—Tribute to Fellow Helodermaphile

Along with so many others, my heart was broken when I heard the miserable news that we had lost Roger Repp, a fine friend, extremely passionate herpetologist, and impeccable observer of nature. I met Roger in 1990 when he joined the THS board. In that capacity I had the pleasure of working with him on recruiting and funding presentations for the Speakers Bureau. I was inspired by the way he shared his unbridled passion for herps with both peers and the public. We kept in touch over the years, primarily through our shared enthusiasm for Gila Monsters and rattlesnakes. Roger generously shared Gila Monster data with me for my book and, boy did we have some great discussions. Roger's monthly reminders of THS activities lifted my spirits during the cold, dark winters of central Washington. They often left me with aching sides after laughing so hard. I treasure the photos we traded of our adventures; his amazing writing; his humor. He was helpful, supportive, and kind. He was, to quote his description as a THS speaker in 2014: "a whale amongst minnows, a trout amongst carp, a wolf amongst field mice, an eagle amongst turkeys, and a python amongst blind snakes. No brag, just fact."

While it's an understatement to say that Roger was fond of and deeply connected with many herps of the Sonoran Desert (Gila Monsters, spiny lizards, rattlesnakes, desert tortoises, so many more) I'll assert here that he was most like a Gila Monster. In fact, he may have been part Gila Monster himself. Others are free to contest this assertion, but here are the facts. Gila Monsters are icons of the southwestern deserts and so was Roger. Gila Monsters are tough, venomous, wise, and bumpy; so was Roger. Gila Monsters are tenacious, and Roger was tenacious as hell (11,429.5 hours spent herping between 2000 and 2012!—see his reprinted article in the March 2026 issue of *Sonoran Herpetologist*). Gila Monsters inspire wonder and awe; so does Roger. And while Gila Monsters are reluctant to reveal their secrets, Roger helped to reveal the stubborn "secret of the incubation schedule." His now-infamous response to a message from a construction contractor on 28 October 2016 led to Roger's crucial role in the important discovery that Gila Monster eggs hatch in the autumn and remain in the nest until the following spring.

Sometime around November 2001 I accompanied Roger and Gordon Schuett on a trip to their study site where were going to dig up a Gila Monster nest that Roger was certain existed near a large arroyo. We dug for many hours, following leads deep in the soil. We cursed and sweated buckets, but we were unable to locate the Gila Monster nest. I remember Roger falling to the ground, kicking and wailing like a baby when we finally decided to give up. That disappointing experience merely served to make his 2016 discovery so much sweeter. His talk on the subject at the 2019 Desert Tortoise Council symposium in Tucson was delivered as a song that he sang. It was the most original and passionate presentation I have ever witnessed at a scientific conference. Roger's joy was palpable. Nobody wanted to follow him. I had such a wonderful visit with Roger back in August of 2024. He and Diana were so kind to put me up in their place in Tucson and we talked for many hours about life in general, and, of course, Gila Monsters.

Roger felt the sorrow of the world as strongly as he felt the joy. His discoveries, delight, and intimacy with Sonoran Desert herps heightened his sensitivity to the sadness associated with destruction and loss, unfortunately reminding him of the great pain he endured in losing a son. Roger recognized there is no separation between us and our amazing Desert. He was indeed a Gila Monster. May he rest grandly in a fabulous, comfortable crevice under a saguaro perched above an arroyo, emerge each spring to wrestle with his rivals, explore the nooks and crannies of the Great Desert after a summer rain, and find some fat cottontails and quail eggs to gorge on. Fossil evidence suggests that the genus *Heloderma* has been around for at least 23 million years. And so shall Roger—the great Love he has inspired—endure through the ages.

René Clark

Roger called me "she who hunts with long eyes," and I will always remember my times out in the field with Roger. Some of the lifers I got with (and solely because of Roger), were my first *Crotalus willardi*, *C. cerberus*, and *Gambelia wislizenii*. Not only did we talk herps while cruising the trails and backroads, but we also talked life. His was a trusted ear, and I valued his insight and advice. For me, Roger was not only a great herper and one of the best in the field, but he was also my friend. Because of my adventures with him, I have stories of discovered hidden caches, an empty hunter's camp with skinned pelts and a semi-automatic rifle, a massive bee swarm that rivaled a cheap horror movie, and a very scary encounter with a gun toting crazy person with Cujo in the front seat of his pick-up for good measure. All this, Roger handled with decisive action and great care. He pushed me to be more open and braver while out in the field, and in return, he endlessly entertained me with stories of his adventures, and expanded my knowledge of the natural world. You are one of a kind. A champion to all herps, and the sworn enemy of Roadrunners. You enriched my life, and I am better for knowing you. I will never forget you my Friend.

Russell Duncan

Sorry to say that I have no personal photos to remember Roger Repp by. I do remember one time that Roger took me to a Black-tailed Rattlesnake den in the foothills of the Rincon Mountains. It was a sight to behold. Currently, I spend most of my time in southern Wyoming, having moved on from Tucson and southern Arizona (miss it and everyone). My time in Wyoming includes regularly visiting a particularly large den of Prairie Rattlesnakes, which is jointly occupied by Western Terrestrial (Wandering) Garter Snakes. When doing so, I often find myself thinking of that time with Roger. It meant a lot to me that he would take me into his confidence and show me such a site, which I think was one of his soul-searching places. Which species of rattlesnake would Roger choose to come back as?

Andrew Holycross

Every time my phone rang, and I saw "Roger Repp" on the caller ID, I'd smile wryly in anticipation, knowing I was about to be greeted with a creative cacophony of salutations that inevitably began with, "Oh Holiest of…". Even though I knew this exuberance wasn't reserved solely for me, it still made me feel special. Roger had a knack for that.

He was fully present—engaged, attentive, and enthused in every interaction. He made people feel like they mattered. He zoomed in on you, whether evaluating, empathizing, agreeing, or disagreeing. There was no half-assed interaction with Roger; he showed up, and he expected you to do the same.

And that didn't stop at conversation—that was how he lived. He was the lifeblood of the Tucson Herpetological Society for many years, and his polemics and stories there stand as a lasting testament to his passion for people, animals, and engagement. He brought that same intensity to the field, where I was lucky enough to spend time with him.

Roger's passion wasn't fleeting—it had staying power. Decades of commitment to THS and to his study sites speak to that. Like many of us, he was strong-willed and had definite opinions, but every interaction with Roger was an event—something that raised your pulse and left you feeling a little more alive.

Others will speak more eloquently than I can about his contributions to Arizona herpetology, and those contributions are substantial. But what will stay with me is his fervor for human connection, his commitment over time, and the profound depth of his empathy when my own path retraced his in a way neither of us would have chosen.

A herpetological legacy is meaningful—and Roger certainly leaves one—but in the end, it's secondary to the impact we have on one another. I'm grateful for Roger, and for the limited time I had with him.

James Vanas

It took eight long years till he found his first Gila.
Did he know then a bloke from a Sheila?
His patience paid off as he found many more,
So many in fact that his legend is lore.
With keen observations he's shared all his knowledge,
On monster research that you can't learn in college.
Tracking, exploring, alert with each step,
There's no one else like him, THE MAN, Roger Repp....

I met Roger Repp in person once in 2019 in Tucson as he, Dan Beck and Dale DeNardo, led the field trip for the Desert Tortoise Symposium in late February. I had only been working with Gilas and tortoises for three years in the Las Vegas area, and only knew Dan Beck's name when I made the commitment to drive south.

Roger gathered us together on a very cold morning to organize the trip. I immediately thought of Walter Matthau as I heard him speak and watched his gesticulations. This guy was a character and I wanted to be in his hiking group. When we gathered in the field for lunch, Dan and Roger were together and I approached them with my worn out, ripped and tattered copy of Beck's Gila book in hand. Roger immediately saw it a said, "That's what the book should look like, it means you're serious." They talked. I listened. I finally got the courage to read a humorous poem I had written about Dan Beck and the ice was broken. Roger took me under his wing, which is kind of hilarious as I was six years his senior. Yet, I felt like a school kid in his presence.

Over the next few days we chatted a lot. I came late to a crowded lunch table where Beck, DeNardo, Roger and a few other giants in the lizard world were seated. My brain was swimming with questions I had for Dan, and Roger could tell. He insisted I take his seat and walked away to another table.

The symposium weekend was the last time I saw Roger in person. It was far from the last time we communicated, always by text or email. He never failed to answer questions I had about Gilas and my methods of field work. It got way more serious, in a friendly way, as he began to comment and edit all the humorous nature poems I shared with him. He told me I needed an agent to publish my poems and stories. He also said the book I wrote with my grandson on reptiles and amphibians was a gem that needed to be in all middle school libraries across the country.

All of this praise coming from a man who wrote and spoke with great eloquence was humbling. We shared more on a personal level as well. A couple of months before he passed he sent a text with pictures from his operation and saying he was "clawing back from the worst experience of his life." Of course, he was "clawing back," and not just "recovering from."

In another text he wrote, "I am having lame thoughts about my life and all the time I spent studying our crawly friends and wondering, Why. Do you ever ask yourself that question?" He signed it, "Your friend, roger" I tried several times over the years to get to Tucson and see roger. I have thought that maybe having an internet connection made it easier for him to share some of his inner thoughts. Whatever it was, I am glad he shared them with me. We were texting back and forth two days before he passed away. I intended one day to ask why he always used a lower case 'r' when signing his name. I am sure he had a reason.

I will forever be thankful for having met roger in person. I never thought I would have an internet 'pen pal,' but in this case it worked out beautifully. And, "Yes roger, all the time spent with your crawly friends made a huge contribution to science and conservation."

Your friend, "calico jim"

RESEARCH ARTICLE

Notes on Reproduction of the Amargosa Toad, *Anaxyrus nelsoni* (Anura: Bufonidae)

Stephen R. Goldberg, Whittier College, Department of Biology, Whittier, CA; *sgoldberg@whittier.edu*

The Amargosa Toad, *Anaxyrus nelsoni* (Stejneger, 1893) (Fig. 1) is known only from the Oasis Valley, Nye County, Nevada, where it inhabits several springs and wetlands (Dodd 2023). The size of the adult population is not known, but it is probably at least several hundred (Stuart et al. 2008). It is listed as Critically Endangered as its extent of occurrence is only 93 square km and there is continuous decline in number of mature individuals and quality of its habitat along the Amargosa River (IUCN SSC Amphibian Specialist Group 2022). *Anaxyrus nelsoni* are reported to breed from February into summer (Elliot et al. 2009). In this paper I add information on reproduction of *A. nelsoni* from a histological examination of gonadal tissues. The use of museum collections for obtaining reproductive data avoids euthanizing specimens and obviates the need for a collecting permit from state and federal authorities.

A sample of 13 *A. nelsoni* collected 1931 to 1983 (Appendix) consisting of 4 adult males (mean SVL = 63.3 mm ± 6.5 SD, range = 60-73 mm) and 9 adult females (mean SVL = 69.1 mm ± 10.0 SD, range = 54-81 mm) was examined from the herpetology collection of the Museum of Vertebrate Zoology (MVZ), Berkeley, CA.

A small incision was made in the lower part of the abdomen, and the left testis was removed from males and a piece of the left ovary from females. Gonads were embedded in paraffin; sections were cut at 5 µm and stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman 1997). Histology slides were deposited at MVZ.

The testicular morphology of *A. nelsoni* is similar to that of other anurans as detailed in Ogielska and Bartmańska (2009a). Within the seminiferous tubules, spermatogenesis occurs in cysts which are closed until the late spermatid stage is reached; cysts then open and differentiating sperm reach the lumina of the seminiferous tubules (Ogielska and Bartmańska 2009a). A ring of germinal cysts is located on the inner periphery of each seminiferous tubule. All 4 *A. nelsoni* males in my sample were undergoing spermiogenesis. By month these were: May (*n* = 2), June (*n* = 1), October (*n* = 1). The smallest mature males (MVZ 84526, 84528, 142830) each measured 60 mm SVL.

The ovaries of *A. nelsoni* are typical of other anurans in being paired organs lying on the ventral sides of the kidneys. In adults the ovaries are filled with diplotene oocytes in various stages of development (Ogielska and Bartmańska 2009b). Mature oocytes are filled with yolk droplets; the surrounding layer of follicular cells is thinly stretched. Only one stage was present

Fig. 1. Amargosa toad (*Anaxyrus nelsoni*); photo Copyright © 2014 by Adam G. Clause. Photo has a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 (CC BY-NC-SA 3.0) license.

in the spawning cycle: "Ready to spawn" in which mature oocytes predominated. All nine females in my sample were in spawning condition and were from the following months: May (*n* = 2), June (*n* = 4), October (*n* = 3). The presence of *A. nelsoni* females in spawning condition from May, June, and October likely reflects a prolonged period of reproductive activity which includes both spring and summer and possibly autumn. The smallest mature female (MVZ 142829) in spawning condition measured 54 mm SVL and contained mature yolk-filled oocytes.

Occasional atretic follicles were observed in (33%, 3/9) of my female sample. Atresia is a widespread process occurring in the ovaries of all vertebrates (Uribe Aranzábal 2009). It is common in the amphibian ovary (Saidapur 1978) and is the spontaneous digestion of a diplotene oocyte by its own hypertrophied and phagocytic granulosa cells which invade the follicle and eventually degenerate after accumulating dark pigment (Ogielska and Bartmańska 2009b). See Saidapur and Nadkarni (1973) and Ogielska et al. (2010) for a detailed description of stages of atresia in the frog ovary. Atresia plays an important role in fecundity by reducing numbers of ovulated oocytes (Uribe Aranzábal 2011).

Since there are no reports of autumn spawning for *A. nelsoni* in Elliot et al. (2009), it is conceivable the eggs in mature females from October would have been utilized during reproduction the following spring. Jørgensen et al. (1979) reported ovaries are close to breeding size, by the time of hibernation, in frogs from the temperate zone.

Acknowledgments—I thank Carol Spencer (MVZ) for permission to examine *A. nelsoni* and for facilitating the loan 2025.9638. Herp.

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Appendix: Thirteen *A. nelsoni* from Nye County, Nevada (37.01975°N, 116.74138°W) examined from the herpetology collection of Museum of Vertebrate Zoology (MVZ), University of California, Berkeley, California, USA.

MVZ:Herp:12936 May 1931; MVZ:Herp:49124 June 1949; MVZ:Herp:84525 May 1967; MVZ:Herp:84526 May 1967; MVZ: Herp:84528 May 1967; MVZ:Herp:142829 June 1976; MVZ:Herp:142830 June 1976; MVZ:Herp:142839 June 1976; MVZ:Herp:142840 June 1976; MVZ:Herp:187217 October 1983; MVZ:Herp:182718 October 1983; MVZ:Herp:187221 October 1983; MVZ:Herp:187222 October 1983.

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Including the THS in your will is an excellent way to support the value of this organization and the conservation of the herpetofauna of the Sonoran Desert. We thank anyone who has included the THS in their will. Please contact us so we can express our appreciation. For information about designating the THS in your will, please contact Ryan Perry, Treasurer, at *tucsonherps@gmail.com*.

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RESEARCH ARTICLE

The Desert Box Turtle—Tucson's Rarest Native Reptile?

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Few local herpetologists are aware that the desert type of Ornate Box Turtles (*Terrapene ornata*) are part of the herpetofauna of greater Tucson area, in large part because they are so infrequently observed. Box turtles are naturally wary of humans and hard to detect. The species also appears to be highly selective in its habitat use, and much of that habitat in the Tucson basin has been lost during the past century. In addition to box turtles being rare and elusive, there has long been a common belief that all the box turtles in Tucson are escaped pets. Some surely are, but Rosen (2008a) presented clear evidence that Ornate Box Turtles were once native to the Tucson Basin. He could not verify that they still occurred here but believed that small populations may persist along the edges of the city. Here we report on observations and photos of *T. ornata* in east Tucson over the past 30 years, especially in areas of low housing density in tributaries of the Rillito and Pantano Wash. These records suggest that native individuals of this species most likely still occur here in the natural riparian habitats described by Rosen, though they remain of high conservation concern.

Background

The Ornate Box Turtle (*Terrapene ornata*) ranges throughout the western United States north to South Dakota and Michigan, east to Indiana and Louisiana, south into south Texas and Sonoran and Chihuahua, Mexico, and west to central Arizona (Dodd 2001). The current taxonomy is unsettled. Stebbins (2003) considered the Ornate Box Turtle to be two subspecies: the Desert Box Turtle (*Terrapene ornata luteola*), which occurs in the southwestern part of the range, and *T. o. ornata*, which occurs in the north and east and intergrades with *T. o. luteola* in New Mexico and west Texas. The Society for the Study of Amphibians and Reptiles (Taggert and Carr 2025) does not currently recognize the subspecies distinction, based on genetic work by Martin et al. (2013) and recommendations of the Turtle Taxonomy Working Group (2021); however, TTWG states that more complete genetic sampling may revise this decision. Herrmann and Rosen (2009) found "tentative" support for the recognition of the *T. ornate luteola* and *T. ornata ornata* as distinct subspecies, but their results may not have been considered by TTWG. Regardless of the taxonomy, the individuals previously considered to be *T. o. luteola* are recognizable by the greater number (10-16) of pale radiating lines on the second pleural scute (Ernst and Lovich 2009). These lines are more numerous and thinner relative to those found on individuals considered to be *T. o. ornata*, which is hypothesized to be due to environmental and growth form differences of grasses in the arid semidesert grasslands in the southwest versus the more mesic grasslands and prairies in the eastern portion of the species' range (Auffenberg and Milstead 1965; M. Tuegel, pers comm). For the purposes of this paper, we will use the names "Desert Box Turtle" and *T. o. luteola* to refer to the type of native box turtle in the Tucson area.

Some local herpetologists do not believe that box turtles are native to the Tucson area, and that wild individuals found here are escaped pets (Bezy 2021). For example, a 1975 record in Saguaro National Park's wildlife database includes a note from naturalist Hal Coss: "This reptile does not occur in this ecosystem. It was probably released by some well-meaning individual who picked it up on grasslands to the east of Tucson."

In the early 2000s, the late Phil Rosen with the University of Arizona, in collaboration with UA geneticist Hans-Werner Herrmann, did extensive conservation biology research on Arizona turtles, including Ornate Box Turtles (Rosen and Herrmann 2008, Rosen 2008b, Herrmann and Rosen 2009). Rosen (2008a) includes a detailed appendix entitled *Box Turtles of Tucson* that asks whether the species: 1) ever occurred naturally in the Tucson Basin; 2) still persists here; and 3) could survive in the urban setting through backyard conservation efforts. Based on historic records (e.g., Van Denburgh 1896, Ortenburger and Ortenburger 1926, King 1932, Arnold 1940), Rosen (2008a) found compelling evidence that Ornate Box Turtles were common about a century ago along the Santa Cruz River in downtown Tucson and San Xavier Mission, the Rillito, tributaries of Tanque Verde Creek such as Sabino Canyon and Aqua Caliente Spring, and tributaries of the Pantano Wash such as Cienega Creek and Rincon Creek.

To determine if box turtle populations were still extant in the Tucson Basin (which Rosen did not define but is generally considered to include the low elevation Santa Cruz River valley and adjacent alluvial plains within the mountain ranges surrounding Tucson), Rosen (2008a) did field work along Tanque Verde Creek and its tributaries and interviewed residents of eastern Tucson. He found "no convincing evidence indicating the presence of a wild box turtle population anywhere on the floor of the Tucson Basin." However, he did find evidence that wild populations might still persist in Upper Tanque Verde Wash and the Rincon Valley and that the species was still extant in Cienaga Creek (Rosen 2008a).

In the eastern district of Saguaro National Park, which includes tributaries of the Rillito and Pantano Wash

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Fig. 1. Desert Box Turtle (*Terrapene ornata luteola*) photographed in Saguaro National Park by Eric Stitt, 9 August 2006.

such as Box Canyon, Rincon Creek, and Wildhorse Canyon, box turtle observations appear occasionally in the park's historic wildlife records (Swann 2011). Lowe and Holm (1991) listed the species as present in the park and considered them as rare. Curiously, an undated park brochure that appears to be from the 1960s includes a photo of a box turtle and a caption that mentions that the species is "occasionally seen in the Cactus Forest."

One of us (DES) was a biologist at Saguaro National Park for more than 30 years and assembled records on wildlife in and near the park, both historic (e.g., Swann 2011) and contemporary (e.g., Flesch et al. 2010). The second author (MAT) is a co-author of the chapter on *T. ornata* in the forthcoming book, *Amphibians and Turtles of Arizona*. The purpose of this paper is to add these contemporary records to the solid foundation of box turtle history in Tucson by Rosen (2008a).

Records

We examined records of 26 box turtles from within and near Saguaro National Park's Rincon Mountain District from 1992 through 2023. For all photos (e.g., Fig. 1), we attempted to match the shell patterns to see if they were unique individuals or photographed previous. Of the 26 records, 20 records include voucher photos, one is a specimen (shell of dead individual), and five are observations by experienced wildlife biologists. We could only conclusively match shell patterns for two photos of a single individual observed in two different years near the park's Visitor Center. All the photographic records appear to be of *T. o. luteola*. Fifteen observations are near creeks in the Rincon Creek watershed, six are from creeks in the Tanque Verde watershed, and five are in Arizona Upland within the Tanque Verde watershed but not near creeks. Twenty-one of the observations were in or near riparian forest habitat, and five were in Arizona Upland habitat. All 26 records were in areas of relatively low population density or within the boundaries of Saguaro National Park or other protected area. To protect the turtles and respect private property boundaries, we are not revealing specific locations in this paper.

Discussion

Our records supplement Rosen (2008a) and provide support that small populations of the Desert Box Turtle persist along the edges of the Tucson Basin. Our records include observations in low density neighborhoods east of Tanque Verde Loop Road and in the Rincon Valley; only a few records were in Arizona Upland habitat not near riparian areas.

Images in the citizen science app *iNaturalist* provide additional support for a wild population in eastern Tucson. Although specific locations for this species are obscured within a 10 × 10 km area to protect this sensitive species, photographs by citizen scientists north of Interstate 10 cluster in several areas in eastern Tucson in or near the upper Rillito and Pantano Creek watersheds. There are also a few observations within the city and foothills of the Santa Catalina Mountains, and many observations along the northern San Pedro River corridor and Arivaipa Canyon (*iNaturalist.com*, accessed 28 December 2025).

Box turtles are occasionally seen in and near Sabino Canyon. Since the 1990s local herpetologist Paul Condon

Our records supplement Rosen (2008a) and provide support that small populations of the Desert Box Turtle persist along the edges of the Tucson Basin. Our records include observations in low density neighborhoods east of Tanque Verde Loop Road and in the Rincon Valley; only a few records were in Arizona Upland habitat not near riparian areas.

(pers. comm.) has observed at least two individuals in Sabino near the Visitor Center, and two others in nearby Bear Canyon just outside the recreation area. Lazaroff et al. (2006) said of these individuals that "less than a century ago box turtles were common along the Rillito and elsewhere in Tucson's riparian bottomlands and were likely living in woodlands along Sabino Creek." They speculated that turtles observed in the canyon today are probably a mix of hybrids, escaped pets, and possibly turtles from the original native Tucson population. Indeed, a free-living eastern box turtle (*T. carolina*) was photographed high in the canyon only four years ago (P. Condon and D. McPeak, pers. comm.).

Without further DNA study we cannot know if the records of Desert Box Turtles in east Tucson are of native individuals, escaped pets, or both. Herrmann and Rosen (2009) sampled DNA from box turtles in the Tucson area, including captive specimens, and found that the captives were a mix of local and non-local populations. However, they did not have sufficient sample sizes to determine if wild box turtles were native or non-native.

Our records and the *iNaturalist* records suggest that Desert Box Turtles still occur on the edges of Tucson as wild, free-living individuals. With so many of these records in areas of appropriate riparian habitat and low human population density, it seems likely that these turtles are native. But the low number of observations over many years suggest that these populations are small —perhaps containing fewer individuals than any other native species in the Tucson Basin—and highly threatened by continuing development in that area. The population in the Rincon Valley is probably larger than the one near Tanque Verde Creek but is no less vulnerable due to large-scale development of the Rocking K Ranch and other former natural areas that is occurring now and expected to expand in the near future.

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RESEARCH ARTICLE

Discovery of Diploid Parthenogenetic *Aspioscelis laredoensis* Clonal Complex A on North Padre Island, Nueces County, Texas, USA

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Abstract—We verify the presence of diploid parthenogenetic *Aspidoscelis laredoensis* clonal complex A on North Padre Island, Nueces County, Texas, based on sanctioned specimens collected in 2025. This represents a significand eastward range extinction for this distinctive clonal complex of the species from recently visited mainland sites near the Rio Grandein Hidalgo County, Texas. It is possible that this represents an inadvertent human introduction. Other reports have confirmed the introductions of the diploid parthenogens *A. laredoensis* clonal complex B, *A. neomexicanus*, and *A. tesselatus* to new areas distant from their apparent natural distributions. The same is true for the triploid parthenogenetic species *A. exsanguis*, *A. sonorae*, *A. neotesselatus*, and *A. velox*.

Keywords— *diploid, introductions, North Padre Island, parthenogenetic, Texas, whiptail lizards*

On 13 May 2023, an e-mail originating with Texas herpetology and natural history enthusiast SF was forwarded to JMW by MAP; it contained links to images and localities posted on *iNaturalist.org*. These links raised the possibility that one or both of the following species of whiptail lizards were established on the part of North Padre Island that is a component of Nueces County, Texas, USA. These possibilities were that a subspecies of gonochoristic Six-lined Racerunner (*Aspidoscelis sexlineatus*) as defined by Trauth (1980, 1992, 1995, 2025) and an array of diploid parthenogenetic Laredo Striped Whiptail (*Aspidoscelis laredoensis*) clonal complex A (hereafter *A. laredoensis* A) as defined by Walker (1987), Abuhteba et al. (2000), Paulissen (2000), Barley et al. (2021),and Cordes et al. (2025b) were present on the barrier island. We considered the information provided by SF via links to *iNaturalist.org* to warrant visits to North Padre Island in 2024 and 2025 to collect sanctioned voucher specimens, of the deme (if a gonochoristic species of males and females), and array (if a parthenogenetic species of all-females), or both of the whiptail lizard species in question. The verified presence of the parthenogenetic species on this barrier island would be of great interest as it would confirm the existence of a highly significant eastward range extension for *A. laredoensis* A from recently discovered mainland sites in Hidalgo County, Texas (Manuel et al., in press), albeit by one or more likely inadvertent insular introductions.

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Background, Methods, and Materials

Originally, Padre Island was the largest barrier configuration of its kind in the world with a length of 113 miles (182 km). However, in 1957 the construction of the Port Mansfield Channel resulted in the creation of North and South Padre islands. Different parts of North Padre Island belong to four Texas counties. Our access to North Padre Island from the mainland was by the JFK Causeway (i.e., State Highway 361) from the city of Corpus Christi to the beach and then via the bridge to the island.

After traveling from Louisiana State University Eunice, Louisiana, on 19-20 July 2024, JEC searched the 38 acre Packery Channel Oak Motte Sanctuary and several adjoining areas on the Laguna Madre side of North Padre Island, Corpus Christi, Nueces County, Texas. This is the area strongly recommended by SF based on postings on *iNaturalist.org* and a personal visit to the island. The primary objective of the visits to the island was to search for the presence of likely inadvertently introduced individuals of *Aspidoscelis laredoensis* clonal complex A. Perhaps *A. sexlineatus stephensae* is native to the island as it also occurs on South Padre Island (Trauth 1992, Pérez-Ramos et al. 2010, Cordes et al. 2025a, b). Unfortunately, no whiptail lizards were observed on North Padre Island by JEC in 2024. However, follow-up visits to essentially the same sites were conducted by JEC on 1-4 June 2025 and 16-19 July 2025. Voucher specimens of both gonochoristic *A. sexlineatus* (n = 1) and diploid parthenogenetic *A. laredoensis* A (n = 2) were obtained using large rubber bands as either stunning or lethal projectiles during the June visit, whereas vouchers of only *A. laredoensis* (n = 5) was obtained by the same methods during the July visit.

Results

The first visit by to the Packery Channel Oak Motte Sanctuary on North Padre Island in late July of 2024 resulted in no sightings of whiptail lizards during a two day visit by JEC. We attributed this unfortunate outcome to a combination of the oppressively hot and dry weather conditions, unfamiliarity with the best areas to search for ground dwellings lizards, and relatively low levels of whiptail lizard abundance therein. This was in marked contrast to experiences on South Padre Island in 2023 when the presence and relative abundance of *A. laredoensis* clonal complex B was readily confirmed on the first visit to the small targeted site, which consisted of the small Migratory Bird Sanctuary of only ca. 464.5 m^2 (Cordes et al. 2024).

Our present knowledge of the distribution of parthenogenetic *A. laredoensis* clonal complex A on North Padre Island is limited to the aforementioned sanctuary and immediately bordering sites. The protected nature preserve that was searched on North Padre Island was mostly bordered by private holdings with occupied homes. The sanctuary proper included numerous live oak trees throughout the areas searched and scattered sago palms near the periphery. Thick layers of leaves made some areas unproductive for ground dwelling lizards. Relatively open structured grassy areas were present particularly in the sandy areas and trails through thickly vegetated were most productive within the preserve (Fig. 1). However, areas with tangled growths of passion flower vines and thorny vines with the absence of trails were largely unproductive. Young of year (YOY) individuals of *A. laredoensis* A were mostly observed and collected on small sandy hillocks, whereas adults of the species were mostly observed and collected from a friendly couple's flower beds and yard. The distinguishing characters of parthenogenetic *A. laredoensis* A and B are readily apparent (Fig. 2) from hatchling through adulthood both in hand and in the field by a workers with a modest experience with the diversity of south Texas whiptail lizards. We identified UADZ 9888, 9889, 9891, 9913-9917 as *A. laredoensis* A from North Padre Island based on their moderately enlarged postantebrachial scales (Fig. 5) compared with small in scales in *A. sexlineatus* (Fig. 4), no reddish or pinkish coloration in the ventral pattern or plates as in postantebrachial scales as in *A. gularis*, presence of either whitish or bluish ventral colorations, persistence of the seven relatively invariable longitudinal cream to pale yellow lateral, dorsolateral, and paravertebral primary stripes, and a relatively invariable middorsal pattern consisting of a single longitudinal vertebral stripe that never appeared as partially or vaguely doubled (as in *A. laredoensis* B). Moreover, the structure of the lateral stripes were not fragmented and incorporated into parts of lateral bars as in *A. laredoensis* B (Fig. 2).

Discussion

Paulissen (2000), in a lengthy study of *A. laredoensis* clonal complexes A and B in Bentsen-Rio Grande

Fig. 1. Images (A-D) depicting sites on where sandy trails through vegetation North Padre Island, Nueces County, Texas, which were among successfully searched areas for individuals of *Aspidoscelis laredoensis* A in June and July 2025. (Photos by James E. Cordes).

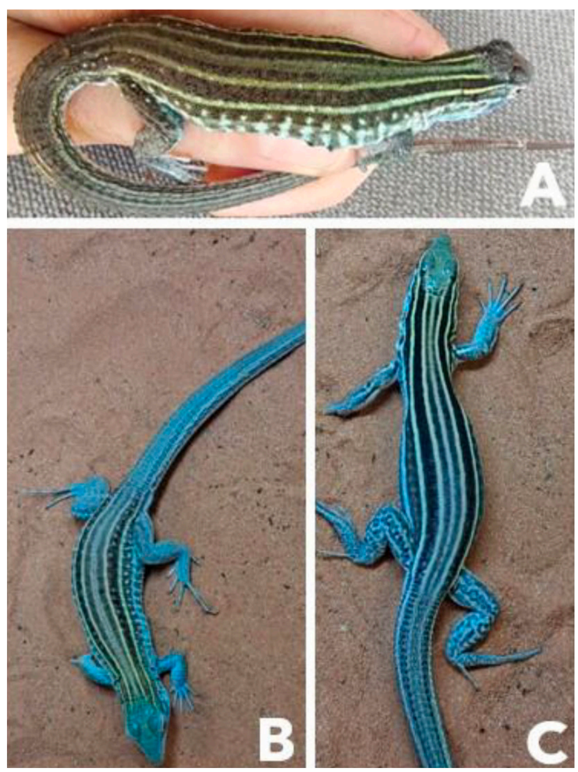

Fig. 2. Dorsal color patterns of a preserved (A) and live adults (B-C) of *Aspidoscelis laredoensis*: **(A)** clonal complex B top from South Padre Island, Cameron County, Texas; **(B)** an individual of clonal complex B from south of Carrizo, Dimmit County, Texas; and **(C)** an individual of *A. laredoensis* clonal complex A (note incipient spots visible in left upper lateral field) from North Padre Island, Nueces County, Texas. (photo **A** by Ben Camper; photos **B** and **C** by James E. Cordes).

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Fig. 3. Dorsal color patterns of preserved adult females of *Aspidoscelis laredoensis* clonal complex A (**A**, UADZ 9915, SVL 78 mm) and (**B**, UADZ 9916, SVL 79 mm) collected from North Padre Island, Nueces County, Texas, on 17 July 2025. In each specimen note the diagnostically important single vertebral stripe between the paravertebral stripes, the incipient to actual pale spots in upper lateral fields, the intact lateral stripes, and absence of lateral bars. (Photos by James M. Walker).

Valley State Park (B-RGVSP), found that they were essentially annual arrays (herein we reserve the term "population" for species with males and females) in terms of life histories. Based on the presence of both adults of 78 and 79 mm and young-of year of 36, 38, and 44 mm SVL of *A. laredoensis* A being collected on 17 and 18 July 2025 (UADZ 9913-9917) in the Packery Channel Oak Motte Sanctuary of North Padre Island, the mild climate and long activity cycle there allows lizards to grow to adulthood in a similar period of time as observed in B-RGVSP by Paulissen (2000). That would also explain the apparent absence of subadults on the island during the first half of June. We first recorded YOY of *A. laredoensis* B (UADZ 9859–9860) on South Padre Island during 20 July 2023. Confirmation of the presence of an array of *A. laredoensis* B on South Padre Island marks the easternmost range limits from mainland Cameron County for this distinctive clonal complex. This was an especially welcomed development. When we first discovered *A. laredoensis* B in 1984 in B-RGVSP, Hidalgo County, Texas, it was by far the most abundant whiptail lizard complex in the park, with individuals of clonal complex A of *A. laredoensis* rare and *A. gularis gularis* not observed (Walker et al. 1996). Today, *A. g. gularis* is very abundant in the forested enclave and clonal complex *A. laredoensis* A is only occasionally encountered in the park. It appears that *A. laredoensis* B has either been extirpated or occurs in such small numbers as to appear to be absent. In 2023 a research group from Clemson University discovered three new sites for clonal complex A and B in mainland Hidalgo County. Prior to those discoveries by Manuel et al. (in press), an area in distant Dimmit County was the only reliable source for individuals of clonal complex B for either genetic (e.g., Barley

Fig. 4. Ventral color pattern of a preserved adult female of *Aspidoscelis laredoensis* clonal complex A (**A**, UADZ 9915, SVL 78 mm) collected on 17 July 2025 and a male of *A. sexlineatus stephensae* (**B**, UADZ 9889, SVL 68 mm) collected on 3 June 2025 from North Padre Island, Nueces County, Texas, and photographed before preservation. Note the following diagnostically important color pattern aspecéts of a male of *A. sexlineatus stephensae* which includes yellow-green suffusion of lateral surface of head, pale bluish ventral coloration, and small postantebrachial scales on distal aspect of forelimb. (Photos by James E. Cordes).

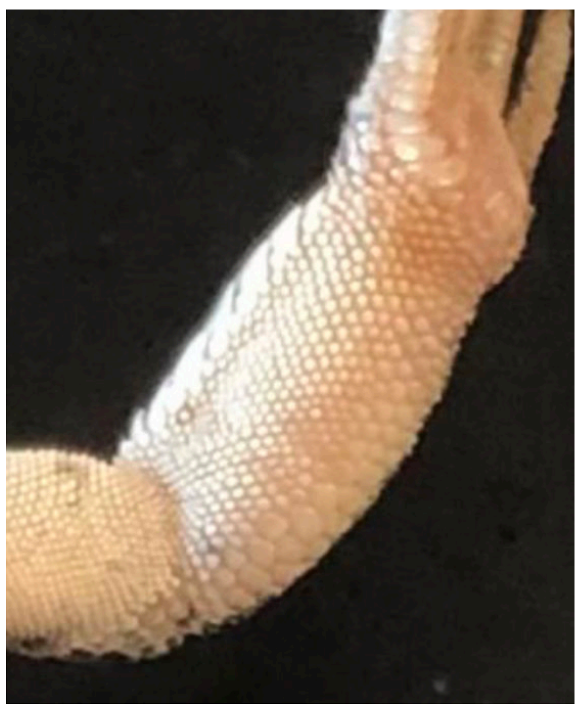

Fig. 5. Moderately enlarged postantebrachial scales in lower right of distal part of a forelimb of in an adult of diploid parthenogenetic *Aspidoscelis laredoensis* clonal complex A (UADZ 9915, SVL 78 mm) collected 17 July 2025 on North Padre Island, Nueces County, Texas. (Photo by James M. Walker).

Based on the presence of both adults of 78 and 79 mm and young-of year of 36, 38, and 44 mm SVL of *A. laredoensis* A being collected on 17 and 18 July 2025 (UADZ 9913-9917) in the Packery Channel Oak Motte Sanctuary of North Padre Island, the mild climate and long activity cycle there allows lizards to grow to adulthood in a similar period of time as observed in B-RGVSP by Paulissen (2000).

et al. 2021) or ecological studies (e.g., Walker et al. 2016). Therefore, the field work of the Clemson group in late May of 2023 not only led to the discovery of previously unknown sites for *A. laredoensis* A and B in Hidalgo County, more recently, JEC participated in a total of three trips to the newly discovered site for clonal complex B on South Padre Island. Whether the species is naturally occurring or has been deliberately or inadvertently introduced to the island by human agency remains an intriguing question. Established arrays of the following have been reported as apparently introduced parthenogenetic species of *Aspidoscelis*: diploid *A. neomexicanus* in Arizona (P and Wright 1999), Utah (Oliver and Wright 2007), and New Mexico (Leuck et al. 1981); triploid *A. exsanguis* in Colorado (Livo and Wilcox 2021); triploid *A. neotesselatus* in Washington state (Weaver et al. 2011); and triploid *A. velox* in Oregon (Storm et al. 1995; Kusaka et al. 2024).

Acknowledgements—Voucher specimens of whiptail lizards were collected under authority of Texas Parks and Wildlife Scientific Permit No. SPR-1090-298 and Texas State Park Scientific Study Permit No. 37-23 held by JEC. Funding for field research by JEC was provided by an Endowed Professorship through Louisiana State University Eunice Foundation and Opelousas General Hospital and supplemented by the Walker Family Trust managed by JMW. The success of the visits to North Padre Island in 2025 was in no small part result of two private homeowners who allowed access to their property near the Sanctuary. They asked to retain their identity and be remembered only as 'friendly neighbors.'

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RESEARCH ARTICLE

Demographics of a Large Colony of the Eastern Collared Lizard, *Crotaphytus collaris*, in Northern Arkansas

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Introduction

Pugnacious! There are few words that can better describe the lizard-in-hand disposition of the Eastern Collared Lizard (hereafter referred to as collared lizard), *Crotaphytus collaris* (Figs. 1-3). Maybe awesome, fabulous, and majestic are other terms that come to mind for some people to adequately characterize this amazing lizard. Regardless of a choice of descriptors, this lizard catches the fascination and admiration of anyone who sees it in the wild. I had the fortunate opportunity to study the biology of this lizard early in my professional herpetological career. In fact, my experiences with the colorful male actually began when I was a youngster growing up at my family's fishing resort along Bull Shoals Lake in northern Arkansas back in the mid-1950s. Chasing collared lizards along the rocky shoreline habitats of this lake was always something to look forward to during the summer months. The chase often led to lifting a rock and grabbing blindly at a lizard before it could escape. As I recall, most of these occasions ended up with a handful of lizard as well as a painfully bitten finger. A catastrophic flooding of the lake in 1957 inundated most of the habitable shoreline retreats for the lizard at that time and, thus, ended my early days searching for collared lizards (see related lake flooding information in Trauth 2011).

I graduated with a bachelor's degree in zoology from the University of Arkansas (UA) in 1970 and, by then, I had persuaded myself to become a herpetologist. I was accepted into the graduate program at the UA starting the spring semester of 1971, and I was fortunate to have Dr. James M. Walker (see *Acknowledgments*) as my advisor in herpetology. As classes began that January, I visited with Dr. Walker regarding a possible thesis topic. I suggested several species options to him, such as the natural history of Ozark Hellbenders, Prairie Lizards, and Common Five-lined Skinks. However, when I mentioned studying collared lizards, he immediately agreed that that species was my best choice.

During my numerous trips (undergraduate days) to and from the UA from my childhood home, I would drive through the small community of Flippin. By scanning the horizon about 3 km to the northwest of this town, I could easily see Lee Mountain (hereafter referred to as LM; Fig. 4B), the excavation site for rock quarried to build Bull Shoals Dam. I decided to visit the abandoned LM quarry site on 10 April 1971, and I witnessed an amazing number of collared lizards. Subsequently, I returned to the LM quarry site weekly (or nearly so) a total of 19 times in 1971 to conduct a population analysis and then for a follow-up five times (monthly) in 1972.

The specific objective of the present paper is to provide unpublished data from my field notes and master's thesis (Trauth 1974), which primarily addressed the demographics of this collared lizard colony during the 1971 activity season. Along with this population study, a portion of my thesis focused on a histological analyzes of the testicular and ovarian cycles (Trauth 1978, 1979). Nearly all specimens used in the histological investigations, however, were collected from commercial rock quarries, from rock quarries for other hydroelectric dams of the White River system, and from the shorelines of reservoirs impounded by these dams (Fig. 4A).

Pugnacious! There are few words that can better describe the lizard-in-hand disposition of the Eastern Collared Lizard (hereafter referred to as collared lizard), *Crotaphytus collaris* (Figs. 1-3).

Fig. 1. Head profile coloration in adult male (above) and female collared lizards from northern Arkansas.

Methods and Materials

I captured collared lizards by noosing using dental floss tied to the end of a cane pole. Body measurements included snout-vent length (SVL) and tail length (TL), each to the nearest mm, and body mass to the nearest 0.1 g. A triple-beam balance was placed inside a wind resistant enclosure which was mounted on a small platform to enhance body mass measurements. Five of these platforms were established at strategic staging points within the LM quarry basin.

Lizard gender was usually determined by body size and coloration with males being larger and more brightly colored than females (Fitch 1956). The presence of enlarged postanal scales in males

Fig. 2. Body coloration in adult male (above) and female collared lizards from northern Arkansas. Orange postnuptial blotches are present laterally on female.

and their absence in females was used to identify gender in hatchlings and juveniles. For permanent identification, I toe clipped the distal phalanx of two toes per lizard at a point just posterior to a toenail. Only one toe per manus and pes were clipped. Before each marked lizard was released, I placed a small dab of model airplane paint dorsally between the shoulders to enhance visual identification of each lizard. Also, this paint marking was beneficial in monitoring ecdysis.

I captured collared lizards by noosing using dental floss tied to the end of a cane pole. Body measurements included snout-vent length (SVL) and tail length (TL), each to the nearest mm, and body mass to the nearest 0.1 g.

Results and Discussion

Quarry Habitat—The LM quarry study area consisted of a broad, mostly flat, plain with very few clusters of boulders along with sparse permanent vegetation (Fig. 4C, D) and an elevated region made up of an expansive scattering of rocks containing little vegetational cover (Fig. 4C-a). Initially, I captured many lizards along a line of scattered boulders that were strewn at the interface of the plain base and an abrupt rock bluff (Fig. 4C-b) lying at the southeastern edge of the quarry. I followed this boulder interface as it meandered internally within the quarry basin. A few scattered rock piles (Fig. 4E) were situated along this interface. Also, the quarry possessed a single rocky peninsula that

Fig. 3. Hatchlings (SVL of female above-41 mm; male-42 mm. 3 Aug 1971). Body measurement data of adult female (18 July 1972). Data regarding her eight captures are detailed in the text.

appeared to be remnants of a truck road for hauling rock to the conveyor belt that transported rock ca. 20 km to the dam site. Access to the quarry was a gravel road that followed the former path of the conveyor belt (see arrow in Fig. 4B). As my visits to the quarry increased and my capture numbers gradually increased, my recapture numbers also grew substantially. Eventually, this capture rate resulted in a decrease in new individuals. I then shifted my search area to include the higher plateaued region of the quarry (Fig. 4C-a) later in the mid-summer in order to find more adults. This move did not increase my adult captures as many adults had already begun summer aestivation; however, hatching season had started, resulting in sampling of numerous hatchlings.

Population Structure— Sexually mature adults ranged from 76-104 mm SVL in males and 72-93 mm SVL in females. Juveniles ranged from 55-72 mm SVL in females and 55-76 in males (Fig. 5). Hatchlings ranged from 37-56 mm SVL in both males and females. A near 1:1 sex ratio was evident. In all, I recorded data for a large number of individuals (154 adults [80 males; 74 females] and 59 hatchlings/juveniles [26 males; 33 females]). The cumulative catch number reached an asymptotic level by mid-July (Fig. 5) for adults and yearlings; thereafter, new lizards were either hatchlings or maturing juveniles. My mark/recapture numbers were noteworthy and illustrate the catchability of collared lizards. The following data includes date of capture, mark/recapture number, and gender of recaptured lizards (males/females): 17 April, 9/0, 5/4; 24 April,12/1, 9/4; 1 May, 24/8, 13/19; 8 May, 9/12, 13/8; 15 May, 8/22, 15/15; 23 May, 4/12, 6/10; 1 June, 5/19, 12/12; 7 June, 3/24, 12/15; 15 June, 5/35, 18/22; 22 June, 3/33, 14/22; 29 June, 2/30, 15/17; 6 July, 1/21, 9/13; 14 July, 5/11, 5/11; 21 July, 12/30, 23/19; 27 July, 11/26, 17/20; 8 Aug, 17/28, 19/26; 15 Aug, 10/14, 16/8; 28 Aug, 6/13, 9/10; 11 Sept, 14/7, 7/14, and 2 Oct, 6/5, 5/6. The male/female recapture summary numbers (242/267) favored females but also presumably indicated that males were noose leery and avoided recapture more often compared to females. In summary, this large population at the LM quarry of over 200 animals exceeded all other known large colonies reported for collared lizards in Arkansas (Brewster et al. 2014).

I recaptured many lizards multiple times (Figs. 6, 7). For example, I recorded an average of 7.2 (5-11) captures per lizard among 35 adult lizards with the greatest capture numbers. One female (Fig. 3), in particular, was nearly always present atop a large boulder at the point of entry into the quarry (vicinity of arrow tip in Fig. 4B). I noosed her eight times—six times in 1971 and two times in 1972. She appeared to accept my presence, and during each encounter she allowed an uneventful noosing and measuring event. Her body measurements through time were as follows (date of capture, SVL, TL, and mass): 8 May, 67,132, 10.0; 1 June, 76, 143, 12.9; 22 June, 82, 158, 18.9; 29 June, 85, 162, 22.0; 6 July, 88, 128, 24.1; 22 April, 94, 135, 20.5, and 18 July, 93, 138, 24.0. Two things of note regarding this female: 1) her tail loss from 162 mm to 128 mm and then a regeneration of approximately 10 mm, and 2) her mass loss, which undoubtedly was a result of oviposition (see Fig. 8). For comparison, in the most recent population study in Arkansas, Brewster et al. (2014) recorded a total of 141 captures of yearlings and adults and 77 captures of 37 hatchlings. They recaptured 76% of adults and 42% of hatchlings at least once.

Growth—Sexual maturity in collared lizards normally requires less than one calendar year (Fitch 1956). Growth during subsequent years of life is greatly reduced. Growth data were obtained from 98 marked lizards using approximately 300 captures (Figs. 6, 7). Males and females reach an approximate size of 104 mm and 93 mm SVL, respectively, after one year of life, whereas the maximum SVL recorded were 110 mm and 103 mm for males and females, respectively, during my entire study of this lizard.

As my visits to the quarry increased and my capture numbers gradually increased, my recapture numbers also grew substantially. Eventually, this capture rate resulted in a decrease in new individuals.

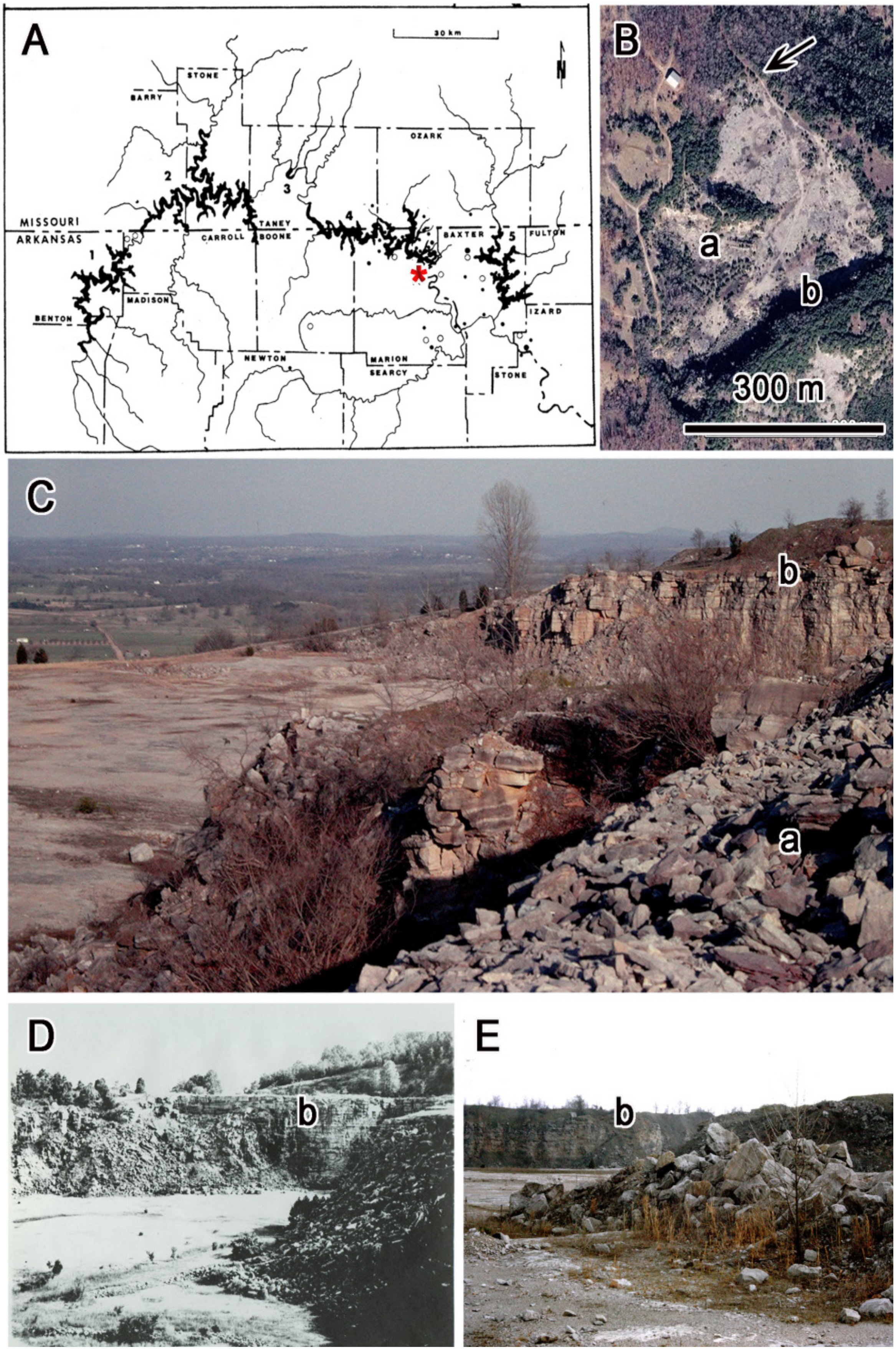

Fig. 4. A. Location (red asterisk) of LM quarry site (36.286975° N, 92.626011°W; elev. 318 m) in Marion County (bordering Missouri) in northern Arkansas. Reservoirs are as follows: 1-Beaver; 2-Table Rock; 3-Taneycomo; 4-Bull Shoals, and 5-Norfork. **B.** Aerial view of LM quarry (via Google Earth) and gravel access road (arrow); **a** = vantage point as shown in **C**; **b** = southeastern bluff escarpment as shown in **C**, **D**, and **E**. **E**. Isolated rock pile in quarry basin.

Females exhibited distinct body mass changes associated with oviposition (Fig. 8). Several of the largest adults experienced two mass losses, which was indicative of doubling clutching. Smaller females had a less striking mass loss, which was presumably related to smaller clutch sizes (Trauth 1978). Females carrying oviductal eggs may experience 17-36% decrease in body mass, but recover at a rate of 0.4 g per day. Following the reproductive season, both males and females gain mass in their coelomic fat bodies at approximately 0.52 g per day. The relationship between body mass and SVL (Fig. 9) revealed that females greater than 76 mm SVL experienced the largest degree of mass variation due to the presence or absence of yolked ovarian follicles or oviductal eggs.

Growth based on molting frequency (ecdysis) was recorded in 36 lizards with 56 recaptures in late April and May with an average of 0.50 molts per individual. During June 53 lizards recaptured 136 times averaged 1.50 molts for both sexes; one female molted four times. From July through late August 63 lizards captured 128 times averaged 1.10 molts per individual. Two juveniles marked on 2 October 1971 still retained the marking on 22 April 1972. Three adult males marked on 28 August 1971 retained the paint marks on 22 April 1972. Two adult females retained marks from 27 July and 28 August 1971 until 22 April 1972. Fitch (1956) stated that molting frequency was directly related to the rapid growth of first year individuals. His principal findings indicated that an increase in linear dimensions occurs between successive molts.

Acknowledgements—I am grateful for the mentorship provided to me over the past 55 years by Dr. James M. Walker of the Department of Biological Sciences at the University of Arkansas at Fayetteville (beside me holding the jar of whiptail lizards). He has contributed greatly to my passion for collared lizards as well as to my keen interest in and understanding of the biology of whiptail lizards (photo taken in April, 2016).

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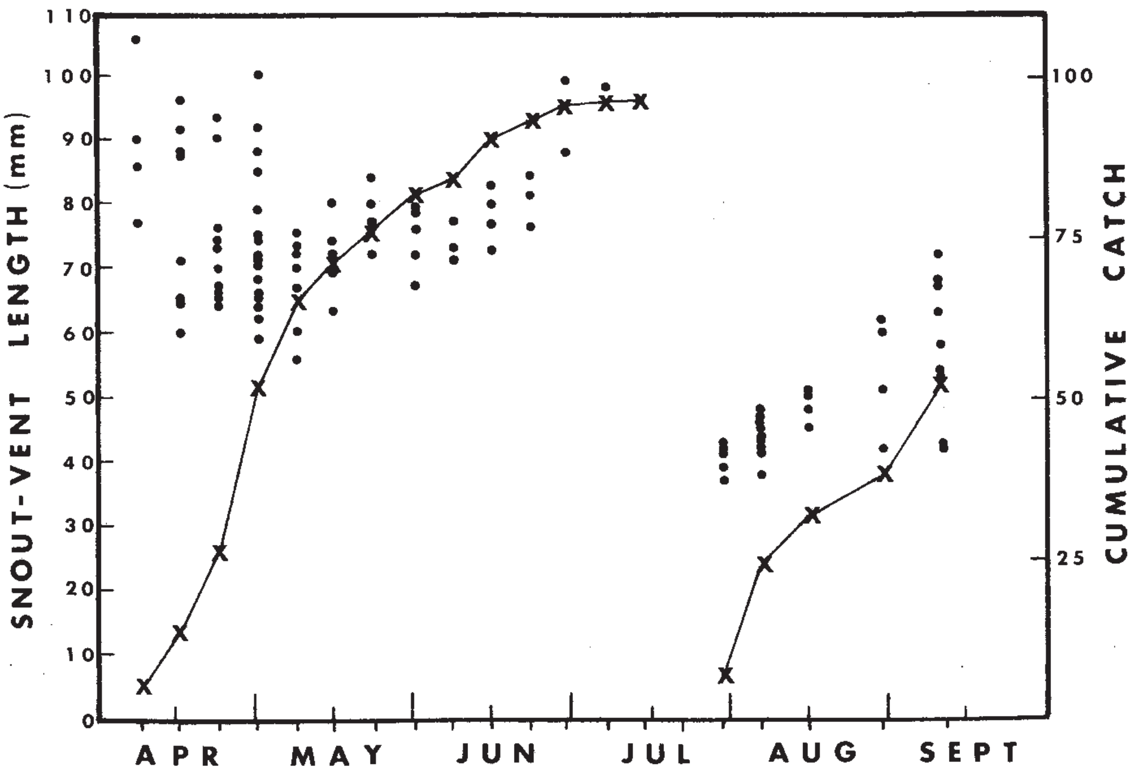

Fig. 5. Cumulative total number of marked lizards per date during the 1971 sampling period. Cumulative catch lines link 19 collection dates (X); SVL (dots) of marked lizards are shown. (Some dots represent multiple numbers of lizards.)

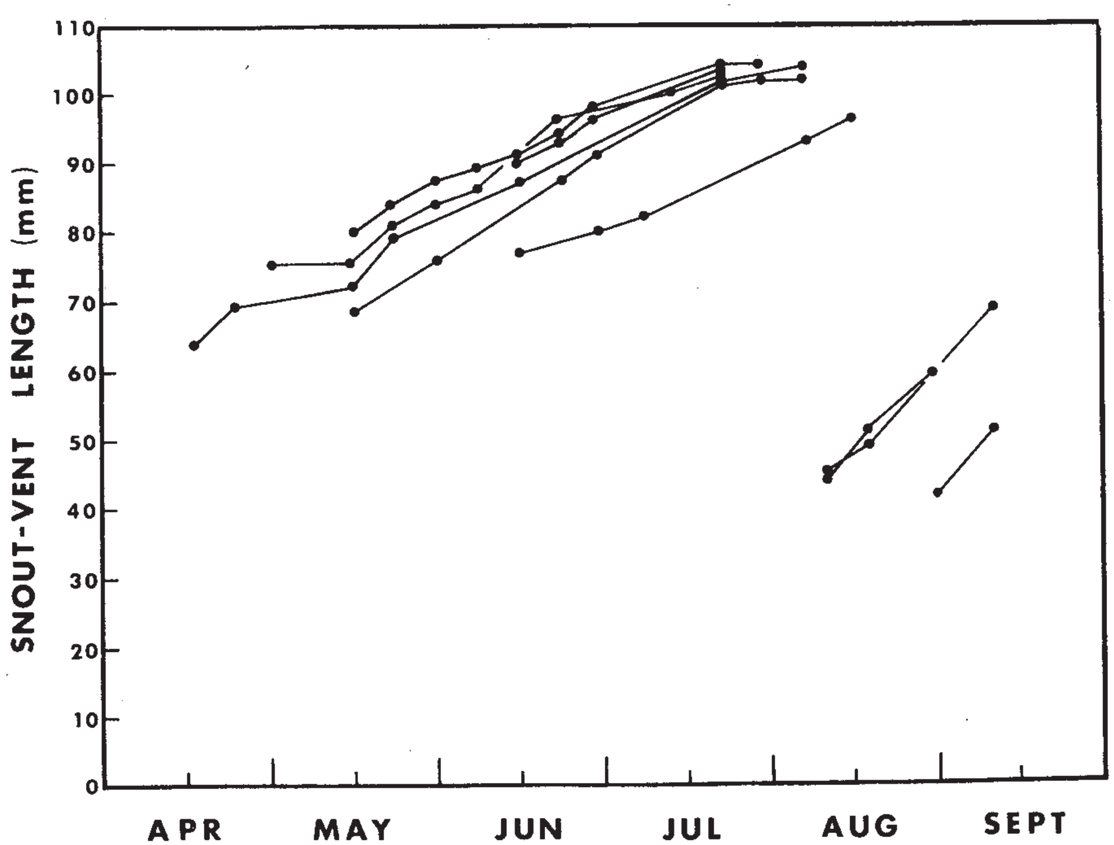

Fig. 6. Growth in SVL during the first year of life in males. Lines connecting dots equal capture intervals.

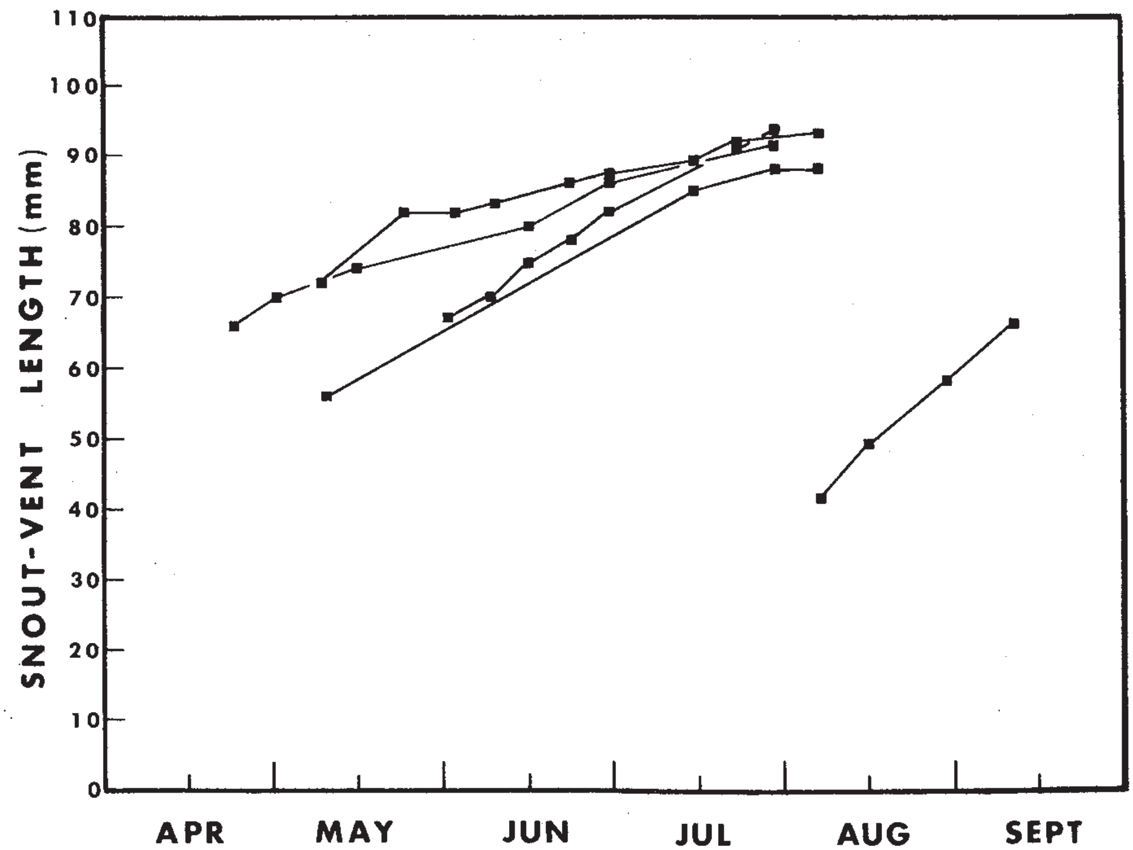

Fig. 7. Growth in SVL during the first year of life in females. Lines connecting dots equal capture intervals.

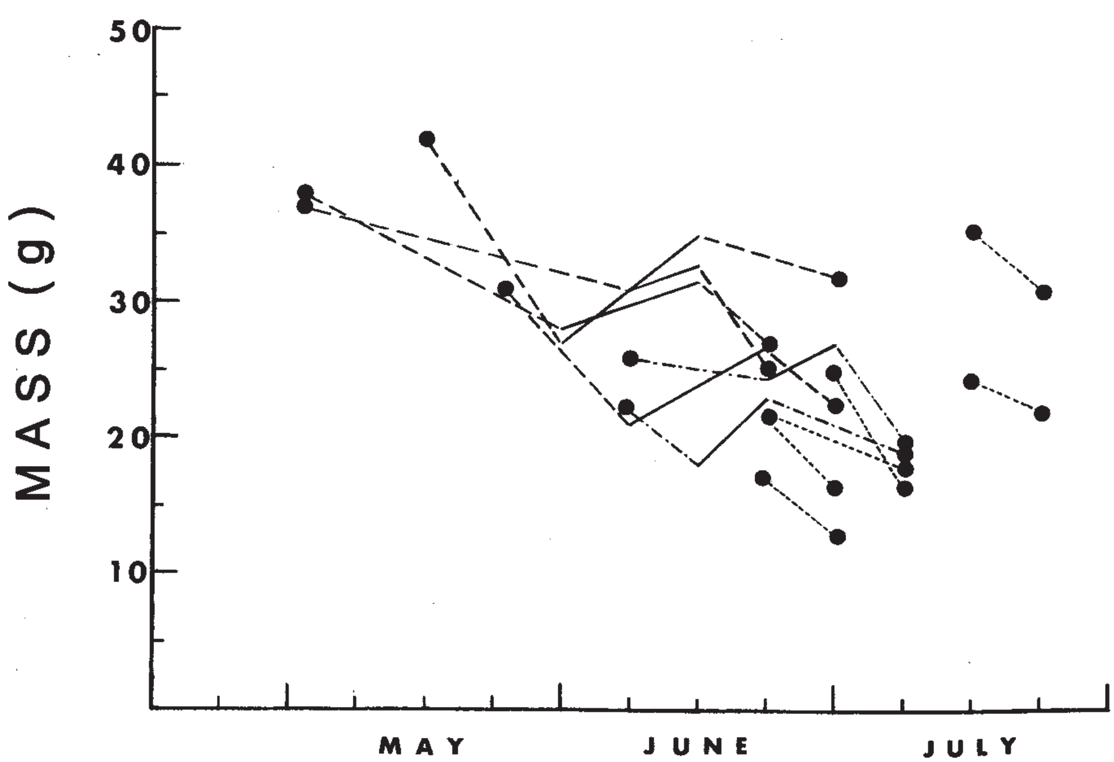

Fig. 8. Relationship between body mass and date of capture in adult females. Lines with numerous dots = first year and older females; dot-dash-dot lines = two clutches, first year females; dashed lines = two clutches, older females; solid lines = period during which no recaptures occurred.

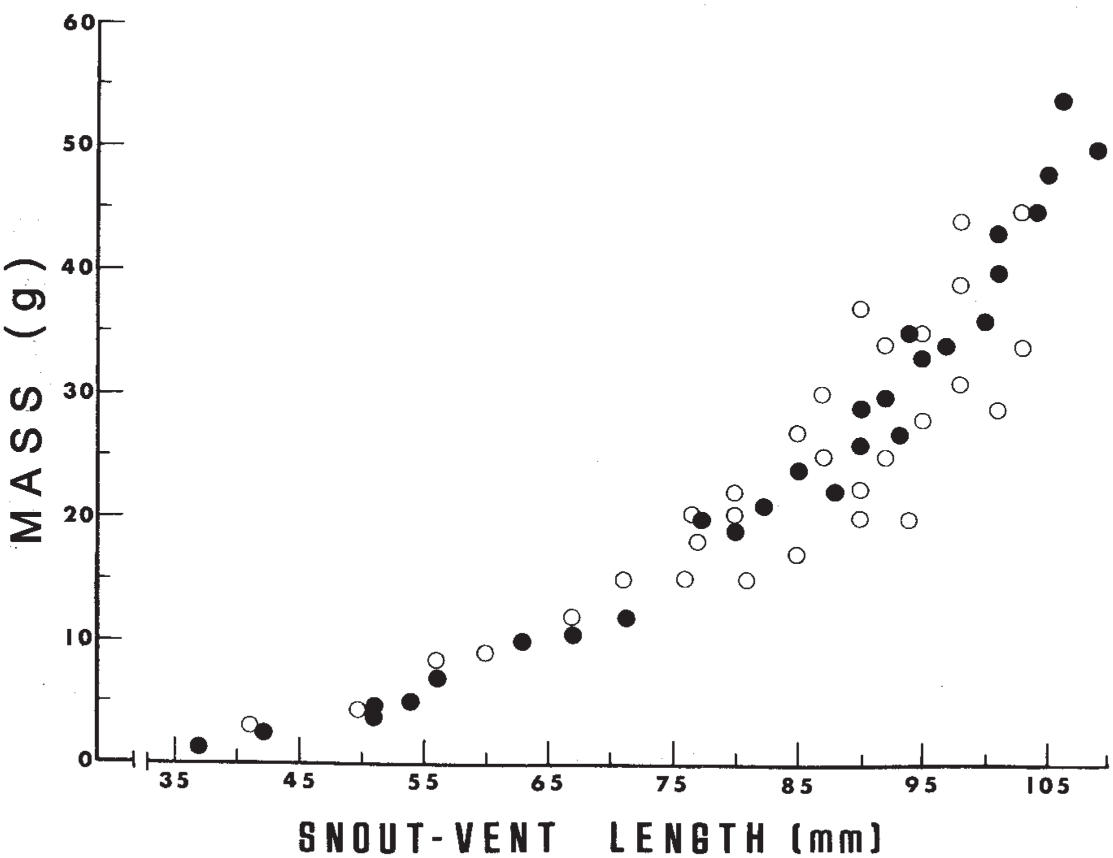

Fig. 9. Relationship between body mass and SVL. Solid circles are males, and open circles are females.

RESEARCH ARTICLE

Monitoring Gila Monster (*Heloderma suspectum*) Populations in Southeastern Cochise County, Arizona

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Abstract—Gila Monsters (*Heloderma suspectum*) are an iconic species of the desert landscapes of the southwestern United States and Mexico. These large, venomous lizards appear to be rather uncommon throughout their range, but our understanding of their population status is complicated by the fact that they spend most of their lives underground where they cannot be easily observed and documented. Personnel and volunteers from the U.S. Fish and Wildlife Service opportunistically monitored Gila Monsters in the vicinity of San Bernardino and Leslie Canyon National Wildlife Refuges in southeastern Cochise County, Arizona, from 2000-2024. Lizards were captured, measured, weighed, sexed, photographed, PIT-tagged, and then released at the capture site. Data from 234 individual Gila Monsters (330 total captures, including 96 total recaptures) provided insight into seasonal and daily activity periods, individual movement, home range size, habitat use, life history and reproduction, growth and longevity, mortality, and food habits. Such basic ecological information was easily and economically gathered by Service staff and has contributed to the overall knowledge of Gila Monster ecology.

Introduction

Gila Monsters (*Heloderma suspectum*; Helodermatidae) are one of the most iconic creatures of the American Southwest and adjacent Mexico. They are characterized by their relatively large body size, beadlike osteoderms covering most of the body and tail, venom glands in their lower jaw, thick, forked tongues, and a substantial sausage-shaped tail used to store fat reserves (Lowe et al. 1986). The color pattern of Gila Monsters, described as having irregular, reticulated patches of black blotches on a rose, orange, or yellow background (Beck 2005), varies among populations and is subject to ontogenetic change (Bogert and Martín del Campo 1956).

The geographic range of Gila Monsters includes portions of Sonora, Chihuahua, and Sinaloa in the Republic of Mexico, and portions of Arizona, New Mexico, California, Nevada, and Utah in the United States (Beck 2005). Gila Monsters are highly sedentary for most of the year, spending up to 92% of the annual cycle at rest in their shelters in some populations (Beck 1990). Gila Monsters appear to be rather uncommon and putatively exhibit low population densities throughout their range (Lowe et al. 1986, Farrar et al. 2016). The lizard's secretive behavior through most of

Gila Monsters (*Heloderma suspectum*; Helodermatidae) are one of the most iconic creatures of the American Southwest and adjacent Mexico.

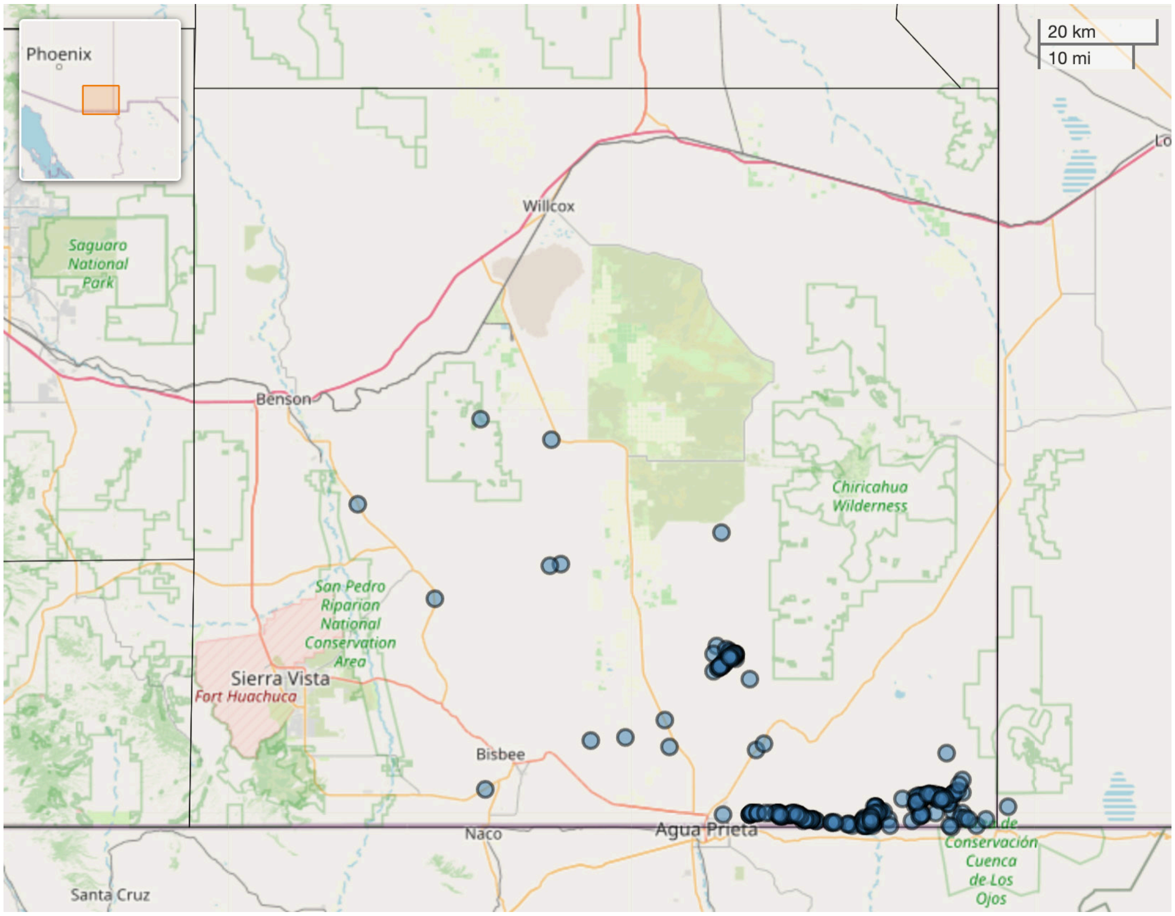

Fig. 1. Map showing locations of Gila Monsters captured from 2000-2024 in Cochise County, AZ.

the year is also responsible for our relatively limited knowledge of their natural history and conservation status (Gienger 2003, Gehman and Gienger 2025).

Here, we describe the results of a long-term opportunistic monitoring program conducted by the U.S. Fish and Wildlife Service (Service) in Cochise County, Arizona. The data from this monitoring have been efficiently gathered during the course of other work and added additional information on several aspects of Gila Monster natural history that have not previously been reported.

Here, we describe the results of a long-term opportunistic monitoring program conducted by the U.S. Fish and Wildlife Service (Service) in Cochise County, Arizona.

Description of Field Sites—The Cochise County, Arizona, monitoring site, centered around San Bernardino National Wildlife Refuge (SBNWR) and Leslie Canyon National Wildlife Refuge (LCNWR; Fig. 1), is characterized by Chihuahuan desert-scrub, influenced by limestone and volcanic soils, relatively high elevations, cold winters, and hot summers. Refuge elevations range from about 1,134-1,195 m (3,719-3,919 ft) on SBNWR to about 1,402-1,722 m (4,600-5,650 ft) on LCNWR. Climate data gathered from the Bisbee-Douglas International Airport (GHCND:USW00093026; Elevation:1251.2 m; Lat/Lon: 31.45838/-109.60676) shows the average annual high temperature in this area was 26.6°C (79.9°F), the average annual low temperature was 8.2°C (46.7°F), and temperature extremes ranged from -18 to 43°C (0-109°F); (*http://www.rcc-acis.org*) during the time of this monitoring effort. Annual precipitation is bimodal, with mid to late summer thunderstorms comprising the majority of the annual rainfall, which ranged from 15.24 cm (6.0 in) during 2009 to 45.45 cm (17.9 in) during 2013 and averaged 28.45 cm (11.2 in) during the 25-year monitoring effort (but data for 2020-2022 was incomplete or missing at this station).

Characteristic plants include velvet mesquite (*Prosopis velutina*), whitethorn acacia (*Acacia constricta*), creosote bush (*Larrea tridentata*), littleleaf sumac (*Rhus microphylla*), sandpaper bush (*Mortonia scabrella*), prickly pear cactus (*Opuntia engelmannii* and *O. santa-rita*), banana yucca (*Yucca baccata*), soaptree yucca (*Yucca elata*), sotol (*Dasilyrion wheeleri*), ocotillo (*Fouquieria splendens*), and multiple annual and perennial grass species. Narrow riparian corridors containing Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), velvet ash (*Fraxinus velutina*), netleaf hackberry (*Celtis reticulata*), and other species, are more widely spaced across the landscape.

Methods

Gila Monsters within the general landscape surrounding SBNWR and LCNWR were opportunistically monitored by U.S. Fish and Wildlife Service personnel between 2000-2024. When we encountered an individual Gila Monster, we captured and temporarily detained it for processing at a local field office. We measured the snout to vent length (SVL), total length (TL), weight, sex (when possible; see discussion below), took a dorsal photograph, and PIT-tagged each individual to provide positive individual identification and capture history. We then released the lizard at the original capture site within 48 hrs. PIT-tags were injected subcutaneously on the underside of the abdomen with no problems involving tag retention or injury to the lizards. Sexing was accomplished following Gienger and Beck (2007), which indicate males generally have larger, wider heads and a more squared body shape, while females generally have narrower heads and a more pear-shaped body. Smaller individuals are not able to be accurately sexed. Coordinates for capture sites were recorded with GPS devices or determined by online mapping software.

Results

Refuge staff and volunteers captured and processed 234 individual Gila Monsters (330 captures, including 96 total recaptures) between 2000-2024. This includes 27 individuals that were collected as road kills, which were processed and included in our database before being donated to museums or university collections.

Many of the Gila Monsters in our monitoring area typically have darker patterns (Fig. 2) than those found in other areas of Arizona (Beck 2005), perhaps

Fig. 2. Example dorsal patterns and coloration of Gila monsters captured from 2000-2024 in Cochise County, AZ. **A)** 4B1D5D6A0D 12 May 2014 Female SBNWR; **B)** 4B21752166 24 Jun 2010 Male. LCNWR; **C)** 44215E061B 13Apr 2010 Female. SBNWR; **D)** 47200F1F14 30 Sep 2006 Female. N of Guadalupe Canyon Road; **E)** 4579240D75 25 Jul 2014 Female. Guadalupe Canyon Road; **F)** 4720003E1C 31 Jul 2007 Female. Guadalupe Canyon Road.

conforming to the principle of Gloger's rule (Bogert and Martín del Campo 1956) or perhaps providing a greater degree of favorable cryptic coloration in areas dominated by the dark volcanic rock within this landscape. Dark adults have also been discovered in black basaltic lava flows in Southwest Utah (Beck 1985, Rognan 2010).

Activity Periods—We observed active individuals annually between 20 March through 3 December, with two peaks of activity (Fig. 3A). The earliest lizards were observed basking at the entrances of their presumptive hibernacula during mid-March (starting 20 March) but their activity away from burrows generally began during April, with an activity pulse during spring from April-June, accounting for 26.3% of total captures. Maximum activity occurred during the summer rainy season (July-September; 67.3% of total captures), when lizards take advantage of opportunities for rehydration and foraging (Davis and DeNardo 2010, Gienger et al. 2014). Most lizard activity tapered off quickly in October with the onset of cooler temperatures, and the last individual of the year was captured 3 December.

Our data (n = 276; exact capture time was not recorded for 54 of the 330 total individual captures) document Gila Monster activity between 0628 h and 2015 h local time, with most activity (65.2%) occurring in the morning between 0700-1159 h, some activity (9.4%) occurring during the middle of the day (1200-1559 h), and another smaller pulse of activity (23.6%) occurring in the afternoon between 1600-2000 h (Fig. 3B). Nocturnal activity by Gila Monsters was likely underestimated by our efforts because Service staff were generally present on the landscape between 0500-1700 h and were largely absent outside of that time. However, some staff did spend evening hours conducting inventory and monitoring work, and Gila Monsters were rarely observed during those periods.

We captured 19 juvenile (<165 mm SVL; and having a <67 g mass) Gila Monsters, but only one of these was recaptured to determine growth rate or survivorship. This is not completely surprising because their conservative energy-use strategy permits them to subsist for long time periods with limited activity (Beck and Lowe 1994), and because smaller Gila Monsters are more secretive than adults and subsequently may show greater nocturnal activity (Beck 2005). We captured 53% (n = 8) of the juveniles between 0720-1150 h, and 47% (n = 7) between 1440-1935 h (the remaining four were DOR specimens).

Movement—Home range is an area within an organism's habitat through which it moves to fulfill its resource needs, which may include foraging, rehydration, and reproduction (Beck 2005).

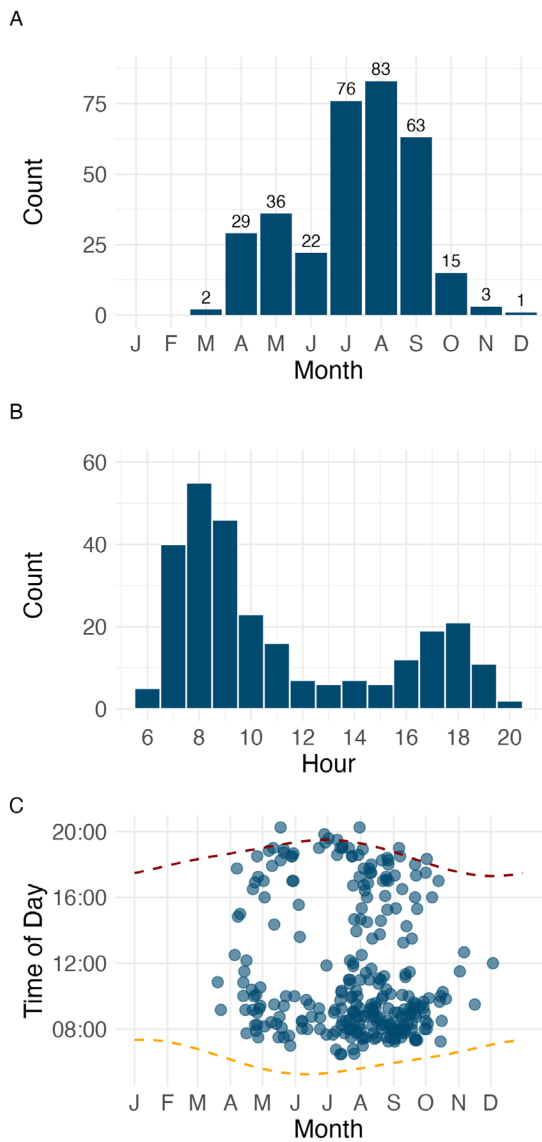

Fig. 3. (A) Gila Monsters in southeastern Cochise County, Arizona, have two activity peaks during the year, with the larger peak associated with the summer rainy season. The bars show the number of lizards per month (n = 330), including both living and dead individuals. **(B)** Activity appears to have two daily activity peaks, with most activity in the morning hours. The bars show the number of captures (n = 276) for which exact capture time was recorded. Note that personnel tended to be in the field more in the morning than in the evening, which may have affected the distribution of documented captures. **(C)** Annual distribution and timing of captures. Dotted lines indicate timing of sunrise and sunset.

Recapturing the same Gila Monster over time allowed limited determination of spatial, habitat use, and apparent home range use by an individual. We calculated home range sizes by constructing the minimum convex polygon that encompassed all of the observed locations (Jennrich and Turner 1969). The accuracy of home range calculations is based on having an adequate number of accumulated relocation points (minimum of three), and this was limited by our opportunistic monitoring, but does not influence an animal's movement in the way that tracking a radio-

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tagged individual may impact an animal's behavior (Millspaugh et al. 2012).

Gila Monster home ranges (*n* = 18) in this effort varied from 0.03-37.7 ha (0.07-93.2 a), and a mean gross home range of 6 ha (14.85 a). This compares with home ranges from about 6-147 ha (14.8-363.2 a) determined for Gila Monsters radio-tracked across several sites (Beck 2005), and a mean home range of 48.1 ha (116.4 a) for adults and 13.4 ha (33.1 a) for subadults at a site near Tucson, Arizona (Gallardo 2003), and 6-68 ha (14.8-168.0 a) at another site near Phoenix, Arizona (Sullivan et al. 2004).

The maximum distance between capture points of individual lizards (*n* = 55) during this monitoring effort ranged from 11-3,842 m (37-12,606 ft), and a mean of 563 m (1,847 ft), with nearly half (47%) of lizards exceeding 402 m (1,320 ft) between relocation points. Notably, a juvenile captured 8 July 2009 (147 mm SVL, 45 g mass) and recaptured 25 August 2009 showed a movement distance between capture points of ~100 m (~328 ft). It is unknown whether the movement of this small individual (likely < = 1 year old) between captures was a dispersal from its natal area, but the movement distance is notable and suggests that even the smallest and young individuals are capable of substantial movements.

Habitat Use—Habitat use by Gila Monsters in Arizona has been described as desertscrub, semi-desert grassland, and sometimes woodland areas (Lowe et al. 1986, Beck 2005). Our monitoring area, characterized by extensive elevation complexity and topographical relief, and composed of small canyons, foothills, and rocky slopes, provides different directional aspects, rock outcroppings, drainages, and flatlands. Elevation range of the Gila Monsters captured during this effort ranged from 1,138 m (3,732 ft) to 1,490 m (4,888 ft), and the average elevation where Gila Monsters were captured (*n* = 313) was l,278 m (4,193 ft).

Gila Monsters were not found evenly across the landscape, rather they seemed to occur as "clusters" of individuals within suitable habitat patches. Most of our captures occurred on or immediately adjacent to rugged, rocky areas with substantial vegetative cover, especially velvet mesquite. We occasionally (*n* = 5) found individual Gila Monsters in grassland valley bottoms or at other locations that were far from rocky habitats or other captures. These "wandering individuals" may represent pioneering lizards utilizing microenvironments that are not completely recognized or understood. Thus, while Service personnel spent considerable time in a variety of habitats across the monitoring area, Gila Monsters appeared to select rocky habitat over flat and grassland habitats. Even within the areas having the highest capture rates, population densities of the species appear to be low.

Life History and Reproduction—Mating by Gila Monsters occurs during April-June (Beck 2005). We observed an instance of spontaneous mating by two recently captured individuals occurring on 7 May 2007. These were captives that had not yet been released following processing, and they were placed together in a large tub where they decided to spend their captive hours copulating (Fig. 4). Studies from southern Utah have recently reported copulation of wild Gila Monsters for the first time on 21 May 2024 (Kellam et al. 2025) and such observation of mating in wild individuals is indeed rare.

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Previous research has documented that free ranging Gila Monsters laying 2-12 eggs (mean 5.7) during the summer rainy season (Goldberg and Lowe 1997, DeNardo et al. 2018), which appears crucial for establishing the necessary moisture conditions required for successful incubation and hatching (Goldberg and Lowe 1997, Seward 2002, Beck 2005). However, we observed a female (325 mm SVL) lay a clutch of nine eggs on 5 August 2005 and another female (307 mm

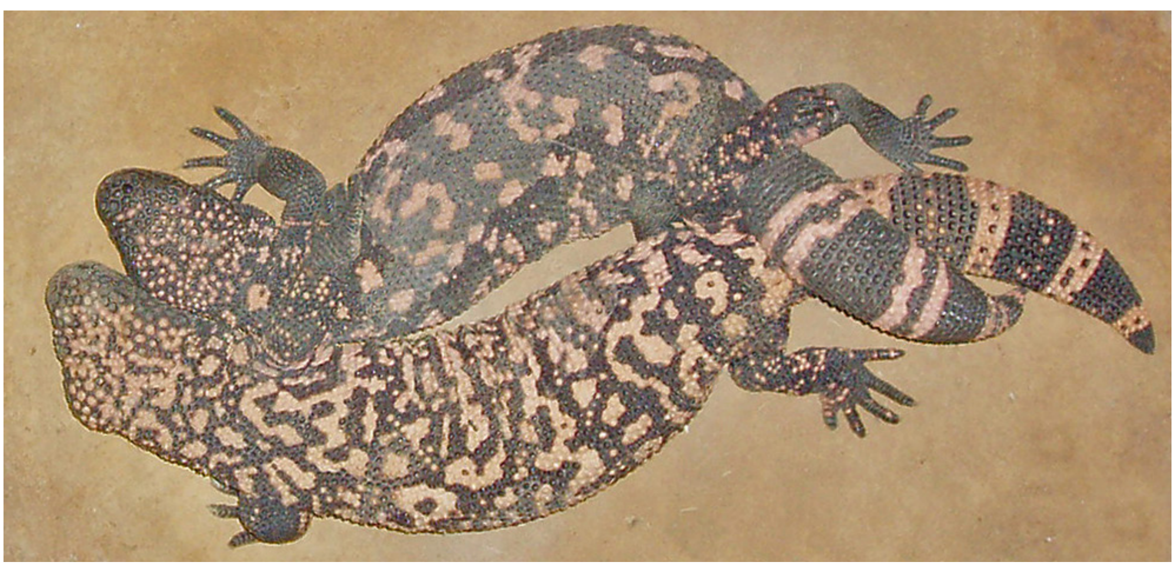

Fig. 4. Spontaneous copulating by two recently captured Gila Monsters occurring on 7 May 2007, Cochise County, AZ.

SVL) lay 13 eggs on 12 August 2012. Clutch sizes for both these observations are notable as they are among the largest clutch sizes expected for wild Gila Monsters (Goldberg and Lowe 1997). Captive Gila Monsters lay eggs within 5-8 weeks following copulation (Shaw 1968, Eidenmüller and Reisinger 2011). Eggs hatch about 120-152 days after oviposition (Eidenmüller and Reisinger 2011) and hatchlings overwinter in their underground nest before emerging during the following spring/summer (DeNardo et al. 2018). Hatchling sized Gila Monsters have been variously described as ranging from 110-141 mm (4.33-5.55 in) SVL, ranging from 150-186 mm (5.9-7.32 in) total length, and having a body mass ranging from 23.1-44 g (0.81-1.55 oz) (Shaw 1968, Lowe et al. 1986, Beck 2005, Eidenmüller and Reisinger 2011). Five presumed hatchlings captured during our monitoring efforts ranged from 115-142 mm (4.53-5.59 in) SVL, 175-203 mm (6.89-7.99 in) TL, and ranged in weight from 23.5-30.0 g (0.83-1.06 oz). Hatchlings have been observed in nature between April-August (Beck 2005), and this was supported by our hatchling observations (*n* = 5) between 23 June-31 July.

Growth and Longevity—Gila Monsters can reach more than 30 years of age in captivity and may exceed 20 years in nature (Crosman 1956, Jennings 1984, Beck 2005). Growth rates are variable among individuals and size classes, with Gila Monsters taking 10.1-12.8 years to reach 325 mm (12.80 in) SVL, and taking at least 17.6 years to reach over 360 mm (14.17 in) SVL (Beck 2005). Based on this information, we estimate that 75 (33%) of the 228 Gila Monsters encountered during our monitoring effort in which SVL was recorded were at least 10.1-12.8 years old, including five (2%) that were at least 17.6 years old when captured. Subsequent recaptures of some of those lizards documented one male (original capture 4 July 2002 with 335 mm [13.2 in] SVL and final recapture 1 September 2010) and one female (original capture 8 April 2003 with 345 mm [13.6 in] SVL and final recapture 28 July 2011) reaching an estimated age of 18.3-21 years old when last recaptured; and one female that was between 19.8-22.5 years old when last recaptured (original capture 12 September 2004 with 346 mm [13.6 in] SVL, and final recapture 21 May 2014).

During our monitoring efforts in Cochise County, the Gila Monsters having the greatest length included a female captured in April 2005 measuring 370 mm (14.6 in) SVL and 547 mm (21.5 in) total length, a male captured in September 2012 measuring 345 mm (13.6 in) SVL and 601 mm (23.7 in) total length, and an unknown sex individual captured in August 2009 measuring 380 mm (15.0 in) SVL and 555 mm (21.9 in) total length. The Gila Monster having the shortest length was an individual captured in June 2013 measuring 115 mm (4.5 in) SVL and 175 mm (6.9 in) total length. The Gila Monsters having the greatest mass included a female captured in May 2008 that weighed 1,100 g (38.8 oz) and a male captured in May 2007 that weighed 1,085 g (38.3 oz). The Gila Monster having the smallest mass was the individual captured in June 2013 that weighed 23.5 g (0.83 oz). These values are all consistent with size information reported by other authors (Goldberg and Lowe 1997, Beck 2005).

Recaptured lizards demonstrated considerable variation in their weights between captures that were not correlated with significant changes in their length (Figs. 5 and 6), ranging from 295 g (10.4 oz) gains to 585 g (20.6 oz) losses. The young Gila Monster captured 8 July 2009 and recaptured 25 August, 2009 demonstrated increases in: SVL from 147 to

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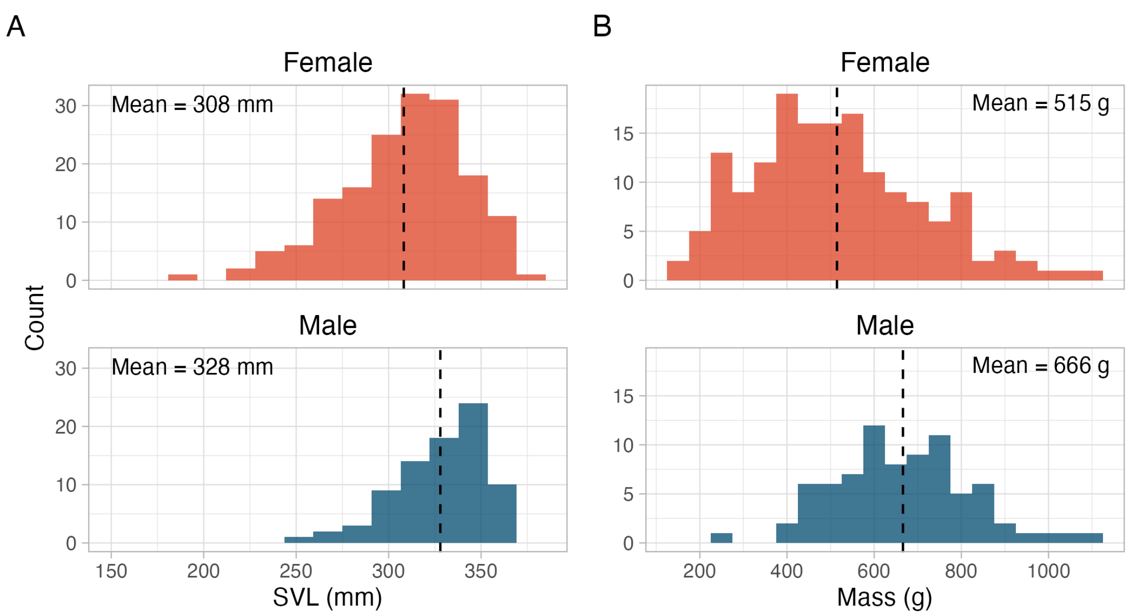

Fig. 5. Distribution of SVL (mm) and body mass (g) by sex for Gila monsters captured in Cochise County, Arizona.

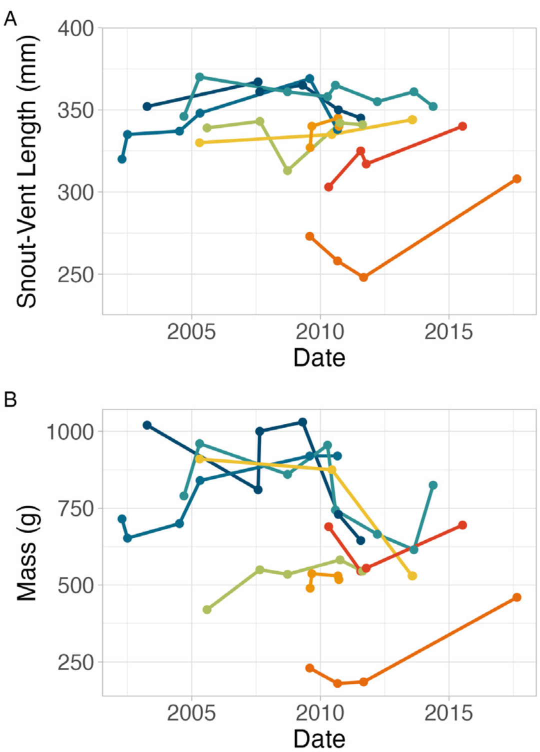

Fig. 6. Accumulation of SVL and body mass for Gila monsters in Cochise County, Arizona. Plots shows the individuals captured >= 4 times between 2000-2024.

159 mm (5.79-6.26 in); total length from 220 to 257 mm (8.66-10.12 in); and mass from 45 to 55 g (1.59-1.94 oz). In some cases, changes reflected an individual's reproductive condition (e.g., gravidness), but more often they likely represented gains and losses in association with annual and seasonal changes in food and water availability. *Heloderma* have relatively high rates of evaporative water loss when compared with other lizards (Lowe et al. 1986, DeNardo et al. 2004, Gienger et al. 2014), which would affect body mass. These fluctuations in their body conditions likely mirror changing ecological conditions such as drought, precipitation, food availability, population dynamics of prey species, and other conditions upon which they depend for their survival.

Mortality—Vulnerability to predation was not adequately assessed by our monitoring. During our efforts, five individuals were captured that were missing various portions of their tails from prior injuries, eight were missing toes, six others exhibited scars on their body or face (including one missing an eye), and two had injuries that were not specifically identified on data sheets. While a Ringtail Cat (*Bassariscus astutus*) was documented by remote trail camera photos as showing an interest in a Gila Monster (Fig. 7), no actual predation by that animal was identified. The only Gila Monster fatalities documented during our effort were 27 individuals collected as road kills from vehicles.

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Food habits—Gila Monster food habits observed as part of this monitoring effort included a 61 g (2.2 oz) recently consumed baby Desert Cottontail (*Sylvilagus audubonii*), regurgitated by a captured 351 mm (13.8 in) SVL, 885 g (31.2 oz) female lizard on 30 June 2009. Additionally, on 21 June 2014 Radke observed fresh Gila Monster tracks that showed the individual was systematically hunting sandy stretches of beach along the east side of the San Pedro River near Sierra Vista, AZ. The searching successfully resulted in preying upon one nest laid by Spiny Softshell Turtles (*Apalone spinifera*), a

Fig. 7. Remote trail camera photos documented this ringtail cat (*Bassariscus astutus*) showing an interest in a Gila Monster at Leslie Canyon NWR in southeastern Cochise County, Arizona, though the outcome of the interaction is unknown.

non-native species in AZ. The lizard appeared to investigate turtle nests previously preyed upon by other predators such as Raccoons (*Procyon lotor*) and would excavate and consume the contents of newly located nests. This same geographic location had fresh tracks demonstrating similar Gila Monster foraging behavior a year later on 20 June 2015.

Summary—Data collected during this long-term monitoring effort are generally consistent with studies of Gila Monsters in other locations, with some interesting differences. These differences include daily and seasonal activity periods, which are likely influenced by the higher elevation and overall cooler temperatures of the monitoring area compared to other locations and may reflect the lizard's adaptation to meeting optimal thermoregulation requirements. Additionally, home range sizes are generally smaller than those determined by other researchers. This may reflect an abundance of resources within the area we monitored, or a potential sampling bias. For convex polygon estimates of Gila Monster home range, increasing sample size is correlated with increasing home range size (Pierson 2020, Edelkind 2024).

Our data add to the overall knowledge of Gila Monster population ecology and may help inform management decisions. Consider two examples. First, knowing that activity is highest in mid-spring and during the summer rainy season, local managers can focus potential Gila Monster habitat disturbance, e.g., with heavy equipment, during those times because individuals are most likely to be able to disburse and avoid mortality. Second, the measurement and mark-recapture data provide an important baseline against which future measurements may be compared. If future data indicate a systematic decline in body size or condition, or if recaptures suddenly begin to decline with similar effort in the field, managers may develop a structured research program to identify the causes of the changes. In brief, while the data do not provide answers to every question, they provide key insights that can advance Gila Monster conservation.

There are advantages and disadvantages to long-term monitoring work being accomplished opportunistically by staff or "citizen scientists." Perhaps the greatest advantage is that long-term monitoring of a fixed area can be accomplished cost effectively; it can be done opportunistically while employees are engaged in their other duties. Importantly, participants build comradery that promotes teamwork, and participation builds interest in principles of conservation ecology, population dynamics, behavioral patterns, and other ecological values. There are also limitations to opportunistic monitoring compared to structured, intensive monitoring by more qualified researchers. These include employee turnover and participants having differing levels of interest and expertise, which requires continual training, oversight, and error checking.

There is also a potential bias relating to any monitoring occurring only during established employee working hours. Accounting for these benefits and costs over the 25 years of the Gila Monster monitoring effort, we believe the benefits have far outweighed any costs as we have learned more about this animal in Cochise County, AZ.

Acknowledgements—We thank reviewers Michael Hill, Jacob Malcom, and Charles Hathcock for providing suggestions that improved this manuscript. The information included in this paper is based on lizards captured by many participants including C. Baldenegro, J. Barron, E.C. Bloom, L. Brasher, T. Bender, J. Broska, A. Cajero, A. Chenevert-Steffler, O. Childress, M. Collado, N. Congdon, G. Gigliotti, W. Glenn, C. Glock, S. Glock, J. Greff, T. Harden, V. Harden, V. Herrick, B. Hill, M. Hill, J. Jia, K. King, M. Koole, A. Lavanchy, B. Leon, C. Lohrengel, J. Magoffin, J. Malcom, R. Mendoza, J. McMahon, F. Montoya, R. Perkins, A. Pock, M. Radke, H. Rodriguez, R. Shelton, M. Suttner, K. Todd, E. Wong, R. Vanderpool, and C. Walker, with the overwhelming number of individuals captured by Anna Magoffin and Matthew Magoffin. A. Radke assisted with production of figures, J. Malcolm calculated home range sizes, and T. Harden and A. Cajero calculated distances travelled. The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

Data collected during this long-term monitoring effort are generally consistent with studies of Gila Monsters in other locations, with some interesting differences.

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NATURAL HISTORY NOTE

Body Postures in a Female Prairie Lizard, *Sceloporus consobrinus* (Squamata: Phrynosomatidae): Sit-and-Wait Basking and Foraging Behavior

Stanley E. Trauth, 13 Woodland Loop, Morrilton, Arkansas 72110; *trauthse@outlook.com*

The Prairie Lizard (*Sceloporus consobrinus*; also known as fence lizard or fence swift), is a relatively small, common phrynosomatid species (snout-vent length rarely exceeding 70 mm). This species has a wide geographic range throughout the central United States (Jones and Lovich 2009, Powell et al. 2016); and by being a sceloporine-type lizard, it is well-known as a sit-and-wait predator (Pianka and Vitt 2003).

In Arkansas, Prairie Lizards can be found alternating between basking and foraging in an assortment of different terrestrial microhabitats. Favorite dwelling sites for the lizard include forest edges and among fallen logs, woodpiles, rocky outcroppings, shelf rock ledges along lakeshores, and rocky rip-rap bordering roadways near lake shorelines (Litmer et al. 2023, Trauth et al. 2004).

I have previously reported on biting behavior in adult males around a stacked woodpile in my backyard (Trauth 2022a). In addition, I recorded an adult female exhibiting basking site philopatry as well as her courtship activity with a male on a low retaining wall in my front yard flower bed at my house (Trauth 2023a,b). My rural home is situated near the edge of a small mixed forest in a residential area, which is approximately 2 km N of the city of Morrilton in Conway County of central Arkansas (35.192222°N, 92.714722°W; WGS 84; 108.3 m elev.).

In the present study, I used an iPhone 16 to photograph an adult female on several days between 4 and 12 May 2026. This lizard occupied a home range area limited to a small portion of my backyard flower bed and, specifically, she utilized microhabitats between the upper and lower retaining walls. Earlier, I had become interested in her daily routine movements and, in particular, her regular pattern and manner of body posturing during her presence on the upper wall. My goals in this natural history note are as follows: **1)** to describe the body postures as displayed by this female on a cinder block retaining wall, and **2)** to compare these postures to those exhibited by females (Fig. 1) previously observed in my backyard wildlife habitat setting (e.g., see habitats in Trauth and Walker 2024). During my efforts to obtain a consistent set of body posture images, the female eventually became accustomed to my presence and allowed me to record her positions and movements (Figs. 2 and 3), and, in doing so, I did not appear to alter her routines. By comparison, adult males found on the retaining walls rarely tolerate my presence. They immediately begin performing push-ups and then dash away to seek cover.

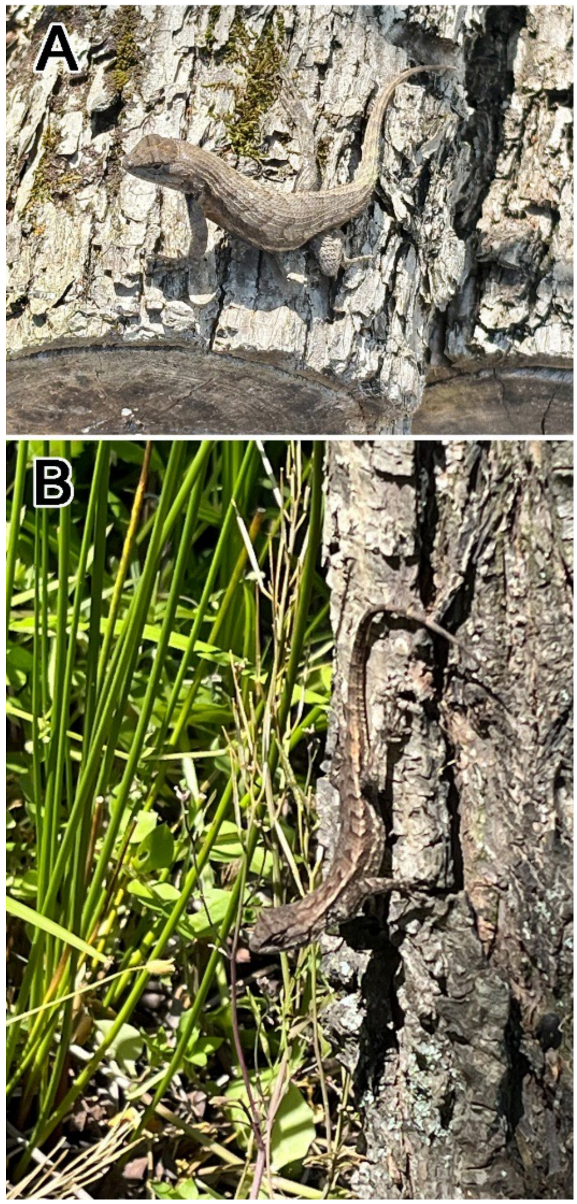

Fig. 1. Two common body postures observed in female Prairie Lizards. **A.** Horizontal body and head raised with eyes directed downward atop end of a log (photo date: 22 April 2024). **B.** Vertical body, head raised, trunk arched, and legs extended while clinging to a tree trunk (photo date: 1 April 2025).

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I assembled her general body positions in a series of selected photos beginning with her horizontal basking postures at or along the top surface of the retaining wall (Fig. 2A-C). She would often tilt her head downward over the wall's edge (e.g., Fig. 2C), which allowed her a wide-ranging view of the mulch (wood chip) substrate that was intermixed with plant vegetation lying

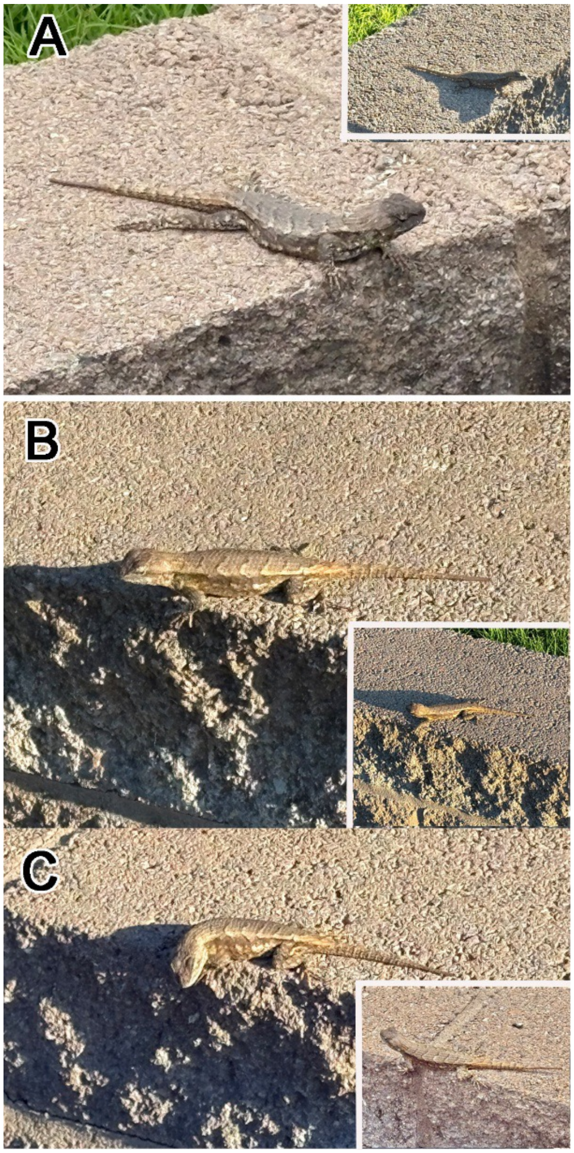
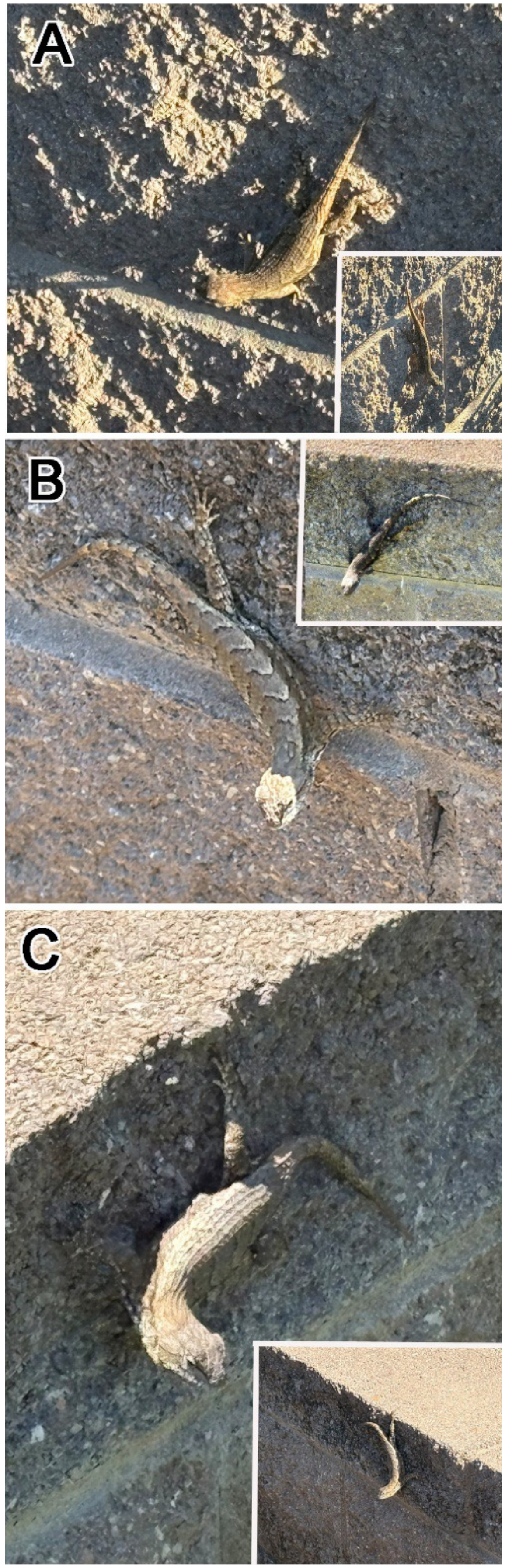


Fig. 2 (above). Horizontal body and prey observation postures with date and hour. **A.** Observation post at edge of retaining wall on 10 May (1204 h); inset, 12 May (1850 h). **B.** 8 May (1818 h); inset, 9 May (1917 h). **C.** 8 May (1822 h); inset, 10 May (1314 h).

Fig. 3 (right). Vertical body and prey observation postures along with date and hour. **A.** Clinging to the vertical side of retaining wall on 8 May (1823 h); inset, 12 May (1850 h). **B.** 9 May (1344 h); inset, 9 May (1139 h). **C.** 4 May (1257 h); inset, 9 May (1555 h).

approximately 45 cm below. There, I often observed her primary prey: ants and spiders. Soon, following the spotting of prey, she would move down the retaining wall into a mostly vertical observation position (Fig. 3A-C). The body postures here included the arching of the trunk with the head extending outward and a stretching of the hind legs with the claws of the hind feet firmly clinging to wall irregularities. She would maintain this "arched posture" until a food item appeared, after which she would immediately descend the wall to capture the prey. Soon thereafter, she would either remain on the mulch surface or would often ascend the wall and begin basking again.



I assembled her general body positions in a series of selected photos beginning with her horizontal basking postures at or along the top surface of the retaining wall (Fig. 2A-C).

Soon, following the spotting of prey, she would move down the retaining wall into a mostly vertical observation position (Fig. 3A-C).

This female's repeated basking and feeding movements were reminiscent of basking site philopatric behavior exhibited by another female in my front yard flower bed (Trauth 2023a). That particular female returned to the same basking site on eight separate days. Retaining walls with their heat retention along with the opportunity for visual orientation and microhabitat monitoring, therefore, provide optimal basking and foraging conditions for Prairie Lizards.

I have observed the same body posturing exhibited by this female in other females on a stacked woodpile (horizontal body position; Fig. 1A) and on a tree trunk (vertical body position; Fig. 1B) in my backyard. Although placed within the sit-and-wait predator category of squamates, female Prairie Lizards at least actively pursue prey items, combining visual prowess with a mastery of body positioning movements.

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This female's repeated basking and feeding movements were reminiscent of basking site philopatric behavior exhibited by another female in my front yard flower bed (Trauth 2023a). That particular female returned to the same basking site on eight separate days.

Sonoran Herpetologist Natural History Observations

The Tucson Herpetological Society invites your contributions to our Natural History Notes section. We are particularly interested in photographs and descriptions of amphibians and reptiles involved in noteworthy or unusual behaviors in the field. Notes can feature information such as diet, predation, community structure, interspecific behavior, or unusual locations or habitat use. Please submit your observations to Howard Clark, *editor.sonoran.herp@gmail.com*. Submissions should be brief and in electronic form.

Local Research News

The *Sonoran Herpetologist* welcomes short reports on Local Research News in our journal. We are interested in articles that can update our readers on research about amphibians and reptiles in the Sonoran Desert region. These articles need be only a few paragraphs long and do not need to include data, specific localities, or other details. The emphasis should be on how science is being applied to herpetological questions. Please submit your materials to Howard Clark, *editor.sonoran.herp@gmail.com*. Submissions should be brief and in electronic form.

High Jumper: Lowland Leopard Frog Records from High Elevations in the Rincon Mountains and Implications for Conservation

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The Lowland Leopard Frog (*Lithobates* [*Rana*] *yavapaiensis*) is a desert-adapted, water-dependent species that historically occupied the lower Colorado River and its major desert river tributaries in southern California and Arizona (Platz and Frost 1984). The species' range has declined dramatically in recent decades. The frogs no longer occur in the lower Colorado, Santa Cruz, and Gila rivers due to surface water loss, introduced predators such as American Bullfrogs (*Lithobates catesbeianus*), and other factors (Sredl 2005), although some populations persist in the San Pedro River. In the Tucson area, the species also occurs in stream pool habitat in a limited number of intermittent tributaries of the Santa Cruz River that flow out of the Rincon, Santa Catalina, and Santa Rita mountains (Zylstra et al. 2019).

The known elevational range of Lowland Leopard Frogs is from near sea level (historically, at the mouth of the Colorado River in Mexico) to approximately 1,700 m (5,577 ft; Stebbins 2003), although Sredl et al. (1997) documented individuals as high as 1,817 m (5,960 ft). Here, we report what we believe is the highest known elevational record for this species, as well as other high elevation records in the Rincon Mountains in Saguaro National Park.

On 22 September 2021, one of us (DB) observed and photographed an adult Lowland Leopard Frog (Fig. 1) at 1,853 m (6,080 ft) in the main branch of Rincon Creek near the former site of Happy Valley Campground in an area known as Happy Valley Saddle. Rincon Creek flows west from the saddle into Pantano Wash and the Santa Cruz River. Just to the east, Miller Canyon flows east into Paige Creek and the San Pedro River. The observed frog was in a stream pool below a stand of Southwestern Ponderosa pines (*Pinus ponderosa* var. *brachyptera*; Fig. 2). This frog was observed within a few meters of an adult Lowland Leopard Frog photographed by one of us (GF) in Rincon Creek in early September 1984, but the 1984 record was not previously published and the photograph can no longer be located.

On 27 April 2022, DB also observed an adult *L. yavapaiensis* in a different tributary of Rincon Creek (Fig. 3) at an elevation of 1,768 m (5,800 ft), and on 17 May 2022, he and NG observed very large tadpoles that were very likely this species in a third tributary at an elevation of 1,524 m (5,000 ft).

Biologists at Saguaro National Park have searched for high-elevation leopard frogs since 1996 as part of a long-term monitoring program (summarized in Zylstra et al. 2019) and have never found evidence of resident populations of frogs above 1,524 m (5,000 ft). However, the two records from Happy Valley Saddle, both of which occurred following exceptionally rainy summers (in 1984 and 2021), suggest that adult Lowland Leopard Frogs are at least capable of moving between the Santa Cruz and San Pedro River watersheds (Fig. 4). Happy Valley Saddle is approximately 1,865 m (6,120 ft), and a nearby saddle between the two watersheds at Redington Pass, where leopard frog populations occur on both sides of the pass, is 1,310 m (4,300 ft).

In a recent genetic study of *L. yavapaiensis* populations in the Rincon-Santa Catalina Mountain complex, Hasl (2026) found that individuals from the southern Rincon Mountains (Rincon Creek watershed) formed a distinct cluster, isolated from populations in the northern Rincon, southeastern Santa Catalina, and San Pedro regions (Fig. 4A). In contrast, populations within the Reddington Pass corridor, connecting the northern Rincon and San Pedro regions, showed

Fig. 1. Lowland Leopard Frog at 1,853 m (6,080 ft) near Happy Valley Saddle, tributary of Rincon Creek in Rincon Mountains. Photo by Dan Beckman, 22 September 2021.

The Lowland Leopard Frog (*Lithobates* [*Rana*] *yavapaiensis*) is a desert-adapted, water-dependent species that historically occupied the lower Colorado River and its major desert river tributaries in southern California and Arizona (Platz and Frost 1984).

little genetic differentiation and largely overlapped in multivariate space, indicating ongoing gene flow (Fig. 4B). These patterns suggest that high-elevation dispersal across the Rincon and Santa Catalina mountains, including over Tanque Verde Ridge, is rare and does not substantially contribute to maintaining genetic connectivity. Instead, lower hydrological corridors such as Redington Pass appears to facilitate movement and may represent important pathways for maintaining connectivity among populations in the Santa Cruz and San Pedro river drainages.

It is unknown whether the reproducing population at 1,524 m (5,000 ft) indicates an upslope range shift; as populations of *L. yavapaiensis* are highly variable and subject to frequent local extinction and re-occupation events (Zylstra et al. 2019). Nevertheless, these records are interesting to consider for the conservation and research on this species. Although high-elevation populations may not substantially contribute to broad-scale landscape connectivity, they may still play an important role in maintaining regional genetic diversity and demographic resilience. Such populations may function as refugia during drought or other environmental stressors and have the potential for supporting recolonization following local extirpation. Conservation efforts should therefore prioritize both the protection of low-elevation dispersal corridors that maintain regional connectivity and the preservation of isolated high-elevation habitats that may harbor important genetic diversity and contribute to long-term population persistence.

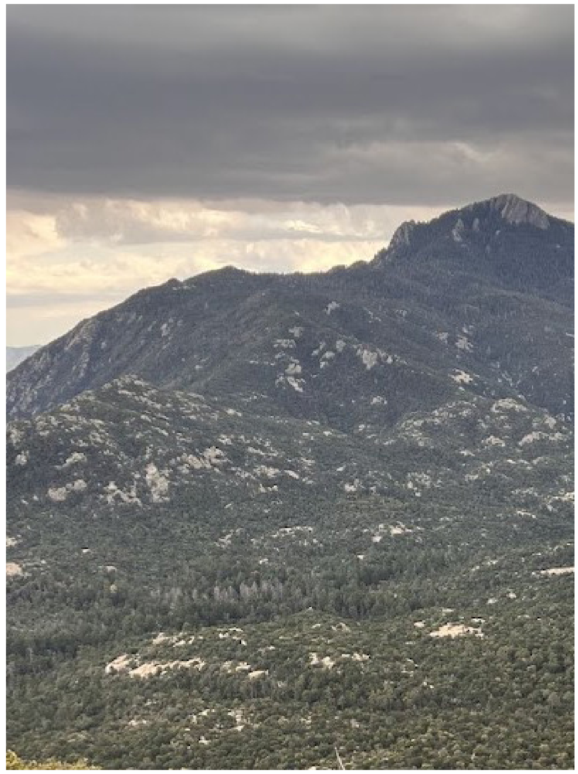

Fig. 2. View of Southwestern Ponderosa pine forest habitat (left foreground) in Happy Valley Saddle where frog in Fig. 1 was observed. Rincon Peak is to right. Photo by Don Swann.

Fig. 3. Lowland Leopard Frog observed in tributary of Rincon Creek at an elevation of 1,768 m (5,800 ft). Photo by Dan Beckman on 27 April 2022.

Such populations may function as refugia during drought or other environmental stressors and have the potential for supporting recolonization following local extirpation.

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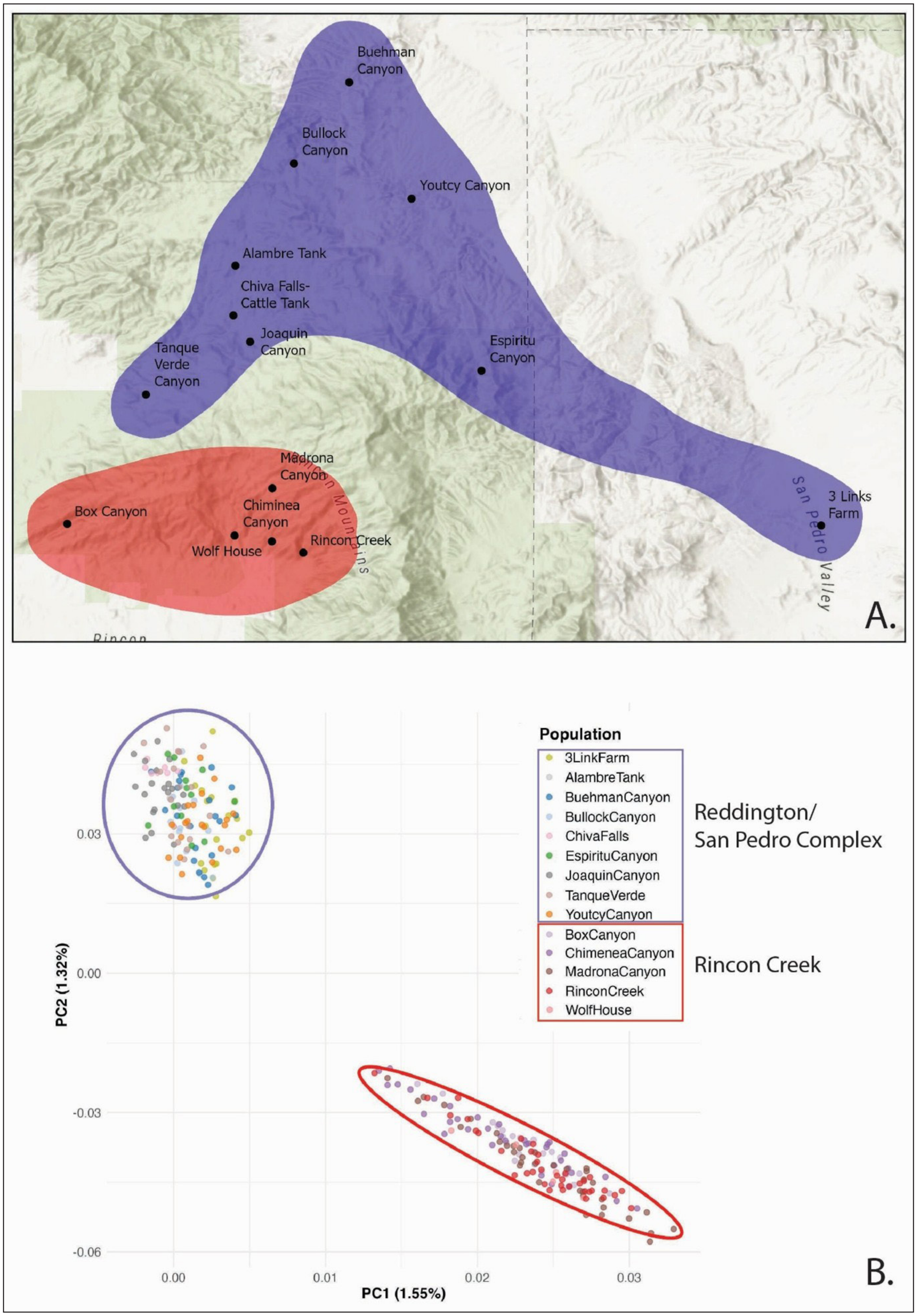

Fig. 4. Geographic structure and genetic differentiation among sampling sites in the Rincon Mountain complex. (A) Map of sampling locations across the study area, with sites grouped into two geographic regions: Reddington/San Pedro complex (blue) and Rincon Creek (red). (B) Principal components analysis (PCA) of genetic variation among individuals. Points represent individuals by sampling location, with ellipses highlighting the two regional groupings shown in panel A (Hasl 2026).

NATURAL HISTORY NOTE

A Contribution to the Feeding Ecology of Western Spadefoot (*Spea hammondii*) from Northern California

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Basic natural history information for every species of wildlife is critical to understanding and conducting successful management (Fitch 1987, Bury 2006, Doremus 2008, Gonzales-Suarez et al 2012, Mitchel and Pague 2014). Many species lack very basic natural history information in published form, and their ecological context is missing or contains significant gaps (Parr et al. 2024). If field guides are available regionally, they provide information that may or may not reflect direct observations, and rarely, if ever, cite original published work (Stebbins 2003, McGinnis and Stebbins 2012, Hansen and Shedd 2024).

In the case of the Western Spadefoot (*Spea hammondii*), little has been published on the foraging ecology, save for inferential information related to the sister species (New Mexico Spadefoot [*Spea multiplicata*]; Whitaker et al. 1977, Morey and Guinn 1992, and others, see also: Alvarez et al. 2024), and generalized descriptions in field guides (Stebbins 2003, McGinnis and Stebbins 2012, Hansen and Shedd 2024, and others). Foraging ecology, particularly aspects of the cannibalistic larvae have been reported for this species (Alvarez et al. 2024, Kleponis and Alvarez 2025), but there is a paucity of reports on the feeding ecology of adult forms, particularly those from the current range in California and Baja California. Crespi and Denver (2004) reported feeding crickets to post-metamorphic individuals in experimental conditions but did not note the species or the prey item. We note that Sloggett (2012) reported that Western Spadefoot fed on ladybird beetles (Coleoptera: Coccinellidae), but referred back to Whitaker et al. (1977), who were working with the sister species. To our knowledge, no specific food items have been reported for adult Western Spadefoot. Herein we report on food items consumed by Western Spadefoot in Central California.

As part of a workshop on the ecology of the Western Spadefoot in Central California (Western Spadefoot, An Introductory Workshop, put on by The Wildlife Project, Western Section of The Wildlife Society, and California State Parks), we conducted 72 person hours, on 28 March, 3 April, and 18 April 2026, of night time upland habitat surveys for adult and post-metamorphic spadefoot at the Carnegie Off Highway Vehicle Park, Tracy, CA. Our surveys were restricted to an approximately 3.2 ha area known as the "4 × 4 Play Area." Each survey included surveyors using a 400-500 lumen hand-held flashlight or a headlamp, searching for eyeshine of Western Spadefoot. Surveys were conducted in two consecutive time blocks, from 2030 to 2230; and 2230 to 0000 and consisted of approximately fourteen people (twelve students and two instructors) per time block. Our surveys included incidental accounts of other vertebrate species, and we noted invertebrate prey items as we searched. Western Spadefoot adults were counted, handled when possible, and released at the site of capture. Faeces were also noted and broken apart to inspect prey items.

Basic natural history information for every species of wildlife is critical to understanding and conducting successful management (Fitch 1987, Bury 2006, Doremus 2008, Gonzales-Suarez et al 2012, Mitchel and Pague 2014).

Across the three-night survey, we observed 157 adult Western Spadefoot. We also documented Western Toad (*Anaxyrus boreas*), Northern Pacific Rattlesnake (*Crotalus oreganus*), Heermann's Kangaroo Rat (*Dipodomys heermanni*), and Desert Cottontail (*Sylvilagus audubonii*). During our surveys we noted craneflies (Tipulidae) on the ground (approximately 1 animal/5 m^2), field crickets (*Gryllus* spp.), California Camel Crickets (*Ceuthophilus* cf. *californianus*), ground beetles (Carabidae), darkling beetles (Tenebrionidae), earwigs (Dermaptera), harvestmen of the Order Opiliones, believed to be of the suborder Eupnoi, grass spiders (Agelenidae), and wolf spiders (Lycosidae), all very common. On the night of 3 April 2026, one biologist from our group picked up a western spadefoot and noted that a prey item was lodged within its buccal cavity, with limbs hanging from the front of the mouth (Fig. 1). We identified it as a harvestman (Opiliones) of an unknown genus and species. We also regularly collected scats from what we felt confident were Western Spadefoot (including two which defecated in our hands) and crushed many samples between our fingers and open palm. On at least two occasions we noted the elytra of small ground beetles (Carabidae) and other invertebrates were found within the scats. Some of the remains were intact enough to identify to the carabid beetle *Calathus ruficollis* and the earwig *Forficula dentata*.

We acknowledge that Western Spadefoot likely feeds in a similar manner and on similar species groups to that of its sister taxa, the New Mexico Spadefoot, which might include a large host of ground dwelling insects, spiders, worms, and other invertebrates (Tanner 1931, Whitaker et al. 1977). But until a thorough investigation of the feeding ecology is completed, we suggest that a growing list of food items, starting with harvestmen and ground beetles, does have some management significance. The Western Spadefoot, particularly during the post breeding season, appears to feed on upland species in the habitat in which it resides for the majority of the year.

Acknowledgements—We are grateful to Laura Patterson of the California Department of Fish and Wildlife for allowing us to handle western spadefoot under our respective permits: JAA:SCP-192240005; IP: SCP S-230690010-23073-001. We also thank the California Department of Parks and Recreation, Off-highway Motor Vehicle Division for access to this site and the San Francisco State University Vredenberg Lab for their assistance with securing site access. Field Assistance was offered by: Sarah Albertson, Liz Armistead, Megan Barajas, Samuel Bresler, Shelby Clark, Shane Emerson, Rick Evans, Zachary Fenske, Caroline Hamilton, David Norris, Alessandra Phelan-Roberts, Michelle Picca, Leslie Rivas, Susan Seville, Dalton Stanfield, Aaron Sunshine, Sarah Teed, Kacy Twist, and John Wandke. The Wildlife Project provided support for the preparation of early drafts of this manuscript.

Fig. 1. Hayley Milner holding an adult Western Spadefoot from Carnegie Off Highway Vehicle Park, Tracy, CA. The spadefoot is ingesting an adult harvestman of the Order Opiliones, believed to be of the suborder Eupnoi. Photo by Jeff Alvarez.

The Western Spadefoot, particularly during the post breeding season, appears to feed on upland species in the habitat in which it resides for the majority of the year.

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NATURAL HISTORY NOTE

Southwestern Pond Turtle (*Actinemys pallida*) Nests Excavated in the Fall in Coastal Central California, and Implications for Management

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The Western Pond Turtle (*Actinemys marmorata*) currently occurs from Washington State, south to Baja California Norte (Bury and Germano 2008, Alvarez et al. 2017). Spinks et al. (2010) indicated two taxa are warranted based on phylogenetic divergence—the Northwestern Pond Turtle (*Actinemys marmorata*) and Southwestern Pond Turtle (*Actinemys pallida*). The San Francisco Bay area is the approximate zone of intergradation between the two taxa (Spinks et al. 2010). Throughout their ranges, the Northwestern Pond Turtle and Southwestern Pond Turtle have been declining due to factors such as habitat conversion, agricultural practices, disease, predation, and effects of invasive species (Ernst and Lovich 2009, Thomson et al. 2016, Alvarez et al. 2017). As such, aspects of the life history of these taxa need to be understood to better inform their management (Bury and Germano 2008, Alvarez and Del Vecchio 2024). This includes a need for more knowledge regarding the nesting ecology of the taxa, such as whether hatchlings overwinter in the nest or emerge prior to winter. We report the timing of nesting of Southwestern Pond Turtles from nests we encountered in Coastal Central California.

While monitoring earthen berm maintenance along several anthropogenic ponds on 3 October 2024, we encountered four Southwestern Pond Turtle nests near the unincorporated town of Orcutt, California, in northern Santa Barbara County. The activity monitored was undertaken in compliance with measures included in a Habitat Conservation Plan (HCP) for which the covered species are California Tiger Salamander (*Ambystoma californiense*) and California Red-legged Frog (*Rana draytonii*), both of which overlap in habitat use with the Southwestern Pond Turtle. Specifically, we monitored the hand-excavation of Botta's Pocket Gopher (*Thomomys bottae*) and California Ground Squirrel (*Otospermophilus beecheyi*) burrows to avoid take of individuals covered by the HCP. Four Southwestern Pond Turtle nests were inadvertently encountered between 0845 h and 1415 h. In each situation, the small mammal burrow being excavated intersected a Southwestern Pond Turtle nest. There was no indication of nests observed above ground (such as a nest plug). After the discovery of the fourth nest, the hand-excavation activities were discontinued to avoid additional nests that may have been in the vicinity. No California Tiger Salamanders, California Red-legged Frogs, or small mammals were found during the hand-excavation of burrows. No Southwestern Pond Turtle eggs, eggshell fragments, or neonates were found above ground.

The depth and contents of the four nests included: Nest 1 was 12.7 centimeters (cm) deep (measured from the undisturbed surface) and contained four eggs and one hatchling. One of the eggs was cracked and ultimately hatched during the biologist's examination, resulting in two hatchlings. Both hatchlings had a carapace length of approximately 2.5 cm, and both hatchlings were sedentary. Nest 2 was 10.2 cm deep and contained zero eggs and 2 hatchlings, both of which had a carapace length of approximately 3.0 cm. A single hatchling was active, while the second was inactive. Nest 3 was 10.2 cm deep and contained one intact egg and zero hatchlings. Nest 4 was 2.5 cm deep and contained zero eggs and two hatchlings, both of which had an approximate carapace length of 3.0 cm. Both hatchlings were active within the nest chamber. The depths of Nests 1-3 were greater than the 8.5-cm average nest depth reported by Bettelheim et al. (2006), while the depth of Nest 4 was substantially less.

Based on a range of reported incubation periods of 73-122 days (Feldman 1982, Holland 1994, Bury and Germano 2008), we infer that these four nests were oviposited in June or July of 2024. Nesting has been reported as early as April and as late as August (Holland 1994) in Oregon. Several researchers have reported peaks in nesting from May through July in California and Oregon (Feldman 1982, Ashton et al. 1997, Holte 1998, Germano and Riedle 2015, Gallentry et al. 2025). The presumed timing of nesting timing we encountered is consistent with what is considered typical.

As described previously, Nest 4 contained two hatchlings with carapace lengths of approximately 3.0 cm, similar to the size of neonates reported by (i.e., 2.4-2.8 cm) Hill (2006) near Los Banos in Merced County, California. Moreover, the depth to those two hatchlings was only 2.5 cm. Based on the size of the hatchlings we measured, as well as its proximity to the surface, it is possible that the hatchlings in the nest would have attempted to emerge in the year of their discovery (i.e., not overwintered in the nest chamber). With a few exceptions, Western Pond Turtle hatchlings in western Oregon overwinter in

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nests, then emerge the following spring (Rosenberg and Swift 2013). Similarly, Reese and Welsh (1997) and Rathbun et al. (2002) reported that hatchlings primarily overwinter in nests in northern and central California. Holland (1994) stated that at least some hatchlings in southern California emerge in the fall, but those in central California, northern California, and northward likely overwinter in the nest and emerge the following spring.

Our observations of nests in an area subject to excavation, with no indication of their presence, confirm the putative nature of nest crypticism (Davidson and Alvarez 2020). With our observation of at least one of four nests appearing to have hatchlings about to emerge in early October, we add to the knowledge of nesting ecology of Western Pond Turtles; more specifically, Southwestern Pond Turtles in coastal central California, an area from which little data on hatchling overwintering have been collected. Such knowledge will be valuable for informing the timing of management and maintenance decisions at facilities located in and near nesting habitat.

Acknowledgments—We thank the Laguna County Sanitation District for allowing the use of these data. This paper was strengthened by comments from John Storrer. Jeff Alvarez helped guide us in our process by providing suggestions, reviewing an early draft of this paper, and sharing his accumulated knowledge of Western Pond Turtles.

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Our observations of nests in an area subject to excavation, with no indication of their presence, confirm the putative nature of nest crypticism (Davidson and Alvarez 2020).

NATURAL HISTORY NOTE

Absence of Rattle in the Mexican Dusky Rattlesnake (*Crotalus triseriatus*; Squamata: Viperidae)

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Rattlesnakes of the genera *Crotalus* and *Sistrurus* are characterized by a keratinized and segmented caudal appendage, commonly known as rattle, which arises from the distal portion of the tail and represents one of the most distinctive structures among new world viperids (Klauber 1972, Campbell and Lamar 2004, Meik and Schuett 2016). This structure is part of a specialized anatomical and behavioral system that includes the external rattle segments, the bony style, subepidermal connective tissues, specialized musculature, and the caudal vibration behavior associated with defensive contexts (Greene, 1988, Meik and Schuett 2016). During ontogeny, rattle segments are progressively added in association with ecdysis cycles; therefore, the number and integrity of segments may vary among individuals and throughout the life of a single specimen (Klauber 1972, Meik and Schuett 2016).

Fig. 1. Dorsal view of *Crotalus triseriatus* without rattle *ex situ*. Photograph by AGB.

Although the rattle plays an important role as a warning signal against predators or potential threats, this structure may be partially or completely lost due to wear, failed predation attempts, or damage to the distal portion of the tail (Greene 1988, Rowe et al. 2002, Schuett et al. 2012). Rattle loss has been documented in some rattlesnake species and may have behavioral and ecological, particularly because the absence modify the expression of defensive behaviors typically associated with the group (Rowe et al. 2002, Meik and Schuett 2016).

Crotalus triseriatus is a species endemic to Mexico, distributed mainly in the highlands of the Trans-Mexican Volcanic Belt, where it inhabits Pinus-Abies forests, grasslands associated with these forests, and anthropized environments, generally at high elevations (Campbell and Lamar 2004, Mociño-Deloya et al. 2014). Here, we document the absence of a rattle in a wild individual of *Crotalus triseriatus* and provide photographic evidence of a caudal alteration that has been rarely reported for this species.

On 17 March 2021, at approximately 11:00 h, an adult individual of *Crotalus triseriatus* (Fig. 1) was observed in El Cerrillo Piedras Blancas, municipality of Toluca, Estado de México, Mexico (19°24'45.72"N, 99°41'39.12"W; WGS84). The individual was found active on black plastic sheeting over dry, cracked soil in an open disturbed environment associated with grassland and patches of agricultural land. During visual inspection of the specimen, the rattle was observed to be completely absent from the distal portion of the tail (Fig. 1).

The terminal caudal region lacked visible keratinized segments and any external structure corresponding to a functional rattle; additionally, the distal portion of the tail showed a scarred appearance (Figs. 2 and 3). No residual segments or clearly distinguishable remains of the caudal appendage were observed. The specimen was handled only with a snake hook for observation and photographic documentation, avoiding direct contact. The individual did not display defensive behavior or sudden movements. Based on the worn appearance of the skin and scales, as well as its poor condition, the snake appeared to be a very old individual and was likely near death. Although the exact cause of the rattlesnake's loss cannot be determined, habitat alteration may represent a relevant contextual factor, as human-modified environments can increase exposure to abrasive surfaces, debris, machinery, human persecution, or other sources of mechanical damage that can affect the distal portion of the tail.

The absence of the rattle observed in this individual of *Crotalus triseriatus* probably represents an acquired alteration of the distal portion of the tail; however, its origin cannot be determined with certainty based solely

Rattlesnakes of the genera *Crotalus* and *Sistrurus* are characterized by a keratinized and segmented caudal append-age, commonly known as rattle, which arises from the distal portion of the tail and repre-sents one of the most distinc-tive structures among new world viperids...

Fig. 2. Close-up of the caudal area of *Crotalus triseriatus*, Photo by AGB.

on the available photographic evidence. The rattle may have been completely lost due to wear, failed predation attempts, or injuries affecting the distal portion of the tail (Rowe et al. 2002, Schuett et al. 2012, Meik and Schuett 2016).

Although rattle loss has been documented in other species of *Crotalus* and *Sistrurus* (Rowe et al. 2002, Schuett et al. 2012), isolated observations in Mexican species remain important for expanding knowledge of external morphological variation and caudal alterations in wild populations.

In conclusion, this record provides photographic evidence of a wild individual of *Crotalus triseriatus* with complete absence of the rattle. Considering that *C. triseriatus* is a Mexican endemic species mainly associated with high-elevation environments of the Trans-Mexican Volcanic Belt, the documentation of this type of condition contributes to basic knowledge of its natural history and morphological variation (Campbell and Lamar 2004). Continued documentation of similar observations in natural populations is recommended, including detailed information on locality, elevation, habitat type, body condition, and characteristics of the caudal region, in order to evaluate whether these alterations correspond to isolated events or recurrent conditions in the species.

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Although rattle loss has been documented in other species of *Crotalus* and *Sistrurus* (Rowe et al. 2002, Schuett et al. 2012), isolated observations in Mexican species remain important for expanding knowledge of external morphological variation and caudal alterations in wild populations.

Fig. 3. Close-up of the tail with absence of rattle in *Crotalus triseriatus*. Photograph by AGB.

NATURAL HISTORY NOTE

Reduced Ventral Coloration in a Male Mesquite Lizard (*Sceloporus grammicus*)

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Ventral coloration in lizards often functions as a secondary sexual trait involved in mate attraction and intrasexual signaling (Cooper and Greenberg 1992). In the Mesquite Lizard (*Sceloporus grammicus*), adult males typically exhibit conspicuous blue ventral patches that may vary in intensity depending on physiological and environmental factors (Hernández-Gallegos et al. 2026).

On 6 April 2026, which corresponds to the non-reproductive season for the species (Granados-González et al. 2025), a capture-mark-recapture survey of the Mesquite Lizard was conducted at "El Cerrillo, Piedras Blancas" Campus, Universidad Autónoma del Estado de México, México. A total of 11 adult males were captured during this sampling session, most individuals displayed the typical condition of intensely blue, well-defined, and symmetrical ventral patches. However, one individual exhibited noticeably less saturated ventral coloration.

This variation is illustrated by comparing two contrasting individuals. A male (Fig. 1; ID 23, left; SVL = 57 mm, tail length = 75 mm, body mass = 5.4 g) displayed highly saturated and clearly defined blue ventral patches. In contrast, the unusual male (Fig. 1; ID 24, right; SVL = 62 mm, tail length = 81 mm, body mass = 6.7 g), showed faint, diffuse blue patches with poorly defined margins, partially interrupted by grayish and orange tones.

To determine whether this individual represented an atypical case within the population, morphometric variables (snout-vent length and body mass) were compared with a box-and-whisker plot (Fig. 2) with those of the remaining adult males captured during the same survey. The analysis indicated that this male falls within the expected range for the population and does not represent an outlier in terms of body size or mass. Additionally, a drop of blood was collected from the tail and analyzed using a Mission HB hemoglobin meter, yielding a total hemoglobin concentration of 5 g/dL. This value is lower than those previously reported for populations of *S. grammicus* at similar elevations (7.6 g/dL; González-Morales et al. 2017), suggesting a potential physiological difference in this individual. Although the biological significance of this finding remains uncertain, reduced hemoglobin concentration could be associated with physiological or health-related factors that may also influence the expression of ventral coloration.

Despite having greater body size and mass, this male showed a clear reduction in ventral color intensity. Because its morphometric characteristics fall within the normal range, this variation may be associated with physiological factors. Alternatively, it may be due to differences in steroid hormone levels such as testosterone, which are known to regulate the expression of secondary sexual traits and coloration in reptiles (Fox 1971, Cooper and Greenberg 1992, Argaez et al. 2021). Although parasitic infections can also alter coloration in species of the genus *Sceloporus* (Ressel and Schall 1988, Argaez et al. 2021), these changes are often associated with the darkening or melanization of the skin, a pattern that was not seen in this individual.

This observation highlights individual variation in ventral coloration among male *S. grammicus* and suggests that the intensity of this trait may depend not only on body size, but also on endocrine status, physiological condition, and the possible presence of parasites. Future studies incorporating hormone measurements and parasitological assessments will aid in testing this hypothesis more directly.

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Fig. 1. Ventral coloration of two adult males of Mesquite Lizard (*Sceloporus grammicus*) from "El Cerrillo, Piedras Blancas" Campus, Toluca, Estado de México, México. Individual ID 23 (left, SVL = 57 mm) exhibits the typical condition of intensely blue and well-defined ventral patches, whereas individual ID 24 (right, SVL = 62 mm) shows reduced and diffuse ventral coloration.

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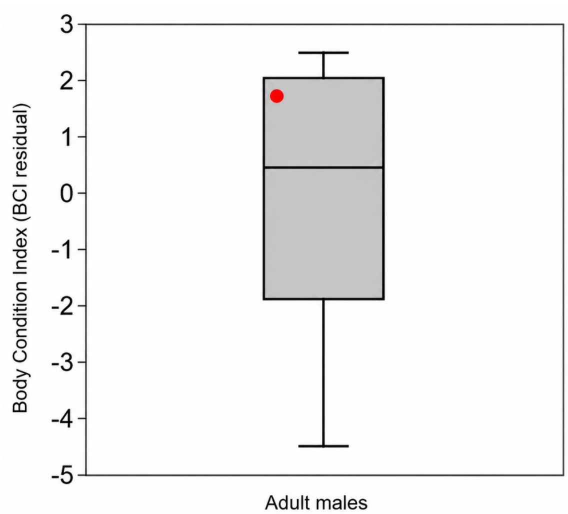

Fig. 2. Box-and-whisker plot of the body condition index (BCI residual) of 11 adult male *Sceloporus grammicus*. The highlighted individual (red dot) with reduced ventral coloration falls within the expected range of variation for the population.

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NATURAL HISTORY NOTE

Ornithodoros (Argasidae) Ticks Parasitizing Western Toads (*Anaxyrus boreas*) and Western Spadefoots (*Spea hammondii*) in California

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Ecological studies of parasites in herpetofauna are receiving increasing attention, with the number of published studies continuing to grow annually (Bower et al. 2019). In light of global climate change and other ecological stressors, investigations of amphibian and reptile diseases and parasitism have become increasingly important (Herczeg et al. 2021, Kiesecker et al. 2004, Pilliod and Esque 2023, Snyder 2020). Of particular interest is parasitism of amphibians by ticks, including hard ticks (Ixodidae) and soft ticks (Argasidae). Various tick species have been documented on amphibians, including *Amblyomma rotundatum* (Ixodidae) on the Cururu Toad (*Rhinella jimi*; Ferreira and Faria 2011), *A. dissimile* on the Cane Toad (*R. marina*; Burgon et al. 2012), and the soft tick *Carios* sp. (Argasidae) on the Common Coquí (*Eleutherodactylus coqui*; Longo and López-Torres 2017). Many of these ticks are vectors of pathogens, including *Haemogregarina* spp., *Rickettsia* spp., and the agents responsible for tick-borne relapsing fever (Cotes-Perdomo et al. 2018, Gong 2025, Osborne et al. 2019). Herein, we report *Ornithodoros* ticks parasitizing the Western Toad (*Anaxyrus boreas*) and Western Spadefoot (*Spea hammondii*).

On 21 May 2026, while hand-excavating and evaluating California Ground Squirrel (*Otospermophilus beecheyi*) burrows in Madera County, California (Township 12 South, Range 18 East, Section 2; 83 m elev.), we encountered Western Toads, Western Spadefoots, and Pacific Chorus Frogs (*Pseudacris regilla*) approximately 1 m inside the tunnel system and ~45 cm below the surface. The amphibians were nestled within side chambers along the burrow corridor. Upon examination, we detected ticks attached to one Western Toad (inner surface of the left forelimb) and one Western Spadefoot (dorsal surface of the left caudal-dorsal quadrant; Fig. 1A and B). We attempted to remove the tick on the spadefoot but it was firmly attached. To avoid injuring the host by tearing the skin, we elected not to remove the tick, however, the tick on the Western Toad fell off after handling. No ticks were observed on any Pacific Chorus Frogs. All amphibians were subsequently relocated to a nearby wetland. No other ectoparasites, including fleas (Pulicidae), mites (Acari), or chiggers (Trombiculidae), were detected within the burrow system.

We identified the ticks as members of the genus *Ornithodoros* based on morphological characteristics diagnostic of soft ticks (Argasidae) and distinct from those of hard ticks (Ixodidae; Inyagwa et al. 2021). Twelve species of *Ornithodoros* have been reported from

Fig. 1A. *Ornithodoros* (Argasidae) tick on Western Spadefoot (*Spea hammondii*) and **B.** Western Toad (*Anaxyrus boreas*). Photos by H. Clark.

Ecological studies of parasites in herpetofauna are receiving increasing attention, with the number of published studies continuing to grow annually (Bower et al. 2019). In light of global climate change and other ecological stressors, investigations of amphibian and reptile diseases and parasitism have become increasingly important ...

California (Furman and Loomis 1984). Based on locality, the most likely species is *Ornithodoros parkeri* (Furman and Loomis 1984, Osborne et al. 2019). Species of *Ornithodoros* are commonly associated with deer and cattle and are typically found in foothill habitats (Furman and Loomis 1984, Teglas et al. 2005). In the present case, however, *Ornithodoros* ticks may have been introduced into the San Joaquin Valley by deer moving along riparian corridors such as Little Dry Creek, the Fresno River, and the San Joaquin River (Clark 2004), thereby facilitating establishment of tick populations within ground squirrel colonies (Furman and Loomis 1984). *Ornithodoros* ticks have previously been reported from several amphibian species, including the Argentine Toad (*Rhinella arenarum*; Venzal et al. 2019), Ornate Forest Toad (*R. ornata*; Luz et al. 2018), Rock River Frog (*Thoropa miliaris*; Barros-Battesti et al. 2015), and Hurter's Spadefoot (*Scaphiopus hurterii*; Balasubramanian et al. 2023).

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Twelve species of *Ornithodoros* have been reported from California (Furman and Loomis 1984). Based on locality, the most likely species is *Ornithodoros parkeri* (Furman and Loomis 1984, Osborne et al. 2019). Species of *Ornithodoros* are commonly associated with deer and cattle and are typically found in foothill habitats (Furman and Loomis 1984, Teglas et al. 2005).

CULTURAL NATURAL HISTORY NOTE

Herpetofaunal Representations in Western North American Rock Art

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For thousands of years, Indigenous peoples of western North America have used "rock" surfaces, such as canyon and cliff walls, talus boulders, caves and rock shelters, and the natural ground surface, as canvases to record visions, experiences, and observations of arid landscapes (Schaafsma 1980, Whitley 1996). These expressions, collectively referred to as rock art, were created using two primary techniques: pictographs are paintings made with mineral or organic pigments, and petroglyphs are produced by pecking, carving, or abrading surfaces to expose fresh stone beneath a weathered patina (Welsh and Welsh 2000). Rock art may date back thousands of years, though some examples are comparatively recent.

Rock art imagery generally falls into two broad categories. Representational imagery depicts recognizable life forms, including anthropomorphic (human or human-like) and zoomorphic (animal or animal-like) figures, such as quadrupeds, birds, snakes, and other wildlife. Abstract imagery consists of nonfigurative elements; if such imagery can be linked to living forms, the connection is likely unintentional or symbolic rather than literal (Schaafsma 1980).

Interpreting the meaning of rock art remains one of the central challenges in archaeological research. Ideally, archaeologists collaborate with modern descendant communities, whose oral traditions can provide cultural context and insight into the symbolic meanings of these images. When such connections are unavailable, interpretations are necessarily limited, often relying on stylistic analysis or broader cultural patterns rather than specific meanings or describing what is depicted in the simplest of terms (Schaafsma 1980, Patterson 1992). Scholars have proposed a range of interpretations, including references to social relationships, communication systems, trade routes, and religious or ideological beliefs. Changes in rock art styles through time may reflect shifts in worldview, ritual practice, or broader cultural transformations (Schaafsma 1980).

The study of rock art has generated hundreds of books and scientific papers, and a comprehensive synthesis would extend well beyond the scope of this paper. Accordingly, this discussion focuses exclusively on representational imagery, and more specifically on depictions of herpetofauna: reptiles and amphibians. Each taxonomic group is examined in turn, with consideration given to possible symbolic interpretations. In some cases, however, the simplest explanation may apply: the artist may have chosen to depict a snake, lizard, or frog simply because it was a familiar or compelling feature of the surrounding landscape.

General Symbolism of Animal Figures

Whitley (1996) offers several interpretations of animal imagery in rock art, particularly from the Great Basin region. He suggests that animals such as reptiles, amphibians, birds, and mammals often appeared in shamanic visions and served as spirit helpers. Some shamans specialized in specific powers and therefore relied on particular animal allies. For example, rattlesnakes were associated with Rattlesnake Shamans throughout much of western North America; these individuals were believed to possess the ability to cure snakebite and safely handle venomous snakes.

In other contexts, however, dangerous animals—rattlesnakes included—were depicted not as helpers but as guardians of the supernatural realm (Whitley 1996). Less overtly dangerous species, such as lizards and frogs, may have functioned as metaphors for transformation or passage between worlds. Lizards, which move easily in and out of rock crevices, can symbolize transitions between physical and spiritual realms, while frogs—moving between land and water—may represent shifts between different planes of existence. Animals capable of crossing such boundaries were thought to act as messengers between the mundane and supernatural worlds, mirroring the shaman's ability to traverse these realms (Whitley 1996).

Additional symbolic layers may also be present. Zedeno et al. (1999) suggest that lizard imagery could mark the location of portals to the supernatural world. In south-central California, depictions of frogs or turtles have been interpreted as metaphors for "going underwater," reflecting beliefs that water sources were inhabited by supernatural beings. In this context, drowning should be understood symbolically rather than literally (Whitley 2006). More broadly, aquatic imagery in rock art may signify this underwater or liminal metaphor (Whitley 1996). At the same time, Welsh and Welsh (2000) caution that an overreliance on shamanistic explanations may obscure alternative interpretations for petroglyphs and pictographs at certain sites.

Can Herpetofaunal Rock Art Be Identified to Species?

Schaafsma (1980) argues that representational rock art in western North America generally favors stylization over realism. This tendency is influenced in part by the limitations of the medium, whether pigment applied to rock or images carved into stone. Nevertheless, certain reptiles and amphibians possess distinctive morphological

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Fig 1. Hospital Rock, Sequoia National Park, CA. Pictured here is a pictograph using red pigment. Historical records indicate that the rock art site was used by two brother shamans during the mid to late 19th century (Whitley 1996). The meaning behind the images is unknown, but some features are recognizable such as the human figures and the zigzag patterns interpreted as rattlesnake designs (Whitley 1996). The rattlesnake zigzag can be seen in the upper left corner, and measures approximately 45 cm. Photo by Sue Hagen (June 2014).

traits that may allow identification to genus, species, or at least a broader taxonomic group.

For example, Gregonis and Evans (2025) suggest that some rock art associated with the Hohokam culture of southern Arizona depicts horned lizards (genus *Phrynosoma*). Horned lizards have a distinctive, flattened body, rounded shape, and large head with prominent rear-facing horns (Sherbrooke 2003), features that are often captured in rock art. Notably, horned lizard expert Wade Sherbrooke observed that carved stone bowls from the region appear to distinguish between two species based on morphology. Regal Horned Lizards (*Phrynosoma solare*) possess a crown-like arrangement of spiny horns encircling the back of the head, whereas Short-horned Lizards (*Phrynosoma hernandesi*) have smaller horns and a hornless notch at the rear of the head. These species occupy different habitats within the Hohokam region, the former in the Sonoran Desert and the latter in higher-elevation sky islands, suggesting that artists were aware of ecological differences among species.

Similarly, Gregonis and Evans (2025) report that depictions of Common Chuckwallas (*Sauromalus ater*) can be distinguished by their round bodies and thick tails. Chuckwallas may also carry symbolic significance, as they spend their lives among rocks and talus slopes and inflate their bodies within rock crevices when threatened (Clark 2008). In another case, a petroglyph from Rincon Valley in Saguaro National Park, Arizona, has been interpreted as a gecko based on its body proportions, large head, and prominent eyes (Schaafsma 1980).

Snakes in Rock Art

Snakes are among the most frequently depicted animals in western North American rock art (Figs. 1 and 2). Patterson (1992) summarizes the symbolic roles snakes play, noting that they are commonly rendered as sinuous or wavy lines, sometimes with a head or forked tongue. On the Hopi Mesas of Arizona, a wavy line without a tongue may represent lightning, whereas the addition of a tongue signifies a snake. In one Hopi example, two snakes encircling animals and corn symbolize tribal boundaries in the form of major rivers, specifically the Colorado and Rio Grande.

A pictograph near Yucca Valley in California's San Bernardino Mountains depicts a rattlesnake motif associated with a Luiseño puberty ceremony. During this ritual, a young girl raced to a rock where a family member presented her with ochre paint, which she then used to paint diamond-shaped rattlesnake patterns on the rock (Patterson 1992, Gilreath 2007).

Within Hohokam rock art, snakes are often shown in motion, oriented vertically and seemingly crawling across the rock surface (Gregonis and Evans 2025). They frequently appear alongside other animals and may interact with them. Although identification to species is uncommon, certain features, such as fangs or distinctive movement patterns, can be diagnostic. Some depictions include S-shaped curves suggestive of the tracks left

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Fig. 2. Painted Cave, Santa Barbara, CA. Photographed here is an example of a Chumash pictograph rock art site. Near the center of the panel is a zigzag diamond chain created by rows of red Xs, filled in with white pigment. This diamond chain feature is interpreted as a snake spirit (Whitley 1996). Photo by Howard Clark (June 2012).

by Sidewinders (*Crotalus cerastes*). Schaafsma (1980) describes a petroglyph from Cookes Peak, New Mexico, that clearly represents a rattlesnake, complete with a terminal rattle, triangular head, and forked tongue. These traits allow confident identification, particularly given that New Mexico is home to two rattlesnake genera, *Sistrurus* and *Crotalus* (Bartlett and Bartlett 2013).

Turtles and Tortoises in Rock Art

Turtles and tortoises were common subjects in Hohokam rock art, particularly during the AD 800s and 900s (Gregonis and Evans 2025). Many depictions may represent Desert Tortoises (*Gopherus morafkai*), while others could portray aquatic or semi-aquatic species such as Sonora Mud Turtles (*Kinosternon sonoriense*) or Ornate Box Turtles (*Terrapene ornata*). These animals are typically recognizable by their rounded shells, sometimes marked with crisscross patterns suggesting scutes, and small protruding heads and limbs.

Schneider and Everson (1989) note that the use of turtles and tortoises by Indigenous peoples has been poorly documented, though evidence suggests a wide range of applications, including subsistence, ceremonial, medicinal, technological, and symbolic roles. Their appearance in rock art implies particular cultural or mythological significance. Turtle and tortoise motifs at Nevada petroglyph sites have been interpreted as expressions of hunting magic or clan symbolism, while other interpretations emphasize associations with longevity and old age. The animals' slow movement, durable form, and extended lifespan may have contrasted symbolically with faster-moving species that inhabited the same landscapes (Schneider and Everson 1989).

Concluding Remarks

Rock art offers a compelling window into the past, providing glimpses into the perceptions, experiences, and observations of people who lived thousands of years ago. These images reflect the close relationship between Indigenous communities and their environments, revealing a deep awareness of wildlife and landscape. Yet interpreting the meaning of animal representations remains inherently uncertain. Our understanding relies heavily on oral traditions preserved by descendant communities, as well as cautious inference from the imagery itself.

Welsh and Welsh (2000) caution against imposing modern Western notions of "art" onto rock art traditions. In contemporary Western culture, art is often understood as a form of personal creative expression intended for aesthetic appreciation. There is little evidence that this framework applies to rock art in western North

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America. The term "rock art" itself may therefore carry cultural bias. In many cases, interpretation may not extend beyond identifying what is depicted—a bighorn sheep (*Ovis canadensis*), a snake, or a turtle—and acknowledging that the artist encountered and valued that species within their lived landscape.

Ultimately, the most responsible approach may be one of humility: appreciating rock art on its own terms, imagining the landscapes as they once appeared, and recognizing that humans have long shared space and time with animals, rivers, mountains, and plants. Our connection to these elements may be far deeper, and far older, than we often realize.

Table 1 shows a sampling cross section of various examples of herpetofauna represented in rock art. It is by no means an exhaustive list, but is included here to remind the reader of the richness of herpetofaunal species encountered in western North America over thousands of years by a variety of human cultures.

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Table 1. Taxonomic list of herpetofauna represented in rock art, either petroglyphs or pictographs, with other information, including general location and reference.

Taxon	Type	General location	Reference
Order Anura—Frogs			
Tadpoles	Petroglyph	Cooks Peak, MN	Schaafsma (1980)
Frog	Pictograph	Kaweah River, Tulare County, CA	Whitley (2006)
Order Testudines—Turtles and Tortoises			
Tortoise / turtle	Petroglyph	Valley of Fire, NV	Schneider and Everson (1989)
Tortoise	Pictograph	Caliente Creek, North-Central New Mexico	Renaud (1938)
Turtle	Petroglyph	Cooks Peak, MN	Schaafsma (1980)
Turtle	Petroglyph	East Mesa, Cuyamaca Rancho State Park, San Diego County, CA	Hedges and Hamann (1991)
Turtle	Pictograph	Amistad National Recreation Area, TX	Dering (2002)
Sea turtle	Pictograph	Baja California	Schneider and Everson (1989)
Order Squamata, Suborder Lacertilia—Lizards			
Lizard	Petroglyph	Tularosa Canyon, NM	Schaafsma (1980)
Lizard	Petroglyph	Painted Rocks State Park, Gila Bend, AZ	Schaafsma (1980)
Lizard	Pictograph	Vallecito Potrero, San Diego County, CA	Hedges (2002)
Lizard	Petroglyph	Santan Mountain, AZ	Schaafsma (1980)
Lizard	Pictograph	Northern San Diego County, CA	Erickson and Freers (2018)
Lizard	Pictograph	Western Mojave Desert, CA	Knight et al. (2008)
Lizard	Pictograph	McCain Valley, Eastern San Diego County, CA	Cook and Fulmer (1981)
Lizard	Petroglyph	South Mountains, AZ	Schaafsma (1980)
Common Chuckwalla	Petroglyph	Painted Rocks State Park, Gila Bend, AZ	Gregonis and Evans (2025)
Gecko	Petroglyph	Rincon Valley, Saguaro National Monument, Tucson, AZ	Schaafsma (1980)
Horned Lizard	Petroglyph	Zuni, NM	Sherbrooke (2003)
Order Squamata, Suborder Serpentes—Snakes			
Rattlesnake	Petroglyph	Cooks Peak, MN	Schaafsma (1980)
Rattlesnake	Pictograph	Western Mojave Desert, CA	Knight et al. (2008)

Table 1. (continued) Taxonomic list of herpetofauna represented in rock art, either petroglyphs or pictographs, with other information, including general location and reference.

Taxon	Type	General location	Reference
Rattlesnake	Pictograph	Painted Cave, Santa Barbara, CA	Whitley (1996)
Rattlesnake	Pictograph	Hospital Rock, Sequoia National Park, CA	Whitley (1996)
Rattlesnake	Petroglyph	Barker Dam, Joshua Tree National Park, CA	Whitley (1996)
Rattlesnake	Pictograph	Little Blair Valley, Anza-Borrego Desert State Park, CA	Whitley (1996)
Snake	Petroglyph	South Mountains, AZ	Schaafsma (1980)
Snake	Petroglyph	Utah	Mattison (2025)
Snake	Pictograph	North-Central New Mexico	Renaud (1938)
Snake	Petroglyph	East Walker River, Yerington, NV	Nissen (1974)
Snake	Pictograph	Northern San Diego County, CA	Erickson and Freers (2018)
Snake	Pictograph	Newberry Cave, Mojave Desert, CA	Garfinkel et al. (2016)
Snake	Petroglyph	Nevada Test Site, NV	Zedeno et al. (1999)

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BOOK REVIEW

From Venom to Reflection: A Snakebite, a Book, and the Stories That Follow

Howard O. Clark, Jr., CWB®, CSE, Editor, Tucson Herpetological Society, Tucson, AZ; *editor.sonoran.herp@gmail.com*

But never met this Fellow
Attended or alone
Without a tighter Breathing
And Zero at the Bone.
—Emily Dickinson ("A narrow Fellow in the Grass")

When I published my rattlesnake encounter article in the December 2025 issue of the *Sonoran Herpetologist* (Clark 2025), in which I documented my snakebite experience in a detailed, play-by-play account, I had mixed feelings about sharing it. While the story itself was compelling, it also meant publicly acknowledging my own complacency around a dangerous reptile. I did not make a formal announcement about the article on social media; instead, I simply added it to my growing list of publications on ResearchGate and Academia. Even without any promotion, ResearchGate recorded around 100 reads within a few weeks—an impressive number considering that most of my publications typically receive only about 20 reads per year.

After the December 2025 issue was released, I received several emails from fellow biologists who appreciated the article, expressed relief that I had survived the incident, and were surprised that they had never heard about the bite before its publication—even though it had occurred in October 2024. My friend and colleague Jeff Alvarez also reached out. At the time he was serving as President of the Western Section of The Wildlife Society and asked if he could mention my experience in an upcoming email to the Section's membership. I told him that would be fine and waited to see how the broader biological community would respond. Jeff referenced the article in a 9 January 2026 email to the Section:

> "**The Complacency Trap:** if you don't know what this is, it describes a situation where being comfortable prevents a person from making useful changes. A common complacency trap that I see is being overly comfortable with a skill or with knowledge. As an example, I feel quite comfortable with my driving skill, but that comfort might lead to being in an accident because I stop being vigilant. A better example that I think we need to be reminded of includes venomous snakes. Many of us see rattlesnakes frequently, so we stop worrying about them, or we quickly move them from harm's way without a thought. As our climate changes, the many species in California and Nevada can be active nearly all year, and our encounters may increase. A friend of mine had a recent experience with being bitten and envenomated. Being the professional he is, he very closely documented the entire process from which we all can learn. I strongly urge you to read his article (only a couple of pages) and remind yourself that complacency can be a trap." (See Fig. 1 for another form of a "complacency trap").

Zero at the Bone: Rewriting Life after a Snakebite

By Erec Toso

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Print Length: 224 pages
ISBN-10: 0816525919
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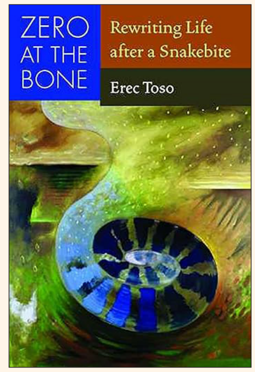
Weight: 11.2 ounces
Dimensions: 6 × 0.6 × 9 inches



Book cover and other information.

Within a day of the email, reads of the article on ResearchGate jumped by several hundred. By the end of the month the article had nearly 800 reads; as I write this, the total stands at 994. At the Western Section wildlife conference in Monterey, California, earlier this year, several biologists approached me to ask how I was doing—and, inevitably, to see where the snake had bitten me. There was little to show beyond a faint red dot on my left index finger. Most people were simply relieved that I had recovered and appreciative that I had written about the experience. My typical response was, "It was fun to write about, but not fun getting bit." We can joke about it now, but the incident was extremely serious and could easily have ended in tragedy.

Another notable response came from *Sonoran Herpetologist* Associate Editor Don Swann in a 25 January 2026 email. Don himself had experienced a rattlesnake bite from a Banded Rock Rattlesnake (*Crotalus lepidus klauberi*; Swann and Bell 1999). He mentioned that, in hindsight, he wished he had emphasized the considerable pain and discomfort he experienced in his own published account. His article, with co-author Dan Bell, described the event as follows:

> "On June 6, 1997, while we were surveying reptiles and amphibians at Coronado National Memorial, Don was bitten on the outside of his right hand by a banded rock rattlesnake (*Crotalus lepidus klauberi*) in an Arizona white oak (*Quercus arizonica*) 107 cm above the ground. The rattlesnake, a young adult ca. 30-40 cm SVL, was positioned vertically against the tree trunk under a large strip of peeling bark. Don's hand was held above the waist due to heavy brush cover, but he did not actually touch the tree. The snake was not noticed until ca. 20 seconds after the bite, when it was observed coiled in an S-shaped posture…

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The snake injected venom through only one fang, and a syringe pump extractor (Sawyer Products, Safety Harbor, FL) was applied within one minute. Reaction to the bite included severe swelling that continued to increase over the next 24 h, eventually reaching ca. 5 cm below the axilla. We arrived at a hospital within 70 min of the bite, and Don was released after 5 h of observation. No antivenin was administered. The swelling decreased over the next two weeks, and the hand completely recovered within 1-2 months."

Don also mentioned another rattlesnake bite account—this one involving a Mojave Rattlesnake (*Crotalus scutulatus*)—written by Erec Toso in another *Sonoran Herpetologist* article (Toso 2005). Curious, I looked up the article and was immediately struck by the literary power of Toso's writing. Toso, who teaches writing at the University of Arizona, captured the experience through a stream-of-consciousness narrative that vividly conveyed both the physical and emotional aftermath of the bite.

Don also told me that Toso later wrote a book about the experience titled *Zero at the Bone: Rewriting Life after a Snakebite* (Toso 2007). I promptly tracked down a copy online and ordered what appeared to be the last one available. While reviewing old issues of the *Sonoran Herpetologist*, I also discovered that Toso and Matt Goode had been guest speakers at the Tucson Herpetological Society in December 2005, presenting a talk titled "Whose Story Is It Anyway? Using Art and Science to Revise Snake Myths." The presentation must have been fascinating. In the April 2007 issue of the *Sonoran Herpetologist* (p. 43), Toso's book was advertised as available for review, though I could find no record that one was ever written. Here, I attempt to offer my own perspective on the book—perhaps uniquely informed by membership in the unfortunate "snakebite club."

I read the book with intense curiosity, eager to see whether our experiences shared any common ground. Over 220 pages, Toso writes with passion and introspection. His encounter with death at the end of a rattlesnake's fang forced him to pause and begin searching for deeper meaning in his life. His experience differed significantly from my own. He was bitten on the foot and spent months unable to walk as his leg became swollen, discolored, and intensely painful. Just as he thought he was ready to return to teaching, the bite site became infected, setting him back again. The physical suffering was compounded by mental strain. An avid runner before the bite, he feared he might never return to that part of his life.

Toso's "rewriting of life" led him through memories of childhood and allowed him to reconsider his relationships with family. His connections with his siblings were strained and required reflection and repair. His parents' stories were even more complicated: a difficult relationship with his father and a mother slowly disappearing into Alzheimer's disease. The snakebite

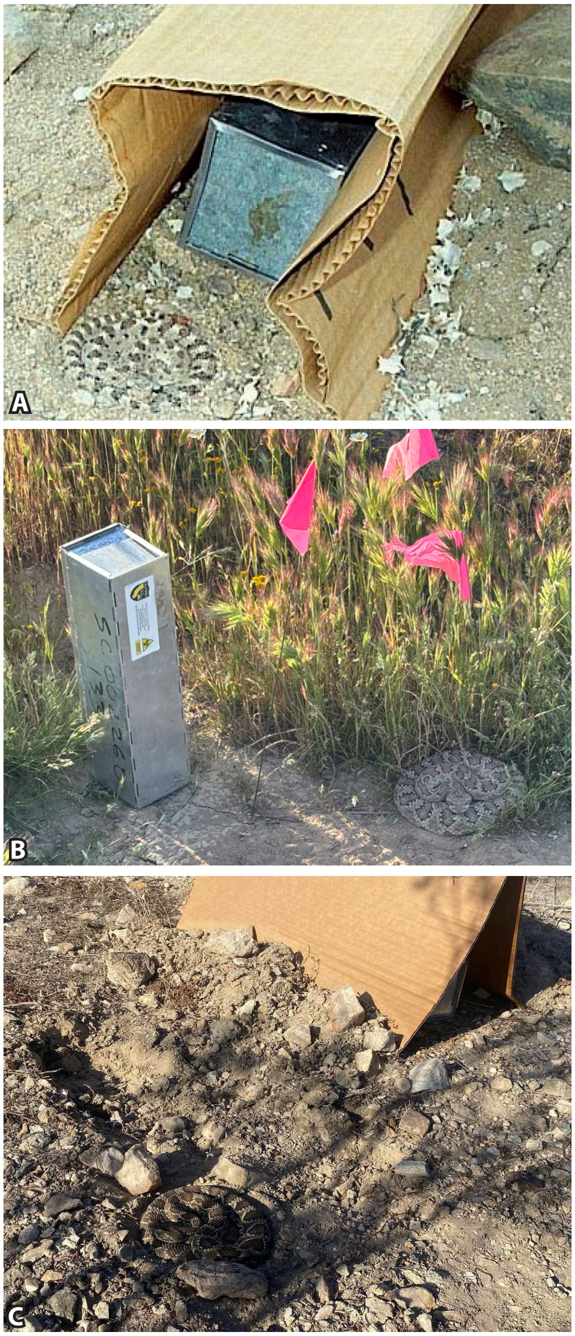

Fig. 1. Three examples of situations wildlife biologists commonly encounter during fieldwork. In each case, a rattlesnake was found adjacent to small-mammal traps during survey efforts, illustrating how inattention in the field can lead to a potentially fatal snakebite. The question arises: is the true danger the animal itself, or our assumption that we have mastered the environment?

A. Sidewinder (*Crotalus cerastes*) cratered beside a Mohave ground squirrel (*Xerospermophilus mohavensis*) trap beneath a cardboard shade. Photo by H. Clark, 4 May 2006, San Bernardino County, CA; originally published in Randel and Clark (2007).

B. Northern Pacific Rattlesnake (*Crotalus oreganus*) beside an upright Sherman live trap during an evening trap set for kangaroo rats (*Dipodomys* sp.). Photo by H. Clark, 12 March 2026, Kern County, CA.

C. Mojave Rattlesnake (*Crotalus scutulatus*) cratered near a Mohave ground squirrel trap beneath a cardboard shade. Photo by H. Clark, 20 April 2022, San Bernardino County, CA.

Toso's "rewriting of life" led him through memories of childhood and allowed him to reconsider his relationships with family. His connections with his siblings were strained and required reflection and repair. His parents' stories were even more complicated: a difficult relationship with his father and a mother slowly disappearing into Alzheimer's disease.

became a catalyst for confronting these relationships and exploring the possibility of forgiveness—an undertaking that was neither easy nor necessarily welcomed by those around him.

Reading his reflections inevitably led me to think about my own life and whether such an event might push me toward a similar journey of self-examination. Toso's narrative seems to mirror Abraham Maslow's hierarchy of needs (Maslow 1943). The bite itself thrust him into the two lowest levels—physiological needs and safety—where survival and health dominate all thought. As his recovery progressed, he began grappling with the next level: love and belonging. His writing flowed through these themes, revealing personal histories and emotional contexts that helped readers understand where he was coming from. At one point he writes (p. 143):

> "My words are a conduit for the overflow of emotion pumping through the viscera and ephemera called my body. I sit with the keys and let words run through my fingers like water. Sometimes they feel like sacred words, incantations, healing words, words that want out. The power of them pushes my censor far into the background of my psyche. He doesn't mind, but lets the Dionysian carnival run its course. There will be time, he says."

Ultimately, Toso's reflections become a powerful reminder that life is short and should be embraced fully. His observations extend even to the rattlesnake itself—an animal often feared yet historically associated with healing, as symbolized by the Rod of Asclepius. I have also explored the idea of embracing wildlife that is frequently misunderstood or resented (see Clark and Whitfield 2024).

The final levels of Maslow's hierarchy—esteem and self-actualization—appear in Toso's book through his drive to tell stories. *Zero at the Bone* is itself an act of self-actualization: the rewriting of a life through the lens of a traumatic encounter. The snakebite forced him to reflect on where he had come from and where he was going.

I appreciate that perspective and hope others who read his book do as well. Perhaps readers can gain insight into the value of their own lives without needing a traumatic catalyst like a snakebite. I will close with a passage from Toso that resonated strongly with me (p. 203):

> "The stories I tell guide my steps. They can be framed to accept the invitation contained within all experience. My actions can be knee-jerk, one-size-fits-all reflexes, outdated but cherished myths, or they can be answers to a world in crisis, a world calling out to me to respond. The desert is calling. I need new stories, new myths about how to live with the desert, how to coexist with rattlesnakes, mountain lions, and pup fish."
>
> "Stories that organize our place in the world need to be revised in times of crisis. Now is just such a time. We need to get out, to wake up, to unplug, to slow down, to stop long enough to realize that the old stories of snakes as slimy, evil messengers from Satan no longer work. The stories of a desert that will support massive, water-hungry cities no longer work. The story that life is a burden to be endured no longer works. The stories that we don't need a wild nature to define us as civilized no longer work. It is time to re-write, re-think, re-see our stories. It is in that rewriting that the experience of being alive can shift from fear to awe, from subjugation to coexistence, from poison to medicine."

Ultimately, Toso's reflections become a powerful reminder that life is short and should be embraced fully. His observations extend even to the rattlesnake itself—an animal often feared yet historically associated with healing, as symbolized by the Rod of Asclepius.

Acknowledgments—I thank Jeff Alvarez for sharing my paper with the Western Section membership, which sparked many meaningful discussions about wildlife safety and emergency response in the field. I am also grateful to Don Swann for sharing his own snakebite experience and for introducing me to Erec Toso's impactful book. These life lessons will be cherished.

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BOOK REVIEW

Listening Again: Science, Story, and the Call to Reconnect in *I Sing to the Earth and She Sings Back*

Howard O. Clark, Jr., CWB®, CSE, Editor, Tucson Herpetological Society, Tucson, AZ; *editor.sonoran.herp@gmail.com*

Nature needs us and
nature misses us.
May we find our way
home once again.

—M. Kat Anderson

I attended the Society for California Archaeology conference in Palm Springs, CA, this past March. While visiting the vendor room, I wandered over to Kat Anderson's table and checked out her new book, *I Sing to the Earth and She Sings Back*. After a conversation with Kat, I felt we connected on multiple levels and shared an appreciation for Planet Earth and its inhabitants—not just humans, but all lifeforms, from the microscopic to the impressively large. After purchasing a copy of her book, I couldn't wait to begin what I sensed would be a wild journey of storytelling and exploration.

Kat Anderson has produced a much-needed book that leads the reader toward exploring the natural world and exercising our powers of observation. She encourages us to think in terms of small details and connect them to the broader theme of understanding life on a global scale. Her primary method of teaching is through glimpses into the culture and worldview of Indigenous people who call California home. During her graduate research decades ago, she interviewed elders from various tribes in California and learned from them the many uses of plants—from food to tools to cultural rituals.

The elders explained that fire was essential in invigorating the landscape and encouraging healthy plant growth (Anderson 2018). The use of fire not only created a landscape teeming with game and wildlife and improved the health of flora—it was necessary. California's diverse landscapes co-evolved with fire, and for thousands of years, Native populations served as stewards, maintaining landscapes that supported many uses. Several key plants used by Indigenous people are fire-adapted and can only germinate with fire. Dense growth was controlled through burning, and new plant shoots grew long and slender—ideal for basketry and other uses.

However, during the post-contact period, Europeans and others discouraged the use of fire as a land management tool. Land was taken from Indigenous people, and many were confined to reservations. As a result, the landscape became unhealthy and far less productive than it once was.

I Sing to the Earth
and She Sings Back
Stories of Learning from Nature and Native People

By M. Kat Anderson

ASIN: B0G6CMXTB9
Publisher: Silverweed Press
Publication date: January 1, 2026
Language: English
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ISBN-13: 979-8218776930
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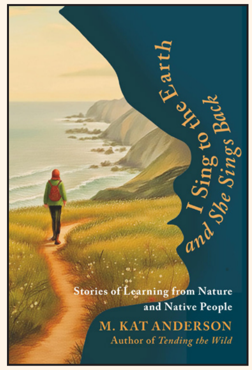

Book cover and other information.

Kat tells these stories of genocide and land transformation with a heavy heart. Much cultural knowledge has been lost, and although she was not raised within these traditions, she does what she can to learn from elders and share these lessons. If land management practices from thousands of years ago can be implemented again, perhaps there is hope for a healthier future.

Also central to Kat's book is learning from plants and animals themselves. She walks slowly and deliberately, observing closely. There are lessons to be learned from all living things—from turkey vultures to frogs and lizards to redbud and pine trees. These organisms can teach us a great deal, if we are willing to set aside bias and fully engage our senses. Sounds, sights, touch, and smells all offer insight—but we must remain open. Over time, it seems we have put on blinders, rejecting these freely available lessons. Humans were once deeply embedded in nature, but over millennia, we have increasingly separated ourselves from it.

From reading Kat's book, I've become more aware of my own limitations. I've worked as a biologist for over 30 years, observing nature—but am I truly connecting? I conduct surveys for rare and special-status species, write reports, and monitor nesting birds such as the Swainson's Hawk (*Buteo swainsoni*). When I encounter something novel, I document it in scientific papers or notes. I have authored or co-authored over 115 papers on wildlife and biology, aiming to share unique perspectives on animal behavior and interactions within the biotic and abiotic world (see Clark 2023, Clark and Whitfield 2024). But with all these contributions, am I truly seeing the world—engaging all my senses

I attended the Society for California Archaeology conference in Palm Springs, CA, this past March. While visiting the vendor room, I wandered over to Kat Anderson's table and checked out her new book, *I Sing to the Earth and She Sings Back*.

and connecting at a deeper level? At times, I feel I've become dismissive or numb, perhaps missing subtle yet meaningful signals the natural world offers freely.

One story Kat shared particularly caught my attention. Near her driveway grows a western redbud (*Cercis occidentalis*), a plant that requires fire for its seeds to germinate. She created a song for the redbud, inspired by Indigenous traditions of singing to nature. In this worldview, all aspects of nature possess spirit—the elderberry shrub (*Sambucus* sp.), a rock outcropping, a formidable mountain. Through song and dance, humans can communicate with these spirits, and they listen.

Western Fence Lizard (*Sceloporus occidentalis*), San Luis Obispo County; photo by H. Clark.

Over time, as Kat sang to the redbud, some seeds began to germinate. She initially suspected a physical cause, such as mechanical disturbance from a vehicle. However, when she shared this with an elder, she was told it was not physical forces that triggered germination, but the song—the metaphysical connection. The redbud heard and responded. Reflecting on this passage, I wonder whether, beneath our skepticism, there may be something worth considering.

Another passage that stood out was a song Kat composed for the Western Fence Lizard (*Sceloporus occidentalis*). I encounter these lizards often and enjoy their blue bellies and their push-up displays. Her song seemed to stir something ancient—a long-quiet awareness. Here is the song (p. 158):

Lizard Song

Hey lizard man,
I love your long, slender hands,
Your belly so blue,
And your wise eyes too.
Lizard, lizard.
Magical lizard.
Wonderful lizard.
It's so nice to see you.
It's so nice to be with you.

Come back home,
Where you're free to roam.
Restore your place,
Amid the human race.
Lizard, lizard.
Magical lizard.
Wonderful lizard.
It's so nice to see you.
It's so nice to be with you.
I love you.

It would be meaningful to hear such songs again—flowing through our consciousness, forming connections that tell nature we are present, and perhaps, that we are sorry.

We have much to relearn. So much has been lost over thousands of years. The Indigenous people of California are likely not alone in their traditions of singing to and connecting with nature. Humans, and even our earlier *Homo* ancestors, may have once known nature as an old friend—one we spoke to, understood, and learned from. Around evening fires, stories and songs were shared with younger generations, passing on knowledge of survival and reciprocity. These oral traditions taught that nature gives of itself so that we may live—and in return, we carry forward a way of life rooted in connection, respect, and understanding.

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Acknowledgments—I thank M. Kat Anderson for being at the right place at the right time—our brief connection has served a purpose, and I hope to serve this purpose well. She also kindly provided permission to reprint her "Lizard Song" in its entirety.

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MEETING MINUTES

BOD minutes can be found here: *http://bit.ly/2m9tXiI*

MEMBERSHIP

Membership Information

Individual	$20	Sustaining	$30
Family	$25	Contributing	$50
Student	$14	Life	$500

The Tucson Herpetological Society would like to thank existing members and new members for renewing their membership. We appreciate your support and are always looking for members to actively participate in THS activities and volunteer opportunities. It is a great way to be involved with the conservation of amphibians and reptiles in the Sonoran Desert.

Including the THS in your will is an excellent way to support the value of this organization and the conservation of the herpetofauna of the Sonoran Desert. We would like to recognize and thank anyone who has included the THS in their will. Please contact us so we can express our appreciation. For information about designating the THS in your will, please contact Ryan Perry, Treasurer, Tucson Herpetological Society, at *tucsonherps@gmail.com*.

What is Wild Apricot, Why is THS using it, and How can you use it?

The Board of Directors, Tucson Herpetological Society, Tucson, AZ; *tucsonherps@gmail.com*

Wild Apricot (WA) is a commercial data management service. We pay a fee and they take care of our data, our financial transactions, and our messaging. They use a payment system, AffiniPay, that is similar to PayPal but free to use for us as WA users.

We are using it because our former system for managing our data is broken and unfixable. With WA (after we make some corrections to data as we imported them) we will have a professionally managed system that we can trust. Using it will make the job of reporting on our member, non-member contact, and donation data accurate, precise and easy. If you are a member or have contacted THS in the past, you are in our contact database. We imported all of you into WA.

First you need to reply to the email you received and click the link to set a password for yourself. You should then check your information, add your address, and note if there are any errors. Email *tucsonherps@gmail.com* if you find anything wrong. Also email us if you did not receive or you lost the link and we will resend.

All Contacts will receive our general emails from WA and the link to our quarterly Newsletter-Journal, the *Sonoran Herpetologist*, which is an excellent publication on herpetological topics.

If you are a Member you will have access to all the past issues of the *Sonoran Herpetologist*. WA will automatically notify you when your membership is due for renewal. You have choices. You can renew at the same level or change your level. You can renew for one year at a time or select one of the auto-renew levels for a small discount (because we are grateful to you for making it easier for us all).

You can pay right away, online, by signing on to the WA payment system, which is very similar to PayPal (We are using it because using PayPal would result in additional charges to THS). It is entirely trustworthy.

If you do not pay right away the WA system will generate an invoice. Then you can return and pay the invoice online or print it out and mail us a check, in which case we will update your membership manually.

If your membership is already lapsed, you can renew it as per the instructions above. We will send out an email via WA to all lapsed members, asking them to renew. If you are a non-member Contact, we hope you will join as a member. If you want to make a donation, you can do that from our website or from WA. If you have a problem, email *tucsonherps@gmail.com* and we will help you. We can send you a hard copy form for memberships and donations to send by regular mail if you prefer.

Sonoran Herpetologist Natural History Observations

The Tucson Herpetological Society invites your contributions to our Natural History Notes section. We are particularly interested in photographs and descriptions of amphibians and reptiles involved in noteworthy or unusual behaviors in the field. Notes can feature information such as diet, predation, community structure, interspecific behavior, or unusual locations or habitat use. Please submit your observations to Howard Clark, *editor.sonoran.herp@gmail.com*. Submissions should be brief and in electronic form.

Local Research News

The *Sonoran Herpetologist* welcomes short reports on Local Research News in our journal. We are interested in articles that can update our readers on research about amphibians and reptiles in the Sonoran Desert region. These articles need be only a few paragraphs long and do not need to include data, specific localities, or other details. The emphasis should be on how science is being applied to herpetological questions. Please submit your materials to Howard Clark, *editor.sonoran.herp@gmail.com*. Submissions should be brief and in electronic form.

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For further information, please contact the editor at: *editor.sonoran.herp@gmail.com*

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Member's Meetings
We meet on the last Mon of every month at 7 PM with the exception of May, which is one week before Memorial Day, Nov, which is our annual meeting, and Dec when there's no meeting

Board of Directors Meetings
Quarterly as feasible, contact *tucsonherps@gmail.com* for more information

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Patrick Brown, *phhbrown@gmail.com*

Herpetological Information Hotline
Bob Brandner, (520) 760-0574

Jarchow Conservation Award
Don Swann

Sonoran Desert Toad Fund
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Publications:
Sonoran Herpetologist ("THS Newsletter", Feb '88 - Apr '90); Backyard Ponds brochure*; Living with Venomous Reptiles* brochure*; THS Herp Coloring Book; THS Collected Papers (1988-1991);* and *Native Plants for Desert Tortoises*

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