TURTLE SURVIVAL ALLIANCE

JULY 25 - 28, 2024

IUCN/SSC Tortoise and Freshwater Turtle Specialist Group

22ND ANNUAL SYMPOSIUM ON

THE CONSERVATION AND BIOLOGY OF TORTOISES AND FRESHWATER TURTLES

TUCSON, ARIZONA, USA 2024

2024 ANNUAL SYMPOSIUM SPONSORS

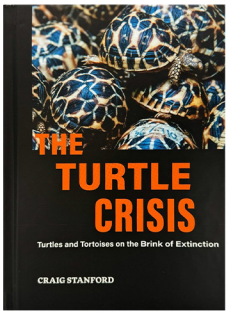
Arizona-Sonora Desert Museum	Visit Tucson	Patricia & Stuart Salenger Foundation	Anonymous	Tim Gregory	Loews Ventana Canyon	Dallas Zoo	Chelonian Research Foundation
Hatchling	*Bale*	*Protector*	*Guardian*	*Guardian*	*Bale*	*Hatchling*	*Awards*

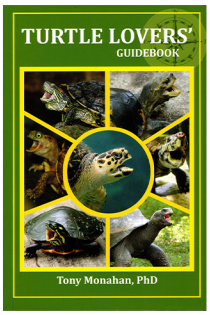
BEHLER AND PRITCHARD CONSERVATION AWARDS SPONSORS

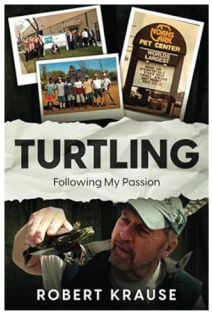
Turtle Survival Alliance, IUCN SSC Tortoise and Freshwater Turtle Specialist Group, Turtle Conservancy, Turtle Conservation Fund, Re:wild, Andrew Sabin Family Foundation, Chelonian Research Foundation, Surprise Spring Foundation, George Meyer and Maria Semple, Brett Stearns, Judith Behler Howells, and Deb Behler

2024 Symposium Highlights

Book Signings—Turtling: Following My Passion, Turtle Lover's Guidebook, and The Turtle Crisis







This year, we are thrilled to once again offer an exclusive book-signing event featuring longtime turtle champion Bob Krause, who will be signing copies of his book *Turtling: Following My Passion*, chelonian enthusiast Tony Monahan, who will be signing copies of *Turtle Lovers' Guidebook*, and renowned turtle conservationist Craig Stanford, who will be joining us to sign copies of his latest work, *The Turtle Crisis*.

We hope everyone enjoys the festivities that this year's venue and special event locations have to offer. Special thanks to the Loews Ventana Canyon Resort, Arizona-Sonora Desert Museum, Three Canyon Beer & Wine Garden, and Tucson Herpetological Society for helping us with the festivities!

Please join us in thanking *Guardian* sponsors Tim Gregory and Anonymous, *Protector* sponsor Patricia & Stuart Salenger Foundation, *Bale* sponsors Loews Ventana Canyon Resort and Visit Tucson, *Hatchling* sponsors Arizona-Sonora Desert Museum and Dallas Zoo, *Awards* sponsor Chelonian Research Foundation, *Travel Grant* sponsors Anders Rhodin, John Iverson, Kristin Berry, Reid Taylor, and SWCA Environmental Consultants, and *Vendors* Desert Tortoise Council, Holohil, Sonotronics, Tucson Herpetological Society, and Turtle Conservancy for helping make this year's symposium possible.

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Behler Award Honoree

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From the Program Committee: WELCOME TO THE SONORAN DESERT!

Dear Esteemed Guests and Colleagues,

It is with great pleasure and enthusiasm that we extend a warm welcome to each and every one of you.

We gather once more for the 22nd Annual Symposium on the Biology and Conservation of Tortoises and Freshwater Turtles, returning to our beloved destination, Tucson, Arizona, in the heart of the eastern Sonoran Desert. When people think of the desert, they often envision a vast, desolate landscape. Tucson is anything but. Nestled in the foothills of the majestic Santa Catalina Mountains, it is a haven of rich flora and fauna, boasting a rugged, captivating landscape, and stunning scenic views. And right here at our symposium venue, Loews Ventana Canyon Resort, you'll find yourself in the midst of an immersive desert adventure.

For herpetologists, there's no better time to be here than right now, during the summer monsoon. These annual rains breathe life into the desert, and the sweet, earthy fragrance of the creosote bush heralds a surge in herpetofaunal activity. Within a 100-mile radius of Tucson, one can encounter an astounding diversity of reptiles and amphibians—more than 130 species. The iconic Gila Monster, the highly venomous Mojave Green Rattlesnake, and, of course, turtles and tortoises of several species call Tucson home. Many can be spotted right here on the symposium venue grounds, such as along the Window Walk Nature Trail, creating a truly unique and exhilarating experience for us all.

For more than two decades, the Symposium stands as a testament to the enduring commitment and collective efforts of individuals who recognize the significance of protecting all chelonian species and their native environments. The Annual Symposium provides a vital opportunity for dedicated conservationists to gather, share insights, and rejuvenate their spirits. It serves as a hub where individuals who tirelessly work towards conservation goals can connect, exchange innovative ideas, and draw inspiration from each other's successes and challenges. In this collaborative environment, we hope you will find renewed energy and motivation, reaffirming your commitment to protecting our planet's chelonian diversity and their habitats.

This year, we're proud to bring you 130 unique presentations representing 26 countries from around the world. Along with featured plenary sessions, topics include the continents of Africa, Asia, Australia, Europe, and North and South America, Kinosternids, Western Pond Turtles, *Gopherus* tortoises, Technology, Health and Welfare, Environmental Variables, and the Great Lakes Region. Furthermore, this gathering provides an exceptional venue for which to further one's skills of information dissemination. With this in consideration, we are excited to have Dr. Jeffrey Seminoff from the NOAA Southwest Fisheries Science Center lead a workshop on the intricacies of writing a scientific paper, an all-too-valuable skill for many in our global community.

As in the previous 21 years, we are eager to continue offering the Annual Symposium experience to our global community. However, this unique gathering would not be possible without the support of many individuals and organizations. Please join us in thanking our sponsors for their generous symposium support, in alphabetical order: Anders Rhodin, Arizona-Sonora Desert Museum, Chelonian Research Foundation, Dallas Zoo, Desert Tortoise Council, Holohil, John Iverson, Kristen Berry, Loews Ventana Canyon Resort, Patricia & Stuart Salenger Foundation, Reid Park Zoo, Reid Taylor, Sonotronics, SWCA Environmental Consultants, Tim Gregory, Tucson Herpetological Society, Turtle Conservancy, Ventana Canyon Club and Lodge, Visit Tucson, and an anonymous donor.

Together, let us embark on a transformative experience as we work towards a future of zero turtle extinctions.

Sincerely,

Jordan Gray
Co-chair
External Relations Manager
Turtle Survival Alliance

Chelsea Rinn
Co-chair
Development Manager
Turtle Survival Alliance

Andrew Walde
Co-chair
Director of Conservation and Science
Turtle Survival Alliance

From the Hosts: WELCOME TO THE 22nd ANNUAL SYMPOSIUM!

Dear Symposium Participants,

Welcome to the 22nd Annual Symposium on the Biology and Conservation of Tortoises and Freshwater Turtles! We are delighted to have you join us for this dynamic gathering of conservation enthusiasts.

This symposium presents a unique opportunity for us to come together, share our research findings, exchange ideas, and build connections with experts and newcomers from across the globe. By integrating diverse perspectives and expertise, we aspire to inspire innovative approaches and collaborative efforts to address the critical challenges faced by turtles and tortoises. We encourage you to take full advantage of networking opportunities and engage in discussions with fellow participants as you stroll the beautiful paths of the Arizona-Sonora Desert Museum during the field trip, at the icebreaker social on the Cascade Terrace at the Loews Ventana Canyon Resort, during the Drink Beer. Save Turtles.© event at Three Canyon Beer and Wine Garden, and session breaks.

Our Program Committee has curated an exceptional lineup of speakers who are esteemed authorities in their fields, ensuring exposure to cutting-edge research and conservation strategies. Highlights include Brad Shaffer's presentation on "The Turtle Conservation Genomics Project" and Flora Ihlow's insights into "Using Camera Traps to Determine Activity Patterns and Burrow Use in Speke's Hinge-back Tortoise." Don't miss the featured keynote address, "Building Synergies Across the Turtle Spectrum: Perspectives From a Sea Turtle Lifer," by renowned marine turtle conservationist Jeffrey Seminoff, who will also lead a workshop on scientific paper writing. Additionally, we are excited to offer a book-signing event featuring authors Bob Krause (*Turtling: Following My Passion*), Tony Monahan (*Turtle Lovers' Guidebook*), and Craig Stanford (*The Turtle Crisis*). We're confident that you'll want to seize this exceptional opportunity and include a copy of each of these newly autographed books in your collection.

Turtle Survival Alliance and the IUCN SSC Tortoise and Freshwater Turtle Specialist Group are dedicated to fostering an inclusive environment where all participants feel welcome and safe to contribute to our collective understanding of turtle conservation. Through initiatives like our Travel Grants program and virtual participation options, we strive to enhance diversity and inclusivity, particularly for women, students, and individuals from developing countries and underserved communities. We hope you enjoy the broad array of perspectives brought to the Annual Symposium through the 130 unique presentations representing 26 countries from around the world.

As co-hosts, it is our goal to facilitate an enriching and enjoyable experience for all attendees. Should you have any questions or require assistance, our dedicated team members will be available throughout the symposium to provide support. We want to ensure that your experience is both enriching and enjoyable. All of this would not be possible without the hard work and dedication of Turtle Survival Alliance contributors. We extend our heartfelt thanks to President and CEO Marc Dupuis-Desormeaux, the Program Committee of Jordan Gray, Chelsea Rinn, and Andrew Walde for their leadership in organizing this event, as well as to the Turtle Survival Alliance staff of Kirstyn Caldwell, Clinton Doak, Finn Dooley, Elena Duran, AJ Fetterman, Cris Hagen, Heather Lambert, Ratri Lerluksamipun, Makayla Peppin-Sherwood, and Nita Yawn, and Board of Directors member Cristina Jones for supporting logistics and whose hard work and dedication have made this symposium possible.

Welcome once again to the 22nd Annual Symposium on the Biology and Conservation of Tortoises and Freshwater Turtles.

Sincerely,

Patricia Koval, Chair of the Board, Turtle Survival Alliance
Craig Stanford, Chair, IUCN SSC Tortoise and Freshwater Turtle Specialist Group

Behler and Pritchard Turtle Conservation Awards 2024

This year the 19th annual Behler Turtle Conservation Award celebrates and honors **Jeff Lovich**. Jeff is a Research Ecologist with the U.S. Geological Survey, Southwest Biological Science Center in Flagstaff, Arizona. Raised in Virginia, he attended George Mason University, where he met Carl Ernst and started studying turtles, earning an M.S. in biology with Carl as his major advisor. He then attended the University of Georgia for a Ph.D., where he was mentored by Whit Gibbons and Justin Congdon at the Savannah River Ecology Laboratory, working on the causes and consequences of sexual size dimorphism in turtles. Subsequently, Jeff wrote two editions of books on turtles of the United States and Canada with Carl, and a recent book on turtles of the world with Whit.

Jeff has been publishing the results of research on the ecology and taxonomy of turtles and other wildlife for 40 years, resulting in over 200 scientific publications and five books. Along the way he described and named four turtle taxa, including three in the US and one in Japan. Most of his research is in the Mojave and Sonoran deserts of California where he has worked for over 30 years. He is a Fulbright Scholar and an elected Fellow of the Linnean Society of London, the world's oldest active biological society. Jeff has been one of the editors of *Chelonian Conservation and Biology* for over 10 years. His continuing research focuses on all aspects of turtle ecology, and the impacts of utility-scale wind and solar energy development on wildlife, especially desert tortoises. Jeff is a well-respected member of our global chelonian conservation and biology community and highly deserving of the Behler Turtle Conservation Award, and we are pleased to finally honor him with this major award at this time.

We also honor four Pritchard Turtle Conservation Lifetime Achievement Awardees this year, all for their outstanding longterm contributions to turtle conservation and biology: **Pat Koval** for her key impact on the development, growth, and governance of the TSA, notably her instrumental support of the Turtle Survival Center, while also being a longterm active champion of global wildlife conservation efforts with other organizations; **Herilala Randriamahazo** for his longterm conservation efforts focused on Radiated Tortoises and heading up the TSA program in Madagascar; **Elliott Jacobson** for his outstanding herpetological veterinary expertise, research, and many reptile publications, notably on turtles and tortoises, and mentoring many herpetological veterinarians; and **Terry Graham** for his longterm ecological studies on New England turtles, notably his early research and efforts to safeguard the Plymouth Red-bellied Turtle population in Massachusetts with an innovative headstarting program and promotion of its federal protection. We thank all of you for your lifetime dedication, perseverance, and achievement in making a major difference for turtles.

We also remember and honor **Mehmet Atatür** of Turkey, who passed recently, with a Posthumous Turtle Conservation Appreciation Award for his longterm conservation work and seminal publications on Turkey's chelonians.

The IUCN SSC Tortoise and Freshwater Turtle Specialist Group and Turtle Survival Alliance are joined by the Turtle Conservancy and the Turtle Conservation Fund as co-presenters of the Behler and Pritchard awards, bringing together four turtle conservation organizations closely tied to both John Behler's and Peter Pritchard's legacies. Additional support for the Behler Award and its honorarium is also gratefully received from the following generous co-sponsors: Re:wild, Andrew Sabin Family Foundation, Chelonian Research Foundation, Surprise Spring Foundation, George Meyer, Brett Stearns, Judith Behler Howells, and Deb Behler.

Congratulations, Jeff, Pat, Herilala, Elliott, and Terry, and thank you all for your major efforts on behalf of turtles and their conservation—your recognition as Behler and Pritchard Honorees is most highly deserved!

Anders G.J. Rhodin, Rick Hudson, Vivian Páez, Peter Paul van Dijk, and Andrew Walde
Co-Chairs and Vice-Chairs, Behler Turtle Conservation Award Committee

T-shirt Design!

Please join us in thanking Turtle Survival Alliance's **Jordan Gray** for designing our T-shirt for the 22nd Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. This year's design features an artistic rendition of the endangered Asian Spiny Turtle (*Heosemys spinosa*).

Photo Policy

Photographers will be taking pictures at the conference, which may be used for promotional and educational purposes. Registration or participation in the meeting and other activities constitutes an agreement to allow Turtle Survival Alliance to use and distribute attendees' image or voice in photographs and recordings of the meeting—now and in the future.

TURTLE SURVIVAL ALLIANCE SYMPOSIUM
CODE OF CONDUCT
07/08/2024

BACKGROUND

From time to time, The Turtle Survival Alliance Foundation (Turtle Survival Alliance) organizes events to which employees, members, volunteers, and/or members of the public may be invited or admitted. Some events have a wholly educational or a research purpose, while others are primarily fundraising events, and still others have a social purpose. Some events have multiple purposes which may include one or more of the foregoing. Participants may (or may not) be required to pay to attend these events and may have the opportunity to purchase food, beverages or merchandise at the events. In some cases, events may take place at the Turtle Survival Center or in premises rented, licensed or otherwise made available to Turtle Survival Alliance for the event, or owned, rented or licensed by one or more of its directors, officers, employees, independent contractors, or volunteers. In still other cases, events may take place on virtual platforms owned or licensed by Turtle Survival Alliance.

INTRODUCTION

Turtle Survival Alliance is committed to providing a safe, productive, and welcoming environment for all attendees and participants at events, both in-person events and on virtual platforms. Individuals attending Turtle Survival Alliance events have the right to an environment free from discrimination, bullying, inappropriate behavior, and harassment, including but not limited to sexual, sexual identity or racial/ethnic harassment. These behaviors will not be tolerated. **Each participant or attendee at a Turtle Survival Alliance event who registers for, or acquires a ticket to attend, the event must agree, as a condition of participation or attendance, to abide by the terms of this Code of Conduct (Event Code). Participants and attendees at any Turtle Survival Alliance event which does not require registration or ticket (with or without charge) are nevertheless expected to abide by the terms of this Code at those events.** A separate Symposium Code of Conduct (Symposium Code) applies to the Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles organized or co-organized by Turtle Survival Alliance.

Anyone who has violated the Event Code or the Symposium Code of Conduct in the past or who is violating the Event Code may be denied access to, or removed immediately from, a Turtle Survival Alliance event, without repayment of any registration, attendance or other fee of any kind previously paid.

A violation of the Event Code may also constitute a violation of Turtle Survival Alliance's Code of Ethics.

EXPECTED CONDUCT:

Participants or attendees at Turtle Survival Alliance events are expected to:

- Treat everyone with respect and consideration. At any event with an educational, outreach, or research purpose, respect diversity of views, opinions, and cultural practices, and communicate thoughtfully with others.
- Be mindful and aware of your surroundings and sensitive to the experience of fellowparticipants and attendees.
- Ask before initiating physical contact with any other attendee or participant.
- Engage in friendly, consensual interactions among individuals and avoid potentially non-consensual physical contact with others.
- At events where alcoholic beverages are available, drink responsibly.
- Alert any director, officer or employee of Turtle Survival Alliance who is present at the event if you notice a situation at the event that violates this Code or if you see someone in distress. If you believe that the conduct is, or could be, criminal in nature, please contact local law enforcement or ask a Turtle Survival Alliance director, officer or employee present at the event to make that contact.
- Comply with all applicable laws, including wildlife protection laws.

- Respect the rules, policies, and property of the venue, whether a private home or public venue, and regardless of who it is owned or rented by.
- Look out for the safety and comfort of your friends and colleagues.

UNACCEPTABLE CONDUCT

Turtle Survival Alliance has zero tolerance for any form of discrimination, objectification, bullying or harassment, including without limitation sexual, sexual identity, and racial/ethnic harassment.

Behavior that is acceptable to one person may not be acceptable to another, so participants and attendees at Turtle Survival Alliance events must use discretion to ensure that their words and actions communicate respect for others.

Consumption of alcohol or use of other potentially behavior-altering substances is not an excuse for engaging in unacceptable conduct.

Participation in, or facilitation or promotion of, harassment, intimidation, or discriminatorybehaviors at an event, in person, or on virtual platforms, or on social media associated with a Turtle Survival Alliance event or other associated activities will not be tolerated. Turtle Survival Alliance reserves the right to take any action deemed necessary and appropriate, including the immediate removal or blocking of individuals from virtual or social media platforms and the deletion of comments from the same, if comments or behavior are deemed to be unacceptable.

Unacceptable conduct includes harassment, as described below, as well as, but not limited to:

- Physical, emotional, verbal abuse or threats against any participant or attendee, including any Turtle Survival Alliance director, officer, employee, or volunteer, service provider or guest.
- Disruption of a Turtle Survival Alliance event or its associated activities.
- Public sharing of sensitive locality data which might create risk to those sites from illegal harvesting.
- Publicly sharing the location or contact information of any other participant beyond information shared publicly in event materials.
- Making discriminatory comments.

HARASSMENT

Sexual harassment is unacceptable conduct of a sexual nature that makes a person feel uncomfortable. Harassment, including sexual, sexual identity or racial/ethnic harassment, may also violate applicable laws. Examples of behavior constituting sexual harassment include, but are not limited to:

Verbal Conduct

- Comments, jokes or insults based on appearance, age, private life, etc.
- Sexual comments, stories, or jokes.
- Unwelcome sexual advances.
- Repeated and unwanted invitations for dates or physical intimacy.
- Condescending or sexist remarks.

Non-verbal Conduct

- Display of sexually explicit or suggestive material or images.
- Sexually suggestive gestures.
- Whistling or “cat calling”.
- Unwelcome physical contact or inappropriate touching.
- Physical violence, including sexual assault.
- The use of threats or rewards to solicit sexual favors.

- Sending sexually explicit messages electronically or by phone.

RESPONSIBLE DRINKING

At some events, alcoholic beverages may be purchased, served or otherwise made available. Turtle Survival Alliance expects individuals to drink responsibly while also upholding the standards described in this Event Code. Turtle Survival Alliance and the owner or staff of any event venue have the right to deny service to participants and may require a participant or attendee to leave an event. It is expected that responsible drinking will extend beyond events.

REPORTING UNACCEPTABLE CONDUCT

If you have been the victim of an actual or possible violation of this Event Code or have observed an actual or suspected violation in connection with another person, you should report this. **If you see something, say something.** Violations of this Event Code should be reported at the Turtle Survival Alliance event at which they occur, or otherwise as soon as possible thereafter If you do not report a violation or suspected violation of this Code to law enforcement, or to a Turtle Survival Alliance director, officer, or employee present at the event, or to on-site security personnel at the event, you may report it to Turtle Survival Alliance's President and Chief Executive Officer (at ceo@turtlesurvival.org) or to the Chair(s) of TSA's Equity, Diversity, and Inclusion Committee (at EDIChair@turtlesurvival.org) or to any other Turtle Survival Alliance director, officer, or employee. The Turtle Survival Alliance representative who receives the report of the complaint or concern has the responsibility to ensure that it is investigated.

If you believe that the violation or suspected violation has been committed by someone who is a Turtle Survival Alliance director, officer or employee, you may also file a complaint under the Whistleblower Policy of Turtle Survival Alliance available on its website.

If you report a violation or suspected violation of this Event Code, you must be acting in good faith and have reasonable grounds for believing the information disclosed indicates a violation of the Event Code. Any allegation made with a malicious intent or which is knowingly false will itself be viewed as an Event Code violation.

If you report a violation or suspected violation verbally, you may later be requested to provide details in writing. Any report should include the pertinent information needed to investigate the violation (including date, time, misconduct observed, name of the person accused, names of others who may have witnessed the misconduct, and any visual or audio evidence of the violation). Reports of violations or suspected violations will be kept confidential to the extent possible, consistent with the need to conduct an adequate investigation or to the extent allowed by law. All complaints will be treated seriously.

Turtle Survival Alliance will employ a "Two Strikes" policy for most Code violations depending on the severity of the offense. Individuals will receive a verbal and/or written warning as described below for a first violation. Following the second violation, more severe consequences may be levied. **An exception to this Two Strikes policy will be made when an egregious violation occurs (including, but not limited to, one that requires intervention by venue security or law enforcement).** In such instances Turtle Survival Alliance may proceed directly to Removal, Rescission, or Barring Participation.

Two Strike Policy:

Strike 1: Warning

- Anyone requested to stop unacceptable behavior is expected to comply immediately; this strike will be considered a first "strike" warning.
- A person who has engaged in unacceptable behavior may be warned of an alleged or actual Event Code violation at any time during the event, or afterwards based on the timing of reporting and opportunity for an appropriate investigation.

Strike 2: Removal, Rescission, or Barring Participation

Upon egregious violation or following a second incident of unacceptable behavior which constitutes a violation (i.e. the second "strike"), authorized officers or employees of Turtle Survival Alliance or venue security may take any action which, in their discretion, is deemed necessary and appropriate, including immediate removal of the violator from the event without warning or refund of any amounts paid to attend the event or associated activities. Turtle Survival Alliance reserves the right to:

- Prohibit attendance by the violator at any future Turtle Survival Alliance event or Turtle Survival Alliance co-organized event, as well as at, or in, any TurtleSurvival Alliance working group or other Turtle Survival Alliance-related activity.
- Deny consideration of the violator for any award, endorsement, leadership role, or project assignment associated with Turtle Survival Alliance.

PERSONAL SAFETY

As an attendee or participant at a Turtle Survival Alliance event, you should:

- Be aware of your surroundings at all times.
- Do not leave personal property unattended anywhere, any time.

If you are presenting…

Presenters, please plan on turning in your talk no later than the day **BEFORE** you present. No exceptions or last minute edits, please. To upload your talk online, please visit https://bit.ly/TSA2024_Presentations. Files should be named as Time_Day_LastName (ex: 1300_Fri_Smith). If that is not possible, talks will be accepted at the **Registration Desk** during the following times:

- July 24 – 3:00 PM – 6:00 PM
- July 25 – 2:00 PM – 5:30 PM
- July 26 – 7:00 AM – 4:00 PM
- July 27 – 8:00 AM – 4:00 PM

Contents of this Conference Program should be cited as:

Author. 2024. **Title**. In J. Gray, C. Rinn, and A.D. Walde (Eds.). Program and Abstracts of the Twenty-second Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. Turtle Survival Alliance, Tucson, Arizona, USA. pp. *xx–xx*.

Please visit the vendors, sponsors, and non-profits in the Ballroom Foyer:

- Desert Tortoise Council
- Holohil Systems
- Sonotronics
- Tucson Herpetological Society
- Turtle Conservancy
- Turtle Survival Alliance

Conference Notes and Social Activities

Wednesday, July 24

• TSA Board Meeting	9:00 AM – 5:00 PM (Executive Boardroom) (*Closed*)
• Registration	3:00 PM – 6:00 PM (Registration Desk – Tortolita Room)
• Auction Item Drop Off	3:00 PM – 6:00 PM (Registration Desk – Tortolita Room)

Thursday, July 25

• Arizona-Sonora Desert Museum Field Trip	8:00 AM – 1:00 PM (First bus departs at 07:30 AM)
• Registration	2:00 PM – 5:30 PM (Registration Desk – Tortolita Room)
• Auction Item Drop Off	2:00 PM – 5:30 PM (Registration Desk – Tortolita Room)
• Vendor Set up	2:00 PM – 5:30 PM (Catalina Ballroom)
• Workshop	3:00 PM – 4:45 PM (Salon H/I)
• TCF Board Meeting	3:00 PM – 4:45 PM (Executive Boardroom) (*Closed*)
• Poster Hanging	3:30 PM – 5:30 PM (Grand Ballroom Foyer)
• Icebreaker	6:30 PM – 8:30 PM (Cascade Terrace)

Friday, July 26

• Registration	7:00 AM – 4:00 PM (Registration Desk – Tortolita Room)
• Auction Item Drop Off	7:00 AM – 12:00 PM (Registration Desk – Tortolita Room)
• Exhibit Hall Open	7:00 AM – 4:00 PM (Catalina Ballroom)
• Poster Viewing	8:30 AM – 6:00 PM (Grand Ballroom Foyer)
• TFTSG Steering Committee	12:00 PM – 1:15 PM (Executive Boardroom) *(Closed)*
• Silent Auction Opens	1:00 PM (Catalina Ballroom)
• Drink Beer. Save Turtles.®	6:00 PM – 9:00 PM (Three Canyon Beer and Wine Garden)

Saturday, July 27

- Registration — 8:00 AM – 4:00 PM (Registration Desk – Tortolita Room)
- Exhibit Hall — 8:00 AM – 5:45 PM (Catalina Ballroom)
- Poster Viewing — 8:00 AM – 4:00 PM (Catalina Ballroom)
- Silent Auction #1 Closes — 4:00 PM (Catalina Ballroom)
- Poster Session & Book Signings — 4:00 PM – 6:00 PM (Grand Ballroom Foyer)
- Genomics Project Q&A / Discussion — 4:30 PM – 6:30 PM (Presidential Suite)
- IUCN Red List Meeting — 6:30 – 8:30 PM (Executive Boardroom) *(Closed)*

Sunday, July 28

- Registration — 8:00 AM – 1:00 PM (Registration Desk – Tortolita Room)
- Exhibit Hall Open — 8:00 AM – 4:00 PM (Catalina Ballroom) ***Please note*** *– This is your last chance to purchase a commemorative T-shirt or other conference souvenir!*
- Poster Viewing — 8:00 AM – 12:00 PM (Catalina Ballroom)
- Silent Auction #2 Closes — 12:00 PM (Catalina Ballroom)
- Poster/Vendors Breakdown — 12:00-1:00 PM (Authors, please take down your posters at this time. Any posters left behind will be discarded.)
- Auction Payment / Pick-up — 4:00 PM – 6:00 PM (Registration Desk – Tortolita Room)
- Cocktail Reception — 6:00 PM – 7:00 PM (Grand Ballroom Foyer)
- Awards Banquet — 7:00 PM – 9:30 PM (Ballrooms B/C)

Auction Notes

The silent auction is always a fun part of the Annual Symposium, plus it generates funds to help support Turtle Survival Alliance's conservation programs and projects. The silent auction will take place Friday - Sunday in the Exhibit Hall (Catalina Ballroom), in two segments.

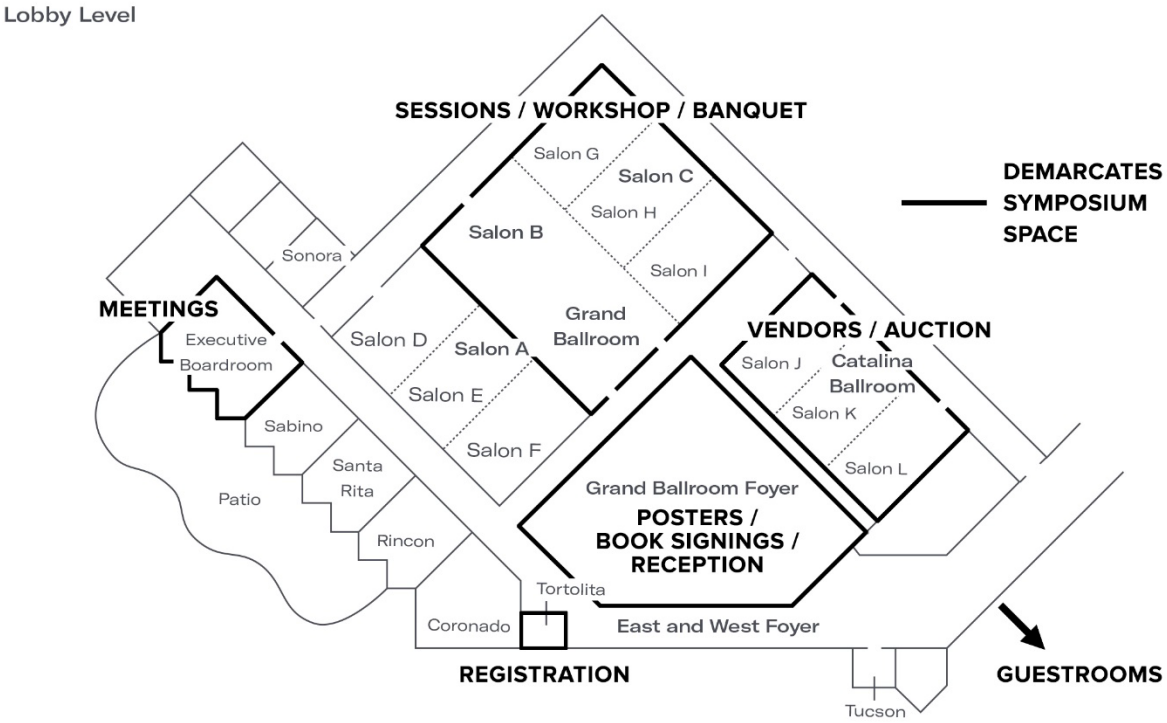
Thanks to all of you who have items that you are donating to this cause. If you were not able to complete the auction form online prior to your arrival, you can do so at the auction drop-off table beside registration. Please note: no auction items can be accepted without completing this process! Auction items will be accepted from 4:00-7:00 PM on Wednesday, 2:00 PM-5:30 PM on Thursday, and 7:00 AM-1:00 PM on Friday. **It is very important that you get your items turned in during this time!** This will allow our volunteers enough time to catalog each donation and make sure that everything runs smoothly.

Social Media

Stay up to date on the latest in turtle conservation news by following us on social media.

Facebook / X / Instagram / LinkedIn @TurtleSurvival

Join the conversation! Use #TSA2024 when you post about the meeting or to follow along!


Lobby Level
SESSIONS / WORKSHOP / BANQUET
Salon G
Salon C
Salon H
Salon B
Salon I
DEMARCATES SYMPOSIUM SPACE
Sonora
MEETINGS
Executive Boardroom
Salon D
Salon A
Grand Ballroom
VENDORS / AUCTION
Salon J
Catalina Ballroom
Salon K
Salon E
Salon F
Salon L
Sabino
Santa Rita
Patio
Grand Ballroom Foyer
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Rincon
Tortolita
Coronado
East and West Foyer
REGISTRATION
GUESTROOMS
Tucson

Conference Schedule Overview

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<tr><td>8:00</td><td rowspan="12"></td><td rowspan="2"></td><td rowspan="6"><u>Arizona-Sonora Desert Museum Field Trip</u>

<u>Departs at 7:30 am</u>
<u>Be in the lobby ready to load at 7:15</u></td><td>Opening Address and Welcome</td></tr>
<tr><td>8:15</td><td>TFTSG</td></tr>
<tr><td>8:30</td><td>Building Synergies Across the Turtle Spectrum: Perspectives From a Sea Turtle Lifer</td></tr>
<tr><td>9:15</td><td rowspan="9"><u>TSA Board</u>
<u>(Closed)</u></td><td>The Turtle Conservation Genomics Project</td></tr>
<tr><td>10:00</td><td>Break/Posters</td></tr>
<tr><td>10:15</td><td rowspan="8">Plenary Talks</td></tr>
<tr><td>10:30</td></tr>
<tr><td>10:45</td></tr>
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<tr><td>11:45</td></tr>
<tr><td>12:00</td><td></td><td>Lunch</td><td></td><td>Lunch</td></tr>
<tr><td>13:15</td><td rowspan="6"></td><td rowspan="6"><u>TSA Board</u>
<u>(Closed)</u></td><td colspan="2"><u>Field Trip Returns to Hotel</u></td><td rowspan="3">Plenary Talks</td></tr>
<tr><td>13:45</td><td colspan="2" rowspan="5"></td></tr>
<tr><td>14:00</td></tr>
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<tr><td>14:30</td></tr>
<tr><td>14:45</td><td>Break/Posters</td></tr>
<tr><td>15:00</td><td rowspan="9"></td><td rowspan="9"><u>Registration In Lobby (15:00-18:00)</u></td><td rowspan="4"><u>Turtle Conservation Fund Board</u>

(15:00-16:45)</td><td rowspan="4"><u>Workshop</u>

How to Write a Scientific Paper

Jeffrey Seminoff
(15:00-16:45)</td><td rowspan="4">Plenary Talks</td></tr>
<tr><td>15:15</td></tr>
<tr><td>15:30</td></tr>
<tr><td>15:45</td></tr>
<tr><td>16:00</td><td rowspan="4">Free</td></tr>
<tr><td>16:30</td></tr>
<tr><td>16:45</td></tr>
<tr><td>17:45</td><td colspan="2" rowspan="3"><u>Icebreaker Social</u>
Loews Ventana Canyon Resort
(18:30-20:30)</td></tr>
<tr><td>18:00</td><td rowspan="3"><u>Drink Beer. Save Turtles.®</u>
Three Canyon Beer and Wine Garden
(18:00-21:00)</td></tr>
<tr><td>18:30</td><td rowspan="2"></td><td rowspan="2"></td></tr>
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Conference Schedule Overview

<table>
<tr><th></th><th colspan="2">Saturday
July 27</th><th colspan="2">Sunday
July 28</th></tr>
<tr><td>8:30</td><td colspan="2">Morning Announcements</td><td colspan="2">Morning Announcements</td></tr>
<tr><td>8:45</td><td rowspan="6">Kinosternids</td><td rowspan="6">Africa and Europe</td><td rowspan="6">Asia and Australia</td><td rowspan="6">Indian Subcontinent</td></tr>
<tr><td>9:00</td></tr>
<tr><td>9:15</td></tr>
<tr><td>9:30</td></tr>
<tr><td>9:45</td></tr>
<tr><td>10:00</td></tr>
<tr><td>10:15</td><td colspan="2">Break/Posters</td><td colspan="2">Break/Posters</td></tr>
<tr><td>10:30</td><td rowspan="3">Kinosternids</td><td rowspan="6">Turtle Tech</td><td rowspan="6">Western Pond Turtles</td><td rowspan="6">Great Lakes!</td></tr>
<tr><td>10:45</td></tr>
<tr><td>11:00</td></tr>
<tr><td>11:15</td><td rowspan="3">Terrapene</td></tr>
<tr><td>11:30</td></tr>
<tr><td>11:45</td></tr>
<tr><td>12:00</td><td colspan="2">Lunch</td><td colspan="2">Lunch</td></tr>
<tr><td>13:15</td><td rowspan="5">North America</td><td rowspan="5">South America</td><td rowspan="5">Gopherus</td><td rowspan="5">Environmental Variables</td></tr>
<tr><td>13:30</td></tr>
<tr><td>13:45</td></tr>
<tr><td>14:00</td></tr>
<tr><td>14:15</td></tr>
<tr><td>14:30</td><td colspan="2">Break/Posters</td><td colspan="2">Break/Posters</td></tr>
<tr><td>14:45</td><td rowspan="5">Health & Wellness</td><td rowspan="5">South America</td><td rowspan="5">Natural History</td><td rowspan="5">Pursuit of Knowledge</td></tr>
<tr><td>15:00</td></tr>
<tr><td>15:15</td></tr>
<tr><td>15:30</td></tr>
<tr><td>15:45</td></tr>
<tr><td>16:00</td><td colspan="2" rowspan="2">Poster Session and Book Signings</td><td colspan="2"></td></tr>
<tr><td>17:00</td><td colspan="2" rowspan="2">Reception and Awards Banquet</td></tr>
<tr><td>18:00</td><td colspan="2">Turtle Genomics Project Q&A / Discussion</td></tr>
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Daily Schedule				
	Wednesday July 24	**Thursday July 25**		**Friday July 26**
	Executive Boardroom			**Salon B/C** Chair: Jordan Gray
8:00				Turtle Survival Alliance - Opening Address and Global Update MARC DUPUIS-DESORMEAUX
8:15				TFTSG - Update CRAIG STANFORD
8:30	**TSA Board** **(9:00 - 17:00)** **(Closed)**			***Keynote Address:*** Building Synergies Across the Turtle Spectrum: Perspectives From a Sea Turtle Lifer JEFFREY SEMINOFF
9:15				***Featured Presentation:*** The Turtle Conservation Genomics Project BRAD SHAFFER
10:00		**Arizona-Sonora Desert Museum Field Trip** **Departs at 7:30 a.m.** **Be in the lobby ready to load at 7:15 a.m.**		***Break & Posters***
10:15				Myanmar Program Update: Conservation in the Midst of a Civil War STEVEN PLATT
10:30				Saving Belize's Turtles: Developing a Culture of Conservation and Leadership for Young Professionals HEATHER BARRETT
10:45				Insights Into the Reintroduction Ecology of the Elongated Tortoise in Cambodia CHRISTEL GRIFFIOEN
11:00				A 33-Year Journey: The Return of Alligator Snapping Turtles to Their Former Range in Kansas DAREN RIEDLE
11:15	**TSA Board** **(9:00 - 17:00)** **(Closed)**			Gopher Tortoise Research and Management at an Urban Nature Preserve in Central Florida GEORGE HEINRICH
11:30				***Featured Presentation:*** Celebrating Ten Years at the Hicatee Conservation and Research Center in Belize BARNEY HALL
12:00	**Lunch**			***Lunch 12:00 - 13:15***
13:15	**TSA Board** **(9:00 - 17:00)** **(Closed)**			***Featured Presentation:*** Evolving Questions and Views On How Growth Influences Life-History Trait Values of Turtles JUSTIN CONGDON
13:45				Recovery of Geometric Tortoise Populations From Fire Through Hatchling Harvesting and Headstarting JAMES JUVIK
14:00				How Many is Too Many? Understanding Aldabra Giant Tortoise Density in Rewilding Projects RICH BAXTER
14:15				What Does the Turtle Say? The Role of Vocal Communication in the Life of Turtles GABRIEL JORGEWICH-COHEN
14:30				***Break & Posters***
14:45				***Featured Presentation:*** Growth in Tortoises and Freshwater Turtles: What We Know and Where to Go MICHAEL DRESLIK
15:15		**Turtle Conservation Fund Board** **(15:00-16:45)**	**Workshop** **How to Write a Scientific Paper** Jeffrey Seminoff **(15:00-16:45)**	Expanding Community-Based Tortoise Rewilding Effort in Bangladesh SCOTT TRAGESER
15:30				Two Years of Monitoring the First 1,000 Reintroduced Radiated Tortoises LANCE PADEN
15:45	**TSA Board** **(9:00 - 17:00)** **(Closed)**			***Featured Presentation:*** Turtles as Predators and Prey of Birds J SEAN DOODY
16:15				Flippin' Turtles Reloaded! BEN ANDERS
18:00		**Icebreaker Social** **Loews Ventana Canyon Resort** **(18:30-20:30)**		**Drink Beer. Save Turtles.®** **Three Canyon Beer and Wine Garden** **(18:00-21:00)**

Daily Schedule		
	Saturday July 27 – Salon B	**Saturday July 27 – Salon C**
8:30	**Morning Announcements**	**Morning Announcements**
	Kinosternids Chair: Lauren Augustine	***Travel Abroad (Africa and Europe)*** Chair: Anne-Sophie Le Gal
8:45	Preliminary Investigations Into the Range and Population Dynamics of Kinosternids in Northern Guatemala LAUREN AUGUSTINE	Assessment of Hunting and Trade and the Conservation of Freshwater Turtles in the Volta Basin of Ghana HARUNA ACHERIGA SUMAILA*
9:00	Diversity and Diversification in Mud Turtles, an American Tale JUAN PABLO HURTADO*	Southern Madagascar Tortoise Poaching Dynamics TSANTA RAKOTANANAHARY
9:15	Clarifying the Murky Evolutionary History of Southeastern Mud Turtles Using a Phylogenomic Approach GROVER BROWN	The Mediterranean Subpopulation of the Nile Soft-shelled Turtle – From Genomics to Conservation Strategy YARON TIKOCHINSKI
9:30	Survivorship and Home Range of Reintroduced Kinosternid Turtles JORDAN DONINI	Anthropogenic Threats Change the Relationship Between Endobiont Nematodes and Spur-Thighed Tortoises ANDRÉS RAMOS*
9:45	Reproductive Cycles and Movements of Northern Giant Musk Turtles LARISSA SAAREL*	The Mediterranean Pond Turtle Shows Resilience to Extreme Flood Events ANNE-SOPHIE LE GAL
10:00	Evaluating the Conservation Status of the Pacific Coast Musk Turtle EDUARDO REYES GRAJALES*	Igniting Pancake Tortoise Awareness and Recovery Path in Kenya DOMINIC MARINGA
10:15	***Break & Posters***	***Break & Posters***
	Kinosternids cont. Chair: Lauren Augustine	***Turtle Tech*** Chair: Scott Trageser
10:30	Tough Crap: The Diet of the Durophagus Northern Giant Musk Turtle THOMAS ZAPLETAL*	Use of Aerial Drones and AI to Locate Bolson Tortoises and TBurrows ROSS KIESTER
10:45	Aestivation and Its Relationship With the Distribution Area of Kinosternidae Turtles RAUL LÓPEZ*	Using Camera Traps to Determine Activity Patterns and Burrow Use in Speke's Hinge-back Tortoise FLORA IHLOW
11:00	Life History and Ecology of Mud Turtles From the N.A. Deserts RODRIGO MACIP-RIOS	Using Time Lapse Photography to Monitor Alligator Snapping Turtles PATRICK DELISLE*
	Terrapene Chair: Jordan Donini	***Turtle Tech cont.*** Chair: Scott Trageser
11:15	Evaluating Translocation Strategies for Box Turtles in Urbanizing Landscapes ELIZABETH HAYS*	Revolutionizing Taxonomy and Education: The Impact of Noninvasive 3D Scanning Technology on Endangered Species Preservation SCOTT TRAGESER
11:30	Post-release Growth, Survival, and Movement of Captive-Reared Eastern Box Turtles Near the Northern Limit of Their Range CARA MCELROY	Assessing Española Giant Tortoise Introduction Impact on Santa Fe Island With Remote Sensing and Behavioral Models CHARLES LEHNEN*
11:45	Eastern Box Turtle Monitoring at the Nashville Zoo KATIE GREGORY	Nocturnal Basking in Aquatic Turtles: Our Current Knowledge DONALD MCKNIGHT
12:00	***Lunch 12:00-13:15***	***Lunch 12:00-13:15***
	North America Chair: TBD	***South America*** Chair: Camila Ferrara
13:15	Density and Biomass in Turtles: A Comparison of Six Species from Southeast Sonora DANIEL ANTELO-BARBOSA*	Efforts to Strengthen Collaborative Networks Focused on the Conservation of Paraguayan Turtles PIER CACCIALI
13:30	Habitat Assessment of the Imperiled Pearl River Map Turtle NOAH DEVROS*	Conservation and Management of Amazonian Freshwater Turtles in Brazil FÁBIO CUNHA
13:45	Habitat Associated Variation in Body Size of Yellow-bellied Sliders JEREMY GEIGER*	Aquatic Chelonians and Mercury Contamination in the Amazon Biome FERNANDA DIAS
14:00	Turtle Nesting Habitat in a Free-flowing and Dammed River in the Western Great Plains LARISSA SAAREL*	A History of Conservation, Management, and Monitoring Podocnemididae Turtles in a Black Water River in the Brazilian Amazon CAMILA FERRARA
14:15	Demography of the Relatively Short-lived Western Chicken Turtle DYLAN WICHMAN*	Working with Fishermen to Reduce Bycatch of the Magdalena River Turtle IGOR VALENCIA
14:30	***Break & Posters***	***Break & Posters***
	Health & Wellness Chair: Jamie Palmer	***South America cont.*** Chair: Camila Ferrara
14:45	Health Threats and Trends Observed in Belizean Turtles ISABELLE PAQUET-DURAND	Population Estimate and Structure of the Pantanal Swamp Turtle, Bolivia MARITA PAREDES-RODRÍGUEZ*
15:00	Health Assessment of Northern Diamondback Terrapins in New Jersey NICOLE LEWIS	Habitat Selection Model for Translocated Individuals as a Strategy to Enhance Conservation Actions for Dahl's Toad-Headed Turtle IGOR VALENCIA*
15:15	A Longitudinal Analysis of Pathogen Shedding Patterns in Confiscated Eastern Box Turtles MARIS DALEO*	Investigation Proposal: Mata Mata Reproductive Cycle and Hormones LUCAS MAIA
15:30	Development and Validation of a Multiplex qPCR Assay for the Detection of Four Pathogens in Eastern Box Turtles MARIS DALEO*	Casualty of Testudinids in a Veterinary Center in Paraguay J. RICHARD VETTER
15:45	Pre-release Health Protocols in Radiated Tortoise Reintroduction JAMIE PALMER	CheloniaCast Podcast: Documenting Histories and Personalities MICHAEL SKIBSTED*
16:00 - 18:00	***Poster Session and Book Signings***	
16:30 - 18:30	***Turtle Genomics Project Q&A / Discussion***	

*** Student Considered for Student Awards Competition**

	Daily Schedule	
	Sunday July 28 – Salon B	**Sunday July 28 – Salon C**
8:30	**Morning Announcements**	**Morning Announcements**
	Travel Abroad (Asia and Australia) Chair: Steven Platt	***Travel Abroad (Indian Subcontinent)*** Chair: Daren Riedle
8:45	An Overview of Australian Freshwater Turtle Research DEB BOWER	Perspectives On Aquaculture Operations in Bangladesh MD. SAIFULLAH BIN AZIZ*
9:00	Tortoise Diversity in the Center of Sulawesi Island, Indonesia FAUZIA NOORCHALIZA*	Case Studies on Religious Commitments Toward Turtle Protection in India RJ RAO
9:15	Aquatic Habitat Preferences of the Eastern Long-Necked Turtle KYRA SULLIVAN*	Role of Temple Ponds in Turtle Conservation in Assam, India JAYADITA PURKAYASTHA
9:30	Parasites of the Southern River Terrapin in the Koh Kong Reptile Conservation Center, Cambodia SOKHA CHEA	Focusing Conservation Efforts for Critically Endangered Softshell Turtles Outside Protected Areas JASON DOMINIC GERARD
9:45	Burmese Peacock Softshell Turtle as a Key Species for the Establishment of the Community-Led Fish Conservation Areas ZAU LUNN	Diving Deep: Consumer Research Findings Leading Strategic Way Forward Towards Reducing Freshwater Turtle Consumption in Bangladesh ZAHANGIR ALOM
10:00	Trafficking of Asian Giant Softshell Turtle in Cambodia STEVEN PLATT	Demographics of Spotted Pond Turtle in Northern India DAREN RIEDLE
10:15	***Break & Posters***	***Break & Posters***
	Western Pond Turtles Chair: Jeff Lovich	***Great Lakes!*** Chair: Faith Kuzma
10:30	Population Structure of the Declining Western Pond Turtle Across Thirteen Military Installations in California EMILY ASCHE*	Toledo Zoo's T.U.R.T.L.E. Program: Using Rare Turtles to Foster Inclusion and Diversity Among High School Students MATT CROSS
10:45	Minimizing Impacts and Maximizing Benefits During Large-Scale Restoration in Occupied Turtle Habitat in Yosemite National Park NINETTE DANIELE	Conservation Status of Blanding's Turtles in the Lake Erie Watershed MATT CROSS
11:00	A Genomic Reassessment of Range Boundaries and Identification of Conservation Units for Western Pond Turtles PETER SCOTT	Development of a Detection Model of the Blanding's Turtle to Guide Conservation Prioritization in Illinois ROSE ARNOLD
11:15	Aspects of the Demography of a Relict Population of Southwestern Pond Turtles in a West Mojave Desert Stream in California JEFF LOVICH	Spatial Ecology of Spotted Turtles at Their Northern Range Edge in Michigan CALEY JOHNSON*
11:30		John Ball Zoo's Field Conservation Initiatives for Great Lakes Rare Turtles FAITH KUZMA
11:45	***Lunch 11:45 - 13:15***	***Lunch 11:45 - 13:15***
	Gopherus Tortoises Chair: Benjamin Atkinson	***Environmental Variables*** Chair: Christel Griffioen
13:15	Sizing Up the Situation: Size Variation in Populations of Agassiz's Desert Tortoises in the Sonoran Desert of California KRISTY CUMMINGS	Outdoor Growing Area? What's That? An Overview of Methods for Hydroponically Growing Produce Indoors to Feed Chelonians BILL HUGHES
13:30	Hurricane Effects On a Barrier Island Gopher Tortoise Population MIKE MILLS	Changes in Growth and Maturation of Suwannee Cooters in Response to Habitat Disturbance in the Santa Fe River GERALD JOHNSTON
13:45	Building a Bolson Tortoise Program in the United States CHRIS WIESE	Impacts of Climate Change on Growth Gate and Sex Ratio of Northern Map Turtles Over a 53-Year Period AMBER PITT
14:00	Bolson Tortoise Conservation in the United States VANCE WOLF	Elongated Tortoise: A Study of Variables Affecting Hatchling Survival Rates in Captivity CHRISTEL GRIFFIOEN
14:15	Monitoring Gopher Tortoise Activity and Burrow Commensals in a Relict Longleaf Pine Preserve BENJAMIN ATKINSON	Influence of Temperature and Photoperiod on Activity Patterns of Alligator Snapping Turtles DENISE THOMPSON
14:30	***Break & Posters***	***Break & Posters***
	Natural History Chair: Will Selman	***The Pursuit of Knowledge*** Chair: Tabitha Hootman
14:45	The Phenology of Brumation Emergence in the Yellow Mud Turtle JOHN IVERSON	Validity of Shell-Based Method of Habitat Inference in Fossil Turtles ASHER LICHTIG
15:00	Poor Hibernaculum Quality Associated with Mortality in Urban Box Turtles JAMIE PALMER	Insights from Over a 15-Year-Long Mark-Recapture Study of Florida Softshell Turtles in Wekiwa Springs State Park ERIC MUNSCHER
15:15	Activity Patterns of Central American River Turtles in Belize DAY LIGON	Identity of the Floodplain Snake-Necked Turtles in Western Australia GERALD KUCHLING
15:30	Distribution and Abundance of Map Turtle Species in the Tombigbee River System of Northeastern Mississippi WILL SELMAN	TEAM TERRAPIN: Impacts of Undergraduate Research Experiences, Participatory Science, and Strategic Partnerships TABITHA HOOTMAN
15:45		Range-wide Surveys for the Rough-Footed Mud Turtle ANDREW GLUESENKAMP
18:00 - 19:00	***Cocktail Reception***	
19:00	***Awards Banquet***	

*** Student Considered for Student Awards Competition**

Poster Presentations *(Grand Ballroom Foyer)*	
Poster Session—Saturday, July 27th at 16:00	
Aquatic Turtle Community Surveys in Eastern Oklahoma DEREK BATEMAN*	Genetic Structure and Loss of Genetic Diversity in the Savannah Side-necked Turtle (*Podocnemis vogli*) MARCELA CARDENAS*
Population Structure of Freshwater Turtles Under Captive Conditions in the Municipality of Acapulco, Guerrero, Mexico BENJAMIN CASTILLO ELIAS	Integrating GPS Tracking and UAS Mapping to Assess Texas Tortoise Habitat and Locomotion in the Lower Rio Grande Valley SAMUEL CHAMBERS
Endangered Species: Can We Save the Southern River Terrapin by Understanding Its Environmental Nesting Needs? LAUREN DE NARDI*	The Macro Marathon: Results From High Intensity Trapping of Alligator Snapping Turtles PATRICK DELISLE*
A Preliminary Survey of a Community of Freshwater Turtles in Caribbean Costa Rica JORDAN DONINI	Spatial Ecology of Blanding's Turtles (*Emydoidea blandingii*) in an Agricultural Landscape in Northeast Illinois NICHOLAS DUNHAM*
Home Range Seasonality of the World's Southernmost Endangered Tortoise (*Chelonoidis chilensis*) MARÍA ECHAVE	Distribution of the Yellow Mud Turtle (*Kinosternon flavescens*) in Northeastern Oklahoma HANNAH EICHELBERGER*
Mercury Concentrations in River Turtles in a Rural Watershed EVAN ELDERMIRE*	Hiding in Plain Sight: Federally Protected Ringed Map Turtles (*Graptemys oculifera*) Found in a New River System BRAD GLORIOSO
Estimating the Threat to Bolson Tortoises (*Gopherus flavomarginatus*) Posed by the Presence of Roads JAVIER GONZALEZ	Description of the Courtship Behavior of the Mexican Spotted Wood Turtle (*Rhinoclemmys rubida rubida*) in Captivity in Mazunte, Oaxaca, Mexico RUBY HERNANDEZ*
Abundance and Road Mortality of Box Turtles (*Terrapene carolina triunguis; T. ornata ornata*) in central Oklahoma TAHNEE HERNANDEZ*	Bolson Tortoise (*Gopherus flavomarginatus*) Reproduction and Nest Site Selection at the Semi-captive Tortoise Rearing Facility in New Mexico SCOTT HILLARD
Unconventional Results of Quantitative Paleohabitus Inference for Fossil Turtles ASHER LICHTIG	Initiation of a Long-term Turtle Monitoring Program at the Savanna Field Station, Belize DONALD MCKNIGHT
Demographic Analysis and Population Viability of Egyptian Tortoises: A Two-Phase Approach Integrating Multi-state Modeling and Population Viability Analysis BASEM MOTWALY*	Preliminary Findings of a Long-term Freshwater Turtle Population Study on Lake Washington and Comparisons to Historic Data JOSEPH PIGNATELLI III
Population Status, and Threat Assessment of Threatened Turtles in the Jamuna River of Bangladesh MD. FAZLE RABBE	Documenting the History and Personalities Behind Turtle Conservation and Research Through the CheloniaCast Podcast MICHAEL SKIBSTED*
Promoting Resilience of Spotted Turtle Populations on Military Installations: Assessing Anthropogenic and Climate-Induced Stressors in Coastal and Inland Populations TRACEY TUBERVILLE	Estimating the Threat to Bolson Tortoises (*Gopherus flavomarginatus*) Posed by the Presence of Roads CHRIS WEISE

***Student Considered for Student Awards Competition**

Diving Deep: Consumer Research Findings Lead Strategic Way Forward Towards Reducing Freshwater Turtle Consumption in Bangladesh

ZAHANGIR ALOM, SAMIUL MOHSANIN, NADIM PARVES, ARIF PRODHAN, ARAFAT RAHMAN, JAMES MORRISON, AND PAUL THOMPSON
Wildlife Conservation Society, Dhanmondi, Dhaka, Bangladesh
[zalom@wcs.org]

The conservation of freshwater turtles (FTs) in Bangladesh is increasingly urgent, with 19 out of 23 species listed as globally threatened by the IUCN, primarily due to pressures of illegal trade and consumption. To better understand the drivers of consumption of freshwater turtles within non-Muslim communities in Bangladesh, a Knowledge, Attitude, and Practice (KAP) survey of 320 randomly selected non-Muslim households and 25 focus group discussions (FGDs) with traders and stakeholders was conducted in eight districts including Dhaka, Gazipur, Madaripur, Gopalganj, Khulna, Jashore, Bagerhat, and Satkhira. These districts were selected based on previous studies, media data, and market surveys. The KAP and FGDs revealed that 42% of households had consumed FTs in the last 12 months (average of twice). This study divulges that motivations for consuming these expensive items were primarily taste preferences and feeding guests at functions. Only 3% reported recent traditional medicinal use, although about 40% believe FT consumption is beneficial to health. Only 7% perceived a health risk from preparing wild meat such as FTs. Nearly two-thirds of the consumers were unaware of the ecological importance of these species' significance and the consequences of their depletion, and half of them were unaware of the legal repercussions of consuming them. Both the KAP study and FGDs suggest that despite reported low knowledge of their protected status, much FT trade is now hidden using personal contacts and e-commerce. This study suggests that educational initiatives are needed to bridge the knowledge gap and foster greater appreciation for FTs. The study revealed a complex attitude towards FTs, with mixed perceptions regarding cultural significance and limited support for conservation efforts. Opportunities exist to work with local opinion and religious leaders to convey conservation messages, particularly during festivals. Behavioral change efforts must target specific geographies and cultural contexts, leveraging local knowledge and networks to effectively communicate the importance of FT conservation and encourage sustainable behaviors. Collaboration between government agencies, conservation organizations, local leaders, and communities is essential to address the conservation challenges facing FTs in Bangladesh. By motivating consumers to reduce demand we hope to reduce a major threat faced by these species.
Oral

Flippin' Turtles Reloaded!

BEN ANDERS AND DON MOLL
Sai Kung, Hong Kong SAR
[casichelydia@hotmail.com]

Lateral preference in righting response behaviors (sometimes referred to as "handedness") has been investigated in multiple animal species. The turtle shell has been demonstrated to have strong relevance in locomotion, but its effects on righting response have been described in limited context only. A previous version of this study assessed whether hatchling turtles (Red-eared Slider *[Trachemys scripta elegans]*) respond predictably to a vertebral keel-mediated tilt when inverted—they did so in 100% of trials, synchronizing head/neck-limbs to "flip" towards the side of less resistance. The present study performed the same trial on hatchlings of a species with a comparatively flat carapace—Chinese Softshell Turtle (*Pelodiscus sinensis*)—to eliminate lateral tilt upon inversion and assess presence or absence of lateral preference in head/neck-limbs synchrony for the righting response. Results and possible implications will be discussed.
Oral

Density and Biomass in Turtles: A Comparison of Six Species From Southeast Sonora

DANIEL ANTELO-BARBOSA[1], ALEJANDRA MONSIVÁIS-MOLINA[2], FÉLIX GARCIA-CABELLERO[2], RODRIGO MACIP-RÍOS[1], AND TAGGERT BUTTERFIELD[2]
[1]Escuela Nacional de Estudios Superiores, Universidad Nacional Autónoma de México, Morelia, Michoacán, México
[2]Estudiantes Conservando la Naturaleza A.C., Morelia, Michoacán, México
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Turtles have been reported to contribute a disproportionate amount of biomass in ecosystems. In this study we investigate the density and biomass relationship of six species in Southeast Sonora. We use mark-recapture data collected over a span of five years to estimate population size of each turtle species at specific sampling sites. At these sites, we marked 103 *Kinosternon*

alamosae, 226 *K. integrum*, 37 *Rhinoclemmys pulcherrima*, 56 *Terrapene nelsoni*, 44 *Gopherus evgoodei*, and 19 *Trachemys nebulosa*. For each species, with exception of *T. nebulosa*, we had more than 20% recapture rate and sufficient data to estimate population size using a log-linear open population model. Using these data we estimate the population size of *K. alamosae* to be 109.4 ± 4.4 individuals, *K. integrum* 420.2 ± 72.2 individuals, *G. evgoodei* 90.8 ± 43.9 individuals, *R. pulcherrima* 38.9 ± 2.9 individuals, and *T. nelsoni* 57.1 ± 1.2 individuals. The estimated density and (biomass) for each species is 266.8 turtles/ha (54.6 kg/ha) for *K. alamosae*, 15.6 turtles/ha (6.9 kg/ha) for *K. integrum*, 0.62 turtles/ha (1.3 kg/ha) for *G. evgoodei*, 0.8 turtles/ha (0.4 kg/ha) for *R. pulcherrima*, and 2.5 turtles/ha (0.9 kg/ha) for *T. nelsoni*. We are unable to calculate population size of *T. nebulosa* but using a conservative estimate that the 19 individuals we have marked represents 100% of the population, there are an estimated 4 turtles/ha and 13.2 kg/ha. In general, we find there is more biomass in the species that depend on water for foraging (*K. alamosae*, *K. integrum*, and *T. nebulosa*), and less in semi-terrestrial or terrestrial species (*G. evgoodei*, *R. pulcherrima*, *and T. nelsoni*). Turtles have diversified in aquatic more than terrestrial habitats, and our finding of higher biomass in aquatic habitats may reflect these origins, in which turtles are better adapted to consuming resources and attaining higher biomasses in aquatic habitats. Moreover, *G. evgoodei* and *R. pulcherrima* are both herbivorous which could create interspecific competition and limit biomass of one or both species. The lower biomass in *T. nelsoni*, which consume beetles, fungi, and some plant species, may reflect the foraging limitations of turtles on land.

Oral

Development of a Detection Model of the Blanding's Turtle (*Emydoidea blandingii*) to Guide Conservation Prioritization in Illinois

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Like many turtle species, Blanding's Turtle (*Emydoidea blandingii*) populations are declining range-wide due to the synergistic effects of habitat fragmentation, loss, and degradation. In Illinois, Blanding's Turtle populations are isolated within urbanized or agricultural landscapes, thus hindering migration. Additionally, the status of the species at many historical locations remains unknown, whereby many populations may already be functionally extirpated. Thus, determining the status of populations in Illinois is the paramount conservation priority. Surveys for Blanding's Turtles require a substantial investment of resources (time, funds, and effort) through trapping and visual searches. Currently, there are few tools for quantitatively determining the effort needed to confirm site occupancy. Here, we construct a detection probability model considering temporal, effort, habitat, weather, and environmental variables. The model will allow surveyors to calculate how much effort is necessary to determine occupancy status for a given site under a given set of conditions. The findings from the initial model sets suggest temporal factors exert the most influence on detection, particularly when compared to weather. However, even in strong-performing models, predicted detection rates remained low.

Oral

Population Structure of the Declining Western Pond Turtle (*Actinemys spp.*) Across Thirteen Military Installations in California

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The Western Pond Turtle (*Actinemys spp.*) is currently undergoing assessment to be listed as a Threatened species under the Endangered Species Act. It is designated as a species of special concern in California, sensitive/critical in Oregon, and endangered in Washington, indicating an imminent likelihood of listing. Habitat loss, predation, and shell disease have caused significant population declines, yet there remains a scarcity of data necessary for informed management decisions. Understanding the existing population structure of remaining populations is pivotal for initiating effective conservation strategies. We are gathering demographic data from thirteen military installations across their California range to assess the

level of concern and identify key management priorities. Data collection spans two seasons, with sampling conducted in week-long intervals using 50 aquatic traps per base, supplemented by relevant data from prior or concurrent studies at each installation. Recorded parameters include body size, life stage, and sex of all individuals to characterize the population structure. Additionally, growth rate and recruitment will be derived from the final dataset. Our study's objective is to delineate targeted conservation efforts for species recovery.
Oral

Monitoring Gopher Tortoise (*Gopherus polyphemus*) Activity and Burrow Commensals in a Relict Longleaf Pine Preserve

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We examined Gopher Tortoise (*Gopherus polyphemus*) activity and commensal diversity associated with burrows in a Longleaf Pine (*Pinus palustris*) sandhill ecosystem in a northeast Florida private preserve. Longleaf Pine ecosystems have dramatically decreased in the southeastern United States, primarily due to human activity/development and prevention of critical natural processes like forest fires. Gopher Tortoises are an essential keystone species; they dig extensive burrows that promote biodiversity and ecosystem health. We placed RECONX Hyperfire 2 and JOH mini trail cameras near selected burrows based on evidence of activity. Trail cameras are triggered by movement, allowing for noninvasive and consistent observations. Using Shannon's diversity index of species richness, we hypothesized that indices associated with at least two of the burrows would differ from one another due to their differences in proximity to human development and activity. Additionally, we computed a Hutcheson *t*-test to determine pairwise comparisons between the Shannon indices of two burrows at a time. The Hutcheson alternative hypothesis suggests each of the burrows would have statistically significant species richness variations from one another. The burrow farthest from human development exhibited the greatest wildlife activity out of all studied burrows, including the highest tortoise activity levels, but did not exhibit the highest species richness. The burrow closest to human development showed the least diversity (excepting an outlier) but showed relatively high tortoise activity when compared to other burrows in the study. A burrow with the highest species richness, our outlier, was second closest to human development. These data to date indicate most observed commensal taxa are birds, followed by mammals. Organisms we commonly observed included Bobcats (*Lynx rufus*), Carolina Wrens (*Thryothorus ludovicianus*), Virginia Opossums (*Didelphis virginiana*), and Tufted Titmice (*Baeolophus bicolor*). Our research sheds light on the status and needs of our local Gopher Tortoises, their habitats, and commensals in this private preserve, and may benefit others pursuing trail camera fieldwork.
Oral

Preliminary Investigations Into the Range and Population Dynamics of Kinosternids in Northern Guatemala

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Central American freshwater turtle species, and those in Guatemala in particular, are understudied. Gaps in knowledge of distribution and population ecology exist for most species making population trends unknown. Recent CITES listings of mud and musk turtle populations make species in the family Kinosternidae of particular interest. Baseline data on the populations of Guatemalan Kinosternids are critical for ensuring successful conservation action and results. A multi-institutional team conducted a preliminary investigation into the population ecology, health, and distributions of the five species of turtles found in Guatemala; Narrow-bridge Musk Turtle (*Claudius angustatus*), White-lipped Mud Turtle (*Kinosternon leucostomum*), Creaser's Mud Turtle (*Kinosternon creaseri*), Scorpion Mud Turtle (*Kinosternon scorpioides*) and Tabasco Mud Turtle (*Kinosternon acutum*) in October 2023. In addition to the five focal species, data was collected opportunistically from other non-focal chelonian species encountered. Trapping in conjunction with visual encounter surveys in three protected areas and a private property within the El Petén department or Guatemala resulted in total of 109 turtles representing four species. Samples

for genetic and disease testing were collected and are pending importation. Herein we will present the preliminary findings from this trip and plans for the future.
Oral

Aquaculture Enhances Food Security and Develops Socioeconomics, but Does It Deplete Freshwater Turtles? A Perspective From Bangladesh

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In Bangladesh, as with many countries, aquaculture has made the country's most popular earning source compared with rice or other crops. Consequently, increasing aquaculture farms has reduced freshwater turtle surveillance, potentially placing a large imbalance in aquatic ecosystems in the country. Slow degradation of turtle movement area has reduced the breeding possibilities and reduced offspring of turtle species. Based on an extensive analysis comprising literature studies, interpolation of published data, and field investigations, we have identified an emerging concern regarding the surveillance of freshwater turtle species in Bangladesh. We have estimated the area of the aquaculture farm and its production in the Mymensingh district and documented the potential in aquaculture ponds and its impacts on socio-economics. In a field survey of 130 ponds in the Mymensingh district, 99.5% no turtle species were found, only one species (*Kachuga kachuga*) was found in 0.5% of the pond, while no other species of turtle were found. Bangladesh has a rich freshwater resource which it depends upon for export trade, nutrition of the population, and jobs. Freshwater turtle species are facing a decline due to various factors. According to fishers, habitat degradation is the primary concern, cited by 55% of respondents. Water pollution follows closely, with 35% recognizing its detrimental impact. Overexploitation of turtle resources is also a significant worry, expressed by 23% of fishers. Illegal trade and human consumption are contributing factors, identified by 12% and 11% of fishers respectively. A smaller percentage, 5%, are concerned about the use of turtles for medicinal purposes. To mitigate potential acute and chronic impacts on fresh water turtle species for aquaculture, recommendations are made that, if adopted, would reduce. Aquaculture has become a significant contributor to food security and economic development in many countries, including Bangladesh. However, the expansion of aquaculture has been accompanied by environmental problems, including habitat destruction and degradation. Freshwater turtles are one of the most affected species, as they depend on aquatic habitats that are increasingly being converted into aquaculture ponds. This paper discusses the impact of aquaculture on freshwater turtle habitats and suggests some potential solutions to minimize these negative impacts. Using literature reviews, extrapolation of published data, and field observations, we present an emerging issue of degradation of turtle habitat in Bangladesh
Oral

Saving Belize's Turtles: Developing a Culture of Conservation and Leadership for Young Professionals

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In 2014, the Hicatee Conservation and Research Center (HCRC) was opened at the BFREE Field Station in Southern Belize with the goal of captive breeding the critically endangered Central American River Turtle (*Dermatemys mawii*) and saving them from extinction in the wild. BFREE is located on a 1,153 acre privately protected area at the foothills of the Maya Mountains in the Toledo District, which is often called the "forgotten district." Communities who live here are primarily of Maya descent: they are subsistence farmers who live in this, the wildest and most under-resourced part of the country. Belizeans from central and northern districts rarely venture south to look for jobs and opportunities and, instead, young people from Toledo go north in search of a better life after receiving high school or junior college education. With the launch of the HCRC, came opportunities for jobs, research, and innovation. However, there was no workforce trained or interested in moving south to contribute because living in the jungles of Toledo was not something any educated, motivated, young professional would commit to. Plato states, "Necessity is the mother of invention." At BFREE, we constantly innovate and invent to adapt to the impossible conditions that exist when doing conservation work in a developing country. Therefore, in 2017, the BFREE Science and Education Fellowship Program was born in response to a need to fill a gap in our staffing and to create a gateway for young people to matriculate from an associate degree, to work experience, then on to the completion of their bachelor's and beyond to ultimately become leaders in the conservation of Belize's natural resources. This two-year work-training program has been

game-changing for our organization and for the individuals who have taken the giant leap out of their comfort zones and into the rainforest – all in the name of turtle conservation. In this talk, I will describe the program along with Turtle Survival Alliance's role in cultivating these young leaders and developing a culture of conservation that is critical to saving the Hicatee and other turtle species in decline.
Oral

Structure and Health of a Freshwater Turtle Assemblage in a Highly Developed Ecosystem
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Turtles have important ecological roles in wetlands as omnivores, scavengers, food sources, and nutrient recyclers. Despite such importance globally, their populations are declining, with the proliferation of infectious diseases emerging as a major threat. Our study aims to assess turtle's community structure and evaluate the physical health of those turtle individuals. We began a turtle capture-mark-recapture survey at a university wetland to study assemblage, composition and individual health. In our first year (2023), we captured 39 turtles of 6 species. Based on the species composition, our study suggests the site may be used for illegal pet releases. We screened 37 individuals for adenovirus, herpesvirus, ranavirus, and mycoplasma using conventional and quantitative PCR. Two species (Painted Turtle [*Chrysemys picta*] and Red-eared Slider [*Trachemys scripta elegans*]) were adenovirus-positive, with the virus strain being 99% similar to Sulawesi Tortoise adenovirus. No mycoplasma, Ranavirus, or herpesvirus was detected. Moreover, the Red-eared Slider is likely a natural host of Sulawesi Tortoise adenovirus (STAdV-1). The study forms a baseline for long-term demographic monitoring and health assessments of the turtle assemblage.
Poster

Aquatic Turtle Community Surveys in Eastern Oklahoma
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Turtle communities have become of increasing interest for assessing ecological conditions within aquatic ecosystems and are of particular value at locations where historical data are available for comparison. Several studies surveying eastern Oklahoma's turtle communities have taken place since the late 1990s, providing a baseline for many of the turtle communities that were the focus of this study. Here, we assess the data from the first year of aquatic turtle surveys that were primarily conducted in the southeast corner of the state from 27 May – 25 June 2023. We conducted surveys of the aquatic turtle communities at nine sites, including Lake Eufaula, Verdigris River, Neosho River, Arkansas River, Little River, and the Illinois River. No surveys were conducted in July due to high water temperatures that were likely to suppress turtles' activity, but once the weather returned to more moderate conditions, we surveyed a tributary of Hugo Lake and the associated Kiamichi River, and resurveyed locations at Lake Eufaula, the Neosho River, and Blue River from 25 August to 15 October. Using 0.9-m diameter hoop nets baited with fish or chicken, we captured a total of 2,346 turtles 2,391 times. Across our sites we averaged a catch per unit effort (CPUE) of 1.863 across 1,229 net nights with a range from 0.192–7.375 with locations generally following trends matching previous studies. *Trachemys scripta* composed the majority of (58.4%), *Graptemys ouachitensis* was second at 23.7%, and other species comprised proportions ranging 0.78–6.1% of total captures. *Kinosternon subrubrum* was not detected at any of our sites, which likely reflects habitat preferences that deviate from many of Oklahoma's other native turtles. The Neosho River had the greatest richness with 8 species. We detected 7 species in Deep Fork, Kiamichi, and a tributary of Lake Eufaula, and documented the lowest species richness values in a tributary of Hugo Lake and the Illinois River, where 4 species were detected at each site. Subsequent survey efforts in 2024–25 will continue to expand on the number of aquatic systems surveyed and further investigate seasonal patterns in species-specific detection rates.
Poster

How Many, Is Too Many? Understanding Aldabra Giant Tortoise Density in Rewilding Projects

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Aldabra Giant Tortoises (*Aldabrachelys gigantea*) are vital for maintaining the structure and function of ecosystems on small islands. To restore lost ecosystem functions, rewilding projects have been initiated on Western Indian Ocean islands through the introduction of these tortoises either as reintroductions or as analogue replacements. However, to ensure the success of these projects continues, it is crucial to have a thorough understanding of tortoise density and estimated carrying capacity of tortoise populations. We ask, how many tortoises are required to have any impact on the habitat, and how many tortoises are too many before their density has negative impacts on the habitat? To measure this, we compared rewilded tortoise populations with wild population densities across multiple islands ranging from a density of 4/ha to 30/ha with assumptions on population growth rate. Variables included were reproduction and mortality rates of tortoises, habitat types to assess the availability and quality of food and water sources, along with the type of conservation action on the islands such as forest restoration. Tortoise density appears patchy across islands influenced by habitat type, whilst high tortoise densities have significant positive impacts on herbivory and seed dispersal. Higher density of tortoises may have negative impacts on smaller islands with minimal habitat types. Providing managers with a comprehensive understanding of the carrying capacity of tortoise populations can inform management decisions, such as adjusting tortoise densities, implementing habitat restoration measures, and controlling invasive species, to maintain healthy tortoise populations and create resilient and sustainable island ecosystems.

Oral

Australian Freshwater Turtle Research

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Australian wetlands are characterised by highly dynamic hydrological cycles that support booms in productivity. These same characteristics have created sought after human resources with agronomically rich alluvial soils and high demand for agricultural irrigation. Of the 27 species of native Australian freshwater turtle, the IUCN red list currently lists 1 Near threatened, 1 Vulnerable, 3 Endangered, 1 Critically Endangered and 2 Data Deficient. With increasing need to understand the ecology and conservation requirements of Australian freshwater turtles, many new projects are emerging. We summarize research from freshwater systems around Australia including farm dams and upland streams of the New England Tablelands, the highly regulated Murray-Darling Basin, and desert river systems of the unregulated Lake Eyre Basin to explore impacts of disturbance on the ecology and physiology of turtle communities, and to discuss prospects for conservation. Physical and chemical changes driven by river regulation provide challenges to freshwater turtles in a changing climate through salinization, barriers to dispersal, and habitat alteration. ~~I~~ntroduced species such as foxes, invasive weeds and pathogens, pose ongoing challenges to the conservation success of turtle populations. Yet there are logistical obstacles to undertaking research in unregulated rivers. Using the Lake Eyre Basin as an example, the practical challenges of studying unpredictable Australian rivers during flood quickly becomes evident. Successful actions driven by partnerships between universities, private landowners, citizen scientists and government agencies are improving ecological knowledge~~,~~ and conservation efforts for freshwater systems in Australia.

Oral

Clarifying the Murky Evolutionary History of Southeastern Mud Turtles (Genus *Kinosternon*) Using a Phylogenomic Approach

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The Southeastern United States is a region marked by incredibly high biodiversity, such that the North American Coastal Plain was recently classified as global biodiversity hotspot. Turtles are no exception to this trend. In fact, with the advent of high-throughput sequencing, biologists have discovered multiple cryptic species of turtles in the Southeast US in the past 10 years suggesting there is still much to learn about the turtles of the region. A recent review of the literature found that small species of turtle have received significantly less research attention than larger species. A case and point to this trend is exemplified by the mud turtles of the genus *Kinosternon*. These turtles are marked by their diminutive stature, and the genus is considered one of the top three least studied in North America. What's more is that the taxonomy of the group has been in flux for over forty years. We aim to employ robust phylogenomic methods coupled with Bayesian analyses and species delimitation approaches to disentangle the evolutionary history of this group. Preliminary mitochondrial sequencing data suggest cryptic genetic divergence within the genus. We collected tissue from nearly 300 *Kinosternon* from all recognized taxa and subtaxa from Texas to the Florida Keys and up the Atlantic seaboard to Delaware to determine evolutionary relationships of these taxa.
Oral

Efforts to Strengthen Collaborative Networks Focused on the Conservation of Paraguayan Turtles

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Paraguay is a landlocked country located in the middle of South America, and it holds a diversity of about 188 reptiles, 10 of which are chelonians. In spite of the low diversity of turtles in Paraguay, only desert tortoises are relatively well known, but almost nothing is known about freshwater turtles, and thus literally we do not know the actual distribution of most of the species, and sadly due to land use change, many freshwater habitats are disappearing. In response to the critical need for chelonian knowledge and conservation in Paraguay, we developed the "*Programa de Conservación de Tortugas del Paraguay*" [Turtles of Paraguay Conservation Program] our program aims to expand scientific understanding and try to implement effective protection strategies for these vital species. Recognizing the global significance of turtle conservation, we will employ a combination of field research, interdisciplinary work, community engagement, captivity care, and habitat preservation to address the threats facing these animals.
Oral

Genetic Structure and Loss of Genetic Diversity in the Savannah Side-necked Turtle (*Podocnemis vogli*)

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The Savannah Side-necked Turtle (*Podocnemis vogli*) is a freshwater turtle species with a restricted distribution along the savannas of the Orinoco basin in Colombia and Venezuela. Several populations have been decreased and extirped due to their overexploitation as a food and economic resource for human consumption and the degradation of their habitat. Currently, this species is classified as Least Concern (LC) by the IUCN Red List due to their apparent abundance and listed as Vulnerable by Tortoise and Freshwater Turtle Specialist Group. The purpose of this research was to initiate an assessing the conservation status of the species in Colombia, using molecular tools to perform a population genetics study. Five population along their distribution range were analyzed using 19 microsatellites markers where ten of those markers were useful to reveal: high levels of genetic diversity, a distinct genetic structure comprising of five populations, and low and asymmetric gene flow between them. However, the analyses also indicated the loss of genetic diversity (low allelic richness) and recent bottlenecks in some populations. Those identified detrimental indicators are evidencing a population decline most likely related to anthropic activities. Each of these five populations represents an independent management unit. These findings provide crucial insights for proposing management and conservation strategies for these populations in the Orinoco ecoregion.
Poster

Population Structure of Freshwater Turtles Under Captive Conditions in The Municipality of Acapulco, Guerrero, Mexico

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Continental turtles are a taxon of the world's most threatened vertebrates, with more than half of the species in means of extinct, they have been little studied in terms of their spatial distribution and ecology probably due to the cryptic character of many species. In the State of Guerrero, Mexico, little work has been done with mainly regard to the management of these reptiles, without paying any attention to their conservation as well as their sustainable use. The species studied here are specimens that have been confiscated by the Federal Attorney for Environmental Protection and put under shelter in a rustic property located in the municipality of Acapulco, Guerrero, Mexico, being necessary to monitor these specimens to identify species, their population structure, sexes, physical conditions, and optimal conditions for their stay in shelters, in order to guide the people protecting these specimens. The objective was to determine the population structure and morphological variations of these species of freshwater turtles in captivity, analyzing the statistical correlation between carapace length and weight (LCS - Weight). There were monitored 62 specimens of captive freshwater turtles belonging to the species of Yellow-bellied Slider (*Trachemys scripta scripta*), Red-eared Slider (*Trachemys scripta elegans*), Guerrero Wood Turtle (*Rhinoclemmys pulcherrima pulcherrima*), and the Mexican Mud Turtle (*Kinosternon integrum*). It was assessed the general physical condition of each individual, the morphometric measurements, sexing and weight. There were registered 26 females, 10 males, 4 juveniles for *T. scripta scripta*; 11 females and 6 males for *T. scripta elegans*; 1 male and 3 females of *R. pulcherrima pulcherrima* and 1 juvenile of *K. integrum*. The predominant species was *T. scripta scripta* with 64. 5% and the highest percentage of sex were females with 59. 7%. The correlation of the LCS vs weight variables was obtained, resulting in a normality test through Kolmogorov-Smirnov analysis (significance 0.053 and 0.200, respectively), a parametric correlation test was applied through the Pearson correlation of 0.954 and sig. 000, in which there is a direct correlation between both quantitative variables.
Poster

Integrating GPS Tracking and UAS Mapping to Assess Texas Tortoise Habitat and Locomotion in the Lower Rio Grande Valley

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Texas Tortoise (*Gopherus berlandieri*) in the Lower Rio Grande Valley (LRGV) are listed as threatened due to habitat fragmentation resulting from increased land conversion for urban development, agriculture, and border projects. Compounding this is a lack of an informed conservation plan outlining habitat restoration scenarios. To better understand habitat requirements and how they relate to the ecophysiology of the species, this study introduces a novel methodology coupling GPS tracking with Unoccupied Aerial Systems (UAS) mapping to assess the energy expenditure of Texas tortoises in fragmented landscapes of the LRGV. Specifically, we developed plant species and landcover maps from multispectral 4 cm orthoimagery and canopy structural data. Microtopography maps were generated from ultra-high resolution aerial lidar (Light Detection and Ranging) collected at 500 points/m^2. By integrating GPS tracking, vegetation and canopy data, and microtopography assessment, our research provides nuanced insights into tortoise locomotion across micro-landscapes. Using statistical and spatial analysis of UAS derived variables and a literature review of tortoise physiology, we developed a mathematical function which translates landscape variables to the caloric cost of locomotion. This in turn was translated to a geospatial cost-distance model to quantify local habitat connectivity. Our findings provide tools for targeted conservation interventions informed by fine-scale geography, ultimately contributing to the preservation of ecosystem functionality, while fostering resilience in the face of ongoing environmental challenges.

Poster

Investigation of Parasite Presence in the Southern River Terrapin (*Batagur affinis*) at the Koh Kong Reptile Conservation Center

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The Southern River Terrapin (*Batagur affinis*) is one among the most endangered species on the globe. It has been recorded as extinct in Cambodia before the year 2000, then re-discovered along Sre Ambel river called *Batagur baska* and later re-identified as *Batagur affinis*. The parasite study on *B. affinis* was conducted at the Koh Kong Reptile Conservation Center (KKRCC) where 134 turtles are kept in four different 12m*18m*2m ponds. Following the new parasite discovered on Burmese Batagur in 2018, the study aimed to identify parasites that present in turtle, water, sediment, and feed (vegetable). The findings from this study could potentially be beneficial for turtle rescue, husbandry, and help to guide conservation efforts to be more effective. Sample collection was scheduled in late dry season, in early rainy season before pond cleaning, and in late rainy season after pond cleaning. Environmental samples collected from each pond including 10 fresh feces, 2 water and two sediments were collected, and feed (vegetable). Additional samples were obtained during pond cleaning and carcasses necropsy. Parasites *Ascaridia* spp. and *Strongyloides* spp. were detected at the parasitology laboratory of the Faculty of Veterinary Medicine (FVM), Royal University of Agriculture (RUA), using Floatation, McMaster, Sediment and Coproculture. Also, 1120 (887 female) adult parasites were found in one *B. affinis* carcass during necropsy. Microphotographic images were sent to parasitologist in Mahidul university, Thailand, and identified as *Ascaridia* spp (family Kathlaniidae (Order Ascaridida: Superfamily Cosmoceroidea)). There was statistically significant difference between ponds before versus after pond cleaning with the average log 2.145)GM=139.5(and 3.128)GM=1342.9(as p=<0.001. *Strongyloides* spp. was detected before pond cleaning in the average log is 2.029)GM=107(, and the average log after cleaning is 0.795)GM=6.2(with *p*=<0.001. This finding suggests that deworming is needed. The limitation of time and facility, the recommendation for the future study should be considered looking deeper in the parasite screening and refining the species identification. The potential of new parasite

species discovery in *Batagur affinis* remains in hope. The finding from pond cleaning also suggests that regular deworming should be practiced with the good case from Myanmar using Fenbendazole.
Oral

Evolving Questions and Views on How Growth Influences Life-History Trait Values of Turtles

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Compared to short-lived vertebrates, data on long-lived turtles were inadequate to understand how environmental variation influences demographic (age specific survivorship and fecundity), and resource-based traits (growth rates and fecundity). In the "olden days," there were calls for long-term field studies of long-lived organisms (e.g., turtles) that would provide empirically sufficient data to test predictions based evolutionary life history theory. Some easily influenced and youngish investigators that could see the value of long-term field studies responded by starting new or altering existing studies that would extend over lifespans of turtles and investigators. Over 33 consecutive years of mark-recapture study on the University of Michigan, E.S. George Reserve, we made 46,985 captures of 8220 individuals, determined clutch size and egg width with X-radiographs of 6,278 clutches, and recorded data on 7,412 nests of Painted Turtles (*Chrysemys picta*), Blanding's Turtles (*Emydoidea blandingii*), and Snapping Turtles (*Chelydra serpentina*). Longitudinal data on growth and reproductive characteristics of individual juvenile females revealed that juvenile growth is a major mechanism influencing age and body size at maturity of female freshwater and Green Sea Turtles (*Chelonia mydas*). Faster growing juveniles matured earlier in life and at a larger body size than slow growing juveniles; a result that does not support that the pattern was established by phenotypic plasticity and does not represent a life-history tradeoff and suggests an evolutionary conservative trait that occurs in fish, and may occur in other ectothermic vertebrates. Lack of data on Indeterminate growth, variation in ages at maturity, and age specific influences on reproductive traits of adult females resulted in serious problems for life history models of vertebrates with indeterminate growth (e.g. rates of indeterminate growth was calculated as the difference between the smallest and largest adult females in a population and was assumed to be constant over all ages. As age specific indeterminate growth rates slow with age, body size relationships with reproductive characteristics of females also change.
Oral

Toledo Zoo's T.U.R.T.L.E. Program: Using Rare Turtles to Foster Inclusion and Diversity Among High School Students Interested in Wildlife Conservation

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Early exposure to STEM experiences is widely recognized as a method to increase interest and retention in undergraduate and graduate programs. However, there are several barriers (i.e., lack of pay, transportation, access, etc.) limiting high school students from participating in STEM internship experiences, especially those from underrepresented minority groups. Using our long-term mark-recapture study on Blanding's Turtles (*Emydoidea blandingii*), we developed T.U.R.T.L.E (Teens understanding Research Techniques and Learning Ecology) program to provide high school students with hands-on, authentic field experiences that also foster inclusion and belonging in the conservation biology field. We provided 9 high school students with paid internship positions, transportation to-and-from work, lunches, and gifted them the equipment required to participate in field conservation activities. The impact of the T.U.R.T.L.E. program was evaluated using pre- and post-surveys along with interviews. We were interested in examining the potential change in intern's confidence with field conservation skills, perceived inclusion in the field, and sense of belonging in the program as a whole. Through these surveys and interviews, we found that interns gained field conservation skills, felt like they belonged, and built a community among their cohort. Interns enjoyed their experience so much that many wanted to return in subsequent years to become peer-to-peer mentors for the new cohort, which we explored slightly in the second year of evaluation. Given the experience gained and satisfaction reported by the high school students enrolled in the T.U.R.T.L.E. program, we think this could serve as a model for other institutions.
Oral

Conservation Status of Blanding's Turtles in the Lake Erie Watershed

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With Blanding's Turtles (*Emydoidea blandingii*) under review for listing under the U.S. Endangered Species Act, many states have initiated, or completed, monitoring and conservation programs to determine the species' status throughout its range. In 2023, Michigan and Ohio concluded three-years of coordinated survey efforts at 77 unique sites which resulted in 30,707 trap nights and capture of 757 Blanding's Turtles, 6,198 Painted Turtles (*Chrysemys picta*), and 1,770 Snapping Turtles (*Chelydra serpentina*). Surveys provided data for estimates of occupancy, abundance, and density, distribution models, and evaluation of genetic composition within and among populations in the Lake Erie Watershed. Results of this project informed a multi-state conservation plan and led to development of a combined metrics worksheet to describe and monitor the status of Blanding's Turtles within various management units, ecoregions, or wildlife areas.

Oral

Sizing Up the Situation: Size Variation in Populations of Agassiz's Desert Tortoises in the Sonoran Desert of California

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Agassiz's Desert Tortoise (*Gopherus agassizii*) occupies portions of the Sonoran and Mojave deserts. Populations in California are listed as "threatened" under the Endangered Species Act. *G. agassizii* is a slow growing and long-lived species, experiencing its greatest period of growth during the first 20 years leading up to maturity, after which growth slows dramatically. Tortoise size is dependent on several variables including environmental influences. Their growth is influenced by the amount of food they consume when temperatures and resources are not limiting. Desert tortoises spend up to 98% of their time below ground to avoid temperature extremes in the desert, limiting time to perform essential tasks including foraging for food. We examined four populations of *G. agassizii* to determine the extent of sexual size dimorphism among the populations and determine if tortoises at cooler, higher elevation sites are larger than tortoises at warmer, lower elevation sites. Sites varied in elevation, proximity to coastally-influenced climate, and topographic diversity. Because of these geographic and physical differences, each site experienced different climates (e.g., temperature and precipitation). These variables also affected the amount and quality of available tortoise food plants, tortoise activity and foraging schedules, and possibly growth rates and mean body sizes. Male tortoises were larger than females at all sites. Tortoise body size varied among sites with no interaction with sex. Variation in adult tortoise body size among and between sites reflects a combination of multiple factors that we will review.

Oral

Development and Validation of a Multiplex qPCR Assay for the Detection of Four Pathogens in Eastern Box Turtles (*Terrapene carolina carolina*)

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Many wildlife conservation efforts focus on the effects of one disease, but in order for these conservation efforts to be successful, researchers must have an understanding of disease ecology. This includes multiple pathogen dynamics, and their influence on individual disease dynamics. We developed a multiplex quantitative PCR (qPCR) assay to detect four pathogens in eastern box turtles (*Terrapene carolina carolina*), including frog virus 3 (FV3), *Terrapene* herpesvirus 1 (TerHV1), box

turtle *Mycoplasma* sp. (BTMyco), and *Terrapene* adenovirus (TerAdv). TaqMan primer-probes were designed using previously published assays with four different fluorophores (FAM, VIC, JUN, ABY). Slope, R^2, and efficiency performance of each primer-probe assays were compared between multiplex and singleplex master mixes on a QuantStudio7, a real-time qPCR thermocycler. Inter- and intra- assay variability was also analyzed for the multiplex assay. Clinical validation was performed on FV3, TerHV1, BTMyco, and TerAdv positive eastern box turtle samples. The multiplex assay performed with high efficiency and had similar Cq values compared to each singleplex assay from 10^7-10^1 target copies per reaction. Intra-assay variability ranged from 0.85%-1.23% for all four targets, while inter-assay variability ranged from 0.63%-2.80%. This multiplex assay was able to accurately detect all four pathogens within a single DNA sample. The ability to reliably screen for four pathogens in a single reaction reduces costs associated with testing as well as the time and consumables needed, making multiplex qPCR highly efficacious. This diagnostic tool will be beneficial when characterizing disease ecology and epidemiology of eastern box turtle pathogens.

Oral

A Longitudinal Analysis of Pathogen Shedding Patterns in Confiscated Eastern Box Turtles (*Terrapene carolina carolina*)

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Eastern Box Turtles (*Terrapene carolina carolina*) have experienced population declines due to the illegal wildlife trade and its association with the spread of infectious diseases, yet the impacts of disease, as well as ideal pathogen surveillance protocols for wildlife confiscations, are not thoroughly described. Characterizing the diagnostic sensitivity of testing protocols (i.e., the probability that a testing strategy will successfully detect a diseased animal) is important for developing effective pathogen surveillance practices, however, this information is lacking for eastern box turtles. In the fall of 2022, 17 confiscated Eastern Box Turtles arrived at the University of Illinois after being intercepted from the illegal wildlife trade. The turtles were individually housed for one year and tested monthly for frog virus 3 (FV3), *Terrapene* herpesvirus 1 (TerHV1), box turtle *Mycoplasma* sp. (BTMyco), and *Terrapene* adenovirus (BTAdv1) using quantitative PCR on combined oral/cloacal swabs. No turtles tested positive for FV3 for the duration of the study. In contrast, all individuals tested positive for TerHV1, 15 were positive for BTMyco, and 12 were positive for BTAdv1. Each of these pathogens was detected intermittently in positive individuals, likely indicating temporal variation in pathogen shedding. Co-pathogen infections were also intermittently detected including BTMyco, BTAdv1, and TerHV1 (n=6), BTMyco and BTAdv1 (n=10), BTMyco and TerHV1 (n=7), and TerHV1 and BTAdv1 (n=6). The probability of detecting BTMyco during any given month was 49.2% (± 0.037) while monthly detection probabilities were lower for TerHV1 (30.4% ± 0.032) and BTAdv1 (20% ± 0.031). These findings have implications for determining optimal sampling intervals in future box turtle confiscations and can better inform placement decisions for confiscated and translocated turtles.

Oral

It Gets Worse Before It Gets Better? Minimizing Impacts and Maximizing Benefits During Large-Scale Restoration in Occupied Turtle Habitat in Yosemite National Park

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The desperate state of our world's natural systems increasingly requires drastic, large-scale actions to restore ecological function. Yosemite National Park is undertaking the largest project of its kind to restore a Sierra Nevada meadow, in a site is occupied by Northwestern Pond Turtles (*Actinemys marmorata*) which are proposed for federal listing. Meadow restoration is being achieved through extensive heavy equipment work to fill occupied erosion gullies, creating unique challenges in protecting this declining freshwater turtle. We utilized pre-project trapping, interdisciplinary planning for retention and construction of long-term aquatic habitats, radio telemetry of high value-turtles, small scale translocations, manual clearance surveys, and canine clearance surveys to achieve our objectives. We will describe our multi-pronged approach to developing

informed turtle protection and impact minimization measures, and report "lessons learned" following the first year of project implementation, in the intention that our highlights may help others involved in large-scale habitat manipulations (such as consulting biologists and land managers) to achieve favorable outcomes for freshwater turtles.
Oral

Endangered Species: Can We Save the Southern River Terrapin (*Batagur affinis*, Cantor, 1847) by Understanding Its Environmental Nesting Needs?

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The Southern River Terrapin (*Batagur affinis*), a member of the Geoemydidae family, was classified as one of the World's Top 25 Endangered Tortoises and Freshwater Turtles in 2018. This elusive species, once common in southern Peninsular Malaysia, Sumatra, Cambodia, and Vietnam is listed as critically endangered by the IUCN Red List of Threatened Species due to range wide population declines. In Cambodia, the species was thought to be extinct until its rediscovery in 2001. In Cambodia the small endemic subpopulation relies on head-started and reintroduced individuals for its recovery. Two facilities in Cambodia, one run by the Angkor Center for Conservation of Biodiversity (ACCB) and the other by the Wildlife Conservation Society (WCS) at the Koh Kong Reptile Conservation Center (KKRCC), maintain an assurance population for this species. Here we present our study evaluating the environmental cues influencing females to come out of the water during the breeding season. We take into account the number of the females that leave the water and the time spent on the beach, influenced by the air temperature, air humidity, moon visibility and the moon phase. The survey was conducted on both assurance populations places, to assess whether differences occur due to the localization. Observations were made by the utilization of camera traps to avoid any human disturbance. We found that females are more likely to come out when the air humidity is higher than 75%, and the air temperature is between 23 and 29°C. The results also found that activity was higher when the moon's visibility was higher than 34%. The results give us a first glimpse into the understanding of some of the potential influences on the nesting behaviour of the elusive Southern River Terrapin. These results, whilst still preliminary, will allow ex-situ conservation efforts to encourage and predict nesting behaviours through changes to their environment and continued monitoring of environmental cues. Research on these influences should be conducted for future breeding seasons to further understand and improve ex-situ breeding of the assurance populations and save this incredible species from extinction.
Poster

Using Time Lapse Photography to Monitor Alligator Snapping Turtle (*Macrochelys temminckii*)

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Population estimates are often used to inform wildlife management decisions. Many herpetofauna populations that rely on aquatic environments have declined in the last century, and hence would benefit from baseline estimates of population size. However, estimating the population size of rare aquatic species often requires extensive field work that is expensive and labor intensive, which often precludes such population surveys. Therefore, we developed a protocol for estimating the population size of air-breathing aquatic animals using non-invasive camera traps. Our method uses time lapse photography in conjunction with estimates of the fraction of the day that the foci species spends at the surface of the water breathing. We test our method in a case study on the Alligator Snapping Turtle (*Macrochelys temminckii*), a large aquatic turtle that is currently proposed for listing as threatened under the Endangered Species Act. We preliminarily found that *M. temminckii* spent an average of 8 minutes at the water's surface (max = 28 minutes). We deployed 60 trail cameras in a randomly placed systematic grid throughout our study sites between September 17th and September 23rd 2023, and collected 422,583 photos, many of which

include *M. temminckii*. We will present population estimates from our new method and compare these to estimates from capture-recapture models in the same site.
Oral

The Macro Marathon:
Results From High Intensity Trapping of Alligator Snapping Turtles (*Macrochelys temminckii*)
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The Alligator Snapping Turtle (*Macrochelys temminckii)* is currently proposed for listing as Threatened under the Endangered Species Act. In the 19th and 20th centuries, largescale habitat conversion and commercial harvest heavily impacted *M. temminckii* populations throughout much of their range. Previous trapping surveys of the Mississippi River alluvial plain (i.e., "Delta") in Mississippi located a population with a demography and abundance that suggest it was minimally impacted by historical threats. In April 2024, we conducted an interagency collaborative and week-long intensive effort to trap this *M. temminckii* population. Traps were placed over 26 river km amongst 6 different areas for a total of 347 trap nights. We captured 104 unique individuals, 14 of which were recaptured from previous trapping efforts in 2020 and 2022. Catch-per-unit-effort varied among sites (number *M. temminckii* captured per trap night; range: 0.20-0.41 CPUE). Sizes of individuals varied greatly (range: 1.2-61 kg), with 16 males over 40 kg and 10 females over 25 kg. One female weighed 37.65 kg, approximately 1.29 kg heavier than the previous record for largest female range wide. We also conducted a pilot study investigating *M. temminckii* hook ingestion using Garrett Pro Pointer metal detectors. Several positive detections were indicated by the metal detectors, but follow-up x-rays revealed no presence of internal metal. Additional methodological refinement will determine if the use of metal detectors is a viable way to determine the presence of ingested fishing hooks in Alligator Snapping Turtles. Data collected through this collaborative effort provides valuable information on survivorship, growth, and population estimates, as well as supporting an upcoming four-year mark-recapture project for this, and other, populations.
Poster

Habitat Assessment of the Imperiled Pearl River Map Turtle *(Graptemys pearlensis*)
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The Pearl River Map Turtle (*Graptemys pearlensis*) is an Emydid found in the Pearl River drainage system of Mississippi. *Graptemys pearlensis* is listed as Endangered by the IUCN and is a CITES Appendix II species. Between April 2022 and October 2023, we conducted the first comprehensive population estimates of *G. pearlensis* in Mississippi. The drainage-wide density of *G. pearlensis* was estimated at 22.4 turtles per rkm, although site specific densities varied from 2.2 to 141.7 turtles per rkm. As these dramatic disparities might be explained by differences in habitat variables between sites, we have begun to assess habitat across the Pearl River drainage. Alongside quantifying visible microhabitat (e.g., canopy cover, stream width, depth, etc.), we have begun using a recreation-grade side scan sonar unit (Humminbird Helix 9 fish finder) to produce high quality benthic images. These images allow us to describe substrate composition as well as enumerate deadwood density, a variable associated with density of other species in the *Graptemys* genus. We will discuss our findings relating to substrate variables associated with *G. pearlensis* abundance, as well as strategies used for determining benthic profiles.
Oral

Conservation Challenges: Aquatic Chelonians and Mercury Contamination in the Amazon Biome

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The Amazon biome faces growing concern about mercury contamination due to mining activity, which began significantly in the region in the 1970s. The high concentrations of mercury found in the Amazon ecosystem have been attributed to the presence of soils with relatively high concentrations of mercury in natural origin, atmospheric transport and deposition of mercury of anthropogenic origin. Mercury is a metal that occurs naturally in the Earth's crust and can be released in large quantities during the mining process, polluting aquatic environments where its most toxic form is organic mercury, which tends to accumulate quickly in biota. Due to its affinity to animal adipose tissue, mercury tends to bioaccumulate and biomagnify more quickly in aquatic organisms, resulting in very high environmental exposure via the food chain for consumers at high trophic levels, including aquatic chelonians. Among the vertebrates present in bodies of water, chelonians are one of the most studied groups of aquatic animals to explain the interaction of terrestrial and aquatic environments, as in these organisms their behavior in different aspects is governed by variations in the hydrological cycle, and they can occupy the most varied aquatic ecosystems. Aquatic chelonians, as they are long-lived organisms, with both herbivorous and carnivorous and/or omnivorous representatives, and which can accumulate toxic substances for long periods of time, have proven to be important monitors of environmental contamination. Research shows an abundance of mercury in different tissues of aquatic chelonians, such as muscle tissue, adipose tissue and liver tissue. Mercury contamination in aquatic chelonians can have serious consequences for human health, since these animals are frequently consumed in the Amazon and proven to be the only metal that has caused deaths in humans due to the consumption of contaminated chelonians. Therefore, the need for conservation and management measures is highlighted to mitigate mercury contamination in aquatic ecosystems and observe the effect of mercury on the physiology, reproduction, genetics, biochemistry and behavior of chelonians.
Oral

Survivorship and Home Range of Confiscated Kinosternid Turtles Post Reintroduction

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Collection of turtles for the illegal wildlife trade is a known threat to wild populations. However, when trafficking rings are broken up and animals are confiscated, seldom are they able to be returned to the wild. From 2019-2021 a joint collaboration between the Florida Fish and Wildlife Conservation Commission and United States Fish and Wildlife Service lead to the breakup of multiple turtle trafficking organizations in south Florida. Several species of turtles were confiscated, including three Kinosternid species, Common Musk Turtle (*Sternotherus odoratus)*, Florida Mud Turtle (*Kinosternon steindachneri)*, and Striped Mud Turtle (*Kinosternon baurii)*. A number of confiscated turtles of these three species were held as evidence before receiving medical clearance for reintroduction into a similar geographic region as their likely origin. A subset of turtles large enough, fitted with radio-transmitters and monitored from July 2022-January 2023 *(K. baurii* n=10, *K. steindachneri* n=3). Minimum Convex Polygons (MCPs) were used for initial home range analysis. *K. steindachneri* exhibited immediate long-distance movements > 300 m with MCPs averaging 7.6 ha. By October 2022 all three *K. steindachneri has* disappeared from the release site or lost transmitters. *K. baurii* generally showed higher release site fidelity with MCPs averaging 0.72 ha and only a single individual leaving the borders of the release site. Survivorship of tagged *K. baurii* is confirmed 90% six months' post release. Additional individuals too small for radio-tags have been opportunistically captured via hoop traps and have showed weight gains of 5-17% post release. This preliminary data indicates the *K. baurii* are likely a good candidate for reintroduction, while *K. steindachneri* may need additional consideration prior to reintroduction.
Oral

A Preliminary Survey of a Community of Freshwater Turtles in Caribbean Costa Rica

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Through a join collaboration with Florida SouthWestern State College, and Turtle Love Costa Rica we initiated a preliminary survey to investigate the demography and community make up of freshwater turtles within the Caribbean slope. We trapped and surveyed for 12 initial days from late June to early July as part of a study abroad research trip, while Turtle Love continued regular surveys from July-November 2023. In total we captured 161 individual freshwater turtles of five different species via regular aquatic trapping sessions, and opportunistic visual surveys. *Kinosternon leucostomum* were the most common (n=148). *Rhinoclemmys funerea* were the second most common species (n=7), followed by lower abundance in *Rhinoclemmys annulata* (n=3), *Chelydra acutirostris* (n=2), and *Trachemys venusta* (n=1). Counting recaptures, over 220 individual turtles were encountered during surveys. *K.leucostomum* were encountered in traps in jungle pools and ephemeral wetlands, and also while aestivating under fallen palm fronds on jungle trails. *R. funerea* were detected via trapping in riverine edges and in recently formed pools under the jungle canopy, while *R.annulata* were found in open jungle patches and under fruiting shrubs in the beach dunes. *Chelydra* and *Trachemys* were trapped in shallow jungle pools or along riverine edges. Initial demographic data for *K.leucostomum* indicate a female biased sex ratio with 66 recorded adult females compared to 42 adult males. Sub-adult size classes of unknown sex followed at 29 individuals, with juvenile and hatchling individuals totaling 11. The lack of sample size from other species limits the ability to display demographic data as a whole. Additional data is continuously being collected throughout the initial trapping site, along with several other sites in close proximity and will continue for the next 5-10 years to help establish population estimates, along with other valuable life history and ecological information in a data deficient region.

Poster

Turtles as Predators and Prey of Birds

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The advent and ubiquitousness of cell phone cameras and social media has armed laypersons with a means to record and report field observations at an unprecedented rate, causing an explosion of natural history observations, some of which penetrate herpetological research circles. One example is predator-prey encounters between turtles and birds. Although large birds are well known to prey upon small turtles and a few raptors prey upon larger turtles, the reverse is thought to be unusual or uncommon, prompting the hypothesis that the relationship between turtles and birds is, overall, unimportant and uninteresting. We examined the unlikely predator-prey association between turtles and birds using the literature, but especially using internet resources including social media. Herein we present preliminary results of our findings. Birds as predators of turtles followed a predictable relationship based on their relative sizes; some eagles are exceptions, taking large turtles by breaking their carapaces on rocks. Most turtle eggs are unavailable to birds because turtles bury their eggs; exceptions include crows and vultures. Similarly, most bird eggs are unavailable to turtles because most birds nest in trees (but tortoises and other terrestrial species may eat the eggs of ground-nesting birds). Turtles as predators of birds may also follow a predictable relationship based on their relative sizes, but overall there is little evidence for turtles consuming birds as prey. A major exception, however, is the common snapping turtle (CST), which was already thought to feed on birds opportunistically and somewhat rarely based on many decades of research. Recent observations, however, suggest we have underestimated CSTs as predators of birds. We found direct evidence for CSTs preying upon 25 species of birds, including 72 individuals; there is indirect evidence or unconfirmed evidence of many more attacks and kills on birds by CSTs. Remarkably, CSTs have successfully killed and eaten birds as large as swans, great blue herons and flamingos, and there is evidence for CSTs stalking and drowning birds too large to kill by biting alone. We conclude that CSTs should be considered typical predators of aquatic, semi-aquatic or other birds frequenting wetlands, large and small.

Oral

Growth in Freshwater Turtles and Tortoises: What We Know and Where to Go

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Growth is a fundamental life history trait expressed as shape, rate, and size at specific times for individuals in a population. Because energy allocated to competing life demands shifts, all expressions have impactful relationships with other life-history traits. In general, the overall growth pattern of turtles is well understood, but representative studies are decidedly lacking for many species and populations. Additionally, we are building a stronger foundation of the drivers and their consequences on growth; few studies have had the luxury of serially examining populations to determine environmental and habitat-related effects. Herein, we present the state of knowledge on growth in freshwater turtles, covering aspects such as pattern, seasonality, determinism, dimorphism, extrinsic drivers, maternal effects, and individuality. Finally, we will provide insight into current analytical advances and direction for future work.
Oral

Spatial Ecology of Blanding's Turtles (*Emydoidea blandingii*) in an Agricultural Landscape in Northeast Illinois

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Agriculture in Illinois dominates the landscape, leading to widespread alteration of terrestrial and aquatic ecosystems. Much of Illinois' freshwater wetlands have been heavily channelized and converted into vast networks of ditches in agricultural drainage systems. Thus, these agricultural ditches may represent some of the only available wetland habitats for turtles. A small population of Blanding's Turtles (*Emydoidea blandingii*) was discovered living in an agricultural ditch system in Kankakee and Iroquois counties of Northeast Illinois. Blanding's Turtles use terrestrial and aquatic habitats throughout the season, increasing their mortality risks from farming equipment. To better understand how Blanding's Turtles utilize an agricultural landscape, we trapped and used VHF radio-telemetry to track 15 individuals (9 females, 6 males) from April to November 2023, totaling 533 locations. Our objectives were to investigate home range sizes, movement rates, and macrohabitat and microhabitat selection by sex and season. The results of our study are preliminary, and data collection will continue from 2024 to 2025. Our results can aid the management of Blanding's turtles in agricultural-dominated landscapes.
Poster

Home Range Seasonality of the World's Southernmost Endangered Tortoise (*Chelonoidis chilensis*)

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In Northern Patagonia, Argentina, lives the southernmost population of the Chaco Tortoise (*Chelonoidis chilensis*). This species experiences significant thermal differences between summer and winter, which influence the behavior and ecology of the tortoises. Our goal was to quantify the home range of *C. chilensis* throughout the year and determine where they seek refuge during the winter. Between January 2022 and June 2023, we monitored 3 males and 6 females in Northern Patagonia. We attached small GPS data-loggers to their carapace together with a radio transmitter, recording coordinates every 15 minutes. Every 15 days we registered their trajectories and the type of shelter they used. Despite the thermal differences between summer and winter, they consistently used the same types of burrows across seasons. Of the 17 different burrows used during the brumation period, 59% were shallow caves under shrubs that protected only one-third of their body, 24% were deep caves under shrubs where they protected their full body, and 18% were simple burrows under bushes, exposing the animals to the extreme low temperatures of winter. We estimated their monthly home range as the smallest convex polygon enclosing all the points of each trajectory. The estimated average annual home range was 2846 m² with a standard error of 656 m². As expected, home ranges differed between months. During the brumation period (May, June, July, and August in the Southern Hemisphere), the home range varied from 0 m² to 401 m², except for one male that surprisingly showed activity on sunny days throughout the winter, exploring an area of 1194 m². He even used 3 different but close burrows during his brumation. The maximum monthly home range was 3498 m² in January (Summer). Individuals shared common areas within their respective territories,

regardless of their sex. This overlap can have various implications for social interactions, competition for resources, and population dynamics. This information is highly novel for this species and may help inform future conservation and management strategies to ensure the protection of this endangered species and its environment.
Poster

Hiding in Plain Sight? Distribution of the Yellow Mud Turtle (*Kinosternon flavescens*) in Northeastern Oklahoma

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Oklahoma is biogeographically interesting because diverse taxa have eastern or western geographic range boundaries in the state. Two species of mud turtles (*Kinosternon*) have overlapping longitudinal range boundaries in northeastern Oklahoma: the yellow mud turtle (*Kinosternon flavescens*) and the Mississippi mud turtle (*Kinosternon subrubrum hippocrepis*). While *K. flavescens* has been extensively researched in parts of its range, there are few studies from Oklahoma. Museum records of *K. flavescens* in northeastern Oklahoma are scarce and historic, with the most recent record being in 1977 for Mayes County. The purpose of our study was to determine whether *K. flavescens* is more prominent in northeastern Oklahoma than historical records indicate, potentially converging with state-endangered southwestern Missouri populations. From 2022 to 2023, we sampled northeastern Oklahoma farm ponds and creeks using mark-recapture surveys, alongside salvaging road-killed specimens. Surveys resulted in two new county records for *K. flavescens*, along with observations of the two species co-occurring. It is unclear if these records reflect a lack of historical sampling or a range expansion. Regardless, these new records indicate the eastern longitudinal range boundary of the contiguous range of *K. flavescens* to be near, if not connected, to southwestern Missouri populations, including the most northeastern county of Oklahoma. Although the primarily focus of this study was genus *Kinosternon*, data were taken for all species captured to examine turtle assemblages in northeastern Oklahoma. Red-eared sliders (*Trachemys scripta elegans*) and common snapping turtles (*Chelydra serpentina*) were ubiquitous at sites. Infrequent species included common musk turtle (*Sternotherus odoratus*), eastern river cooter (*Pseudemys concinna concinna*), spiny softshell (*Apalone spinifera*), as well as *K. flavescens* and *K. subrubrum*.
Poster

Mercury Concentrations in River Turtles in a Rural Watershed

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Mercury pollution of aquatic environments is a pervasive threat to semi-aquatic and aquatic species including turtles. Atmospheric mercury is deposited into aquatic environments, sometimes far from the source, where it becomes bioavailable and can bioaccumulate in aquatic organisms, including turtles, as it transfers throughout the food web. Mercury has also been shown to pass from mother to offspring and has been hypothesized to pass through the egg membrane in turtles. Mercury can cause sublethal effects in turtles, including reduced fertility, number of offspring, development, and hatching success, and increased embryonic mortality. While discouraged for conservation concerns, turtles are ingested as food by people. If turtles contain mercury, consuming turtles can lead to the accumulation of mercury in humans, leading to adverse effects on human health. We measured the concentration of mercury in scutes collected non-lethally from turtles of various species and size classes to assess the extent of bioaccumulation within turtles and to view trends within and between species. Mercury concentrations were elevated and exceeded safe levels for human consumption in all species and sizes classes, including in the smallest size class measured (5.1-8.0 cm plastron length). Our data demonstrate that mercury is bioaccumulating in turtles despite no obvious nearby anthropogenic mercury source. Our results support the hypothesis that mercury is passed through eggs to hatchlings from their mother. Our results also demonstrate that turtles are unsafe for human consumption even when harvested from rural areas without local mercury sources. Efforts are needed to reduce mercury emissions and remediate present contamination in aquatic ecosystems to lessen the possibility of mercury-related issues. People should also refrain from consuming turtles to both conserve turtle populations and reduce the risk of mercury-related human health consequences.
Poster

A History of Conservation, Management, and Monitoring Podocnemididae Turtles in a Black Water River in the Brazilian Amazon

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The hunting of wild animals is an activity historically present in rural areas across various regions of the world and represents an important source of protein for the subsistence of the local people who practice it. However, even subsistence hunting can have impacts on wildlife. It is necessary to manage the resource in a way that ensures the needs of local social groups without jeopardizing the ecological functions of wildlife. Despite this, there are few formal initiatives for wildlife management in tropical forests. Turtles are the second most consumed resource in the Amazon region, with 90 individuals being killed per hour in the city of Manaus alone. Therefore, conservation and management initiatives are essential for the maintenance of the group. Because of the high demand for turtles in both urban centers and local communities, monitoring of Unini river turtles began in 2010 to achieve population stability of turtles, combining the conservation of these species with fully sustainable consumption practices. For 12 years, the consumption of individuals and eggs by communities has been monitored, and for the past nine years, monitoring of nesting areas and individuals has been ongoing. During this period, approximately 27,722 individuals and 58,776 eggs were consumed among the nine river communities. Additionally, 983 individuals of five turtle species (*Podocnemis erythrocephala*, *P. expansa*, *P. unifilis*, and *Peltocephalus dumerilianus*) were captured and tagged, and 3,132 nests were protected, with 7,289 hatchlings released. Our next step is to develop management strategies that implement defined quotas for egg and individual consumption by local communities and measure the effect on the wild turtle populations.
Oral

Habitat Associated Variation in Body Size of Yellow-bellied Sliders (*Trachemys scripta scripta*) in a Northern Florida River

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The occurrence of a few exceptionally large individuals within a turtle population may suggest an association between body size and habitat type or geographic location, but a larger sample and comparative data from other local habitats are needed before such a conclusion can be made. For example, recently reported record-size individuals of several species (e.g., *Trachemys scripta*, *Chelydra serpentina*) from some of Florida's spring-fed habitats suggest these environments promote exceptional growth and attainment of larger than normal body sizes. We used capture data from a 16-year study to compare body sizes of adult female and adult male Yellow-bellied Sliders (*T. s. scripta*) among three different riverine habitats in the Santa Fe River (SFR) ecosystem in northern Florida to test the assumption that large body sizes are associated with springs. The largest known female and male *T. s. scripta* have been reported from the Ichetucknee River (IR), a spring fed, clear-water tributary of the SFR. The SFR originates as a tannin-stained blackwater river but receives substantial input from many artesian springs in its lower reaches as it flows west to its confluence with the Suwannee River. Our sampling sites are a 5-km reach of blackwater river in the upper section of the SFR, a 9-km reach of spring-influenced blackwater river in the lower SFR, and a 6-km reach of the entirely spring-fed IR. The blackwater reach is geographically separated from the other reaches by a 5-km land bridge; the spring-influenced blackwater reach and IR are separated by 25 river km. Our results indicate there is no significant difference in the average body size of adult female or adult male *T. s. scripta* among the three riverine habitats, suggesting that exceptionally large individuals found in spring-fed habitats are not representative of conspecifics sharing their local habitat.
Oral

Focusing Conservation Efforts for Critically Endangered Softshell Turtles Outside Protected Areas

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The Cantor's Giant Softshell Turtle (*Pelochelys cantorii*) and Leith's Softshell Turtle (*Nilssonia leithii*) are two critically endangered and endemic species found in the Cauvery River, Tamil Nadu, India. The river flows 800 km through two states Karnataka and Tamil Nadu. The section passing through Tamil Nadu is highly diverted and utilized for irrigation and industries. Recent surveys in 2021, for *P.cantorii* near the Grand Anicut region in Cauvery revealed the presence of both species. Furthermore, signs of nesting turtles falling prey to mongooses along the riverbanks emphasized the breeding activity of these species in the area. Given the absence of protection status, these unique turtles face threats like poaching and habitat degradation in Tamil Nadu. The conventional conservation strategies primarily concentrate within protected areas, leaving unprotected regions like this overlooked. The discoveries of these endangered turtles beyond the borders of sanctuaries provide a glimmer of hope for the species' survival. This underlines the importance of extending conservation efforts to unprotected areas. To address this critical gap, it is imperative to engage local stakeholders actively and raise awareness among communities. By involving these stakeholders in conservation activities, we can create a sense of shared responsibility toward safeguarding the future of these imperiled species. This necessitates a paradigm shift in conservation practices, highlighting the urgency to protect and preserve these threatened turtles beyond the reaches of designated sanctuaries.

Oral

Hiding in Plain Sight: Federally Protected Ringed Map Turtles (*Graptemys oculifera*) Found in a New River System

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Understanding the geographical range of a species is essential to successful conservation and management, but their ranges are not always fully known. Ringed Map Turtles (*Graptemys oculifera*) have been federally listed as a Threatened species since 1986, and they have long been considered endemic to the Pearl River system of central Mississippi and southeastern Louisiana, USA. Based on a 2021 citizen scientist observation, a new *G. oculifera* population was discovered in the Bogue Falaya, a river system that is west of and isolated from the Pearl River system. Genetic analyses of 23 individuals from the Bogue Falaya demonstrate their genetic distinctiveness relative to sites in the Pearl River, suggesting it is a natural rather than introduced population. Therefore, *G. oculifera* should no longer be considered endemic to the Pearl River system, and this Bogue Falaya population of *G. oculifera* may warrant the designation of a distinct population segment under the U.S. Endangered Species Act. A thorough assessment of the distribution, abundance, and conservation threats to the Bogue Falaya population of *G. oculifera* as well as surveys of surrounding systems could help to inform future management actions. This discovery of a long-time federally protected species in the city limits of Covington, Louisiana, documents how citizen scientists can advance scientific knowledge.

Poster

Range-wide Survey with Ecological and Genetic Characterization of the Rough-Footed Mud Turtle (*Kinosternon hirtipes*)

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The Rough-footed Mud Turtle (*Kinosternon hirtipes*) is widely distributed, typically occurring in isolated populations, and may contain multiple, evolutionarily distinct lineages. Populations in Texas, USA, and Chihuahua, México, have very low genetic diversity and management actions may be required to ensure their survival. Development of sound management recommendations and actions requires additional data and research. Increased geographic sampling will allow us to characterize lineages within *K. hirtipes* and assess the patterns of genetic, and ecological differentiation among them. We do not know what the major geographic and ecological barriers to dispersal and gene flow among populations are, which limits our ability to understand how climate change will impact different populations. Furthermore, we have little understanding of the demographic history of this species, or any lineages contained within this taxon. This project utilized environmental DNA (eDNA) sampling, in addition to traditional trapping methods, to detect the presence of the target species. Several sites sampled

outside the known range in Texas have yielded positive eDNA results although turtles have not yet been detected at any novel sites. Over a century of altered hydrological regimes and decimated riparian habitats, as well as increasing demands on groundwater, paint a dismal future for northern populations of this species.
Oral

Asian Giant Softshell Turtle (*Pelochelys cantorii*): Illegal Capture and Trafficking in Cambodia

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The Cantor's Giant Softshell Turtle (*Pelochelys cantorii*) is listed as Critically Endangered on the IUCN Red List and ranked as Endangered on the Cambodian Fisheries Red List. Its status is in part due to life-history characteristics of low annual reproductive output, high mortality rate of eggs and juveniles, a lengthy period to reach maturity (typically over a decade), and a reproductive lifespan of several decades. Populations are severely threatened by rapidly increasing human populations and rural development accompanied by rapid loss or degradation of forest and wetland habitat, as well as unsustainable levels of exploitation for food and traditional medicines. Before the 2000s, Asian Giant Softshell Turtle collection by local communities occurred, but the species was not commonly trafficked, largely due to the absence of road network, and the abundance of other fisheries resources. Traditionally, villagers consumed these turtles exchanging them for rice or other goods, or selling locally within their communities. Between the early 2000s and 2010s, the market value of Asian Giant Softshell Turtle increased dramatically, and it started being sold in some markets for up to 15,000 riels (US$4.00) per kilogram, although capture remained relatively opportunistic. From 2010s to 2020, the demand for Asian Giant Softshell Turtle increased, apparently driven by the demand from urban rich consumers. The market became more important, with prices ranging from 30,000 to 40,000 riels (US$8.00-10.00) per kilogram, and local and non-local fishermen started to capture them intentionally. Since 2017, WCS has been implementing a project to protect the Asian Giant Softshell Turtle population along the Mekong River in Cambodia through conservation interventions that include 1) nest protection, 2) joint Fisheries Administration (FiA)-Community patrols, 3) support to Community Fisheries (Cfis), 4) conservation awareness raising, and 5) livelihood alternatives (Aquaculture and Livestock. Our recent nest monitoring data strongly suggests a sharp decline in the Asian Giant Softshell Turtle population in the Mekong River. The number of nests found along the Mekong River dramatically decreased from 65 in 2022 to ten in 2023. The drivers of this decline remain poorly understood.
Oral

Estimating the Threat to Bolson Tortoises (*Gopherus flavomarginatus*) Posed by the Presence of RoadS

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The Bolson Tortoise (*Gopherus flavomarginatu*s; listed as "Endangered" by the USFWS and as "Critically Endangered" on the IUCN Red List) is endemic to the Chihuahuan Desert, the northern tip of which extends into southern New Mexico in the US. Working on a private ranch, we recently released 101 juvenile Bolson Tortoises with VHF transmitters to begin establishing free-living Bolson Tortoise populations in the US. Following a particularly rainy period in summer 2022, we frequently encountered tortoises or tortoise tracks on or along unpaved ranch roads near the release site during regular tracking surveys, and we noticed that tortoises seemed to spend quite a bit of time on the road. Moreover, 12 of the tortoises moved closer to the road during the 2022 active season and established new overwinter burrows within 35 m of a road (average: 16.1 m; range: 1.7-34.5 m). Six additional tortoises that established burrows within ~100-200 m of a road (average: 131.4 m; range 98.4-199.7 m) were also occasionally observed using the road in 2022. To gain a better understanding of how much danger threats like vehicle traffic or predators associated with these roads could potentially pose to 'road-using' tortoises, we initiated a pilot study in 2023 to quantify the average *distance* tortoises travel along roads and the average amount of *time* tortoises spent on or near a road. In addition to measuring and recording fortuitously encountered tortoise tracks on roads, during several randomly chosen days in summer of 2023 we monitored a 'popular' ~300 m section of road for the presence of tortoises and recorded when and where tortoises entered and exited the road. Once the tortoise had returned to its burrow we measured its distance traveled by following its tracks using a measuring wheel, and we calculated the total time the tortoise spent on the road. We also deployed game cameras to count the number of vehicles and the number and species of potential predators using the road

each day. Although overall road use by tortoises was reduced compared with previous years, overall tortoise activity was also reduced in 2023, most likely due to drought conditions.
Poster

Are They Still There?: Evaluation of the Conservation Status of the Pacific Coast Musk Turtle (*Staurotypus salvinii*) on the Coast of Chiapas, Mexico

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The Pacific Coast Musk Turtle (*Staurotypus salvinii* Gray 1846) is one of the of the least studied turtle species worldwide. The distribution of this turtle is restricted to the Pacific coast of Central America, from the state of Oaxaca (southeastern Mexico) to El Salvador. This zone has been identified as an area of high natural alterations for real estate development and tourism. Despite being highly traded illegally as pets and food, *S. salvinii* is currently considered as Near Threatened under the IUCN Red List. As a result of these challenges, there is currently uncertainty regarding the conservation status of wild populations of this turtle throughout its distribution. The register of basic ecological data is fundamental to applied conservation programs according to the socio-environmental context. Due to the above, the aim of this study was to analyze the population status throughout the Pacific Coast of Chiapas, México. Additionally, we recorded the use of *S. salvinii* by local communities and gathered their perspectives on the status of the populations and the main activities influencing the decline of their populations. Considering the published literature, consultation with the environmental secretaries of the Mexican government, and historical records in public databases, we conducted the work in 25 localities from 2019 to 2023. According to the results, individuals were only detected in 20% of the locations visited, with all populations represented by medium-sized individuals (larger juveniles and/or small adults). In all localities, the use of *S. salvinii* as a complementary food, which holds great importance in the religious festivities of Holy Week, was recorded. Most of local people (~70%) agreed that wild populations of *S. salvinii* have decreased due to excessive local consumption and annual fires. Approximately half of those interviewed mentioned that mangrove logging and filling in estuaries have contributed to the local disappearance of this turtle. The presence of three crucial sites for conservation programs focused on the species is identified. Lastly, with the information recovered over five years, it is recognized that a reassessment of the conservation status at the national and international level is essential to promote the protection of *S. salvinii*.
Oral

Eastern Box Turtle (*Terrapene carolina*) Monitoring at the Nashville Zoo

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Chelonians are an especially imperiled faunal group, with over half of known species being of conservation concern worldwide. Most turtle species exhibit the life history traits of delayed sexual maturity and low offspring survivorship, which often results in slow population recruitment. Because of this, turtles can be particularly impacted by human made disturbances, such as urbanization. The Eastern Box Turtle (*Terrapene carolina*) is a terrestrial species of emydid turtle native to the eastern and central United States. Though widely distributed and often locally common, this species is experiencing range-wide population declines due to a variety of factors, including habitat alteration or fragmentation, disease, and the impact of subsidized predators on nesting success. Because of this, the e Eastern Box Turtle is a species of conservation concern in many range states, including Tennessee, where it is considered a Species of Greatest Conservation Need by the TN State Wildlife Action Plan. In order to assess their status on the grounds of the Nashville Zoo, the Herpetology Department is conducting a long-term project consisting of mark-recapture and radio telemetry of free-ranging box turtles on the property. As of the beginning of the season in 2024, a total of 119 turtles have been processed and individually marked and 25 turtles have been tracked via radio telemetry over our 4 years of study. Working alongside with Tennessee Wildlife Resource Agency (TWRA), we have been able to start a disease study by taking swabs of turtles when found, as well as looking at microhabitat data to start to understand why these turtles are choosing certain areas to inhabit.
Oral

Elongated Tortoises (*Indotestudo elongata*): A Study of Variables Affecting Hatchling Survival Rates in Captivity

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The Elongated Tortoise (*Indotestudo elongata),* is listed as Critically Endangered by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species since 2019. Furthermore, this species is listed under Appendix II in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Although they are a relatively widespread species, occurring through much of Asia, the species faces threats from habitat loss and overexploitation for human consumption and the commercial trade. Species recovery in Cambodia depends on a combination of effective protection of remaining wild populations, and reintroduction of captive-bred tortoises to enhance or restore depressed or extirpated populations. The Angkor Centre for Conservation of Biodiversity (ACCB) maintains the only assurance population of Elongated Tortoises in Cambodia. This population is founded with individuals obtained through wildlife rescue and rehabilitation efforts, and a pilot augmentation translocation study of captive-bred and head-started Elongated Tortoises from this assurance population is underway. In April of 2024 the assurance colony at ACCB consists of 310 individuals, of which 210 were hatched between 2012 and 2023. Increasing the number of founders and enhancing husbandry practices resulted in a rise in egg production and hatching rates, from breeding eight individuals in 2012, to a record breaking 124 in 2023. In this talk, we discuss successful measures implemented, alongside the ineffective trials and challenges that a booming population comes with. All data is taken from ZIMS, Zoological Information Management System, and was recorded between the years of 2017 and 2023. One study of wild populations found a survival rate of 67% for hatchlings within the first three months of life, and for offspring hatched in 2023, the ACCB had an 81% survival rate for the same duration, highlighting the benefits of the ex-situ work. However, between the 3-6 month mark this survival rate dropped drastically to 51%. This talk discusses the potential causes and correlations identified, specifically looking at the role climate, disease and incubation type plays in the continuous survival of hatchlings.

Oral

Insights into the Reintroduction Ecology of the Critically Endangered Elongated Tortoise (*Indotestudo elongata*) in Cambodia

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The Elongated Tortoise (*Indotestudo elongata*), a critically endangered species found in South and Southeast Asia, faces severe threats from habitat loss and overexploitation for human consumption and traditional medicine. To mitigate the risk of extinction, the Angkor Centre for Conservation of Biodiversity (ACCB) established and maintains the largest assurance population globally for this species and initiated the first-ever soft-release program for head-started individuals of the F1 generation in January 2022. This pilot study seeks to monitor the translocated tortoises, in order to gain insights into their behaviour and ecology. The findings will be valuable for conservation efforts for the species and will inform future translocation strategies. Over a period of eight months in 2023, 100 Elongated Tortoises were carefully monitored in an acclimation pen built at a secure Wildlife Sanctuary within their natural habitat, a bamboo-mixed deciduous forest, before 84 individuals were allowed to self-liberate from the pen in January 2024. Individuals selected based on carapace length and assessed as fit for release after undergoing extensive health screening, were fitted with GPS and/or VHF trackers for continuous monitoring post-release, spanning a minimum of two years. Data collection will focus on understanding their ecological needs and home range establishment, including dispersion, habitat preference, and survival. All VHF-tagged tortoises are currently being monitored weekly, with GPS data collected every four months. We will discuss the adaptation of tortoises to their new environment and present the data gathered during the initial five months post-release. We will also highlight the challenges faced during this timeframe.

Oral

Celebrating Ten Years at the Hicatee Conservation and Research Center in Belize

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The Central American River Turtle (*Dermatemys mawii*), colloquially known as the Hicatee in Belize, has faced drastic declines in population due to significant removal of the species from their habitat for human consumption. As part of BFREE's ongoing multi-disciplinary conservation efforts and to prevent this critically endangered species from imminent extinction, in 2014 the Hicatee Conservation and Research Center (HCRC) was established in partnership between BFREE and Turtle Survival Alliance. The goals of the HCRC are to conduct research on the reproductive biology and nesting ecology while building a large assurance colony to aid in reintroductions. The HCRC is the first facility to successfully breed high numbers of Hicatee in captivity. Because of the unique physiology of the species, husbandry techniques have been adapted to mimic the most natural habitat conditions for the species to grow and reproduce. We've made modifications over the years to the facilities to better suit the turtle's needs and to mirror conditions in the wild. After ten years in operation, we have successfully hatched over 1,000 eggs – of which over 500 have been released into the wild. In this talk, we will describe the advances in the facility and our associated programming over those ten years and will highlight lessons learned, challenges and successes. We will describe Hicatee Awareness Month and National Hicatee Day, which are outreach initiatives born from this program. We will also detail the development of the Conservation, Management and Action Plan for the species and other bold actions that have taken place to ensure the long-term success of the program.
Oral

Description of the Courtship Behavior of the Mexican Spotted Wood Turtle (*Rhinoclemmys rubida rubida*) in Captivity, Belonging to the Collection of the Mexican Turtle Center (CMT) in Mazunte, Oaxaca, Mexico

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The Mexican Spotted Wood Turtle (*Rhinoclemmys. rubida rubida*) is a terrestrial organism endemic to Mexico, found in the states of Oaxaca and Chiapas. This species is distinguished by its head with yellow stripes; morphologically, it has a brown shell, with vertebral and marginal shields darker than the costal ones, and a yellow spot on each central shield. It feeds mainly on plants, especially cacti. Regarding reproduction, they exhibit sexual dimorphism based on size, with males usually being smaller with a larger tail. The incubation period of the eggs is 3 months, and the CMT has the first record of reproduction in captivity. This species is listed as near threatened according to the IUCN and as subject to special protection according to the NOM-059-SEMARNAT-2010, with the main risk factors being habitat destruction through logging and wildfires. Daily monitoring of the organisms was conducted for 3 months during their breeding season at the CMT facilities. Behavior was captured on videos, which were subsequently analyzed for a detailed description of courtship. Currently, no previous publications related to the reproductive behavior of this species have been found, so we invite the scientific community to conduct further studies regarding its behavior in both wild and captive settings.
Poster

Evaluating Translocation Strategies for Box Turtles in Urbanizing Landscapes

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Translocation is a common management strategy for wildlife populations, yet hard-release of reptiles, including box turtles (*Terrapene* spp.), has often proven ineffective due to homing attempts and wandering. Soft-release translocation has been presented as a possible method for mitigation of the negative effects of hard-release translocation, but studies incorporating standard soft-release strategies have produced mixed results and often see persistent homing attempts by soft-released study animals. We examined long-term holding (>1 year) of box turtles prior to translocation as a means to reduce homing attempts and wandering commonly observed in immediate-release box turtles. We radiotracked translocated Three-toed Box Turtles (*Terrapene carolina triunguis*) to compare movements of nine immediate-release box turtles and nine box turtles that had been maintained for > 1 year at a nearby off-site holding facility (long-term holding) prior to a 750 - 1000 m translocation. Box

turtles held long-term before a short-distance translocation moved significantly shorter distances each day post-release than immediate-release turtles. Turtles held long-term moved in nondirectional, random orientations, whereas immediate-release turtles exhibited consistent directionality in movements back towards their initial capture (home) locations. Our results demonstrate that turtles held off-site remained within the translocation site more reliably than the immediate-release turtles, which had a higher tendency to home. Long-term holding of turtles prior to translocation could significantly reduce homing responses and wandering, thus increasing translocation efficacy while reducing intensity of post-translocation management.
Oral

Gopher Tortoise Research and Management at an Urban Nature Preserve in Central Florida

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The Gopher Tortoise (*Gopherus polyphemus*) is an imperiled keystone species that occurs in upland habitats within the Southeastern Coastal Plain of the United States. Listed as Threatened by the Florida Fish and Wildlife Conservation Commission (FWC), this species is in steep decline primarily due to habitat loss and modification. Gopher Tortoises are ecosystem engineers that create extensive burrow systems and disperse seeds, significantly contributing to upland biodiversity. This herbivore is dependent on fire to maintain open upland habitat with abundant rich forage species. The burrow systems serve as refugia from extreme temperatures, fire, and predators for tortoises, and over 364 other documented species rangewide. We report on Gopher Tortoise research and management challenges on 150.0 ac (60.7 ha) of upland habitat in a remnant natural area (Boyd Hill Nature Preserve) in urban St. Petersburg, Florida. This population is of regional significance and the preserve is included on an FWC list of public and protected lands relevant to the species' conservation in Florida. Mark-recapture was conducted from 1991-2013, then reinitiated in 2018. Biannual burrow censuses (100%) that started in 2011 generate data that informs management decisions and allows preserve staff to assess habitat management strategies and track the success of such efforts. The most recent burrow census (2022) generated an estimated population size and density of 144.5 and 1.0/ac (0.40/ha) respectively. Studies on demographics, diet, movement, physiology, reproduction, and social behavior were added beginning in 2018. Research focused on nest site choice revealed nesting inside the burrow. Multiple threats (e.g., inadequate fire regime, invasive vegetation, predation, and road mortality) have presented significant habitat and tortoise management challenges. A recent mass mortality event due to Coyotes (*Canis latrans*) will be discussed. We will review past and current habitat restoration and management efforts (e.g., prescribed fire, thinning of trees, and control of invasive non-native plant species), and discuss the challenges of managing a natural area bordered by urban interface.
Oral

Abundance and Road Mortality of Box Turtles (*Terrapene carolina triunguis; T. ornata ornata*) in Central Oklahoma

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Urbanization changes natural habitats into developed areas in ways that ostensibly benefit humans. One of the most significant factors in the spread of urban environments are the road systems that branch across countries worldwide, causing fragmentation of natural habitats. Box turtles have life histories that make them vulnerable to encounters with vehicles when crossing roads. Increased mortality resulting from vehicle encounters are expected to reduce population density, average body size, and average age. We tested predictions about the effects of road mortality on demography in box turtles (Three-toed Box Turtle [*Terrapene carolina triunguis*] and Ornate Box Turtle [*T. ornata ornate*]) using road surveys. We do this by making two comparisons using three data sets. The first dataset was collected during 1995-2000 from rural Oklahoma and Logan County roads. We collected the other two datasets during the 2022 and 2023 field seasons. First, we replicated the 1995-2000 samples by intensively surveying the same network of roads every day during the box turtle activity season. The third dataset involved road surveys in rural Payne County, to replicate the conditions in rural Oklahoma and Logan County in the late 1990s. When comparing datasets, there is no apparent difference in sex ratios. Instead, we found that in the new data, *T. o. ornata* was encountered far less than *T. c. triunguis*. When comparing the number of captured versus salvaged box turtles across the data

sets, we found that in the 1995-2000 and new Payne County samples there were more than twice as many box turtles captured than those salvaged. However, in the new Oklahoma County samples, roughly 1 of 3 turtles were found dead on the road. More turtles were salvaged in areas of higher traffic while more live turtles were captured in lower trafficked areas across all three datasets.

Poster

Bolson Tortoise (*Gopherus flavomarginatus*) Reproduction and Nest Site Selection at the Semi-Captive Tortoise Rearing Facility in New Mexico

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The Bolson Tortoise (*Gopherus flavomarginatus*; listed as "Endangered" by the USFWS and as "Critically Endangered" on the IUCN Red List) is endemic to the Chihuahuan Desert, the northern tip of which extends into southern New Mexico in the US. Starting with 30 captive adult and sub-adult Bolson Tortoises in the fall of 2006, the Turner Endangered Species Fund (TESF) spearheads a unique Bolson Tortoise breeding and head-starting project that has produced over 700 juvenile bolson tortoises ranging in age from 0-18 years in 2024. As head-started female bolson tortoises reach reproductive age, we can now begin to document age and size at first reproduction for female Bolson Tortoises. Thus far, only two of the female offspring (16 and 17 years old, respectively) show signs of reproductive maturity. Thus, preliminary results suggest that females require at least 16 years to reach an average minimum reproductive size of ~300 mm straight-line shell length. Nearly two decades of monitoring individual adult females for reproductive output and hatching success rates show that in northern Chihuahuan Desert habitats, the average clutch size is 5.1, all tortoises appear to produce at least one clutch every year, and some tortoises lay up to three clutches in a year between the end of April and the end of July. Hatchlings emerge after ~ 3 months (100-120 days). Hatching success varies from female to female and from year to year, but the overall average hatching success rate is ~ 60%. Like other *Gopherus* species, Bolson Tortoises exhibit temperature-dependent sex determination and cooler incubation temperatures produce males while warmer temperatures produce females. In 2023, we mapped the location of 33 nests produced by the 13 female tortoises in our breeding group. We found that only six of the 33 (18.2%) were associated with a tortoise burrow, while the majority of the nests were located in diggable soil along fence-lines.

Oral

TEAM TERRAPIN: Impacts of Undergraduate Research Experiences, Participatory Science, and Strategic Partnerships

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In scientific research, the utilization of Undergraduate Research Experiences (URE), Participatory Science, and collaborative Partnerships has been a longstanding practice for data collection. Historically, these methods have often been employed individually within research projects. In the initial phase of this study, a graduate student enlisted undergraduates to assist in data collection. Subsequently, the project transitioned to the domain of Florida State Parks, leading to significant changes and adaptations in data collection techniques. In 2016, Team Terrapin was established. A pivotal development occurred in 2022, when a partnership was forged with the Turtle Survival Alliance – North American Freshwater Turtle Research Group. This partnership proved transformative, leading to over a threefold increase in volunteer participation within the first year and a subsequent 1.5-fold rise in the second year. Notably, nest counts exhibited a striking increase, nearly doubling the highest historical counts and quadrupling the lowest historical counts. These synergistic methods not only fostered a substantial volunteer base but also facilitated the application of advanced data collection methodologies. This collaborative approach has significantly enhanced the impact of conservation efforts, highlighting the efficacy of integrating URE, Participatory Science,

and strategic Partnerships in ecological research and wildlife conservation and has resulted in increased awareness, funding, and species protections. Additionally, this success has resulted in expanded partnerships within the community and multiple collaborations.
Oral

Outdoor Growing Area? What's That?
An Overview of Methods for Hydroponically Growing Produce Indoors to Feed Chelonians
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Commercial produce sources are not always consistent in quality and prices fluctuate greatly – usually in an upward direction. It is also difficult to determine what chemicals (e.g., pesticides) the produce has been exposed to. One solution is to grow the food yourself – but that traditionally requires outdoor space, which is something that we do not have at the Aquarium. In 2023, the horticultural staff at the Tennessee Aquarium began an effort to grow produce such as greens and tomatoes hydroponically. This started on a small scale as proof of principle, but now enough produce is grown to feed not only turtles and tortoises but also lemurs. The horticulturists continually refine their methods; they also research and try new food items to increase dietary variety. This presentation will cover the specifics of the methods and setups used as well as issues resolved as this program evolved.
Oral

Diversity and Diversification in Mud Turtles, an American Tale
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The mud turtle genus *Kinosternon* is the most speciose among extant turtles, with 22 currently recognized species, distributed across large parts of the Americas. Most species have small distributions, but the White-lipped Mud Turtle *(Kinosternon leucostomum)* and Scorpion Mud Turtle (*K. scorpioides)* range from Mexico to South America. Previous studies have found discordance between mitochondrial and nuclear phylogenies in some kinosternid groups, with the current taxonomy following the nuclear-based results. Herein, based on extended molecular, geographic and taxonomic sampling, we explore the phylogeographic structure and taxonomic limits for the White-lipped Mud Turtle (*Kinosternon leucostomum*) and the *K. scorpioides* group (Central Chiapas Mud Turtle [*K. abaxillare*], Mexican Mud Turtle [*K. Integrum*], Oaxaca Mud Turtle [*K. oaxacae*], White-throated Mud Turtle [*K. s. albogulare*], Red-cheeked Mud Turtle [*K. s. cruentatum*], and Scorpion Mud Turtle [*K. s. scorpioides*]) and present a fossil-calibrated nuclear time tree for *Kinosternon*. Our results reveal contrasting differentiation patterns for the *K. scorpioides* group and *K. leucostomum*, despite overlapping distributions. *Kinosternon leucostomum* shows only shallow geographic divergence, whereas the *K. scorpioides* group is polyphyletic with up to 10 distinct taxa, some of them undescribed. We support the elevation of *K. s. albogulare* and *K. s. cruentatum* to species level. Given the deep divergence within the genus *Kinosternon*, we propose the recognition of three subgenera, *Kinosternon*, *Cryptochelys* and *Thyrosternum,* and the abandonment of the group-based classification, at least for the *K. leucostomum* and *K. scorpioides* groups. Our results show an initial split in *Kinosternon* that gave rise to two main radiations, one Neartic and one mainly Neotropical. Most speciation events in *Kinosternon* occurred during the Quaternary and we hypothesize that they were mediated by both climatic and geological events. Additionally, our data imply that at least three South American colonizations occurred, two in the *K. leucostomum* group, and one in the *K. scorpioides* group. Additionally, we hypothesize that discordance between mitochondrial and nuclear phylogenetic signal is due to mitochondrial capture from an extinct kinosternine lineage.
Oral

Using Camera Traps to Determine Activity Patterns and Burrow Use in Speke's Hinge-back Tortoise (*Kinixys spekii*)

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Here we examine burrow utilization and activity patterns of Speke's Hinge-back Tortoise (*Kinixys spekii,* Gray 1863) based on camera trapping of burrow entrances in South Africa and Eswatini. Both study sites are located in the Savannah lowveld but exhibit distinct differences in vegetation type and density, climatic conditions, and tortoise populations. The Tshukudu Game Reserve situated in Hoedspruit, South Africa, features a granite lowveld habitat, endures extreme heat during summer, and appears to have a relatively sparse tortoise population. The Mbuluzi Game Reserve, located 230 km further south in northern Eswatini is covered with dense Tshokwane-Hlane Basalt Lowveld habitat. This reserve enjoys higher humidity and more consistent rainfall, supporting a notably higher density of tortoises. The study sides exhibited distinct activity and burrow utilization patterns. In the drier and more open Savannah habitat of Tshukudu, the burrow was almost exclusively and continuously used by a single female tortoise. In contrast, the burrow located in the denser vegetation of the Mbuluzi Reserve was used by 13 different individuals that only occasionally returned. Activity in both sites was higher during the summer (November-April) with little to no activity in winter. Daily activity also varied between sites. The tortoise at Tshukudu was predominantly active in the mornings and afternoons, whereas activity in Mbuluzi was more evenly distributed throughout the day.

Oral

The Phenology of Brumation Emergence in the Yellow Mud Turtle (*Kinosternon flavescens*) in Nebraska

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We quantified brumation emergence dates for 14,196 Yellow Mud Turtles (*Kinosternon flavescens*) captured from a population in the sandhills of Nebraska between 1983 and 2018. Average spring emergence date over nine years for 1,691 adult (≥85 mm carapace length) males was 29 April and for 2,546 females was 4 May. For 6,119 juveniles and 3,761 hatchlings it was 22 and 21 May, respectively, over 12 years. However, these means varied by about three weeks among years, and emergence seasons for each cohort were typically about 40 days in length. Average emergence date across years for adult males and females was related primarily to spring temperatures. Average dates for juveniles and hatchlings were not correlated with general patterns of spring weather; however, the combination of warm temperatures for several days with rainfall stimulated the most emergence. Emergence date was inversely related to body size and age. Females that nested in a respective year of emergence had better body condition, but did not emerge earlier than those that did not. Although spring emergence was influenced by temperature and moisture, precise timing varied primarily by individual and year.

Oral

The Spatial Ecology of Spotted Turtles (Clemmys guttata) at Their Northern Range Edge in Michigan

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Understanding an animal's spatial ecology is critical to developing effective management plans for the species. In Michigan, United States, the Spotted Turtle (*Clemmys guttata*) is listed as a state-threatened species and regional studies on its spatial ecology have been limited. Spotted Turtles face many of the same threats as other turtle and tortoise species, such as habitat fragmentation, predation, and road mortality. The goal of this study is to provide baseline information on the spatial ecology of Spotted Turtles in Northern Michigan and inform conservation and management plans for Spotted Turtles both locally and throughout their northern range. We used radio telemetry to track Spotted Turtles (n=15) at two sites in a National Forest in Michigan, across two years (2022, 2023). These location data were used to estimate home range areas and quantify habitat selection, which were then compared between sexes, age classes, seasons, and years. We saw average annual home range areas

of 3.01 (SE ± 0.71) ha and limited seasonal variation in habitat selection. Among turtles tracked across both years (n = 9), mean home range overlap was 41.89 ± 8.09 % and high overwintering site fidelity was observed. We did not observe significant differences in home range sizes between sexes, age classes, or years in this population. The results of this study are preliminary and data collection will continue through the 2024 active season. Data collected in this study will be used to develop effective local management recommendations for Spotted Turtles in the National Forest through collaboration with the United States Forest Service.

Oral

Changes in Growth and Maturation of Suwannee Cooters (*Pseudemys concinna suwanniensis*) in Response to Habitat Disturbance in the Santa Fe River

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Florida's springs have created habitats that support species rich assemblages of freshwater turtles. But many of these habitats have undergone changes in the diversity and abundance of their submersed aquatic vegetation (SAV). For example, the Santa Fe River (SFR) in northern Florida exhibited a shift in dominant SAV from rooted macrophytes to macroalgae in 2013–2014. Our long-term (2004–present) mark-recapture study of turtles in the SFR has provided an opportunity to assess some of the possible consequences of this habitat disturbance to each of the 11 native species. The dominant species in the SFR assemblage is the Suwannee Cooter (*Pseudemys concinna suwanniensis*), and we examined whether this herbivorous species exhibited any changes in growth associated with the vegetation shift. We found that the relative annual instantaneous growth rate of juveniles (< 150 mm straight-midline plastron length) was significantly lower during 2015–2022 (macroalgae dominated SAV) than during 2008–2012 (rooted macrophyte dominated SAV). This decline in juvenile growth led to delays in the onset of sexual maturity of ca. 1 year (from 5 to 6 years) in males and ca. 4 years (from 12 to 16 years) in females. Our results suggest that under the current ecological conditions in the SFR the *P. c. suwanniensis* population is less resilient to anthropogenic threats such as illegal harvest than before the vegetation shift.

Oral

What does the Turtle Say? The Role of Vocal Communication in the Life of Turtles

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Recent studies have shown that vocal communication is a common place behavior among turtles, rejecting previous hypotheses that only few turtle lineages can vocalize. Despite the important recent advances in turtle bioacoustics, the present knowledge is still rudimentary and scarce, preventing a broader understanding of ecological contexts, associated behaviors, and even morphological mechanisms used by turtles when communicating vocally. Much ground work is needed in order to put turtles at the same level of bioacoustics research observed in groups such as birds and mammals. Here, a plethora of methods were used – from computed tomography scans to sound recordings – in order to set base knowledge from where turtle bioacousticians can advance research in the field. This research focus on turtles as a whole group (Testudines), and includes data from both the fossil record and living species, as an effort to bring evolutionary insights to diverse ecological questions. This talk summarizes the findings of three correlated yet different studies and showcases findings on synchronicity, ontogenetic changes, and morphological mechanisms associated to vocalizations in turtles.

Oral

Recovery of Geometric Tortoise (*Psammobates geometricus*) Populations from Fire Through Hatchling Harvesting and Headstarting

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The habitat of the critically endangered Geometric Tortoise consists of wildfire adapted lowland fynbos and renosterveld shrublands of South Africa's Western Cape. This habitat is under constant threat of runaway wildfires during the hot and dry summers so non-burrowing juvenile and adult Geometric Tortoise populations are highly vulnerable and have near-total die off in areas subject to frequent burning. Immediate post-fire predators including highly subsidized and numerous crows and ravens, as well as ants, consume dead, injured, and any surviving juvenile tortoises exposed by lack of vegetative cover. This tortoise has a seasonally adapted breeding strategy that involves rainy season nesting in September and October with post-summer emergence of hatchlings shortly after the fall rainy season begins in April through May when some herbaceous food plants also appear. However, following wildfires, there is reduced vegetative cover and hatchlings are typically subject to intense predation. Because this population is surrounded by incompatible agricultural and urban land use and suffers from aerial predators, there is little prospect for natural population recovery without conservation management intervention. Here we report intervention efforts on a 57.5 ha fynbos burn in November, 2023 and January, 2024 that killed 79 adult Geometric Tortoises including 37 mature females. A further 19 living tortoises including 10 females were rescued. So we estimate that 47 females were potentially able to lay eggs before the fire and those eggs are now in the ground raising the question whether eggs in the ground that are not affected by fire can help restore the population. Based on typical clutch size of 3 to 5 eggs with a 30% frequency of double clutching and a conservative estimate of 60% egg hatching success, we estimate a potential of 150-200 emergent hatchlings from the burn area. During April and May 2024, human search teams, trained scent detection dogs and cover-board hides were used repeatedly along with avian predator harassment to assess the general efficacy of harvesting hatchlings for relocation to fully protected headstarting enclosures.
Oral

Use of Aerial Drones and Artificial Intelligence to Locate Bolsón Tortoises (*Gopherus flavomarginatus*) and Their Burrows

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The Turtle Conservancy (TC) and Habitat para la Biodiversidad (HABIO) created the Bolsón Tortoise Ecosystem Preserve (BTEP) from Ranchos San Ignacio and Guimbalete in the Bolsón de Mapimi Biosphere Reserve in Durango and Coahuila, Mexico, for the purpose of conserving lands for the Critically Endangered Bolsón Tortoise (*Gopherus flavomarginatus*). Composed of 25,334 ha, the Preserve presents a challenge for us to estimate the tortoise population. So Resi Solutions partnered with the TC and HABIO to search for Bolsón Tortoise individuals and their burrows on Rancho San Ignacio using aerial drones and Artificial Intelligence (AI) that searches the aerial drone imagery for burrows and tortoises. In May 2023 we initiated aerial drone flight missions at Rancho San Ignacio. Our goal was to cover large areas to identify highly visible, larger burrows and to follow up with pedestrian inspections. Searching nearly 13,000 images, the AI system identified 195 Bolsón Tortoise burrows and 31 Bolsón Tortoises, including a large, densely populated colony in a flight area near the western border of the ranch where 109 burrows and 4 tortoises were detected. In November 2023, we performed pedestrian checks of the burrows in this colony and recorded a total of 135 tortoise burrows. Most (94%) burrows were assessed as being actively occupied by tortoises. We confirmed that 10 (9%) of the burrows identified by the AI were false positives and 11 (10%) were double counted. The AI also missed 50 tortoise burrows that were encountered opportunistically during the pedestrian checks, representing about 37% of the confirmed tortoise burrows in the colony. This pedestrian verification of the burrows will allow us to develop statistical models that relate burrows found by the AI to those it cannot because they are too small or covered by vegetation. Using both aerial and ground surveys lets us maximize finding tortoises and their burrows and to collect important ecological data.
Oral

Identity of the Floodplain Snake-necked Turtles (*Chelodina* [*Chelydera*]) of the Northeastern Kimberley, Western Australia

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Until the late 20th century only one wide-spread species of Northern Snake-necked Turtle (*Chelodina rugosa*) was considered to range throughout northern Australia including the Kimberley of Western Australia. *Chelodina kuchlingi* from the northern Kimberley was described in 1997 and *C. walloyarrina* from the Kimberley sandstone plateau in 2007. Until recently Australian authorities did not recognize *C. kuchlingi* as a valid taxon and still don't recognize *C. walloyarrina* which is synonymized under the Arnhem land sandstone plateau species *C. burrungandjii*. This has the consequence that *C. kuchlingi* and *C. walloyarrina* were and are ignored in environmental impact assessments for the damming of rivers and agricultural developments, a fact that may have contributed to *C. kuchlingi*'s critical endangerment: the species occurs in the Ord River coastal floodplain which, since 1973, is drying out due to progressive river impoundment that created Australia's largest dam reservoir, Lake Argyle. Turtles showing the typical morphology of *C. kuchlingi* have not been collected since 1974. However, during the 21st century turtles with a morphology close to the Northern Territory form of *C. rugosa* sensu lato (described as *C. kurrichalopongo* in 2019, also a floodplain species, but again not recognized as valid by Australian authorities) were recorded in the Ord River floodplain, suggesting this species may be displacing its closely related sister species *C. kuchlingi*, possibly through hybridization and introgression. To test this hypothesis, we extracted DNA from tissue samples of historic specimens in the Western Australian Museum and specimens in Northern Territory Museum as well as from turtles that were released after study at the collection site. Unfortunately, of the three *C. kuchlingi* specimens collected in 1965/66 only one, the type specimen of *C. kuchlingi*, was well enough preserved to yield usable DNA. Mitochondrial and nuclear DNA suggest that the range of the Northern Territory taxon (*C. kurrichalpongo*) extends into the now largely dry Ord River floodplain. To solve the conundrum surrounding *C. kuchlingi* and to identify genetically pure individuals, comprehensive turtle surveys in floodplain country of the northeastern Kimberley will be needed, an area rarely sampled due to the abundance of the Saltwater Crocodile (*Crocodylus porosus*).

Oral

John Ball Zoo's Field Conservation Initiatives for Great Lakes Rare Turtles

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John Ball Zoo (JBZ) is committed to the conservation of native species, and rare turtles are one of our conservation priorities. Many species of emydid turtles reside in the Great Lakes region, but several species have become rare due to anthropogenic activities that have caused rapid population declines. Habitat loss and fragmentation, collection of individuals for the pet trade, high levels of road mortality, and increasing rates of predation by human-subsidized predators have reduced survival rates for all age classes and put many populations at risk. To combat these declines, JBZ initiated the Great Lakes Rare Turtle Program in 2020. This program aims to address threats to turtle survival and advance conservation efforts for rare species in the Great Lakes region. We are currently involved in four projects that emphasize in situ conservation for our focal species. In collaboration with the Michigan Natural Features Inventory (MNFI), JBZ is conducting Spotted Turtle (*Clemmys guttata*) surveys across southwest Michigan to improve our understanding of this species' distribution and demography. Additionally, we are contributing to MNFI's efforts to identify Wood Turtle (*Glyptemys insculpta*) nesting sites and assess the efficacy of various nest protection strategies. In partnership with Grand Valley State University (GVSU) and Pierce Cedar Creek Institute (PCCI), JBZ has established an Eastern Box Turtle (*Terrapene carolina carolina*) headstarting program and participated in post-release monitoring efforts to evaluate the effectiveness of headstarting as a conservation tool for this threatened species. Finally, JBZ and GVSU recently developed a community science project that engages the local community in our efforts to monitor turtle road mortality and identify priority areas for mitigation. Each of these projects will provide valuable information that will guide the conservation and management of our Great Lakes rare turtles.

Oral

The Mediterranean Pond Turtle (*Mauremys leprosa)* Shows Resilience To Extreme Flood Events

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Understanding the impact of climate change-related extreme weather events (EWEs), such as exceptional floods, on ecosystems is essential for managing and conserving landscapes while preserving local biodiversity. In this study, we examined the impact of an extreme flood that occurred in November 2014 on the Baillaury River (Southern France) on a population of Mediterranean Pond Turtles (*Mauremys leprosa*) monitored since 2012. Between 2012 and 2022, a total of 377 turtles (170 females and 207 males) were individually marked. Survival, recruitment, and transition probabilities were estimated before and after the flood, using Pradel Robust-Design (N = 889 capture-recaptures) and Multistate (N = 606 capture-recaptures) models. Female population size slightly decreased by 14% immediately after the flood and even more (26%) two years later, while the male population remained stable. Interestingly, the adult population returned to its initial size with a balanced sex ratio within eight years. Our study shows that neither the structure nor the temporal dynamics of the adult population were altered over a ten-year period. This suggests that *M. leprosa* shows significant resiliency. However, the flood has impacted the spatial dynamics of the population by increasing turtle movements downstream, resulting in changes in their distribution along the river. Our study highlights the importance of preserving ecological continuity in flood protection schemes, to ensure the free movement of aquatic animals and help their resilience to EWEs.
Oral

Assessing Española Giant Tortoise (*Chelonoidis hoodensis*) Introduction Impact on Santa Fe Island With Remote Sensing and Behavioral Models

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Following the extinction of the keystone Santa Fe Giant Tortoise (*Chelonoidis indet.*) in the mid-1800s due to over-hunting and competition with invasive species, the ecosystem of Santa Fe Island degraded. In part, this was evidenced by a proliferation of various woody plants and a marked decline in cactus (*Opuntia echios barringtonesis*) populations, which are the primary trophic resource for tortoises and other wildlife. In a restoration effort, Española Giant Tortoises (*Chelonoidis hoodensis*) were introduced to the island as ecological proxies beginning in 2015. As part of a multi-faceted study designed to quantify the ecological impact of this introduction, we collected multispectral drone imagery across the entirety of the 24km^2 Santa Fe Island in the summer of 2023. We used this imagery to classify and map cacti using Support Vector Machine (SVM) algorithms. We used the result as training and validation layers for satellite imagery classification in order to analyze the shifts in cactus distribution since the introduction of tortoises. These results were combined with Hidden Markov Models (HMMs) to map how the distribution of tortoise activity is related to resource density both temporally and spatially. In this talk, I will discuss this field and modeling methodology as well as what these results indicate about how introduced tortoises may be impacting Santa Fe's ecosystem. I will also briefly discuss my other ongoing approaches to quantifying the impact of this introduction. Overall, these findings will inform conservation policy and management decisions within the Galapagos including whether further human intervention is required. More generally, this research serves as an important early case study for projects aimed at restoring ecosystems through the augmentation or restoration of keystone species populations.
Oral

Health Assessment of Wild Northern Diamond-Backed Terrapins (*Malaclemys terrapin terrapin*) in New Jersey, USA

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The Diamond-backed Terrapin (*Malaclemys terrapin terrapin*) is a popular species in the pet trade, making it a target in the illegal wildlife trade, which has led to significant population declines. When terrapins are confiscated from the illegal wildlife trade, there's often a lack of standard procedures for their reintroduction into the wild. Additionally, there's insufficient data on the pathogens present in the wild population. To address this gap, we sampled 30 wild female Diamond-backed Terrapins for

herpesvirus, Mycoplasmopsis, ranavirus, as well as intestinal and blood parasites. We also conducted white blood cell counts, differentials, and evaluated biochemistry values. The terrapins averaged 10 years of age, with 70% of them gravid at the time of sampling. Our results revealed that 33% of the sampled Northern Diamond-backed Terrapins tested positive for Mycoplasmopsis sp., while all were negative for ranavirus and herpesviruses. We observed occasional blood parasites and few intestinal parasites. Blood chemistry values appeared to vary based on feeding activity, with no differences found in relation to gravid status. Notably, four terrapins exhibited heterophil to lymphocyte (H:L) ratios above 4.5, indicating potential inflammation. Among these, two had Mycoplasmopsis infection. Although our study was limited to a small sample size of female terrapins at a specific time point, our findings provide valuable insights into the pathogens circulating in this population. This data contributes to the existing knowledge base, aiding decision-making for the reintroduction of confiscated Diamond-backed Terrapins into New Jersey's wild population.

Oral

Unconventional Results of Quantitative Paleohabitus Inference for Fossil Turtles

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Habitat inferences for fossil turtles based on shell measurements have recently been criticized due to their unconventional conclusions. Shell-based measurements for *Proganochelys quenstedti* and *Meiolania platyceps* that indicate aquatic habitat inferences find support from limb morphology. In both these cases, the femur has a deep intertrochanteric fossa, and the forelimb proportions are indicative of an aquatic habitus. This may surprise some, as it did us. Measuring a cast of *Proganochelys* at the American Museum, AMNH FARB 29838, the humerus is 130.6 mm long, the ulna is 87.8 mm long and the hand is 65 mm long. This gives proportions of 46% humerus, 31% ulna and 23% hand. This places *Proganochelys* in the "Primarily on land often in water" category of Joyce and Gauthier and not far from the values of their stagnant or small bodies of water categories. This was far different than the measurements of 140 mm humerus length, 76 mm ulna length and 55 mm hand length, or 52% humerus, 28% ulna and 20% hand, previously reported by Joyce and Gauthier. The forelimb lengths of *Meiolania platyceps* are 30.8% humerus, 34.6% ulna, and 34.6% hand. This coincides with the range of turtles of aquatic habitus, most closely matching *Podocnemis sextuberculata*. *Meiolania* is also similar in hand proportions to *Macrochelys* and *Platysternon*. The femur-length-to-intertrochanteric-fossa-depth ratio of *Meiolania* is 17.2; this is closest to *Macrochelys temminckii*. In conclusion, though some of the results of quantitative paleohabitus analysis appear to be unconventional, they are largely consistent and should not be ignored because they don't fit preconceptions.

Poster

Activity Patterns of Central American River Turtles (*Dermatemys mawii*) in Belize

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The Central American River Turtle (*Dermatemys mawii*) is critically endangered. It is native to southern Mexico, eastern Guatemala, and Belize and is primarily restricted to watersheds that drain into the Gulf of Mexico and Caribbean Sea. Hunting, both for personal consumption and market meat, has been the primary driver of declines. Results from past studies that have used netting and visual surveys to detect *D. mawii* suggest that the species is chiefly nocturnal. However, more recent surveys have detected activity during both day and nighttime efforts, and it is unclear to what extent the perception of nocturnality has been biased by the timing of survey efforts (e.g., animals may appear to be nocturnal if efforts to detect them are restricted to nighttime surveys). A more detailed understanding of activity patterns is important, in part because it informs many other aspects of the species' biology (foraging patterns, social interactions, etc.), but also because understanding when individuals are most likely to be moving can help to inform hunting regulations. Therefore, we set out to quantify the daily and seasonal activity patterns of 24 *D. mawii* in a natural river system in Belize. We equipped 8 males, 8 females, and 8 juveniles with archival dataloggers to record acceleration (movement), temperature, and pressure (water depth), and sonic transmitters to relocate and recapture turtles, from June 2021 to July 2022. Over the course of five sampling trips, we recaptured and downloaded data from 18 of the 24 tagged individuals, resulting in intervals of consecutive data for each turtle ranging from 1–13 months. Surprisingly, and contrary to previous assertions that *D. mawii* are chiefly nocturnal, our results indicate that this

species exhibits a crepuscular activity pattern, with lowest rates of activity occurring at night. Overall, males were more active than juveniles, which were more active than females. Additionally, we observed a distinct seasonal pattern in activity among males and females, with higher levels of nocturnal activity in the rainy season and higher levels of diurnal activity during the dry season.
Oral

Aestivation and Its Relationship With the Distribution Area of Kinosternidae Turtles

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Aestivation as a behavioral trait added to the movement of species due to the decrease in environmental temperature and precipitation, gives aestivating turtles the ability to inhabit or colonize new sites, which in turn could be reflected in distribution areas more extensive. Aestivation is a period of inactivity during the summer in which an organism's metabolism decreases due to scarcity of water, food, and/or high temperatures. Under a phylogenetic comparative approach, in this study we determined: 1) If kinosternidae turtles with the ability to aestivate have larger distribution areas compared to species that do not estivate and if aestivation behavior (presence or absence) and the duration of aestivation is a characteristic associated with distribution área, and 2) If the aestivation behavior and the duration of aestivation together with environmental temperature, environmental humidity and/or solar radiation are associated with the distribution area. We found that the species that estivate have larger distribution areas compared to those that do not estivate. Using phylogenetic generalized least squares (PGLS), we did not find an association between distribution area and maximum aestivation days (p=0.7836), but we did find an association with aestivation behavior (p=0.0155) and distribution area. Regarding the association between aestivation behavior in conjunction with environmental variables with the distribution area, we recorded an association with temperature (p= 0.0045) and precipitation (p= 0.0479), but not with UVB radiation (p= 0.5583). No association was recorded between maximum aestivation days in conjunction with environmental variables with the distribution area. Turtles that aestivate have larger distribution areas; this could be because aestivation behavior, regardless of the duration, is associated with the distribution area, and together with environmental changes, can influence the patterns movement of kinosternidae turtles.
Oral

Aspects of the Demography of a Relict Population of Southwestern Pond Turtles (*Actinemys pallida*) in a West Mojave Desert Stream in California

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In 2023, both species of Western Pond Turtles (*Actinemys* spp.) were proposed by the U.S. Fish and Wildlife Service for listing as threatened species under the Endangered Species Act. We studied Southwestern Pond Turtles (*A. pallida*) in the Amargosa Creek drainage basin, near Palmdale, California from 1997 – 2023. The population in the upper creek was censused during compliance monitoring required by a road construction project from 1997 – 2003. During that time 118 turtles were marked and the estimated population size was 151 (95% CI 132 – 170) individuals in upper Amargosa Creek. The age and size structure included many immature individuals, with evidence of recent recruitment due to the capture of more than 30 hatchlings. Overall survival was estimated at 0.87 (SE = 0.04). The population declined over the years during a multi-decadal megadrought that was the driest 22-year interval in the Southwest USA in about 1,200 years. Turtles in upper Amargosa Creek were presumed

to be extirpated after 2003 as a result of stream drying. However, as of 2023 there was a remnant breeding population of at least 22 turtles in lower Amargosa Creek where it drains into Piute Ponds at the south end of Rosamond Dry Lake on Edwards Air Force Base in the Mojave Desert. Piute Ponds is maintained by discharge of treated wastewater from the Lancaster, California sewage treatment plant and episodic inputs from upper Amargosa Creek in wet years. The extirpation of turtles in upper Amargosa Creek was not an isolated event. The multi-decadal megadrought and changes in water quality caused by a large wildfire resulted in a similar fate for another large population at nearby Elizabeth Lake in 2015. Even though Southwestern Pond turtles are semi-aquatic and can estivate when wetlands dry out temporarily, drought severity has a strong impact on survivorship as shown in this and other studies. Only two populations of Southwestern Pond Turtles survive in the Mojave Desert, the other in the Mojave River about 100 km to the east, both tenuous relicts of a once wider distribution during the Pleistocene. Their continued survival is by no means assured.

Oral

Burmese Peacock Softshell Turtle as a Key Species for the Establishment of the Community-Led Fish Conservation Areas Along the Ayeyarwady River Basin in Myanmar

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The Critically Endangered species Burmese Peacock Softshell Turtle (*Nilssonia formosa*; BPST) is endemic to Myanmar. This species can be found in the freshwater system, especially along the rivers, and wetlands. The BPST plays as an indicator species of the health of the freshwater habitats. The health of the habitats is crucial for the sustainability of capture fisheries resources. Fisheries resources are essential to Myanmar after agriculture. Fish-based products, such as fish paste and fish sauce are vital nutritional sources for Myanmar people. Capture fisheries resources provide subsistence livelihood opportunities for the landless communities in Myanmar. Therefore, the sustainability of capture fisheries resources guarantees nutritional security and subsistence income livelihood opportunities of the marginalized population in Myanmar. BPST conservation can support the success of freshwater fish conservation. BPST conservation has been implemented in Myanmar since 2022. BPST live specimens were recorded from several locations along the Ayeyarwady River basin in Myanmar. Marine Science Association Myanmar (MSAM) is implementing the BPST project supported by the Fauna & Flora-Myanmar Program. MSAM is dialoguing with the identified seven communities along the Ayeyarwady River system for the BPST conservation leading to the establishment of the Community-led Fish Conservation Areas. Community-led Fish Conservation Area is a kind of Other Effective Conservation Measure (OECM) approach based on the local communities. MSAM could develop the community-agreed conservation map and boundaries, and obtain the agreement signatures from the communities for the establishment of Community-led Fish Conservation Areas. The conservation area management plans are being consulted with seven communities in participation with concerned stakeholders for the official designation process of the Community-led Fish Conservation Areas along the Ayeyarwady River System in Myanmar by the Department of Fisheries for the sustainability of freshwater fisheries resources for Myanmar people. The official designation of these Community-led Fish Conservation Areas based on the BPST will become a model conservation approach in Myanmar for the sustainability of freshwater capture fisheries resources in the future.

Oral

Comparative Life History and Ecology of Mud Turtles from the North American Deserts

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The warm deserts of North America are characterized by diverse environments that include the transition zone between tropical and temperate regions on the continent. This vast region includes the Sonoran and Chihuahuan deserts which have different precipitation regimes and are composed of different turtle faunas. Seven mud turtles (genus *Kinosternon*) inhabit these deserts, and we compared their basic ecology, life history, and behavior to test for variation between deserts. We used phylogenetic comparative methods to correlate the life history and behavior traits with environmental variables (climate) to test for variation among life history strategies between deserts. Life history strategies of mud turtles were similar across both deserts, with

correlations between egg size with latitude, clutch size with aridity and with maximum temperature. Also, maximum aestivation time was correlated with an index of seasonality of each studied locality. It seems that overall, life history strategies are quite similar, with small local specialization to avoid high temperatures and periodic lack of water. There is also a trend to enhance reproductive success by producing larger eggs in northern populations. Ecology of the studied populations showed varied sex ratios biased to males or females, along with different population structure among populations and species, but most published studies lack data for hatchlings. Phylogenic signal is high in traits related to body size, including sexual size dimorphism. Overall, mud turtles from the southwest deserts are adapted to regional seasonality and rain regimes, with minor adjustments to fit local conditions.

Oral

Igniting Pancake Tortoise Awareness and Recovery Path Using Community Conservancies in Northern Kenya

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Pancake Tortoises (*Malacochersus tornieri*) are a critically endangered species within the *Testudinidae* family, characterized by their small size, soft shells, and habitat preference for rock crevices in the dry savannas of northern and southern Kenya, as well as eastern Tanzania. These regions are home to array of free-roaming wildlife coexisting alongside human communities engaged in various livelihood activities. However, the escalating impacts of climate change and rapid human population growth have disrupted this delicate balance of human-wildlife coexistence, resulting in the alarming decline of several wildlife species over the past fifty years. The emergence and increasing popularity of Community Conservancies in northern Kenya have provided a ray of hope for wildlife conservation and protection efforts. These conservancies, equipped with established governance systems, have been instrumental in safeguarding critically endangered species such as the Black rhino, lions, and elephants, leading to notable population recoveries. Despite these successes, there remains a significant gap in conservation awareness, particularly concerning smaller animals and reptiles like the Pancake Tortoise, whose populations have dwindled largely unnoticed. This project aimed to leverage the infrastructure and momentum of existing community conservancies to raise awareness, enhance protection, and implement monitoring protocols for Pancake Tortoises. By integrating the species into wildlife monitoring and reporting mechanisms within conservancies, while advocating for a national species recovery strategy, we seek to ensure the long-term survival of this imperiled species. Preliminary surveys conducted since 2021 have identified over 280 Pancake Tortoises dispersed across a wide area in across central-northern Kenya. We found that the species faces numerous threats including negative cultural beliefs, climate change impacts, illegal killings, and pet trade. Most concerning is the lack of awareness within community conservancies, where the majority of the species reside outside protected areas. The main conclusion is for conservancies to recognize the Pancake Tortoises as an endangered species deserving of protection and monitoring within their jurisdiction. This necessitates capacity building among conservancies' stakeholders, focusing on habitat characteristics, feeding preferences, reproduction, and the species' economic importance. Additionally, national agencies must take a leading role in formulating and implementing a comprehensive species recovery strategy, guided by constitutional mandates and multilateral frameworks. By fostering collaboration between government agencies, stakeholders, and local communities, we can realize the vision of a thriving Pancake Tortoise population not only in Kenya but across the region.

Oral

Growth, Survival, and Movement of Captive-Reared Eastern Box Turtles Near the Northern Limit of their Range up to 5 Years Post-Release

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We study a small but regionally significant population of Eastern Box Turtles (*Terrapene carolina carolina)* near the northern limit of their range at the New Hampshire and Massachusetts boundary. From 2017 to the end of 2023, we observed 22 unique box turtles at this site, three of which were wild-born juveniles. We captive-reared 30 hatchlings from *in situ* nests and released them after ~21 months of headstarting. These hatchlings were released at a substantial size for their age (on average, 109 mm straight-line carapace length and 316 g mass.) We monitored a subset of these hatchlings (22, in two cohorts) via radiotelemetry for up to 5 seasons post-release. Below, we report on growth, survival, and home range of these

captive-reared individuals, including comparisons to the adult box turtle adults in the same population. Our results, including robust survival rates from both adults and captive-reared juveniles (100% and 93.8% respectively,) suggest that headstarting juveniles may be a highly effective management strategy to augment sparse or declining populations of eastern box turtles at the northern limit of their range.
Oral

Nocturnal Basking in Aquatic Turtles: An Overview of Our Current Knowledge

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It was recently documented that some aquatic turtles "bask" at night (i.e., emerge from the water to sit on logs and rocks). Subsequent research has examined both the purpose and extent of this behavior, with compelling and consistent results. Herrin, we will briefly discuss the research to date and what we have learned thus far. First, two laboratory studies tested the possibility that nocturnal basking was related to parasite (leech) removal. One study tested the effectiveness of nocturnal basking for removing leeches, while the other tested whether leeches affect the duration of nocturnal basking events. Both studies returned negative results, suggesting that parasites are not driving this behavior. Additional studies examined the seasonality of nocturnal basking in a tropical population of Krefft's River Turtles (*Emydura macquarii krefftii*) and observed that it was predominantly associated with the warmer summer months, suggesting a relationship with temperature. Laboratory work established a thermal preference of 26°C for that population, and both laboratory and field work showed that nocturnal basking is significantly associated with environmental conditions where the water temperature is both >26°C and higher than the air temperature. In other words, this behavior typically occurs when the water temperature is above the turtles' thermal preference and exiting the water offers the opportunity to cool down. Additionally, we looked for nocturnal basking in 29 turtle species from seven families spread across North America, the Caribbean, Europe, Asia, Africa, the Seychelles, and Australia, and we documented the behavior in 13 species from six families. All observations of nocturnal basking occurred in tropical or subtropical environments. Taken together, these results suggest that nocturnal basking is primarily a means of behavioral thermoregulation (cooling), which could have important implications for future conservation efforts under increasingly dire climate change scenarios.
Oral

Initiation of a Long-term Turtle Monitoring Program at the Savanna Field Station, Belize

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Long-term monitoring programs provide a wealth of information for conservation and understanding species' ecology. Nevertheless, long-term data sets are relatively scarce due to the difficulty involved in obtaining them. Therefore, we have initiated a long-term study of the turtle community at the Savanna Field Station (Belize) and surrounding portions of the Sharon Matola Wildlife Sanctuary. The site is a mosaic of pine savanna and broad-leaf forest, with multiple man-made ponds as well as seasonal pools that fill during the rainy season. To date, we have documented five turtle species: Furrowed Wood Turtles (*Rhinoclemmys areolata*), Mesoamerican Sliders (*Trachemys venusta*), Red-cheeked Mud Turtles (*Kinosternon scorpioides*), White-lipped Mud Turtles (*Kinosternon leucostomum*), and Narrow-bridged Musk Turtles (*Claudius angustatus*), with *R. areolate* and *K. scorpiodes* being the most abundant. Staff at the Savanna Field Sation will conduct continuous opportunistic monitoring (as turtles are encountered), as well as using hoop nets for targeted surveys during the rainy season. All individuals will be measured, marked with a PIT tag, and have their location recorded. Many of the species present at this site are understudied, and this location offers an excellent opportunity for long-term monitoring.
Poster

Hurricane Effects on a Long-Term Monitored Southwest Florida Barrier Island Gopher Tortoise (*Gopherus polyphemus*) Population

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The Gopher Tortoise (*Gopherus polyphemus*) is threatened throughout its entire southeastern United States range due to the loss, fragmentation, and reduced quality of habitat. They face additional threats on islands where there is limited space and resources, as well as infrequent gene flow into the population compared to their mainland counterparts. On a southwest Florida barrier island, Gopher Tortoise burrows were surveyed annually on two different preserves, beginning in the year 2000, and on three additional preserves in the year 2007 to current. Burrows are classified as active, inactive, or abandoned to determine the estimated tortoises per hectare. From the year 2007-2021, all preserves maintained a relatively stable active burrow count. In September 2022, Hurricane Ian caused up to 12 feet of storm surge on the island, flooding burrows and drastically altering Gopher Tortoise habitat. The 2022 survey, following the hurricane, found most active burrows were lost within four preserves, as well as total loss on one preserve. Although these preserve populations have suffered a significant loss of active burrows, the aftermath of the hurricane has accelerated our upland management efforts due to fire hazard, fire line loss and hurricane debris. This provided the opportunity to clear out hardwood hammocks and replant forage plants to increase open-canopy habitats preferred by Gopher Tortoise. Many of these tortoises were displaced on the island from the high water and providing optimal habitat should encourage recruitment back to these areas.

Oral

Demographic Analysis and Population Viability of Egyptian Tortoises: A Two-Phase Approach Integrating Multi-State Modeling and Population Viability Analysis

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The Egyptian Tortoise (*Testudo kleinmanni*), is the smallest tortoise species in the Mediterranean basin and critically endangered. This study examines the long term population dynamics of several populations within the Zaranik Protected Area in North Sinai, Egypt. We estimated the survival rates, growth rates, and extinction risks across four distinct sites between 2001 to 2022 through the use of a NIMBLE-Mark-Recapture modeling and Population Viability Analysis (PVA). Our analysis showed site-specific variation in survival and transition probabilities between life stages. We found significant relationships between environmental variables and tortoise demographics, shedding light on factors influencing population size, sex ratios, and reproductive success. Notably, one site emerged as a stronghold for Egyptian Tortoise conservation, characterized by a high survival rate and a low extinction risk. Sex-specific and age-specific disparities in survival rates underscore the complexity of ecological dynamics within the population. Our findings emphasize the importance of tailored conservation strategies that consider both geographical and age-specific factors for effective management of Egyptian Tortoise populations.

Poster

The Perceived Common, the Absolutely Ferocious, Insights from Over a 15-Year-Long Mark-Recapture Study of Florida Softshell Turtles in Wekiwa Springs State Park

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The Florida Softshell Turtle (*Apalone ferox* [Schneider 1783]) is considered common and found in many different freshwater habitats throughout its range. However, little is understood about the species' life history and population dynamics due to difficulties with capture and long-term marking. We have conducted a mark–recapture study of this species since 2007 as part of a long-term freshwater turtle population monitoring program at Wekiwa Springs State Park, Apopka, Florida. A total of 31 capture events were conducted from 2007 to 2023 with a median of 2 capture events per year. Capture events were spread over a median of 5 days each year (range, 2 – 11 days) and a total of 88 capture days. A total of 120 individual *A. ferox* were captured or recaptured a total of 225 times. We observed strong sexual dimorphism as the largest female captured was 566 mm carapace length (CL), 391 mm in carapace width (CW), and weighed 18.9 kg while the largest male was 246 mm CL, 184 mm CW, and weighed 2.6 kg. Using a Bayesian multivariate von Bertalanffy growth model, we estimated females are 132% larger than males at their average maximum carapace length of 525 mm CL. As a result, the female Brody growth coefficient of 0.08 was much lower than the males of 0.21. We estimated a population size of 135.6 individuals using a Schnabel ratio estimator but a superpopulation of 204 individuals with a state-space Jolly-Seber model. From the Jolly-Seber model, the median survival probability was 0.884, the median detection probability was 0.10, and the current population size was on average 70 individuals. This population marks the largest documented population of this species within the literature. What is known is sparse as there have only been two population demographic studies completed on this species. More research needs to be conducted to better understand this species' ecology.

Oral

Two-Years of Monitoring the First 1,000 Reintroduced Radiated Tortoises (*Astrochelys radiata*) in Southern Madagascar

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The TSA Madagascar program is currently in its third year of conducting large-scale reintroductions of Radiated Tortoises (*Astrochelys radiata*) which were previously confiscated from the illegal trade. In 2021, the first 1,000 sub-adult tortoises cleared for reintroduction were placed into a 6-ha soft-release enclosure within a community protected forest, Malaintsatroke, of the Androy region. Following an approximately 8-mo penning period (intended to increase site fidelity), the pen was opened in March 2022 allowing the tortoises to disperse into the surrounding spiny forest habitat. Immediately prior to this release, 35 reintroduced and 15 wild resident tortoises were equipped with VHF radio-transmitters and custom-designed GPS loggers to track their movements for the next two years. Manual radio-telemetry efforts by TSA Madagascar staff and local forest guardians from the surrounding communities were utilized to visually monitor how reintroduced and resident tortoises in this area were responding to the reintroduction and to relocate them for GPS logger changes which occurred approximately every 6 months. Here, we will present two-years of GPS logger monitoring data that our team has collected on wild resident and reintroduced tortoises alike (as of April 2024). This fine-scale monitoring data illustrates post-release movement patterns, early establishment of home-ranges, insights into interesting movement behaviors, and predation threats that were observed during this period. Finally, there will be a brief discussion of the ongoing reintroduction monitoring research activities and lessons learned from this first large-scale reintroduction of Radiated Tortoises in southern Madagascar. The knowledge and experiences gained from this monitoring will undoubtedly benefit the many thousands of additional confiscated tortoises awaiting their reintroduction.

Oral

Poor Hibernaculum Quality Associated with Mortality in Urban Box Turtles (*Terrapene mexicana triunguis*)

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Urban wildlife often shows pronounced differences in their ecology, behavior, and survival compared to their rural counterparts. Given the broad impacts of temperature in ecology, thermal discrepancies between cities and their rural surroundings are likely to play a major role in explaining these differences between urban and rural animals. Although experimental work has demonstrated the impacts of urban temperatures on wildlife, we lack field data on the body temperatures of free-living urban animals and the ecological impacts of these temperatures. In addition, while urban heat islands have directed research towards the impacts of warmer temperatures, relatively little focus has been given to the potential for urban organisms to experience colder temperatures, especially in reptiles. Here, we use 10 years of data to show that urban box turtles were less efficient thermoregulators at both hot and cold temperature extremes than their rural counterparts. In contrast to the heat island effect, the body temperatures of brumating urban box turtles (*Terrapene mexicana triunguis*) were colder and more variable in the winter compared to rural turtles, despite similar environmental temperatures. Furthermore, during the hottest months we found no evidence of an urban heat island effect, yet body temperatures of urban turtles are hotter than rural turtles. These body temperature differences suggest that urban turtles have a reduced ability for behavioral thermoregulation, likely due to lower habitat quality in the urban environment. We further showed that turtles that experience extremely cold body temperatures in the winter were less likely to survive the subsequent year, indicating that over-winter thermoregulatory ability may play an under-appreciated role in the fitness and abundance of urban ectotherms. As urbanization continues to degrade landscapes and as climate change increases the occurrence of temperature extremes, we highlight the need to understand the impacts of cold temperatures on chelonian brumation patterns/survival strategies in human-altered environments.

Oral

Incorporating Pre-release Health Protocols in the Radiated Tortoise (*Astrochelys radiata*) Reintroduction Program

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Wildlife trafficking is a multibillion-dollar global industry, now ranked fourth internationally in profitable crimes. Turtles and tortoises are all too common victims of these illegal activities. Radiated Tortoises (*Astrochelys radiata*), endemic to Madagascar, are one of the most globally trafficked tortoise species with more than 45,000 tortoises removed from the wild annually. For the Turtle Survival Alliance–Madagascar, large-scale confiscations of trafficked Radiated Tortoises are a regular occurrence that require long-term husbandry and medical management. In general, much of the focus, as expected, is on triage health work post-confiscations. Between 2020 and 2023, more than 5,000 Radiated Tortoises in human care required pre-release assessments and microchip placement for individual identification. In taking on this task, our team of zoo/wildlife veterinary professionals developed a protocol for pre-release health assessments, which we identified as often overlooked for reptile species as a necessary part of the reintroduction process of confiscated animals. Pre-release assessments are needed for two main reasons: (1) to ensure that healthy animals are released giving the best possibility of success; and (2) to control for pathogens that might be introduced to free-living animals and the environment as a whole. The identification of health parameters that are the most relevant for pre-release can take time to determine given variation between reptile species and pre-release/confiscation circumstances. Through our collaborative work in Madagascar, we developed a protocol for pre-release health assessments that includes what we have identified as the most essential and practical methods for this species. As part of this protocol, we considered the limitations that exists in these often resource limited locations, and prioritized the need for in-county capacity building. Here we provide a working health assessment protocol that may be adapted across species before release to ensure that the healthiest animals are being released, and to minimize risk to both free-living animals at release sites, as well as the confiscated individuals.

Oral

Health Threats and Trends Observed in Turtles Received at the Belize Wildlife & Referral Clinic 2012–2023

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The Belize Wildlife & Referral Clinic (BWRC) provides veterinary care and rehabilitation to imperiled wildlife in Belize as well as field support for conservation partners since 2012. BWRC has hospitalized and treated 7 of the 8 terrestrial species of turtles of Belize at our facilities. Thanks to the great success of our partners at the HCRC Central American River Turtle (*Dermatemmys mawii*) breeding program, the critically endangered Hickatee have become one of our most commonly seen species since 2017. But some turtle species like the Furrowed Wood Turtle (*Rhinoclemmys aerolata*) were received since the inception of the wildlife clinic and by 2023, 7 of the 8 terrestrial species had been hospitalized and rehabilitated/relocated by BWRC team. This talk will present the causes for intakes of 7 species of turtles over the course of 10 years as well as their outcomes. Trends in intakes and observed threats as well as some hopeful changes in human interactions after educational outreach will be presented.
Oral

Population Estimate and Population Structure of the Pantanal Swamp Turtle (*Acanthochelys macrocephala*) in Palmar de las Islas, Santa Cruz, Bolivia

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Pantanal Swamp Turtle (*Acanthochelys macrocephala*) is distributed in the southeastern wetlands of the Bolivian Chaco, including the Chaco and Pantanal ecoregions in Paraguay and Brazil, respectively. It is classified as Near Threatened by the UICN, but in Bolivia it was categorized as Vulnerable since 2021 due to the loss and degradation of its habitat. Few studies have been conducted on this species in Bolivia, resulting in gaps in knowledge regarding the population status at the national level. This study was carried out in two lagoons (7021 and 2574 ha) located in the Kaa Iya National Park and Integrated Management Natural Area, Santa Cruz, Bolivia. The main goal was to evaluate abundance and population structure of *Acanthochelys macrocephala* in a locality where two decades ago access to livestock activities was restricted and the area was converted into a research center favoring ecological restoration. For this purpose, we (1) estimated the population size by using Mark-Recapture techniques, and (2) compared this results with those collected almost 20 years earlier to determine if sex ratios, and size structure changed over time. We captured 206 turtles, including 11 recaptures. The proportion of recaptures was low for both ponds: 0.083 for Poza del Oso and 0.008 for Poza Tapacaré. Both water bodies belong to the same ecological system and for the entire system, a population of 1252 individuals was estimated (range: 1184-1321). Distribution of turtle carapace lengths and body mass shows that females are more frequent at larger sizes (between 190 and 210 mm) than males (180 mm), and tend to have greater body mass 7 (between 0.8 and 1.1 kg) than males (0.8 kg). The sex ratio did not differ from 1:1. Size structure and sex ratio were similar, without significant differences, between time periods. This results are important because it is the first study focused on estimating the population size of *A. macrocephala*, and places the study location as an important locality for this species, being the largest population recorded to date.
Oral

Preliminary Findngs of a Long-Term Freshwater Turtle Population Study on Lake Washington and Comparisons to Historic Data

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The Turtle Survival Alliance North American Freshwater Turtle Research Group (TSA-NAFTRG) established a long term turtle population monitoring project at a site along Lake Washington, Seattle in 2021. We compared our capture data to similar data collected in 1995 by the Washington Department of Fish and Wildlife (WDFW). We identified similar species and captured

them in similar numbers. However, the 1995 study had significantly more success with their trapping effort, while we had to supplement our trapping by including hand captures. We collected data on turtle species, sex, morphometrics, health, and age class. We collected leeches to assist USGS with a freshwater leech survey, collected blood samples to assist an international genetics study and took shell swabs and scrapings to assist WDFW in shell disease research. The 2021 data will be built on and surveys will continue to allow TSA-NAFTRG to better understand the turtle populations of our study location.
Poster

Impacts of Climate Change on Growth Gate and Sex Ratio of Northern Map Turtles Over a 53-year Period

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Climate change is influencing biodiversity globally. For turtles and other ecothermic organisms, climate change has the potential to alter the growth rates of individuals. Climate change may also lead to a skewed sex ratio of turtle populations for species with temperature-dependent sex determination, such as the Northern Map Turtle *(Graptemys geographica*). Alterations to individual growth rates and the sex ratio of a population may shift population dynamics and jeopardize its overall long-term viability. Using a dataset that spans 53 years, we evaluated changes in the individual growth rates and the sex ratio of a population of Northern Map Turtles in south-central USA. Temperature data spanning the time period indicated extended growing seasons and overall warming trends in the region. As was predicted, the growth rate of immature turtles varied temporally, with turtles growing at significantly greater rates in recent years. No significant difference in growth rate for sexually mature turtles of either sex was detected. However, the overall growth models shifted for each sex, with turtles reaching size of maturity in a shorter time span in recent years. The sex ratio of the population shifted significantly towards a female-dominated population in recent years. Our results indicate that warming temperatures are altering growth rates of immature turtles and turtles are reaching size of maturity more quickly in recent years. The population shifted from a historically even sex ratio to one that was female-biased in recent years, which is consistent with predictions for this species in a warming climate. Such shifts in growth rate and sex ratios may alter population dynamics and lower genetic diversity in the population over time.
Oral

Myanmar Program Update (2023-24): Conservation in the Midst of a Civil War

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In the early 2000s, Turtle Survival Alliance (TSA) and Wildlife Conservation Society (WCS) initiated a number of conservation projects focused on threatened chelonians in Myanmar, most of which are endemic. A combination of *in-* and *ex-situ* methods proved effective in staving off extinction and recovering several species, including Burmese Star Tortoise (*Geochelone platynota*) and Burmese Roofed Turtle (*Batagur trivittata*). However, on 1 February 2021 the democratically elected civilian government of Myanmar was overthrown in a military coup, elected leaders were imprisoned or fled the country, and security forces brutally suppressed widespread, but peaceful civilian protests. The country has since descended into civil war pitting ethnic armed organizations and local guerrilla groups against the military. As a result, sustaining our conservation projects is becoming increasingly challenging as the security situation continues to deteriorate. Moreover, recent (April 2024) involuntary mass conscription by the junta has spurred a mass exodus of young men from Myanmar, including some essential TSA/WCS staff. Nonetheless, our conservation efforts continue. At the time of this writing (April 2024), 70 to 90 clutches of *B. trivittata* eggs have been deposited at the three assurance colonies (Lawkanandar Wildlife Sanctuary, and Yangon and Mandalay Zoos) with hatching expected during April-June. Additionally, 50 head-started *B. trivittata* were released into the upper Chindwin River after being penned on-site for 12 months. Translocation of *G. platynota* eggs from the assurance colonies and into the wild continues at Minzontaung and Shwe Settaw Wildlife Sanctuaries (988 eggs from 170 nests). At Shwe Settaw Wildlife

Sanctuary (SSWS), 1000 head-started tortoises were transferred to acclimation pens in March 2022 with release originally slated for 2023. Unfortunately, the Forest Department has so far refused to grant permission for the release of this group into the wild. Notably, several clutches were deposited by tortoises in the acclimation pens during 2024. Captive-breeding of Asian Brown Tortoise (*Manouria emys phayrei*) and Big-headed Turtle (*Platysternon megacephalum*) continues with limited success at the Turtle Rescue Center (Pin Oo Lwin). The TRC was directly threatened by heavy fighting in late 2023, although this danger has passed, at least for the moment.

Oral

A Bit of God's Grace: Role of Temple Ponds in Turtle Conservation in Assam

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The study aims to assess the threats faced by turtles, particularly in Assam, India, and evaluate the conservation efforts within temple ponds, which serve as significant habitats for these species. In the study temples and community ponds across Northeast India and West Bengal were surveyed out of which we came across 29 community and temple ponds having turtles in them. Of these 29 ponds, seven (Baneshwar, Deopani, Haragauri, Haigriv madhav, Nagshankar, Tripureshwari and Ugratara) were seen suitable for carrying out captive and conservation imitative. Observation and data collection were carried out to assess factors such as habitat degradation, breeding failures, lack of basking spots, and introduction of non-native species. In Assam, where 21 out of 29 recorded species of freshwater turtles are found, temple ponds play a crucial role in turtle conservation. Species observed in these temple pond includes Assam Box Turtle (*Cuora praschagi*), Asian Leaf Turtle (*Cyclemys gemeli*), Spotted Pond Turtle (*Geoclemys hamiltonii*), Tricarinate Hill Turtle (*Melanochelys tricarinata*), Brown Roofed Turtle (*Pangshura smithi*), Assam Roofed Turtle (*Pangshura sylhetensis*), Indian Tent Turtle (*Pangshura tentoria*), Indian Roofed Turtle (*Pangshura tecta*), Elongated Tortoise (*Indotestudo elongata*), Narrow-headed Softshell Turtle (*Chitra indica*), Indian Flapshell Turtle (*Lissemys punctate*), Ganga Softshell Turtle (*Nilssonia gangetica*), Peacock Softshell Turtle (*Nilssonia hurum*) and Black Softshell Turtle (*Nilssonia nigricans*). However, these ponds face several challenges including concretized boundaries, lack of basking spots, feeding of non-natural food, and the introduction of non-native species like the red-eared slider. Despite these challenges, conservation efforts in some temple ponds have shown promising results, with over 300 hatchlings, including the endangered Black softshell turtle, being released into protected areas. The study concludes that temple ponds in Assam serve as important habitats for turtle conservation, but they face significant threats that hinder successful breeding and survival. Conservation efforts in some ponds have demonstrated positive outcomes, but further action is needed to address the challenges identified, such as habitat degradation and the introduction of non-native species. Future research will focus on understanding the genetic composition of temple-bred hatchlings to support their conservation effectively. Overall, the study underscores the importance of protecting temple ponds and implementing targeted conservation measures to safeguard turtle populations in Assam.

Oral

Population Status and Threat Assessment of Threatened Turtles in Jamuna River of Bangladesh

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Bangladesh is diversified with many wildlife species and turtle is one of the most significant groups. There are 30 turtle species and 23 of them live in freshwater ecosystems such as major rivers, tributaries, canals, streams, estuaries, ponds, and ditches. Jamuna river is one of the major dynamic rivers of Bangladesh, which is considered a significant habitat for five threatened freshwater turtles: Three-striped Roofed Turtle (*Batagur dhongoka*), Indian Narrow-headed Softshell Turtle (*Chitra indica*), Spotted Pond Turtle (*Geoclemys hamiltonii*), Crowned River Turtle (*Hardella thurjii*), and Indian Softshell Turtle (*Nilssonia gangetica*). This study focused to investigate the current population status, and threat assessment of five threatened freshwater turtles in the Jamuna river. Boat survey and questionnaire survey were be used to conduct the study in upstream of the Jamuna from March 2023 to February 2034. Direct field survey did not reveal the presence of any of the turtle species in the study area. The questionnaire survey of 81 respondents suggested limited information about the presence of the species. More than half of

the respondent (n=44) answered positively about the presence of Three-striped Roofed Turtle (*Batagur dhongoka*) which was the highest followed by 22 positive responses for Indian Narrow-headed Softshell Turtle (*Chitra indica*) and 16 for Indian Softshell Turtle (*Nilssonia gangetica*). The least positive response was recorded for Spotted Pond Turtle (*Geoclemys hamiltonii*), and Crowned River Turtle (*Hardella thurjii*) (n=16). According to the questionnaire survey, Spotted Pond Turtle (*Geoclemys hamiltonii*) is seen very rarely (last seen 105.6 ± 22.9 month ago) while Indian Softshell Turtle (*Nilssonia gangetica*) is seen the most frequently (last seen 34.41 ± 10.5 month ago). The threats were evaluated based on three criteria: scope, severity, and irreversibility. The total score is calculated for each threat, and they are classified into different categories based on their cumulative score. River erosion, Char encroachment and Unintentional entanglement in fishing net is classified as very high-risk threat while Intentional hunting, Illegal trade, and Egg collection is ranked as medium threat for turtle in Jamuna river. More rigorous field study and urgent threat mitigation is highly recommended through this study area.
Poster

Southern Tortoise Poaching Dynamics: Origins, Seizure Statistics, and Conservation Implications

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The illegal trade of wild animals poses a significant threat to biodiversity. Malagasy tortoises are among the victims of poaching, targeted for the pet trade or wild meat consumption. In this study, we investigated the dynamics of poaching affecting Southern Madagascar tortoises, focusing on the origins of poaching activities and the statistical analysis of seized tortoises. Data on poaching incidents and tortoise seizures were collected through the Turtle Alliance Survival. Our analysis revealed the primary regions of Madagascar where poaching occurs and provided insights into the scale of the issue through seizure statistics. These findings underscore the urgent need for conservation measures to mitigate the threat to Southern Madagascar tortoises and preserve their populations. Effective enforcement strategies, community engagement, and habitat protection are crucial for addressing the challenges posed by poaching and ensuring the long-term survival of these iconic reptiles.
Oral

Antropogenic Threats Change the Relationship between Endobiont Nematodes and Spur-thighed Tortoises (*Testudo graeca*)

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The role of helminths remains uncertain in herbivore reptiles, as endosymbiont interactions are thought to range from mutualistic to commensal or parasitic. Wild populations of Spur-thighed Tortoises (*Testudo graeca*) are threatened by habitat destruction and over-collection. We investigated how the helminth communities in *T. graeca* are affected by these threats and evaluated: 1) the differences in helminth communities between wild and kept in captivity tortoises, and 2) differences among wild populations with different levels of habitat loss. We took fecal samples from 198 tortoises in Spain and analyzed their endobiont nematodes communities. For free-living tortoises, we assessed the relationship between oxyurid richness and abundance with tortoises' growth rates, weight and carapace length across varying levels of habitat loss (low, intermediate and high). We also evaluated the structure and diversity of tortoise-oxyurid interactions using an intra-population ecological network approach. For captive tortoises, we investigated the relationship between oxyurid and ascarid egg loads with biometric measurements, sex, captivity time and physical condition indices of tortoises, as well as comparing helminth communities between captive and free-living tortoises. It was found that oxyurid infestation was positively associated with tortoise growth

rates in populations with low habitat loss (mutualistic relationship), but associated negatively when habitat loss was high (parasitic relationship). No relationship was observed when habitat loss was intermediate (commensal relationship). The network analysis showed that the oxyurid community was not randomly assembled but significantly nested, revealing a structured pattern for all levels of habitat loss. We found the lowest diversity of interactions at low habitat loss, the greatest specialization at intermediate level, and the most generalist infestations at high level. Heavier and larger tortoises tended to show a greater number of oxyurid species interactions. Ascarid infections affected mostly captive animals and were associated to carapace deformities and symptoms of upper respiratory tract disease. Oxyurid infections showed a negative effect on the weight of captive tortoises and prevalence increased with tortoises' age. Our results reveal a complex relationship between nematodes and tortoises, of interest for their potential use as indicators of health status in wild populations and for a better management of tortoises in captivity.

Oral

Case Studies on Religious Commitments Towards Protection of Freshwater Turtles and Tortoises in India

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In India a large percentage of people are affiliated with the religious faiths so they voluntarily participate in the protection of environment thereby helping the wildlife to survive. Religious people in the country believe on divinity related to nature, such as rivers, mountains, trees, animals, and the earth. Although the national and state governments are putting efforts in conserving chelonians, in declaring the habitats as protected areas, the locals and religious people are also contributing for the protection of freshwater turtles and tortoises in religious reserves/sanctuaries and temples. For outreach conservation activities the religious leaders in India are coming forward and contributing for conservation and protection of Chelonians. People believe that turtle/tortoise is the incarnation of the Hindu deity Lord Vishnu so they protect them in the temple premises. A temple known as the Kurmanathaswamy temple is a Hindu temple dedicated to Kurma – the second avatar of Vishnu. It is located in Srikurmam village, Srikakulam district in Andhra Pradesh, India. In the temple's premises, a tortoise park has been built to conserve the star tortoises *Geochelone elegans*. Srikurmam is the conservation centre for this species, which are breeding in the temple premises. Devotees offer these tortoises from the nearby fields. The fifteenth century Tripureswari temple constructed by King Dhanyamanikya in Udaipur, 55 km from Agartala, in north-east India is believed to be one of the holiest Hindu shrines in the country. The rare species of Bostami turtles *Nilssonia nigricans* inhabit the Kalyan Sagar lying in the eastern side of the temple. These turtles are breeding in the lake At Bateshwar in Uttar Pradesh there is a temple complex along the Yamuna River. Fishing is banned by the temple administration along the temple complex. In the river different freshwater turtle species like *Batagur kachuga, B. dhongoka, Pangshura tentoria, P. tecta and P. smithi* are protected by the faith people. For protection of freshwater turtles in the Ganga River along the Varanasi Pilgrimage city in Uttar Pradesh a sanctuary was declared during 1989 to protect rehabilitated freshwater turtle *Nilssonia gangetica* and other freshwater turtles. Turtles and all other aquatic species are conserved/ protected and efforts are being made to increase their population in this sanctuary.

Oral

Demographics of *Geoclemmys hamiltonii* in Northern India

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The Black Pond Turtle (*Geoclemys hamiltonii*) is a medium sized Geomydid turtle found Pakistan, northern India, Sri Lanka, and Bangladesh. Populations are highly susceptible to illegal commercial harvest and has been the subject of multiple confiscations over the years. We sampled a population of *G. hamiltonii* along at three sites along a 100 km stretch of the Sarju River in northern India. We made 143 captures of *G. hamiltoni* during this study. Only one individual was captured at the most downstream site, with the rest of turtles captured at upstream and midstream sites. Upstream sites were shallower and more heavily vegetated than midstream sites. Upstream sites had larger population estimates, but were smaller in size than midstream sites. Elasticity testing of different age classes suggests that adult female survivorship had the greatest influence on population growth and persistence than did hatchling survivorship or % females breeding. Maintaining mortality levels between 0-5% for adult females and 0-10% for hatchling mortality would maintain a stable population with a $\lambda = 1.06$ and an extinction risk of

0. We then simulated a one-time harvest event where 10% of the adult females were removed resulting in a declining population with a $\lambda = 0.96$ and extinction risk of 78%.
Oral

A 33-Year Journey, the Return of Alligator Snapping Turtles to Their Former Range in Kansas

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The Neosho and Verdigris rivers were once major corridors for movement of Alligator Snapping Turtles (*Macrochelys temminckii*) between Oklahoma and Kansas. Historic harvest and the proliferation of impoundments in both states resulted in highly fragmented and reduced populations. Alligator Snapping Turtles have long been considered extirpated from Kansas. The last known living Alligator Snapping Turtle in Kansas was outfitted with transmitters and released in 1991 and has not been located since 1992. A series of surveys were conducted in Kansas from 2016-2020, but no individuals were captured. In concert with these survey efforts a Programmatic Agreement, which includes a Safe Harbor Agreement and Candidate Conservation Agreement, that allows our agency to enter into agreements with private landowners. Using habitat information collected during survey work several interested landowners with adequate habitat were identified and agreed to come on as signatories to our programmatic agreement. Between 2024-25, 100 Alligator Snapping Turtles between 4-10 years of age, are slated to be released within the Neosho River drainage. A subset of these turtles will be monitored via radio-telemetry. Depending on the success of the initial releases, future releases will be planned for the Verdigris River drainage.
Oral

Turtle Nesting Habitat in a Free-flowing and Dammed River in the Western Great Plains

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Riverine turtles' life cycles are highly adapted to the dynamic river systems in which they live. Spiny Softshell Turtles (*Apalone spinifera*) rely on complex habitat produced through spring-flood pulse flows and minimal anthropogenic modifications for their life processes, particularly during nesting. We examined the alluvial nesting habitat of Spiny Softshell Turtles as indicators of ecological river function in two rivers (dammed and free-flowing). Sentinel-2A satellite imagery was used to identify potential alluvial (turtle nesting) habitat to be used to guide our selection of random and actual sites for this study and was paired with a handful of known nesting sites to aid in selection. Both rivers were then surveyed for nest sites to aid in training sample selection for the refined model utilizing Land Cover Classification processes in ArcMap to disseminate nest site availability between the FFR and DR. The free-flowing river (FFR) had approximately 7.5 times the amount of potential nest habitat and twice the total available habitat. The model most effectively identified nesting sites on alluvium along the DR, which had fewer sites and more concentrated nesting areas. On the FFR, many more nests were located on island nesting habitats compared to the DR, where most nests were found on habitats connected to the mainland. Population demographics varied between the FFR and DR, with a notable scarcity of juveniles and small size classes on the DR, suggesting challenges in maintaining a stable population. On both rivers, nests were significantly associated with gravel substrates, large woody debris, and had access from side channel or backchannel areas to the nesting sites. Managing hydropower on the DR is crucial for establishing alluvial nesting habitats, but it may also increase the risk of nest flooding and failure due to delayed nesting. Our findings suggest that the habitat conditions of the FFR can serve as a useful reference for managing and restoring other western Great Plains rivers as an ecologically intact system. Our habitat model provides an efficient way to monitor alluvial

(turtle nesting) habitats. These methods can also evaluate landscape-level changes linked to the management of discharge regimes.
Oral

Reproductive Cycles and Movements of the Northern Giant Musk Turtle (*Staurotypus triporcatus*) in Belize

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The Northern Giant Musk Turtle (*Staurotypus triporcatus*) is a freshwater species native to eastern drainages in Mesoamerica. We initiated a study of movement and reproductive patterns of *S. triporcatus* in central Belize in 2023. Our study site is a small lagoon with limited seasonal connectivity with the Belize River. In May–June, we captured 10 reproductively mature female *S. triporcatus*. We affixed radio and acoustic transmitters to the carapace of each turtle to allow tracking in both water and on land and tracked nearly daily from August to December. Additionally, turtles were recaptured monthly to assess reproductive condition using an ultrasound and, when eggs were present, we obtained radiographs to assess reproductive investment (size and number of eggs/clutch). Follicular growth and presence of eggs were monitored May–December, and the first shelled eggs were observed on 13 September. Rates of gravidity peaked in October when 100% of females contained shelled eggs. X-ray data indicated that most females produced multiple clutches between November and February. Finally, movement patterns varied among individuals, with some occupying small segments of the lagoon and others moving over much larger areas. Movements of at least some individuals appeared to be influenced by flooding events.
Oral

A Genomic Reassessment of Range Boundaries and Identification of Conservation Units for Western Pond Turtles (*Actinemys sp.*)

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The western pond turtle has been the subject of considerable taxonomic and conservation-oriented research in the last decade. Until recently, it was considered to represent a single polytypic species referred to as the Western Pond Turtle (WPT), *Actinemys (Emys) marmorata*. In 2014, the taxonomy of Western Pond Turtles was revised to recognize two distinct species: Northwestern Pond Turtles (NPT; *Actinemys marmorata*) and Southwestern Pond Turtles (SPT; *Actinemys pallida*). Both the NPT and SPT are long-lived and widely distributed in the western United States and northern Baja California, Mexico. However, both species are experiencing population declines throughout their range and receive varying levels of state or local protection. Previous genetic studies have been limited to mtDNA or a handful of single nucleotide polymorphisms (SNPs), and have thus limited our ability to clearly define species boundaries, and therefore species-specific conservation actions. Here we aim to accomplish three goals important for the taxonomy and conservation of WPTs: 1) clarify the ranges of both NPSs and SPTs and define regions of admixture between them; 2) identify genomically-defensible conservation management units within each species; and, 3) quantify levels of heterozygosity and inbreeding with each genetic unit as a measure of genetic health. To accomplish these goals, we sequenced over 230,000 high-quality SNPs for 1,259 individual georeferenced turtles, including all occupied watersheds in their range. With dense geographic and genetic sampling, we are able are able to clarify the ranges of the NPT and SPT and show that although the species are not reproductively isolated when they come into contact – they don't appear to be forming a hybrid swarm or extensive introgressive hybridization. There are two or four (NPT) and five or six (SPT) genomically-defensible management units within each species and wide variation in genetic diversity reflecting both evolutionary history and anthropogenic impacts. This work clarifies the taxonomy of the WPTs and is a critical first step for informing conservation priorities informed by both the genetic history and observed demographic declines across their distribution.
Oral

Distribution and Abundance of *Graptemys* Species (*G. nigrinoda* and *G. pulchra*) in the Tombigbee River System of Northeastern Mississippi

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The Black-knobbed Sawback (*Graptemys nigrinoda*) and Alabama Map Turtle (*G. pulchra*) are both endemic to the Mobile River drainage of Alabama, northwestern Georgia, and northeastern Mississippi. Little is known of their current distribution and abundance in the Tombigbee River (TR) system in northeastern Mississippi even though both are being considered for protection under the U.S. Endangered Species Act. During May–July 2019, 2022, and 2023, I used a combination of methods (e.g., point count surveys, basking density surveys, trapping, mark-resight population estimates) to determine the presence and densities of both species in the TR drainage of northeastern Mississippi. Both *Graptemys* species were detected throughout most of the TR and Tennessee-Tombigbee Waterway (TTW). *Graptemys nigrinoda* and *G. pulchra* were found near or upstream of almost all historic localities, and they were found in 4 and 5 previously undocumented creeks, respectively. Basking densities at 33 sites were 15× greater for *G. nigrinoda* (15.0/rkm) compared to *G. pulchra* (1.0/ rkm), while different habitat types had different densities of *G. nigrinoda* and *G. pulchra*; both species occurred at their lowest densities in the TTW lakes. Trapping at 5 sites yielded 107 *G. nigrinoda* and 14 *G. pulchra*, and mean mark-resight population estimates at 5 sites for *G. nigrinoda* averaged 173/rkm (range: 82–397/rkm) and estimates at 3 sites for *G. pulchra* averaged 13/rkm (4–20/rkm). *Graptemys pulchra* is of greater conservation concern in Mississippi compared to *G. nigrinoda* due to lower densities and apparent extirpation from parts of the drainage.

Oral

The Turtle Conservation Genomics Project

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Turtles are in decline globally. No one disputes this fact. The question is how we can use the best combination of science and policy to reverse this decline. Landscape genomics provides critical data to address two aspects of species declines. First, by systematically sampling the geographic range of a species, it returns a spatially explicit map of the primary evolutionary lineages that define the total lineage diversity and the management units that are the centerpiece of conservation strategies for any taxon. Second, landscape genomics allows one to identify the provenance of any individual, be it a turtle confiscated from poachers, an individual housed at a zoo or private collection, or a potential member of a captive breeding program. Given our parallel goals of identifying and protecting populations that encompass the lineage diversity of species and returning confiscated/captive propagated turtles to safe sites within their lineage of origin, we view comprehensive landscape genomics as one of the key elements of the turtle conservation toolkit. Our strategy is built upon lessons learned from the California Conservation Genomics Project (CCGP), the first effort to produce a comprehensive landscape genomic analysis for conservation planning at a state level. We propose to use whole genome resequencing to produce detailed, comprehensive insights to the conservation and management of all species of US turtles. Whole genome resequencing guarantees that the greatest precision and accuracy can be brought to bear; it also ensures that consistent, comparable, combinable data are available for all species. Given technological sequencing advances and analysis pipelines developed and freely available from the CCGP, the greatest challenge to completing this project is assembling geographically comprehensive samples of all species. We hope that those members of the TSA with samples in hand or the capacity to generate them will join us in a collaborative project that will put turtles at the leading edge of conservation genomics, locally and globally.

Oral

Documenting the History and Personalities Behind Turtle Conservation and Research Through the CheloniaCast Podcast

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It is important to chronicle the history, processes, and accomplishments within the field of turtle conservation and research in a holistic manner. While critically important to advancing knowledge on a subject, academic journal articles usually cannot capture the stories intrinsic to a particular body of research. They also usually do not express the personalities of those who undertook the research and are limited in how much they can explore a topic in the pursuit of conciseness. It can be hard for members of the public to access or understand research articles as well, limiting the public's ability to obtain knowledge on a subject like turtle and tortoise biology and conservation. It is pertinent to spread knowledge and promote critical thinking about turtle and tortoise research and conservation in the 21st century, so that people can better understand their dire conservation status and appreciate them for how fascinating they are. In the age of technology and podcasts, there is an immense opportunity to bring this incredible field to the ears of a broad audience in a digestible manner. The CheloniaCast Podcast, started by a team of high school students, seeks to explore the immense world of turtle research and conservation through the lens of those actively involved in progressing the field. This paper explores key insights that have been gained so far through conducting over 100 hours of interviews with active participants in the field of turtle biology, ecology, and conservation. The adventures and challenges that have accompanied each interview are addressed. Focus is put on why turtles matter, how they are faring, and where the future of turtle conservation is headed.

Oral and Poster

Aquatic Habitat Preferences of the Eastern Snake-necked Turtle in Australia

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River regulation and urban or agricultural development often reduces the water quality of freshwater systems. Water quality is an important environmental variable to freshwater turtles, and many species have limited tolerances to different abiotic parameters. Despite the potential for large effects of water quality variables on turtle physiology, we still do not understand the extent to which many species identify and select different water quality parameters within their habitats. The Eastern Snake-necked Turtle (*Chelodina longicollis*) frequently migrates between different habitats throughout east Australia, including rivers, lakes, lagoons, dams, agricultural ponds, and sewage systems. However, their ability to perceive the quality of these environments and whether they select for specific water quality attributes is unknown. Our objective was to identify the preferences of Eastern Snake-necked Turtle to different water quality parameters. We aimed to quantify the time spent in varying concentrations of abiotic variables: dissolved oxygen, fertilizer, pH, salinity, and turbidity. Ten turtles were each placed in an enclosure containing a single water quality parameter (e.g. salinity) at four different concentrations; the selected concentration of each turtle was monitored via a time lapse camera over a period of two continuous days for each water quality parameter. Each turtle was rotated through all water quality parameters in a random order. Eastern snake-neck turtles demonstrated a preference for freshwater over treatments with high concentrations of salinity, pH, turbidity, and fertilizer. However, they showed no preference for differing dissolved oxygen concentrations. Here, we show that although the eastern snake-neck turtle occupies a variety of natural and artificial environments, they have the ability to identify and select specific water quality attributes. Maintaining such water quality parameters should be a focus of catchment management and is likely to benefit both turtles and the broader food web.

Oral

Assessment of Hunting and Trade in Freshwater Turtles, and Conservation of African Softshell Turtle or Nile Softshell Turtle (*Trionyx triunguis*), and Other Freshwater Turtles in the Volta Basin of Ghana

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Ghana is home to many freshwater turtle species, among them is the African Softshell Turtle or Nile Softshell Turtle (*Trionyx triunguis*), locally known as Na-meenga or Meenga in the Mole Dagbani language. It is the largest freshwater turtle species on the African continent and the only extant species in the genus *Trionyx*. Despite the common name been "African softshell turtle", *Trionyx triunguis* ranges widely across Africa in to the coastal regions of southern Turkey and to the Mediterranean coastal area of Israel. *Trionyx triunguis* was previously listed as Least Concern globally in view of its wide distribution (1996). However due severe decline in recent decades many of the sub population have been reclassified with the Mediterranean sub population now considered as Critically Endangered by IUCN. Strong arguments have also been presented by many authors for the West African sub population to be reclassified as Critically Endangered due to severe decline in population resulting in over exploitation and habitat degradation. Nonetheless it remains listed as vulnerable by the IUCN Red List of threaten species. It is also placed in Appendix III by CITES's, nevertheless, little effort is given to the conservation of the species, as the species are silently going extinct owing to escalating spate of hunting for trade and traditional medicine. Preliminary results from our opportunistic surveys in some communities around Ghana revealed several illegal turtle trading markets in the country. It is against this background that we are conducting a detailed assessment of freshwater turtle trade focusing (*Trionyx triunguis*), using interviews with fishermen and middle men involved the trade and ecological survey of some water bodies. We have also estimated population of *T. triunguis* based on data acquired from fishermen, and middle men and carried out community education to engender community support for turtle conservation using outreach to schools, communities and turtle markets. Finally, we will also discuss some of the challenges that have been encountered during our interaction trading and trafficking agent.

Oral

Influence of Temperature and Photoperiod on Activity Patterns of Alligator Snapping Turtles (*Macrochelys temminckii*)

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Seasonal and diel activity cycles play an important role in meeting the biological needs of organisms. Defining these patterns provides useful insights into the physiology, behavior, and ecology of animals. Photoperiod (daylength) is a key factor regulating the activity cycles of most animals while temperature plays a critical role in the activity regulation of ectotherms. We used automated radiotelemetry and the signal change method to study the effects of temperature and light intensity phases (daytime, nighttime, twilight) on the seasonal and diel activity patterns of a captive population of Alligator Snapping Turtles maintained under semi-natural conditions in southeastern Oklahoma over a one-year period. Females were seasonally more active within a warmer average temperature range (17.1–31.8°C) than males (12.7–27.6 °C). Temperature also explained a greater portion of seasonal variation in female activity (49%) than male activity (31%). Both sexes maintained some level of activity throughout the year suggesting they do not enter complete dormancy. Activity was detected during all hours of the day across most months and changed in proportion with light availability. Diel activity patterns changed seasonally such that turtles exhibited modest nocturnal tendencies during the warmer months of the year, pronounced diurnal rhythms during the cooler months of the year and an arrhythmic diel cycle during the hottest month of the year. Changes in diel activity patterns were influenced by changes in light intensity and temperature.

Oral

The Mediterranean subpopulation of the Nile Softshell Turtle (*Trionyx triunguis*) – From Genomics to Conservation Strategy

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The Nile (or African) Softshell Turtle (*Trionyx triunguis*) is inhabiting freshwater and brackish- water streams in Africa and the Eastern Mediterranean basin. It is the only extant species in the genus *Trionyx*. The African population is rapidly declining due to extensive hunting. The ability of softshell turtles to tolerate salt water enabled the species to colonize streams in the eastern and northeastern Mediterranean. The Mediterranean subpopulation of the Nile Softshell Turtle was listed in the "Red List of Threatened Species" by the IUCN, as critically endangered and classified as severely fragmented. Though difficult to estimate, it is believed that the entire Mediterranean population contains less than 1,000 adults. In Israel, most of the turtles inhabit two streams with small populations in five others. Most of the molecular studies aiming to decipher the genetic structure of *Trionyx triunguis* populations from the Mediterranean and African continent were based on the mtDNA D-loop and several microsatellite loci. These works revealed very little variation within the Mediterranean samples. Our study aimed to generate a reliable tool for genetic analysis of the Nile turtle. Using the RAD-Sequencing technology, we were able to locate thousands of SNPs, allowing for individual identification as well as relatedness measurement. The results of this study found a significant difference between the Israeli populations sampled and samples from Turkey with a distinctly different genetic profile. In addition, the research obtained insights into previously undocumented ways of reproduction, such as nesting in groups of females during a particular nesting season and even multiple paternity. The analysis also hinted at a complex genetic relationship between the two major Israeli populations, which could indicate past gene flow or a common genetic origin. In our talk we will provide our study's comprehensive information that emphasizes the importance and urgency of conservation efforts to protect the genetic diversity of the softshell turtle in Israel, and in the Mediterranean Sea.

Oral

Expanding Community-Based Tortoise Rewilding Effort in Bangladesh

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Turtle Survival Alliance and Creative Conservation Alliance, in collaboration with the Bangladesh Forest Department, have set up a successful conservation breeding program for four critically endangered tortoise and freshwater turtle species in Bangladesh in 2017 in Bhawal National Park. Since 2019, the facility has been successfully breeding Asian Giant Tortoise (*Manouria emys phayrei)* and Elongated Tortoise (*Indotestudo elongata*). A pilot reintroduction program of *M. e. phayrei* was initiated in Bangladesh in 2021. A confirmed survival rate of 70%, the establishment of home ranges, and a positive, steady growth in terms of mass, and carapace and plastron length of specimens, combined with zero occurrence poaching and the observed enthusiasm of the local communities towards tortoise conservation during the first 18 months of the release indicate the initial success of the reintroduction effort. Based on what was learned from the pilot study, two new batches of *M. e. phayrei* and *I. elongata* will be rewilded in two different sites in 2024. Successful long-term post-release monitoring of reintroduced animals is crucial to evaluate the effectiveness of the reintroduction program. To ensure effective post-release monitoring, VHF telemetry combined with a trained conservation detection dog will be utilized. Additionally, the translocation of adult pairs of Black Softshell Turtle (*Nilssonia nigricans)* from the Shrine in Chittagong to the Turtle Conservation Center is underway, aiming to establish a second captive colony of *N. nigricans* in Bangladesh.

Oral

Revolutionizing Taxonomy and Education: The Impact of Noninvasive 3D Scanning Technology on Endangered Species Preservation

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For centuries, the documentation and study of wildlife have necessitated practices that, while invaluable for scientific research, often result in the loss of life for the subjects studied. Traditional methods have involved the collection and preservation of specimens, a process that, while providing critical data, comes at a cost to biodiversity, especially among endangered species. The Biodiversity Group's latest innovation in conservation presents a groundbreaking shift in this paradigm through the development of the world's first 3D scanning technology for wild animals – the NATURE (Non-invasive Advanced Taxonomy Utility for Research Expeditions) Scanner. Paired with noninvasive DNA collection techniques, this approach not only eliminates some need for euthanizing specimens, but also ushers in a new era of conservation taxonomy and educational

strategies. The implementation of 3D scanning technology enables the creation of digital museum specimens, offering an ethical and sustainable alternative or addition to physical preservation. This method is particularly useful when encountering species that are critically endangered or have been considered extinct for decades. Species rediscoveries, a not uncommon occurrence for our team, pose significant ethical dilemmas when the survival status of the individuals found is uncertain, yet in-country partners desire museum specimens. Our noninvasive approach mitigates these concerns by allowing for in-depth study of these species without compromising their well-being, ensuring that potentially the last remaining individuals of a species can continue to thrive in their natural habitats. Moreover, this technology holds the potential to revolutionize environmental education and public engagement in conservation efforts. By harnessing 3D, virtual reality, augmented reality, and other immersive technologies, we can bring the wonders of the natural world into classrooms and homes across the globe. This not only enhances educational experiences by providing interactive and engaging learning opportunities but also fosters a deeper connection between the public and wildlife conservation initiatives. The Biodiversity Group's pioneering 3D scanning technology represents a significant leap forward in the ethical study and preservation of endangered species. It promises to enrich scientific research, conservation strategies, and environmental education, helping to ensure that future generations inherit a richer, more diverse world.

Oral

Promoting Resilience of Spotted Turtle Populations on Military Installations: Assessing Anthropogenic and Climate-Induced Stressors in Coastal and Inland Populations

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The Spotted Turtle (*Clemmys guttata*) is currently under review for federal listing, occurs on 40 U.S. Department of Defense (DoD) installations and potentially occurs on another 48. All populations are vulnerable under climate scenarios that reduce wetland hydroperiod. Coastal populations are additionally vulnerable to wetland loss and saltwater intrusion from sea level rise and overwash during major storm events. Thus, hydrology is considered the major climate-induced stressor because of its great impacts on turtle habitats. Spotted Turtles are also exposed to landscape stressors such as distance to other suitable wetlands, road density, woody encroachment, and accessibility to potential poaching – a major threat to the species. Through recent funding from SERDP, our project aims to promote the resilience of Spotted Turtle under anthropogenic and climate-induced stressors on DoD installations. The relative vulnerability of coastal and inland Spotted Turtle populations to hydrologic alterations, connectivity, and susceptibility will be evaluated using an interdisciplinary approach composed of laboratory, field, and model work. Field work will focus on turtle movement, population surveys, quantifying stressors at occupied sites, collecting blood samples for measurement of chemical stressors and characterizing turtle health. Lab work will test the effects of salinity and temperature on physiological and immune responses in turtles. The omics-based assays will be conducted on a subset of biological samples collected from field surveys and controlled lab experiments. An individual based model and Bayesian Network-Relative Risk Model supported by data will be used to explore how multiple stressors affect turtle populations and inform management for promoting their resilience on DoD installations. Field and laboratory work will quantify climate, landscape, and chemical stressors and evaluate the demographic (via population assessments), behavioral (via telemetry), and physiological (via biological and omics-based assays) effects on Spotted Turtles. These data will be used in two different modeling frameworks to evaluate the effects of multiple stressors on this at-risk species. In addition to providing baseline population data for monitoring future trends, our work will quantify stressors at each site and identify which stressors Spotted Turtles are most sensitive to, helping prioritize management actions and best management practices for the species.

Poster

Habitat Selection Model for Translocated Individuals as a Strategy to Enhance Conservation Actions of Dahl's Toad-Headed Turtle (*Mesoclemmys dahli*)

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Understanding habitat selection patterns and the factors influencing them is crucial for developing effective conservation strategies. Habitat selection involves ecologically adaptive decisions that are influenced by environmental and biological factors and maximize survival and reproductive success. Critical habitats for nesting, feeding, or breeding are essential for species survival, especially with habitat degradation and fragmentation being major extinction threats. Consequently, conservation efforts should prioritize understanding species' habitat requirements since habitat loss and degradation can lead to population decline and increased extinction risk. The Carranchina turtle, an endangered Colombian species, is threatened by habitat loss and fragmentation of tropical dry forests, which, by increasing inbreeding and reducing genetic diversity, can increase extinction risks. Thus, a protected area was established to restore local populations and facilitate genetic rescue through translocations. Therefore, to inform conservation and resource management strategies for *Mesoclemmys dahli*, we studied habitat selection in the La Carranchina Natural Reserve, Sucre, Colombia. Consequently, using VHF transmitters, we daily tracked individuals translocated to the reserve to record location, estivation, health, adaptation, and reproductive status post-translocation over a year. With the collected data, we created a habitat selection model for the species at the reserve, allowing us to build a management tool that could be used to predict the monthly occupancy probability of different habitats for individuals of the species across the year. This tool provides valuable information that managers could use to prioritize conservation areas within the reserve and give us more insight into the species' behavior. We gain relevant data on the factors influencing the population dynamics of the species by focusing on habitat selection—an active choice by individuals or populations. Moreover, non-invasive tracking technologies provided detailed data on animal movements and habitat preferences without disrupting the studied individuals. Integrating these approaches will lead to more informed and sustainable conservation practices that help optimize resource use and decision-making, particularly in protected areas.

Oral

Casualty of Testudinids in a Veterinary Center in Paraguay

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The wild animal practice in the National University of Asunción operates since 2003, and is nowadays considered a local referral clinic for wild animals. The object of this study is to report the species of testudinids that were brought to the clinic, detailing the number of individuals per species, and the main clinical findings. Patient files from 2004 to 2023 were reviewed and the following data was registered in an Excel sheet: file number and date, species, weight, sex, approximate age, origin, time with the person, feeding, diagnosis and cause. A total of 496 turtles and tortoises were registered in individual patient files. Of these, 386 are *Chelonoidis* spp. (260 *Chelonoidis chilensis* and 122 *C. carbonaria*, 4 unknown), 8 *Acanthochelys macrocephala*, 1 *A. pallidipectoris*, 7 *Mesoclemmys vanderhaegei*, 6 *Phynops* spp. (3 *P. hilarii,* 2 *P. geoffroanus*, 1 unknown), 2 *Hydromedusa tectifera*, 14 *Kinosternon scorpioides*, and 12 unknown pleurodira. Also, 60 *Trachemys* spp. (52 *T. scripta*, 7 *T. dorbigni*, 1 unkown). Regarding casualty, of the 260 *C. chilensis* brought to the practice, 130 related to trauma (vehicle-related, bite wounds, burnt), 20 had respiratory signs, 39 had unspecific management issues, 6 had reproductive issues. Routine control involved 41 animals, and 7 files were incomplete or undiagnosed. Regarding *C. carbonaria*, of the 122 cases, 26 were related to trauma, 12 had reproductive issues, 11 had digestive issues, and 5 had respiratory signs. Routine control involved 50 animals. Regarding native freshwater species (*A. macrocephala, A. pallidipectoris, K. scorpioides, H. tectifera, M. vanderhaegei, Phrynops* spp.), of the 38 cases, 12 were related to trauma, 8 involved management issues, and 17 involved routine control. There is a wealth of information to work with, and many relations to be tested, such as: diet to casualty and to species, time in captivity to casualty, species to place of origin, as well as analyzing weight ranges for the species, etc. This constitutes the first report on testudinid casualty in Paraguay, and may aid in identifying critical species to work with, while concluding that the main problem is still illegal captivity.

Oral

Building a Bolson Tortoise (*Gopherus flavomarginatus*) Program in the US

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The "Critically Endangered" (IUCN Red List) Bolson Tortoise (*Gopherus flavomarginatus*) is endemic to the Chihuahuan Desert, the northern tip of which extends into southern New Mexico in the US. The only native wild Bolson Tortoise population inhabits an isolated basin in north-central Mexico. Starting with 30 captive adult and sub-adult Bolson Tortoises in the fall of 2006, the Turner Endangered Species Fund (TESF) established robust breeding and head-starting programs on media mogul Ted Turner's southern NM ranches that encompass suitable habitat. Regular, long-term monitoring of marked individuals allowed us to calculate typical growth rates for juvenile tortoises (~ 10 mm per year) and survivorship (~70% overall) as well as examine parameters such as predation pressures on nests and juveniles, fecundity, and forage preferences. To better understand space requirements and habitat use of Bolson Tortoises introduced into northern Chihuahuan desert habitats, we experimentally released 101 juvenile Bolson Tortoises (all carrying VHF transmitters) in a remote location on one of the Turner ranches in 2021 and 2022. At the beginning of 2024, 94 of these are still alive, and most (~85%) remain within ~1,200 m (0.75 mi) of their release location. We lost track of two tortoises due to failed transmitters and we returned two tortoises to captivity. Of the three documented mortalities to date, one tortoise was killed by a vehicle, one tortoise overheated after its transmitter antenna was entangled by dry vegetation, and one apparently froze during a spring 2024 coldsnap. Growth rates of released tortoises vary from year to year but are similar to those of unsubsidized semi-captive juvenile tortoises at nearby locations. With over 700 juvenile tortoises produced to date (ranging in age from 0-18 years old in 2024), and recent progress towards our goal of forming free-living, minimally managed Bolson Tortoise assurance populations in the US, the United States Fish and Wildlife Service (USFWS) proposed that these tortoises could also serve as the foundation for a US-based Bolson Tortoise recovery program. The success of the Bolson project indicates that recovery of the Bolson Tortoise in the northern Chihuahuan desert should be feasible.

Oral

Life in the Fast Lane? Demography of the Relatively Short-lived Western Chicken Turtle (*Deirochelys reticularia miaria*) in Oklahoma

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Turtles are increasingly threatened globally with major population declines and local extirpations necessitating fine-scale demographic analysis. The Western Chicken Turtle (*Deirochelys reticularia miaria*) is a relatively short-lived freshwater turtle located in the United States with widespread extirpations and declines of populations across its range. While several aspects of its unique behavioral ecology have been studied, no long-term demographic studies have been conducted on this taxon. From 2012 to 2022, we monitored and trapped a large metapopulation of Western Chicken Turtles in Oklahoma. By comparing annuli to changes in time of years, we determined that annuli are laid down approximately annually, though there is an increase in the rate of annulus deposition with age. We also determined that, consistent with Eastern Chicken Turtles (*D. r. reticularia*), Western Chicken Turtles that do not grow over 3 or more years can accurately be assigned a minimum estimated age of 5 years old. Using mark-recapture data, we determined that females have relatively prolonged growth while males have a much faster growth period followed by ambiguity around the asymptote which greatly contrasts with the growth patterns reported for Eastern Chicken Turtles. This suggests that female Western Chicken Turtles may be relatively longer-lived than Eastern Chicken Turtles. Additionally, we found that Western Chicken Turtles produced relatively similar clutches to the eastern subspecies, both in number and dimensions of eggs. Female Western Chicken Turtles, however, also have the potential to produce eggs at smaller and/or younger stages than other chicken turtle subspecies, suggesting more variable reproductive output. Reproductive output also appeared to be more strongly correlated with female size in the *Deirochelys* genus than previously described.

Oral

Bolson Tortoise Conservation in the United States

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We (USFWS) finalized a Safe Harbor Agreement on the Armendaris Ranch, for the Bolson Tortoise (*Gopherus flavomarginatus*) in 2023 as a first step toward conservation of the species in the United States. The Armendaris Ranch is a 344,955 acre (139,598 hectare) private ranch in central New Mexico. This newly created United States population has 121 free-ranging animals and additional releases, to bolster numbers, are planned. The wild population in the tri-state area of Mapimí, Mexico is thought to be at less than 2,500 individuals. This 50-year Safe Harbor Agreement provides a net conservation benefit to both the Mexican and New Mexican population. With finalization of the Safe Harbor Agreement, the New Mexico Ecological Services Field Office is assuming recovery responsibility for efforts in the United States. We will continue to work with partners in Mexico and the United States to help assure conservation in both countries. We are considering the possibility of additional tortoise release locations on protected lands in suitable habitat. Habitat modeling efforts indicate that suitable habitat may exist on Sevilleta and Bosque del Apache National Wildlife Refuge's. We are interested in finding other potential sites to locate conservation populations that have large areas of suitable habitat, protection from human mortality or collection, and lack of conflict with human activities or other species.
Oral

Tough Crap: The Diet of the Durophagus Northern Giant Musk Turtle (*Staurotypus triporcatus*)

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Belize is home to nine species of freshwater and terrestrial turtles, many of which are listed as Critically Endangered, Vulnerable, or Near Threatened, in part due to demand for bushmeat. The Northern Giant Musk Turtle (*Staurotypus triporcatus*) is an unusually charismatic species that has nonetheless reserved scant recent study. Past research suggests that this species is primarily carnivorous, inhabits a wider range of wetland types, and resides in terrestrial habitats for part of the year. Information concerning this species' diet is limited, both in the types of studies conducted and their geographic scope. To better understand ecological role and trophic position of Northern Giant Musk Turtles, we conducted parallel investigations of diet and strike kinematics. To investigate variation in these traits we worked with six populations—three that inhabit systems with typically turbid water and three occupying systems with relatively better water clarity. Turtles were captured via active pursuit with dip nets, free-diving, and trapping using baited hoop traps. After capture, turtles were immediately stomach flushed to obtain a pre-digested diet sample and transported back to the Savana Field Station. There, turtles were held for 48 hours in tubs of water to collect fecal samples (post-digestion diet samples). Stomach and fecal samples were sifted through a fine mesh filter and stored in 70% isopropyl alcohol until being sorted to lowest possible taxonomic classification. Preliminary data suggest that The Northern Giant Musk Turtle diet largely consists of bivalves, gastropods, and seeds from plants in the palm family Arecaceae.
Oral

IT'S TURTLE TIME.