12th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles

Joint Annual Meeting of the Turtle Survival Alliance and IUCN Tortoise & Freshwater Turtle Specialist Group

Program and Abstracts
August 4 — 7, 2014
Orlando, Florida

This year’s Symposium is made possible by . . .

Title Sponsor
ZOOMECHERION REPTILES FOUNDATION

Additional Conference Support
Generously Provided by:
Brett and Nancy Stearns, Frank and Kate Slavens
John Carr, John Iverson, and Michael Redmer

Funding for the 2014 Behler Turtle Conservation Award generously provided by:
Brett and Nancy Stearns, Chelonian Research Foundation,
Chelonian Research Institute, Deb Behler, George Meyer,
IUCN Tortoise and Freshwater Turtle Specialist Group, Matt Frankel
TSA PROJECTS

India: 103 new additions to the Sundarbans River Terrapin, Batagur baska, population at Sanjekhali facility in West Bengal.

Madagascar: The largest tortoise confiscation in its history occurred in June when 968 juvenile Radiated Tortoises (Astrochelys radiata) and one Ploughshare Tortoise (Astrochelys yniphora) were discovered tightly taped and packed in 8 suitcases.

Myanmar: TSA/Wildlife Conservation Society team returned from the Upper Chindwin River where the Burmese Roofed Turtle (Batagur kachuga) is setting nesting records!

Turtle Survival Center: Volunteers make a huge impact after ice storm and the new buildings are filling up with turtles and tortoises.

Turtle Survival Alliance 2014 Conference Highlights

Keynote Speaker: Arthur Georges

Arthur Georges, a biologist with a longstanding interest in freshwater turtles, will be our keynote speaker at this year’s symposium. Arthur is a leading expert on freshwater turtles in Australia whose work has included projects on turtles in the dune lakes of Fraser Island; arid central Australia; northern Australian wet-dry tropics with the Aboriginal communities; lowlands of southern Papua New Guinea on the Pig-nosed Turtle; and now also in the Murray-Darling Basin, Australia’s biggest river. Join us as we welcome Arthur in Orlando.

Look for Two Book Signings at this Year’s Conference!

Peter Lindeman will be signing his Map Turtle and Sawback Atlas: Ecology, Evolution, Distribution, and Conservation. Covering all facets of the biology of a little-known genus, Peter’s lavishly illustrated book is both a scientific treatise and an engaging introduction to a striking group of turtles. Peter details the habitat, diet, reproduction and life history, natural history, and population abundance of each species.

David Rostal (lead editor) will be signing the newly released Biology and Conservation of North American Tortoises. While Earl McCoy and Henry Mushinsky (co-editors) won’t be able to join us in Orlando, they have pre-signed copies for us! Don’t miss out on this opportunity to get a copy of this great new book signed by all three editors.

The book signing event will be on Tuesday (Aug 5) at 6:30 PM, after the Poster Session.

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WOW! Where did the time go? It seems like only yesterday we were all saying our goodbyes in St. Louis and already it is time to welcome each of you to the 12th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. As we have stated before, the Symposium has become a fixture in our personal and professional lives, a reunion if you will. An opportunity to meet with our friends and colleagues to share successes and failures from the last year and get pumped up to tackle the next. And this symposium does just that, it energizes and motivates us to keep moving forward and doing good work for turtle conservation. We can never say it enough times, the Joint Annual Meetings of the Turtle Survival Alliance and the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group is the BEST gathering of turtle biologists, zookeepers, husbandrists, and enthusiasts, anywhere in the world. And once again we will be meeting at the beautiful Rosen Plaza in Orlando, Florida.

In previous letters we have mentioned how these annual meetings create an atmosphere where one can rub elbows and exchange ideas with some of the biggest names in the field. This is true, but this meeting would not be what it is without the new faces and eager students who also attend and help this gathering grow each and every year. There is such a diverse background of experiences and disciplines represented at this meeting and we encourage everyone to take advantage of this. There is so much we can all learn from each other, and it is the synergy we create from these interactions that ensures our success and the future preservation of turtles worldwide.

In order to maintain this continuity we are ever so grateful to those professors who continue to bring students every year, and for the top-notch work the students do. In addition, the generosity of our sponsors make Travel Grants a possibility, which many students benefit from; take the time to visit the sponsors booths, buy their products, or just say thanks. A major student bonus at conference is the Student Presentation Awards made possible through generous donations from Anders Rhodin and the Chelonian Research Foundation.

This year we are honored to have Arthur Georges as our keynote speaker, speaking about turtle conservation in Papua New Guinea. Arthur’s presentation will be followed up by special sessions on *Cuora galbinifrons*, *Rhinoclemmys*, Zoos and Chelonians, Tortoises, Reintroductions, as well as multiple sessions on Captive Husbandary, Biology and Ecology, and Conservation. And of course, no TSA meeting would be complete without our wonderful evening social events. These mix and mingle activities truly create the “family” atmosphere we all associate with this symposium.

As the "front" people who interact with the presenters, an impression that we "organize" the conference is created. Nothing could be further from the truth. Lonnie McCaskill (Disney's Animal Kingdom) and Scott Davis (TSA Executive Director) find, and negotiate with the fabulous conference locations; Thanks to them, we once again a great and affordable venue. Heather Lowe and Christine Bowie have turned into quite the team keeping us all on track! Robert Villa, Michael Hance, and Kimberly Schmidt will be running the AV and making sure your presentations run smoothly. Peter Miller will be taking your photos; smile! Brian Bower will be here to capture some videos along the way (behave!). The crew from Disney's Animal Kingdom will be here again to run the hospitality suite and do a million other necessary jobs to keep the conference running smoothly behind the scenes. And finally, producing the program is a major endeavor of technical formatting and organization, thanks to Beth Walton!

If you are interested in volunteering at next year’s conference, please let us know. We are always looking for session chairs, student paper and poster judges, Program editors, and additional hands to help behind the scenes. We also welcome your comments and suggestions on ways to make this conference more meaningful and enjoyable.

We look forward to visiting with all of you. On behalf of the Conference Committee and Volunteers:

Welcome! We hope you enjoy the conference!

Andrew Walde and Daren Riedle
Program Co-Chairs
WELCOME!

On behalf of the Turtle Survival Alliance (TSA) Board of Directors, and the IUCN Tortoise and Freshwater Turtle Specialist Group (TFTSG) leadership, we welcome you to the 12th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. We are back on the east coast this year and we expect another great conference in Orlando. Maybe because there are just so many good turtle folks in Florida!! And for the third time we are hosted at the fabulous Rosen Plaza, whose hospitality and conference staff are attentive and in tune with our needs.

We have some exciting and fun evening events planned for you this year. Tuesday is the traditional Pizza Night, and running concurrently will be judging for our first ever Photo Contest. We will also feature two book signings that night: Peter Lindeman will be on hand to autograph his exceptional Map Turtle and Sawback Atlas (with copies for purchase), and Dave Rostal will be signing the hot-off-the-press Biology and Conservation of North American Tortoises. I am told that Henry and Earl will have signed in advance, making this a great opportunity to pick up a few signed instant classics for your library. On Wednesday night, our BBQ and auction will be hosted by the Central Florida Zoo in nearby Sanford. This is our second time to bus out there and it’s because these folks know how to throw a party and their hospitality reminds us that we are in the south! On Thursday night we wrap up with our Awards Banquet, where the student speaker and poster awards and photo content winners will be announced. The evening will be capped off by the presentation of the prestigious Behler Award to Dick Vogt who will take us through a colorful and memorable (I guarantee it) reflection of his amazing life with turtles.

As always, we give special recognition to our committee and program committee of Heather Lowe, Scott Davis, Lonnie McCaskill, Andrew Walde, Christine Bowie, Beth Walton and Daren Riedle. Heather’s organizational abilities keep the whole process on track, and Andrew and Daren have put together the kind of outstanding program that we have come to expect. Their ability to create order from chaos continues to impress. This year’s program is no exception. Kicking off the conference will be the keynote address by the renowned Australian turtle biologist Dr. Author Georges of the University of Canberra, who will talk about his work in Papua New Guinea, a difficult-to-work region from which scant information emerges. This will be Arthur’s first TSA conference, so he’ll finally understand what he’s been missing all these years.

We also pay tribute to our many sponsors, without whose support it would not be possible to provide the incredible bargain that this symposium has become so well known for. Our reliable partner, Zoo Med, whose support contributes so much to this event’s success, is again the symposium’s title sponsor. There are so many other costs associated with this conference - travel grants, coffee breaks, catering, transportation and the all-important hospitality suite. For their generosity we thank Ben and Jerry’s, Brett and Nancy Stearns, Frank and Kate Slavens, IUCN Tortoise and Freshwater Turtle Specialist Group, John Carr, John Iverson, Michael Redmer, SWCA Environmental Consultants, and Walde Research and Environmental. Awards for the Best Student Presentations will again be presented and supported this year by Anders Rhodin and Chelonian Research Foundation. And special thanks also to Carel Pieter Brest van Kempen who supported our auction again this year by donating an incredible painting of a Burmese Star Tortoise, created specifically for the TSA.

We look forward to another great symposium and we thank you for being a part of it. This conference embodies the true spirit in which both the TSA and TFTSG were founded: that saving turtles would require a lot of like-minded people, from many backgrounds and professions, all working in synergy. With the many people from diverse institutions and countries attending, this conference is a true microcosm of the global turtle conservation community, coming together annually to replenish our enthusiasm, seek inspiration, and remind ourselves why we do what we do for turtles and tortoises.

Rick Hudson, President TSA
Peter Paul van Dijk and Brian D. Horne, Co-Chairs TFTSG

This year the 9th annual Behler Award celebrates and honors one of our most colorful field biologists and conservationists, Richard "Dick" Vogt, who has been active not only in the U.S., where he trained and pursued his early work, but also in Veracruz, Mexico, where he worked for many years, and more recently, in the Amazon of Brazil where he has been stationed for a long time, running a vast array of field projects, student training courses, and conservation-focused research programs. A frequent participant and sometime auctioneer at our Symposium, Dick brings with him not only his own colorful and outgoing personality, but also usually a bevy of Brazilian colleagues and students to improve the international flavor and diversity of our gatherings. We look forward to hearing his life story and details about his turtle-focused accomplishments, including his early seminal work on temperature-dependent sex determination and recent work on Podocnemis hatchling vocalization and maternal socialization and parental care. The TFTSG and TSA are honored to be joined this year by the Turtle Conservancy and the Turtle Conservation Fund as co-presenters and co-founders of the prestigious Behler Turtle Conservation Award, now bringing together the four turtle organizations most closely tied to John Behler's legacy. Associated with this expansion is also a significantly raised honorarium and an expanded group of dedicated and generous co-sponsors: Conservation International, Wildlife Conservation Society, Chelonian Research Foundation, Chelonian Research Institute, Surprise Spring Foundation, George Meyer and Maria Semple, Deborah Behler, and Brett and Nancy Stearns.

Congratulations Dick on important work well done!

Rick Hudson and Anders G.J. Rhodin,
Co-Chairs, Behler Turtle Conservation Award Committee
If you are presenting...

Presenters, please plan on turning your talk in on the day **BEFORE** you present (or earlier). No exceptions or last minute edits, please. Talks will be accepted at the **Registration Desk** at the following times:

- August 4 – 4:00 PM – 8:00 PM
- August 5 – 8:00 AM – 3:00 PM
- August 6 – 8:00 AM – 2:00 PM

Contents of this Conference Program should be cited as:


Please visit the following vendors, sponsors and non-profit organizations in the Exhibit Hall (Ballroom A):

- Asian Turtle Program, Turtle Conservation Centre (TCC)
- Holohil Systems
- Karumbe
- Mazuri
- Paul Gritis Books
- Sonotronics
- Turtle Conservation Society of Malaysia
- Turtle Survival Alliance
- Wildlife Materials, Inc.
- Zoo Med Laboratories, Inc.

**Conference Notes and Social Activities**

**Monday, August 4**

- Registration 4:00 PM – 8:00 PM (Registration Desk)
- Photo Contest Submission 4:00 PM – 8:00 PM (Registration Desk)
- Auction Item Drop Off 4:00 PM – 6:00 PM (Ballroom A)
- Exhibit Hall Open 4:00 PM – 6:00 PM (Ballroom A)
- Poster Hanging 5:00 PM – 6:00 PM (Ballroom A)
- Icebreaker 6:00 PM – 8:00 PM (Ballroom C) *cash bar available

**Tuesday, August 5**

- Complimentary Breakfast available 6:30-10:30 AM (Cafe Matisse) *coupon required - guests registered in the TSA block received breakfast coupons upon check in at the Rosen Plaza
- Registration 8:00 AM – 3:00 PM (Registration Desk)
- Photo Contest Submission 8:00 AM – 3:00 PM (Registration Desk)
- Auction Item Drop Off 8:00 AM – 1:00 PM (Ballroom A)
- Exhibit Hall Open 8:00 AM – 5:30 PM (Ballroom A)
- Poster Viewing 8:00 AM – 5:30 PM (Ballroom A)
- Silent Auction Opens 2:30 PM (Ballroom A)
- Poster Session 5:30 PM – 6:30 PM (Ballroom A)
- Pizza Dinner – 6:30-8:30 PM (Ballroom A) *cash bar available
- Photo Contest – 6:30-8:30 PM (Ballroom A)
- Purple Silent Auction Closes – 8:30 PM (Ballroom A)
Wednesday, August 6
- Complimentary Breakfast available 6:30-10:30 AM (Cafe Matisse) *coupon required - guests registered in the TSA block received breakfast coupons upon check in at the Rosen Plaza
- Registration 8:00 AM – 4:00 PM (Registration Desk)
- Exhibit Hall Open 8:00 AM – 4:00 PM (Ballroom A)
- Poster Viewing 8:00 AM – 4:00 PM (Ballroom A)
- Tan Silent Auction Closes – 10:35 AM (Ballroom A)
- Green Silent Auction Closes – 1:25 PM (Ballroom A)
- First bus leaves for Central Florida Zoo – 4:30 PM
- Last bus leaves for Central Florida Zoo – 5:00 PM
- Buses leave to return to the Rosen Plaza – 9:30 PM

Thursday, August 7
- Complimentary Breakfast available 6:30-10:30 AM (Cafe Matisse) *coupon required - guests registered in the TSA block received breakfast coupons upon check in at the Rosen Plaza
- Registration 8:00 AM – 1:30 PM (Ballroom A)
- Auction Payment / Pick-up 8:00 AM – 1:30 PM (Ballroom A)
- Exhibit Hall Open 8:00 AM – 1:30 PM (Ballroom A) Please note – This is your last chance to purchase a TSA T-shirt or other conference souvenir!
- Poster Viewing 8:00 AM – 12:20 PM (Ballroom A)
- Poster Breakdown 12:20 – 1:30 PM (Authors, please take down your posters at this time)
- Awards Banquet 6:30 PM (Ballroom C)

Support the TSA!
Be sure to visit the TSA merchandise tables in the Exhibit Hall (Ballroom A) while you are here! Purchases of t-shirts, prints, and other items benefit the TSA and its conservation programs. A cashier is available for TSA merchandise purchases anytime that the Registration Desk is open. Credit cards, debit cards, checks, or cash are accepted.

Auction Notes
The silent and live auctions are always a fun part of the TSA Conference, plus they generate funds to help support the TSA’s conservation programs. The silent auction will take place on Tuesday and Wednesday in the Exhibit Hall (Ballroom A), in three segments. The Live Auction will be held after our dinner at the Central Florida Zoo on Wednesday night.

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, copies are available in the Exhibit Hall (Ballroom A), at the auction drop-off table. Please note: no auction items will be accepted without an accompanying form! Auction items will be accepted from 4:00 PM – 6:00 PM on Monday and from 8:00 AM – 1:30 PM on Tuesday. 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.

To our lucky winners: auction items may be paid for and picked up in the Exhibit Hall from 8:00 AM – 1:30 PM on Thursday.
Lunch
Discounted lunches are available for all conference registrants. Visit Cafe Matisse for a $10 lunch buffet, or the Lite Bite for a $10 boxed lunch. Registrants will receive a 20% discount on all other food and beverages in all Rosen Plaza full-service restaurants throughout the meeting. Please show your conference name tag to take advantage of these special offers.

Questions?
Stop by the Registration Desk during open hours, or ask a conference volunteer (wearing a green shirt).

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

http://www.facebook.com/TurtleSurvival
http://twitter.com/turtlesurvival

*Join the conversation! Use #TSAConference to post or tweet about the meeting.*

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 TSA to use and distribute attendees’ image or voice in photographs and recordings of the meeting — now and in the future.

T-shirt Design Contest Winner!

Please join us in congratulating Mark Wallace. Mark submitted the winning entry in the t-shirt design contest for the 12th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. Be sure to purchase your own Conference t-shirt in the Exhibit Hall as a souvenir – supplies are limited!
Dining Specials: $$$

Present your conference name tag to take advantage of dining specials at the Rosen Plaza Hotel, like a $10 lunch buffet at Cafe Matisse or the Lite Bite for a $10 boxed lunch. You will also receive a 20% discount on all other food and beverages in all Rosen Plaza full-service restaurants throughout the meeting.
### Conference Schedule Overview

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<thead>
<tr>
<th>Sunday August 3</th>
<th>Monday August 4</th>
<th>Tuesday August 5</th>
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<tbody>
<tr>
<td>9:00</td>
<td><strong>TSA</strong> Governance Committee</td>
<td>TSA Opening Address</td>
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<td>9:20</td>
<td><strong>TSA</strong> Board</td>
<td>TFTSG/Red List Update</td>
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<td>9:40</td>
<td><strong>TFTSG</strong> Steering Committee</td>
<td>Keynote: Missionaries, Misfits and Manna from Heaven - Challenges of Turtle Conservation in Papua New Guinea ARTHUR GEORGES</td>
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<td>10:30</td>
<td>Lunch</td>
<td>Break/Posters</td>
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<td>10:45</td>
<td>TSA Field Programs</td>
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<td><strong>TFTSG</strong> Steering Committee</td>
<td>Hunting <em>Platysternon</em></td>
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<td>13:15</td>
<td><strong>TSA</strong> Board</td>
<td>Toast for Turtles</td>
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<td><strong>TCF Board</strong></td>
<td><em>Rhinoclemmys</em></td>
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<td>Poster Session</td>
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<td>Book Signing, Photo Contest, and Pizza</td>
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<td>8:50</td>
<td>Morning Announcements</td>
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<td>Population Status</td>
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<td>Nesting Studies</td>
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<td>Central Florida Zoo BBQ and Auction</td>
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<td>Sunday August 3</td>
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<td><strong>9:00</strong></td>
<td><strong>TSA Governance Committee (9:00-9:30) Salon 10</strong></td>
<td><strong>TSA Update</strong></td>
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<td><strong>R HUDSON</strong></td>
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<td><strong>9:40</strong></td>
<td><strong>TSA Board (9:30 – 17:30) Salon 10</strong></td>
<td><strong>TFTSG Update</strong></td>
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<td><strong>10:30</strong></td>
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<td><strong>PP VAN DIJK &amp; B HORNE</strong></td>
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<td><strong>10:45</strong></td>
<td><strong>KEYNOTE: Missionaries, Misfits and Manna from Heaven - Challenges of Turtle Conservation in Papua New Guinea</strong></td>
<td><strong>Break &amp; Posters – Ballroom A</strong></td>
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<td><strong>11:00</strong></td>
<td><strong>ARTHUR GEORGES</strong></td>
<td><strong>TSA Field Programs Chair R. Hudson</strong></td>
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<td><strong>11:15</strong></td>
<td><strong>India Turtle Conservation Project: Saving Imperiled Indian Turtles</strong></td>
<td><strong>Expansion of &quot;Project Batagur baska&quot; in Bangladesh and Shifting to a Pedigree Breeding Strategy</strong></td>
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<td><strong>11:30</strong></td>
<td><strong>S SINGH</strong></td>
<td><strong>P PRASCHAG</strong></td>
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<td><strong>11:45</strong></td>
<td><strong>Implementation of Actions for the Conservation of the Magdalena River Turtle and Dahl’s Toad Headed Turtle, Colombia’s Most Imperiled Turtle Species</strong></td>
<td><strong>Update on TSA’s Confiscation to Reintroduction Strategy in Madagascar</strong></td>
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<td><strong>12:00</strong></td>
<td><strong>R HUDSON</strong></td>
<td><strong>R K PLATT</strong></td>
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<td><strong>Lunch</strong></td>
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<td><strong>13:30</strong></td>
<td><strong>TFTSG Steering Committee (13:00 – 14:00) Salon 10</strong></td>
<td><strong>Steep Streams in Asian Mountains - On the Track of Platysternon</strong></td>
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<td><strong>T BLANCK</strong></td>
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<td><strong>14:10</strong></td>
<td><strong>TSA Board continued (9:30 – 17:30) Salon 10</strong></td>
<td><strong>Toast For Turtles - Fundraising Initiatives</strong></td>
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<td><strong>L CASHMAN</strong></td>
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<td><strong>14:50</strong></td>
<td><strong>TCF Board (14:00 – 17:00) Salon 10</strong></td>
<td><strong>Rhinoclemmys - Central/South American Wood Turtles</strong></td>
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<td><strong>15:10</strong></td>
<td></td>
<td><strong>What Do We Know about Rhinoclemmys?</strong></td>
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<td><strong>15:30</strong></td>
<td></td>
<td><strong>An Assessment of Knowledge for Conservation</strong></td>
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<td><strong>J CARR</strong></td>
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<td><strong>16:10</strong></td>
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<td><strong>Break &amp; Posters – Ballroom A</strong></td>
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<td><strong>17:30</strong></td>
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<td><strong>Rhinoclemmys (cont.)</strong></td>
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<td><strong>18:00</strong></td>
<td></td>
<td><strong>Captive Husbandry and Breeding of the Ornate Wood Turtle</strong></td>
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<td><strong>D MIFSUD</strong></td>
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<td><strong>Natural History of Rhinoclemmys nasuta from Colombia</strong></td>
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<td><strong>M GARCÉS-RESTREPO</strong></td>
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<td><strong>Captive Reproduction of R. rubida and R. pulcherrima in Oaxaca, Mexico</strong></td>
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<td><strong>M HARFUSH</strong></td>
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<td><strong>Patterns of Distribution of R. funerea and R. pulcherrima in Costa Rica</strong></td>
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<td><strong>M MERCHÁN</strong></td>
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<td><strong>Captive Husbandry and Breeding of the Furrowed Wood Turtle</strong></td>
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<td><strong>P VANDER SCHOUW</strong></td>
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<td><strong>POSTER SESSION</strong></td>
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*Student Considered for Student Awards Competition*
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<thead>
<tr>
<th>Time</th>
<th>Wednesday August 6 - Salon 11&amp;12</th>
<th>Wednesday August 6 - Salon 13&amp;14</th>
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</thead>
<tbody>
<tr>
<td>8:50</td>
<td>Morning Announcements</td>
<td>Morning Announcements</td>
</tr>
<tr>
<td>9:00</td>
<td>Chelonian Community Composition Along a River T PATTON</td>
<td>Project Lenuk Lorosa’e - Conservation and Education Fauna for Chelodina mccordi timorelastensis C EISEMBERG</td>
</tr>
<tr>
<td>9:20</td>
<td>Turtle Population at Blue Spring State Park E KUHNS</td>
<td>Karumbe Program, 15 Years of Conserving Turtles in Uruguay A ESTRADES</td>
</tr>
<tr>
<td>9:40</td>
<td>Population Characteristics of Two Graptemys in the Pearl River W SELMAN</td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td>Status Update for Bog Turtles in Georgia and South Carolina T STRATMANN*</td>
<td>The First Protected River in Colombia: For Turtles and People J DEL RIO</td>
</tr>
<tr>
<td>10:20</td>
<td>Break &amp; Posters</td>
<td>Break &amp; Posters</td>
</tr>
<tr>
<td>10:40</td>
<td>21 Year Study of Seasonal and Interspecific Variation of Hatchling Emergence: to Overwinter or not to Overwinter J LOVICH</td>
<td>Quantifying Road Effect Zones for Desert Tortoises to Estimate Benefits of Mitigation and Habitat Protection M PEADEN*</td>
</tr>
<tr>
<td>11:00</td>
<td>Nest Site Selection by Podocnemis unifilis, Amazonas, Brazil C CAMILLO</td>
<td>Long-term Effects of Predator Fencing on Western Swamp Turtles G KUCHLING</td>
</tr>
<tr>
<td>11:20</td>
<td>Tracking the Movements of Post-nesting River Terrapins P CHEN*</td>
<td>Conservation of Coc Ac, or Yucatan Box Turtle M JONES</td>
</tr>
<tr>
<td>11:40</td>
<td>Nesting Ecology of the Spiny Softshell M BLANCO-PEREZ*</td>
<td>Protection of Swinhoe’s Softshell Turtle in Vietnam T MCCORMACK</td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:30</td>
<td>Turtle Conservancy: 10 Years of Conservation Breeding Success P GIBBONS</td>
<td>Habitat Use of Juvenile Sonoran Desert Tortoises in Arizona C JONES</td>
</tr>
<tr>
<td>13:50</td>
<td>AZA Studbooks: More Than Just Pedigrees with Chelonians L AUGUSTINE</td>
<td>Behavior of Juvenile Sonoran Desert Tortoises in Arizona A OWENS</td>
</tr>
<tr>
<td>14:10</td>
<td>Collaborative Management by Studbook Keeping in Europe H ZWARTEPOORTE</td>
<td>How do Young Gopher Tortoises Balance Energy Assimilation and Predator Avoidance T RADZIO*</td>
</tr>
<tr>
<td>14:30</td>
<td>Smart Science From the Start: Desert Tortoise Translocation and Disease Research by San Diego Zoo A WALSH</td>
<td>Overwintering Ecology of Juvenile Gopher Tortoises B HARRIS*</td>
</tr>
<tr>
<td>14:50</td>
<td>Break &amp; Posters</td>
<td>Break &amp; Posters</td>
</tr>
<tr>
<td>15:30</td>
<td>Oocyte Membrane-bound Sperm Detection for Chelonian Conservation and Breeding Management K CROYLE*</td>
<td>Sighting Frequency Decreases over 21 years in Three Populations of Testudo hermanni from Central Italy R BURKE</td>
</tr>
<tr>
<td>15:50</td>
<td>Torporing Turtles L WYRWICH</td>
<td>Monitoring, Habitat, and Conservation of Texas Tortoises R WOODMAN</td>
</tr>
<tr>
<td>16:10</td>
<td>Detroit Zoological Society: Headstarting Blanding's Turtles J JUNDT</td>
<td>Molecular data reveal that species are not well delimited for Pseudemys and the phylogeny for this clade is unknown P SPINKS</td>
</tr>
</tbody>
</table>

* Student Considered for Student Awards Competition
<table>
<thead>
<tr>
<th>Time</th>
<th>Thursday, August 7 - Salon 11&amp;12</th>
<th>Thursday, August 7 - Salon 13&amp;14</th>
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</thead>
<tbody>
<tr>
<td>9:00</td>
<td>The Indochinese Box Turtle Trade and Threats in SE Asia</td>
<td>Sexual Dichromatism in Turtles</td>
</tr>
<tr>
<td></td>
<td>T MCCORMACK</td>
<td>J ENNEN</td>
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<tr>
<td>9:20</td>
<td>The Flowerback and Keeled Box Turtle in Their Habitat</td>
<td>Von Bertalanffy Growth Model Applied to Southern River Terrapins</td>
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<tr>
<td></td>
<td>T BLANCK</td>
<td>E CHAN</td>
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<tr>
<td>9:40</td>
<td>Status of <em>C. galbinifrons</em>, bourreti, and picturata Studbooks</td>
<td>Vocalizations of <em>Podocnemis expansa</em> In and Out of Water</td>
</tr>
<tr>
<td></td>
<td>L AUGUSTINE</td>
<td>C FERRARA</td>
</tr>
<tr>
<td>10:00</td>
<td>Husbandry/Breeding of Flowerback Box Turtle - Zoo Atlanta</td>
<td>Diets of Syntopic Black-knobbed Sawbacks and Alabama Map Turtles</td>
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<td>L WYRWHIC</td>
<td>P LINDEMAN</td>
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<td>10:20</td>
<td><strong>Break &amp; Posters</strong></td>
<td><strong>Break &amp; Posters</strong></td>
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<tr>
<td>10:40</td>
<td>Notes on Captive Care and Reproduction of <em>C. galbinifrons</em></td>
<td>Sonic Tracking of Migrating Hatchlings of Giant Amazon River Turtles</td>
</tr>
<tr>
<td></td>
<td>J TOUGAS</td>
<td>V BERNARDES</td>
</tr>
<tr>
<td>11:00</td>
<td>Keeping/Breeding the Vietnamese Three-striped Box Turtle</td>
<td>Natural History and Biology of the Oaxaca Mud Turtle</td>
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<tr>
<td></td>
<td>T BLANCK</td>
<td>R MACIP-RIOS</td>
</tr>
<tr>
<td>11:20</td>
<td>Successes, Failures, and Benefits of Networking in the Private Sector</td>
<td>Home Range and Habitat of the Suwannee Alligator Snapping Turtle</td>
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<tr>
<td></td>
<td>C BEDNARSKI</td>
<td>T THOMAS*</td>
</tr>
<tr>
<td>11:40</td>
<td>Simple, Inexpensive Electronics to Incubate Eggs and Other Automated Controls to Meet Husbandry Requirements</td>
<td>Overwintering Habitat and Site Fidelity of Ornate Box Turtles</td>
</tr>
<tr>
<td></td>
<td>P VANDER SCHOUW</td>
<td>K SCHMIDT*</td>
</tr>
<tr>
<td>12:00</td>
<td>Basic to Advanced Wound Care in Chelonians</td>
<td>Using Trained Dogs to Locate Turtles in the Amazon Flood Plain Forest</td>
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<tr>
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<td>T NORTON</td>
<td>D VOGT</td>
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<tr>
<td>12:20</td>
<td><strong>Lunch</strong></td>
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<tr>
<td></td>
<td>M FELDMAN</td>
<td>T TUBERVILLE</td>
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<tr>
<td>13:50</td>
<td>Environmental Enrichment for Captive Turtles and Tortoises</td>
<td>Linking In- and Ex-situ Conservation for the Vietnamese Pond Turtle</td>
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<tr>
<td></td>
<td>J TOUGAS</td>
<td>T MCCORMACK</td>
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<tr>
<td>14:10</td>
<td>Keeping and Breeding the Genus <em>Kinixys</em></td>
<td>Recovering the Northern River Terrapin in the Indian Sundarbans</td>
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<td></td>
<td>D MIFSUD</td>
<td>S SINGH</td>
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<tr>
<td>14:30</td>
<td>Bizarre Foods: Unique Diet Items for Captive Animals</td>
<td>Acoustic Telemetry of Red-crowned Roofed Turtle in Northern India</td>
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<td>N HAISLIP</td>
<td>S SIRSI</td>
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<td>14:50</td>
<td><strong>Break &amp; Posters</strong></td>
<td><strong>Break &amp; Posters</strong></td>
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<tr>
<td>15:10</td>
<td>Population Genetics of Diamondback Terrapins in Louisiana</td>
<td>Reintroduction of Captive-bred Burmese Star Tortoises in Myanmar</td>
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<tr>
<td></td>
<td>C PETRE*</td>
<td>S PLATT</td>
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<tr>
<td>15:30</td>
<td>Surveys of Diamondback Terrapins in Northeastern Florida</td>
<td>Movements/Survivorship of Hatchling and Headstarted Desert Tortoises</td>
</tr>
<tr>
<td></td>
<td>L KOLLURI*</td>
<td>K BUHLMANN</td>
</tr>
<tr>
<td>15:50</td>
<td>Effects of Crab Traps on a population of Ornate Diamondback Terrapins</td>
<td>Radio-tracking of Headstarted Blanding's Terrapins</td>
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<td>E SUAREZ*</td>
<td>S CARSTAIRS</td>
</tr>
<tr>
<td>16:10</td>
<td>Increasing Nest Survivorship with Electric Wire Nest Boxes</td>
<td>Translocating Juvenile Bolson Tortoises: Lessons Learned</td>
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<tr>
<td></td>
<td>D QUINN*</td>
<td>C WIESE</td>
</tr>
<tr>
<td>16:30</td>
<td>Terrapin Nesting Habitat Discovery using Satellite Telemetry</td>
<td>Reintroduction of the Ploughshare Tortoise: 28 Years of Dedication</td>
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<td></td>
<td>C LECHOWICZ</td>
<td>R BOUROU</td>
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<tr>
<td>16:50</td>
<td>Natural History of Mangrove Terrapins in Key West</td>
<td>Reintroductions/Assurance Colonies (cont.)</td>
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<tr>
<td></td>
<td>R WOOD</td>
<td>K Buhlmann</td>
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* Student Considered for Student Awards Competition
<table>
<thead>
<tr>
<th>Poster Presentations (Ballroom A)</th>
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<tbody>
<tr>
<td><strong>Poster Session Tuesday, August 5th at 1730 h</strong></td>
</tr>
<tr>
<td>Environmental Threat to Turtle Habitats in Southwestern Saudi Arabia</td>
</tr>
<tr>
<td>A ALQAHTANI</td>
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<tr>
<td>Legal Status of the Diamond-backed Terrapin Throughout its Range</td>
</tr>
<tr>
<td>A CALICHIÓ*</td>
</tr>
<tr>
<td>Teaming up for Tortoises and People in Madagascar</td>
</tr>
<tr>
<td>C CASTELLANO</td>
</tr>
<tr>
<td><em>Chelus fimbriata</em> in the Rio Negro, Comunidade Floresta, Amazonas, Brazil</td>
</tr>
<tr>
<td>F CUNHA</td>
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<tr>
<td>Using Biological and Social Data to Identify Priority Areas for <em>Carettochelys insculpta</em> Conservation in Papua New Guinea</td>
</tr>
<tr>
<td>C EISEMBERG</td>
</tr>
<tr>
<td>Meta-Analysis of Effects on Home Range of the Eastern Box Turtle</td>
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<tr>
<td>M FIGUERAS*</td>
</tr>
<tr>
<td>The Potential of Using Temple Ponds for the Conservation of Rare Turtle Species in South Asia</td>
</tr>
<tr>
<td>R GHOSH</td>
</tr>
<tr>
<td>Freshwater Turtles in Crab Traps: an Alternative Trapping Technique for Kinosternid Species</td>
</tr>
<tr>
<td>C HUNTZINGER*</td>
</tr>
<tr>
<td>Underwater and Undetected: Aquatic Respiratory Capacity of a Secretive Aquatic Turtle</td>
</tr>
<tr>
<td>C KUPEC*</td>
</tr>
<tr>
<td>The Freshwater Turtle Population Assemblage at Wekiwa Springs State Park</td>
</tr>
<tr>
<td>E MUNSCHER</td>
</tr>
<tr>
<td>Population and Community Structure of Smooth and Spiny Softshell Turtles in Illinois</td>
</tr>
<tr>
<td>J ROSS*</td>
</tr>
<tr>
<td>Assessing Relatedness in a Captive Population of Alligator Snapping Turtles (<em>Macrochelys temminckii</em>)</td>
</tr>
<tr>
<td>D THOMPSON</td>
</tr>
<tr>
<td><strong>Building Turtle Traps: An Inexpensive, Yet Effective Trap for Box Turtle (<em>Terrepene</em> sp.) Field Studies</strong></td>
</tr>
<tr>
<td>E WALTON</td>
</tr>
</tbody>
</table>

*Indicates Consideration for Student Awards Competition

Pizza will be provided to those attending the Poster presentations, Book Signings, and Photo Contest in Grand Ballroom A. Donations will be accepted to offset food costs. Thanks to Ben & Jerry’s for also donating some of their new Turtle Cheesecake ice cream for the event. A cash bar will be available for beverages during the poster and photo contest session.
Fine Scale Variation in Environmental Temperature Determines Activity in Agassiz’s Desert Tortoise (Gopherus agassizii)

MICKEY AGHA, JEFFREY E. LOVICH, MASON O. MURPHY, BENJAMIN AUGUSTINE, JOSHUA R. ENNEN, BARRY SINERVO, ROBERT COOPER, DAVID DELANEY AND STEVEN J. PRICE

Department of Forestry, University of Kentucky, Lexington KY, USA
[mickey.agha@uky.edu]

Using environmental conditions to quantify activity is a popular practice in wildlife research and highly important to management, especially for threatened species such as the Desert Tortoise (Gopherus agassizii). We studied the effects of temperature, sex, unique identification, calendar days from January 1, and year on a population at a wind energy generation facility for five study years between 2009 and 2013. Using a generalized linear mixed-effects model and multi-model inference, we assessed how abiotic conditions (e.g. temperature) influence the probability of activity. Of 1001 capture events, tortoises were recorded as active on 331 occasions in 31 individuals. Active tortoises were recorded by a researcher above ground at surface temperatures ranging from 6.11° C to 36.67° C. In the summer of 2013, 48 trail cameras were deployed at tortoise burrows to investigate activity in desert tortoises. Tortoises were recorded as active on 1887 occasions in 24 individuals, at surface air temperatures ranging from 8.33° C to 41.67° C. The top model predicting activity included the covariates temperature, sex, unique identification and calendar days from January 1. Our top model indicated that increases in temperature led to significantly higher probabilities of activity in males and females, and that activity significantly decreased as temperatures neared a thermal threshold exclusive to this population of Desert Tortoises. In addition, tortoise gender was significantly correlated with activity, as males were more likely to be active than females in any given month of a study year. Climate variation has been documented to alter thermal niches and cause species extinctions, therefore continuing to quantify the thermal sensitivity of wildlife (e.g. optimal temperature range) over extended periods of time is fundamental to effective wildlife and habitat management.

Tortoises: Oral (Student)

Environmental Threats to Turtle Habitats in the Southwest of Saudi Arabia

ABDULAZIZ ALQAHTANI

King Khalid University – Bisha Campus AlRiyadh Street, Bisha, Asir 551, SAUDI ARABIA
[almash3ali@gmail.com]

The present study is based on observations and construction of environmental reasons that threaten the abundance of freshwater turtles species in the Tehama region of southwest Saudi Arabia. Turtle species include Geochelone sulcata and Pelomedusa subrufa. These species were affected recently by natural and human related threats. The natural threats include drought with longer droughts creating significant risks to turtles species in the Arabian Peninsula and prevailing drought conditions affecting a wide swath of the study area. Climate change in the southwestern region in the last twenty years is a reality, where the landscape is changing to an arid climate, similar to the climate transformation taking place in many areas of the Kingdom. In addition to natural threats, a more recent problem stems from anthropogenic pollutants, such as pesticides. While conducting field visits to turtle habitats, our attention was drawn to the spraying of massive amounts of insecticides over most of the areas where aquatic resources were available. Several pesticide application techniques were used to apply unlimited amounts of these toxic pesticides, including aerial spraying by ground and municipal workers of the Ministry of Health. These pollutants are entering into valley streams. The destruction of the natural environment is evident in a number of aspects in Jazan and Asir, such as the conversion of swamps and many water bodies are stagnant or have been drained. Exploitation and depletion of water rivulets and the withdrawal of permanent and semi-permanent aquatic streams in areas of the valleys are impacting the most important natural environments for these turtle species. Additional human impacts considered to be a danger to biological life include the disposal of sewage and solid waste in the valleys, hunting and turtle mortality due to cars. Finally, the study revealed that there are many environmental factors that contribute to and affect the turtle's life in Saudi Arabia.

Poster Session

AZA Studbooks: More than Just Pedigrees with Chelonians

LAUREN AUGUSTINE

Smithsonian National Zoological Park, 3001 Connecticut Ave. NW, Washington D.C. 20008, USA
[augustinel@si.edu]
An Association of Zoos and Aquariums (AZA) regional studbook can be an effective method for monitoring and managing captive zoo populations, particularly those of threatened or endangered species. In addition to providing useful demographic and survivorship statistics, which can be used to assess and evaluate animal welfare and husbandry practices, studbooks also provide pedigrees which enable population managers to make informed decisions on selected pairings aimed at maximizing genetic diversity within captive populations. In addition to the population management benefits obtained from studbooks, these formalized management methods can also provide captive husbandry professionals with important data otherwise not collected. With approximately 50 chelonian species managed by the AZA, keepers who utilize studbooks to the fullest extent have an enormous opportunity to gather data and facilitate conservation through captive propagation. Studbooks are useful tools for developing relationships between institutions and hobbyists, as a sustainable population is generally a common goal. Furthermore, these programs provide husbandry professionals the opportunity to collect vast amounts of data on their focal species. Many aspects of the captive husbandry and natural history of chelonian populations are data deficient and studbooks provide invaluable networks for identifying problems within populations and incorporating solutions. The North American captive populations of Cuora galbinifrons, Cuora bourreti and Cuora picturata are threatened by few and aging adults, low fertility and high hatchling mortality resulting in low annual recruitment. In order to alleviate these problems, studbook participants are asked for information beyond that necessary for population management, allowing the studbook keeper to further understand these concerns and disseminate information on successful techniques to participating institutions. Focusing on mitigating the problems in the aforementioned studbooks, this presentation will discuss the ways in which studbook keepers can utilize AZA studbooks to alleviate problems in captive breeding populations.

Zoos and Chelonians: Oral

Current Status of the Cuora galbinifrons, bourreti and picturata Studbooks

LAUREN AUGUSTINE
Smithsonian National Zoological Park, 3001 Connecticut Ave. NW, Washington D.C. 20008, USA
[augustinel@si.edu]

The Indochinese Box Turtle (Cuora galbinifrons) is a polytypic, terrestrial species from Asia which is listed as critically endangered by the International Union for Conservation of Nature and in Appendix II by the Convention on the International Trade of Endangered Species. This species is highly variable and five subspecies have been described within the C. galbinifrons clade. In 2004, based on genetic analysis and an earlier description of morphological distinctions, two species were elevated from subspecies to species: Cuora bourreti and Cuora picturata. Both of these species are endemic to Vietnam, C. picturata is found in southern Vietnam and C. bourreti in central Vietnam. Additionally, C. g. hainanensis, known from Hainan Island China, is nested within the C. galbinifrons clade and remains a subspecies. All three of these species are currently managed by the Association of Zoos and Aquariums through regional studbooks. The subspecies C. g. hainanensis is currently within the C. galbinifrons studbook, but is being managed separately in terms of breeding. The current North American studbook holdings are as follows: 12.21.9 Cuora galbinifrons, 3.3.6 C. g. hainanensis, 4.6.0 Cuora bourreti and 2.2.0 Cuora picturata. In 2013 all three studbooks yielded a total of 20 eggs, 3 of which were reported as fertile, and 1 hatching C. galbinifrons. This presentation will cover the current status of the North American studbooks, the challenges facing these populations and differentiating the three species and their subspecies.

Cuora galbinifrons Complex: Oral

Habitat Use and Morphometric Analysis of Kinixys homeana in a West African Rainforest

DAN BARBOUR1, LORI KIM ALEXANDER2, KRISTIN BEYER2, LOGAN MCDONALD3, PHIL ALLMAN3
1Department of Biological Sciences, Florida Gulf Coast University, 10501 FGCU Blvd., South Fort Myers, FL 33965-6565, USA
2Department of Marine and Ecological Sciences, Florida Gulf Coast University, 10501 FGCU Blvd., South Fort Myers, FL 33965-6565, USA
[dbbarbour@eagle.fgcu.edu]

Home’s Hinge-back Tortoise, Kinixys homeana, is a rarely studied species endemic to West Africa. Populations are threatened by loss of habitat, direct harvest for food, and collection for the pet trade. The species is currently listed as vulnerable under the International Union for Conservation of Nature’s Red List of Threatened Species. The few studies directed toward understanding their natural history, behavior, and demography have been conducted in a limited portion of their range, typically using small sample sizes. The purpose of this study is to investigate the demography and habitat features utilized by this species in a portion of their range that has not been examined. The investigators searched for tortoises in a 20-ha plot of
Keeping a large collection of chelonians has proven to have its ups and downs over the last 15 years. In those first few years, I moved several times and lived in locations where my collection had to be maintained indoors before finally settling down in Houston, Texas. The warm summers and mild winters of Houston have given my collection the opportunity to spend much of the year outside. The changes seen over those years and moves have taught me many valuable lessons. During this time, networking with other chelonian specialists in the private sector and zoo community, has been far more valuable than keeping and studying these animals on our own. Building partnerships with responsible, ethical chelonian keepers, working with the TSA, as well as participating in AZA studsbooks are just a few of the benefits and why we do this for the greater good of chelonian conservation. Passing along the experiences we have had, both good and more importantly bad, can be the most beneficial tool in a chelonian keeper’s tool box.

Captive Husbandry: Oral

Tracking Migrating Hatchlings of Giant Amazon River Turtles *Podocnemis expansa* in the Rio Trombetas, Brazil with Sonic Transmitters

**VIRGINIA CAMPOS DINIZ BERNARDES¹, RICHARD CARL VOGT¹, AND CAMILA RUDGE FERRARA²**

¹Instituto Nacional de Pesquisas da Amazônia – INPA, BRAZIL
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We studied habitat use and migration of *Podocnemis expansa* hatchlings with sonic transmitters on the Rio Trombetas, PA, Brazil. We released 38 hatchlings equipped with sonic transmitters of the evening of 16-Dec-2013, in front of the nesting beach the day after they hatched, along with 5000 hatchlings without transmitters. We used two different telemetry receivers to monitor the turtles: one to track actively and the other for passive monitoring with fixed locations to detect the presence/absence of tagged turtles, creating an array of locations on the river. We tracked the hatchlings along with 10 female turtles for 80 days using mobile and fixed receivers. The hatchlings were migrating with adult females and in the river’s deep channel, 13 hatchlings migrated that night and were located 8 hours later in 6 m of water 6 km downstream. Another 7 hatchlings were followed as they migrated downstream for 23 days, a total of 71 km downstream in 10-17 days after their release. One hatchling detected on 29-Dec was later recorded 65 km downstream on 3-Jan 2014, 65 km in 5 days. Six hatchlings migrated over 2 km upstream past our fixed recorder. The remainder of the hatchlings remained in an area within 4 km of the release site until 24-Feb. Hatchlings do not remain in shallow water along the shorelines of the river, just the opposite: they migrate out in the river channel with the adults, often at depths up to 25 m. Hatchlings did not all behave in the same way, most went downstream, some went upstream, and some stayed within the vicinity of the nesting beach, always with others turtles of different ages. Only two hatchlings were found entering into the nearby lake system, in the same place Reserve personnel have been releasing hatchlings for 20 years along the shoreline in shallow water.

Chelonian Biology: Oral
Tracking a Shy Beauty and the Cave Turtle – Finding the Southern Vietnamese Flowerback Box Turtle (Cuora picturata) and the Central Vietnamese Keeled Box Turtle (Cuora mouhotii obsti) in Their Habitat

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Cuora picturata and Cuora mouhotii obsti were both described in 1998 by German researchers based upon specimens derived from the pet trade. While both are quite common in the food and pet trade in eastern Asia for more than two decades, it took scientists until 2010 to find Cuora picturata in the wild. For C.m.obsti, two old museum specimens collected in 1966 from the wild in central Vietnam exist, but apart from this record, this subspecies of the Keeled Box Turtle was not seen by scientists in the wild again since then and its distribution area remained mysterious. This changed in 2011 when a team of the Asian Turtle Program surveyed for C. picturata in southern Vietnam’s Khanh Hoa Province and was able to find C.m.obsti in the wild, a significant range extension to the south. In May 2012 the author, together with a team of the Asian Turtle Program surveyed for both species in Phu Yen and Khanh Hoa provinces to gain further understanding of the current status of both species in the wild and to learn more about their habitat and life history. Both species were readily found in villages along the Deo Ca mountain range which forms the boundary between the two provinces. With the help of trained dogs the team was able to find both species in the wild. Both species occur sympatrically in evergreen tropical rainforests at 400-600 m elevation, but prefer different microhabitats. C. picturata is an open forest dweller, and C.m.obsti inhabits rocky areas providing plenty of stone piles, hiding in caves most of the time. While both species used to be abundant 20 years ago, when it was easy to collect dozens a day, their numbers have since decreased significantly according to local hunters interviewed. Still, one single hunter collects about 50 specimens each hunting (rainy) season, which lasts from July to November. Due to deforestation and overharvesting, the already very restricted range has decreased significantly. Despite the fact that the Deo Ca range is partially protected (at least the trees are), the remaining forest is under heavy pressure by the local villagers. Illegal logging of valuable tropical trees, hunting of remaining wildlife with weapons, dogs, and large numbers of traps are extensive and evident in the entire area. To save both species in the wild, urgent action is required by the authorities to effectively protect the remaining habitat and the species living within it.

Cuora galbinifrons Complex: Oral

Keeping and Breeding the Vietnamese Three-striped Box Turtle (Cuora cyclornata)

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Cuora cyclornata is a critically endangered species that is functionally extinct in the wild. It used to occur in Vietnam, Laos and the extreme southern China, but the Chinese demand has driven the species to the brink of extinction. Two subspecies have been described and a third variety is known. It ranks amongst the most expensive and sought after turtle species on the planet. While a few thousand founder specimens exist in Chinese turtle farms, less than 50 wild caught founders exist in western assurance colonies. Chinese farms are not currently collaborating with conservation projects and most offspring produced are not genetically pure, but often represent a mix between the different subspecies, or are even hybrids with closely related Cuora trifasciata or even other species like Mauremys mutica and others. Thus, only the western breeding stock is currently a suitable basis for conserving pure lineages of this species. A European studbook exists for the species that includes all known European specimens, which have been genetically tested, and pure breeding groups have been formed. About two dozen hatchlings are currently produced by two breeders, which were placed with members (zoos and private entities) of the Studbook. Different ways of keeping and breeding this species within the European Studbook are presented.

Cuora galbinifrons Complex: Oral

Steep Streams in Asian Mountains – On the Track of Platysternon megacephalum

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Platysternon megacephalum, the Bigheaded Turtle, or the Eagle Beak Turtle as the Chinese call it, is one of the most peculiar looking species of turtles. It adorns this year’s official TSA t-shirt, designed by Mark Wallace. The species, along with most other Asian species, is listed as critically endangered and has been listed on the Convention on the International Trade of...
Endangered Species (CITES) Appendix I since 2013, but is still traded in significant numbers within Asia. Although already described in 1831 by Gray, based upon a semi-adult dry specimen, it remained unstudied in nature until Rudolf Mell published his observations in southern Chinese forests in the 1920’s. For about eight decades, no real studies where conducted in the field due to its rather secretive life and hard-to-access habitat. This changed in the 2000’s when the species became increasingly rare, but still had some strongholds, especially in Hong Kong. Four additional subspecies have been described, of which three are still considered valid, although sometimes difficult to distinguish since the species shows a high level of morphologic and phenotypic variability that is still weakly understood and the museum material used for the description is complicated. During my travels in Asia, I had several opportunities to study the species and its habitat in East Asia. Weeks of frustrating search without seeing a single specimen, and sometimes a dozen specimens in a single night is what field herpetology is all about. Despite the high trades volumes, the species is still surprisingly common in some areas.

Presentation: Oral

Nests, Nesting Behavior and Nest Depredation of the Spiny Softshell, *Apalone spinifera*

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The Spiny Softshell (*Apalone spinifera*) is distributed throughout the eastern and central United States, and adjoining areas of southeastern Canada and northeastern México. Basic aspects of the species’ reproductive ecology were studied at Black Bayou Lake National Wildlife Refuge in northeastern Louisiana. Data were obtained primarily from nest surveys around the northwestern periphery of Black Bayou Lake, which have been conducted intermittently since 1997. In 2013, we made an intense effort to collect data on nesting behavior at the specific spot with the greatest nesting intensity. Using a combination of time-lapse and motion-sensitive cameras (8 maximum), we were able to monitor the main nesting area for part or all of 67 days in May, June and July. Out of a total of 100,440 photos, 3,113 (3.1%) have Spiny Softshells visible, and another 955 (0.95%) have turtle egg predators (Northern Raccoon, *Procyon lotor*, and a crow, *Corvus* sp.). Oviposition began on 20 May, and the last nest was observed on 3 July. Approximately 96 instances of nesting were recorded; the peak time for nesting to begin was 14:20 h, and a complete nest took an average of 47 minutes from inception to completion. The recently described phenomenon called “troughing” was observed on 14 occasions. In addition, we recorded the presence of a “trough” next to depredated nests in 36% of 69 instances we could make a determination. Predators were observed destroying nests on 52 occasions. The crows were only observed during the day, and usually at the same time or following the appearance of raccoons and turtles. A total of 8 nests were found containing 3 intact and 5 partial clutches. Clutch size averaged 15 eggs (N = 3, range 14-16). Average egg weight for 55 eggs was 13.1 g, and average egg length and width were 29.13 mm and 27.66 mm, respectively. The study site experiences a very high rate of nest predation. Given our observations, some of the hypotheses concerning the evolution of the “troughing” behavior can be discounted – a more plausible hypothesis is that it is associated with attempting to disguise the nest cavity location from nest predators.

Nesting: Oral (Student)

Reintroduction of the Ploughshare Tortoise *Astrochelys yniphora*: 28 Years of Dedication Leads to Significant Milestones for the Conservation of the World’s Rarest Tortoise

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A reintroduction program for the Ploughshare Tortoise, *Astrochelys yniphora*, was started in Beaboaly, Madagascar in 1998, as part of a larger, long term commitment to conservation of the species that has included captive breeding, field research, establishment of a National Park encompassing the entire wild population, and community engagement in the protection of the Ploughshare Tortoise. The goal of the reintroduction has been to re-establish a self-sustaining wild sub-population, by releasing captive-bred juvenile and sub-adult tortoises to an area of historical habitat from which Ploughshares had been extirpated. A captive-breeding program initiated in 1986 has produced more than 600 Ploughshare Tortoisesess in captivity to date. One of the objectives of the captive breeding program has been to produce animals for reintroduction. In 1998, five juvenile tortoises (8-9 years old) were released at Beaboaly. This initial trial was documented to have been successful in that these captive born and
raised tortoises adapted to the wild and established home ranges near the release site. The project continued with 20 animals released at Beaboaly in 2006. Additionally, 16 animals were released in 2009, and another 20 tortoises were released in each of 2011 and 2012, bringing the total number of tortoises released to 81. Post-release mortality has been very low with a single death in 2007, unprecedented for a tortoise reintroduction. Mortality rates in other tortoise reintroductions have ranged from 21-40%. All of the released Ploughshares have established home ranges near the release site. In 2012 we discovered two baby Ploughshares at Beaboaly and thirteen more were found in 2013-2014, representing a major milestone in the conservation of this species. Post-release monitoring has been a critical component of the reintroduction. All released individuals have been fitted with radio-transmitters, and intensively monitored and measured since their release. All have had their carapace engraved with a large identification number to discourage collection for the international pet trade. This intensive post-release monitoring has required a significant investment and we currently employ seven staff at Beaboaly, four from the nearby village of Baly. The project is now at an evaluation stage and we are exploring options for a second reintroduction site in Baly Bay.

**Reintroductions/Assurance Colonies: Oral**

** Movements and Survivorship of Direct-release Hatchling and Yearling Desert Tortoises (Gopherus agassizii) Translocated into the Mojave National Preserve, California**

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Beginning in Autumn 2012 (September), we conducted comparative releases of recently hatched (direct-release) and yearling Desert Tortoises, Gopherus agassizii, in the Mojave National Preserve, California. Tortoises were released into two distinct habitats (Creosote Scrub and Yucca Woodland) from which gravid females were collected during May 2011 and May 2012 to obtain eggs as part of a long-term head-starting program. A total of 18 tortoises were released, comprising 12 hatchlings (2012 cohort) and 6 yearlings (2011 cohort). A subsequent release in Spring 2013 (April) of 18 siblings representing now 6-mo-old hatchlings and 1.5 yr-old yearlings from the same cohorts was also conducted at the same two habitats. All 36 released animals have been radio-tracked bi-weekly during the activity season and winter inactivity. We will present more detailed data on survivorship, movements, settlement time, site fidelity, and behavior in the manuscript of these translocated tortoises, as well as provide comparisons between hatchlings and yearlings and autumn and spring releases. Our data will cover one-year post-release for Autumn-released animals, and 6 months post-release for Spring-released animals. This initial study is part of a long-term project to assess the feasibility of head-starting and translocation to augment Desert Tortoise recovery efforts.

**Reintroductions/Assurance Colonies: Oral**

**Sighting Frequency Decreases over 21 years in Three Populations of Testudo hermanni from Central Italy**

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Sighting frequency of tortoises (Testudo hermanni), standardized by the number of person-hours of field effort, was studied between 1992 and 2013 at three different study areas in central Italy. Although the frequency of tortoise sightings fluctuated substantially across years and among study areas, there was a significant declining trend in all the three areas, with generalized linear model analyses showing also a significant interaction between study area and sampling year. The decreasing trend was higher in Castel Fusano than in the other two sites, with yearly frequency of sightings being independent of search effort in all of the study areas. These trends may indicate populations declines, because no other explanations seem plausible. Total rainfall from the previous autumn to the study period was positively correlated to tortoise sightings in only one locality. The yearly frequency of sightings of juvenile tortoises did not vary significantly among study areas and across years, thus indicating that
simple differences in detectability cannot explain the observed patterns. Summer fires and forest overgrowth seem to explain the tortoise decline in two study areas (Castel Fusano and Oriolo) whereas we were not able to identify any specific reason for tortoise decline in the third study area (Manziana).

**Presentation type:** Oral

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**Legal Status of the Diamondbacked Terrapin (Malaclemys terrapin) Throughout its Range**

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The Diamondbacked Terrapin (*Malaclemys terrapin*) is a threatened keystone turtle that inhabits salt marshes of the U.S. Atlantic and Gulf Coasts. This threatened status is due to the numerous threats this species faces throughout this fragmented linear range due to human activities. Threats such as loss of nesting habitat, commercial harvest, and drowning in crab pots necessitate conservation efforts like increased legal protections. To determine the legal status of the Diamondbacked Terrapin, Marydele Donnelly in 1988 contacted conservation authorities in 17 states in an unpublished but widely circulated study. Christina F. Watters followed on this initial study in 2004 by determining the updated legal status within each state again, with the exception of Pennsylvania. However the current status of the Diamondbacked terrapin has not been updated since then and the trends in conservation have not been analyzed. The intent of this study was to determine the current state of regulations regarding the Diamondbacked Terrapin and analyze the trends in conservation. In order to determine the current status, officials in each state were contacted via email and phone; additional information was obtained from official state websites. Overall, the Northeastern States increased protection for terrapins since 1988 and 2004 to prohibit wild harvest and require the inclusion of terrapin excluder devices on crab pots. In the Southeast states the regulations have drastically increased to prohibit wild harvest of eggs and adults as well as prohibiting the general sale and possession of Diamondbacked Terrapins in some states. In the Gulf States the changes in regulations were more varied, with increased regulations in some states and no significant change in regulations allowing for few protections in others. Over the past 26 years the trend towards better regulations in the majority of states may help reduce the negative impacts of human activities on Diamondbacked Terrapins, however, the actual effectiveness of these regulations is unknown. But without a federal set of regulations to govern human interactions with this species, it continues to be vital to know what regional protections are afforded to the Diamondbacked Terrapin.

**Poster Session** (Student)

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**Nest Site Selection by Podocnemis unifilis (Testudines, Podocnemidae) in the Margins of a Small Water Channel, in Mamirauá Sustainable Development Reserve, Amazonas, Brazil**

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Among Brazilian *Podocnemis* species, *P. unifilis* is the most generalist species when selecting nesting sites, nesting not only on major rivers’ sandy banks, but also on the margins of lakes and small water channels. This study aimed to evaluate nest site selection by *P. unifilis* females in the margins of a “paranã”. During the 2012 breeding season (August to October), we monitored a 9.5 km stretch of paranã do Clétão, a small water channel, located in the Mamirauá Sustainable Development Reserve, in Amazonas State, Brazil. During daily monitoring, we registered and marked nests. In November, we divided this stretch into points every 100 m on both margins and randomly selected 59 points. We characterized random points and nest sites according to: vegetation type (no vegetation, bushes and trees); margin type (clayey, sandy, clay with litter, and litter); thickness of recent sediment (0-10 cm and ≥ 10 cm). According to this, we categorized points into nine habitats. The most common habitat was “Arboreal-shrub-clayey with recent sediment 0-10 cm” (45.8%). Of the 59 random points, only 4 were nesting sites. These four points were “No vegetation-Sandy with recent sediment ≥ 10 cm” habitats. Considering other nesting points characterized, but not coincident with random points, we observed that nesting occurred in five of the nine habitats. Although 44% of the random points were classified as one of these five habitats, thus representing available areas for nesting, 91.8% of nests were located in “Arboreal-shrub-Sandy with recent sediment ≥ 10 cm” and “No vegetation-Sandy with recent sediment ≥ 10 cm” habitats, which corresponds to only 11.9% of the sampled random points. This suggests that nesting site

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selection by females is not random, but depends on and is related to geological factors, particularly the type of margin. Most nests were built in banks containing recent deposit of sandy sediment, followed by banks containing litter deposits (6.1%). Selection of sandy sediment appears to be related to a greater hatching success. However, in order to plan conservation strategies, more studies are needed. These research projects should focus on the influence of nest site in hatching success and in hatchlings characteristics, as well as on females’ nest site fidelity.

**Nesting:** Oral

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**How do Podocnemis expansa (Schweigger, 1812) (Testudines: Podocnemididae) Females Affect Clutch Variables in Mamirauá Sustainable Development Reserve, Amazonas, Brazil?**

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It is known that for many chelonian species, including *Podocnemis expansa*, female size affects clutch variables, such as number of eggs and hatchlings size. In this study, we aimed to analyze the relationship between female variables and their clutches, in an endangered population of *P. expansa*. We developed our study in sandy beaches in Solimões River, in the Mamirauá Sustainable Development Reserve (MSDR), Brazil (S02°45’59.9”W065°13’12.5”S). From 2011 to 2013, during the nesting season (August to December), we captured, measured, weighed and marked nesting females. After female release, we opened their nests and measured a sample of 10 eggs. We captured hatchlings after their emergence from the nest for measuring and for quantification of hatching success (% of live hatchlings). We performed simple linear regressions to evaluate the relationship between female characteristics and clutch variables. Females had a mean straight carapace length (SCL) of 69.07 ± 3.68 cm (*n* = 111) and weighed, in average, 33.09 ± 4.85 kg (*n* = 80). The average number of eggs in a clutch was 109±22.27 (*n* = 72), with a mean hatching success of 76.98 ± 22.41% (*n* = 57). Egg mean diameter was 38.74 ± 2.62 mm (*n* = 810), while hatchlings had an average SCL of 50.87 ± 2.86 mm (*n* = 380). Females size and weight did not influence clutch size (*p* = 0.0858 and *p* = 0.1370, respectively). However, larger and heavier females produced larger eggs (*r² = 0.1468, p = 0.0005, n = 81; *r² = 0.11, p = 0.0019, n = 80) and larger hatchlings (*r² = 0.1474, p = 0.0150, n = 33; *r² = 0.2718, *p* =0.0014, *n* = 33). Additionally, we observed that larger eggs produced larger hatchlings (*r² = 0.6883, *p* <0.0001, *n* = 33). Female characteristics did not influence hatching success, which is probably more related to nest site characteristics and nest microhabitat. We observed that larger females invest more in the size of eggs and, consequently, size of hatchlings, than in producing more hatchlings. However, variation in female size and weight explain only 14.68% and 10.44% of the variation in egg diameter. Research projects on female reproductive investment should be continued in order to assess which characteristics, other than female traits, are influencing reproductive outputs of *P. expansa*. This information is essential to define strategies for species conservation.

**Poster Session**

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**What Do We Know about Rhinoclemmys: An Assessment of Knowledge for Conservation**

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The genus *Rhinoclemmys* currently consists of nine species, 14 total taxa, distributed in 16 countries in Latin America. They range from fully aquatic to highly terrestrial in a variety of habitats from near desert to rain forest. The species have received very little conservation attention—none have been listed for protection under the Convention on the International Trade of Endangered Species (CITES), and the highest degree of threat among the International Union for Conservation of Nature (IUCN) Red List of Threatened Species categories is Vulnerable (VU) that has been proposed for *R. diademata*. Indications of conservation concern can be found in national red lists; for example, the three *Rhinoclemmys* species in Ecuador are all listed as EN (Endangered) in the national categorization, but DD (Data Deficient), LC (Least Concern) and NT (Near Threatened) for *R. annulata*, *R. melanolysterna*, and *R. nasuta*, respectively, in the draft global rankings. Recent efforts to quantify the status of knowledge for species based on published literature, and exploring alternative means of assessing conservation status, such as the Environmental Vulnerability Score (EVS), highlight the desire to call attention to particular gaps in emphasis and illuminate our ignorance. In an exercise developed for the genus *Rhinoclemmys*, I created a species by factor matrix in which I
have separated threat indicators from life history and species-level characteristics. The latter is for quantification of the state of our knowledge of more than a dozen factors considered important for an honest assessment of the conservation status of a species. Using binary coding for presence or absence of published information on the topic, along with some weighting of selected factors, I obtained a simple score ranging from 0 to the number of factors—the higher the score the more information is available. By converting the score to a proportion, it will be more flexible to changes in the number of factors. Preliminary scores range from 0.09 to 0.62. Only one species, \textit{R. nasuta} crossed the 50\% threshold. Next best known is \textit{R. areolata} (0.42), and all the rest fall below half the value of \textit{R. nasuta}. The scores can be easily modified, updated, and improved upon to highlight taxa, and review of the matrix will pinpoint specific areas in need of attention.

\textbf{Rhinolemmys - Central/South American Wood Turtles: Oral}

\section*{Preliminary Results of Field Studies Radio Tracking Blanding’s Turtles (\textit{Emydoidea blandingii}) Headstarted at the Kawartha Turtle Trauma Centre (Ontario Turtle Conservation Centre)}

\textbf{SUE CARSTAIRS}  
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The Kawartha Turtle Trauma Centre operates as a turtle conservation centre through rehabilitation, research and education. The hospital treats, rehabilitates and releases over 400 adult turtles per year. Many of these turtles are gravid and as such the centre began headstarting the eggs harvested from injured or deceased turtles. Over 500 hatchlings were successfully released from the 2013 season. The centre began a field research project tracking twice overwintered, headstarted Blanding’s Turtles in 2012, to evaluate survival and behaviour, and establish best practices for release protocols. It is hoped that this will help provide data needed to evaluate headstarting as a conservation strategy for Ontario’s turtles. Of 10 juveniles released in 2012, 8 were predated, one was known to successfully hibernate into 2013, and one transmitter was lost. In 2013, a total of 49 turtles were tracked at 5 different field sites. These turtles included 10 wild Blanding’s turtles, to act as a control group with which to compare the headstarts. The control group contained wild juveniles, sub adults and adults, with the plan of developing a control group of 10 wild juveniles of comparable size to our released turtles. With the wild juvenile’s cryptic nature, this is envisioned to take an additional year to fully accomplish. As of publication, all but one of the headstarted Blanding’s turtles successfully survived hibernation, including the one juvenile from 2012 who has successfully hibernated twice now. The one deceased headstarted Blanding’s turtle appeared to have frozen to death; no signs of predation were present. It is hoped that this will become a long term study and follow survivors into adulthood.

\section*{Reintroductions/Assurance Colonies: Oral}

\section*{Toast For Turtles - A Fundraising Event for TSA Hosted by the St. Augustine Alligator Farm Zoological Park}

\textbf{LAUREN CASHMAN}  
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The St. Augustine Alligator Farm Zoological Park is very well known for their complete collection and experience with all living species of crocodylia, but in recent years the collection of other amazing animals has grown as well. Chelonians are starting to receive more attention, and as a way to help raise awareness for many of these endangered species the zoo decided to spend 2 months to help raise money for the TSA, a group that the zoo has worked with before. Donate-a-dollar programs and piggy banks help, but to raise the most amount of money, an evening fundraiser event was created. Toast For Turtles includes everything that makes any fundraiser successful, it is a program that any zoo can put together, and an event that the whole community can take part in. People have put together many other types of fundraisers that are very successful including Bowling for Rhinos and Crocfests around the country, so this is a way to get people excited and involved in saving these species.

\textbf{Presentation: Oral}

\section*{Teaming Up for Tortoises and People in Madagascar}

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Soccer is shared through a universal language; no other sport is more popular or impactful in the world. Soccer has even been used to build relationships between local communities and conservationists in Africa. Utah’s Hogle Zoo, the Turtle Survival Alliance, and Conservation Fusion are using soccer as a culturally relevant way to create conservation awareness for the Radiated Tortoise, Astrochelys radiata and other imperiled wildlife in southern Madagascar. Recently, we launched a social media campaign with the One World Futbol Project (www.oneworldfutbol.com) to build international support and acquire 250 nearly indestructible One World soccer balls for this project. Through this play-based environmental education and awareness program, we hope to motivate and inspire youths living in 10 communities that are critical to the survival of the species to take action. This campaign and the “Give Balls” and “Buy One, Give One” programs, let anyone, anywhere in the world help save the Radiated Tortoise by giving the power of play to local youths.

**Poster Session**

**Using the von Bertalanffy Growth Model to Describe Growth in the Southern River Terrapin, Batagur affinis edwardmollisi**

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The von Betalanffy (VB) growth model has been found to be applicable in describing the growth of several species of turtles, in addition to fish and other animals. In this paper, we test the model with growth data obtained from recaptures of head-started Southern River Terrapins, Batagur affinis edwardmollisi in the Setiu River in Terengganu, Malaysia. The terrapins were hatched from years 2000 to 2010, head-started for varying periods of time, micro-chipped for identification, released into the Setiu River from 2005-2010, and recaptured between 2009-2013. Recaptures were obtained from traditional fishermen using gillnets and hooks. Over 400 recapture events were analysed to provide length (straight carapace length in cm) at age (in years) data to generate the growth parameters of the VB growth model. The software VONBIT AL for MS Excel developed by C. Stamatopoulos was used to fit the data. The Brody coefficient, K, was estimated to be 0.108, which is a likely value for a long-lived species. The maximum or asymptotic length, L∞ was 56.263 cm. This falls within the observed straight carapace lengths of nesting female terrapins that range from 51-57 cm. Time taken to reach the maximum length was 37 years. Hence the longevity of Batagur affinis edwardmollisi is expected to exceed 37 years. From the growth curve it is estimated that this terrapin takes 22 years to reach first maturity at 51 cm, the smallest nesting female encountered.

**Chelonian Biology: Oral**

**Tracking the Movements of Post-nesting River Terrapins: An Experiment**

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The population of Southern River Terrapin (Batagur affinis) in the Kemaman River in Terengganu, Malaysia, was discovered during a questionnaire-based survey conducted on 2010. Immediately after, Turtle Conservation Society of Malaysia (TCS) initiated a River Terrapin Research and Conservation Project in 2011. To date, more than 3,000 River Terrapin eggs have been saved from human consumption, from which more than 1,600 hatchlings have emerged. Since this project was initiated, the Society was instrumental in the gazattement of three nesting banks along the Kemaman River, from which all River Terrapin eggs are collected for incubation. However, there are at least a dozen other “unprotected” nesting banks along the river. This experimental project attempted to determine the movements and habitat use of post-nesting River Terrapins. Our solution – albeit experimental – was a low cost (US $700) tracking device. The tracking device, which we codenamed Abigail, was a two-way communication-capable unit that collected data and transmitted coordinates every hour over cellular networks. Location data was sent to a Gateway running on a Raspberry Pi server, which then tabulated and presented data via a Google Maps API protected account. It was a complete tracking and monitoring system that was supported by a USB power bank. We were able to track the movements of the post-nesting River Terrapin for eight days before the batteries were drained. On the sixth day, this River Terrapin ascended an adjacent riverbank just south of Pasir Pok Yok, and spent almost two hours on the bank.
presumably to deposit her remaining eggs. This experiment suggested that River Terrapins do utilize other suitable nesting banks if/whenever available. We are currently securing grants to procure a set of radio-tracking transmitters that enable us to track the movements of more post-nesting River Terrapins. Results from the radio-tracking study will be used to leverage on the protection of adjacent nesting banks/critical habitats.

Nesting: Oral (Student)

**Population Ecology of Gulf Coast Box Turtles (Terrapene carolina major) in Coastal Mississippi**

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Coastal Mississippi supports an apparently healthy population of Gulf Coast Box Turtles (*Terrapene carolinamajor*); however, this population has been poorly studied and could be experiencing an unsustainable amount of road mortality. A long-term study was initiated in 2012 to gather important demographic data on this population. For box turtles that were encountered and collected, location, sex, and a suite of morphological measurements were noted. Adult males were generally larger (average straight-line carapace length (SCL): 16.6 cm ± 1.53 cm) than adult females (average SCL: 14.22 cm ± 2.05 cm). Females were also radiographed to evaluate reproductive status and clutch size. Turtles that inhabited the area around the IMMS property were tagged before release, and recaptures allowed for examining growth in tagged individuals. Additionally, habitat use of a subset of individuals will be studied using a novel methodology that allows for real-time tracking. Locality data points will be analyzed using minimum convex polygons to determine home ranges and any seasonal patterns in movements. These baseline data will be critical in any future management activities for this coastal species.

**Poster Session**

**Oocyte Membrane-bound Sperm Detection for Chelonian Conservation and Breeding Management**

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Oocyte membrane-bound sperm detection (OMSD) has recently been incorporated into avian breeding programs to determine fertility of eggs that fail to develop during incubation. As this technique confirms the presence of sperm trapped on the oocyte membrane, it can be used to confirm breeding, male reproductive status, and pair compatibility. Due to similarities between avian and chelonian egg structure and development, and because fertility determination in chelonian eggs lacking embryonic growth is difficult, OMSD also has the potential to influence the management of captive propagation and conservation of turtles and tortoises. This study is the first to successfully demonstrate the use of OMSD in chelonian eggs, as well as explore the impact of bacterial and/or fungal infection on OMSD. Oocyte membranes removed from chelonian eggs, provided by the San Diego Zoo Global and the Turtle Conservancy’s Behler Chelonian Center, were stained with the nucleic acid dye Hoechst 33342, and examined for the presence of sperm using fluorescence microscopy. Sperm density was estimated by counting the maximum number of sperm per field of view at 200X. Sperm were positively identified in 22 fresh and incubated chelonian eggs representing 7 different turtle and tortoise species: *Astrochelys radiata*, *Geoclemys hamiltonii*, *Geochelone pardalis*, *Geochelone platynota*, *Geochelone sulcata*, *Kinixys serosa*, and *Pyxis arachnoides*. Length of incubation with detectable sperm ranged from 7 days without diapause, to 158 days following 48 days in diapause. Advanced bacterial and/or fungal infection hindered the ability to detect oocyte membrane-bound sperm by obscuring the fluorescing sperm heads. Oocyte membrane-bound sperm detection is a promising method for assessment of chelonian fertility. In addition, OMSD may significantly impact studies of artificial incubation and sperm storage, and could be used to evaluate the success of artificial insemination in chelonian species.

**Zoos and Chelonians**: Oral (Student)

**Chelus fimbriata** in the Rio Negro, Comunidade Floresta, Amazonas, Brazil

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The Matá-matá (Chelus fimbriata) is well known to the turtle community; both scientists and hobbyists alike have awed over this bizarre species of Chelid in captivity, but next to nothing is known about its natural history, despite its widespread distribution in the Amazon and Orinoco River basins. For over 25 years one of us (rcv) has been trying to locate an adequate population to study the ecology of this species in the Amazon Basin of Brazil. Finally, through interviews with piabeiros from the region of Barcelos, we got a lead on where this species may be found concentrated during the dry season, once the water levels of flooded forests have receded. Two expeditions were foiled because the water level rose again before we arrived to look for the turtles. Finally through the diligence of Fabio, we were able to connect with the piabeiros and ascertain when water levels would be at their optimum depth to pursue this species in an area equidistant between Barcelos and Santa Isabel in February 2014. From 24 February until 4 March 2014 we hand captured, either by snorkeling or directly from the canoe, 28 adults (27 males, 1 female). The turtles were found in clear water pools, 1-1.5 m deep. The turtles were usually seen on the bottom with their necks extended out of the leaf litter. Turtles were caught both day and night. No subadult turtles were caught or seen. Mean straight line carapace length was 348 mm and mass 5.2 kg for the males and the female was 359 mm and 5.9 kg. The clear water streams where the turtles were captured had a low pH 2.8-3.0, with a high quantity of leaf litter on the substrate. Visibility, due to clarity of the water, varied between sites, but was sufficient to be able to discern turtles in the water while sitting in a boat. Cabeçudos (Peltocephalus dumerilianus), Irapucas (Podocnemis erythrocephala), and Tracajas (Podocnemis unifilis) were also captured in the same pools as the Chelus. Fish of the order Characiformes and aquatic insects (Ephemenoptera) were found in the stomach content flushings.

**Poster Session**

**Turtles and People from Bita River, the First Protected River in Colombia**

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The Rio Bita is approximately 500 km in length and one of the last pure rivers on the planet because it does not have cities, towns, factories or petroleum installations along its course, and is the habitat of a great variety of wildlife, including the South American River Turtle (Podocnemis expansa), the Yellow-spotted River Turtle (Podocnemis unifilis) and the Savanna Side-necked Turtle (Podocnemis vogli). The La Pedregoza Environmental Corporation (La Pedregoza Natural Reserve) has been working for the conservation and protection of these turtle species since 2012 in the Bita River. Last 26 April, 2014 the Bita River was declared a protected river within the Orinoco basin in Vichada, Colombia. This issue is very important for the Turtle Conservation program at La Pedregoza. Our Reserva Natural La Pedregoza, a conservation area registered with Resnatur and with the Colombian national parks system, is located in the heart of this newly protected area. The natural reserve shares 7 km of river bank with the Rio Bita, so we can add excitement to the pride we feel regarding this achievement. The concept of a protected river is not to stop all human activity, but rather to insure that all activities are sustainable and are done with conservation and the protection of biodiversity in mind. This includes efforts to stop illegal hunting and wildlife poaching, to stop illegal commercial fishing, and to stop unsustainable traditional practices, like the collection of giant river turtle eggs, by providing law enforcement coupled with education and alternative solutions to local populations. This year we continued to work with our TurtleConservation program, and included some experiences and lessons learned from conservation programs from neighboring countries as well as stronger work with the local community. Environmental education in schools, tagging turtles with the participation of foreign students, and releasing turtles are some of the activities we are making in 2014.

**Community Conservation:** Oral

**Microhabitat Use and Movements of Subadult Alligator Snapping Turtles (Macrochelys temminckii) in Wadeable Streams of the Upper Calcasieu Watershed, Fort Polk, Louisiana**

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Alligator Snapping Turtle (*Macrochelys temminckii*) populations are undergoing long-term declines throughout their range. In Louisiana the species is considered rare and local, though comprehensive data from the southwestern portion of the state are lacking. The purpose of this study is to determine home range and habitat use of *M. temminckii* within three headwater streams of the Upper Calcasieu Watershed. This pilot study is the first to determine habitat use and movement of *M. temminckii* within wadeable streams of southwestern Louisiana. We used ATS external transmitters to track 4 subadults weekly between April and July 2014. Habitat data are collected at each radio-located position, including water depth, stream wetted width, hi-bank to hi-bank, water temperature, turbidity, canopy closure, bank angle, substrate, and volume of large woody debris. Though a small sample size, our preliminary data indicate that subadult *M. temminckii* select for rootwads and large woody debris within narrow channels with a high percentage of canopy closure. The linear home range of these individuals averaged 200 m. Radio tracking will continue into the fall and winter to determine if there are seasonal changes in habitat use and movements. Study effort may be expanded with additional radio transmitters deployed next year and including adult individuals. The Upper Calcasieu Watershed may serve as a source population for the more heavily used Lower Calcasieu. Understanding the habitat requirements of subadult and adult *M. temminckii* is necessary for effective long-term management recommendations in southwestern Louisiana.

**Poster Session**

**Projetu Lenuk Lorosa’e – Chelodina mccordi timorlestensis:**
Conservation and Environmental Education Program in Timor-Leste

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The Long-necked Turtle, *Chelodina mccordi*, is critically endangered under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species criteria. The Timor-Leste subspecies (*Chelodina mccordi timorlestensis*) is restricted to a small area of lacustrine habitat near the eastern tip of Timor in Lake Iralalo (Lautén District). The “Projetu Lenuk Lorosa’e” was initiated in 2014 to study and protect *C. mccordi* in this area. Here, we present the findings and activities developed for the conservation of *C. mccordi* during this project’s first phase from February to July, 2014. Local threats to this species were identified by direct observation and during local community meetings. Human harvest is the main threat in the area. Factors that may be reducing the capacity of this turtle to survive in the face of human harvest include habitat modification by buffalo and cattle and nest predation by pigs and dogs. Fire is also likely to be an important factor causing a potential decline. During this first phase we (1) raised awareness about the Critically Endangered status of *C. mccordi* in local communities; (2) provided environmental educational materials for teachers locally and nationally; (3) collected essential data to initiate a long term monitoring project that can be continued by the community and park staff; and (4) trained park rangers and national students that can potentially continue their studies researching this species.

**Community Conservation:** Oral

**Using Biological and Social Data to Identify Priority Areas for Carettochelys insculpta**
Conservation in the Kikori Region, Papua New Guinea

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The Pig-nosed Turtle (*Carettochelys insculpta*) is subject to intense harvest pressure throughout much of its range in Papua New Guinea. However, the elimination of harvest is unrealistic in the short term, as is the protection of its entire distribution. Given these constraints, it is necessary to prioritize areas to focus conservation efforts in the near future. This study aims to identify priority areas for *C. insculpta* conservation in the Kikori region, taking into account the data available on population biology and harvest, as well as the Kikori human settlement patterns and demography. We identified seven potential priority areas for conservation and no-take areas. Five priority areas are small in size and surround main nesting sandbanks where females congregate before and after nesting. One priority area is larger in size and probably encompasses an important feeding ground for this species. Another larger area is the Turuvio-Kerewo priority area; this area seems to play a vital role for *C. insculpta*, as it has been used both for feeding and nesting. Our results represent the first attempt to identify priority areas for
Sexual Dichromatism in Turtles: An Understudied Facet of Turtle Evolution

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Sexual dichromatism is common in other vertebrate groups, in particular birds and fish. However, sexual dichromatism is reported in comparative fewer turtle species. In this study, we measured 22 pigmentation characters from 234 preserved specimens of Graptemys flavimacula, G. oculifera, and G. nigrinoda to test for sexual dichromatism using the first three PCA axes scores in several non-parametric multivariate analyses of variance (NP-MANOVA). At each specimen locality, environmental variables (i.e., river width, cumulative drainage area, and max current velocity) were extracted from the National Hydrology Plus database and used as a measure of stream size, which were used as covariates in the NP-MANOVA to remove the effect of environmental parameters on pigmentation expression. The first three PCA axes explained 51.9% of the variance, and all species and sexes were separated along axes 1 and 2. All three species, G. flavimacula, G. oculifera, and G. nigrinoda, display sexual dichromatism. River width was significant (i.e., sex x river width) in the G. flavimacula and G. nigrinoda analysis.

Chelonian Biology: Oral

Karumbe Program, 15 Years Conserving Turtles In Uruguay

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Uruguay is a small country in South America with a surface area of 110 mi². Five species of freshwater turtles can be found in Uruguay, the Emidyidae “Morrocoyo” (Trachemys dorbignyi) and four species of the Chelidae family: the Hilarie’s Side-necked Turtle (Phrynops hillari), the William’s Toadhead Turtle (Phrynops williamsi), the Black Spine-necked Swamp Turtle (Achmatochelys spixii), and the South-American Snake-headed Turtle (Hydromedusa tectifera). Multiple threats take their toll, but uncontrolled and non-sustainable direct commercial exploitation has been the single-most damaging factor. Up to know, A. spixii and Ph. williamsi are considered “Endangered” in Uruguay by the International Union for Conservation of Nature National Red List of Threatened Species team. NGO Karumbé drives a species conservation program, especially in the coastal areas of Uruguay. A novel protected areas system was created by the government in 2005 in order to formalize and combine agendas. Many of these new protected areas are in the process of formation, and few ranger personal are working in the parks. Our organization has been working towards the creation of protected areas. PA Cerro Verde was created in 2013 after nine years of work. PA Cabo Polonio is another protected area where this species occurs. In this area we have conducted population monitoring and training workshops for staff rangers. Regarding P. williamsi, we have been working in the PA Paso Centurion, conducting workshops with the local people. In January 2004, Karumbé created the Turtles and Tortoises Refuge with the aim of receiving pets abandoned by their former owners. Because of this problem, we established an Environmental Awareness Program in order to inform the general public about the biological characteristics and threats to the native freshwater turtle species and other exotic tortoise species. Karumbe ran two Turtle Visitor Centers (CTM): one located on La Coronilla Rocha and one in Montevideo. Karumbe receives about 50,000 visitors each year, mostly children. In the CTM Montevideo, Karumbe serves as a refuge for turtles with injuries and illnesses and receives 30 to 50 turtles per year, most of which were extracted from nature. Thus, Karumbe has a permanent group of turtles that cannot be returned to their native habitat.

Community Conservation: Oral
Multiple Paternity in Clutches from Captivity of Giant River Turtle (Podocnemis expansa) Using Microsatellite Markers

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The Giant River Turtle, Podocnemis expansa, is an important representative of the turtle fauna of the Amazon, its large size makes it one of the most consumed turtles by the local human population, furthermore, and is marketed illegally. For these reasons, populations have been reduced and currently this species is classified as low risk/conservation dependent, according to the International Union for Conservation of Nature. As a conservation measure, to ease the pressure of capture in nature, this species can be commercially raised in captivity. However, the lack of technical support regarding captivity and important ecological information about the biology of the species hinders their proper management. The aim of this study was to determine the type of reproductive behavior this species employs based on analysis of clutch paternity from samples of captive turtles. Blood samples were collected by puncture of the femoral vein of 191 offspring in captivity from Fazenda São Francisco, Manacapuru-AM and genotyped using 5 microsatellite loci. The analysis of the loci revealed 100% occurrence of multiple paternity in captivity. The markers used in this study were quite polymorphic and had a highly discriminatory power for the analysis of kinship with identity values (I) IC = 1.08 x 10^-6 for samples of captivity, and the probability of paternity exclusion (Q) QC = 99.9%, indicating the detection power of multiple paternity of these loci used. From the allele counting method, it was possible to estimate the number of males that were contributing offspring; we observed contribution from at least 10 males from two nests in captivity. These results also reveal the ability of females of this species to store sperm from multiple matings. Knowledge about the type of reproductive behavior for species is fundamental and has great implications when considering the conservation of P. expansa. The data obtained in this study will support management and conservation programs suitable for this species.

Poster Session

A Very Simple Way to Induce Egg Laying in Turtles

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This season we returned to the Concordia Turtle Farm in Louisiana, USA to experiment with new, longer acting agents to induce egg laying in various species of aquatic, North American turtles. While experimenting with the long acting, synthetic versions of oxytocin (carbetocin) and prostaglandin F2 alpha (Hypophysin LA), we realized we had made a serious error of omission in 2008 when we were running trials with various prostaglandins. When we repeated the 2008 trials using prostaglandin F2 alpha (Lutalyse) alone the outcomes were as good, or better, than any other combination we have developed in the past. Using Lutalyse alone in doses of 1.0 mg/kg - 2.0 mg/kg resulted in over 90% of 250 Red-eared Sliders laying all their eggs. We have obtained similar results in smaller numbers of other species. This compares to a 37% success rate when using oxytocin alone. Lutalyse is easily obtained by any veterinarian and is a lot more convenient than any of our previously recommended combinations. However, it must be used carefully because it migrates through mammalian skin and can cause diarrhea/abdominal cramps in everyone and abortion in pregnant women. By the time of the conference we will be able to report on the effects of Lutalyse alone in spiny softshell turtles and possibly other species. We will also be able to report on the effects of combining Lutalyse with xylazine, a sedative popular with veterinarians for use in large mammals. Xylazine has the potential to over-ride the inhibiting effects of capture stress on egg laying. It appears that Lutalyse initiates most of the cascade of natural events that leads to egg laying. Oxytocin is not as effective because its action is further along the cascade. We no longer believe that oxytocin has a role as a primary agent to induce egg laying.

Captive Husbandry: Oral

Comparison of the Vocal Repertoire of Podocnemis expansa In and Out of the Water

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Turtles are known to have a considerable audio sensitivity below 1000 Hz; the ear is a well developed organ in this order, with specialized structures adapted to absorb sound waves both in and out of the water. This premise has been documented with Terrapene carolina, Chelonia mydas, Lepidochelys kempi and Caretta caretta. Our ongoing study has the objective of verifying the audio sensitivity of Podocnemis expansa in and out of the water, testing whether or not these sounds utilized above and below the water have the same characteristics or not. After 400 h of recording adults and hatching P. expansa in the Rio Trombetas Reserve, we found 11 types of sound. Air borne sounds were the most diverse (I, II, III, IV, V, VI, VII, VIII, IX, X) compared to those in the water (II, III, V, VI, VII, VIII, IX, X). The peak frequency was the same in both air and water. Our results reveal that the audio sensibility of this species in air and water is the same, as has been reported for other species of turtles. The sounds emitted by aquatic turtles in the air have been described structurally as simple sounds, without any great significance for communication. Podocnemis expansa, in addition to having simple structured air borne sounds as do other turtles, also present complex sounds and complex sounds specifically used in air rather than in water. This result demonstrates an aspect quite different from the literature, emphasizing the importance of these complex air borne vocalizations in the exchange of information between P. expansa individuals when they are out of the water, as well as when submerged. Only through long term observations and play back experiments in nature will we be able to determine exactly how these vocalizations are used and what they mean to the turtles.

**Chelonian Biology:** Oral

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**Meta-Analysis of Effects on Home Range of the Eastern Box Turtle, Terrapene carolina**

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Previous studies measuring the home ranges of Terrapene carolina (Eastern Box Turtle), have shown wide variation in home range sizes within and between populations, probably due to factors such as data collection method and differences in habitat. These diverse studies were performed using different tracking methods (i.e., radio telemetry, string trailer), analyzed differently (minimum convex polygons, kernel analysis, bivariate normal, Multivariate Ornstein-Uhlenbech (M.O.U.), harmonic mean method), and have different sample sizes, which may contribute to the variable results. Dodd (2001) included a table of 19 field studies on T. carolina and T. ornata, but there has never been a systematic review, including all studies with home range data, to really summarize what we know about home range size in this well-studied species. After a thorough search of the literature, including unpublished theses to avoid biased results due to under publication, I found 23 studies listing the home range areas of T. carolina. A meta-analysis of data from these papers was conducted to quantify the effect of sex, latitude, habitat type, sample size, number of captures, tracking method, analysis method, and duration of study on T. carolina home range size estimation. The effects caused by relocation were also considered.

**Poster Session:** (Student)

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**Long-Term Mark-Release-Recapture Study to Describe the Turtle Community at the John Heinz National Wildlife Refuge**

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The John Heinz National Wildlife Refuge at Tinicum is designed to protect the last 200 acres of freshwater tidal marsh in Pennsylvania. Despite its urban surroundings, the Refuge has become a sanctuary to a broad diversity of wildlife, including a variety of turtle species. These include PA-state-threatened Red-bellied Turtles (*Pseudemys rubriventris*), Eastern Painted Turtles (*Chrysemys picta*), Common Snapping Turtles (*Chelydra serpentina*), Common Musk Turtles (*Sternotherus odoratus*), and invasive Red-eared Sliders (*Trachemys scripta elegans*). In the summer of 2013, we initiated a mark-release-recapture study to describe the populations that comprise the turtle community at the refuge. This involved trapping turtles to gather data on species, size, distribution, diet, and movement. Turtles were collected using three techniques: baited hoop net traps, floating basking traps, and hand captures/dipnetting. Processing turtles involved measuring weight, plastron and carapace length, width, and height. Sex was determined by assessing secondary sex characteristics, and any signs of deformity or injury were noted. Fecal samples were also collected for dietary analysis. Each captured turtle was identified by use of PIT (Passive Integrated Transponders) tags, microchips that contain a unique serial number that can be read by a scanner. Over the course of the summer of 2013, 147 turtles were captured, marked, and released. Only one was recaptured, and all but two were equipped with PIT tags. Fecal samples were collected from 33 turtles, primarily *C. picta picta* and *Trachemys scripta elegans*. Another
component of this project involved visually marking adult turtles with non-toxic paint markers in a way that enabled visitors to the refuge to become involved in the study by reporting turtle sightings.

Poster Session (Student)

Natural History of Rhinoclemmys nasuta from the Pacific Coastal Region of Colombia

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We studied Rhinoclemmys nasuta in the Pacific coastal region of the Department of Valle del Cauca, Colombia, between 2005 and 2012. Limited knowledge of the natural history and ecology of this species had impeded an appropriate assessment of its conservation status. We have assessed population size and structure on an island and at a mainland locality. Isla Palma has no human disturbance, while the mainland locality is human-influenced. The island population was dominated by adult individuals, with a female: male: juvenile ratio of 1.00: 0.71: 0.85. Females were significantly larger than males (♀: 179.87 ± 3.27 mm; ♂: 151.83 ± 2.41 mm) with a sexual dimorphism index of 1.18. The population size estimate based on capture-recapture records with a closed model was 990 individuals (confidence interval 90%: 941 to 1044 individuals) with a mean density of 2444 ± 122 turtles per ha. The density of the island population was 6.3 times greater than that of the mainland locality, which may correspond with the absence of some predators and the lack of human disturbance on the island. Additionally, there was no significant difference between localities in demographic structure and size classes, which may reflect that there is no removal of individuals for consumption or use as pets in the mainland population. We also studied the ectoparasites associated with R. nasuta, and found the tick Amblyomma sabanerae present in both island and mainland populations, and the leech Placobdella ringueleti infecting the mainland population. Reproduction in this species has proven difficult to study. We found one egg with about 95% of its surface area buried in the forest substrate on Isla Palma; it was transported to the laboratory where it completed incubation in 66 days. Initial neonate size was 58.4 mm straight carapace length, and it weighed 33 g. It is important to stress the importance of Isla Palma as a site for regional conservation of R. nasuta, now reinforced by its inclusion in the newly established Uramba-Bahía Malaga Natural National Park. Our study of this species has been the first ecological study of a continental turtle species from the Pacific region of Colombia.

Rhinoclemmys - Central/South American Wood Turtles: Oral (Student)

The Potential of Using Temple Ponds for the Conservation of Rare Turtle Species in South Asia

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In South Asia, religion exerts a much larger influence on the population than in the West. While legislation and regulations seem slowly into the awareness of the local population, tradition, faith, religious rituals and worship are historically grown and deeply anchored in the soul of the people. Turtles have played an integral role in many religious traditions. Many Hindu, Buddhist and Islamist temples in these regions have adjacent ponds, where a variety of turtle species have been released, fed, and even worshipped and adored. In India the most widespread name given to the tortoise/turtle is Kurma and is known as an incarnation of one of the creators, Lord Vishnu as tortoise/turtle. The Shatapatha Brahmana text identifies the earth as its lower shell, the atmosphere as its body and the vault of heaven as its upper shell. In Hindu mythology turtles or tortoises play a vital role, giving a high priority to offer them to the gods. Many Indian temples throughout the country hold turtles of different species in the adjacent pond, giving the devotees a chance to pray to them as a media to reach their gods and goddesses. These temple ponds have the potential to act as safe, well-protected sanctuaries and breeding facilities for rare turtle species. Unfortunately, many of the ponds are ill-equipped to provide adequate nesting beaches for breeding; they contain excessive amounts of trash and the turtles are fed an improper diet. The temple authorities and responsible forest departments have been very open and accessible for changes in offered food items, improving water quality and even constructing activities like creating nesting beaches. Since early 2012 the Baneswar temple pond in Northern West Bengal has been modified to stop the
former dying off and maximize the breeding success of the Black Softshell Turtles (*Nilssonia nigricans*). Most recently the Matabari temple in the remote northeastern state Tripura was visited and chosen to be the second target pond putting effort for an ex-situ conservation project of *N. nigricans*. The central fisheries department joined us to help establish a community based program with village ponds for aquaculture, including selected turtles species. First results look very promising; in West Bengal the newly made sand beach was quickly used by a number of nesting females and authorities in Tripura are very supportive and want to push modifications for improving the temple pond.

**Presentation type:** Oral

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**Turtle Conservancy: 10 Years of Conservation Breeding Success**  
**PAUL GIBBONS, ERIC GOODE, AND CHRISTINE LIGHT**  
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Since John L. Behler helped establish the Turtle Conservancy (TC) in 2004, it has become the world’s most successful chelonia conservation-breeding center, hatching 19 species and over 1,300 offspring, 99% from Endangered or Critically Endangered species. TC has cared for 44 species in all: 18 Critically Endangered, 13 Endangered, and 2 Vulnerable. Many of these are challenging to keep alive, let alone breed, in captivity including *Manouria impressa*, *Kinixys erosa*, *Chelondois chilensis*, *Geoemyda japonica*, *Pyxid arachnoides*, and *Pyxid planicauda*. We are narrowing our focus to species that need international ex-situ breeding and on defining the best possible techniques to provide each species’ microhabitat needs in Ojai’s Mediterranean climate with limited indoor environments. We group species from similar habitats; several species are outdoors year-round. One greenhouse simulates cloud forests with humid moderate temperatures and another simulates lowland hot ecoregions with moderate humidity and 15°C diurnal temperature fluctuations. Both employ multiple heating, cooling, and moisture systems coordinated by an advanced climate computer. Two semi-enclosed environments utilize removable translucent panels to curtail temperature extremes and manage humidity; one simulates coastal dry zones and the other simulates southern hemisphere scrub habitats. Two well-insulated houses provide bio-secure climate-control for sensitive species and hatchlings, and variously sized tortoise houses provide warm refuge on cool nights for outdoor tortoises. Fountains, ponds, and aquariums have recirculating bio-filtration with UVB sterilization. Each specimen is recorded and monitored to meet the reproductive and demographic goals of conservation programming. In addition to providing a last line of defense against extinction, Turtle Conservancy’s goals are to actively refine husbandry, enhance reproduction, and protect habitats so offspring can help augment reintroduction programs, restore ecosystems, and fund in-situ conservation.

**Zoos and Chelonians:** Oral

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**Recovery of the Western Painted Turtle (Chrysemys picta bellii) in the Lower Mainland and Fraser Valley: Recovery Through Partnership, Planning and Persistence**  
**ANDREA GIELENS, AIMEE M. MITCHELL, VANESSA L. KILBURN, CHRIS CURRIE AND DEANNA MACTAVISH**  
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The Western Painted Turtles (*Chrysemys picta bellii*) is British Columbia’s only native turtle species. The Pacific Coast population within the Lower Mainland and Fraser Valley is threatened with extirpation by loss of habitat, harvesting, invasive species, and extensive human impact. Several years of survey, outreach, threat mitigation and habitat restoration have allowed for the assessment, prioritization and implementation of recovery actions. However, recovery of turtle populations in this region will require more intensive forms of recovery actions, such as augmentation, particularly at sites with non-breeding (non-viable) populations. Currently, there is only one site, out of 23 known occupied sites, which is viable and appears to be stable, however, it is also under threat. Additional occupied sites are degraded, yet turtles persist in limited numbers often less than 5 individuals per site. These sites have been prioritized according to an evaluation matrix (community and conservation planning matrix), considering community/landowner support, risk assessment, habitat quality and historical implications, and present different priorities for population recovery. This novel assessment process has prioritized recovery sites and will help inform a 5-year plan for recovery that is currently being developed. Recovery is directly focused on the implementation of management efforts based on increased knowledge of this species’ genetics, distribution, threats and possible recovery actions and plans for decreasing extirpation risk. The development of novel assessment approaches, in-situ and ex-situ threat abatement, and comprehensive recovery planning drive the progression of species recovery.

**Poster Session**
Bizarre Foods: Chelonian Edition: Utilizing Unique Diet Items for Captive Animals

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This talk will focus on discussing unique and innovative food items for both herbivorous and carnivorous animals including rearing techniques for a variety of live prey items. Commonly, diets for chelonians in captivity are bland, homogenous, and lack variation. Herbivorous diets often contain a few select greens while excluding other vegetables and browse items that have essential nutrients or trace minerals. There are a multitude of browse items that can be offered including grasses, succulents and cacti, flowering and fruiting plants each providing different elements of a complete diet. Carnivorous diets tend to focus around “complete diet” items such as pellets that claim to provide everything essential to carnivorous turtles while excluding whole prey or a variety of food options necessary for a balanced diet. These imbalances can have negative effects on captive animals such as depriving them of trace vitamins and minerals essential for proper eggshell production, spermatogenesis, and normal growth processes. Live prey items are frequently overlooked for chelonians, however they can be grown very affordably in-house with minimal effort and can be an engaging and nutritious diet addition. Efforts should be made to offer captive chelonians a varied diet to ensure that a balanced nutrition is maintained for the production of healthy animals while also providing an enriching and stimulating environment.

Captive Husbandry: Oral

Captive Reproduction of Rhinoclemmys rubida and R. pulcherrima in Southern Oaxaca, México

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In order to broaden the appeal to the public and to educate them, non-marine chelonians from the immediate area began to be housed at the Centro Mexicano de la Tortuga (CMT) in 1994. Specimens of both locally sympatric species of Rhinoclemmys, R. p. pulcherrima and R. rubida rubida, have been obtained by unsolicited private donation from local people and tourists, who more and more frequently visit the center. Rhinoclemmys rubida has the distinction of being a Mexican endemic species and had hitherto not been studied in nature, nor was anything documented about its reproduction. The location of the CMT in Mazunte, on the coast of the state of Oaxaca, Mexico, is ideal for such ongoing research. Between 1999 and 2010, data on the reproduction of both species housed in outdoor exhibits at the CMT have been compiled. Dimensions of some of the eggs and of all neonates have been recorded, followed by measurements at intervals to assess growth in the earliest hatchlings. A highly variable incubation period, under conditions probably approaching those in nature, has been noted. Observations on nesting behavior and courtship are also presented, and the care of adults and juveniles is summarized. Two of the R. pulcherrima females in the breeding group exceed the greatest known carapace length for the species (202 mm). The reproductive cycle of all species of Rhinoclemmys, the sole Neotropical geoemydid genus, is poorly understood. The breeding success at Mazunte, under both near natural and artificial conditions, sheds some light on these chelonians which may prove useful to their management in an environment increasingly beset with adverse impacts.

Rhinoclemmys - Central/South American Wood Turtles: Oral

Overwintering Ecology of Juvenile Gopher Tortoises at St. Catherines Island, Georgia

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Winter can be a dangerous time for many reptiles; as ectotherms, temperature decreases increase the risk of mortality, primarily concerning freezing. The Gopher Tortoise (Gopherus polyphemus) is a large terrestrial turtle that constructs and occupies...
underground burrows which protects them from temperature extremes and predation. Individuals thermoregulate behaviorally by adjusting their position inside the burrow and through surface activity. Due to their smaller body size and higher surface to volume ratio, juvenile thermal ecology might be expected to differ from that of adults. Much of what is known about the overwintering behavior of gopher tortoises is based on adults. Knowledge regarding the ecology of juvenile tortoises has been limited primarily due to the difficulty in obtaining a sufficient sample size. We investigated the overwintering ecology of juvenile gopher tortoises on St. Catherines Island, Georgia using externally attached temperature data loggers. Data loggers were set to record temperatures every 2 hours on 11 juvenile tortoises over the winter of 2012-2013. Tortoise temperatures were compared to burrow and surface air temperatures collected in the same habitat, allowing us to infer surface activity of the tortoises. We examined the onset, termination, duration, and the number of winter emergences recorded of the juvenile tortoises’ overwintering. We also examined the mean, maximum, and minimum temperatures experienced by the tortoises, as well as the minimum temperature of tortoise winter activity. Tortoises initiated overwintering over a 48 day-period (median date of 14 November 2012). Termination of dormancy took place over a 32-day period (median date of 15 March 2013). Mean overwintering duration was 127 days ± 7 days. Juvenile tortoises emerged 5-22 different days over the 2012-2013 winter. The mean temperature experienced by overwintering tortoises was 17.9 ± 0.02 °C and the minimum ambient temperature when a juvenile tortoise emerged from its burrow to bask was 15.8 °C. Timing of juvenile gopher tortoise overwintering is similar to the timing reported for adult tortoises; however, juveniles are frequently active on the surface during the winter and emerge from burrows at lower temperatures than has been reported for adults. 

Tortoises: Oral (Student)

**Turtle Diversity and Abundance in U.S. Zoos and Aquariums: Do Conservation Needs Match Current Holdings?**

**BRIAN D. HORNE**¹, **BILL HUGHES**², AND **ANDREW D. WALDE**³

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We performed an analysis of the current holdings of U.S. Zoos and Aquariums in an effort to determine species composition, abundance, and breeding activity. We gathered the majority of the data from TRACKS® and ZIMS, inventory and management software programs utilized by members of the Association of Zoos and Aquariums (AZA). We also collected data from up-to-date species specific studbooks. We then cross referenced this information to the U.S. Endangered Species List, the 2011 Top 25+ Most Endangered Tortoises and Turtles, and the International Union for Conservation of Nature Red-list of Threatened Species. From this analysis, we will make recommendations on the need, if necessary, to increase both the diversity/number of assurance colonies as well as the number of individual chelonians maintained across all AZA member organizations. We will also make recommendations on the need, or lack thereof, for increasing breeding activity with the goal of long-term AZA collection sustainability.

**Zoos and Chelonians: Oral**

**Freshwater Turtles in Crab Traps: an Alternative Trapping Technique for Kinosternid Species**

**CYBIL C. HUNTZINGER**¹, **KATIE CANTRELLE**³, **IRVIN LOUQUE**³, **EDDIE K. LYONS**³, AND **WILL SELMAN**²

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Razorbak Musk Turtles (*Sternotherus carinatus*), Common Musk Turtles (*Sternotherus odoratus*), and Eastern Mud Turtles (*Kinosternon subrubrum*) are three relatively widely distributed Kinosternid species in the eastern United States. They have been observed in medium to large flowing rivers, but have also been found in smaller creeks, slower-moving side channels, ponds, and bayous. While trapping turtles for a related study in three watersheds in southwestern Louisiana (Calcasieu, Mermentau, and Sabine River systems), baited hoop nets and unbaited fyke nets indicated a relatively wide distribution of these Kinosternid species in southwestern Louisiana. However, trapping success was relatively low with these methods. Therefore, in May 2013, modified crab traps baited with Gulf Menhaden were incorporated into the study to increase trapping success of Kinosternid species. Modified crab traps produced 0.37 turtles per trap night (TTN) in comparison to 0.08 TTN for baited hoop nets from 28 May to 31 October 2013. Modified crab traps have been reported as a successful trapping technique for Diamondback Terrapins (*Malaclemys terrapin*), but have not been used for freshwater turtle species. As a result of high
trapping success in this study, modified crab traps may be a feasible trapping technique for other Kinosternid studies because they are more successful, cost-effective, time efficient, and less likely to be stolen than the traditional baited hoop net.

**Poster Session** (Student)

**Habitat Use of Juvenile Sonoran Desert Tortoises in Central Arizona**

**Cristina A. Jones and Audrey K. Owens**

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Most of what is known about Desert Tortoises is based on research conducted on adult Mojave Desert Tortoises (Gopherus agassizii), a species listed as Threatened under the Endangered Species Act (ESA); significantly less is known about Sonoran Desert Tortoises (Gopherus morafkai), despite their status as species of greatest conservation need by the Arizona Game and Fish Department, and Candidate status under the ESA. In particular, very little is known about juvenile Sonoran Desert Tortoises, which are notoriously difficult to find due to the complex nature of tortoise habitat in the Sonoran Desert. We used radio-telemetry to study juvenile Sonoran Desert Tortoise habitat use and activity. Our study site is in the Mazatzal Mountains, Maricopa County and is characterized as Arizona Upland paloverde-mixed cacti series with an elevation between 550–850 m. It has a high density of desert tortoises, with over 200 tortoises marked since 1991 in an approximately 66 ha area. We equipped 15 juvenile desert tortoises (ranging in size from 124–175 mm midline carapace length) with radio-transmitters in 2010–13 and tracked them at least once a week during the active season and periodically during winter dormancy. We present our findings on juvenile tortoise movement, home ranges, and habitat use, including observations of possible emigration events. Given the recognized differences in morphology, ecology and genetic structure between the two desert tortoise species, these natural history data on juvenile desert tortoises will be valuable in guiding management of this species in the Sonoran Desert of Arizona.

**Tortoises:** Oral

**Using Diamondback Terrapins, Malaclemys terrapin, as a Bioindicator Species of Mercury Pollutants in a Georgia Saltmarsh**

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The Diamondback Terrapin, Malaclemys terrapin, is a small brackish water turtle that lives in estuarine habitats from Cape Cod, Massachusetts to the Florida Keys and up to the Gulf of Mexico as far as Texas. Terrapins have very high site fidelity throughout their life history making them a good choice to use as a bioindicator species for habitat and wildlife health. Additionally, the Diamondback Terrapin is a top food chain predator feeding predominately on Fiddler Crabs (Uca sp.) and Periwinkle Snails (Littorina planaxis) in Georgia. Because of these characteristics, we used the terrapins in this study as a sentinel species representing the overall health of the saltwater marsh ecosystems they inhabit. Automobile mortality is a significant threat to Diamondback Terrapins throughout their range. The elevated causeways running through the marsh ecosystem to reach many of the barrier islands are attractive to female Diamondback Terrapins as nesting sites. The Georgia Sea Turtle Center (GSTC) and its collaborators have been investigating this problem on the causeway that leads to Jekyll Island, GA since its opening in 2007. Although mitigation strategies are being implemented to decrease mortality, 100 to 300 Terrapins are hit every year. These fresh carcasses found on the road afforded us the opportunity to collect tissue samples for mercury and other locally important contaminants for analysis. There are 4 Environmental Protection Agency superfund sites found in Glynn County, Georgia – all of which are known sources of mercury, other heavy metals, and several organochlorine compounds. These pollutants have implications for the overall health of the ecosystem, wildlife, and humans living and fishing in the area. This study measured mercury content in selected tissues collected from Diamondback Terrapins killed by automobiles. Furthermore, this study is part of a larger, long term Diamondback Terrapin health and contaminant study being conducted by the GSTC staff and their colleagues.

**Poster Session**
Conservation of Coc Ac, or Yucatán Box Turtle (Terrapene carolina yucatana): A Multidisciplinary Collaboration at the Community and Landscape Level

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The Yucatán Box Turtle (Terrapene yucatana) is the southernmost representative of the Terrapene carolina species complex, which is broadly distributed over most of the temperate eastern United States. Terrapene yucatana has been reported only from Campeche, Yucatán, and Quintana Roo on the Yucatán Peninsula of southeastern Mexico, where it apparently occurs in association with subtropical hardwood hammock, deciduous thornscrub, and open agricultural habitats. Despite a broad distribution of records from central interior Campeche to northern Yucatán, very few corroborated occurrences are known from natural habitats and little is known of the seasonal ecology of the turtle. Furthermore, although it is geographically and genetically isolated in a threatened landscape, it has been considered only “vulnerable” because of its taxonomic placement in T. carolina. From 2013 to 2014 we conducted interviews and field surveys to augment the understanding of the distribution, abundance, seasonal ecology, and behavior of this temperate lineage in tropical Mexico. Our interviews and field surveys over approximately 28 days in January, February, and July have led us to believe that while the species may be widely distributed across the peninsula, it is generally poorly known, and, although it appears to be frequently encountered by locals during the rainy season in a few areas, it is also heavily traded for local consumption and regional and international pet markets in some areas. We will present our key findings and our strategy for ongoing conservation research and outreach.

Community Conservation: Oral

Making a Big Difference with Minimal Resources: A Look at the Blanding’s Turtle (Emydoidea blandingii) Head Starting Program at the Detroit Zoological Society

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The role of zoos has changed significantly and so have the expectations, both from the public as well as governing bodies such as the Association of Zoos and Aquariums (AZA). Conservation priorities have been placed front and center with expectations of percentages of an institutions’ annual budget being used for conservation in one form or another ranging from donations to on the ground field work. While not having to invest a lot of funds and getting creative in utilizing unused spaces on property, the Detroit Zoo has been able to take part in local turtle conservation. The Blanding’s Turtle (Emydoidea blandingii) is a special concern species in the state of Michigan. Since 2011, the Detroit Zoo has been involved in a head start program at the Shiawassee National Wildlife Refuge in Saginaw, MI, to boost the younger age classes of turtles on the refuge as it was determined the refuge population is primarily composed of adults with little to no juvenile recruitment due to the excessive predator population. The project had gained the interest of a student from the University of Michigan-Flint who had utilized the released hatchlings as part her graduate work radio tracking the turtles to study movements, habitat use and survivorship of the turtles. A second graduate student from University of Michigan-Flint will be continuing the radio tracking looking at the survivability of one year old head started turtles to see if there is a specific type of release site that is best suited to increasing their survivability. Zoos becoming involved in relatively easy to implement projects such as this can increase working relationships with a wide variety of local partners who may be interested in doing local conservation, but may be too much for a single entity to do on their own.

Zoos and Chelonians: Oral

Current Threats to the Southern African Tortoise Fauna with Particular Reference to Psammobates geometricus and Homopus boulengeri

JAMES JUVIK3 AND MARGARETHA HOFMEYR2

1Department of Agriculture and Natural Resources Management,
At a 2013 International Union for Conservation of Nature Red-List meeting for African Chelonian, more than half of the 18 southern Africa tortoises were recommended for up-listing to: Vulnerable (all 6 Kinixys and Homopus boulengeri); Endangered (Homopus solus and Psammobates tentorius trimeni) or Critically Endangered status (Psammobates geometricus). We focus on three drivers that appear contributory to this bleak reassessment. Catastrophic Habitat Loss; Rapid agricultural and urban expansion around Cape Town has eliminated more than 95% of the lowland Renosterveld habitat of Psammobates geometricus. Remaining small fragments are unprotected on private farms. The total surviving population is estimated at less than 1000 animals. An ex-situ head-starting program has been launched at a private reserve where a 2012 wildfire decimated the largest surviving population. Predator subsidy and other novel threats: As documented for the California Desert Tortoise (Gopherus agassizii), predator subsidies in the form of desert irrigation (and other surface water storage), garbage dumps, and elevated power-line perching sites also appear to pose comparable threats in Southern Africa. A farmer in the Karoo recently documented tortoise predation by a single pair of Pied Crows (Corvus alba). The pair successfully raised 4 offspring in both 2012 and 2013, during which a total of 475 juvenile tortoise shells (mostly Chersina angulata) were collected below the nest. In the Ceres Valley, with a small remaining population of Psammobates geometricus, we documented the impact of a 27 km irrigation canal that has been anecdotally reported to trap and kill many tortoises since construction in 1961. Recently, community tortoise rescue efforts between December 2012 and January 2014 collected and released more than 1,300 tortoises from this canal (mostly Chersina angulata). Climate change: Global warming and altered rainfall patterns are drivers of changing plant community diversity in semi-arid biomes of southern Africa (Karoo, Kalahari). Temperature rise in hyper-arid areas of the Namib fog-desert (and anticipated warming of the cold Benguela Current) is projected to reduce both the water flux and inland penetration of coastal fog, important for both Homopus solus and Psammobates tentorius trimeni. Our recent survey of H. boulengeri populations suggests inexplicable extirpations from former habitat in the Succulent Karoo, potentially climate related.

Community Conservation: Oral

Survey of Diamondback Terrapins (Malaclemys terrapin) in Four Counties in Northeast Florida
LILIANA KOLLURI AND JOSEPH BUTLER
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The Diamondback Terrapin (Malaclemys terrapin) is the only North American turtle to prefer brackish water. Currently, their numbers are in decline due to anthropogenic threats. At the Third Workshop on the Ecology, Status, and Conservation of Diamondback Terrapins, it was agreed that a range map was needed to better evaluate terrapin populations, and that more extensive population and habitat usage studies were needed to fill in gaps in knowledge throughout the range. Malaclemys terrapin is also listed as a species of greatest conservation need in the state of Florida. The goal of this study is to create a range map of diamondback terrapin populations in northeast Florida. We searched for terrapin evidence by boat along the Intracoastal Waterway and associated tributaries from the Georgia border to the southern border of Flagler County, FL and also conducted walking surveys on land. We recorded locations of terrapin evidence on a Garmin GPSPM 78sc hand-held unit and uploaded the data to ArcGIS 10.2 to create the range map. The data collected from this study will also be used to develop and test a nesting habitat suitability index that can be used by researchers throughout the range to better locate terrapin habitat.

Diamondback Terrapins: Oral (Student)

Long-term Effects of Predator-proof Fencing on the Last Self-sustaining Wild Population of the Western Swamp Turtle Pseudemydura umbrina
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The last tiny self-sustaining wild population (about 20 adults) of the critically endangered Western Swamp Turtle, Pseudemydura umbrina, at Ellen Brook Nature Reserve in south-western Western Australia was fenced with a predator-proof fence in 1991 to protect it from predation by the introduced European Red Fox (Vulpes vulpes). Additional conservation measures included temporary protection of some of the turtles in captivity, and headstarting 86 hatchlings for a few weeks prior
to releasing them directly into the water – equal to protection of those nests and hatchlings from predation. Removal of those headstarted individuals from population analyses reveals that the wild adult population slowly but steadily increased over eight years following fencing from 21 to 29 individuals, but declined again slowly since to less than 20. The juvenile population, however, declined over eight years following fencing from 18 to five, followed by an increase over eight years to 20 and it is more or less plateauing since. Recruitment of wild hatchlings (no headstarting) peaked in 1993-1994, 2003-2004 and 2011, but was variable and low in other years. Nest predation was monitored in the 1992-1993 and 1993-1994 seasons when it was zero, but in the 2006-2007, 2008-2009 and 2001-2013 seasons combined it was 83%. Native bandicoots, Isoodon obesulus, were found to predate nests in 2006-2007 and were since trapped and removed from the reserve every year except 2012. From 2007 to 2013 P. umbrina hatching production, survival and recruitment was negatively correlated to bandicoot densities. Bandicoot densities are low under fox and cat predation, but can reach high levels when those are excluded – a classic example of mesopredator release. In conclusion, the fragmentation of home ranges established prior to fencing appears to be detrimental for adult P. umbrina, with 50% of long-term residents having been lost over just 4 years. Hatchling and juvenile recruitment is heavily impacted by high bandicoot densities promoted by fox exclusion. Even together with headstarting and temporary protection of adults, 24 years of fox exclusion at Ellen Brook Nature Reserve through fencing did not result in a lasting increase of the last self-sustaining wild population of P. umbrina.

Community Conservation: Oral

The Freshwater Turtle Population Assemblage at Blue Spring State Park

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Little is known about turtle assemblages within the St. Johns River Watershed in eastern Florida. Since 1999 the North American Freshwater Turtle Research Group (NAFTRG) has been surveying aquatic turtles in Blue Springs State Park, Orange City, Florida to eventually compare to populations and assemblages at other sites within this and other watersheds in Florida. Here we provide population parameters for three freshwater turtle species, the Peninsula Cooter (Pseudemys peninsularis), Florida Red-bellied Cooter (Pseudemys nelsoni), and the Loggerhead Musk Turtle (Sternotherus minor), estimated from six years of mark and recapture data at Blue Spring State Park. Population estimates of P. nelsoni and P. peninsularis have been constant over the study time period, while the population of S. minor is increasing. Recapture probabilities were much lower for P. peninsularis than for P. nelsoni, suggesting that P. nelsoni are spending most of their time in the spring, while P. peninsularis maybe using additional habitats outside of the sampling area. Specific management recommendations for Volusia Blue Spring include increasing Pseudemys’ access to banks, establishment of food vegetation within the spring run, and continued removal of invasive species that may interfere with the former recommendations. In addition, the authors urge policy makers to protect other manatee overwintering sites within the St. Johns Water Management District to relieve Blue Spring from the increased large herbivore pressure.

Population Status: Oral

Underwater and Undetected: Aquatic Respiratory Capacity of a Secretive Aquatic Turtle

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Aquatic turtles vary widely in their capacity to remain submerged in water for extended periods. Ecologically, remaining below the water’s surface can have great benefits to individuals by prolonging foraging bouts and reducing the likelihood of detection by predators. However, prolonged submersion presents obvious physiological challenges for a group that classically relies on aerial respiration across pulmonary surfaces to support metabolic demands for gas exchange. Two options for metabolically supporting long diving bouts include, 1) relying on anaerobic metabolic pathways to supplement or supplant aerobic
metabolism, and 2) engaging in aquatic gas exchange across non-traditional respiratory surfaces, including skin, oral and buccal surfaces, and cloacal bursae. In general, ecology tends to trump phylogeny in predicting species’ capacity for aquatic respiration; therefore, highly aquatic species that are seemingly ill-suited for aquatic respiration warrant extra scrutiny. One such species is the Alligator Snapping Turtle (Macrochelys temminckii), a secretive denizen of rivers, oxbows and swamps in the southeastern United States. Although the species possesses cloacal bursae (whose function in this species is presently unknown), its large size dictates that it have a relatively low surface area-to-volume ratio thereby limiting the degree to which cutaneous respiration could replace pulmonary respiration as a means of supporting metabolic demands. Therefore, we measured oxygen consumption in water to determine what fraction of their metabolism could be supported by non-pulmonary means. Additionally, we conducted both aerial and aquatic gas exchange measurements across a range of size classes (all juveniles) and temperatures to determine whether there was a threshold below which metabolic demands could be wholly supported via aquatic respiration. Contrary to what we predicted based on the species’ ecology, we found that even juvenile Alligator Snapping Turtles—individuals whose small size imbues a relatively high surface area-to-volume ratio—had very low capacity for aquatic respiration. Therefore, extended submersion bouts by this species are likely supported anaerobically.

Poster Session (Student)

Terrapin Nesting Habitat Discovery Using Satellite Telemetry
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Locating nesting areas for many turtle species can be difficult due to their secretive nature, as well as possibly being outside of their normal home range. Diamondback Terrapins (Malaclemys terrapin), a brackish water species, are known to nest in sandy areas near their estuarine habitat in most of their range, but are suspected of using small mangrove islands with shell, sand or even oyster beds along the west coast of Florida. Radio telemetry, a fairly cost effective method of tracking turtle movement, is mostly ineffective in marine environments due to the disruption of radio waves by salt water. Satellite telemetry is an alternative option to track animal movements. With this technology, much like with radio telemetry, a transmitter is fastened to the turtle, but the animal’s GPS position is collected by a satellite orbiting the Earth and then downloaded with any internet connected personal device. Satellite transmitters are frequently used with marine (sea) turtle studies, but have not been used with other turtle species in the United States. The high cost and larger size of satellite transmitters (opposed to radio transmitters) limit their use to larger turtles and greater project budgets, but allow turtles existing in marine environments to be tracked almost anywhere in the world. Like other forms of telemetry, there are other advantages and drawbacks to this technology. The Sanibel-Captiva Conservation Foundation (SCCF) is in its second year (of three total) using satellite telemetry to locate nesting sites of southwest Florida terrapins. This telemetry project is part of the SCCF Diamondback Terrapin Project, a study that’s purpose is to increase knowledge about populations of terrapins in southwest Florida and to conserve the species through research, land management, and public awareness.

Diamondback Terrapins: Oral

Preliminary Analysis of the Use of Canopy Gaps by Eastern Box Turtles (Terrapene carolina carolina)
MARIAH A. LEWIS, MICKEY AGHA AND STEVEN J. PRICE
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Previous studies have shown that canopy gaps created by natural disturbance can be mechanisms for diversity in unmanaged forests because gaps create variation in microclimatic conditions allowing animal species with different traits to coexist within gaps and across the forest matrix. Theoretically, forest management practices that emulate natural canopy gap patterns may provide thermally suitable microhabitats for reptiles, including the forest-inhabiting Eastern Box Turtle (Terrapene carolina). In this study, we assessed the use of canopy gaps by Eastern Box Turtles in September and October 2013. We used radiotelemetry to assess habitat use while simultaneously using thermochron microdataloggers to track box turtle carapace temperatures. Environmental temperatures were also collected in the gap, along the gap edge, and in closed canopy forest. Preliminary results indicate use of canopy gaps by box turtles; however, these results were only supported minimally through relocation of individuals via radiotelemetry. Conversely, carapace temperatures indicated frequent (i.e., daily) use of canopy gaps up to hibernation. Thus, our preliminary results indicate that small, canopy gaps may be highly used by box turtles and provide thermally suitable microhabitats.

Poster Session (Student)
The genus *Graptemys* is characterized by intra- and interspecific dietary diversity. Sympatric species pairs typically differ in trophic morphology and dependence on mollusks in female diets, yet there have been few comprehensive comparisons of the diets of sympatric species. I collected feces from 92 Black-knobbed Sawbacks (*G. nigrinoda*) and 58 Alabama Map Turtles (*G. pulchra*) from the Alabama River at a site in Autauga and Lowndes Counties, Alabama. Samples were analyzed separately for unsexed juveniles, adult males, juvenile females larger than the smallest mature males, and adult females. Sponges, aquatic insects (particularly caddisfly larvae), and filamentous algae were the primary foods of *G. nigrinoda*. Native mussels, introduced Asian Clams, and aquatic insects (but few caddisfly larvae) were the primary foods of *G. pulchra*. Each set of four gender and size classes exhibited substantially greater similarity with other classes of the same species than with classes of the other species. Interclass similarity showed size-structured patterns in both species, but with opposite patterns: in *G. nigrinoda*, the most similar classes, with highest reliance on sponges, were unsexed juveniles and adult males, while adult females, the class that fed most heavily on filamentous algae, were least similar. In *G. pulchra*, the most similar classes, with highest take of mollusks, were adult and juvenile females, with unsexed juveniles being least similar. These results reinforce the importance of body size in determining *Graptemys* diets and suggest that dietary differentiation of sympatric *Graptemys* species may extend beyond adult females more often than generally thought.

**Chelonian Biology:** Oral

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**Diets of Syntopic Black-knobbed Sawbacks (*Graptemys nigrinoda*) and Alabama Map Turtles (*Graptemys pulchra*) in the Alabama River**

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A 21 Year Study of Seasonal and Interspecific Variation of Hatching Emergence in a Nearctic Freshwater Turtle Community: To Overwinter or not to Overwinter?

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Hatching emergence patterns were studied in a community of six species of freshwater turtles in Lancaster County, Pennsylvania, USA including: *Chelydra serpentina*, *Chrysemys picta*, *Clemmys guttata*, *Glyptemys insculpta*, *G. muhlenbergii*, and *Sternotherus odoratus*. Data were collected every year from 1965 to 1985 on estimated date of emergence, carapace length, April – May precipitation, August – September precipitation, annual precipitation, and low temperature and occurrence of precipitation during the 24 hrs prior to the time of each hatching detection (n = 806). *Chelydra serpentina*, *Ch. picta*, and *Cl. guttata* hatchlings have a facultative delayed emergence strategy. The other species (*G. insculpta*, *G. muhlenbergii*, and *S. odoratus*) appear to be obligate early emergers, with the exception of one hatching *G. muhlenbergii* that delayed emergence. Early emergence occurred in some species every year except 1973, the year following intense flooding and nest destruction associated with a major hurricane. However, the majority of hatchlings delayed emergence until the year following oviposition. Mean estimated calendar day of emergence varied annually in *C. serpentina* and *Ch. picta*. The same variable also varied among species for comparisons of both early and delayed emergence. *Chelydra serpentina* hatchlings emerged earlier than all other species whether they used an early or delayed strategy. Carapace length of *Ch. picta* hatchlings varied significantly among years and *C. serpentina* hatchlings that delayed emergence were significantly larger in carapace length than those that emerged early. Seasonal and previous 24 hr precipitation had varying effects on the number of emerging hatchlings, but August – September precipitation in one year had a strong correlation with the number of hatchlings that delayed emergence until the following spring. The number of hatchlings detected peaked at a previous 24 hr air temperature of about 12°C for both early and late emergence. Small species like *G. muhlenbergii* and *S. odoratus* may emerge early to limit potential hatching competition in diverse communities of freshwater turtles with primarily delayed emergence.

**Nesting:** Oral
Natural History and Conservation Biology of the Oaxaca Mud Turtle (Kinosternon oaxacae) in the Vicinity of Mazunte, México

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The Oaxaca Mud Turtle (Kinosternon oaxacae) is one of the last known turtles in Mexico. It was described in 1980, but now it is only known from 44 specimens and 15 localities. It is distributed from the Papagayo River to the western limits of Isthmus of Tehuantepec. The Mexican Government considers the species under special protection, a level of protection conceded to endemic taxa; nevertheless, it is not included in other conservation lists. In the vicinity of Mazunte, the Centro Mexicano de la Tortuga (Mexican Turtle Center) has surveyed Oaxaca K. oaxacae from 1997 to 2010, gathering a database of 233 records with observations on its natural history. We conducted a survey from August to November in three localities around Mazunte: Escobilla, El Aguacate, and San Roque. We used typical collecting techniques (traps and hand capturing) and a mark-recapture technique to infer population size. An overall total of 273 turtles were captured, but only 36 were recaptured. We found a significant 1:2.2 female-biased sex ratio. Males (CL = 135.68 ± 189.95 mm) were larger than females (CL = 127.68 ± 14.49 mm). The calculated population size for the San Roque population was 287 individuals; meanwhile, the population size for Escobilla was 195, but only 47 individuals were captured at El Aguacate with no recaptures. Population structures were mainly composed of adults and juveniles, with only some records for hatchlings in all populations. Overall mean clutch size was 4 eggs (range 1-4 eggs) and relative clutch mass was 0.049 (±0.027). According with our observations, a high average density of 3127.6 individuals/ha was calculated for the study area. Humans do not seem to be interested in the species in the region, however, extended habitat loss and degradation could jeopardize the species’ occurrence in the region.

Chelonian Biology: Oral

Slow and Steady Wins the Race: Linking In-situ and Ex-situ Conservation for the Endemic Vietnamese Pond Turtle (Mauremys annamensis)

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The continued pressures of global exploitation of tortoise and freshwater turtles makes the need for effective assurance colonies to provide secure populations for priority species clearly apparent. These long term facilities are often demanding on resources, especially considering the time frame of decades with which they have to be maintained to be beneficial. We review the successes and challenges for a captive assurance facility, the Turtle Conservation Centre in Cuc Phuong National Park, Vietnam. We also will present on the slow and steady progress made towards the establishment of a Species Habitat Conservation Area for the endemic Vietnamese Pond Turtle (Mauremys annamensis) in central Vietnam. With protection of lowland wetland habitat in a densely populated country, completing the circle linking of in-situ assurance populations in Europe, the USA and Vietnam with ex-situ conservation of populations will be critical for the survival of this species. We made a number of visits to commercial wildlife farms in Vietnam during 2012-2014 and we will discuss the risks such commercial breeding operations pose to protection of the species. In particular, the challenges of monitoring farms and poor regulation by authorities provide opportunities for laundering of threatened and protected tortoise and freshwater turtle species.

Reintroductions/Assurance Colonies: Oral

The Indochinese Box Turtles (Cuora galbinifrons, C.bourreti and C.picturata) Trade and Threats in Southeast Asia

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The 12th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles | Orlando, FL
As a group, the turtles within the genus *Cuora* are considered to be one of the most threatened globally. A staggering 92% of the 12 species are currently listed as Critically Endangered or Endangered by the International Union for Conservation of Nature, Red List of Threatened Species. While many species within the genus are in urgent need of additional conservation focus, and gaps remain in the knowledge of the species, here we will discuss the Indochinese Box Turtles, now recognized as three distinct species, *Cuora galbinifrons*, *C. boureti* and *C. picturata*. These species continue to be observed in wildlife markets of China and in recent years have begun to reappear for sale in the international pet markets, including in the west. In Vietnam, extensive interview and field surveys have continued to find the species in local trade. A database of 251 trade and field records have provided a clearer picture of the distribution within Vietnam, while online investigations have found social media and forums are increasingly used to trade the species which was listed as nationally protected in Vietnam in 2013. *Cuora galbinifrons* Complex: Oral

**Conserving a Legend: Protection of Swinhoe’s Softshell Turtle (Rafetus swinhoei) in Vietnam**

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Widely recognised as the world’s most endangered turtle, Swinhoe’s Softshell Turtle (*Rafetus swinhoei*) is currently only supported by four known surviving individuals spread across three localities in Vietnam and China. Growing to over 150 kg in size, this large, yet secretive, softshell turtle was largely hunted to extinction between the 1970’s and early 1990’s where it survived in lowland wetlands, lakes and rivers. During our extensive work in Vietnam over the course of the last decade, over a dozen historic sites where the species used to occur have been identified. As some recent accounts still remain, a joint project between the Asian Turtle Program (ATP), Turtle Survival Alliance (TSA) and a team of international DNA experts are hoping to utilise the newly available technique of environmental DNA (eDNA) to confirm presence or absence of the species at these lakes through DNA collected from lake water samples. We will also present recent progress to protect the species in Vietnam with the inclusion of *R. swinhoei* within a new national wildlife protection law in Vietnam: Decree 160/2013/ND-CP as well as efforts to secure the only known location for the species in Dong Mo Lake, Hanoi, Vietnam. Newly captured photographs of the only known wild individual within the lake will also be presented in which the head markings are clearly visible and can be overlaid with photographs from 2007, 2008 and 2014 using basic photo editing software which indicate the animal photographed in each occasion has been the same individual.

**Community Conservation:** Oral

**Patterns of Distribution of Rhinoclemmys funerea and R. pulcherrima in Costa Rica:**

**Geographical Barriers and Adaptive Divergence**

**MANUEL MERCÁN AND MARÍA F. BLANCO**

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Costa Rica, located in Central America, is characterized by its mountainous topography. The Guanacaste range, the Central volcanic range, and the Talamanca range divide Costa Rica from the Northwest to the Southeast, creating two separate large basins: the “Caribbean” and “Pacific and Central Valley.” There are many differences between the Pacific and Central Valley and the Caribbean basins, mainly at a climate level. These differences are one of the most important causes to explain the distribution patterns and the morphological variation between *Rhinoclemmys funerea* and *R. pulcherrima* in Costa Rica. A three-year long project on *R. funerea* and *R. pulcherrima* was carried out in Costa Rica. Morphological variables (biometric and growth analysis), feeding, reproduction, behavior and distribution were analyzed. The objective of the study was to establish the causes of the great variability between *R. funerea* and *R. pulcherrima* from a view point of morphology and behavior. To examine the distribution of both species in Costa Rica, locations from 130 specimens of *R. funerea* and 52 specimens of *R. pulcherrima* were compiled from collected individuals. The localities obtained were plotted on a 20 x 20 km² Costa Rican map. Results show that the distribution patterns of both species in the country are strongly influenced by the existence of geographical barriers. These barriers and the corresponding climatic and environmental differences might explain the morphological differences between species as adaptations to different habitats. In addition, differences in behavioral and reproductive patterns in *R. pulcherrima* and *R. funerea* have also been observed. Behavioral patterns of *R. funerea* are usually observed in aquatic terrapins; however, *R. pulcherrima* shows patterns of behavior (i.e., defensive, reproductive or feeding
behavior) typical of tortoises such as Gopherus or Testudo. These differences between the two species might represent an outstanding case of adaptive divergence regarding different ecological niches.

**Rhinoclemmys - Central/South American Wood Turtles:** Oral (Student)

**Keeping and Breeding the Genus Kinixys in Captivity**  
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Hingeback Tortoises (genus Kinixys) are among the most critically endangered tortoises in the world. These species are in decline throughout much of their range for various reasons including habitat loss, bushmeat consumption, and collection for the pet trade. They are faced with multiple stressors which may reduce their range, number of species, and number of individuals within populations. The International Union for the Conservation of Nature, Sub-Saharan African Chelonian workshop held in August of 2013 and the Kinixys Conservation Blueprint, published earlier this year, have both identified captive assurance colonies as a critical step in the conservation and long-term preservation of the genus Kinixys. Unfortunately, this genus has a reputation for being difficult to maintain in captivity. This bias often results in these species being underrepresented in conservation collections. It is critical that assurance colonies be established throughout the US and Europe for the long-term preservation of Kinixys. This presentation will discuss various techniques used to successfully maintain and breed various Hingeback Tortoises. Emphasis will be placed on basic husbandry needs, breeding, and incubation. Indoor and outdoor housing will be discussed as well as dietary and health concerns. Current knowledge gaps for the genus as well as ways to get involved in the Kinixys Conservation Breeding Program will also be discussed.

**Captive Husbandry:** Oral

**Captive Husbandry and Breeding of the Ornate Wood Turtle (Rhinoclemmys pulcherrima manni)**  
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*Rhinoclemmys pulcherrima manni*, also commonly known as the Ornate Wood Turtle, Painted Wood Turtle, or Central American Wood Turtle, have been collected and sold in the pet trade since at least the 1970’s with tens of thousands exported from the species range of Costa Rica and Nicaragua. This vividly colored, relatively small, and even tempered semi-aquatic turtle has recently been given greater attention both by hobbyist and conservation organizations. The historic exploitation and continued collection pressures facing *R. p. manni* warrants greater overall conservation and development of assurance colonies. Recognizing the need for focused conservation of this species, Herpetological Resource and Management has been maintaining Ornate Wood Turtles for over ten years. Through this time we have learned a great deal about the species’ husbandry, reproduction, incubation, and developmental needs. This presentation will focus on basic captive needs, breeding, incubation and rearing of young for both indoor and outdoor setups.

**Rhinoclemmys - Central/South American Wood Turtles:** Oral

**The Freshwater Turtle Population Assemblage at Wekiwa Springs State Park**  

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We calculated population size, survivorship, density, biomass, and sex ratios for four aquatic turtle species in the 1.2 ha lagoon and 0.6 ha proximal spring run in Wekiwa Springs State Park, Orange and Seminole counties, Florida. Sampling sessions were
Behavior of Juvenile Sonoran Desert Tortoises in Central Arizona  
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Very little is known about the natural history of juvenile Sonoran Desert Tortoises (Gopherus morafkai), given the difficulty in surveying for them in the structurally complex Sonoran Desert. The Sonoran Desert Tortoise is considered a species of greatest conservation need by the Arizona Game and Fish Department, and is given candidate status under the Endangered Species Act. Natural history information on the juvenile size class is important, given the necessity to understand Sonoran Desert Tortoise population dynamics as a whole for their management and conservation. We used radio-telemetry to study juvenile Sonoran desert tortoise natural history in the Mazatzal Mountains, Maricopa County, at a site characterized as Arizona Upland paloverde-mixed cacti series with an elevation between 550–850 m. We equipped 15 juvenile desert tortoises (ranging in size from 124–175 mm midline carapace length) with radio-transmitters from 2010–13 and tracked them at least once a week during the active season and periodically during winter dormancy. We present our findings on juvenile tortoise behavior, activity, and hibernation, including observations on caliche mining and osteophagia. Given the lack of information on juvenile Sonoran Desert Tortoises, these natural history data will be valuable in guiding conservation of this species in the Sonoran Desert of Arizona.

Tortoises: Oral
Are There Patterns of Chelonian Community Composition Along the Longitudinal Profiles of Rivers?

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Rivers and streams have numerous characteristics that change as they progress from the headwaters to the downstream environment, including both physical (e.g., slope, velocity, substrate, sunlight penetration) and biological (e.g., species richness, species densities, trophic status, organic material) parameters. Changes in community structure of fishes along the longitudinal profile of rivers have been widely elucidated, but little work has been done to explain patterns of chelonian communities along riverine gradients. We sampled 5-8 sites along the length of each of four rivers (29 sites total) in southeastern Oklahoma in an effort to assess turtle community characteristics along longitudinal riverine gradients. Baited hoop nets were used at each site for 21 net-nights per site, resulting in the capture of 657 turtles of nine species. Regression analyses indicated that species abundance and species richness were weakly related to distance downstream. Detrended correspondence analysis (DCA) was used to look for additional community patterns and relationships, and further suggested that a weak relationship occurred along the longitudinal gradient and that downstream communities were distinct from upstream communities. The DCA also indicated that two of the four rivers had relatively distinct communities, and that 1-2 species often determined placement of sample sites along DCA axes. Looking at patterns among individual species (as opposed to community patterns), our results suggested that some species were more common in distinct portions of the riverine profile, while others were more ubiquitous. For example, *Sternotherus carinatus* and *Chelydra serpentina* tended to be more prevalent in upstream and mid reaches, *Graptemys pseudogeographica* and *Apalone spinifera* were more prevalent in downstream reaches, and *Graptemys ouachitensis* and *Trachemys scripta* tended to be ubiquitous throughout the longitudinal riverine profile. While no overly strong patterns emerged as a result of this research, we believe understanding community structure and individual patterns of distribution of turtles within river systems promotes a greater understanding of the role of turtles in stream ecology, and should be considered for management and conservation purposes.

**Population Status:** Oral

Quantifying Road Effect Zones for Desert Tortoises (*Gopherus Agassizii*) to Estimate Benefits of Mitigation and Habitat Protection

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Roads can have significant negative impacts on wildlife populations, including reduction of habitat and increased fragmentation. These impacts are often observed in vagile species and those with slow life histories. Many turtle and tortoise species have slow life histories, and large home ranges. With half of turtle and tortoise species identified as threatened, identifying and quantifying the impact of roads to species has the potential of providing appropriate conservation or mitigation techniques for species preservation and recovery. We investigated and quantified the road effect zone on the Desert Tortoise with two studies finding that the abundance of tortoise sign is reduced along roads. To quantify the distance at which roads negatively affect tortoise abundance (i.e., the “road effect zone”), line transect surveys were conducted in 2012 along seven interstate plots and ten county road plots in the eastern Mojave Desert of San Bernardino County, California. All signs of Desert Tortoises were recorded along 1.6 km transects parallel to roads at distances of 0, 200, 400, 800, and 1600 m from the road’s edge. Abundance of tortoise sign was significantly reduced closer to roads and increased with distance from roads. The effect of road type was also significant; tortoise abundance was reduced up to 229.6 ± 34.0 m from the edge of a county road and up to 305.7 ± 60.7 m from the edge of an interstate. Based on these results it is estimated that for each 1.6 km of fencing installed along one side of the road, 36.8 hectares of habitat would be reclaimed along that side of a county road and 49.0 hectares would be reclaimed along that side of an interstate by reducing tortoise mortality. Lastly, we provide one way to prioritize roads for the installation of road-side fencing for mitigation purposes and we discuss the limitations of road-side fencing in preserving Desert Tortoise populations.

**Community Conservation:** Oral
Understanding the level of genetic diversity within populations and the connectivity among them across various spatial scales is essential information for conservation biologists to make well-informed decisions about species management. Previous studies have examined the population genetics of Diamondback Terrapins (Malaclemys terrapin) at large spatial scales, but these studies have poorly represented the Gulf Coast, and some entirely neglected sampling in Louisiana. There currently is no federal protection for terrapins, but they are listed or regulated in most of the states within their range. Although the Louisiana salt marsh appears to be an expansive and contiguous habitat, there are two major waterscape features within the terrapin’s range in Louisiana: the Atchafalaya Delta and Mississippi River Delta. These freshwater systems may serve as ecological barriers to movement and gene flow of this salt and brackish marsh-dependent species. To determine whether genetic differentiation exists across these features and throughout the state, we have collected over 475 samples along the entire Louisiana coastline from the Sabine Pass (west) to the Pearl River (east). We are in the process of genotyping these individuals for ten polymorphic microsatellite loci and analyzing the data using standard approaches (e.g., STRUCTURE, TESS, & Geneland) to determine if population structure is present across the range of our samples. Patterns of gene flow will also be examined via multiple analyses including model testing using Migrate-n, and demographic history will be inferred from the genetic data. We will present the preliminary results of these analyses and additional measures of genetic diversity. The results of this study will help conservation biologists and managers understand the degree of population structure and level of connectivity across sites in order to make well informed decisions about terrapin management.

**Diamondback Terrapins:** Oral (Student)

**Reintroduction of Captive-bred Burmese Star Tortoises at a Wildlife Sanctuary in Central Myanmar**

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The Burmese Star Tortoise (Geochelone platynota) is endemic to the dry zone of central Myanmar and classified as Critically Endangered by the International Union for Conservation of Nature. Populations were decimated during the early 2000s by illegal collecting to supply animals for the international pet trade, and G. platynota is now ecologically extinct in the wild. Captive-breeding efforts at several government operated facilities have been successful and large numbers of hatchlings are now being produced each year. A wildlife sanctuary in central Myanmar was identified as a suitable release site and a pilot reintroduction project was launched in 2013. An intensive education campaign in agricultural villages surrounding the sanctuary preceded this project. Because indigenous religious beliefs already protect free-living tortoises, local Buddhist clergy were asked to participate in the project. In October 2013, 150 captive-bred subadult G. platynota (75 males, 75 females) were selected for release. A radio transmitter was attached to each tortoise, and these animals were screened for infectious diseases, implanted with PIT tags, and permanently marked by tattooing a unique identification number and Buddhist iconography on the carapace; it is hoped the latter will deter theft by superstitious Burmese huntsmen. Three pre-release pens, each encompassing 1.0 ha of natural habitat were constructed in the sanctuary. A “release ceremony” involving area villagers, local government officials, and Buddhist monks was held in early November 2013 at a monastery atop a mountain within the sanctuary. During the ceremony Buddhist monks blessed the tortoises and a spirit whisperer called upon Nats (= Earth spirits) to protect the animals after release. Immediately following the ceremony, the tortoises were transferred to the pre-release pens where continuous security is now provided by Forest Department rangers. Fifty tortoises were placed in each pen and will be held there for varying periods (6, 12, and 18 months) before being released. Tortoises subsist on natural forage; supplementary food is not provided. Each tortoise was physically located once a month and weighed and measured; growth continued unabated during the 2013-14 dry season. The first group of 50 tortoises was allowed to self-release in May 2014. Post-release dispersal is being monitored with radio telemetry.

**Reintroductions/Assurance Colonies:** Oral
Myanmar harbors at least 26 species of non-marine chelonians, including eight endemic forms. Unfortunately, this diverse assemblage of species is threatened by habitat loss, poverty-driven subsistence harvesting, and rampant over-collection for wildlife markets in southern China. In response to these threats, Turtle Survival Alliance and Wildlife Conservation Society initiated a number of conservation projects in Myanmar. Focal species for conservation include the Burmese Star Tortoise (Geochelone platynota), Burmese Roofed Turtle (Batagur trivittata), Rakhine Forest Turtle (Heosemys depressa), and Asian Brown Tortoise (Manouria emys). A combination of ex- and in-situ conservation strategies have been successfully employed to halt and reverse population declines among these species. Captive assurance colonies and head-starting have bolstered numbers of critically endangered G. platynota and B. trivittata, creating a pool of animals that are now available for reintroduction. A 2011 survey identified two protected areas where reintroduction of captive-bred G. platynota was thought likely to succeed. A reintroduction is currently underway at one site; 150 subadult tortoises were selected from an assurance colony, screened for infectious diseases, transferred to soft-release pens (November 2013), and the first group of 50 was liberated in May 2014. Funding has been secured to conduct a similar reintroduction at a second protected area in 2015. An egg collection and head-starting program initiated in 2006 along the upper Chindwin River has staved off the near-certain extinction of B. trivittata. Two assurance colonies of these critically endangered turtles were also established, and almost 700 B. trivittata are now in captivity. Field surveys conducted in 2013-14 identified two potential release sites and small groups of head-started B. trivittata are slated for release in late 2014. A small assurance colony of H. depressa was established in 2012 and five offspring produced in 2013. Additionally, a radio telemetry study of H. depressa was initiated by a graduate student from Yangon University in early 2014. Two assurance colonies stocked with Manouria emys confiscated from illegal wildlife traffickers are now established. Surveys of protected areas throughout Myanmar are being conducted to identify chelonian populations that can benefit from protection.

**TSA Field Programs:** Oral

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**Expansion of “Project Batagur baska” in Bangladesh and Shifting to a Pedigree Breeding Strategy**

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For the past two years the Northern River Terrapin (Batagur baska) was successfully bred at the Bhawal National Park situated a little north of Dhaka. All acquired females were kept together with a few randomly selected males in a breeding pond. However, little is known about the population of not more than ten founder females, thus establishing breeding lines based on genetic analyses and gathering knowledge about the natural history of these elusive terrapins will prove crucial for long-term survival of the species. All adults and offspring have been pit tagged and tissue and blood samples have been collected to conduct parental analyses with microsatellites. With the financial help of German-based conservation organizations, we plan to set up a second breeding and rearing facility in the Sundarbans, in the south of Bangladesh, to split the risk of disastrous losses by diseases or natural disasters and to move into the estuaries, the natural habitat of the Northern River Terrapins. Therefore, we visited several locations owned by the Bangladesh Forest Department for evaluation. First records of wild caught hatchlings give evidence of an existing reproducing population. According to local fishermen, hatchlings are migrating upstream from nesting sites most likely located on offshore marine islands or river mouths. B. baska seems to perform a similar migration and nesting behavior as the Painted Terrapin, B. borneoensis, and not like the closer related Southern River Terrapin, B. affinis. To be able to learn about the migration routes and the nesting sites, we will use satellite transmitters on adults. At the moment we can only use long-term male captives from which we do not even know the original capture location. Released males will hopefully follow females into the breeding and nesting grounds. Although we are facing a variety of challenges, the situation for the long-term survival of the Royal Turtle, B. baska, looks significantly better than it did just a few years ago.

**TSA Field Programs:** Oral
Augmenting Nest Boxes With an Electric Wire Increases Nest Survivorship in the Diamondback Terrapin (Malaclemys terrapin)

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Female Diamondback Terrapins (Malaclemys terrapin) suffer from extensive vehicle related casualties during the summer nesting season (May-July) along the Downing-Musgrove causeway (DMC) leading to Jekyll Island, GA. Terrapin nests are also susceptible to nest predation by Raccoons (Procyon lotor). These threats are likely to cause population declines and eventual extirpation if not mitigated. The Jekyll Island Authority’s Georgia Sea Turtle Center and the University of Georgia’s Savannah River Ecology Laboratory have conducted research exploring a suite of mitigation techniques to assuage this decline. In 2009, artificial nest mounds with protective boxes were constructed in order to intercept and attract female M. terrapin that were in search of optimal nesting ground near the DMC while simultaneously providing safe nesting sites from nest predators. Initial research along the DMC suggested that nest boxes were not as predator proof as originally intended. During the 2013 nesting season we augmented a subset of artificial nesting mounds by placing an electric wire along the entrance of nest boxes. To estimate the rate of nest depredations we used time-lapse photography from wildlife cameras to document nesting females during the day and counted depredated nests throughout the season. We compared nest boxes with different treatments and in fall 2013 and spring 2014, we excavated nest boxes to estimate the number of successful clutches at the study site. We found that the use of an electric wire significantly decreased depredation rates and that clutches maintained high rates of survivorship to hatching within the nest mounds that included nest boxes.

Diamondback Terrapin: Oral (Student)

Evaluating the Effectiveness of Head-starting as a Potential Conservation Tool for Gopher Tortoises (Gopherus polyphemus) on Managed Areas: Prospectus

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Gopher Tortoise (Gopherus polyphemus) populations are declining and are currently listed as threatened or warrant listing throughout their range. One management tactic to help bolster depleted populations is to augment them in areas where threats have been mediated. Head-starting hatchlings to larger size classes for release in protected areas may prove to be a useful conservation tool for the species. Using hatchlings produced and reared on St. Catherines Island, GA, we will conduct a study to evaluate the use of head-start Gopher Tortoise juveniles for augmenting a depleted population at the Yuchi Wildlife Management Area (YWMA) in Burke County, GA. Two cohorts from 2013 and 2014 will be reared on St. Catherines Island and the Savannah River Ecology Laboratory and released in successive years at YWMA. We will experimentally test indicator variables prior to release that may allow us to gain insight into the mechanisms that affect performance. These indicator variables, collected prior to release, will include individual behavior, morphology, and health parameters. A subset of the head-starts will then be tracked via radio telemetry to determine post-release performance as measured by health, site fidelity, and survivorship. The data we obtain from this study will aid in our understanding of the utility of head-starting as a conservation tool for augmenting depleted gopher tortoise populations. The results will then enable us to make future recommendations for head-start efforts at YWMA and other managed locations throughout Georgia.

Poster Session (Student)
Many reptiles bask to raise their body temperatures and increase energy assimilation. However, basking can expose individuals to increased predation risk, which may lead juveniles of some species to exhibit an energetic strategy that includes limited basking. We are investigating how hatchlings and juveniles of the Gopher Tortoise (Gopherus polyphemus), a burrowing reptile of the southeastern United States, behaviorally balance energy assimilation and predation risk in different environments. Little is known of the behavior of young Gopher Tortoises in part due to their tendency to flee into burrows when approached. Using video and miniature temperature recorders, we determined that hatchling and juvenile tortoises from Georgia spend great amounts of time basking and engage in extensive behavioral thermoregulation by frequently shuttling between relatively cool burrows and warm surface microhabitats. In simulated predator approaches, basking hatchlings and juveniles retreated into burrows long (often > 30 seconds) before the arrival of a walking researcher, indicating that tortoises use non-visual cues to identify potential predators. Tortoises emerged soon following disturbance, particularly when burrows were cool, which is consistent with the idea that individuals adjust hiding times in response to physiological costs of refuge use. The ability of young tortoises to sense potential predators at long distances may be key to enabling hatchling and juveniles to exhibit an energetic strategy that includes extensive, albeit secretive, basking activity.

**Tortoises:** Oral (Student)

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**Population and Community Structure of Smooth Softshell (Apalone mutica) and Spiny Softshell (Apalone spinifera) Turtles in the Kaskaskia River of Illinois**

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The Smooth Softshell Turtle (Apalone mutica) is generally considered a large river specialist whereas the Spiny Softshell Turtle (Apalone spinifera) is considered a generalist. We investigated the co-occurrence of these species in two reaches (sixth and seventh stream orders) of the Kaskaskia River in Illinois. Our objectives were to determine where A. mutica and A. spinifera place in the turtle community and determine if relative abundance, sex ratios, juvenile to adult ratios, and population size structure differ between reaches. We set 133 traps (8,400 trap hrs) upstream and 177 traps (12,803 trap hrs) downstream from June through October of 2013. At the upstream reach turtle species richness ($S$) was 7, Shannon Diversity ($H'$) was 1.25, and species evenness ($J'$) was 0.64 and downstream $S$ was 6, $H'$ was 1.27, and $J'$ was 0.71. We captured 37 A. mutica (13 adult male, 18 adult female, 4 juvenile female, 2 juvenile unknown) and 80 A. spinifera (36 adult male, 1 juvenile male, 18 adult female, 21 juvenile female, 4 juvenile unknown) upstream and 56 A. mutica (42 adult male, 9 adult female, 2 juvenile female, 3 juvenile unknown) and 3 A. spinifera (all adult male) downstream. In terms of abundance, A. mutica ranked 3rd upstream (23%) and 2nd downstream (30%), whereas A. spinifera ranked 1st upstream (49%) and 6th downstream (2%). Chi-square tests showed a significant difference in A. mutica and A. spinifera species abundance between reaches ($p < 0.001$) and A. mutica sex ratio between reaches ($p < 0.001$), but no significant difference between A. mutica adult to juvenile ratio between reaches ($p = 0.287$). Our best fit model found body size (PL) for both species did not differ between reaches, but there was a sex and species effect driven by the large sizes of female A. spinifera. Preliminary results suggest A. mutica is fairly common in both reaches, whereas A. spinifera is common upstream, but rare downstream. Some aspects of population structure may also differ between reaches. Overall, our results suggest that these species can co-occur in moderately sized streams. Field work for our study is ongoing and will continue through October 2014.

**Poster Session** (Student)

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**Reproductive Patterns in Three Genera of Asian Turtles: Manouria, Heosemys and Coura**

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Most turtle species in southeast Asia are under heavy exploitation pressure by human beings. The development of captive breeding programs at zoos and aquaria have provided the opportunity to study their reproductive biology. We present reproductive data on three different genera of threatened Asiatic turtles and compare their reproductive traits: Impressed Tortoise (Manouria impressa), Arakan Forest Turtle (Heosemys depressa), and McCord’s Box Turtle (COURA mccordi). Reproductive cycles were monitored using ultrasonography. Circulating testosterone levels were measured using enzyme-linked immunosorbent assay (ELISA). All three species were seasonal and reproduced at different times of the year. Coura mccordi hibernated during the winter and produced multiple clutches of 1 to 2 eggs during the spring and summer.
Vitellogenesis and follicular development were primarily observed in fall prior to hibernation. Both *M. impressa* and *H. depressa* produced one clutch of eggs from June to January. *Manouria impressa* underwent vitellogenesis and follicular growth from January to July and ovulated eggs from July to January. They displayed nest mound building characteristics like *Manouria ensis*. *Heosemys depressa* underwent vitellogenesis and follicular growth in the summer and ovulated eggs from September to January. While *C. mccordi* is found in southern China above 20° latitude and exposed to more seasonal temperature extremes, it still lays multiple clutches of several large eggs across the season similar to *Kinosternon* turtles in North America. Both *M. impressa* and *H. depressa* are from more tropical equatorial Asia and display slightly different timing of reproduction, most likely driven by seasonal rain patterns influenced by ocean currents.

**Poster Session**

**Overwintering Habitat Use and Site Fidelity of Ornate Box Turtles (Terrapene ornata) in Northwestern Illinois**

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Turtles in temperate regions can overwinter for half of their lives and may return to the same sites annually. Overwintering site habitat characteristics were quantified and site fidelity was examined for state-threatened Ornate Box Turtles (*Terrapene ornata*) in northern Illinois at two sites from 2011-2013. We affixed radiotransmitters to 37 adult turtles (19F, 18M). Turtles were tracked to their overwintering sites (8 animals in 2011, 28 animals in 2012, and 30 animals in 2013). Overwintering sites of 24 animals (13F, 11M) were compared across two years. Overwintering site fidelity was high. At site 1, 60% of turtles exhibited fidelity within 5 m buffers from the previous overwintering site (2011-2012). From 2012-2013, fidelity within 5 m buffers increased to 83.3%. If points were viewed from a 50 m buffer, 100% of turtles exhibited fidelity. Overwintering locations of 5 animals (2F, 3M) were compared across three years (2011-2013), with varying patterns of site fidelity. At site 2, 75% of turtles exhibited fidelity within 5 m buffers, 83.3% exhibited fidelity within 10 m buffers, and 100% exhibited fidelity within a 50 m buffer. Overall, overwintering habitat varied among individuals and did not differ significantly with sex or year. Remnant prairie was the most frequently used land cover type and agricultural fields were not used by any individuals. Most turtles (95.8%) overwintered in the same land cover type during the duration of the study. Turtles excavated their own burrows (73.1% of individuals observed) more frequently than using abandoned mammal burrows (22.4% of individuals observed) or local features (4.5% of individuals observed). Overwintering survival was high, with only one male observed dead and 2 females suspected to have succumbed during the duration of this study. Understanding habitat use and patterns of fidelity can inform planning of management activities to minimize negative human-turtle conflict.

**Chelonian Biology: Oral (Student)**

**Population Status and Demographics of Two Graptemys Species from the Pearl River, Mississippi, USA**

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Population demographic and density data is lacking for many Gulf of Mexico *Graptemys* species, with this genus considered one of the least studied North American turtle genera. Two *Graptemys* species, *G. oculifera* (Ringed Sawback Turtle) and *G. pearlensis* (Pearl Map Turtle), are both endemic to the Pearl River system of Mississippi and southeastern Louisiana. Population demographic and density data exists for *G. oculifera*, but very little information is available for *G. pearlensis*. We studied both species at the Columbia site on the Pearl River (Marion Co., Mississippi, USA) via a trapping and basking survey study in 2005 and 2006; catch per unit effort for both species was also collected at this site and four additional sites across 20-25 years for both species. Both male and female *G. oculifera* at Columbia exhibit normally distributed body lengths, while *G. pearlensis* body lengths were normally distributed for males, but too few females were captured making their distribution less clear. Mean and maximum body lengths for both male and female *G. pearlensis* are considerably smaller than specimen data.
and data for the sister species, *G. gibbonsi* (Pascagoula Map Turtle). Comparisons to historical trapping data indicate a ≥ 70% relative abundance decline of *G. pearlensis* compared to *G. oculifera*, with the latter exhibiting similar numbers at the same site over the last 25 years. Mark-resight estimates for *G. oculifera* at the Columbia site indicate a stable to slightly increasing population size compared to similar data from 25 years ago. At all five sites and during all sampling periods between 1989 to 2009/2013, *G. oculifera* was more abundant than *G. pearlensis*, with only one of five sites having a stable to increasing *G. pearlensis* population, while the other four sites have instable or declining *G. pearlensis* populations. It is possible that some environmental change over the last 50 – 75 years has differentially impacted *G. pearlensis* and not *G. oculifera*, with the most likely explanations being 1) impaired water quality due to municipal/industrial effluents, 2) the regulation of river flow at the Ross Barnett Reservoir, and/or 3) collection for the pet trade.

**Population Status:** Oral

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**India Turtle Conservation Project: Saving Imperilled Indian Turtles**

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TSA India has been attempting different conservation projects targeting endangered chelonians in different Turtle Priority Areas (TPAs) identified during a national strategic turtle conservation workshop held in 2010. Major species of focus are Red-crowned Roofed Turtle, *Batagur kachuga*, Three-striped Roofed Turtle, *B. dhongoka*, Northern River Terrapin, *B. baska*, Indian Narrow-headed Soft-shell Turtle, *Chitra indica*, Black-softshell Turtle, *Nilssonia nigricans*, Leith’s Soft-shell Turtle, *N. leithii*, and the Assam Roofed Turtle, *Pangshura sylhetensis*. The project component involves status surveys and population monitoring, captive breeding, nest protection, participatory conservation, and community outreach. This communication details the progress made on implementation of the recommendations of above-noted conservation action plans.

**TSA Field Programs:** Oral

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**Recovering Northern River Terrapin, *Batagur baska*, in Indian Sunderbans**

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The Northern River Terrapin, *Batagur baska*, is the most critically endangered turtle species of India. Turtle Survival Alliance has been implementing a captive conservation project for the species since 2008 in Indian Sunderbans. Besides developing a dedicated enclosure to enhance captive breeding and husbandry of resulting cohorts, we have conducted a habitat viability assessment in deeper Sunderbans to release a pilot cohort from 2012 equipped with sonic-transmitters. This communication details the result of the captive husbandry, habitat assessment and future plans to recover the species.

**Reintroductions/Assurance Colonies:** Oral

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**Acoustic Telemetry of the Red-crowned Roofed Turtle (*Batagur kachuga*) in North India**

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The Chambal River in North Central India contains the last known population of the Critically Endangered Red Crowned Roofed Turtle (*Batagur kachuga*). In order to arrest species population declines, in 2006, Turtle Survival Alliance-India began implementing active conservation initiatives, such as headstarting and nest protection. Following nearly 9 years of project implementation a sonic telemetry study was commenced to study post release survivorship and habitat use in headstarted *B. kachuga*. This was to help test the inherent assumption of headstarting by determining survival rates of headstart groups while focusing our monitoring efforts on areas used by turtles. Because accidental drowning in illegal fishing gear remains the greatest source of mortality among *B. kachuga*, better focusing of patrol efforts would increase survivorship of released turtles. Ten individuals (6 females, 4 males) from the Deori Eco Centre in Morena, Madhya Pradesh were tagged with ultrasonic transmitters and ‘soft’ released in a temporary enclosure on the river. Initial observations during the pre-monsoon season seemed to imply low vagility in the cohort with no specimen moving more than 5 km downstream or upstream of the release.
site. Monitoring after the monsoon provided varying results; two females had moved nearly a 100 km downstream from the release site. Such individual dispersal toward downstream areas is not without risk, as most clandestine fishing is seen in the lower section of the river. Regular surveys — especially through the nesting season — to detect and remove such nets and other traps set by illegal fishermen, would reduce risks posed to the most demographically important part of the population. Two individuals (1 female, 1 male) were found to remain at the release site, while another female had moved nearly 10 km downstream of the release site. A last female recently detected was found more than 10 km upstream of the release site. Observations on survival and dispersal seem to vary from former notions of either low vagility or all released turtles being flushed down during annual monsoonal flooding. Sustained monitoring would help understand survival rates and movement patterns of these critically endangered terrapins. 

**Reintroductions/Assurance Colonies:** Oral

**Molecular Data Reveal that Species are Not Well Delimited for Pseudemys and the Phylogeny for this Clade is Unknown**

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Reconstructing the species tree for groups of closely related taxa is one of the most serious challenges facing systematists because species are oftentimes not well delimited. A common phylogenetic practice is to use single-exemplar sampling under the implicit assumption that the sampled taxa are all good species. We examine this fundamental assumption in the North American turtle genus *Pseudemys* whose species boundaries and phylogenetic relationships have challenged systematists for over half a century. We sequenced 10 nuclear and three mitochondrial genes from the nine currently recognized species and subspecies of *Pseudemys*, and found little or no evidence supporting the division of *Pseudemys* into the currently recognized species and subspecies. Our data suggest that the group has been oversplit and contains fewer species than currently recognized. In addition, we conducted 100 replicated, single-exemplar phylogenetic analyses of these same nine taxa and recovered multiple well resolved, but completely conflicting, topologies. These analyses suggest that phylogenetic analyses based on single-exemplar sampling can recover trees that depend on the individuals that are sampled, rather than the underlying species’ tree. In addition, our results clearly indicate that final resolution of the number of *Pseudemys* species and their interrelationships will require an integrated analysis of morphology, extensive geographic sampling and large amounts of molecular data.

**Tortoises:** Oral

**A Status Update for Bog Turtles (Glyptemys muhlenbergii) in Georgia and South Carolina**

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Bog turtles (*Glyptemys muhlenbergii*) reach their southernmost extent in Georgia and South Carolina. First described in 1801 in Pennsylvania, they were not found in Georgia until 1980 and in South Carolina until 1982. While a handful of populations have been confirmed in Georgia, captures in South Carolina have been more sporadic and yielded only single individuals at any given site. In both states there is a pressing need to survey for suitable habitat and populations within that habitat before land cover changes extirpate remaining populations. Due to the rare and elusive nature of the species, surveys require an extensive and strategic effort beyond that which has been applied previously. We used a species distribution model to guide our search for suitable habitat within the Blue Ridge physiographic region of each state. We found this model greatly oversplit and contains fewer species than currently recognized. In addition, we conducted surveys which involved soliciting post hoc methods for on-the-ground surveys which involved soliciting information from locals, state agencies, and land trusts. Once habitat was located, we conducted surveys using a trapping method we tested in known bog populations to enable us to confidently associate a lack of captures with an absence. Trapping took place from May to mid-July of 2014, with efforts led by the Georgia Department of Natural Resources in Georgia and Clemson University in South Carolina. Initial efforts have resulted in the discovery of two new populations in Georgia. The extensive searches for habitat and trapping will allow us to give an overview of available habitat and make recommendations for future bog turtle research in these states.

**Population Status:** Oral (Student)
Status, Population Structure, and Habitat Use of the Ornate Diamondback Terrapin (Malaclemys terrapin macrospilota) on a Small Gulf Coast Island while Investigating the Impacts of Crab Traps on this Marked Population

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Diamondback Terrapins (Malaclemys terrapin) are the only species of turtle in North America that occur exclusively in brackish water habitats ranging from Massachusetts to Texas and Florida’s coastline accounts for 20% of their total range. Range wide, researchers have reported declines in local terrapin populations. In this study we used mark-recapture techniques to assess this population’s size and structure while developing an effective search methodology for finding terrapins in similar barrier island habitats. We also designed and deployed modified crab traps to study trap and terrapin interactions in Lanark Reef located in Franklin County, Florida. These traps were modified by installing an air chamber on the top of the trap. During our surveys we captured 442 individuals (800 total) in eight months of sampling, which yielded a catch per unit effort of 0.21 or 1 terrapin every 4.9 minutes. We captured all size classes (plastron length = 27 – 167 mm) in this site with a population estimate of 1.124 ± 127 terrapins. During these surveys we determined that the best time to search for terrapins is during low tide, on clear or partly cloudy days, and within patches of vegetation with tidal wrack (if available). Our submerged modified crab traps were deployed from the at various distances (14 – 708 m) from shoreline for eight months (2,925 trap days) with only two terrapins captured during this time. Once these traps were set in areas where we had hand captured terrapins (intertidal zone of island), our captures were significantly higher (65 captures in 330 trap days). Lanark Reef currently has one of the largest reported populations of terrapins range wide. This population also does not seem to enter crab traps or there may be a large amount of tresspass occurring in this site. The intertidal traps that captured a significant number of terrapins show the potential for ghost pots that wash up on shore to be detrimental to populations. Our next step in this study is to modify the internal structure of the standard blue crab trap that will increase the likelihood that terrapins will escape, while maintaining normal crab capture rates.

Diamondback Terrapin: Oral (Student)

Home Range and Habitat Selection of the Suwannee Alligator Snapping Turtle (Macrochelys suwanniensis) in the Suwannee River

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The Alligator Snapping Turtle (Macrochelys temminckii) has typically been characterized as relatively sedentary. Recent telemetry studies conducted in Missouri, Kansas, Oklahoma, and Louisiana recorded extensive movements throughout available aquatic habitat, with rest or core sites generally associated with greater submerged structure and denser canopy cover. The Suwannee Alligator Snapping Turtle (Macrochelys suwanniensis) is a newly described species that is endemic to the Suwannee River drainage and very little is known about its ecology. In fact, most telemetry studies have been conducted on M. temminckii in lakes, impoundments, and small streams. To better understand the spatial ecology of M. suwanniensis, we attached ultrasonic telemetry tags to 20 turtles. Due to the dynamic nature of river systems, we conducted telemetry at 2 different sites (upper n = 9 and lower n = 11). We located turtles weekly at each site from December 2012 through December 2013. Upon locating a turtle, we collected a series of habitat measurements. Random locations were sampled to represent habitat availability. For each turtle, we measured the linear home range (LHR), removing any extreme outliers. We used a generalized linear model (GLM) to analyze habitat selection in relation to availability. In total, we collected 818 turtle locations for 16 M. suwanniensis. Three turtles were lost, and 1 turtle was found dead after a major flooding event. The mean LHR was larger for males (1,854 ± 341 m) than females (1,763 ± 192 m) and sub-adults (1,188 ± 373 m) but not significantly so (t = -1.0185, p = 0.3317). Although not significant, the mean LHR was slightly larger in the lower site (1,951 ± 366 m) than the upper site (1,534 ± 185 m). The GLM suggests that different types of underwater structure and water depths were selected for, whereas canopy cover had no effect on habitat selection. Turtles selected sites close to the bank, and preferentially selected woody debris and undercut banks. Multiple turtles were tracked moving between the floodplain and the river channel with no aquatic corridor. The removal of woody debris from the Suwannee River could have a negative impact on M. suwanniensis due to the high importance of this habitat as a primary refuge.

Chelonian Biology: Oral (Student)
Assessing Relatedness in a Captive Population of Alligator Snapping Turtles (Macrochelys temminckii)

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The degree of relatedness among individuals in a population is a concern for management of threatened and endangered species. Often these populations are small, and problems with decreased genetic variation and inbreeding depression can arise quickly. We used 7 variable microsatellite loci to assess relatedness among 25 adult Alligator Snapping Turtles that constitute a captive breeding population in southern Oklahoma. This captive propagation/head-start program is aimed at restoring Alligator Snapping Turtles where populations have declined or been extirpated in the Mississippi River system. We used the same microsatellite markers to determine relatedness for natural populations spanning the species’ range and consider our results in the context of relatedness observed among and within these natural populations. Finally, we determined parentage and examined relatedness among a subset of offspring produced by the captive population in 2013 to assess patterns of genetic contribution by adults to the head-start initiative. Relatedness among the captive turtle population (r = 0.267) was comparable to relatedness observed in natural populations across the species range (r = 0.175–0.968). Pairwise comparisons of populations revealed that the captive population was most closely related to natural populations within the Mississippi River Basin. We found evidence of multiple paternity in 3 of 5 clutches tested, with the number of sires per clutch ranging from 1 to 4. The degree of relatedness among clutches was low. Our results begin to build a framework to develop and implement a genetically sound conservation plan for the species.

Poster Session

Notes on the Captive Care of Cuora galbinifrons and an Update on Reproductive Efforts

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In 2002, I imported 3.3.0 adult specimens of the species Cuora (galbinifrons) galbinifrons. They originated from Hainan Island, China. These animals have been cared for privately in my home. As of May 2014, two of the imported males and the 3 females remain alive and are thriving, and so are 4 of their offspring. During this presentation I will discuss my methods of acclimation and quarantine, housing, diet, cycling and incubation. I will also present my observations regarding daily and reproductive behaviour, as well as conspecific interactions. I will briefly present my group’s past reproductive outcomes and provide an update on recent reproductive efforts. I will review my observations and discuss what I have learned while working with this rare and unfamiliar species. I anticipate that this shared information may aid others in the successful care and reproduction of this species.

Cuora galbinifrons Complex: Oral

Environmental Enrichment for the Captive Turtle and Tortoise

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I’ve been working with turtles and tortoises in captivity for over 30 years. My turtles and tortoises have been kept indoors. The enclosure's sizes and designs have been limited by available space, and also by a Canadian climate, which causes challenges when trying to provide outdoor enclosures with proper temperature gradients during most of the year. Turtles and tortoises have developed senses of vision, smell and hearing. These senses are utilized during their search for food and shelter, during their search for a mate and during courtship and copulatory practices. I feel that it's important to stimulate these senses by providing an interactive and / or varied environment for my turtles and tortoises. I will discuss various methods of providing environmental / sensory enrichment. These methods involve providing visual, olfactory and auditory stimuli for the freshwater aquatic turtle, the terrestrial turtle and the tortoise.

Captive Husbandry: Oral
Multi-year Analysis of Parentage in a Captive Box Turtle (Terrapene carolina) Population: Implications for Captive Assurance Colonies

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Assurance colonies are a cornerstone of the Turtle Survival Alliance’s strategy for the conservation of imperiled turtles. In many assurance colonies, adults are maintained communally and allowed to breed freely. However, in most cases, little is known regarding the parentage of—and thus the genetic diversity of—resulting offspring for potential use in future reintroduction efforts. Here we present the results of a multi-year analysis of parentage in a captive box turtle (Terrapene carolina) population. The captive population consisted of 25 adults (10 females, 15 males) displaced from a development site near Richmond, Virginia, USA and maintained in a semi-natural outdoor enclosure in a suburban neighborhood near the collection site. Adults were monitored for mating and nesting behavior, and nests from known females were collected for incubation indoors. During 2004-2006 we collected 112 hatchlings representing 25 clutches. In 2007 we obtained blood samples from all the adult breeders and the head-started juveniles, which we genotyped at 5 species-specific polymorphic microsatellite markers. Parentage analysis was performed using GERUD and Cervus software programs. We will present our findings with box turtles and discuss the implications for assurance colony and reintroduction program management for other turtle species.

Reintroductions/Assurance Colonies: Oral

Using Simple, Inexpensive Off-the-Shelf Electronics to Incubate Chelonian Eggs, with Implications for Automating and Controlling Other Husbandry Requirements

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The final, and arguably most important, stage in the effort of captive propagation of chelonians, is the successful incubation to hatching of eggs. As technology advances, consumer electronics become progressively more sophisticated, yet simultaneously less expensive. Traditional incubation techniques utilize equipment that provides radiant heating almost exclusively, which can make temperature control at lower temperatures difficult, if not impossible, when ambient temperatures are already elevated. Temperature influenced sex determination studies have shown conclusively that maintaining incubation temperatures within specific thresholds significantly improves the probability of manipulating the resulting gender of the progeny. A detailed description is provided, of the assembly and application of a digital temperature control device that is both simple to operate and inexpensive. When integrated with other off-the-shelf products, an effective incubator can be constructed that will allow for the control of incubation temperatures within a fixed range, regardless of the ambient temperatures. Potential uses for other aspects of captive management, including mitigation of lower winter and higher summer habitat temperatures, are also discussed.

Captive Husbandry: Oral

Notes on Captive Husbandry and Breeding of the Furrowed Wood Turtle, Rhinoclemmys areolata, Housed Outdoors Under Semi-Natural Conditions

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The Furrowed Wood Turtle, Rhinoclemmys areolata, is a medium-sized, semi-terrestrial Geoemydid native to the Yucatan Peninsula of Central America. A group of several individuals has been maintained for over twenty years outdoors, year-round, under semi-natural conditions, with successful breeding through F2 generations. Details regarding housing, feeding, breeding, incubation/hatching, and rearing of neonates will be discussed.

Rhinoclemmys - Central/South American Wood Turtles: Oral
The Role of Communities in the Conservation of Oaxacan Freshwater Turtles

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In Oaxaca, as around the world, rural communities depend directly on natural resources for sustenance and income. They live in the turtles’ habitat and their role in conservation of chelonians is very important. In this project we were working with three different communities on the coast: El Aguacate, Paso Xonene and Escobilla. We recognize that a community’s well-being is intimately linked to the state of the natural environment, and each impacts the other. Adults, teenagers and children from these places help us monitor freshwater turtles (Rhinoclemmys pulcherrima, R. rubida and Kinosternon oaxacae) on their lands and in return they receive government benefits, training in environmental conservation, productive projects, and the ability to use eco-friendly agriculture instead of using slash and burn. The next step is a change from lack of concern over the condition of the natural environment, to active management of natural resources resulting in a sustained offer of goods and services provided by nature. Communities might measure this change in terms of healthy and sustainable ecosystems with multiple benefits for the community. We monitor the satisfaction of the needs of these communities to help us achieve the final result by contributing to community assets, accessing these, and implementing ways and means to satisfy their needs so that we may change the community’s objectives from private or personal satisfaction of needs, to a more collective satisfaction of needs. The gradient of positive change goes from only a minority that has access to these benefits, to a majority of the community, to all the members of the community that have access with everybody involved, happy.

Poster Session (Student)

Use of a Professionally Trained Belgian Shepherd Bitch for Locating Kinosternon scorioides, Platemys platyccephala, Mesoclemmys gibus, and Rhinoclemmys punctularia in the Amazon flood plain forests of Brazil

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Canines have been used to help researchers locate turtles. The classic study of box turtles by the Schwartz’s is perhaps the most well known study. But we also used a mongrel bitch to find Kinosternon leucostomum both in and out of the water in Veracruz, Mexico. Steve Platt also had great success using a rat terrier to find Rhinoclemmys areolata in Belize. Belgian Shepherds (Canis sp.) are the preferred race, in that their sense of smell is highly refined; also they were not bred for hunting, thus they do not have a genetic instinct to be distracted by wildlife. Neutered animals are preferred, in that bitches in heat can be a problem in the field. Training can begin once the puppy is six months old. Preliminary training is conducted using the scent of the animals to be studied, collected by the evaporation of water into cloth spread over the top of glass aquaria containing the turtles to be used. After three months of training, scents are collected by placing silica gel in a stainless steel bowl within dry glass aquaria where each species of turtle is maintained for 24 h. Training continues for two months more until live turtles are used the last month. Commands are usually taught in a language not native to the country where the animal will be working. Canines are capable of working with the scents of four different species, finding adults, juveniles, tracking females to nests, both on land, underground, and in the water. When a turtle is found, she sits at the spot and waits for the handler to come to her to catch or observe the turtle. She never is allowed to touch the turtle. This is a very useful technique to use for semiterrestrial turtles that live in intermittent bodies of water, such as rainfilled jungle pools. It is hard to find Platemys during the dry season, in that they cannot be seen while aestivating in the leaf litter. Trained canines find what traps and drift fences cannot capture, stationary turtles, and what researchers cannot see.

Chelonian Biology: Oral

Smart Science from the Start: Implications of Desert Tortoise Translocation and Disease Research Conducted by San Diego Zoo at the Desert Tortoise Conservation Center, Las Vegas, Nevada

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12th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles | Orlando, FL 55
The Mojave Desert ecosystem of the American Southwest has changed dramatically over the past century. Rapid human population growth, urbanization and large-scale renewable energy projects have fragmented and deteriorated native habitats. Changes in this environment have reduced numbers of the Desert Tortoise (*Gopherus agassizii*) by 90% over the last 30 years, and populations continue to decline in four out of six desert tortoise recovery units. A major by-product of land development is the continuous displacement of hundreds of tortoises forcing mitigation-driven translocations, the conservation benefits of which remain largely unstudied. The displacement of tortoises was a primary reason for the construction of the Desert Tortoise Conservation Center (DTCC) in the early 1990’s within an 11,014-acre area set aside by the Bureau of Land Management’s Las Vegas Resource Management Plan. The principal function of the DTCC was as a holding facility for formerly wild tortoises removed from the path of development and unwanted pet tortoises. In 2009, San Diego Zoo Global was contracted by US Fish and Wildlife Service to transform operations of the center to play a critical role in supporting range-wide recovery efforts for the desert tortoise through conservation research, on-the-ground recovery actions, training and public education. We have made significant progress in standardizing the health assessment of tortoises, offering training courses to renewable energy biologists, and in furthering our understanding of disease and translocation ecology thru experimental population augmentations. Just as we are starting to impact recovery, we are faced with funding shortfalls and are being forced to shut down at the end of 2014. Our future vision remains to promote conservation of the Desert Tortoise and Mojave Desert ecosystem by providing a first-class multi-disciplinary program of recovery related research, training, and public education.

**Zoos and Chelonians: Oral**

**Building Turtle Traps: An Inexpensive, Yet Effective, Trap for Box Turtle (Terrepene sp.) Field Studies**

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Conducting field studies on turtle species allows researchers to collect data on habitat use and preferences, available resources, home range, and numerous other aspects of a species’ biology and ecology. The incorporation of a mark-and-release study can provide significant data on the population’s overall size, health, demographics, and home range. However, cryptic species can be difficult to detect and visual searches can only provide opportunistic sightings of turtle species. Field studies can be greatly enhanced when turtle traps are incorporated into the research area, but these traps can be quite costly at the onset. I constructed 50 terrestrial turtle traps out of hardware cloth and zip ties that proved quite successful when trapping *Terrapene* sp. over a 4 yr field study. These traps can be slightly modified to use with other small-sized turtle species. Only one time did we trap a non-targeted species during the study period. Detailed instructions are provided on trap building techniques and maintenance.

**Translocating Bolson Tortoise (Gopherus flavomarginatus) Juveniles on Turner’s Armendaris Ranch: Lessons Learned for Eventual Releases**

**CHRISTIANE WIESE AND SCOTT HILLARD**

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The Bolson Tortoise (*Gopherus flavomarginatus*) is native to the Chihuahuan Desert of north-central Mexico. With the goal of establishing free-living populations of Bolson Tortoises in the northern portion of their prehistoric range, the Turner Endangered Species Fund has been heading Bolson Tortoises on two of Ted Turner’s ranches located in the northern Chihuahuan Desert in New Mexico using a captive group of 29 Bolson Tortoise adults as breeding stock since 2006. In the fall of 2012, we constructed 25 artificial juvenile burrows in the ~16 acre enclosure that houses the adult Bolson Tortoises. We outfitted 10 juvenile Bolson Tortoises (≥ 110 mm MCL) with radiotransmitters and translocated them from one of two juvenile head-starting pens into the adult enclosure, releasing each tortoise facing one of the artificial burrows. We followed the released juveniles until they settled into their overwintering location, which took anywhere from days to weeks. In the spring of 2013, we released a second group of 8 juveniles in or near the same burrows we used for the previous release and followed these tortoises as they settled into their new environment. Interestingly, all of the 18 juvenile tortoises walked away from their release burrows and found (temporary) refuge under a clump of grass, in one of the adult burrows, under a yucca plant, or in a rodent burrow. One individual took over an artificial burrow (not its release burrow) as its new home. In the end, most of the juveniles found and modified rodent (mainly kangaroo rat) burrows to serve as their new homes. Five tortoises settled into burrows they started from scratch, mostly under clumps of grass. On average, the juvenile tortoises settled 57 ± 40 m from their release site (range 8-130 m). We saw no difference in distance travelled between tortoises that were raised in the near-by pen.
(~ 200 m away) or in a pen ~ 60 mi away. We concluded that (1) juvenile Bolson Tortoises do not home, (2) rodent burrows provide an important refuge for juvenile Bolson Tortoises, and (3) future releases should occur in places that provide ample rodent burrows.

**Reintroductions/Assurance Colonies:** Oral

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**Natural History of Mangrove Terrapins (Malaclemys terrapin rhizophorarum) in Key West National Wildlife Refuge, FL, USA**

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Key West National Wildlife Refuge (KWNWR) is home to the southernmost population of Mangrove Terrapins (*Malaclemys terrapin rhizophorarum*). I began a long-term study of this population in 1981. Mangrove Terrapins are the southernmost of the seven diamondback terrapin subspecies currently recognized. They also have, by far, the smallest geographic range of any Diamondback Terrapin subspecies. Very little has been published about Mangrove Terrapins since the first specimen was discovered in 1904 within the boundaries of what is now KWNWR. The islands of KWNWR are small and very low-lying.  
Three of the largest islands have relatively large, very shallow interior saline ponds; there is little suitable nesting habitat. Within KWNWR terrapin distribution is patchy, they are absent on many islands and scarce on most of the others. A single island appears to be home for the vast majority of the Refuge’s Mangrove Terrapins and there is no evidence of inter-island terrapin movement. The KWNWR terrapin population consists of no more than 750 to perhaps 1,000 individuals and appears to have been stable between 1981 and 2011. Hurricane-caused destruction of black mangrove (*Avicennia germinans*) forests has apparently not changed terrapin population structure or size. The adult female/male sex ratio (11:1) of KWNWR terrapins is more skewed than has been reported for any other diamondback terrapin population. Only a very few juveniles and hatchlings (*n = 23* vs. *724 adults*) have ever been found. The lifespan of some KWNWR terrapins has so far been documented to be in the range of 43 to 50 years. How much older they may get is yet to be determined. KWNWR terrapins are active all winter becoming dormant (buried in mud) in the summer and during periods of prolonged drought. This seasonality is exactly opposite to the activity cycle of the northern Diamondback Terrapin (*M. t. terrapin*) population that I have long monitored on the Cape May Peninsula of southern New Jersey.

**Diamondback Terrapins:** Oral

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**Monitoring, Habitat Management, and Conservation of Texas Tortoises (Gopherus berlandieri) on National Park Service Lands**  

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The National Park Service, in collaboration with researchers at University of Georgia - SREL, has developed a long-term monitoring project for Texas Tortoise (*Gopherus berlandieri*) to support resource management on Palo Alto National Historical Park. Starting from 2008, our team developed visual ground search methods coupled with permanent marking and GPS-locating of individuals in a twice-annual (May and November) sampling design to provide detailed population assessment, including estimates of population size, density, age, sex structure, and modeling of habitat use and apparent home-ranges and movements. Timed habitat searches by experienced personnel have been used to detect Texas Tortoises at our study site, although the thorn-scrub vegetation makes surveying a challenge. This presentation provides a look at project development and methods and some outcomes obtained from five years of field testing leading to the current monitoring protocol. Texas Tortoises, endemic in the US to south Texas, differ from congener Gopher and Desert Tortoises in that they do not exhibit site fidelity to a specific resource (i.e., a burrow), and some may wander over large distances. They often occur in isolated patches of thorn-scrub (i.e., elevated lomas) embedded in larger landscapes of low-lying coastal grasses which makes management actions very important at the local level. Tortoise monitoring data collected is used in association with light detection and ranging (LIDAR) elevation data and aerial photo imagery to help the National Park Service 1) maintain faunal biodiversity and 2) inform management decisions that could potentially affect the resident tortoise population, such as timing
of mowing and prescribed fire, and location of fencing to prevent road mortalities. Our project has provided insights into the species’ habitat use and identified conservation needs that will help the National Park Service manage this species.

**Tortoises: Oral**

**Torporing Turtles**

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Offering captive chelonians a dormant period can be an effective husbandry management technique for any species that has seasonality in their native geographical distribution. Giving our captive populations annual rhythms can induce natural behaviors and physiological cycles including reproductive hormones, which can increase reproductive output and make our conservation efforts more effective and powerful. This presentation explains some of the torporing techniques used for the turtle collection at Zoo Atlanta, which include ponds, hibernacula, and piles of vegetation. In addition, a study was conducted using 15 temperature data loggers in strategic locations to distinguish optimal hibernation environments. The results of this study and the methods used to create, maintain, and observe these environments will be explained in detail.

**Zoos and Chelonians: Oral**

**Captive Husbandry and Breeding of the Flower-back Box Turtle, Cuora galbinifrons, at Zoo Atlanta**

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Cuora galbinifrons has a history of being problematic to establish and breed in captivity. Zoo Atlanta has a long history in breeding other challenging species in captivity including Heosemys depressa, Cuora mccordi, and Manouria impressa. A breeding group of two males and five females came to Zoo Atlanta in late 2011 and had its first successful hatchling in October 2013. This presentation will explain the husbandry practices and experiences with C. galbinifrons including diet, enclosure set ups, hibernation techniques, reproductive behavior, incubation parameters, and hatchling rearing.

**Cuora galbinifrons Complex: Oral**

**Collaborative Captive Management by Studbook Keeping in Europe**

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Studbook/breeding programs are vital for the establishment and management of assurance colonies. In Europe the European Studbook Foundation (ESF) manages and coordinates a number of studbooks for critically endangered species with an emphasis on the *Cuora* genus and a number of Malagasy species. Except for *Cuora yunnanensis* all other *Cuora* species studbook/breeding programs are operational. The total number of registered animals is approximately 800 and eleven *Cuora* species are bred on a regular basis. For the *C. trifasciata / cyclornata* complex, DNA sampling has been executed over the past two years resulting in breeding recommendations. Both ESF privates and European Association of Zoos and Aquaria institutions cooperate within these studbooks. Within these captive management framework, the *Pyxis planicauda* and *Manouria impressa* European projects are important components and will be discussed as well.

**Zoos and Chelonians: Oral**
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