9th 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 14 — 17, 2011
Orlando, Florida

This year’s Annual Symposium made possible with the generosity of our sponsors:

Additional support generously provided by:
Aquarium Innovations, Brett and Nancy Stearns, Central Florida Zoo, Chelonian Research Foundation, David Shapiro, Desert Tortoise Council, Harris Rosen Foundation, John Iverson, Mazuri, Mike English, Reptiles Magazine, San Diego Zoo Institute for Conservation Research, Scott Hendrickson and Kate Evans, Terrapin Beer, and the Animal Programs Nutrition Team and Department of Animal Programs from Disney’s Animal Kingdom
**TSA Projects**

**Belize:** A sponsored workshop led to development of Hicatee Conservation Monitoring Network in Belize, and ponds were installed for the Hicatee Conservation Research Center at BFREE.

**Myanmar:** TSA completed $60,000 in new construction projects for expansion of captive assurance colonies of critically endangered endemic species. Hired full time turtle conservation coordinator.

**Madagascar:** TSA developed partnerships with two local communities to protect key populations of Radiated Tortoises. Hired full time turtle conservation coordinator.

To learn more about these and other TSA projects, visit our website [www.turtlesurvival.org](http://www.turtlesurvival.org).

---

**Turtle Survival Alliance 2011 Conference Highlights**

South American Turtles: Reports from Brazil and Colombia

Join us on Monday as we kick off the Conference proceedings with presentations on turtle species from both countries. Reports indicate that many turtle species are in serious decline and need urgent attention.

---

Special Session by Whit Gibbons: Mysteries to Discoveries: The Never Ending Story of Turtle Biology

*Monday, August 15, 8:45 am*

---


*Monday, August 15, 11:00 am*

---

**Table of Contents**

- Conference Highlights .................................................................................................. 1
- Welcome Message from the Program Co-Chairs .......................................................... 2
- Welcome Message from the Turtle Survival Alliance Board of Directors .................... 3
- Conference Notes .......................................................................................................... 4
- Note to Presenters ......................................................................................................... 4
- How to Cite this Work .................................................................................................. 4
- Social Activities and Timelines ..................................................................................... 4
- Hotel Conference Map .................................................................................................. 6
- Daily Program Schedules .............................................................................................. 7
- Poster Presentations ...................................................................................................... 12
- Program Abstracts ......................................................................................................... 13
- Subject Index .................................................................................................................. 57
From the Program Co-Chairs: WELCOME!

It is both an honor and a privilege to welcome each of you to the 9th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles, the Joint Annual meeting of the Turtle Survival Alliance and the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group. It will be great to see so many familiar faces and we look forward to meeting so many new members.

Last year’s conference was such a huge success, we decided to return to Orlando, and this year’s conference is yet another great value that includes a lineup of amazing speakers, an Icebreaker Social, a barbeque hosted by Central Florida Zoo, and the Awards Banquet. After last year’s conference, some of us went off to explore the springs surrounding Orlando and we had such an awesome time, we decided to offer organized field trips before and after the conference. We hope this becomes a tradition and a fun part of the conference for colleagues to meet outside of the conference venue. We would like to thank Eric Munscher and his colleagues with the Central Florida Freshwater Turtle Study for collaborating with the TSA and organizing the field trips this year.

We are pleased to see that registration for this year’s conference is up, especially in light of current economic conditions and decreases in available travel funds experienced by many in our group. While our own dedicated and growing membership is not immune to the global economy, it seems many of you have recognized that this conference is too important to miss the opportunity to share ideas, communicate new findings, and talk “turtles.”

Outside of this annual meeting, the TSA has been very active since last year’s conference as we have been involved in many workshops and meetings around the globe. These include the Indian Freshwater Turtle and Tortoise Conservation Priorities Areas and Initiatives; Training Workshops for Hicatee monitoring in Belize; Conservation of Asian Tortoises and Freshwater Turtles (Singapore); the Asian Box Turtle (Cuora spp.) Workshop (China); a Chelonian Vet Workshop (India); and the Conservation of Colombian Freshwater Turtles and Tortoises. An impressive list of co-hosted meetings showing just how globally integrated the TSA has become in its mission to ensure zero turtle extinctions.

We would like to take this opportunity to acknowledge that this conference would not be possible without the generous contributions made by donors and specifically our conference sponsors. We leave the formal acknowledgments to Rick and Anders’ welcome letter below, but we encourage you to visit our vendor and sponsor tables to say hello to these sponsors and to support them with a purchase of their products.

A conference like this one is only as good as its volunteers and those that support the Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles are no exception. As conference organizers, we would like to extend our great appreciation to all of the session chairs who have done an wonderful job of lining up speakers this year. Conference Committee co-chairs Lonnie McCaskill (Disney’s Animal Kingdom) and Scott Davis (TSA Executive Director) have once again done an incredible job of negotiating with the Rosen Plaza to ensure that we offer one of the most affordable venues in the Chelonian community. We would also like to thank Heather Lowe who kept us all organized and somehow efficiently managed the myriad of details, emails, and questions that came her way. We thank Rose Tremblay, Nancy Reinert and Wendy Crofut, better known as the “Ladies,” who come each year to run the merchandise tables and hospitality suite, fill the ZooMed gift bags, take in auction items, and help to make the conference run smoothly. In addition, our many thanks go to Andrea Currylow for serving as Poster Co-chair this year.

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 we can make this conference more meaningful and enjoyable.

Please note this year we are having an official Poster Session at 5:30 pm on Monday evening where you can meet the poster presenters, ask questions, catch up with old friends and meet new ones.

We look forward to visiting with all of you. Once again, welcome! We hope you the conference!

Andrew Walde
Program Chair
WELCOME!

On behalf of the Board of Directors of the Turtle Survival Alliance (TSA), and the leadership of the IUCN Tortoise and Freshwater Turtle Specialist Group (TFTSG), we welcome you to the 9th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles. Last year’s venue in Orlando, the Rosen Plaza Hotel, turned out to be an incredible value and the 2010 conference was a breakout year in attendance. Given that success, we are passing those savings on to you again in 2011 and judging from pre-registration numbers, we are on track to match last year’s attendance.

This year we are pleased to present a special full-day symposium on South American turtles, and we are very fortunate to have been able to attract some of the best and brightest minds in turtle research and conservation from that important region. Our speakers represent Colombia and Brazil, countries rich in turtle diversity that rank fourth and sixth on a global scale. In particular, we owe debts of gratitude to our esteemed colleagues Vivian Paez for organizing this impressive program, and Dick Vogt for bringing such a large contingent of his student research group to participate. Travel support for this symposium was provided by the TSA and Brazilian petroleum giant PETROBRAS. The seeds for this symposium were planted during the October 2010 South American turtle IUCN Red Listing workshop on the Rio Trombetas, Brazil, and it signals the beginning of TSA’s increased involvement in this region.

As always, we give special recognition to our exceptional conference organizing and program committee of Scott Davis, Heather Lowe, Lonnie McCaskill, Andrew Walde, and Beth Walton. Andrew has put together an amazing program, while managing to balance travel grant requests to assure that we would have a diverse slate of speakers and keeping it within budget – a herculean task that required close to 1000 pieces of e-mail correspondence. Lonnie handled most of the local arrangements, and Heather kept the whole process on schedule with a level of organization that comes only from years of experience and practice. Other conferences pay out tens of thousands of dollars to conference planners that this TSA team pulls off annually, largely on a volunteer basis.

We also pay tribute to our sponsors, without whom this conference would not be possible. Our title sponsor is Zoo Med once again, an integral TSA partner whose support for this event is essential. For general conference and travel support we also recognize John Iverson, David Shapiro, Scott Hendrickson and Kate Evans, The Orianne Society, Brett and Nancy Stearns, Mazuri, Aquarium Innovations, Turtle Conservancy, San Diego Zoo Institute for Conservation Research, Desert Tortoise Council, Conservation International, Reptiles Magazine, Terrapin Beer, and The Harris Rosen Foundation. We also extend a hearty thanks to the Disney's Animal Kingdom Department of Animal Health and Animal Program Nutrition Team for both monetary and volunteer support. In addition, thanks go out to Jen Stabile, Joe Montisano and the Central Florida Zoo for providing their facility at an unbelievable value for our BBQ and auction. Our master BBQ chef, Mike English, will be generously donating his services again this year so we’re definitely in for a great meal and good times.

Awards for Best Student Presentations will again this year be presented and supported by the Chelonian Research Foundation. Also, the prestigious annual Behler Turtle Conservation Award, with its major honorarium, will again be presented at the banquet by the TFTSG and TSA, this year honoring one of the preeminent turtle biologists of our time, John Iverson. The 2011 Behler award was sponsored by the Chelonian Research Foundation, the Turtle Conservancy, Conservation International, Wildlife Conservation Society, Deb Behler, and Brett and Nancy Stearns.

Our Turtle and Tortoise Symposium benefits greatly from the synergy of having some of our partner organizations – the Turtle Conservation Fund, TFTSG, and Turtle Conservancy – sharing our venue, conducting workshops and meetings and providing their support to global and local turtle conservation efforts. This Symposium provides an annual venue for the global turtle conservation community to gather and share experiences and build those all important alliances that help build and sustain momentum. The market forces working against us – and turtle and tortoise populations – are formidable and the challenges we face are increasingly daunting. We need this time together to restore our shared commitment and fuel our passion for protecting what we love. The global sense of community that this Symposium provides becomes more important each year, and we look forward to another great conference in Orlando.

Rick Hudson, President TSA
Anders Rhodin, Chair TFTSG
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 14 – 4:00 PM – 8:00 PM
- August 15 – 8:00 AM – 3:00 PM
- August 16 – 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 C):

- Centro Quelonios da Amazonia
- Conservation Fusion
- Marvin H. Bennett, Jr.
- Mazuri
- Petraworks, Inc.
- Serpentine Designs
- The Orianne Society
- Tiaro and District Landcare Group
- Turtle Conservancy
- Wildlife Materials, Inc.
- Zoo Med Laboratories, Inc.

Conference Notes and Social Activities

Sunday, August 14
- Registration 4:00 PM – 8:00 PM (Registration Desk)
- Auction Item Drop Off 4:00 PM – 6:00 PM (Ballroom C)
- Exhibit Hall Open 4:00 PM – 6:00 PM (Ballroom C)
- Poster Hanging 5:00 PM – 6:00 PM (Ballroom C)
- Icebreaker 6:00 PM – 8:00 PM (Ballroom D)

Monday, August 15
- Registration 8:00 AM – 3:00 PM (Registration Desk)
- Auction Item Drop Off 8:00 AM – 1:30 PM (Ballroom C)
- Exhibit Hall Open 8:00 AM – 6:30 PM (Ballroom C)
- Poster Viewing 8:00 AM – 5:00 PM (Ballroom C)
- Poster Session 5:30 PM – 7:00 PM (Ballroom C)
- Video Night / Pizza Dinner – 7:00 PM (Ballroom B)

Tuesday, August 16
- Registration 8:00 AM – 2:00 PM (Registration Desk)
- Silent Auction 8:00 AM – 1:00 PM (Ballroom C)
- Exhibit Hall Open 8:00 AM – 4:30 PM (Ballroom C)
- Poster Viewing 8:00 AM – 4:30 PM (Ballroom C)
- Silent Auction Payment / Pick-up 3:00 PM – 4:00 PM (Ballroom C)

Be sure to present your conference name tag to take advantage of dining specials at the Rosen Plaza Hotel. Specials include a $10 “Grab and Go” lunch special from Lite Bite, as well as discounts at Café Matisse.
- First bus leaves for the Central Florida Zoo 4:30 PM
- Last bus leaves for the Central Florida Zoo 5:00 PM
- Free time and dinner buffet at the Central Florida Zoo 6:00 PM – 7:30 PM
- Live Auction 8:00 PM
- Buses leave to return to the Rosen Plaza 9:30 PM

**Wednesday, August 17**

- Registration 8:00 AM – 1:00 PM (Registration Desk) **Please note** – This is your last chance to purchase a TSA T-shirt or other conference souvenir!
- Auction Payment / Pick-up 8:00 AM – 1:00 PM (Registration Desk)
- Exhibit Hall Open 8:00 AM – 1:00 PM (Ballroom C)
- Poster Viewing 8:00 AM – 12 Noon (Ballroom C)
- Poster Breakdown 12 Noon – 1:00 PM (Authors, please take down your posters at this time)
- Cocktails 6:30 PM (Ballroom A)
- Awards Banquet 7:00 PM (Ballroom A)

**Support the TSA!**

Be sure to visit the merchandise tables in the Exhibit Hall (Ballroom C) 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 in the Exhibit Hall (Ballroom C). The Live Auction will be held after our BBQ at the Central Florida Zoo on Tuesday.

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 C), 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 Sunday and from 8:00 AM – 1:30 PM on Monday. 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: silent auction items may be paid for and picked up at the registration table from 3:00 PM – 4:00 PM on Tuesday and from 8:00 AM – 1:00 PM on Wednesday. Live auction items can be paid for at the Central Florida Zoo BBQ. A cashier’s table will be set up at the event site.

**Questions?**

Stop by the Registration Desk during open hours, or ask a conference volunteer (wearing a green shirt). A message board will also be posted at the Registration Desk with up-to-date information or changes.

*Stay informed on all conference news and announcements! Text TSAMeeting to 27138 to subscribe to TSA text messaging during the symposium.*

“Text messaging service limited to US-based cell phone numbers only”
Present your conference name tag to take advantage of dining specials at the Rosen Plaza Hotel, like a $10 “Grab and Go” lunch special from Lite Bite, as well as discounts at Café Matisse.

**TSA Conference Registration Desk**
- Ballroom A – Awards Banquet
- Ballroom B – Video & Pizza Night
- Ballroom D – Icebreaker Room and General Session Room
- Ballroom C – Exhibit Hall and Poster Presentations
- Salon 13/14
- Salon 9/10

**Dining Discount Offers**
### Daily Schedules

<table>
<thead>
<tr>
<th>Saturday August 13</th>
<th>Sunday August 14</th>
<th>Monday August 15 (Ballroom D)</th>
</tr>
</thead>
</table>
| **8:30** | **TSA Governance Committee (8:30–9:15)** | **Mysteries to Discoveries: The Never Ending Story of Turtle Biology**  
W GIBBONS |
| **8:45** | **TSA Animal Management (9:15–10:00)** | **TSA Update and Field Report**  
R HUDSON |
| **9:15** | **TSA Board (10:30–17:00)** | **TFTSG Update**  
A RHODIN |
| **10:00** | **TSA Board**  
**South American Turtles** | **Vocal Communication in Turtles: New Directions for Behavioral Research**  
D VOGT |
| **10:30** | | **Break / Posters / Vendors** |
| **11:00** | | **Poster Presentations Session**  
(Ballroom C) |
| **12:00** | **Lunch** | **Video Night and Pizza**  
(Ballroom B) |
| **13:00** | **TFTSG Steering Committee (13:00–14:00)** | |
| **13:15** | | |
| **13:30** | | |
| **13:45** | | |
| **14:00** | | |
| **14:15** | | |
| **14:30** | | |
| **14:45** | | |
| **15:00** | **TCF Board**  
**South American Turtles** | |
<p>| <strong>15:15</strong> | | |
| <strong>15:30</strong> | | |
| <strong>15:45</strong> | | |
| <strong>16:00</strong> | | |
| <strong>16:15</strong> | | |
| <strong>16:30</strong> | | |
| <strong>17:00</strong> | | |
| <strong>17:30</strong> | | |
| <strong>18:00</strong> | <strong>Turtle Conservation Coalition Dinner and Field Trip</strong> | |
| <strong>18:30</strong> | <strong>Student Presentation Awards Committee Meeting</strong> | |
| <strong>19:00</strong> | | |
| <strong>19:30</strong> | | |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Tuesday August 16-A</th>
<th>Tuesday August 16-B</th>
<th>Wednesday August 17-A</th>
<th>Wednesday August 17-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Role of Zoos in Chelonian Conservation (Salon 13/14)</td>
<td>North American Box Turtles (Salon 9/10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:20</td>
<td>Break / Posters / Vendors</td>
<td>Break / Posters / Vendors</td>
<td>Break / Posters / Vendors</td>
<td>Break / Posters / Vendors</td>
</tr>
<tr>
<td>10:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:00</td>
<td>Role of Zoos in Chelonian Conservation (Salon 13/14)</td>
<td>North American Box Turtles (Salon 9/10)</td>
<td>Captive Husbandry (Ballroom B)</td>
<td>Population Studies (Salon 9/10)</td>
</tr>
<tr>
<td>11:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:20</td>
<td>Chelonian Conservation (Salon 13/14)</td>
<td>Asian Chelonians (Salon 9/10)</td>
<td>North American Tortoises (Ballroom B)</td>
<td>Turtle Ecology (Salon 9/10)</td>
</tr>
<tr>
<td>13:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:20</td>
<td>Break / Posters / Vendors</td>
<td>Break / Posters / Vendors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:00</td>
<td>Chelonian Conservation (Salon 13/14)</td>
<td>Chelonian Habitats (Salon 9/10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td>Prepare to Leave for Central Florida Zoo for BBQ and Auction</td>
<td></td>
<td>Field Studies (Ballroom B)</td>
<td>Turtle Ecology (Salon 9/10)</td>
</tr>
<tr>
<td>16:20</td>
<td>Load Bus for Central Florida Zoo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17:00</td>
<td>Last Bus for Central Florida Zoo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17:20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17:40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18:00</td>
<td>Central Florida Zoo BBQ and Auction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19:00</td>
<td></td>
<td></td>
<td>Cocktails (Ballroom A)</td>
<td>Banquet and Awards (Ballroom A)</td>
</tr>
<tr>
<td>21:30</td>
<td>Return to the Rosen Plaza Hotel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Saturday August 13</td>
<td>Sunday August 14</td>
<td>Monday August 15 (Ballroom D)</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>---------------------</td>
<td>------------------</td>
<td>-------------------------------</td>
<td></td>
</tr>
<tr>
<td>8:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:15</td>
<td>Turtle Conservancy / Behler Chelonian Center (8:30–12:00)</td>
<td>TSA Governance Committee (8:30–9:15)</td>
<td>Mysteries to Discoveries: The Never Ending Story of Turtle Biology W GIBBONS</td>
<td></td>
</tr>
<tr>
<td>10:00</td>
<td></td>
<td></td>
<td>TSA Update and Field Report R HUDSON</td>
<td></td>
</tr>
<tr>
<td>10:30</td>
<td></td>
<td></td>
<td>Break / Posters / Vendors</td>
<td></td>
</tr>
<tr>
<td>11:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>13:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:15</td>
<td>TFTSG Steering Committee (13:00–14:00)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13:45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14:45</td>
<td></td>
<td></td>
<td>Break / Posters / Vendors</td>
<td></td>
</tr>
<tr>
<td>15:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15:45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16:15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Indicates Student Presentation for Student Awards Competition

**9th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles | Orlando, Florida**
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>A Slow but Steady Return to Chelonian Conservation Ideals to the Jacksonville Zoo and Gardens</td>
<td>S Gott</td>
</tr>
<tr>
<td>9:20</td>
<td>Recent Turtle Breeding Efforts at the Tennessee Aquarium</td>
<td>B Hughes</td>
</tr>
<tr>
<td>9:40</td>
<td>An Overview of Recent Changes to Captive Management Programs in American Zoo Association Institutions</td>
<td>D Lawson</td>
</tr>
<tr>
<td>10:00</td>
<td>Chelonian Operations at Zoo Atlanta</td>
<td>L Wyrywich</td>
</tr>
<tr>
<td>10:20</td>
<td>Break / Posters / Vendors</td>
<td></td>
</tr>
<tr>
<td>10:40</td>
<td>Busch Gardens Supports World Turtle Day Celebration Including Information on Sea World &amp; Busch Gardens Conservation Fund</td>
<td>K Fulton*</td>
</tr>
<tr>
<td>11:00</td>
<td>Defining Success for Ex-situ Breeding Programs</td>
<td>P Gibbons</td>
</tr>
<tr>
<td>11:20</td>
<td>Update on Rescued Malaysian Giant Pond Turtles, Orlitia borneensis, at Zoo Miami</td>
<td>A Stern</td>
</tr>
<tr>
<td>11:40</td>
<td>Large River Turtle Consortium: Conservation of Critical Species through Captive Management in the 21st Century</td>
<td>B PoynTER*</td>
</tr>
<tr>
<td>12:00</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>13:00</td>
<td>The Pinzon Island Tortoise, Chelonoidis duncanensis - From Certain Extinction to the Final Stage of a Conservation Miracle</td>
<td>F Caporaso</td>
</tr>
<tr>
<td>13:20</td>
<td>Freshwater Turtle Recovery Associated With an Oil Spill Along the Kalamazoo River, Michigan, USA</td>
<td>D Mifsud</td>
</tr>
<tr>
<td>13:40</td>
<td>Effects on the Population Genetics for the Central American River Turtle, Dermatemys mawii: the Mexican Transition Zone</td>
<td>G Syed*</td>
</tr>
<tr>
<td>14:00</td>
<td>The Precarious Status of the Madagascar Spider Tortoises, Pyxis arachnoids, and Radiated Tortoises, Astrochelys radiata</td>
<td>R Walker*</td>
</tr>
<tr>
<td>14:20</td>
<td>Break / Posters / Vendors</td>
<td></td>
</tr>
<tr>
<td>14:40</td>
<td>Kawartha Turtle Trauma Center: Conservation in Action</td>
<td>S Carstairs</td>
</tr>
<tr>
<td>15:00</td>
<td>Conservation of Radiated Tortoise, Astrochelys radiata: Pilot Program Development through Community Training and Outreach at Lavavolo Classified Forest, Madagascar</td>
<td>S McGuire</td>
</tr>
<tr>
<td>15:20</td>
<td>Evaluation of a Community-based Management Experience of Podocnemis Species in the Lower Amazon, Brazil</td>
<td>J Pezzuti</td>
</tr>
</tbody>
</table>

*Indicates Student Presentation for Student Awards Competition
## Daily Schedule

### Wednesday, August 17  
#### (Ballroom B)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session – A (Ballroom B)</th>
<th>Session – B (Salon 9/10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Trade in Turtles Chair: B. Horne</td>
<td></td>
</tr>
</tbody>
</table>
| 9:00  | A Retrospective Look at the Past Decade of Asian Chelonian Conservation  
B HORNE |  |
| 9:20  | The Trade of Turtles in Jakarta, Indonesia Revisited  
C STENGEL |  |
| 9:40  | Searching for the Last “Survivors” of Batagur baska |  |
| 10:00 | Break / Posters / Vendors | Break / Posters / Vendors |
| 10:40 | Failing the Giant Tortoise: Massive Growth Potential Challenges Accepted Rearing Practices  
C ADAMS | Population Ecology of the Snapping Turtle, Chelydra serpentina osceola, in a Northern Florida River  
G JOHNSTON (E SUAREZ* presenting) |
| 11:00 | Husbandry of Cuora flavomarginata  
R FARRELL | Current Status of Turtle Populations in Eastern Oklahoma  
E JOHANSEN* |
| 11:20 | Captive Breeding of the Chinese Yellow Headed Box Turtle, Cuora auropunctata, at the WCS’s Bronx Zoo  
M BAUMER | Distribution and Status of the Ornate Diamondback Terrapin, Malaclemmys terrapin macrospilota, in the Big Bend Region of FL  
J BUTLER |
| 11:40 | Captive Husbandry and Breeding of the Spiny Turtle, Heosemys spinosa, at the Tennessee Aquarium  
B HUGHES | Status of the Federally Endangered Alabama Red-bellied Turtle, Pseudemys alabamensis, in the Mobile-Tensaw Delta  
J GODWIN |
| 12:00 | Lunch | Lunch |
| 13:00 | North American Tortoises Chair: D. Rostal | Turtle Ecology Chair: B. Anders |
| 13:00 | Reproductive Physiology of North American Tortoises  
D ROSTAL | Use of Side-scan Sonar to Detect and Survey Cryptic River Turtles  
C DAVY* |
| 13:20 | The Effectiveness of Conservation Actions to Protect the Five Endangered and Threatened Gopherus Species  
K BERRY | Nesting Ecology in Reintroduced Alligator Snapping Turtles  
J MILLER* |
| 13:40 | Genetic Diversity Within and Among Northern Populations of the Gopher Tortoise, Gopherus polyphemus  
S HARRISON | Alligator Snapping Turtles, Macrochelys temminckii, Alter Germination of Ingested Bottomland Hardwood Seeds  
J ELBERS* |
| 14:00 | Range-wide Population Genetics of the Gopher Tortoise  
D GAILLARD* | Habitat Partitioning and Sampling Efficacy of an Aquatic Turtle Community in East Texas  
D RIEDLE |
| 14:20 | The Effectiveness of Conservation Actions to Protect the Five Endangered and Threatened Gopherus Species  
K BERRY | Nesting Ecology of Batagur Species along the Chambal River, India  
S SINGH (B HORNE presenting) |
| 14:40 | Survival, Demography, and Growth of Gopher Tortoises, Gopherus polyphemus, from Three Study Populations  
T TUBERVILLE | What do Turtles do When They Ain’t Doing Nothing? Winter Ecology of the Yellow Mud Turtle, Kinosternon flavescens  
D LIGON |
| 15:00 | Break / Posters / Vendors | Break / Posters / Vendors |
| 15:20 | Field Studies Chair: W. Selman | Turtle Ecology Chair: B. Anders |
| 15:20 | Impacts of the Canoe Toad on Sandstone Long-necked Turtle and North-west Red-faced Turtle in Western Australia  
C CASTELLANO | Wood Turtles, Glyptemys insculpta, in New England: Long-term Research and Conservation Planning  
M JONES |
| 15:40 | The Effects of Eutrophication on the Painted Turtle  
O ATTUM | Movement and Habitat Use of Translocated Spur-thighed Tortoises  
M ATTUM |
| 16:00 | Movement Patterns and Site Fidelity of Translocated Red Ear Sliders and Common Musk Turtles  
C CUTSHALL* | Population, Survivorship, Biomass, Sex Ratios, and Density of the Freshwater Aquatic Turtle Population at Wekiwa Springs State Park  
E MUNSCHER |
| 16:20 | Geographic Variation in Population Structure, Morphology, and Sexual Size Dimorphism in Graptemys flavimaculata  
W SELMAN | Effects of Warmer than Normal Incubation Temperature upon the Behavioral Function of Hatching Freshwater Turtles  
M CAMPBELL* |
| 16:40 | Restoration of Western Pond Turtles in San Diego, California  
T OWENS | NY Terrapins Undergoing Dramatic and Rapid Reproductive Changes  
R BURKE |
| 17:00 | Morphology of the Alligator Snapping Turtle  
T THOMAS | Impacts on the Mary River Turtle During Australian Summer of Floods  
M CONNELL |

*Indicates Student Presentation for Student Awards Competition
# Poster Presentations

**Poster Presentations Chair: B. Walton Co-Chair: A. Currylow**

**Poster Session Monday, August 15th 5:30 – 7:00 PM (Ballroom C)**

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet of Creek-Dwelling Loggerhead Musk Turtles and Stinkpots in Northwest Florida</td>
<td>B ATKINSON* and M BERNIER</td>
</tr>
<tr>
<td>Selectivity of Different Sampling Methods: Case Study for Trachemys dorbigni (Testudines, Emydidae)</td>
<td>ALEX BAGER and MELISE SILVÉIRA</td>
</tr>
<tr>
<td>Bioclimatic Variables and Distribution of Freshwater Turtles in Brazil</td>
<td>A BAGER, J CESAR LIMA, A COSTA, AND I ABREU</td>
</tr>
<tr>
<td>Global Warming May be Affecting Reproductive Behavior of Podocnemis expansa in Amazon Basin, Brazil</td>
<td>C FERRARA*, L SCHNEIDER, and R VOGT</td>
</tr>
<tr>
<td>Alligators and Freshwater Turtles as Long-lived Bio-indicators in Aquatic Ecosystems of the Southeastern US</td>
<td>B HARRIS, A GROSE, R HORAN III, D SCOTT, B METTS, and T TUBERVILLE</td>
</tr>
<tr>
<td>Box Turtle Population Assessment and Their Contribution to the Spread of Invasive Plants at SIUE</td>
<td>E HOFFMAN*, J MARKOVICH, S DILTZ, H HAAG, S KHADKA, and E WALTON</td>
</tr>
<tr>
<td>Everyone’s a Winner: the Turtle, Science, &amp; Community</td>
<td>M MICHELI-CAMPBELL*, C FRANKLIN, and M CONNELL</td>
</tr>
<tr>
<td>Status Surveys of Two Endangered Softshell Turtles in Peninsular India</td>
<td>S SIRSI, B MURTHY, and S SINGH</td>
</tr>
<tr>
<td>Can Automated Radio Telemetry be used to Quantify Ornate Box Turtle (Terrapen ornata) Activity and Nesting Patterns?</td>
<td>T RADZIO*, J STRICKLAND, C TUCKER, and D DELANEY</td>
</tr>
<tr>
<td>A Study on In-situ and Ex-situ Rearing of Narrow Headed Softshell Turtle (Chitra indica) in National Chambal Sanctuary, India with Special Reference to Nesting and Hatching Conditions</td>
<td>R SHARMA and S SINGH</td>
</tr>
<tr>
<td>Understanding the Historical Range of the Radiated Tortoise (Astrochelys radiata): Preliminary Outcomes from a Projection Modeling Initiative</td>
<td>T RADELARISSOA*, R WALKER, and E LOUIS JR.</td>
</tr>
<tr>
<td>Mountain Bog Habitat Restoration and Education and Outreach for the Bog Turtle in Northern Georgia</td>
<td>H HALL, C JENKINS, W TAYLOR, and C CASTELLANO</td>
</tr>
<tr>
<td>Freshwater Turtle Hunting Technology, Preservation Systems, and Complex Trade Social Networks in Bangladesh</td>
<td>M RAHMAN and D OLSON</td>
</tr>
<tr>
<td>Occurrence of Alien Species of Freshwater Turtle in an Urban Area in the Amazonia, Brazil</td>
<td>D FÉLIX-SILVA and J PEZZUTI</td>
</tr>
<tr>
<td>Conservation and Trade Management of Freshwater and Terrestrial Turtles in the United States</td>
<td>T LEUTERITZ</td>
</tr>
<tr>
<td>Distribution and Habitat Use of the Gopher Tortoise in a Declining Southeast Florida Conservation Area</td>
<td>J SCHOLL*, E FRAZIER, and T HINDLE</td>
</tr>
<tr>
<td>SIUE Box Turtle Demographic Study 2011</td>
<td>J MARKOVICH, S DILTZ, E HOFFMAN, H HAAG, S KHADKA, and E WALTON</td>
</tr>
<tr>
<td>Why Did The Terrapin Cross The Runway?</td>
<td>L FRANCOEUR, A KANONIK, and R BURKE</td>
</tr>
<tr>
<td>Initial Surveys for Diamondback Terrapins (Malaclemys terrapin) on Rockefeller Wildlife Refuge in Southwestern Louisiana</td>
<td>W SELMAN and B BACCIGALOPI</td>
</tr>
<tr>
<td>Gopher Tortoise (G. polyphemus) Management and Conservation on the Orianne Indigo Snake Preserve in Southeast GA</td>
<td>C JENKINS, D STEVENSON, K STOHLGREN, H HALL, J BAUDER, and C CASTELLANO</td>
</tr>
</tbody>
</table>

**Video Night – Monday 7:00 PM (Ballroom B)**

Pizza will be provided to those attending the video night presentation. Donations will be accepted to offset the cost of food. A cash bar will be available for beverages during the poster and video night sessions.

*Indicates Student Presentation for Student Awards Competition
Failing the Giant Tortoise: Massive Growth Potential Challenges Accepted Rearing Practices

COLETTE HAIRSTON ADAMS
Gladys Porter Zoo, Brownsville, Texas, USA
[cadams@gpz.org]

Over the past thirty years, chelonian husbandry has steadily improved, thereby increasing the chances that captive-reared hatchlings and juveniles will resemble their wild counterparts in appearance, behavior, and reproductive success. Information assimilated via controlled studies and trial-and-error has taken much of the mystery out of how to avoid many health problems and shell deformities, particularly in developing terrestrial species. Through the provision of adequate nutrition and proper accommodations, in most cases, our captive-reared young are getting closer to the wild standard. Exceptions to this collective success story seem to be the Giant Tortoises. Based on observations of growing Galapagos Tortoises (*Chelonoidis nigra*) at the Gladys Porter Zoo, and combined with information and photographs collected from numbers of Giant Tortoise owners, rearing a healthy, “normal” Giant Tortoise poses a unique set of challenges. Many of these are presumed to be related to the massive growth potential of the species. Failure to make adjustments for this difference has caused serious health issues often accompanied by abnormal shell growth and ambulatory problems that might preclude reproductive success at maturity. This presentation takes a practical look at the husbandry guidelines proven effective for most tortoises and offers some new perspectives on the special considerations that should be given a growing Giant Tortoise.

Captive Husbandry: Oral

Methodically Saving the Kwangtung River Turtle (*Mauremys nigricans*)

BEN ANDERS
Biology Department, Box 19498, The University of Texas at Arlington, Arlington, TX 76019, USA
[mbanders@uta.edu]

The Kwangtung River Turtle (*Mauremys nigricans*) is a highland stream-dwelling species endemic to the Pearl River drainage of Guangdong and Guangxi Provinces, China. Demand from Southeast Asian markets and abroad precipitated overcollection across this species’ known range, and in-situ conservation measures are currently impossible since there are no known populations in the wild. A detailed Taxon Management Plan (TMP) has been constructed with the initial goal to coordinate breeding and exchange among the limited captive stock available because the Kwangtung River Turtle is likely dependent on ex-situ assurance colonies for survival. The TMP gives protocol for two recovery methods, both of which aim to establish viable assurance colonies, eventually release head-started specimens into the wild, and subsequently track natural recruitment. Possible costs and benefits are outlined for range country headstarting vs. headstarting abroad and small-scale releases vs. large-scale releases. Simultaneous use of both methods is advocated, as this will lend insight on which method, if either, is more efficient. Minimum time commitment should be 21 years to foster analysis of success rates within and among recovery methods. The Kwangtung River Turtle presents a unique opportunity for scientific reestablishment of a turtle species within its former range, and methods outlined in the TMP should be used to secure a future for this unique, enigmatic component of southern China’s biodiversity.

Asian Chelonians: Oral (Student)

Diet of Creek-Dwelling Loggerhead Musk Turtles (*Sternotherus minor*) and Stinkpots (*Sternotherus odoratus*) in Northwest Florida

BENJAMIN K. ATKINSON1 AND MEAGHAN E. BERNIER2
1Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, Florida, 32611, USA
2Department of Environmental Engineering Sciences, University of Florida, Gainesville, Florida, 32611, USA
[bka@ufl.edu]

We collected fecal samples from 40 Musk Turtles at Nokuse Plantation, Walton Co., Florida. Loggerhead Musk Turtles, *Sternotherus minor* and Stinkpots, *Sternotherus odoratus*, were trapped in four blackwater creeks with considerable habitat differences. Our study systems were Dismal and Big Cypress Creeks (cypress-dominated floodplain swamp communities), and Black and Seven Runs Creeks (upland moderate-flow seepage-fed communities). We rinsed turtles to remove debris and held them individually overnight in plastic containers with fresh water. Turtles were then removed from the containers and the water was filtered through a fine mesh sieve. Filtered material was transferred to labeled 35 mm film canisters and stored in isopropyl alcohol for analysis. All turtles were released at the point of capture. Dietary analyses were conducted using a 30x binocular dissecting microscope. Prey was identified to the lowest taxonomic level possible for each turtle. We inferred relative importance of food items by separating sample contents by taxon in a Petri dish under the dissecting scope. We then transferred each taxonomic group of a sample into a graduated cylinder using microforceps and recorded the level of
volumetric displacement. Dietary analyses revealed a wide variety of food items consumed. Diets differed between study creeks and our data suggest an ontogenetic shift in dietary preferences. Diet composition was more diverse in turtles from higher primary productivity habitats: Dismal and Big Cypress Creeks, than the lower primary productivity habitats: Black and Seven Runs Creeks. Younger Musk Turtles fed more heavily on odonates (dragonflies and damselflies). Adults fed more opportunistically, consuming a wider range of prey including: pelecypods (bivalves), decapods (crayfishes), gastropods (snails), fishes, coleopterids (beetles), hymenopterids (ants), annelids (segmented worms), and simulids (flies). Our study reinforces the ecological assumption that habitat differences influence diet diversity.

**Poster Session (Student)**

**Movement Patterns and Habitat Use of Soft-released Translocated Spur-thighed Tortoises, *Testudo graeca***

**OMAR ATTUM1,3, MOHAMMAD OTOUM1, ZUHAIR AMR2, AND BILL TIETJEN1**

1Royal Society for the Conservation of Nature, P.O. Box 1215, Jubeiha 11941, Jordan
2Department of Biology, Jordan University of Science & Technology, P.O. Box 3030, Irbid, Jordan
3Department of Biology, Indiana University Southeast, 4201 Grant Line Rd., New Albany, IN 47150, USA
[oattum@ius.edu]

Wildlife translocations, the deliberate movement of animals from one part of their distribution to another, are increasingly used as a conservation method for the reestablishment of rare and endangered species. The objective of this study was to examine the movement patterns and macro and microhabitat use of translocated and resident Spur-thighed Tortoises. This translocation was considered a soft-release as the tortoises were forced to be relatively inactive due to being released at the beginning of the aestivation season. Our results suggest that forced aestivation soft-releases may succeed in reducing dispersal by forcing Spur-thighed Tortoises to spend time at the release site as the majority of translocated tortoises had similar activity range sizes and movement path tortuosity as resident tortoises. Spur-thighed tortoise conservation will require protecting habitats at multiple scales, with the remaining native forests in the country of Jordan being important to the spur-thighed tortoise during the activity and aestivation / hibernation seasons as this macrohabitat was used significantly more than the human-modified habitats. Microhabitat structures such as leaf litter and availability of large stones may also be especially important in human-modified landscapes as these microhabitats may help reduce the effects of habitat degradation.

**Turtle Ecology:** Oral

**Bioclimatic Variables and Distribution of Freshwater Turtles in Brazil**

**ALEX BAGER, JÚLIO CÉSAR LIMA, ALINE COSTA, AND ISABELLA ABREU**

Department of Biology, Universidade Federal de Lavras, MG, CEP 37200 000, Brazil
[abager@dbi.ufla.br]

The distribution of species depends on intra- and interspecific interactions, in addition to climatic and geographic aspects. Knowing the species’ distribution favors the development of in-situ conservation strategies. Our objective was to identify the variables that Brazilian freshwater turtle species depend upon. Models were created for *Acanthochelys spixii*, *Mesoclemmys hoge*, *Mesoclemmys tuberculata*, *Mesoclemmys vanderhaegei*, *Hydromedusa tectifera*, and *Hydromedusa maximiliani*. We used the Maxent program and seven bioclimatic variables: 1) average annual temperature; 2) average daily temperature; 3) maximum temperature of the hottest month; 4) minimum temperature of the coldest month; 5) annual precipitation; 6) precipitation of the rainiest month; and 7) precipitation of the driest month). We used scales of 800-m and 8-km for Brazil and 8-km for South America. The relationship between variables and turtle species was defined through a cluster analysis. All models had an area under the curve (AUC) greater than 0.867. According to model results, the 8-km scale model for Brazil was the most appropriate due to the cluster analysis and AUC greater than 0.904. *Hydromedusa tectifera* and *Acanthochelys spixii* were separated from other species by similar annual average temperature, showing that they dwell in similar environments. *Hydromedusa maximiliani* was influenced by the variables maximum temperature of the hottest month and average daily temperature, indicating the species prefers local regions of high altitude with high daily temperatures. *Mesoclemmys* was clustered; however, with distinctions among species. The model confirmed *Mesoclemmys tuberculata*’s preference for regions with low rainfall and high temperatures. *Mesoclemmys vanderhaege* distribution was influenced by the variable precipitation of the rainiest month, confirming the distribution of the species in areas with well-defined dry seasons. The results for *Mesoclemmys hoge* showed high relationships with cold environments and low rainfall. The variables
considered important by the models are consistent with the existent data of distribution for these species. This project was supported by Fapemig (APQ 00132-09).

**Poster Session**

**Selectivity of Different Sampling Methods: Case Study for Trachemys dorbigni (Testudines, Emydidae)**

**ALEX BAGER AND MELISE SILVEIRA**

*Department of Biology, Universidade Federal de Lavras, MG, CEP 37200 000, Brazil*

[abager@dbi.ufla.br]

Interpretations of species population structure are directly dependent on sampling method and selectivity related to sex, size and life stage. Many studies discuss advantages and disadvantages of the capture methods in relation to species abundance, but few compare the relative efficiency. We analyzed the variation in size structure and life stage rates of a population of Trachemys dorbigni in the county of Pelotas, Brazil, using four different sampling methods. Two models of fyke nets were used: fyke simple (FS) and fyke multiple (FM), as well as two manual collecting methods: captura de agua (water) (CA) and capturo campo (field) (CC). Our objective was to determine which method approximates the real population structure and which of the four methods is more accurate. We captured 548 turtles including hatchlings, juveniles and adults with carapace lengths ranging from 37.4mm to 255mm. The CA and FS methods had the same life stage structure with 80% of the adults recaptured with a sexual ratio of 1:1, and 20% of hatchlings and juveniles recaptured. The FM method recaptured 45% of males, 28% of juveniles and only 21% of females. The CC method was more efficient in identifying nesting females (97% recaptured) because few males are ever found on land. In size structure, females from the CC method were significantly larger in carapace length than with the other methods (average = 206.2mm; \( n = 93 \)). The smaller carapace lengths were found using the FM method (average = 162.3mm; \( n = 7 \)). We did not observe any significant difference for male turtle carapace size among the different methods. FS was the best overall capture method with the recapture of the largest males and females and a population structure that corresponded to the original captures and an identical life stage rate with CA. The results show the importance of analyzing research methods to analyze efficiency and selectivity of sampling designs. This project was supported for Fapemig (APQ 00132-09).

**Poster Session**

**Captive Breeding of the Chinese Yellow Headed Box Turtle (Cuora aurocapitata) at the Wildlife Conservation Society’s Bronx Zoo**

**MEGAN C. BAUMER, PAUL E. KMIOTEK, AND C. DREW FOSTER**

*Department of Herpetology, Wildlife Conservation Society / Bronx Zoo, Bronx, NY, 10460, USA*

[mBaumer@wcs.org]

Cuora aurocapitata is an aquatic, montane turtle species native to the Anhui province of eastern China. It is potentially extinct in the wild and currently classified as Critically Endangered by the International Union for the Conservation of Nature and listed under CITES as an Appendix II species. According to the International Species Information System, the Bronx Zoo is the only American Zoo Association institution currently working with Cuora aurocapitata with 2.2.1 animals. Female 1 was already in a controlled brumation when our second female (female 2) was recalled from a breeding loan. Our breeding male and female 1 were brumated in a Thermoforma incubator for approximately 6 months. In this controlled environment, water temperatures dropped to 3.3°C. Female 2 was bromated in an outdoor garage for approximately five months where water temperatures were more varied and reached a low of approximately 6°C. At the termination of brumation, turtles were moved into breeding enclosures and housed individually except during pairings. The male was introduced into each female’s enclosure several times for up to 30 minutes while staff monitored behaviors. Both females were receptive and the male copulated with female 2 in her breeding enclosure. After unsuccessful pairings with a receptive female 1, however, she was introduced into the male’s enclosure for mating where copulation occurred. Both females laid eggs 44 days after copulation. Palpation of female 2 on day 39 indicated she was ready for oviposition. She was placed in a nesting tank where she laid three eggs on 10 June. Female 1 laid four eggs on 14 June in her enclosure. All eggs are being incubated individually in 6:5 vermiculate:water in 16 oz. deli-cups with three ventilation holes at either 25°, 27.5° or 30°C. Despite differences between brumation parameters and enclosure types, both adult females laid fertile eggs, and we attribute this success to changes to our husbandry parameters.

**Captive Husbandry:** Oral
Status of the Yellow Spotted River Turtle (*Podocnemis unifilis*, Troschel 1848) in Amazon Basin in Brazil

**Virgínia C. D. Bernardes, Rosana De Almeida Thiel, and Richard C. Vogt**

*Association of Ichthyologists and Herpetologists of the Amazon, Manaus, Brazil*

[virginiabernardes@yahoo.com.br]

*Podocnemis unifilis* is known from the Amazon Basin of Colombia, eastern Ecuador, northeastern Peru, northern Bolivia, southern Venezuela, and Brazil, and the Caribbean drainages of the Guianas, Venezuela, and Colombia. *Podocnemis unifilis* is a relatively large member of the genus, up to 46 cm in carapace length and up to 8 kg body mass. The head of hatchlings and juveniles is black with bright yellow spots. Although most of the head spots are retained in adult males, they are lost in adult females. Sexual dimorphism is marked: adult males possess head spots; a longer, thicker tail, with more distally-located vent; a deeper anal notch; and are smaller (carapace length to 33.5 cm; females to 46.5 cm). The Yellow Spotted River Turtle, was recently listed by the Tortoise and Freshwater Turtle Specialist Group of the Species Survival Commission of the IUCN as endangered, as endangered by the US Fish and Wildlife Service, and it is on Appendix II of the Convention on International Trade of Endangered Species (CITES). While still abundant locally, many populations of Yellow Spotted River Turtle in Brazil are experiencing a decline due to the indiscriminate collection of turtles and their eggs in many areas. The exploitation of *Podocnemis unifilis* populations is currently increasing due to a dramatic decline of *Podocnemis expansa* populations and their populations have been reduced. In contrast, there are high-density populations in many rivers inside reserves. In the Trombetas River Biological Reserve, we studied the population structure of *Podocnemis unifilis* for four years using the capture and recapture method. We captured 2,544 individuals: 931 females, 851 males, and 758 juveniles. The recapture rate of 2.79%, suggests that the population is stable, but it is necessary to monitor this population over the long term to determine the conservation status in this Reserve.

**South American Turtles – Brazil:** Oral (Student)

Ecology of *Podocnemis erythrocephala* in the Middle Rio Negro, Amazon, Brazil

**Rafael Bernhard** and **Richard C. Vogt**

1Associação de Ictiólogos e Herpetólogos da Amazônia, Av. André Araújo, 2936, Manaus, AM, Brazil, 69083-000

2Instituto Nacional de Pesquisas da Amazônia – Av. André Araújo, 2936, Manaus, AM, Brazil, 69083-000

[rafbernhard@gmail.com]

*Podocnemis erythrocephala*, the Red-headed Amazon River Turtle, is a species of turtle that inhabits black water rivers and lakes in the Rio Negro Basin and ventures into clear water habitats in the Tapajós and Trombetas Rivers in Brazil. It is also found in the extreme eastern tip of Colombia and most of the states within the Venezuelan part of the Amazon Basin. This is one of the most consumed species of turtle in the Rio Negro Basin. The existing information documenting the natural population sizes of Podocnemididae are scarce, therefore, monitoring studies are needed for all of the species in this family. Here we present the results of a five-year population study conducted with the objective of characterizing the population structure, growth rates, sexual maturity, and movement patterns of *Podocnemis erythrocephala* in a tributary of the Rio Negro, situated in Amazonas state of Brazil. The study was conducted between 2003 and 2008 in a 148.5 km section of the Ayuanã River, a small lake in an island in the channel of Rio Negro, and the Jurubaxi River. Turtles were captured in trammel nets and during free diving. We marked 4,111 individuals. The estimated sex ratio for the population in the Ayuanã River was 0.41:1. The proportion of juveniles was estimated to be 40% for the population studied. The frequency of recaptures suggests that only a small part of this population was captured during this study. The study concerning movement patterns (defined as the linear distance between the points of capture) indicates that this species disperses along the entire Ayuanã River without having a small fixed area of use. The linear distance moved by females was greater than that observed for males. The longest linear distances moved were greater than 2.7 km, including the movements between Ayuanã River and a lake in the middle of the Rio Negro, or to the next river entering the Rio Negro, the Jurubaxi River. The size at sexual maturity in males and females was 161 and 218 mm in straight-line maximum carapace length, respectively. Both sexes attain sexual maturity at about 10 years.

**South American Turtles – Brazil:** Oral

The Effectiveness of Conservation Actions to Protect the Five Endangered and Threatened Gopherus Species

**Kristin H. Berry** and **Matthew J. Arecco**

1U.S. Geological Survey, Western Ecological Research Center, Riverside, CA, USA

2Nokuse Plantation, Bruce, Florida, USA

[kristin_berry@usgs.gov]

9th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles | Orlando, Florida
We evaluated rankings of rarity and endangerment, threats, and conservation measures taken to protect Gopherus flavomarginatus, Gopherus polyphemus, Gopherus agassizii, Gopherus berlandieri, and the newly described tortoise in the southwestern United States (U.S.) and Mexico. The five or potentially six species of Gopherus are federally listed as threatened or endangered in one or both countries (U.S., Mexico) where they occur. Species occurring within the U.S. also are protected by state statutes, acts or other regulations, but few regulatory agencies protect species from incidental take, and none require protection of habitat on private land. Two species, Gopherus polyphemus (in part) and Gopherus agassizii, have federal recovery plans and one species, Gopherus agassizii, has designated critical habitat. All five described species have commonalities: some populations and habitats ostensibly are protected within natural areas, national wildlife refuges, national and state parks or wilderness, federally designated critical habitats, or, in the case of Gopherus flavomarginatus, a biosphere reserve. Unfortunately, existing protective measures are insufficient to prevent anthropogenic sources of mortality, disease, and trauma to individuals; loss, deterioration, conversion, and fragmentation of habitats; and loss of connectivity of populations and habitat. Non-profit, non-government organizations have played critical conservation roles. They have petitioned federal and state governments to list some species or population segments, secured conservation easements on unprotected habitat and purchased land, hastened implementation of recovery or other management plans through court actions, and protected tortoises from mortality. Two species, Gopherus agassizii and Gopherus polyphemus, have organizations actively advocating for their well-being. Translocation is being used to minimize losses in some species, but more research is essential to determine long-term effectiveness. Translocation, combined with mitigation fees, is now the core permitting strategy for Gopherus polyphemus on development lands in Florida and the federally listed part of its range. Head-starting to augment populations is another conservation tool. Gopherus flavomarginatus has an ex-situ head-starting program. Gopherus berlandieri is in need of active conservation and education programs. Populations of three species in Mexico would benefit from strong advocates. In spite of existing efforts, most Gopherus species continue to decline, none has “recovered,” and enormous challenges remain.

**North American Tortoises: Oral**

**Contributions to the Study and Conservation of the Colombian Slider (Trachemys callirostris)**

**BRIAN C. BOCK, VIVIAN P. PÁEZ, JUAN M. DAZA, AND ADRIANA RESTREPO**

Instituto de Biología, Universidad de Antioquia, AA 1226, Medellín, Colombia
[brianbock1@gmail.com]

We have studied the Colombian Slider, Trachemys callirostris, in the middle Magdalena River drainage since 2000, providing the first detailed information on its basic nesting ecology, including data on nest site preferences, hatching success rates, and causes of egg mortality. We also successfully incubated eggs obtained from the oviducts of sacrificed females in artificial nests. Morphometric comparisons of nine populations showed that both habitat characteristics and levels of exploitation influenced mean female body size, which in turn influenced reproductive potential and offspring characteristics. Levels of reproductive investment varied over the course of the nesting season. Allozyme analyses revealed low levels of genetic variation and no evidence of genetic structure within the drainage, but we are currently inspecting for structure on a wider geographic scale using more variable genetic markers. We also are beginning two new projects: one designed to provide information on variation among sites in key life history parameters (such as survivorship rates, fecundities, inter-clutch intervals, size at first reproduction, and effective sizes of breeding populations) using a combination of mark-recapture, telemetry, and DNA fingerprinting techniques. Our goal is to produce matrix projections of the demographic tendencies of these populations to provide management authorities with more scientifically based conservation proposals. The other new project also has conservation implications in that it aims to assess levels of mercury bioaccumulation by Trachemys callirostris in different habitats and to inspect for evidence of genotoxicity due to the considerable environmental contamination in this region. The logic is that if existing legislation designed to protect the species has been ineffective, perhaps by demonstrating that consumption of Trachemys callirostris meat and/or eggs represents a human health risk, we will have a greater impact on curtailing the levels of over-exploitation of this species. Laboratory studies also are inspecting for the effects of differing levels of exposure to mercury on neonate growth rates, performance, and other behavioral attributes. Artificial incubation of nests is also providing the first data on the threshold incubation temperature in this species with temperature-dependent sex determination.

**South American Turtles – Colombia: Oral**
Management Plan for the “Hicotea” Turtle in the Caribbean Wetlands of Colombia, South America

ARGENIS BONILLA, NATALIA LUQUE, ELIANA MARTINEZ, MONICA CUERVO, ARGELINA BLANCO, PRISCILLA SAAB, LUCIA JARMILLO, DARIO ZAMBRANO, AND SIMON QUINTERO

Biología de Organismos Tropicales, Department of Biology, Universidad Nacional de Colombia, Bogotá, Colombia

[mabonillag@unal.edu.co, nluques@unal.edu.co]

The endemic Caribbean “Hicotea” Turtle (Trachemys callirostris callirostris and Trachemys venusta venusta) has one of the highest numbers of illegal fauna traffic in Colombia. These two species are highly hunted and consumed by the local people of the Colombian coasts as a cultural custom during the Holy week. In addition, these turtles are hunted as a source of protein in poor rural areas all year round, and are illegally captured to be sold as pets. Very little is known about the populations, distribution, biology and natural history of these two species in Colombia. The construction of a management plan was not only urgent, but also pioneering because of the inclusion of the use perspective. The methodology included expert consultations, a participative workshop with academics, legislative agencies, staff and local community surveys, as well as local data gathering of capture methods and evidence of traffic in the site. In this way, we found information about principal collecting sites, traffic routes, extraction methods, natural and anthropogenic threats to the species, principal distribution, as well as the local community perspectives about the possible uses and regulatory guidelines for the species. Finally, a multi-perspective management plan was developed, which included the priority to recognize the importance of these species in the culture and life of the local people. It is also necessary to develop a deeper understanding of the biological processes of the two species in order to establish and regulate the priority spots for conservation and protection, and the possible uses of the species in each place.

South American Turtles – Colombia: Oral

Big Apple’s Terrapins Undergoing Dramatic and Rapid Reproductive Changes

RUSSELL BURKE

Department of Biology, 128 Gittleson Hall, Hofstra University, Hempstead, NY 11549, USA

[biorlb@hofstra.edu]

My lab has been conducting a mark-recapture study of Diamondback Terrapins (Malaclemys terrapin) in Jamaica Bay, New York City, since 1998, to determine whether this population is sustained by recruitment. Hatching success of eggs under good field conditions is > 80%; however, raccoons predate 95 – 98% of nests. Hatchlings are also predated by Norway rats. The number of nesting females in the population has remained fairly constant at just under 1,000 adults. However, the number of nests laid annually has been dropping steadily and is now 37% lower than in 1999. It appears that the number of nests per female is decreasing, and both average egg size and average clutch size is increasing. These are ecological, not evolutionary changes. Such changes have not been reported in any other turtle populations, but may be a response to decreasing resources due to the rapid erosion of Jamaica Bay salt marshes. Urban turtle populations probably experience dramatically different levels of resource availability than more natural populations, and the effects of both high and low resource levels should be explored.

Turtle Ecology: Oral

Survey of the Distribution and Population Status of the Ornate Diamondback Terrapin (Malaclemys terrapin macrospilota) in the Big Bend Region of Florida

JOSEPH A. BUTLER¹ AND GEORGE L. HEINRICH²

¹Department of Biology, University of North Florida, Jacksonville, Florida 32224, USA
²Heinrich Ecological Services, 1213 Alhambra Way S., St. Petersburg, Florida 33705, USA

[jbutler@unf.edu]

One important recommendation from a national group of terrapin biologists was to identify Diamondback Terrapin population centers so they can be studied and managed. Little is known about the Ornate Diamondback Terrapin from the Big Bend region of Florida and only 12 museum specimens are known from this area. We surveyed for terrapins from the St. Marks River south to the Suwannee River in order to identify terrapin populations, locate and assess nesting habitats, create maps demonstrating these areas, and offer management recommendations to improve terrapin conservation in this region. We used a combination of trapping, head counts in tidal creeks, and land surveys to accomplish our goals. We recorded 37 new terrapin sites, captured 5 live terrapins, recorded 6 intact nests, 16 crawls, terrapin remains from 48-49 individuals, and 453
raided nests. This survey documents the importance of this region as habitat for terrapins. These terrapin populations and their habitats warrant protection and large-scale development along this coastline should be resisted. We also recommend the continuation of Florida Fish and Wildlife Conservation Commission funding for Diamondback Terrapin surveys along the Gulf coast of Florida so that other population centers can be identified.

**Population Studies: Oral**

**Effects of Warmer than Normal Incubation Temperature upon the Behavioral Function of the Hatchling Freshwater Turtles**

**MARIANA A. MICHELI-CAMPBELL, HAMISH A. CAMPBELL, DAVID BOOTH, AND CRAIG E. FRANKLIN**

*School of Biological Sciences, The University of Queensland, St. Lucia, Queensland, 4072, Australia*

[m.campbell4@uq.edu.au]

The Mary River Turtle (*Elusor macrurus*) is listed as the 20th most endangered freshwater turtle in the world. The population has undergone significant decline over the last three decades and the present population is located within a single river system in Eastern Australia. Archival meteorological data shows that the local ambient temperature has undergone a 0.7°C increase since 1980, and the present study aimed to quantify whether slight alterations in nest temperature during incubation affect the physiological and behavioral traits of the hatchlings. We recorded the average temperature from wild *Elusor macrurus* nests during the 2009 – 2010 nesting season, and mean nest temperature ranged between 26 to 31°C. Freshly laid *Elusor macrurus* eggs were collected and incubated at three constant thermal regimes, from the lowest to 1°C above the mean nest temperature recorded in the wild (26, 29 and 32°C). Embryos incubated at the warmest regime had the shortest incubation period, but upon hatching their growth rate was significantly less than those incubated at the lower temperatures. The warmer the incubation temperature, the lower stroke force exhibited by the hatchlings whilst swimming, and the lesser the amount of time they spent swimming during a trial. The implications of this reduced swimming performance could be observed in the behavioral function, as turtles incubated at 32°C spent most of their time in shallow water, whilst turtles with the better swimming performance (incubated at 26°C) preferred to remain in deeper water. The food supply of hatchlings *Elusor macrurus* and their refuges from predators are located on the river substratum and we hypothesize that the eggs incubated at 32°C would have an impaired survivorship in the wild because of a reduced prey consumption and exposure to predators. Although other factors may have been significant in the decline of the *Elusor macrurus* population, the present study shows that hatchlings incubated at warmer temperatures have a reduced ability to carry out the necessary behaviors for survival. Climate models predict a 1.6 to 3.0°C rise in ambient temperature for this locality by 2070, and therefore, we argue that the survival of hatching *Elusor macrurus* may be further compromised.

**Turtle Ecology: Oral (Student)**

**Everyone’s a Winner: the Turtle, the Science, the Community**

**MARIANA A. MICHELI-CAMPBELL¹, CRAIG E. FRANKLIN¹, MARILYN CONNELL²**

¹*School of Biological Sciences, The University of Queensland, St. Lucia, Queensland, 4072, Australia*

²*Tiaro & District Landcare Group, PO Box 6, Tiaro, Queensland, 4650, Australia*  

[m.campbell4@uq.edu.au]

The Mary River Turtle (*Elusor macrurus*) is the second most endangered freshwater turtle in Australia. Currently, there are no direct conservation actions being undertaken by the Australian Government. Concerned about the urgent situation, the local rural community – Tiaro & District Landcare Group – has taken action to aid the survival of this species through a multi-pronged conservation approach. The program incorporates in-situ nest protection, educational activities, fund raising and establishment of a support scholarship for a post-graduate student, funded through sales of home made chocolate turtles. The partnership has allowed the Tiaro community to gain new skills and knowledge, economic benefit for local businesses, and cross-cultural exchanges. Collaborating with a tertiary institution has also opened new funding opportunities to the landcare group that were previously unavailable. The University has benefited from local knowledge about the turtles’ biology, access to landholders, equipment and field assistance. Both community and academia possess a different array of skills and knowledge base, which complement each other to further the biological understanding for this species, and other threatened freshwater turtles. Essentially, the primary goal of turtle conservation is enhanced through the partnership; everyone’s a winner.

**Poster Session (Student)**
The Pinzón Island Tortoise (*Chelonoidis duncanensis*): From Certain Extinction to the Final Stage of a Conservation Miracle  

**FRED CAPORASO**  
*Schmid College of Science, Chapman University, Orange, CA 92866 USA*  
[caporaso@chapman.edu]

This presentation details the challenging natural history of a species of Giant Tortoise from a remote uninhabited island in the Galápagos Islands. Due to the introduction of Black Rats (*Rattus rattus*) onto Pinzón in the late 1890s, this species had no surviving young for over 70 years! For most animals on Earth, this would assure extinction, but Galápagos Tortoises are unique and can effectively reproduce through old age. The extraordinary conservation program conducted jointly by the Charles Darwin Research Station (CDRS) and the Galápagos National Park Service (GNPS) to bring the Pinzón Island Tortoise back from the brink of extinction will be presented. A dismal census in the early 1960s revealed a small population of only very old adults, and no surviving young. The initial plan in 1965 called for egg collection followed by incubation and hatching rearing at the CDRS. The first 20 young tortoises were repatriated to Pinzón in 1970, and were exhibiting courtship behavior in August of 1986 when I visited. In total, 552 tortoises were repatriated to Pinzón by 2007, but attempts to rid the island of rats were still not successful. In 2007, Linda Cayot, Galápagos Conservancy, facilitated a workshop and was the primary author of a plan to eradicate introduced rodents in the Galápagos (Development of a Strategy for the Eradication of the Introduced Rodents in the Galapagos Islands). In January 2011, I witnessed the initial test phase of this project, the helicopter baiting of Bartolomé, a small islet with an alien rodent population. A cereal bait containing brodifacoum, an anticoagulant based poison was used. Recently, 8.12 adult Pinzón tortoises, half repatriated animals and half old adults, were moved to an isolated breeding coral at the CDRS. By January 2011, 30 eggs had been laid and were incubating.

**Field Studies:** Oral

Kawartha Turtle Trauma Centre: Conservation in Action  

**SUE CARSTAIRS**  
*Kawartha Turtle Trauma Centre, Peterborough, Ontario*  
[suecarstairs@sympatico.ca]

The Kawartha Turtle Trauma Centre’s (KTTC) mission is to make Ontario a safer place for its native turtles through operating a hospital for native turtles, creating an appreciation of Ontario’s turtles, and increasing our impact through partnerships and professional cooperation. Ontario has 8 species of turtles, 7 of which are presently on the list of Species at Risk in Ontario. KTTC is located in Ontario, Canada. One of only two rehabilitation centers that specialize in Ontario’s turtles, KTTC is a registered charity formed in 2002. In 2010, the center admitted 242 turtles. In addition to the adult turtles presented to it, KTTC also harvests eggs from gravid females. In 2010 we hatched 102 turtles and it is anticipated that this headstarting project will expand greatly next season. We have also partnered with the Ministry of Natural Resources on a separate headstarting project. A study to evaluate the effectiveness of road signage is underway. Additional projects, including post release studies, toxicological studies, and establishment of normal blood values, are planned pending funding. The other essential component of this conservation initiative is an extensive education and outreach program. We reached over 6,000 people in 2010, thanks to an Ontario Trillium Foundation grant. Education as to the plight of Ontario’s turtles targeted specific groups such as cottagers, motorists, boaters, fishermen, and students, to implement change. Conducting workshops on turtle trauma is also an ongoing initiative of KTTC, and we recently completed one in conjunction with Seneca College which drew participants from the veterinary, biology, rehabilitation, zoo and shelter world, from all over the province. KTTC also has an extensive training program for their many volunteers. The centre is almost entirely volunteer run, with volunteers in husbandry, turtle ambulance, outreach, and fundraising. The KTTC partners with many organizations including the Riverview Park and Zoo, Metro Toronto Zoo, Ontario Road Ecology Group, Ecokare, Toronto Wildlife Centre, Midland OSPCA, universities and colleges, private veterinarians, and province wide rehabilitation centers. We hope that further partnerships will develop over the following years, and that our effect will be felt on a wider scale.

**Chelonia Conservation:** Oral

---

9th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles | Orlando, Florida
Assessing the Impacts of the Invasive Cane Toad (*Bufo marinus*) on the Little-known Sandstone Long-necked Turtle (*Chelodina burrungandjii*) and North-west Red-faced Turtle (*Emydura australis*) in the Kimberley, Western Australia

CHRISTINA M. CASTELLANO¹, J. SEAN DOODY², AND DAVID RHIND³

¹The Orianne Society, 579 Highway 441 South, Clayton, Georgia 30525, USA
²School of Biological Sciences, Monash University, Clayton, Victoria 3800, Australia
³Department of Sustainability, Environment, Water, Populations and Communities, Canberra, ACT 2601, Australia

[ccastellano@oriannesociety.org]

Australia is critical for the conservation of turtles on a global scale. It is one of the world’s turtle diversity hotspots with about 24 freshwater species. About 85% of these species are endemic to the island and nearly 30% are threatened with extinction. Habitat loss, illegal collection for the pet trade, egg predation by feral animals, and reduced water quality are the primary causes for population declines. In addition, the spread of the toxic Cane Toad (*Bufo marinus*) may result in major negative impacts for Australia’s turtles. Since its introduction into Australia in 1935, the Cane Toad has advanced from Queensland through to Western Australia. It has had major negative impacts on several native species through toxic lethal ingestion; nevertheless, impacts do vary significantly among and within taxonomic groups. The impact of the Cane Toad on freshwater turtles has not been previously investigated. This study aims to determine the impacts of this toxic invader on the little-known Sandstone Long-necked Turtle (*Chelodina burrungandjii*) and North-west Red-faced Turtle that inhabit the Kimberley, Western Australia. These species occupy rivers and rock pools along some of the gorges within the El Questro Wilderness Park and it is expected that the Cane Toad will enter these waterways as soon as 2012. A mark-recapture study has been initiated to determine population trends following the arrival of the toad. Understanding the interactions between invasive and native species is critical for determining management and conservation strategies.

Field Studies: Oral

Impacts on the Endangered Mary River Turtle During an Australian Summer of Floods

MARILYN CONNELL¹ AND MARIANA A. DE MICHELI-CAMPBELL²

¹Tiaro & District Landcare Group, P O Box 6, Tiaro 4650 Queensland, Australia
²School of Biological Sciences, University of Queensland, St. Lucia, Queensland. 4072, Australia

[connellmarilyn@gmail.com]

Early spring rains assisted in creating ideal nesting conditions for the endangered Mary River Turtle (*Elusor macrurus*). Seventy-five Mary River Turtle nests were located and protected *in-situ*, making it one of the most productive seasons recorded by Tiaro & District Landcare Group since 2001. However, due to a La Niña event, major flooding occurred in many rivers throughout the State of Queensland (Australia) in late 2010 to early 2011 which coincided with the incubation period of the Mary River Turtle. Falls of over 300mm (12inches) of rain were recorded within a 24-hour period. In the mid catchment, the Mary River (Queensland) rose over 15m causing it to over top the banks and flow out onto the floodplain. Four days after the peak of the flood, the river peaked again at a similar height amplifying and prolonging the impacts. River banks were eroded, riparian vegetation washed away and enormous quantities of sand, gravel and cobbles moved through the river system smothering aquatic plants and submerging basking platforms and all nesting banks. Turtles were observed in flooded minor gullies escaping the high flow. The severity of the erosion has made some banks unsuitable for nesting activity in the next season. As all nesting banks were submerged, all the Mary River Turtle eggs laid during the 2010/2011 nesting season which were not relocated were drowned. Observations of basking indicate changes in usual behaviour due to logs and rocks being submerged for lengthy periods. Tiaro & District Landcare Group aims to monitor the nesting patterns of this species throughout future years to investigate if this season’s flooding events had a significant impact on *Elusor macrurus* populations.

Turtle Ecology: Oral

Effects of Forest Management on the Ecology and Behavior of Eastern Box Turtles

ANDREA CURRYLOW, BRIAN MACGOWAN, AND ROD WILLIAMS

Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana USA

[A.Currylow@gmail.com]

Despite declines, Eastern Box Turtles’ (*Terrapene carolina carolina*) ability to endure in a range of available habitat and its physiological ties to environmental flux make it ideal for study of habitat use and selection amid anthropogenic disturbances.
We investigated temporal thermal habitat availability, habitat use, thermal behavior, and intersexual differences among 50 Eastern Box Turtles within the framework of a managed forest setting. As part of the Hardwood Ecosystem Experiment, we used nine experimental forest management sites to investigate the effects of clearcut and group selection harvest openings on box turtles. Analyses included movement parameters from radiotelemetry and GIS and temperatures during the active seasons from 2007-2010. During the winter of 2010, we also investigated the hibernal thermal ecology within clearcut harvest openings. We found that timber harvests had no effect on home range size using 100% Minimum Convex Polygons (MCP), however our turtles maintained MCPs that were 33% larger than any other published report for this species. Following harvests, turtles decreased the daily distances they traveled by approximately 30%, but their thermal optima increased by 8%. Microclimates inside the timber harvests were significantly warmer (29%) in the summer and colder (31%) in the winter than forested habitats, effectively excluding many animals from consistently using them. Instead of leaving the harvested areas, however, turtles continued to use the habitat differently. During the active season, box turtles used the edges of harvest areas apparently for behavioral thermoregulation and possibly for foraging. Turtles that used the harvest areas maintained 9% higher body temperatures during the active season than those that did not. During the winter, turtles generally burrowed to 10 cm for overwintering, but depth varied by slope and gender. Depth influenced the emergence timing, which was also correlated with a soil-surface temperature inversion. A single female turtle that hibernated in a group-selection harvest opening had an estimated burrowing depth of nearly 30 cm to maintain her hibernal body temperature. Using Eastern Box Turtles as a model, our data indicate that even in a relatively contiguous forested landscape with small-scale timber harvests, there are local effects on the thermal ecology of ectotherms.

North American Box Turtles: Oral (Student)

Movement Patterns and Site Fidelity of Translocated Red Ear Sliders (Trachemys scripta elegans) and Common Musk Turtles (Sternotherus odoratus)

CHRISTIAN CUTSHALL, KELLY EBERLY, HANNAH DAY, AND OMAR ATTUM
Department of Biology, Indiana University Southeast, New Albany, Indiana 47150, USA
[cdcutsha@ius.edu]

Wildlife translocations – the movement of animals from one location to a new area where the species currently or historically occurred – are increasingly being used as a management tool to restore or rescue populations. Past translocations attempts have often been unsuccessful because of problems associated with low site fidelity and excessive movements. This study compares the movement patterns and release site fidelity of resident and translocated Common Musk (Sternotherus odoratus) and the Red-eared Slider (Trachemys scripta elegans) Turtles. There was no significant difference in the movement patterns (minimum convex polygon size, number of wetlands used, and the number of shifts between wetlands) between resident and translocated turtles for each species. There was also no overall significant difference in the site fidelity between resident and translocated turtles for each species as most individuals hibernated within the wetland in which they were released. In addition, resident and translocated turtles of both species used all four wetlands available at the study site, but spent the majority of their time in only one wetland. The translocated turtles may have experienced high levels of release site fidelity due to the fact that the chosen turtle species are highly aquatic and do not spend much time outside of the wetland. Therefore, translocated individuals of both species were forced to spend time in the wetland in which they were released. Our results suggest that translocations may be an effective management method to assist in the conservation of aquatic turtle species. Field Studies: Oral (Student)

Use of Side-scan Sonar to Detect and Survey Cryptic River Turtles
CHRISTINA M. DAVY¹ AND M. BROCK FENTON²
¹Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, ON, M5S 3B2 Canada
²Department of Biology, University of Western Ontario, London, ON, N6A 5B7 Canada
[christina.davy@utoronto.ca]

Threatened turtle populations in water-bodies with high turbidity and low visibility can be difficult to survey. Traditional sampling methods include trapping, netting, spot-light surveys and visual surveys. Each method has inherent biases and each may yield different results. A simple, rapid method for assessing abundance of cryptic river turtles would greatly improve our ability to assess the status of such species, many of which are at risk. Side-scan sonar produces an acoustic image of the river bed, effectively enabling one to “see through the water”. Side-scan sonar signals are reflected best by hard, smooth surfaces and by objects filled with air. We therefore hypothesized that this technology could be used to detect and assess abundance of...
cryptic river turtles. We tested the sonar survey method from May 2 – 8th 2011 in the New River Lagoon, Lamanai, Belize. The New River Lagoon is home to the critically endangered Central American River Turtle (Dermatemys mawii), a large, nocturnal species which is difficult to survey in turbid waters. We combined sonar surveys with visual surveys, and we set trammel nets and baited hoop traps in order to compare the efficacy of side-scan sonar compared to other traditional turtle sampling methods. Turtles were less obvious on the sonar output than we had expected, but showed up clearly when positioned at right angles to the direction of the sonar signal. Surprisingly, Morelet’s Crocodiles (Crocodylus moreletii) were also successfully detected on the sonar output. We detected no turtles through visual surveys. Our baited hoop traps captured one juvenile Mesoamerican Slider (Trachemys venusta) in 288 trap hours (0.003 turtles/hour), while six Dermatemys mawii and one large Trachemys venusta were captured in 4 hours of nocturnal trammel-netting (1.75 turtles/hour). In comparison, we detected on average 0.75 turtles/hour during daytime sonar surveys, and 4 turtles/hour during nocturnal sonar surveys. We conclude that sonar surveys are a useful detection tool for large river turtles in waterways with soft substrate, and that side-scan sonar can detect a comparable or increased number of turtles compared to traditional survey methods.

**Turtle Ecology:** Oral (Student)

Decline of Hoge's Sideneck Turtle (*Mesoclemmys hogei*) in the Medium Carangola River, State of Minas Gerais, Brazil  
**GLAUCIA DRUMMOND**, **MARCOS COUTINHO**, **ROGÉRIO SILVA**, **BRAZ COSENZA**, AND **RICHARD C. VOGT**

1Biodiversitas Foundation, 277, Governador Israel Pinheiro Square, Belo Horizonte, Minas Gerais, Brazil  
2Center for Research and Conservation of Brazilian Reptiles and Amphibians/RAN–ICMBio, Brazil  
3Centre for Ecological Studies & Environmental Education, CECO, Brazil  
4National Institute for Amazonian Research–INPA, Brazil  
[glaucia@biodiversitas.org.br]

The Hoge's Sideneck Turtle, (*Mesoclemmys hogei*) is a freshwater turtle with geographic distribution restricted to the Brazilian southeastern Atlantic Forest. The species’ population status is defined as critically endangered according to the IUCN criteria, and is currently considered one of the world’s 25 most endangered freshwater turtle. The species is facing high risk of extinction in the wild in the near future, and its habitat, the Brazilian Atlantic Forest, is severely fragmented and subjected to a number of human disturbances which may critically impact population viability. Available data show that the Medium Carangola River in the state of Minas Gerais, Brazil is one of the rare sites where a natural population of *hogei* can still be found. Studies in the Medium Carangola River started in 1992 when we firstly estimated an index of population size based on capture success using fyke nets in an area of 5 km of river stream. In 2002, we applied the same methodology, but the capture effort increased and the sample area was expanded to cover 30 km of the River. From 2009 to 2011, we monitored the same sampled area and substantially increased the capture effort in order to detect trends in the index of population size. In total, we captured 208 turtles. The number of individuals captured ranged from 20 in 1992 to 90 in 2002, and 98 in 2011, whereas the capture success rate decreased steadily from 0.71 in 2002 to 0.05 in 2011. Based on the regression slope, we calculated the rate of population decline (1-e^-ß). Accordingly, since 1992, the Sideneck Turtle population in the Medium Carangola River has been declining at a mean annual rate of 16.2%, and is expected to experience local extinction in less than a 7-year time period. Given that the Medium Carangola River is a strategic site to *hogei’s* conservation, we suggest that strong action should be taken in order to prevent further damage to the natural population.

**South American Turtles – Brazil:** Oral

Alligator Snapping Turtles (*Macrochelys temminckii*) Alter Germination of Ingested Bottomland Hardwood Seeds  
**JEAN P. ELBERS AND DON MOLL**

Department of Biology, Missouri State University, Springfield, MO 65897, USA  
[jean.elbers@gmail.com]

Seed dispersal by animals is well documented in many habitats; however, this knowledge is depauperate in bottomland hardwood forests. The Alligator Snapping Turtle (*Macrochelys temminckii*) is a large freshwater turtle of the southeastern United States that consumes primarily fish, but also eats vegetation, including seeds of trees. To evaluate the role this species may play as a seed disperser in bottomland hardwood systems, we investigated the effect of ingestion by *Macrochelys temminckii* on germination of seeds of the following trees: common persimmon (*Diospyros virginiana*), water tupelo (*Nyssa aquatica*), and willow oak (*Quercus phellos*). Captive turtles were presented seeds of these three species in a series of feeding
trials. Ingested *Diospyros virginiana* seeds had a decreased percentage germinate, but did not differ in how quickly seeds germinated compared to uneaten *Diospyros virginiana* seeds. *Nyssa aquatica* seeds ingested by turtles did not differ from uneaten *Nyssa aquatica* seeds in percentage that germinated, but ingested seeds took longer to germinate than uneaten seeds. Ingested *Quercus phellos* seeds had an increased percentage germinate and also took less time to germinate compared to uneaten *Quercus phellos* seeds. This study suggests *Macrochelys temminckii* could play some role as a disperser of *Quercus phellos*, *Nyssa aquatica*, and *Diospyros virginiana*; however, information on post-dispersal seed fate is needed to completely assess this species and other freshwater turtles as dispersers of wetland vegetation.

**Turtle Ecology:** Oral (Student)

---

**Assessment of Gaps in Knowledge of the Family Chelidae in Brazil**

**CAMILA FAGUNDES**, **YEDA BATAUS**, AND **RICHARD C. VOGT**

1 Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, 69060-001, Brazil
2 Centro Nacional de Pesquisa e Conservação de Répteis e Anfíbios (RAN), Goiânia, Goiás, 74605-090, Brazil
3 Coordenação de Pesquisa em Biologia de Água Doce e Pesca Interior, Instituto Nacional de Pesquisas da Amazônia, Caixa Postal 478, Manaus, AM, 69083-000, Brazil

[milakurzmann@yahoo.com.br]

In 2010, studies and occurrence points available for the Brazilian continental turtle species were compiled under the coordination of *National Center for Research and Conservation of Reptiles and Amphibians* (RAN). This data gathering is important in developing public policies for the conservation of the group. The information was obtained from literature, the RAN database, researchers, herpetological collections and the Emysystem website. The maps were made using the program ArcGIS 9.3. Polygon shapefiles were created in ArcCatalog for each species based on their most extreme occurrence points. These were used in calculating the species’ extent of occurrence in relation to the Brazilian area (km²). The species occurring in more than 5% of the territory were considered widely distributed and those occurring in less than 5% of the territory were classified as having a restricted distribution. The family Chelidae in Brazil (n = 20) is poorly known. There is no information on reproductive aspects of 30% of the species and there is limited information on these parameters of 55% of the species. More detailed reproduction studies are only available for 15% of species (*Hydromedusa maximiliani*, *Hydromedusa testifera* and *Phrynops hilarii*). The reproduction data of *Acanthochelys radiolata*, *Acanthochelys spinii*, *Mesoclemmys tuberculata* and *Mesoclemmys vanderhaegei* are almost entirely from studies in captivity. Data on population structure are absent for 80% of species. Longevity is known for *Hydromedusa maximiliani* and *Chelus fimbriatus*, while the generation time is only known for *Hydromedusa maximiliani*. The sexual maturity size, reproductive mode (clustered or solitary nests) and reproductive seasonality (number of reproductive periods per year) have not been identified in 55% of species. The number of clutches laid within the same reproductive period has not been recognized in 60% of species. The main threats to the Chelidae family are habitat reduction (affecting 55% of species), illegal use (affecting 40%), urban occupation (affecting 40%), and deforestation, farming and industrial activity (affecting 35% each). Most species (60%) have wide distributions in Brazil, but there are many areas in their extent of occurrence that were not sampled. The creation of protected areas in Brazil is random and inadequate for turtle conservation.

**South American Turtles – Brazil:** Oral (Student)

---

**Captive Husbandry of the Yellow-margined Box Turtle (*Cuora flavomarginata*).**

**RAYMOND FARRELL**

Herpetological Associates, Inc., 31 Fayette Avenue, Staten Island, New York 10305

[Farrell31@aol.com]

The Yellow-margined Box Turtle can still be found in some remote parts of Taiwan, but is almost extirpated from mainland China and can be found only in small numbers on a couple of the Ryukyu islands of Japan. The decline of this species in its natural habitat has been caused by unrestricted collection for both the food and pet markets along with habitat alteration and development. *Cuora flavomarginata* was listed as CITES Appendix II on 19 July 2002. This species has been kept in captivity since the early 1980’s, however little has been published, until recently, on care and breeding. This is a hardy turtle and can be kept outdoors year round in most of the eastern, southern, and western parts of the United States. It prefers a damp environment and does not do as well outdoors in dry climates where temperatures exceed 90 degrees or higher. This species can hibernate up to six months a year in cold climates with little or no effect. *Cuora flavomarginata* generally nests on the East coast from May through July and can double clutch in July and August. Sex in this species is determined by incubation.
temperature (25ºC 100% males, 30ºC 100% females). Females lay from 1–5 eggs and average 3 eggs. The length of incubation ranges from 75–116 days depending on temperature. Blood samples on 25 founders were taken and analyzed using mtDNA data to determine if the founders were of the same sub-species. The results indicated that there were no clear distinct units in the group. It is possible that all of the founders originated from the same country. Cuora flavomarginata hibernates from October through April depending on temperature. Most of the founders spend the winter months in man-made hibernacula while others prefer to hibernate in mulch and leaves. All hatchlings placed with TSA members are numbered and recorded in the Cuora flavomarginata AZA Studbook. Records are maintained on the status and growth of all F1 turtles. Our objective is to have three hundred F1’s (100 males and 200 females) with as much genetic diversity as possible.

Captive Husbandry: Oral

Global Warming May be Affecting the Reproductive Behavior of Podocnemis expansa in the Amazon Basin of Brazil

CAMILA R. FERRARA,1 LARISSA SCHNEIDER,2 AND RICHARD C. VOGT1,3

1Programa de Pós Graduação em Biologia Aquática e Pesca Interior, Instituto Nacional de Pesquisas da Amazônia, Caixa Postal 478, Manaus, AM, 69083-000, Brazil
2Institute for Applied Ecology, University of Canberra, ACT 2601, Australia
3Coordenação de Pesquisa em Biologia de Água Doce e Pesca Interior, Instituto Nacional de Pesquisas da Amazônia, Caixa Postal 478, Manaus, AM, 69083-000, Brazil
[ferrara@terra.com.br]

How global warming might affect animal populations has been contemplated for over a decade. Recent studies have shown that some species of reptiles with temperature sex dependence (TSD), such as turtles and crocodilians, will suffer altered sex ratios. We studied the reproductive behavior of Podocnemis expansa in the Rio Trombetas Biological Reserve, Pará, Brazil in 2008, 2009, and 2010, from the migration to the nesting beaches until the hatchlings emerged. In 2009 we saw turtles basking on the nesting beach for only seven days. This was different from previous years when the females were noted to bask for at least two weeks before nesting to facilitate ovulation. In 2010 the turtles again basked for two weeks before nesting. This reduction in the basking period in 2009 was associated with the increase in water temperature of 2ºC above the temperature recorded in previous years. This modified behavior is not necessarily detrimental; it could be advantageous by reducing the time they are more susceptible to predation by crocodilians or humans. This is the first study suggesting how global warming may affect the biology of Amazon River Turtles.

Poster Session (Student)

Vocal Communication in Turtles: New Directions for Behavioral Research

CAMILA R. FERRARA AND RICHARD C. VOGT
Instituto National de Pesquisas da Amazonia, Manaus, Amazonas, Brazil, 69083-000
[vogt@imp.a.gov.br]

Until recently, freshwater turtles were thought to be silent members of the Class Reptilia, neither vocalizing or hearing very well. It is well known that tortoises make grunts and groans during courtship behavior and the bellows of courting Galapagos Tortoises are legendary. Ray Ashton also reported that tortoises were communicating using infrasound. However, freshwater turtles were not known to be participating in any type of vocal communication, until recently. Giles found that an Australian species, Chelodina oblonga, was producing sounds underwater in captivity. This led us to begin our long term study on the vocalizations of freshwater turtles in nature. To date all turtles we have attempted to record have been producing underwater sounds. New evidence has shown that both hatching and adult turtles are producing sounds in and out of the water. We recorded hatchings in air and underwater in nature and captivity using hydrophones and microphones. We recorded turtles in nature and know in what behavioural context sounds were produced. We recorded air and water borne sounds produced by Giant South American River Turtle (Podocnemis expansa) hatchlings inside open nests, and in captive conditions. Adult females were recorded as they formed migration groups, as they migrated, leaving the water to communally bask on nesting beaches, and leaving the water to nest communally. We hypothesize that the sounds recorded of hatchlings may function to: 1) synchronize hatching, to induce communal digging and help move the siblings towards the surface and out of the nest; 2) synchronize emergence from the nest to dilute the predation pressure during hatchling dispersion to water; and or to 3) solicit parental care from females to help guide hatchlings in their migration to the flooded forest. Many of the unexplained behavioral patterns of turtles are now much more easy to explain when sound enters into the equation. We anticipate that our
findings will influence the way turtle behavior is studied and interpreted, and add vocal communication and sound pollution to turtle conservation concerns.

**Special Session: Oral**

### Occurrence of Alien Species of Freshwater Turtle in Urban Area in the Amazonia, Brazil

**DANIELY FÉLIX-SILVA AND JUAREZ CARLOS BRITO PEZZUTI**

*Núcleo de Altos Estudos Amazônicos (NAEA), Universidade Federal do Pará–UFPA, Rua Augusto Corrêa 01, CEP 66075-110 Belém, PA, Brazil*

[danielyfelix@hotmail.com]

The freshwater turtle *Pelodiscus sinensis* belongs to the family Trionychidae, subfamily Trionychinae, whose natural distribution is throughout central and eastern China and northern Vietnam. This species was introduced to Thailand, Japan and Hawaii, and its occurrence in Korea and Russia needs to be confirmed. Meanwhile, trionichids are a widespread turtle family, with no representatives occurring naturally in South America. This species lives in aquatic habitats such as lakes and swamps, and feeds mainly on insects, fish, crustaceans and larvae. Due to heavy exploitation for food and medicinal purposes throughout its distribution range, natural populations were seriously depleted and *Pelodiscus sinensis* is now considered vulnerable by the IUCN. Nevertheless, it is farmed in China and traded as a pet to many countries. We registered the occurrence of the species in the suburban areas of Belém City, the capital of Pará State, northern Brazil. The specimens were found and captured in small water bodies in densely inhabited neighborhoods. Firstly, two 20mm carapace length hatchlings were found by children in a sandy place next to the artificial lake at February 2010. One year later, three more similarly sized young animals were caught in the exact same local. An adult male was found in a hole near the same lake in November 2010. In April 2011, an adult female was found downstream of the aforementioned locality. This individual laid five small spherical eggs in the water on May 9, 2011 and three eggs on May 31, 2011. As of June 2nd, the eggs appeared to be developing in good conditions. It seems clear that there is a feral population of *Pelodiscus sinensis*, of unknown size, that is being established in the impacted streams of Belém. An assessment of the distribution and impact of *Pelodiscus sinensis* on aquatic habitats and native aquatic biodiversity should be quickly addressed.

### Poster Session

### Distribution, Abundance and Home Range of the Endemic Dahl’s Toad-Headed Turtle (*Mesoclemmys dahli*) in Colombia: Perspectives for Conservation

**GERMAN FORERO-MEDINA¹, ², GLADYS CARDENAS-ARÉVALO³, AND OLGA V. CASTAÑO-MORA³**

¹Nicholas School of the Environment, Duke University, Durham, NC 27708, USA ²Fundación Caipora, Bogotá, Colombia ³Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia

[forecroc@yahoo.com]

The study of species’ geographic ranges and habitat requirements, as well as population monitoring, are key actions for conservation, especially for endemic and threatened species. Dahl’s Toad Headed Turtle (*Mesoclemmys dahli*) is an endemic species from Northern Colombia. It was poorly known for a long time after its original description in 1958. Beginning in the past decade there has been important research and conservation efforts. However, detailed ecological information essential for conservation is still limited. We studied the species distribution in Colombia, and its habitat requirements and population ecology in the locality of Chimichagua, Cesar. We used presence-only data, and maximum entropy and classification and regression trees to model the habitat distribution of *Mesoclemmys dahli* in Colombia, and evaluate the factors that influence the presence of the species in first order streams in Chimichagua. Our model predicts presence of the species in six departments in Northern Colombia, occupying an area of about 32,700 km². This represents a range extension into two new departments, over an area of ~9,000 km². The species was associated with first order streams (1 – 10 m width), with deep pools (> 40 cm of maximum depth), slow flowing water (< 0.22 m/s), and dark water (< 32 cm clarity). Optimal habitat is found at locations with high percentage (> 82%) of canopy cover. We used mark-recapture sampling to estimate density in two streams, and studied home ranges using VHF radio telemetry. We estimated a density of ~82 turtles/ha, lower than reported for other South American Chelids and other populations of *Mesoclemmys dahli* in Colombia. Home ranges for one year varied from 1.6 ha to 30.8 ha. The species range lies completely within the tropical dry forest biome, one of the most threatened and least protected in Colombia. There are no records of the species in any of the few protected areas in this biome. Conservation of a rare species like *Mesoclemmys dahli* will require protection at multiple sites to spread risk and
ensure that sufficient individuals are secure. In Chimichagua, we recommend protection of streams where it occurs, and recovery of the riparian vegetation.

**South American Turtles – Colombia:** Oral (Student)

**Why Did the Terrapin Cross the Runway?**

**LAURA FRANCOEUR**\(^1\), **ALEXANDRA KANONIK**\(^2\), **RUSSELL L. BURKE**\(^3\)

\(^1\)The Port Authority of NY and NJ, JFK International Airport, Bldg. 145, 2nd Floor, Jamaica, NY 11430, USA

[lfancoe@panynj.gov]

\(^2\)Town of Hempstead Department of Conservation and Waterways, P.O. Box 180, Lido Boulevard, Point Lookout, New York, 11569, USA [akkanonik@gmail.com]

\(^3\)Department of Biology, Hofstra University, Hempstead, NY, 11549, USA [biorlb@hofstra.edu]

On June 30–31 2011 domestic and international news agencies once again carried stories about Diamondback Terrapins (*Malaclemys terrapin*) causing departure delays at John F. Kennedy (JFK) International Airport, one of the busiest airports in the world. A similar event occurred in summer 2009. These stories were generally presented as sympathetic and amusing filler pieces in which tiny turtles with amorous intent brought a major travel hub to a stop. JFK Airport is located within New York City on the eastern edge of Jamaica Bay. The airport was constructed, starting in 1942, eventually covering 2000 hectares of salt marsh with solid fill and destroying considerable amounts of terrapin habitat. Nevertheless, a large terrapin population persists, likely in excess of > 10,000 individuals, probably in nearby JoCo Marsh. Most Jamaica Bay salt marshes are eroding for a variety of reasons, but JoCo Marsh appears to be stable. Only female terrapins come on land, and only for nesting forays. Terrapins have been reported on JFK runways annually since 2000, as far back as records exist. A small number are killed each year. However, a dramatic increase in runway crossings began in 2009. We plan to determine whether this increase was due to a surge in recruitment, movement of individuals from other parts of the bay, a change in nesting behavior, or increased detection by airport personnel. Efforts are also underway to prevent terrapin access to runways; these include development of new nesting areas and barriers that will meet FAA requirements.

**Poster Session**

**Busch Gardens Supports Turtle Conservation with World Turtle Day Celebration**

**Including Information About the Sea World & Busch Gardens Conservation Fund**

**KRISTIN FULTON**

_Busch Gardens Tampa, Sea World Parks & Entertainment, 3605 East Bougainvillea Avenue, Tampa, Florida, 33612 USA_[kristin.fulton@buschgardens.com]

For more than 40 years, SeaWorld Parks & Entertainment – encompassing SeaWorld, Busch Gardens and Discovery Cove – has initiated and supported wildlife conservation, research, and education at home and around the world. In 2010, Busch Gardens launched the first ever World Turtle Day Celebration in Tampa, Florida. The focus of the event is to bring turtle conservation, awareness, and inspiration to our park guests in a fun and interactive setting. During the sidewalk event, guests are encourage to interact with animal specialists, view, touch, and photograph turtles and artifacts, play turtle trivia, and meet some of our amazing tortoise ambassadors. Informational talks and interactive sessions are available daily at Busch Gardens and serve to promote our mission: To work with purpose and passion on behalf of wildlife and habitats worldwide, encouraging sustainable solutions through support of species research, animal rescue and rehabilitation and conservation education. Launched in 2003, the Sea World & Busch Gardens Conservation Fund was created to provide guests with an easy, direct way to get involved and make a difference for animals. While the Fund itself is relatively new, the parks have contributed more than $50 million to wildlife conservation since 1970. The Fund intends to continue this legacy and create an even greater one. Continuing our conservation tradition, we are ever expanding our turtle-focused inspirational messages by creating lasting memories through events such as World Turtle Day, and we hope to inspire local and international communities to join in this effort.

**Role of Zoos in Chelonian Conservation:** Oral (Student)
Range-wide Population Genetics of the Gopher Tortoise (*Gopherus polyphemus*)

**Daniel L. Gaillard¹, Joshua Ennen², Brian Kreiser¹, and Carl Qualls¹**

¹Department of Biological Sciences, The University of Southern Mississippi, 118 College Dr., Hattiesburg, MS 39406, USA
²USGS, Southwest Biological Science Center, Flagstaff, AZ 86011, USA
[dgailldr@gmail.com]

The Gopher Tortoise (*Gopherus polyphemus*) has undergone a range-wide population decline, with the greatest decline found in the western portion of the range (west of the Tombigbee and Mobile rivers). The magnitude of decline in the western portion of the range has previously warranted a federal listing of “threatened” and the eastern populations are under consideration for listing. Multiple agencies and conservation groups have been working to not only stop the decline of tortoises, but to also help them rebound in numbers using a variety of management tools to preserve this species. In particular, we were interested in examining genetic variation within and among populations across the range in order to quantify levels of genetic diversity and to identify the most appropriate management units. We genotyped 450 individuals from 22 sites across the range for 20 new microsatellite loci developed in our lab. Our results support the recognition of multiple discrete populations across the range of the Gopher Tortoise and that populations east of the Tombigbee and Mobile Rivers tend to have higher genetic diversity than their western counterparts.

North American Turtles: Oral (Student)

Five-Year Community-Based Conservation and Monitoring Program for the Critically Endangered River Turtle, *Podocnemis lewyana*, in the Sinú River

**Natalia Gallego-García**

Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado 7495, Bogotá, Colombia
[natagalle@gmail.com]

*Podocnemis lewyana* is a critically endangered and endemic river turtle from Colombia that occurs only in the Sinú and Magdalena Rivers. In the Sinú River, it is threatened by overexploitation, habitat degradation and nest site flooding. To counteract these threats, in 2007 a community-based conservation program that included *in-situ* and *ex-situ* management, participatory research and monitoring, education, and awareness-raising, was established in the lower basin of the river. *Ex-situ* management included the retrieval of only those clutches prone to flooding and their incubation under controlled conditions. Mean hatching success was 84.3% with no differences between *ex-situ* and *in-situ* incubated clutches. However, hatching size was smaller (*ex-situ* = 4.57cm, *in-situ* = 4.68cm) and incubation times were longer (*ex-situ* = 55.7 days, *in-situ* = 52.8 days) in clutches incubated *ex-situ* due to differences in incubation temperature. *In-situ* management included river surveillance and habitat restoration by reforestation of riverbanks and the construction of elevated sandbanks located above natural beaches affected by floods. These sandbanks have been successfully used by nesting females, with no differences in the incubation times and hatching success between these nests and those incubated in natural beaches. Hatchling size was smaller when incubated in the sandbanks (sandbanks = 4.6cm, beaches = 4.8cm), but still this technique proved to be a better management option. As part of the program, the species’ reproduction has been monitored annually at three beaches. All nests were counted, but clutch size, hatching success and hatchling size were estimated for only those nests that successfully completed incubation. Monitoring has shown an increase in the number of nests (2007 = 40, 2008 = 30, 2009 = 52, 2010 = 76, and 2011 = 70) and a stable clutch size over time (mean = 19 eggs). Mean incubation time was 53.09 days with no differences among years. Hatching success increased from 82.3% in 2009 to 92% in 2010 and 2011. Hatchling size also increased between 2009 and 2010. The number of nests is an indirect method to monitor the relative abundance of nesting females, and clutch size, hatchling size and hatching success is a measure of their size and fitness, so it seems that the nesting female population has increased slightly from 2007 to 2011.

South American Turtles – Colombia: Oral (Student)

Observations on the Natural History and Behavior of Box Turtles (*Terrapene carolina*) in a River Floodplain of the Florida Panhandle

**Gregory George¹, Maximilian S. Maurer², and A. Ross Kister²**

¹131 Current Dr., Newton, NJ, 07860, USA
²Turtle Conservancy, 49 Bleecker St., Suite 601, New York, NY, 10012, USA
[gregoryag@earthlink.net]
The Common Box Turtle (Terrapene carolina) occurs in a great variety of habitats from Massachusetts to the Yucatan Peninsula. In the panhandle of Florida it occurs both in uplands and in floodplains. Here we describe the annual cycle and behavior of those animals found in floodplains. In the spring and early summer these populations are almost entirely aquatic foraging underwater. Mating also takes place in water. As the high water of spring and early summer retreats, they become more terrestrial but are usually active in the summer only after rain showers.

North American Box Turtles: Oral

Searching for the “Survivors,” Northern River Terrapin, Batagur baska
Rupali Ghosh
Shant Kamal Kunj, I Shakti Colony, Rajkot, Gujarat, 360001, India
[rupalighosh22@gmail.com]

The search began with Dr. Peter Praschag three years ago and under his guidance we searched in a new area for the Northern River Terrapin, Batagur baska. With very little knowledge of a snake charmer’s community, the first phase of our mission started in Eastern India and ended in Bangladesh with little hope of finding any remaining individuals of this species. Only 19 individuals were known in India, and this fueled our efforts to search for any remaining survivors. With the Turtle Survival Alliance’s help and guidance, a vigorous search was conducted and soon rapport with the local traders threw a ray of hope that there were some Northern River Terrapin specimens in a personal collection. Again, regular rapport and visits to the turtle market confirmed the existence of a wild population. Our search resulted in finding four females and ten males – a last ray of hope for the survival of this species. Bhawal National Park (Bangladesh) became the lone abode for this breeding population, established jointly by Bangladesh Forest Department, the Turtle Survival Alliance and Carinam (a Bangladesh NGO). Recent searches suggest a slight chance of a few remaining wild survivors in the southeastern or southwestern part of Bangladesh. Our overall findings indicate a link to the turtle trade route between India, Bangladesh and Myanmar.

Trade in Turtles: Oral

Mysteries to Discoveries: The Never Ending Story of Turtle Biology
J. Whitfield Gibbons
University of Georgia, Savannah River Ecology Laboratory, Drawer E, Aiken, SC 29802, USA
[wgibbons@srel.edu]

The following question was posed more than two decades ago: "Why are there so many unanswered questions about freshwater turtles?" The question was from the last chapter, "Recommendations for Future Research on Freshwater Turtles," in “Life History and Ecology of the Slider Turtle” (1990). The same question can be asked today. Will turtle biologists be able to provide satisfactory answers in areas as diverse as systematics, taxonomy, genetics, reproductive patterns, growth and size phenomena, movement patterns, bioenergetics, geographic variation, survivorship, longevity, and population demographics that are necessary for conservation efforts? Many critical questions in these basic areas remain either unanswered or poorly answered by turtle biologists, sometimes making it difficult to develop conservation plans that will produce satisfactory outcomes. Nonetheless, exciting and fascinating new discoveries and questions about many aspects of turtle biology continue to emerge, some of intrinsic interest and others directly applicable to conservation issues. Delayed emergence from the nest by hatchlings, the significance of color, and reproductive behavior of certain species of turtles are topics that will be discussed in the contexts of both conservation and of the simple mysteries of turtle biology.

Special Session: Oral

Defining Success for Ex-Situ Breeding Programs
Paul M. Gibbons and James Liu
Turtle Conservancy Beher Chelonian Center, Ojai, California, 93023, USA
[paul@turtleconservancy.org]

In 2005, the Beher Chelonian Center embarked on a mission to build a successful program for ex-situ husbandry and breeding of threatened and endangered tortoises and freshwater turtles. The initial collection centered around 10 species and 125 individuals. The collection now stands at 27 species and 585 individuals and continues to grow. Over the past years we have diligently worked to develop partnerships with other organizations, scientists, and private hobbyists to provide the best...
possible captive conditions to stimulate slow, steady growth and reproduction. Reproductive success has occurred in 15 (sub)species and includes a total of 541 hatchings. Currently, animals hatched at the center provide a valuable resource for studies on incubation, temperature-dependent sex determination, metabolism and growth, veterinary medicine, genetics, and behavior. With this productivity, we now face a real opportunity to expand the term “reproductive success” beyond the total number of hatchings. We have begun converting a proportion of these captive-born animals into funding for in-situ conservation via proceeds generated by sales. The ultimate goal, however, is repatriating these animals in the face of numerous obstacles. To date, no North American institution has been able to overcome these obstructions for endangered tortoises or freshwater turtles. A few organizations around the world have, however, participated in releasing offspring from ex-situ breeding with certain species including the California Condor (Gymnogyps californianus) in Baja, Mexico and the Mountain Chicken (Leptodactylus fallax) in Montserrat. Our current efforts directed to this end include habitat preservation, funding park infrastructure and personnel, gathering climate data, characterizing wellness, and collecting population genetics data. The Turtle Conservancy expects offspring of our endeavors to enjoy the opportunity of repatriation through continued cooperation with various non-governmental organizations, government agencies, local groups, and the scientific community. **Role of Zoos in Turtle Conservation:** Oral

---

**Population Density and Conservation Threat to the Terrestrial and Freshwater Turtles from the Central Pacific Region of Colombia**

*ALAN GIRALDO¹, MARIO GARCÉS¹, AND JOHN L. CARR¹,²*

¹Grupo de Investigación en Ecología Animal, Sección de Zoología, Departamento de Biología, Facultad de Ciencias Naturales y Exactas, Universidad del Valle, Cali, Colombia

²Department of Biology and Museum of Natural History, University of Louisiana at Monroe, Monroe, Louisiana, 71209, USA

[ecologia@univalle.edu.co]

Six species of terrestrial and freshwater turtles are known from the central Pacific region of Colombia: *Rhinoclemmys nasuta* (Boulenger 1902), *Rhinoclemmys melanosterna* (Gray 1861), *Rhinoclemmys annulata* (Gray 1860), *Kinosternon leucostomum* (Dumeril and Bibron 1851), *Kinosternon dunni* (Schmidt 1947) and *Chelydra acutirostris* (Peters 1862). According to IUCN Red List categorization, *Kinosternon dunni* is considered Vulnerable (VU), while *Rhinoclemmys nasuta* and *Rhinoclemmys annulata* are considered Near Threatened (NT). With the goal of establishing population indicators for species of the central Pacific region of Colombia, we systematically sampled and explored five localities for the terrestrial and freshwater turtles: Playa Chucheros, Isla Palma, San Pedro, San Isidro and San Cipriano. For each locality, we estimated the relative density of the species encountered and evaluated the local threats. We did not find *Kinosternon dunni* at any of the sites sampled. *Chelydra acutirostris* was only recorded at San Cipriano, where it is used as bush meat “carne de monte.” *Rhinoclemmys melanosterna* was recorded at all localities except San Cipriano, while *Rhinoclemmys nasuta*, *Rhinoclemmys annulata* and *Kinosternon leucostomum* were recorded at all localities. The mean density estimated for *Rhinoclemmys nasuta* was 593 ind/km², 14 ind/km² for *Rhinoclemmys melanosterna*, and 180 ind/km² for *Kinosternon leucostomum*. The locality with the greatest density was Isla Palma, with estimates an order of magnitude greater than that of the continental localities. All turtle species were used by the local communities directly as a source of food, and *Kinosternon leucostomum* and *Rhinoclemmys nasuta* were intensively used in the pet trade. In addition to these threats, the change in land use associated with human settlements has drastically affected habitat conditions, reducing the frequency of occurrence of these species. **South American Turtles – Colombia: Oral**

---


*ALAN GIRALDO¹, MARIO GARCÉS¹, JOHN L. CARR¹,², AND JHONATAN LOAIZA¹*

¹Grupo de Investigación en Ecología Animal, Sección de Zoología, Departamento de Biología, Facultad de Ciencias Naturales y Exactas, Universidad del Valle, Cali – Colombia

²Departamento de Biología, Universidad de Louisiana, Monroe, Louisiana, 71209, USA

[ecologia@univalle.edu.co]

*Rhinoclemmys nasuta* (Boulenger 1902) is an endemic species registered in the Colombian red book of reptiles. This is a mid-sized aquatic turtle that inhabits rivers and creeks in the Tumbes-Chocó region, from Esmeraldas (Ecuador) to the middle region of Atrato River (Chocó, Colombia). To date, a lack of knowledge of the natural history and ecology of this species makes it difficult to analyze its status and threats. According to IUCN Red List categorization, this species is considered Vulnerable (VU). We started a study on the population ecology of *Rhinoclemmys nasuta* in Playa Chucheros, Isla Palma, San Pedro, San Isidro and San Cipriano (central Pacific region of Colombia). In this talk we will present the main results of this study and discuss the conservation status of this species.
species has impeded an appropriate evaluation of its conservation status. In our study we analyzed the population size and structure of a *Rhinoclemmys nasuta* population found at an insular locality in the Colombian Pacific region (Isla Palma, Bahía Málaga). In this insular locality, the *Rhinoclemmys nasuta* population was dominated by adult individuals, with female: male: juvenile proportions of 1.00 : 0.71: 0.85. Female turtles were larger than males (♀: 179.87 ± 3.27 mm; ♂:151.83 ± 2.41 mm). The general sexual dimorphism index for the population on Isla Palma was 1.18. The population size estimate based on capture-recapture records was 990 (IC90%: 941 ind to 1044 ind) and the growth was isometric (b = 3.04). Although strong sexual size dimorphism was detected, the growth trajectory of the relationship between carapace length and weight was similar in females and males. This is the first study to emphasize the ecology of a continental turtle species from the Pacific region of Colombia. This information will strengthen conservation initiatives for turtles in Colombia.

**South American Turtles – Colombia:** Oral

**Status of the Federally Endangered Alabama Red-bellied Turtle (Emydidae: *Pseudemys alabamensis*) in the Mobile-Tensaw Delta**

**JAMES C. GODWIN**

*Alabama Natural Heritage Program, Environmental Institute, Auburn University, AL 36849, USA*  
[jcg0001@auburn.edu]

The Alabama Red-bellied Turtle (*Pseudemys alabamensis*) was listed as an endangered species by the U.S. Fish and Wildlife Service in 1987. Prior to the listing, in 1979, a brief status survey was conducted. Subsequent to the listing, status surveys have taken place in 1992–93, 1994–96, and 2008–11. With all of these surveys, the focal point of sampling has been the Mobile–Tensaw Delta of south Alabama, a globally important region of turtle diversity. The purpose of the surveys has been to collect data on turtle numbers to address the recovery objective pertaining to population trend. As presently stated in the recovery plan, one criterion for reclassifying the Alabama Red-bellied Turtle to “threatened” is the documentation of an increasing population trend based on a minimum of 15 years of data. Hoop net sets, two unbaited hoop nets connected by a 15 m lead net, are the technique used for capturing *Pseudemys*. Nets are set in shallow, side-channel sites near basking logs and beds of aquatic vegetation and are left in place for several days but checked daily. Data collected on each captured turtle include sex, weight, and shell measurements, plus each turtle receives an individual shell marking sequence. Results will be presented on population trend numbers, sex ratio, and adult to immature ratio, and comparisons will be made to syntopic *Pseudemys concinna* and *Pseudemys floridana*. Population trend of the Alabama Red-bellied Turtle, based on trap data, suggests a slow decline over time. Possible causes of decline affecting the turtle include high nest mortality, female mortality, and degraded habitat.

**Population Studies:** Oral

**The Expanding Clandestine Asian Trade in the Ploughshare Tortoise (Astrochelys yniphora): A 2011 Reassessment**

**ERIC GOODE1, A. ROSS KIESTER1, AND JAMES JUVIK2**

1*Turtle Conservancy, 49 Bleecker St., Suite 601, New York, NY, 10012, USA*

2*Department of Geography and Environmental Studies, University of Hawai‘i–Hilo, 200 W. Kawili St., Hilo, HI 96720, USA*

[eric@turtleconservancy.org]

As a consequence of the extended period of political instability in Madagascar since 2009 and the rapidly growing market demand, there has been a dramatic increase in the illegal smuggling of Ploughshare Tortoises (*Astrochelys yniphora*) into Asia over the past two years. Although the true extent of this illegal trade is nearly impossible to know because of its very illegality, we undertook a visit to Asia earlier this year to obtain what insight we could into the magnitude of this trade. We visited zoos, rescue centers, and markets in several countries. We also worked with partners to review the number of tortoises for sale on the Internet in local languages. We observed some apparent trends in this trade. We found that there is a growing collector demand in newly prosperous regional centers like Bangkok, Jakarta and Kuala Lumpur. These cities had previously served largely as transshipment points for animals moving to China and, to a much lesser extent, Japan. Perhaps the most alarming aspect of the 2011 market survey is the comparatively large number of adult animals currently now entering the trade. In March 2011 alone, more than twenty adult animals were documented for sale in Malaysia and China. Posted photos indicated these are all wild-caught animals. They represent a potentially significant proportion of the remaining *in-situ* population in Madagascar. There has been a concurrent increase in government confiscations in recent months as well, with one notable repatriation of animals back to Madagascar from Malaysia. More often seized animals die or disappear after confiscation. In this paper we propose several countermeasures to both suppress illegal export of animals from Madagascar.
and improve the survival of confiscated animals in regional rescue centers and zoos in Asia. These include: 1) carapace defacing (humane shell-engraving) of wild adults in Madagascar; 2) greater support for tortoise rescue centers in Asia; and 3) consolidation of non-situ animals through international partnerships into sustainable institutions to develop conservation-oriented ex-situ colonies.

Trade in Turtles: Oral

A Slow, but Steady Return of Chelonian Conservation Ideals to the Jacksonville Zoo and Gardens
STEVEN GOTT
Division of Herpetology, Jacksonville Zoo and Gardens, 370 Zoo Parkway, Jacksonville, Florida 32218, USA [gotts@jacksonvillezoo.org]

The Jacksonville Zoo and Gardens was once an institution noted for chelonian reproduction, particularly specializing in tortoises. In addition to breeding Redfoot Tortoises (Chelonoidis carbonaria), African Spurred Tortoises (Geochelone sulcata), Star Tortoises (Geochelone elegans) and many other species, Jacksonville was the first institution in the northern hemisphere to breed the Aldabra Giant Tortoise (Aldabrachelys gigantea). A zoo’s focus may change significantly as directors and other senior staff come and go and by 2001, turtles had long been relegated to the back burner. Most of the important breeding stock was gone and even the Aldabra Tortoises were held in off-exhibit pens, eventually to be sent to other zoos. Now however, new changes in upper management over the last few years have brought more focus on conservation while management changes within the herpetology division have brought back a focus on chelonians. The zoo’s recent partnership with the Turtle Survival Alliance (TSA) has resulted in several new chelonian projects within the zoo. We were able to assist with the recent confiscation of Temple Turtles (Heosemys annandaleii) by housing some animals as well as offering space for TSA to process the turtles before sending them out to permanent homes. We have acquired breeding pairs of additional species and have been able to place yet more turtles and tortoises out on display throughout the zoo. We also have plans for more involvement in local chelonian conservation projects and included in our Master Plan is an Asian turtle conservation center. Though the species have changed, it seems the Jacksonville Zoo and Gardens, thanks to partnership with TSA, could once again become an institution noted for chelonian reproduction and conservation.

Role of Zoos in Turtle Conservation: Oral

Genetic Differentiation of Selected Eastern Box Turtle (Terrapene carolina) Populations in Fragmented Habitats, and a Comparison of Road-based Mortality Rates to Population Size
SUSAN HAGOOD
Humane Society of the United States [shagood@humanesociety.org]

The decline of Eastern Box Turtle populations is associated with habitat loss and fragmentation, lack of recruitment into breeding populations, removal of individuals from the wild for pets, and road mortality. Box Turtle populations in many areas of the eastern United States may effectively be isolated as high traffic volumes on roads adjacent to turtle habitats prevent successful dispersal. If so, populations surrounded by heavily used roads may be less genetically diverse than those in relatively intact habitats. I investigated whether populations in three Montgomery County, Maryland parks that were surrounded by roads were genetically differentiated relative to populations in two larger habitats in Maryland’s Prince George’s and Anne Arundel counties. Sampling was conducted between 2005 and 2008. I used 10 microsatellite markers to compare these populations and sampled in an additional five sites (two in Maryland, and one each in Pennsylvania, the District of Columbia, and Florida) to better assess population structure. I found little evidence of genetic differentiation among central Maryland populations regardless of the extent of isolation. I attribute these findings to the slow rate of change in turtle evolution; the observed similarities in genetic diversity may reflect past rather than present gene flow. I found moderate to great differentiation in populations separated by substantial distances. To determine whether road mortality exceeds additive mortality levels believed to be a threat to population persistence, I estimated population size in the three Montgomery County, Maryland, parks using mark-recapture techniques, and compared these estimates to the number of dead, injured, and live turtles in or very near roads observed during walking and driving surveys conducted in 2006. Road-based mortality rates fell within the range estimated to be inconsistent with population growth in one of the parks. Road mortality appeared to affect females out of proportion to their abundance in the population.

North American Box Turtles: Oral
Mountain Bog Habitat Restoration and Education and Outreach for the Bog Turtle (*Glyptemys muhlenbergii*) in Northern Georgia

**HEIDI HALL, CHRISTOPHER L. JENKINS, WAYNE TAYLOR, AND CHRISTINA M. CASTELLANO**

The Orianne Society, 579 Highway 441 South, Clayton, Georgia 30525, USA  
[ccastellano@oriannesociety.org]

Southern Appalachian mountain bogs are one of the most rare and endangered wetland ecosystems in the southern United States. Mountain bog habitat is often lost due to drainage for agriculture, water diversion, and the construction of towns, roads, farms, and reservoirs; as well as, unchecked natural succession to forested communities. Moreover, new bogs are not being created at the rate they did historically because of development, the suppression of natural fire regimes, and a decline in beaver and large grazing ungulate populations. Consequently, the Georgia Department of Natural Resources (GADNR) has identified the restoration of mountain bog habitat as a high priority action within the Blue Ridge Province. The result of mountain bog habitat loss includes the decline of many bog associated fauna, including the federally and state listed Bog Turtle (*Glyptemys muhlenbergii*). The Bog Turtle is only known from eight localities in northern Georgia; however, the GADNR has developed a priority list of sites to survey that contain the appropriate habitat for the Bog Turtle, which may support previously undocumented populations. Two of these sites are located on the campus of the Rabun Gap Nacoochee Preparatory School in Rabun County. In 2010, The Orianne Society and the school formed a partnership to survey for the Bog Turtle at these sites and to restore the mountain bog habitat on the campus for this species. This process is part of The Orianne Society’s new education and outreach program and will provide students with the opportunity to participate in restoration activities. Once restoration is complete, the instructors will use the bog as an outdoor classroom where they will conduct long-term monitoring projects to teach students about mountain bog habitat, the conservation of the Bog Turtle, and the importance of these declining habitats for many other reptiles and amphibians.

Poster Session

Alligators and Freshwater Turtles as Long-lived Bioindicators in Aquatic Ecosystems of the Southeastern US

**BESS B. HARRIS, ANDREW M. GROSSE, ROBERT V. HORAN III, DAVID E. SCOTT, BRIAN S. METTS, AND TRACEY D. TUBERVILLE**

Savannah River Ecology Lab, University of Georgia, Aiken, SC 29802, USA  
[tracey.tuberville@gmail.com]

Future management and remediation recommendations for contaminated aquatic ecosystems will depend in part on predicted risks to wildlife species from contaminant exposure and accumulation. The Savannah River Site (SRS), near Aiken, SC, is a 800-km² Department of Energy installation at which some localized areas contain elevated concentrations of radioactive and metal contaminants. Much of the prior work investigating contaminant body burdens in wildlife in SRS aquatic systems have focused on shorter lived species, such as amphibians, waterfowl and otters. However, models for these relatively short-lived species (typically < 10–15 yrs), may not adequately estimate the exposure risks for species with much longer life spans. American Alligators and several turtle species occur in aquatic systems of the SRS, have diets composed largely of vertebrate and/or invertebrates, and have estimated longevities of up to 40–70 years. By virtue of their long life spans, physiology, and trophic status, alligators and turtles may accumulate significant body burdens of a variety of contaminants—these species may be good ecological receptors for assessing risks associated with long-term contaminant exposure. We sampled turtles—primarily Yellow-bellied Sliders (*Trachemys scripta*)—and alligators (*Alligator mississippiensis*) from a series of aquatic sampling sites that differed in their contaminant types, levels and histories, including reference sites not known to be contaminated. We permanently and uniquely marked all animals, took standard morphometric measurements, and measured gamma radiation. In addition, we collected whole blood, nail, and scute (alligators only) samples for metals analysis. We report preliminary results of body burdens of metals and radioactive contaminants in these long-lived reptiles captured during our first sampling season. Our data, when combined with long-term mark-recapture and previously collected body burden data, offer the opportunity to study legacy effects of contaminants in aquatic systems.

Poster Session

Genetic Diversity Within and Among Northern Populations of the Gopher Tortoise, *Gopherus polyphemus*

**J. SCOTT HARRISON, WADE CARRUTH, AND DAVID ROSTAL**

Department of Biology, Georgia Southern University, Statesboro, Georgia, USA  
[sharrison@georgiasouthern.edu]

*9th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles* | *Orlando, Florida*
Gopher Tortoise populations inhabit sandhill pine habitat that has been highly fragmented in the southern United States. Habitat fragmentation can have a variety of consequences relevant for conservation and management. These consequences include, but are not limited to, decreased rates of interpopulation dispersal, reduction of effective population size, increased rates of genetic drift, and loss of genetic diversity. The goal of this study is to characterize genetic diversity within and among two Georgia populations of *Gopherus polyphemus* (George L. Smith State Park (GLS) and Fort Stewart Army Reserve (FSAR)) that have experienced different population size reductions and habitat management strategies. We compared genetic diversity estimates between these two populations. In addition we compared these populations to a natural “large” population (Kennedy Space Center, Florida (KSC)). A general trend of lower genetic diversity in smaller populations was observed. However, both the GLS and FSAR populations are characterized by lower levels of genetic variation than most *Gopherus polyphemus* populations studied to date. The smallest population (GLS) was the only population to show signs of a genetic bottleneck in recent generations. The implications of these findings for management strategies will be discussed.

**North American Tortoises: Oral**

**Box Turtles and Their Contribution to the Spread of Invasive Plants at Southern Illinois University Edwardsville**

**ERIC HOFFMAN**¹, **JOHN MARKOVICH**¹-², **SHAUN DILTZ**³, **HEIDI HAAG**¹,², **SARJANA KHADKA**², AND **ELIZABETH WALTON**¹,²

¹Department of Geography, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA
²Environmental Sciences Program, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA
³elwalto@siue.edu

The Southern Illinois University Edwardsville Turtle Research and Rescue Lab is continuing its research and assessment of Box Turtle (*Terrapene* spp.) populations on campus. This investigation includes a demographic analysis through trapping, marking and releasing turtles back into their natural habitat at the point of capture. During the course of this investigation, researchers observed the seeds of amur honeysuckle (*Lonicera maackii*) and autumn olive (*Elaeagnus umbellata*) in the fecal content of turtles brought into the Lab. Both plant species are on the Illinois invasive plant list, yet these plants may serve as a source of sustenance long after native fruit-producing plants have senesced. As such, it is possible that Box Turtles are aiding in the spread of these two invasive species. The goals of this study are to continue to collect demographic data through a trapping study and to analyze fecal content for the presence of invasive plant seeds. Fecal samples are analyzed and then planted to determine whether any seeds remain viable. Preliminary results of this on-going study will be presented.

**Poster Session**

**A Retrospective Look at the Past Decade of Chelonian Conservation in Asia – Trade Still the Major Conservation Issue**

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

¹San Diego Institute for Conservation Research, 15600 San Pasqual Valley Road, Escondido, California 92027, USA
²Wildlife Conservation Society, 2300 Southern Blvd., Bronx, New York 10460, USA.
³Turtle Survival Alliance/Walde Research & Environmental Consulting, 8000 San Gregorio Rd., Atascadero, California 93422, USA

[briandhorne@hotmail.com]

It has been over ten years since the first workshop specifically aimed at countering the Asian Turtle Crisis was held in Phnom Penh, Cambodia. During this time much has been learned about the scope and volume of the turtle trade across all of Asia. Trade in wild turtles and turtle parts for consumption as well as high-end pets continues to be the largest threat to the survival of the region’s turtles. From February 21st – 24th, 2011, over 70 delegates from 20 countries – including 16 Asian nations – attended a three-day workshop to again bring global attention to the need for continued and renewed efforts to halt illicit trade in Asian turtles. The “Conservation of Asian Tortoises and Freshwater Turtles” workshop was held at the Singapore Zoo. The top recommendations of the workshop were that there is a need for: (1) greater law enforcement to stem the flow of wild caught turtles to international markets; (2) collection of natural history data of the rarest and least known species; (3) integration of assurance colonies on a global scale; (4) The creation of new protected areas for species that lack significant protected habitat; and (5) range countries making turtle conservation a national priority of their wildlife departments. Yet the suite of problems associated with the trade in turtles and turtle parts was clearly identified as being the area of greatest
concern and the problem that most warranted immediate action. We will discuss how even with hundreds of millions of turtles now being raised in Chinese turtle farms, there is still a great demand for wild caught turtles and that now is time to renew the efforts of the global turtle conservation community to continue the fight for the survival of Asia’s turtles.

Trade in Turtles: Oral

**Recent Turtle Breeding Efforts at the Tennessee Aquarium**

**BILL HUGHES**

_Tennessee Aquarium, One Broad Street, Chattanooga, TN 37402, USA_ [bhh@tnaqua.org]

The Tennessee Aquarium currently houses five hundred turtles, consisting of seventy-five species. In recent years, we have achieved several notable breeding successes including, but not limited to, _Heosemys spinosa_, _Sacalia bealei_, _Sacalia quadriocellata_, _Geoemyda spengleri_, _Graptemys flavimaculata_, and _Mauremys nigricans_. One of our main program goals is to develop husbandry methods that lead to reproduction for species that have been traditionally regarded as problematic. Here we present an overview of our turtle program with details of successful (and unsuccessful) husbandry methods for species that are considered difficult to breed in captivity.

**Role of Zoos in Turtle Conservation: Oral**

**Captive Husbandry and Breeding of the Spiny Turtle, Heosemys spinosa, at the Tennessee Aquarium**

**BILL HUGHES**

_Tennessee Aquarium, One Broad Street, Chattanooga, TN 37402, USA_ [bhh@tnaqua.org]

The Spiny Turtle, _Heosemys spinosa_, has a history of being a problematic captive: imported specimens are sometimes difficult to establish and reproduction is still infrequent. The first captive hatching was at Zoo Atlanta in 1991 and until recent years, very few of these turtles have reproduced in captivity. At the Tennessee Aquarium, the first successful reproduction was in 2007. To date, nine have hatched at the Aquarium and two at the author’s personal facility. Ongoing work with Phil Spinks at University of California Davis indicates that there are two distinct clades of spinosa; whether that has an effect on successful reproduction is currently unknown. _Heosemys spinosa_ is classified as endangered in the wild by the IUCN. Current conservation measures include an AZA studbook.

**Captive Husbandry: Oral**

**Gopher Tortoise (Gopherus polyphemus) Management and Conservation on the Orianne Indigo Snake Preserve in Southeast Georgia**

**CHRISTOPHER L. JENKINS, DIRK J. STEVENSON, KEVIN M. STOHLGREN, HEIDI L. HALL, JAYAN M. BAUDER, AND CHRISTINA M. CASTELLANO**

_The Orianne Society, 579 Highway 441 South, Clayton, Georgia 30525, USA_ [ccastellano@oriannesociety.org]

The Gopher Tortoise (_Gopherus polyphemus_) is a keystone species in the southeastern longleaf pine ecosystem that has declined throughout its range due to habitat loss and fragmentation, diminished habitat quality due to fire suppression, and historical collection for food. Many species depend on Gopher Tortoise burrows for retreat sites, including the federally threatened Eastern Indigo Snake (_Drymarchon couperi_). In July 2010, The Orianne Society initiated a Gopher Tortoise monitoring program on its flagship property, the 2500-acre Orianne Indigo Snake Preserve in Telfair County, Georgia, to monitor changes in this population over time and ensure the persistence of both tortoises and indigo snakes on the Preserve. Burrow surveys were conducted by walking transects through xeric sandhill habitat and occupancy was established using a mirror or burrow camera. Tortoises were trapped at active burrows and all individuals captured were weighed, measured, sexed, and marked. Seventy active burrows were encountered during the surveys. A total of 74 tortoises were captured (68 adults, four subadults, and two juveniles). The male to female ratio did not differ significantly from 1:1. Female tortoises had significantly longer carapace lengths than males with a mean carapace length of 297 mm compared to 285 mm. The Preserve provides a safe haven with protected and actively managed habitat for the Gopher Tortoise. This location and tortoise population is important for the conservation of this species in the eastern portion of its range. Future activities include the
Worldwide declines of reptile populations, especially turtles, have been widely documented, and similar patterns have been noted in Oklahoma. Turtles are among the world's most endangered vertebrates, with about 50% of the more than 300 species threatened with extinction. Aquatic turtles in their natural environment illustrate a classic type III survivorship curve, and they are slow to reach sexual maturity. This type of life history raises their conservation risk if adults experience more than normal mortality, and this is what is happening today with significant exploitation of turtles for food and shipment to Asia. These activities are major causes for current population declines of turtles in the U.S. Recently, Oklahoma was granted a 2-year extension on the original 3-year moratorium on commercial turtle harvest, permitting more time to assess effects of previous commercial harvesting activities on freshwater turtle populations. In the first two years (2009–2010) of a 3-year study, we trapped 35 of 37 sites originally surveyed in 1997–1999, when no moratorium on harvest was in place. The remaining two sites could not be trapped due to logistical reasons. Turtle captures per net night at paired sites (2009–2010 vs. 1997–1999) were significantly lower in northeastern Oklahoma and approached significance in the southeastern part of the state. Catch per unit effort was lower in the northeast for 9 of 10 turtle species caught. Species richness and species diversity were both significantly lower in the northeast, while the southeast showed little difference in species richness or diversity. The Alligator Snapping Turtle (Macrochelys temminckii), which is listed as a species of special concern in Oklahoma Department of Wildlife Conservation’s Comprehensive Wildlife Conservation Strategy, was collected at 11 sites of the sites surveyed. We captured 11 of the 14 species of freshwater turtles found in eastern Oklahoma, while the Western Chicken Turtle (Deirochelys reticularia miara), Painted Turtle (Chrysemys picta), and Common Map Turtle (Graptemys geographica), which are listed on the Oklahoma Natural Heritage Inventory’s Working List of Rare Oklahoma Vertebrates, were not captured (the Painted Turtle Chrysemys picta, was captured in 1997–1999). Population Studies: Oral (Student)
influencing demography. Possible explanations for large body sizes in the Santa Fe River may be related to coexistence with Alligator Snapping Turtles (Macrochelys temminckii), the physical environment of riverine habitat, or the thermal/food resources provided by artesian springs.

Population Studies: Oral (Student)

Wood Turtles (Glyptemys insculpta) in New England: Long-term Research and Conservation Planning

MICHAEL T. JONES, PAUL R. SIEVERT, AND LISABETH L. WILLEY
U.S. Geological Survey, Massachusetts Cooperative Fish and Wildlife Research Unit, Department of Environmental Conservation, University of Massachusetts, Amherst, MA 01003, USA
[mtjones@bio.umass.edu]

Wood Turtles (Glyptemys insculpta) are a species of conservation concern throughout the northeastern U.S. and adjacent Canada. Recent studies have strongly indicated that population declines are underway in widely separated states and watersheds, resulting from habitat degradation, intensive agriculture, roadkill, and collection. From 2004 – 2011 we investigated the population structure and seasonal ecology of Wood Turtles in Massachusetts, New Hampshire, and Maine. We monitored 131 adult Wood Turtles using radio telemetry for at least one year, and subsets of these for two to five years. We evaluated population structure and size in segments of twenty-three streams. We investigated the influence of seasonal flooding, agricultural practices, road density, and landcover on the seasonal movements of individual turtles and on population structure and density. In addition, we explored the relative influence of age, size, and sex on the survival, movements, and reproduction of adult turtles. To do so, we developed a novel method of aging turtles based on a multivariate analysis of shell-wear rates derived from digital photographs taken several years apart. Population density at our New England study sites ranges from 0 – 40 adult Wood Turtles / river-kilometer. Population density is variable within streams and negatively correlated with active agriculture at both riparian and watershed scales. We revisited a 150 year-old account of extremely dense Wood Turtle populations in Lancaster, Massachusetts by Louis Agassiz, and infer from our survey results that this population has substantially decreased. We also found evidence that adult Wood Turtles today are on average 20% larger in body size, and juveniles grow significantly faster than Agassiz’s turtles. We are using our study results to undertake proactive conservation planning for Wood Turtles in New England. In 2011, we identified major focus areas encompassing potentially large, viable populations in each New England HUC4 basin and began standardized monitoring and targeted conservation efforts in these high-priority areas. While some of these populations currently appear to be secure, our population models indicate that on average, some Wood Turtle populations in Massachusetts may be declining by more than 10 % annually, and our landscape models indicate that Wood Turtle populations may be negatively impacted by relatively small land use changes.

Turtle Ecology: Oral

The Ghosts of Meiolania and Chelonooidis in the Melanesian and Caribbean Anthropocene: Resurrecting Trophic and Evolutionary Dynamics with Proxy Tortoise Species

JAMES JUVIK1, A. ROSS KIESTER2, AND DENNIS HANSEN3
1Department of Geography and Environmental Studies, Univ. of Hawai`i–Hilo, 200 W. Kawili St., Hilo, HI 96720, USA
2Turtle Conservancy, 49 Bleecker St., Suite 601, New York, NY 10012, USA,
3Institute of Evolutionary Biology and Environmental Studies, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland
[jjuvik@hawaii.edu]

The recent extinction of many large tortoise species on oceanic islands has reduced the size of top-herbivores in these ecosystems by orders of magnitude, thus causing dramatic changes in ecosystem structure and function. Co-evolved seed dispersal and herbivory interactions between tortoises and vegetation have been especially disrupted. On the Mascarene Islands in the Indian Ocean, efforts are now well underway to restore these lost ecosystem functions by replacing extinct tortoises of the genus Cylindraspis with the introduced proxy alien tortoises Aldabrachelys gigantea and Astrochelys radiata. The extinct, Giant Horned-tortoises of the family Meiolaniidae exhibited a Gondwana distribution from the Cretaceous of Argentina to the late Pleistocene of Australia and Anthropocene of Melanesia. Recent discoveries on Vanuatu of sub-fossil Meiolaniid tortoises contemporary with the Lapita culture (2700 years BP) reinforce a pattern of Melanesian megafauna extinctions as humans settled the islands. Caribbean tortoises of the genus Chelonooidis closely replicate this extinction pattern over the past 500 – 5000 years, which likewise matches with the dates of initial Amerindian settlement. In this paper
we propose the Large Rainforest Tortoise, *Chelonoidis denticulata*, from the Amazon for possible introduction into Melanesia. We also suggest the arid-adapted *Astrochelys radiata* for trial introduction into the Bahamas and Turk-Caicos Islands. Such populations would not only restore ecosystem function, but could also play the role of substantial wild, assurance colonies by potentially absorbing large numbers of confiscated animals now poorly housed and maintained in overcrowded zoos and rescue centers. We outline a specific (and reversible) research protocol to test the feasibility of restoring the ghosts of *Meiolania* and *Chelonoidis* in former island tortoise habitats.

**Chelonian Habitats: Oral**

**Conservation Strategies for Wildlife Managers: Analysis of Repatriated Box Turtles**

*SARJANA KHADKA*¹ AND *ELIZABETH WALTON*¹,²

¹Environmental Sciences Program, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA
²Department of Geography, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA
[elwalto@siue.edu]

Box turtle species have experienced significant declines throughout their range as a result of habitat destruction, human consumption, and pet trade demands. During an investigation of box turtle populations on Southern Illinois University Edwardsville (SIUE) campus, we discovered three box turtle species including the Eastern Box Turtle, *Terrapene carolina carolina*; the Three-toed Box Turtle, *Terrapene carolina triunguis*; and the Ornate Box Turtle, *Terrapene ornata* in the area. The Ornate Box Turtle is listed as “endangered” by the state of Illinois and one individual was found on a road adjacent to campus with an aural abcess. We also encountered a number of box turtles with minor injuries on roads adjacent to SIUE campus. In an effort to conserve as many viable turtle individuals as possible, we believe a small investment of time ($\leq 1$ year) and a period of rehabilitation will allow many of these sick or injured turtles to be rescued, restored to health, and returned to their native habitat. The Turtle Research and Rescue Lab at SIUE works to rescue sick and injured box turtles and restore them back to health so they can return to their natural habitat and continue making a genetic contribution to local populations. We had four rescued turtles in our lab that recovered from injuries or illness. The turtles stayed at a “halfway” house for two months before being fitted with transmitters and released back into their native habitat just before the onset of temperatures falling into the $\sim 5^\circ C$ ($\sim 40^\circ F$) range. The specific objective of this research was to determine how turtles responded in their natural habitat after release including total distance traveled, home range, and habitat preferences. These turtles, and one locally trapped turtle, were tracked daily using radiotelemetry and a GPS unit; all locations and variables were mapped in a GIS. Preliminary results indicated that the native turtle traveled greater distances and had a larger home range than the repatriated turtles. However, as time progressed, the repatriated turtles began to range further than they did initially. Results of this on-going study will be presented.

**North American Box Turtles: Oral**

**Movement Patterns, Meta-populations, and a Possible Range-wide GAP Analysis of the Common Box Turtle (*Terrapene carolina*)**

*A. ROSS KIESTER*

*Turtle Conservancy, 49 Bleecker St., Suite 601, New York, NY, 10012, USA*
[ross@turtleconservancy.org]

The Common Box Turtle (*Terrapene carolina*) is generally perceived to live up to its name. But, as Ken Dodd and Dick Franz emphasized several years ago, this is no reason to be complacent about its status. How, then, can we determine the status of such a widespread species? We begin with a review of individual movement patterns that show an extraordinary variability in this species. We can then characterize the long-distance movements of some individuals as they occur across a landscape of different habitats to begin to understand the structure of box turtle meta-populations. Here the risk of road mortality and land-use change may disrupt that pattern. At the scale of the entire range of the species, the EmySystem database currently has 2861 historical localities. So the question of assessing the status of the species as a whole becomes one of connecting the scale of meta-population analysis to the scale of the range. One possible tool for this scaling-up is GAP Analysis; a conservation assessment tool that looks at the distribution of a species across the habitat types it occupies and estimates the representation of that species in protected areas. The distribution of the Common Box Turtle over so many states creates a problem for traditional GAP Analysis because there is not enough consistency between the modeled ranges in each state. However, Common Box Turtles are often encountered by citizens and are the subject of many scientific field studies. I propose that we think about creating a species-wide Common Box Turtle Conservation Consortium to collect and
synthesize data on this species. Both scientists and citizen scientists could check old distribution records, create new records, and, together with a consistent habitat typology, produce a species-wide conservation assessment.

North American Box Turtles: Oral

Can the Egyptian Tortoise Survive Desertification?
ANDREW KRAMER¹, SHERIF BAHÁ EL-DIN², SRIDHAR RAMACHANDRAN¹, OMAR ATTUM¹,
¹Department of Biology, Indiana University Southeast, 4201 Grant Line Rd., New Albany, IN 47150, USA,
²Nature Conservation Egypt, Egypt
AK:{ajkramer@ius.edu}, OA:{oattum@ius.edu}

Desertification, the process of vegetation loss in arid environments, is widespread and expanding, especially in the Middle East and Africa. As desertification is likely to increase, ecologists want to predict the effects of these impacts on species survival. The Egyptian Tortoise is one of the smallest, most endangered, and the least studied tortoises in the world. The main threats to the Egyptian Tortoise in Egypt is overgrazing by livestock, removal of woody vegetation by local people, and pet collection. The objective of this study was to examine monthly use of vegetation according to size, carapace temperature exposure, and the relationship between vegetation size and temperature exposure. Egyptian Tortoises used a variety of different sized shrubs during the fall, winter, and spring months, but used almost exclusively large shrubs in the summer as aestivation refuge sites. Temperature exposure underneath a shrub refuge increased as shrub size decreased. Tortoise carapace temperature exposure also varied throughout the fall, winter, and spring months, but was relatively stable when tortoises aestivated during the summer months. Our results suggest that desertification will negatively impact the Egyptian Tortoise because the Egyptian Tortoise is dependent upon large shrubs as an aestivation refuge and a thermoregulatory microhabitat.

Chelonia Habitats: Oral (Student)

An Overview of Recent Changes to Captive Management Programs in AZA Institutions
DWIGHT LAWSON
Zoo Atlanta, 800 Cherokee Avenue, Atlanta, GA  30315, USA
[dlawson@zooatlanta.org]

In 2010 the Association of Zoos and Aquariums (AZA) announced significant changes to the rules and guidelines governing captive management programs for AZA accredited institutions. The changes come in response to the recognition that many AZA-managed breeding programs are not sustainable in the long-term. The new system is designed to focus program coordinators on enhancing the sustainability of their captive population. These programmatic changes have prompted much discussion and some confusion within the zoo community and among private animal holders. I will present an overview of the new guidelines for captive programs within AZA, and how these programs can (and must) become more inclusive.

Role of Zoos in Turtle Conservation: Oral

Conservation and Trade Management of Freshwater and Terrestrial Turtles in the United States
THOMAS E.J. LEUTERITZ
U.S. Fish and Wildlife Service, Division of Scientific Authority, 4401 N. Fairfax Dr. Suite 110,
Arlington, VA 22203, USA
[thomas_leuteritz@fws.gov]

The U.S. Fish and Wildlife Service's International Wildlife Trade Program convened a joint Federal-State workshop in St. Louis, MO in September 2010 to discuss the management, regulatory, scientific, and enforcement needs associated with the harvest and trade of freshwater turtles in the United States. The Service convened the workshop in response to a significant increase in the export of native turtles, particularly to Asia. The available data on turtle exports from the United States indicate that species with the most dramatic and consistent increases in export history are the Common Snapper (Chelydra serpentina), Florida Red-bellied Turtle (Chrysemys nelsoni), Florida Softshell (Apalone ferox), Spiny Softshells (Apalone spinifera), and although gross volume is much lower, the Spotted Turtle (Clemmys gutatta). While export levels of freshwater turtles from the United States appear variable, the long-term trend is an increase across the board, over an extended period of time. Workshop participants from 36 states as well as participants from other federal agencies and the wildlife law
enforcement community were included. In addition, we invited a number of academic and non-governmental turtle researchers with specialized expertise on turtle life history, ecology, and management for this meeting. The IUCN Tortoise and Freshwater Turtle Specialist Group was contracted for technical advice prior to the meeting, and the Specialist Group prepared draft revised species assessments of native turtle species for the workshop participants to consider. The poster outlines the conservation, management, and law enforcement recommendations from this workshop.

**Poster Session**

**What Do Turtles Do When They Ain’t Doing Nothing?**

*Winter Ecology of the Yellow Mud Turtle (Kinosternon flavescens)*

**DAY B. LIGON¹, TYLER SANDERS¹, AND RICHARD KAZMAIER²**

¹Department of Biology, Missouri State University, Springfield, Missouri 65897, USA
²Department of Life, Earth, and Environmental Sciences, West Texas A&M University, Canyon, TX 79016, USA

[DayLigon@MissouriState.edu]

Yellow Mud Turtles (Kinosternon flavescens) are putatively aquatic, yet presence of surface water is seasonal and often unreliable across much of its range. Summertime estivation is frequently necessary to survive periods of drought. Additionally, low winter temperatures necessitate hibernation in the northern parts of the species’ range. As a result, individuals frequently spend large portions of the year in terrestrial dormancy. We measured daily and seasonal fluctuations in soil temperatures and body temperatures of hibernating Yellow Mud Turtles at Gene Howe Wildlife Management Area in the Texas panhandle from September 2009 to March 2010. We then used these data to determine: 1) when individual turtles left their pond, burrowed into the soil and began winter dormancy; 2) the depth at which turtles hibernated; 3) the timing and frequency with which they changed depth; and 4) the date on which each turtle emerged from hibernation and returned to the pond. Additionally, temperature-specific metabolic rate data obtained from captive turtles were used to estimate energy consumption during hibernation. Among seven turtles from which data were recovered, hibernation began 20 September through 4 October, turtles buried themselves 11–80 cm below the surface, and several turtles burrowed progressively deeper as winter progressed. Spring emergence was asynchronous, occurring 5 March through 21 April. Lipids were likely the dominant metabolic substrate fueling hibernation, and turtles used an estimated 38–51 kJ during hibernation.

**Turtle Ecology: Oral**

**The Effects of Bush Honeysuckle on the Habitat Use of the Eastern Box Turtle**

**JAMES LOWRY AND OMAR ATTUM**

Indiana University Southeast, 42 lakeshore Dr., Clarksville, IN, USA

[jamlowry@ius.edu]

Bush Honeysuckle (Lonicera maackii) is the most invasive plant species in North America and is especially problematic in urban parks. Invasive plant species are recognized as a major problem in ecosystems across Kentucky. Bush Honeysuckle out competes native plant species altering soil chemistry and structure of forest communities. We studied Eastern Box Turtle (Terrapene carolina) habitat use in relation to distribution and density of bush honeysuckle in Blackacre State Nature Preserve; Louisville, KY. Radiotelemetry was used to locate turtles and compare the microhabitat use of turtle locations to the microhabitat of randomly located points. Bush Honeysuckle density was observed to be significantly lower in turtle locations compared to random points. Thermoregulatory needs and reduced food abundance may cause Eastern Box Turtles to avoid areas of high bush honeysuckle density. Eastern Box Turtles preferred to occur within the vicinity of hiking trails, as turtles were found significantly closer than random points to hiking trails. Hiking trails create artificial canopy gaps which box turtles may use for thermoregulation. Density expansion of Bush Honeysuckle within the forest structure causes disruptions in food supply and thermoregulation for the Eastern Box Turtle. This project is ongoing and should be completed in the next year.

**North American Box Turtles: Oral (Student)**

**Evaluation of Box Turtle Populations in 2010 at Southern Illinois University Edwardsville**

**JILL MAES¹ AND ELIZABETH WALTON¹,²**

¹Department of Geography, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA
²Environmental Sciences Program, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA

[elwalto@siue.edu]
We evaluated a box turtle population located on the campus of Southern Illinois University Edwardsville to determine population demographics, habitat preference, the influence of temperature on turtle observations, and capture method efficacy. Twenty-two box turtles (M8:F8:J6) were captured during the 184-day research period. Eighty-six percent (n = 19) of the turtles were captured in the forest area with the most activity occurring when temperatures were between 24°C to 27°C (76º–80ºF) in the months of April and May. An evaluation of capture methods revealed that visual search hours expended were 18.12 hours per turtle in contrast to more than 6,300 hours required to capture a turtle in a trap.

**North American Box Turtles: Oral**

Southern Illinois University Edwardsville Box Turtle Demographic Study 2011

**John Markovich**1,2, Shaun Dilts1, Eric Hoffman1, Heidi Haag1,2, Sarjana Khadka2, and Elizabeth Walton1,2

1Department of Geography, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA
2Environmental Sciences Program, Southern Illinois University Edwardsville, Edwardsville, IL 62026, USA
[elwalto@siue.edu]

Southern Illinois University Edwardsville (SIUE) hosts a variety of animal species on its 2,660 acre wilderness campus. The different types of habitats on campus provide a home for the Eastern Box Turtle (*Terrapene carolina carolina*), the Ornate Box Turtle (*Terrapene ornata ornata*), and the non-native Three-toed Box Turtle (*Terrapene carolina triunguis*). This spring begins the second year of the SIUE Turtle Research and Rescue Lab’s box turtle demographic study. Forty traps were placed in four different habitats on campus: forest area, tall prairie grasslands, wetlands, and an area experiencing an influx of invasive species. Traps were checked daily and any new turtles were brought back to the lab where they were marked, weighed, measured, and then released back at the point of capture. Turtles recaptured from last year were weighed and measured for comparison to the data collected previously. Results of the study will be presented including habitat preference, demographics and weights and measures.

**Poster Session**

Conservation of the Radiated Tortoise (*Astrochelys radiata*): Pilot Program Development through Community Training and Educational Outreach at Lavavolo Classified Forest, Madagascar

**Susie McGuire**1, Tsilavo Rafeliarisoa2,3, Gary Shore3,4, and Edward Louis, Jr.3,4

1Conservation Fusion, Inc., 5820 Spring Street, Omaha, Nebraska 68106, USA
2Département de Biologie Animale, Université d’Antananarivo, BP 906, Antananarivo, Madagascar
3Madagascar Biodiversity Partnership, ONG, VO 12 Bis A Manakambahiny, Antananarivo, Madagascar
4Madagascar Biodiversity and Biogeography Project, Henry Doorly Zoo, Grewcock’s Center for Conservation and Research, 3701 South 10th Street, Omaha, NE 68107, USA
[conservationfusion@gmail.com]

The Radiated Tortoise, *Astrochelys radiata*, is one of the emblematic species that inhabits the dry spiny forests of southern and southwestern Madagascar. The historic range of this species has been greatly affected by habitat destruction and illicit collection for local consumption and international markets. Recent research reveals that this range is still declining. This reduction is accentuated by the current economic and political situation in Madagascar, which seriously threatens the species’ survival. The Radiated Tortoise Project (RTP) developed a pilot project initiated by Omaha’s Henry Doorly Zoo, the Madagascar Biodiversity Partnership (MBP) and Conservation Fusion, Inc. (CF). The program was aimed to respond to this deplorable crisis by addressing education and community-based infrastructure linked to the conservation of the radiated tortoise. Using a multifaceted approach, representatives of the RTP and Turtle Survival Alliance (TSA) presented training workshops on rocket stove production. These fuel-efficient stoves were designed to accept biofuel briquettes using the introduced *Opuntia* cactus as a fuel source. In Itampolo, a new fence was built in concert with the TSA around the existing nursery to better protect their seedlings from goats. Moreover, a new 10 m by 10 m nursery was constructed in Lavavolo. The Hippo Water Roller was also introduced to the Lavavolo community. Thirty Groasis boxes were also delivered and will be incorporated pending the analysis of the botanical survey. To capture the spirit of the community, CF presented novel educational material to the primary and secondary schools in Itampolo, including movie nights, paper 3-D Radiated Tortoises, puppet painting activities, and other tortoise-inspired crafts. The education program was supplemented with teacher workshops, jointly attended by teachers from Kianjavato who were previous workshop participants. Finally, the education program culminated with the Sokake-O-Rama Festival. This event allowed the children of Lavavolo and Itampolo...
Chelonian Conservation: Oral

Freshwater Turtle Recovery Associated With an Oil Spill along the Kalamazoo River Michigan, USA  
DAVID MIFSUD  
Herpetological Resource and Management, LLC, P.O. Box 110, Chelsea, Michigan, USA  
[DavidAMifsud@Gmail.com]

In late July of 2010, nearly a million gallons of high sulfur crude oil spilled into the Kalamazoo River located in Southwest Michigan, USA. This spill impacted approximately 36 miles of river and potentially hundreds of acres of high quality turtle habitat. The scale of the spill made this one of the worst environmental disasters in Michigan history. Early in the response, the U.S. Fish & Wildlife Service (USFWS) identified a need for focused rescue and recovery of turtles. Herpetological Resource and Management, LLC (HRM) was contracted by the USFWS to help coordinate and develop protocols to rescue affected turtles and to identify release locations for cleaned turtles. HRM was also assisted with cleaning and husbandry of impacted turtles and other herpetofauna. Numerous people and countless hours went into the rescue, cleaning, care and ultimate release of these animals. In total, over 2,500 animals, more than 2,000 of them turtles (eight species), were collected and treated as part of rescue efforts in 2010. This presentation will focus on the efforts made in the early days to rescue turtles including: protocols developed; logistics of working at a spill site; lessons learned; and a brief update on the spill and the status of turtles in that region.  

Field Conservation: Oral

Nesting Ecology in a Reintroduced Population of Alligator Snapping Turtles  
JESSICA MILLER AND DAY B. LIGON  
Department of Biology, Missouri State University, Springfield, Missouri, 65897, USA  
[Miller522@live.missouristate.edu]

The Alligator Snapping Turtle, Macrochelys temminckii, is a large freshwater species that has experienced significant population declines throughout much of its range. In an effort to reestablish a population in southern Oklahoma, adult turtles were reintroduced into the Washita River and associated oxbows in 2007 with the expectation that these animals could quickly establish a reproductively viable population. Nesting ecology has been studied in Macrochelys temminckii populations in Louisiana and Florida, but no studies have investigated reproductive biology in recently relocated individuals. We assessed nest-site fidelity and nest-site selection in Macrochelys temminckii populations. We conducted daily nest searches of shorelines on two oxbow lakes located along the Washita River channel in southern Oklahoma between 15 May and 18 June 2010 and 15 May and 15 June 2011. Unpredated nests were excavated to determine nest depth, clutch size and egg diameter, and then reburied with a data logger to record nest temperatures. These nests were re-excavated at the end of July and incubation was completed at 28°C at Missouri State University so that hatching success could be determined and turtles could be individually marked for future identification. Nesting activity occurred from 16 May to 17 June and incubation periods ranged from 76–97 days. Predation rates by raccoons were extremely high among nests not protected within several hours of being laid, indicating that continued efforts to protect nests will be necessary to boost hatchling recruitment rates. Recorded nest temperatures were used to predict sex-specific recruitment two ways: 1) by calculating average nest temperatures during the middle 1/3 of incubation; and 2) by constructing degree-day models that compensate for fluctuating nest temperatures. Results from these two approaches were then compared to actual sex ratios determined by laparoscopic examination of gonads to test their efficacy for this species.  

Turtle Ecology: Oral (Student)

Population, Survivorship, Biomass, Sex Ratios, and Density of the Freshwater Aquatic Turtle Population at Wekiwa Springs State Park  
ERIC MUNSCHER1, J. BRIAN HAUDE2, JOE MACDONALD2, ELEANOR HAVENS3, AND EMILY A. KUHNS4  
1SWCA Environmental Consultants, Houston, TX, USA  
2Department of Biology, Peninsula College, Port Angeles, WA, USA  
3Huxley College of the Environment on the Peninsula, Western Washington University, Port Angeles, WA, USA  
4Department of Biology, Missouri State University, Springfield, Missouri, 65897, USA
Using mark-recapture data, population size, survivorship, density, biomass, and sex ratios were calculated for four aquatic turtle species in the 1.2 ha lagoon and 0.6 ha proximal spring in Wekiwa Springs State Park, Orange and Seminole counties, Florida. This study began in 1999, with one to three sampling sessions in March, May, August, or November each year through 2011. The four most common species captured were the Florida Peninsula Cooter (*Pseudemys peninsularis*), the Florida Red-bellied Cooter (*Pseudemys. nelsoni*), the Common Musk Turtle (*Sternotherus odoratus*), and the Loggerhead Musk Turtle (*Sternotherus minor minor*). Population estimates were calculated using an open-system technique (Jolly–Seber method). Population estimates from sampling trips from 1999 to 2011 will be presented and trends will be discussed. Density and biomass of these species are high in comparison to estimates obtained from other studies of the same or similar species elsewhere. Sex ratios of all species were not significantly different from 1:1. This monitoring project was undertaken in order to assess the continued impact of development on the area surrounding the park. The flood plain charging this spring includes much of the metropolitan area of Orlando, one of the nation’s fastest growing areas. It is therefore imperative to closely monitor this turtle assemblage in order to quickly and accurately report any impacts and thereby allow for rapid and effective management to occur.

**Turtle Ecology: Oral**

**Restoration of Western Pond Turtles in the MSCP Region of San Diego, California**

**THOMAS C. OWENS¹, CHRISTOPHER W. BROWN², AND ROBERT N. FISHER²**

¹Department of Herpetology, San Diego Zoo, P.O. Box 120551, San Diego, CA 92112, USA

²USGS Western Ecological Research Center, San Diego Field Station, 4165 Spruance Road, Suite 200, San Diego, CA 92101, USA

[towens@sandiegozoo.org]

Riparian systems in coastal San Diego have endured heavy impacts from fragmentation, urban development, altered hydrology, invasive species and high intensity wildfires. These systems are home to the Western Pond Turtle which is covered under the San Diego Multi-Species Conservation Plan. This interagency habitat conservation plan was implemented to conserve nearly forty different animal species in the region and even more plant species. The San Diego Zoo and USGS San Diego Field Station and are studying the recovery of the western pond turtle in a population heavily impacted by exotic species and altered hydrology. This population has produced gravid females in the wild, but no detectable recruitment in recent years. In collaboration with the USGS San Diego Field Station, we are implementing and assessing effectiveness of two management tools by removing invasive species from available habitat and head starting in an effort to increase survival probability. First, we examine the western pond turtle’s response to invasives control through capture/recapture rates, age structure of captured turtles and proportion of gravid females observed. Second, we report on the success of captive rearing of eggs harvested from gravid females found in the wild population.

**Field Studies: Oral**

**Contributions to the Study and Conservation of the Magdalena River Turtle (*Podocnemis lewyana*)**

**VIVIAN P. PÁEZ, ADRIANA RESTREPO, BRIAN C. BOCK, AND CARLOS ORTIZ-YUSTI**

Instituto de Biología, Universidad de Antioquia, AA 1226, Medellín, Colombia

[vivianpaez1@gmail.com]

*Podocnemis lewyana*, the Magdalena River Turtle, is confined to the Sinú, San Jorge, Cauca, and Magdalena drainages in Colombia, making it a biogeographic anomaly, being the only podocnemid species to occur northwest of the Andes. It is classified as Endangered on the IUCN Red List due to the effects of habitat modification and the exploitation of adults and eggs. However, we argue that its classification be elevated to Critically Endangered, based on evidence of declining populations throughout its range and the lack of any protected areas within its range. Here we present the principle findings from our recent studies of *Podocnemis lewyana* and provide a summary of on-going projects. We have quantified aspects of nesting ecology in the middle Magdalena River drainage, such as clutch sizes, nest characteristics, incubation temperatures and periods. We have complimented these field studies by artificially incubating nests in the laboratory, where we have documented significant maternal and locality effects on egg and neonate traits, as well as one of the highest threshold temperatures yet known for a turtle species (33.4°C). We have compared populations using allozymes, showing low levels of
variability and no evidence of genetic structure. A survey of the status of numerous populations showed all to be experiencing heavy exploitation, with most exhibiting evidence of recent population declines. Presently, we are investigating the importance of direct (maternal) vs. indirect (maternal and paternal genetic) effects on neonates produced from nests incubated under homogeneous temperature and humidity conditions. We also are quantifying levels of three different hormones in egg yolks to inspect for associations among yolk composition and neonate sex ratios and traits. Microsatellite data has revealed multiple paternity in all nests examined, and we are conducting historical demographic analyses using these loci. The extensive variability among populations in key parameters has implications for our efforts to conduct niche modeling for this species. Our latest grants are directed towards conducting demographic modeling in different populations to better quantify variation in life history traits, examining the effects of different levels of environmental contamination on eggs, neonates, and adults, and establishing community-based monitoring programs.

South American Turtles – Colombia: Oral

Evaluation of a Community-based Management Experience of Podocnemis Species in the Lower Amazon, Brazil

JUAREZ CARLOS BRITO PEZZUTI, PRISCILA MIORANDO, DANIELY FELIX-SILVA, AND DAVID GIBBS MCGRAITH
Núcleo de Altos Estudos Amazônicos (NAEA), Universidade Federal do Pará–UFPA, Rua Augusto Corrêa 01, CEP 66075-110 Belém, PA, Brazil
[juca@ufpa.br]

Amazon River Turtles are one of the main food resources of the indigenous populations of the Amazon várzea (floodplain) and its main tributaries, and have been exploited for thousands of years. Moreover, during the last five centuries these animals have been exploited on a commercial scale, resulting in the decline of the main commercial species. Since the 1970's, both the government and various communities have invested in the protection of important nesting areas. These locations have become sanctuaries for the protection of these animals, although they are under heavy pressure for both consumption and sale, due to the deeply embedded custom of consuming turtles, in both rural and urban areas. This study describes three initiatives to protect important nesting areas in the Santarém region of the Lower Amazon, State of Pará, by floodplain communities. These initiatives, which have been maintained for up to 35 years, have made a significant contribution to the protection of nests and hatching turtles. Of the three nesting areas, only the São Miguel beach receives large numbers of female Amazon River Turtles (Podocnemis expansa), while the other two beaches, the Taboleiro Água Preta and the Praia da Ilha Grande, receive few individuals of this species. All the beaches receive females of Podocnemis unifilis and Podocnemis sextuberculata, and at least five species of birds and one of lizard. These communities sought out IBAMA and in different periods received informal logistical and financial support, though none receive any support at present. Although the three areas are known locally to be protected, they are the target for eggs and females poaching during the nesting season. Females are captured with gig nets placed perpendicularly to the beach, capturing females as they leave or return to the water to lay their eggs, and in other locations where animals are known to concentrate during the low water season. In addition to the recommendation that these initiatives be encouraged and supported, it is also important that local communities obtain the right to plan, implement and administer their own management projects to consolidate structurally and financially the protection of natural resources within their territories.

Chelonian Conservation: Oral

An Assessment of Viable Habitat for Blanding’s Turtle (Emydoidea blandingii) in the State of Ohio using GIS and Remote Sensing

BRADLEY M. POYNTER
Cleveland State University, Cleveland, Ohio, USA
[bmp@clevelandmetroparks.com]

The Blanding’s Turtle (Emydoidea blandingii) has received threatened status in the State of Ohio in 2010. The goal of this study is to provide information that can be used in conservation management to locate suitable habitat for conservation of the species as well as potential repatriation or translocation sites. Wetland Inventory and Land Use/Land Cover maps were combined with aerial photography to evaluate regions located in Ohio’s Lake Erie Drainage Basin that would meet the essential requirements of the turtles’ life history by quantitative methods used in Geographic Information Systems (GIS) and Remote Sensing programs. This study identified suitable wetlands and vernal pools, lakes and ponds, and other areas with minimum canopy for nesting and movement. Throughout the region, the highest concentration of available habitat is found in Erie, Lucas, and Ottawa counties of the Blanding’s Turtle’s historical range. This approach to creating Habitat Niche Models
was validated by close correlation between the counties identified as having remaining appropriate habitat and the counties from the historical populations in which Blanding’s Turtles still remain. The potential exists to restore these areas through various means: restoring wetlands, protecting areas near agriculture that are more suitable for nesting, constructing small tunnels under roads and fences, and installing road warning signs to allow for safer migration. With protection and restoration of the habitat, the species may still have a chance to recover and become a stable population without the need for intense management.

**Chelonian Habitats:** Oral (Student)

**Large River Turtle Consortium: Conservation of Critical Species through Captive Management in the 21st Century**

**BRADLEY M. POYNTER**

*Cleveland Metroparks Zoo, Cleveland, Ohio, United States*

[bmp@clevelandmetroparks.com]

As we move into the 21st century, the role of zoos continues to contribute to the conservation of species they exhibit. Often conservation comes in the form of monetary contributions to existing programs in the field. The grants offered and the donations to projects is an important aspect, however, much of what can be contributed to *in-situ* programs can come from the captive management of species. Large river turtles present a particular problem in captivity due to the size of the animals and the facilities necessary to house them properly. A consortium of institutions interested in the conservation of river turtles can pool resources to accomplish a larger contribution to turtle conservation overall. Each institution involved in this consortium has different strengths and abilities and each can choose their level of involvement in the program. Fifteen critical species of river turtles (13 Southeast Asia and 2 South America) from the top 40 most endangered turtles in the world were chosen for potential programs. The goal of this Large River Turtle Consortium is to contribute to *in-situ* programs by means of assurance colonies, head-start facilities, genetic studies, behavior studies, natural history, education/awareness, etc. With the looming threat of extinction of large river turtles, zoos not only have the unique ability to house large species in their exhibits for display, but also contribute a wealth of knowledge vital to the conservation of critical species in the wild.

**Role of Zoos in Turtle Conservation:** Oral (Student)

**Can Automated Radio Telemetry be used to Quantify Ornate Box Turtle (*Terrapene ornata*) Activity and Nesting Patterns?**

**THOMAS RADZIO¹, JERAMIE STRICKLAND², CHARLES TUCKER³, AND DAVID DELANEY⁴**

¹Department of Biology, Drexel University, 3141 Chestnut Street, Philadelphia, Pennsylvania 19104, USA

²Upper Mississippi River National Wildlife and Fish Refuge, United States Fish and Wildlife Service, 7071 Riverview Road, Thomson, Illinois 61285, USA

³Department of Biology, Missouri State University, 1901 South National Avenue, Springfield, Missouri 65897, USA

⁴United States Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory, 2902 Newmark Drive, Champaign, Illinois 61822, USA

[tar55@drexel.edu]

Miniature data loggers and transmitters allow biologists to efficiently study wary or cryptic animals in their natural habitats with minimal disturbance. In spring-summer 2010, we investigated whether automated radio telemetry and the signal change method could be used to quantify the activity and nesting patterns of Ornate Box Turtles (*Terrapene ornata*) inhabiting a sand prairie in northwestern Illinois. The signal change method relies on the principle that any movement of a radio transmitter (including minor changes in orientation) can strongly affect the intensity of the transmitter’s signal at a stationary receiving station. Using video observations of radio-monitored turtles, we confirmed that recordings of transmitter signals strength values can be analyzed to generate accurate indices of box turtle activity patterns. Notably, between late May and mid-June, most of 19 monitored females exhibited substantial activity on 1 or more nights. Previous reports indicate that Ornate Box Turtles nest at night, but are otherwise inactive after dark. Based upon this information, relatively little indication of night activity by males, and other patterns present within the radio signal recordings, we hypothesized that night activity corresponded to nesting. We visually confirmed nesting in 3 of 4 night-active females, but observations of the fourth female were inconclusive. Although our validation efforts are limited, the night activity recordings and visual observations suggest that females may require multiple nights to successfully nest. In conclusion, we demonstrate that the signal change method can be used to generate accurate indices of box turtle activity and, potentially, nesting patterns.

**Poster Session** (Student)
Understanding the Historical Range of the Radiated Tortoise (*Astrochelys radiata*): Preliminary Outcomes from a Projection Modeling Initiative

**TSILAVO H. RAFELIARISOA** 1,2, **RYAN C.J. WALKER** 3,4, AND **EDWARD E. LOUIS JR** 1

1Madagascar Biodiversity Partnership, Omaha’s Henry Doorly Zoo, Grewcock’s Center for Conservation and Research, 3701 South 10th Street, Omaha, NE 68107, USA
2Département de Biologie Animale, Université d’Antananarivo, BP 906, Antananarivo 101, Madagascar
3Nautilus Ecology, Oak House, Pond Lane, Greetham, Rutland, LE15 7NW, United Kingdom
4Department of Life Sciences, The Open University, Milton Keynes, MK7 6AA, United Kingdom
[rafelykely@hotmail.com]

Regardless of its apparent high abundance, the critically endangered Radiated Tortoise (*Astrochelys radiata*) has suffered from heavy conservation pressures during recent decades. The combined consequences of habitat degradation and poaching for both international pet market and human consumption have caused a drastic reduction of this species’ range over the last two hundred years. We present an overview of the results from a range-wide survey investigating the current range of the species; utilizing a standard ArcGIS based analysis. The analysis used quantitative field data collected during two field expeditions (2010 and 2011) and additional GPS coordinates collected as a result of field operations between 2000 and 2010. Range data, including published maps detailing the historical range of the species, were added to the GIS. Our results show that there has been as much as a 65% reduction in the species range since the mid 1800s. We present a preliminary stage result of a presence-only modeling performed under Maxent, using different variables such as precipitation, vegetation, geology and population. Although this study lacks data on some major parameters such as the anthropic pressure projection, this study represents an intuitive approach on understanding the limiting factors influencing the range and the occurrence of the Radiated Tortoise in southern Madagascar.

**Poster Session** (Student)

---

**Freshwater Turtle Hunting Technology, Preservation Systems, and Complex Trade Social Networks in Bangladesh**

**MD. MAKSUDUR RAHMAN** 1 AND **DEANNA H. OLSON** 2

1Programme Coordinator, CCEC, Bangladesh
[milon_nu@yahoo.com]
2US Forest Service, Pacific Northwest Research Station, Corvallis, OR, USA
[dedeolson@fs.fed.us]

Turtle trading is a common scenario in Bangladesh. Although it is prohibited under the Bangladesh Wildlife Preservation Amendment Act 1974, all 25 native species, including those with endangered status, are sold in markets. There are 150–200 turtle selling centers in Bangladesh, with 4–5 turtle trading centers in every Bangladesh district. It is estimated that more than 50,000–70,000 people are involved in turtle trading. Shikari, the turtle hunters, is an occupation passed through families, generation to generation. Two hunting methods are used: fishing hook and kala, a multi-pronged spear. With the fishing hook method, Shikari use a 140–180 m long rope along which there are fishing hooks baited with mussels positioned about every 2 m. This trap-line is set in the evening in canals, or paddy fields (beel). In the rainy season, the turtle hunter can catch approximately 10–15 kg of different turtle species per day. Alternatively, an unbaited hazari fishing hook may be used, with more frequently connected hooks along a 100–140 m long rope. Shikari using a kala will probe the wetland with the spear until they hear the sound of a knock on a turtle shell. Upon hearing the sound that a turtle is there, they collect the turtle using the kala. Fishing nets are sometimes used also. After turtles are collected, they are preserved in a plastic dram, aluminum pan, in a brick-built house with water, plastic or fiber bags, or within boxes or baskets with straw and water hyacinth. Few people depend only upon turtle hunting for their livelihood. Turtle hunters sell their catch to the wholesaler, depot, small trader, middleman, or directly sell to the consumer. A complex network of turtle traders exists, and the consumer often receives turtles that have been through an exchange of at least four or five different people. Turtle traders, hunters/collectors, middlemen, and wholesale sellers are generally not aware of animal transportation regulations. Turtle traders run their business through networking and coordination among each other, and in great confidentiality; they rarely operate as individuals.

**Poster Session**
Habitat Evaluation of Freshwater Turtles in the Chambal River of India Using Remote Sensing and GIS Techniques

R. J. RAO
Conservation Biology Unit, School of Studies in Zoology, Jiwaji University, Gwalior, India [soszool@rediffmail.com]

Assessment of freshwater turtle status in India highlights that many turtle species are endangered and there is a need for extensive studies on these species. The freshwater turtle fauna in the Chambal River in North India is very rich. Multifarious human activities in recent years have increased the adverse impact upon the turtle populations in the Chambal River. These activities include illegal fishing, sand mining, agricultural practices on the riverbanks and wood collection from riverside vegetation. This current study was conducted to evaluate the habitat of turtles in the Chambal River using Remote Sensing and geographic information system (GIS) techniques. Ground truth data were collected at more than 500 check points which were selected on the basis of habitat types like sand banks, rocky banks, hard-soil banks, mid-river rocky and sand islands, and different activities like agriculture, sand mining, and human habitation. The geographic coordinates of these points were noted using Google Earth imagery and checked in the field with a Garmin 76 global positioning unit. Data collected from the check points were used for assessment of habitat features and various developmental activities. Multi-temporal satellite images were used to develop land cover maps of the Chambal River and its catchment area. Maps showing digital layers in accordance to key habitat features of different species of turtles particularly nesting habitats were prepared after calculating Habitat Suitability Index (HSI). The Softshell Turtles used hard-soil for nesting and sand banks for basking whereas hard shell turtles used sand banks for nesting and rocks and hard-soil for basking. It is suggested that care should be taken while extracting sand from the riverbanks, and practicing agriculture on hard-soil banks to avoid disturbance to the turtle habitats.

Asian Cheloniens: Oral

Establishing Assurance Population of Batagur baska in Bangladesh

S. M. A. RASHID
Centre for Advanced Research in Natural Resources & Management (CARINAM), House: 545; Road No: 11, Baitul Aman Housing Society, Adabor, Dhaka, 1207, Bangladesh [carinam.bangladesh@gmail.com]

The Northern River Terrapin (Batagur baska) is one of the most critically endangered turtle species listed on the IUCN Red List as well as in the recently published “Turtles in Trouble: 25+ Endangered Tortoises and Freshwater Turtles”. After reclassification and distribution of the Genus Batagur, Batagur baska has been shown to be distributed only in Bangladesh, India and Myanmar and Batagur affinis in the south to Thailand, Cambodia, and Malaysia. In Myanmar and India, wild populations of Batagur baska are presumed to be non-existent which leaves Bangladesh as the only stronghold for this species. A young male was captured from the Meghna estuary suggesting the existence of a natural population in Bangladesh which needs to be surveyed intensively. With cooperation from the Forest Department (FD) under the Ministry of Environment & Forests (MOEF) and financial support from Turtle Survival Alliance (TSA) (and allied organizations), the Centre for Advanced Research in Natural Resources & Management (CARINAM) has initiated a captive breeding program to secure individuals for establishing assurance colonies of this critically endangered species. Two ponds were excavated and modified to provide near-natural habitat and nesting sand-bed for fourteen (10.4) Batagurs collected from private collections from different areas in Bangladesh. Two females laid eggs on 1-April 2011 in the two different ponds. In Pond 1, a nest with 28 eggs (including 6 broken) was found and the nest from the other female in Pond 2 could not be traced. In both ponds, the females did not lay eggs in the sand bed made at the edge of the pond but laid eggs away from the pond edge in the soil. Of the 22 good eggs from Pond 1 nest, 15 were banded and were placed in a dug out nest in the sand bed 50cm deep. The nest was protected by galvanized wire mesh against predation from predators like monitor lizards and civet.

Asian Cheloniens: Oral

The Effects of Eutrophication on the Painted Turtle, Chrysemys picta

BETH A. REINKE1, A. MICHELLE LAWING2, MAYTÉ RUIZ3, P. DAVID POLLY2
1College of Arts and Sciences, Indiana University, Bloomington, IN, USA
2Department of Geological Sciences, Indiana University, Bloomington, IN, USA
3Department of Biology, University of Puerto Rico – Rio Piedras, San Juan, USA [ereinke@indiana.edu]
Eutrophication of a body of water involves the introduction of excess nutrients, such as phosphorus and nitrate. This is often due to anthropogenic development and agricultural processes. We conducted a field study on diet, growth and immune function in Painted Turtles (*Chrysemys picta*) in Sawyer County, Wisconsin where eutrophication has been occurring for the last thirty years because of water release from two nearby cranberry bogs and recent development. The excess nutrients are known to spur plant and algal growth and often lead to reduced water quality and visibility. This adjustment of resources may affect the habitats and diets of many species of wildlife. Our research focused on the effects of eutrophication on Painted Turtles, one of the most abundant and widespread freshwater turtle species, as a proxy for the potential effects the nutrient loading has on the surrounding ecosystem. The turtle lives throughout the Lac Courte Oreilles system, a large part of the lake system in Sawyer County. Turtles were captured using dip-nets and traps and were measured, photographed, and microchipped, and blood and feces were collected. Our preliminary results indicate a more herbivorous diet, slightly smaller body sizes, and lower immune function in turtles in eutrophic sites. These results are consistent with our hypothesis that anthropogenic eutrophication can significantly affect life history traits because it alters habitat.

**Field Studies: Oral (Student)**

**Habitat Partitioning and Sampling Efficacy of an Aquatic Turtle Community in East Texas**

J. DAREN RIEDLE¹, RICHARD T. KAZMAIER², AND WES B. LITTLRELL³

¹Department of Agriculture and Environmental Science, Lincoln University, Jefferson City, MO 65101, USA
²Life, Earth, and Environmental Science, West Texas A&M University, Canyon, TX 79015, USA
³Gus Engeling Wildlife Management Area, Tennessee Colony, TX 75861, USA

To better understand how diverse assemblages of turtles are structured across a landscape, we sampled one site in east Texas to 1) test for segregation of turtle species along environmental gradients, and 2) determine degree of overlap of resource use, utilizing macrohabitat. During the course of our sampling efforts, we also compared capture efficacy, effort, and detection probability for each trap type and similarity of captures between trap types. We sampled turtle populations at Gus Engeling Wildlife Management Area between 2006–2009 using two sizes of fyke nets, two sizes of hoop nets, two sizes of collapsible box traps, and one size of sea bass or dome trap. At each net type, we collected a suit of habitat data including depth, flow, percent emergent vegetation, canopy cover, and availability of basking structure. We sampled for 1,239 net nights making 651 captures of eight species of turtles. Using Detrended Correspondence Analysis and Canonical Correspondence Analysis, we determined environmental variables important in dictating turtle community structure. Turtles segregated along both flow and vegetative gradients. In particular, we observed partitioning of habitat amongst con-familial species within the Chelydridae and Kinosternidae. Using the Program PRESENCE, we calculated detection probabilities of different families of turtles by net type. Emydids and Kinosterdids had higher detection probabilities within fyke nets, while Chelydrids had higher detection probabilities within larger hoop nets. When proportional captures of individual species were considered, Common Musk Turtles had higher proportion of captures within fyke nets. Large hoop nets captured higher proportions of razorback Musk Turtles, and Alligator Snapping Turtles. Collapsible box traps captured a higher proportion of Common Snapping Turtles, Eastern mud turtles, and sliders. Collapsible box traps were the only traps to capture all 8 species of turtles occurring at Gus Engeling Wildlife Management Area, although fyke nets and large hoop traps captured species sooner.

**Turtle Ecology: Oral**

**Reproductive Physiology of North American Tortoises**

DAVID C. ROSTAL

Department of Biology, Georgia Southern University, Post Office Box 8042, Statesboro, GA 30460, USA

[rostal@georgiasouthern.edu]

The reproductive physiology of North American tortoises belonging to the genus *Gopherus* has been well studied in two species. Limited data is available on a third species but largely is lacking on the two remaining species. Seasonal endocrine cycles are available for the Mojave Desert Tortoise (*Gopherus agassizii*), the Gopher Tortoise (*Gopherus polyphemus*) and the Bolson Tortoise (*Gopherus flavomarginatus*). No information is available on the endocrine cycle of the Texas Tortoise (*Gopherus berlandieri*) or the newly described Sonoran Desert Tortoise (*Gopherus morafkai*). Seasonal patterns in gonadal steroids (testosterone, estrogen and progesterone) as well as corticosterone levels will be reviewed. Similarities and difference in seasonal endocrine cycles will be discussed as well as their relation to ovarian and testicular cycles, egg formation and climate. Where data is lacking, the available information will be reviewed.

**North American Tortoises: Oral**
Distribution and Habitat Use of the Gopher Tortoise in a Declining Southeast Florida Conservation Area

JOSHUA SCHOLL, EVELYN FRAZIER, AND TOBIN HINDLE

1Department of Biological Sciences, Florida Atlantic University, Boca Raton, Florida 33431, USA
2Department of Geosciences, Florida Atlantic University, Boca Raton, Florida 33431, USA

[jscholl1@fau.edu]

Gopher Tortoises have been declining throughout their range over the last few decades due mostly to urbanization, which often leads to the creation of island habitats. This confines populations and eliminates natural management by wildfires resulting in degraded island habitats. To maximize conservation efforts in rapidly developing regions, it is critically important to investigate not only the natural ecology of native species, but specifically, how they are affected in confined and degraded habitats. We studied a Gopher Tortoise population to determine its status, distribution, and habitat use in a confined, degraded ecosystem on the Florida Atlantic University campus in Boca Raton, Florida. We conducted complete burrow surveys using belt transects, directly captured tortoises, and performed vegetation and soil analyses through aerial photos and United States Geological Survey data, respectively. The status of the population was assessed directly based on carapace length measurements and indirectly through ratios of active to abandoned burrow categories. Tortoises burrowed densely in areas of low vegetation and completely avoided areas with closed canopies, which comprised about 15% of the habitat. Soil types had a significant correlation to the spatial distribution of burrows. We found a high ratio of active to abandoned burrows, which could indicate an active and healthy population; however, demographic data compiled from captured tortoises revealed a lack of juveniles, suggesting an unsustainable population. We concluded that superficial burrow surveys may provide misleading results on the status of Gopher Tortoise populations in confined, degraded habitats and more direct population assessment methods such as tortoise captures or burrow measurements need to be used.

Poster Session (Student)

Geographic Variation in Population Structure, Shape Morphology, and Sexual Size Dimorphism in Graptemys flavimaculata

WILL SELMAN

1Department of Biological Sciences, The University of Southern Mississippi, 118 College Dr. #5018, Hattiesburg, MS, 39406, USA
2Current Address: Rockefeller Refuge, Louisiana Department of Wildlife and Fisheries, 5476 Grand Chenier Hwy, Grand Chenier, LA 70643, USA

[wselman@wlf.louisiana.gov]

Graptemys flavimaculata (Yellow-blotched Sawback) is a small, highly aquatic turtle that is endemic to the rivers and large creeks of the Pascagoula River system of southeastern Mississippi, USA. Even though its range is relatively small, little is known about geographic variation in population structure, shape morphology, and sexual size dimorphism (SSD) across its range. Graptemys flavimaculata were captured and measured from three sites in 2005 and 2006, while also conducting field work at two of these sites in 2008 for female head width analysis. Results indicate that body size, as well as population structure, varies across a geographic gradient; turtles from the lower Pascagoula River site were generally larger (both body mass and plastron length) relative to the Leaf and Chickasawhay River sites which were in more upstream localities. Additionally, body shape varies among populations in females, with Pascagoula River females having a more domed architecture relative to upstream sites which have turtles with more streamlined shapes; there was little difference in male shapes among sites. SSD was pronounced in all three populations with females attaining greater sizes relative to males, with varying degrees of SSD across sampling localities. Secondary sex characteristics such as female head width was significantly different across sites (Pascagoula > Leaf), while there was no difference among sites for male claw length. Presumably multiple factors in concert influence population structure, shape morphology, and sexual size dimorphism in Graptemys flavimaculata including: 1) food availability, 2) presence of competitors, 3) thermal environment, 4) presence of alligators, and 5) fluvial conditions.

Field Studies: Oral
Initial Surveys for Diamondback Terrapins (*Malaclemys terrapin*) on Rockefeller Wildlife Refuge in Southwestern Louisiana  
**WILL SELMAN AND BRETT BACCIGALOPI**  
Rockefeller Refuge, Louisiana Department of Wildlife and Fisheries, 3476 Grand Chenier Highway, Grand Chenier, Louisiana 70643, USA  
[wselman@wlf.louisiana.gov]

The Diamondback Terrapin (*Malaclemys terrapin*) inhabits coastal salt marshes, estuaries, bays, mangrove swamps, and tidal creeks from Massachusetts to Texas, USA. Within Louisiana, *Malaclemys terrapin* records are primarily from the coastal Deltaic marshes of southeastern Louisiana, with few records from Chenier Plain marshes of southwestern Louisiana and none from Rockefeller Wildlife Refuge (RWR). Following the Deepwater Horizon Oil spill in April 2010, many biologists within the state recognized the paucity of information regarding *Malaclemys terrapin* in Louisiana. Therefore, we began a pilot study to determine if *Malaclemys terrapin* occurred on RWR, while also testing different methods for capture efficiency. RWR is a 30,700 ha state wildlife refuge primarily managed for wintering waterfowl by Louisiana Department of Wildlife and Fisheries. Of the 30,700 ha, there are approximately 11,700 ha of tidally influenced brackish and saline marshes, which is likely suitable habitat for *Malaclemys terrapin*. Further, no commercial harvest of any species is allowed on RWR, including the use of crab pots which directly contribute to mortality of terrapins. We initiated distribution/abundance surveys in March 2011 and we used multiple methods (including modified crab pots, fyke nets with leads, and manual searching) to sample tidally influenced sites across the refuge. We report on the status of these distributional surveys and the preliminary results of these efforts.

**Poster Session**

A Study on *In-situ* and *Ex-situ* Rearing of Narrow Headed Softshell Turtle (*Chitra indica*) in National Chambal Sanctuary, India with Special Reference to Nesting and Hatching Conditions  
**R. K. SHARMA¹ AND SHAILENDRA SINGH²**  
¹National Chambal Sanctuary, MPFD, India  
²Turtle Survival Alliance, India Program, Etawah, Uttar Pradesh, India  
[rksharma_ncs@yahoo.com]

The biggest among Indian fresh water Softshell Turtles, *Chitra indica*, is on the IUCN Endangered Species list and a Schedule IV species of the Wildlife Protection Act, 1972. Though widely distributed from Indus, Ganga, and Brahmaputra Rivers to Krishna, Godavari and Mahanadi, this elusive species is in grave danger due to hunting for meat and cartilage, collection of eggs, and habitat destruction. The lack of information on its nesting, feeding, habitat requirements and physiology have constricted the conservation action needed throughout its range. In an effort to see the two important life cycle phases of this species, nesting and hatching activities were closely observed in the wild as well as in captivity during the present study. Nesting started in mid-July and lasted until mid September. In the wild, hatching started during first week of October, whereas in captivity it started during mid October and continued until November. The hatching success in the wild was 90.6% and in captivity was 86.94%. Eggs are generally laid a distance of 5.5 m to 13.5 m from the river in sandy beaches with a range of 1.5–2.0 m in height. Average clutch size was 113.4. The main threats were found to be poaching for meat and eggs, entanglement in fishing nets, habitat loss due to anthropogenic activities in nesting beaches, and predation of eggs in the wild. Captive breeding is consistent with *in-situ* success, which is confirmed by hatching success. Thus, *ex-situ* conservation techniques can be of immense importance for propagation of the species.

**Poster Session**

Aspects of Nesting Ecology of *Batagur* Species along Lower Chambal River, India  
**SHAILENDRA SINGH¹, ASHTOSH TRIPATHI¹, AND BRIAN D. HORNE²**  
¹Turtle Survival Alliance – India Program, B 234 Friends Colony, Etawah, Uttar Pradesh, India  
²San Diego Zoo’s Institute for Conservation Research, California, USA  
[tsa.indiaprog@gmail.com]

Under the TSA’s Indian Turtle Conservation Program, a large-scale *in-situ* nest protection-hatch-and-release program is being conducted targeting two species of threatened river turtles, *Batagur kachuga* and *Batagur dhongoka* along the Chambal River in the National Chambal River Sanctuary, in India since 2006. In the last five field seasons (2006–2010), 500 nests of
Batagur kachuga and 2000 nests of Batagur dhongoka were located and protected under the project through fourteen riverside hatcheries. Here we present details about the aspects of the nesting ecology of these two species turtles in lower Chambal River. Data on nesting date, habitat characteristics, habitat preference, nest parameters (shape, depth, width) as well as other environmental and climatic variables for both species was recorded before each nest was translocated. Assumptions regarding the translocation of nests from natural to riverine hatcheries were evaluated through various experiments while leaving a significant number of nests in their natural locations. Temperature and incubation period was monitored for a few selected nests through deploying temperature data loggers. Impacts of anthropogenic activities and predation were observed on the nesting density, pattern and nest site selection. The data from this study indicate that Batagur kachuga is a greater nesting habitat specialist than Batagur dhongoka though they both exhibit significant overlap in nesting season and habitat preference. Nest translocation to the ex-situ protected enclosure has minimal negative impacts on rates of survivorship, incubation period and hatching and can be refined over a few years on the basis of this research and thus may be considered as a recovery tool for both species.

**Turtle Ecology**: Oral

---

**Turtle Priority Areas (TPAs) of India: An Overview and Recommendations for the Conservation of Turtle Diversity**

**SHAILENDRA SINGH**1, **BRIAN D. HORNE**2, and **RICK HUDDSON**3

1Turtle Survival Alliance – India Program, B 234 Friends Colony, Etawah, Uttar Pradesh, India  
2San Diego Zoo’s Institute for Conservation Research, California, USA  
3Turtle Survival Alliance, Fort Worth Zoo, Texas, USA  

[shai@turtlesurvival.org]

A three days’ long national level workshop was organized in Lucknow, India to: 1) review the progress of “Conservation Action Plan for Endangered Turtles and Tortoises of India,” developed by Madras Crocodile Bank Trust (MCBT) and TSA in 2005; 2) to discuss the non-marine chelonian priority areas in the country; 3) and to develop a five year conservation action plan for 2011–2015 to conserve the imperiled turtle fauna therein. The meeting was organized under the aegis of Turtle Survival Alliance in association with MCBT, San Diego Zoological Society, Wildlife Institute of India and IUCN/SSC Tortoise and Freshwater Turtle Specialist Group, and was attended by fifty national and international turtle biologists and representatives of conservation organizations. The main criteria used to prioritize these goals was turtle species’ richness, endemism, number of endangered turtles and the potential to launch/intensify the conservation action for saving threatened imperiled fauna of the country. The workshop identified five turtle priority areas, namely Gangetic plain in North-Central India, Terai (Foothills of Himalaya) region in Northern India, Western Ghats and part of peninsular India in South India, West Bengal and Orissa in Eastern Indian and Assam in North Eastern India. One of the most threatened and charismatic turtles, Batagur kachuga, has been identified as a key species for a regional turtle conservation program. After the preliminary discussions, the balance of the session focused on prioritizing future conservation actions to be implemented for each respective area. This communication briefly reviews past chelonian conservation efforts in each respective region and provides an overview of chelonian conservation recommendations. TSA, in association with partner agencies, will implement the recommendations in the near future.

**Asian Chelonians**: Oral

---

**Status Surveys of Two Endangered Softshell Turtles in Peninsular India**

**SHASHWAT SIRSI**1, **BHCK MURTHY**2, and **SHAILENDRA SINGH**1

1Turtle Survival Alliance – India Program, B 234 Friends Colony Etawah, Uttar Pradesh, India  
2Herpetology Section, Zoological Survey of India, Kolkata, WB, India  

[tsaindia.prog@gmail.com]

Reducing deficit in the knowledge of a species’ distribution, ecology and the intensity of threats prevalent on populations would enable the design of effective species recovery programs. In this regard, status surveys were initiated in southern India, which focused on the threatened trionychid species Nilssonia leithii (Gray, 1872) and Pelochelys cantorii (Gray, 1864). Sampling was carried out at previously recorded sites of species occurrence as well as on the basis of secondary information from local communities. Sampling of riverine sites was carried out using traditional fishing gears as well as specialized turtle traps while secondary information was obtained from local community members using visual guides as well as through questionnaires designed to obtain information regarding presence of target species and prevalent threats. The presence of Pelochelys cantorii was confirmed at three sites on the Nethravati River in Dakshin Kannada district. Additionally,
identification of pressure groups and enhancing awareness of such dependant groups was attempted through chelonian conservation education programs. Intense sampling will be redirected to specific sites in the near future with a view towards setting up *in-situ* conservation measures for the target species.

**Poster Session**

**The Trade of Tortoises and Freshwater Turtles in Jakarta, Indonesia Revisited**  
**CARRIE J. STENGEL, CHRIS R. SHEPHERD, AND OLIVIER S. CAILLABET**  
**TRAFFIC Southeast Asia, Unit 3-2 1st Floor, Jalan SS 23/11, Taman SEA, 47400 Petaling Jaya, Selangor, Malaysia**  
[carriestengel@gmail.com]

In recent years Jakarta has become a focal point for the pet trade in tortoises and freshwater turtles. Alarmingly, observations indicate much of this trade is illegal and includes a growing number of threatened species. To investigate this, TRAFFIC re-surveyed Jakarta’s major markets in 2010. Collected data were compared to data collected by TRAFFIC in 2004 to identify new and continuing trends in origins of stock, threatened status and trade legality. Surveys focused on three types of establishments: animal markets, reptile expos and pet stores. The species observed and volumes of individuals were recorded and, when possible, informal conversations were held with dealers regarding species’ origin, rarity and price. The results were analyzed against the International Union for Conservation of Nature (IUCN) Red List information, the CITES Appendices, the United Nations Environment Programme World Conservation Monitoring Centre (UNEP–WCMC) CITES trade database and Indonesian national legislation. These analyses indicate that in 2010: 1) more species were observed overall; 2) more non-native species were observed; 3) more threatened species were observed; and 4) more CITES-listed species were observed, of which, a larger number were CITES Appendix I-listed. In conclusion, several observations are of particular concern: 1) an increased number of non-native species for sale in Jakarta and 2) an increased amount of, and potentially growing emphasis on, threatened species in the pet trade. In addition, the major continuing trends between 2004 and 2010 are concerning: 1) the continued trade in legally protected species for sale in Jakarta’s markets and 2) the apparent lack of effective enforcement to uphold national and international laws. With an aim to assist in solving this problem, TRAFFIC has made recommendations on effectively monitoring, prosecuting and prioritizing the illegal and unsustainable trade of tortoises and freshwater turtles in Jakarta.

**Trade in Turtles: Oral**

**Update on Rescued Malaysian Giant Pond Turtles (*Orlitia borneensis*) Held at Zoo Miami**  
**ADAM G. STERN**  
**Ectotherm Department, Zoo Miami, FL, USA**  
[astern@miamidade.gov]

This update is to report the status and reproduction of Malaysian Giant Pond Turtles (*Orlitia borneensis*) held at Zoo Miami ten years after the 2001 TSA Asian turtle confiscation. Zoo Miami, then Miami Metrozoo, acquired fifty-three *Orlitias* from the confiscation that underwent treatment upon arrival for a number of medical issues including parasites, open wounds on feet and legs, removal of fish hooks found lodged in the mouths and throats of some turtles, and the treatment of one gunshot wound. Three animals died within seventeen months and thirty-nine turtles were sent to other institutions and TSA members in 2002 and 2003. Zoo Miami has ten adults living in a moated exhibit housing gibbons and siamangs. This moat holds 139,138 gallons and consists of two islands with sloped banks covered in vegetation. A cement concaved wall surrounds the exhibit on the public side. The adult *Orlitia* are fed four times a week, two days with fish and the remainder with a mix of fruit and vegetables. In 2010 eight hatchlings were found sporadically in the beginning of the year. Most of these turtles were estimated to be approximately six months old. In 2011 seven more *Orlitia* were found and were estimated to be newly hatched to approximately one month old in age.

**Role of Zoos in Chelonian Conservation: Oral**

**Effects on the Population Genetics for the Critically Endangered Central American River Turtle, *Dermatemys mawii*, Influenced by the Mexican Transition Zone of the Tehuantepec Isthmus, Inferred from Microsatellite DNA Markers**  
**GRACIA P. SYED1, 2 AND JESUS E. MALDONADO1**  
1Center for Conservation and Evolutionary Genetics, Smithsonian Conservation Biology Institute, National Zoological Park, 3001 Connecticut Ave. NW, Washington, DC, USA
The following project documents the first study of the population genetics of *Dermatemys mawii* performed using nuclear DNA. Results of this study provide evidence that the Isthmus of Tehuantepec acts as a significant barrier to gene flow and that isolation caused by the long distances associated with the different drainages of the Grijalva-Usumacinta river basin had a great effect on the evolutionary history of this species. Overall, our results reveal a signal of phylogeographic structure throughout the range, which appears to have been secondarily blurred by extensive gene flow and a lack of correlation between genetic and geographic distance, and populations carrying a highly divergent haplotype (designated 1D) indicative of more restricted gene flow. In the course of this study we analyzed tissue samples from 253 animals collected from fifteen localities throughout the range of distribution of the species using seven microsatellite loci, six of which we designed specifically for this species during previous research and the three genetic lineages (PAP, GU and 1D) identified. The analysis of population genetic structure indicated that animals in the northwest of the range were differentiated from those in the southeast, consistent with a distance analysis using FST. One location, Papaloapan, was distinctive having the highest number of private alleles 0.64 and the lowest levels of gene flow, a result consistent with restriction to gene flow caused by two biogeographic barriers, the Isthmus of Tehuantepec and the Sierra de Santa Marta barriers. We found no evidence of a recent bottleneck, likely a product of the long life span of the species. From a conservation perspective, our research demonstrates the need to manage the species as two evolutionary significant units, one for Papaloapan, and one for 1D localities, and one Management Unit for the remaining populations. Additional research on lineage 1D is also needed due to its high divergence from other haplotypes found in the species.

Chelonian Conservation: Oral (Student)

**Morphology of the Alligator Snapping Turtle (Macrochelys temminckii)**

**TRAVIS M. THOMAS¹, MICHAEL C. GRANATOSKY², AND PAUL MOLER¹**

¹Florida Fish and Wildlife Conservation Commission, 1105 SW Williston Rd, Gainesville, FL 32601, USA
²Florida Museum of Natural History, Gainesville, FL 32611, USA
³Travis.Thomas@myfwc.com

The Alligator Snapping Turtle (*Macrochelys temminckii*) is an enigmatic and iconic symbol of wetlands of the southeastern United States, and is limited to river systems that empty into the Gulf of Mexico. Examination of mitochondrial DNA revealed three genetic assemblages exist, and turtles from the Suwannee drainage are highly distinct and show a deep separation from other drainages. This study explores the possibility of morphological differences between the three genetic assemblages. Cranial and post-cranial measurements were taken on field captured individuals and museum specimens (n = 142). All data was measured using the image analysis program Image J. All measurements taken reveal a statistically significant difference (P < 0.001) between turtles of the Suwannee river drainage and other drainage systems. Certain measurements also support morphologic distinction between all three assemblages, which is in agreement with genetic analyses. Relatively little information is known about the Alligator Snapping Turtle within the Suwannee river drainage, and due to its distinct taxonomic status, additional work should be conducted to explore appropriate management and conservation actions.

Field Studies: Oral

**Survival, Demography and Growth of Gopher Tortoises (Gopherus polyphemus) from Three Study Populations**

**TRACEY D. TUBERVILLE¹, BRIAN D. TODD², AND CRAIG GUYER³**

¹University of Georgia's Savannah River Ecology Lab, Aiken, SC 29802, USA
²University of California-Davis, Davis, CA 95616, USA
³Auburn University, Auburn, AL 36749, USA
⁴tracey.tuberville@gmail.com

Turtles frequently offer a unique set of conservation challenges due to their “slow” life history strategy. In addition to making them vulnerable to chronic or severe perturbations, the combination of late maturity, low egg and hatching survival, and dependence on high adult survival suggest that turtle populations will be slow to respond to management implementation. Thus, long-term studies are required to understand population dynamics and the potential for population recovery in these imperiled species. We used 5–11 yrs of mark-recapture data to evaluate survivorship, demography and somatic growth in
Podocnemis (Testudines, Pleurodira) of the Brazilian Amazon, to Support Their Management and Conservation

MARIA DAS NEVES S. VIANA1, RAFAELA C. DOS SANTOS1, RICHARD C. VOGT2, AND IZENI P. FARIAS1

1Laboratório de Genética e Evolução Animal Universidade Federal do Amazonas, Brasil
2Centro de Pesquisas em Biologia Aquática, Instituto Nacional de Pesquisas da Amazônia, Brasil
[neves_viana@yahoo.com.br]

The Amazon Basin is the center for biodiversity of Podocnemis. Historically the meat, fat and eggs of these species were used indiscriminately resulting in the crash of many populations. Despite being considered abundant in much of the Brazilian Amazon Basin, and due to the continual decline in populations of some species due to commercial exploitation, both Podocnemis expansa and Podocnemis unifilis have been listed as Endangered by the IUCN, Species Survival Commission. Little is known about the impact that the intensive hunting activity has on the diversity and genetic structure of populations. We studied the population genetics of Podocnemis within and among basins in the Amazon and Negro drainages using mitochondrial DNA. We characterized the genetic structure of natural populations of Podocnemis unifilis (145 individuals), Podocnemis erythrocephala (246 individuals) and Podocnemis sextuberculata (167 individuals) in order to provide relevance for conservation and management programs. Partial sequences of mitochondrial DNA control region were used in the analysis. Podocnemis unifilis revealed 29 haplotypes, Podocnemis erythrocephala 49 haplotypes and Podocnemis sextuberculata 33 haplotypes. The AMOVA results show strong genetic differentiation in comparisons between the sampled populations ($\Phi_{ST} = 0.365, p < 0.001$); these results are consistent with ecological data that characterize turtles’ low mobility. Analysis of molecular variance in Podocnemis erythrocephala also revealed a high degree of population subdivision ($\Phi_{ST} = 0.27931, P < 0.001$). Even though this species has a high mobility, the genetic differentiation can be explained mainly by the presence of waterfalls and rapids between localities in the Rio Negro. Analyses of molecular variance for Podocnemis sextuberculata also revealed the existence of population subdivision ($\Phi_{ST} = 0.12549, P < 0.001$) but the values of the fixation index, $\Phi_{ST}$ were significant only for a Nhamundá River population; comparisons with other all other populations showed no genetic differentiation. The results show that within the Amazon and Negro Basins there are genetically distinct subpopulations of Podocnemis, which should be treated as different management units in order to monitor populations and designate conservation policies that maintain the viability of populations and species.

South American Turtles – Brazil: Oral

Critically Endangered Giant South American River Turtle (Podocnemis expansa) in Brazil

RICHARD C. VOGT
Instituto National de Pesquisas da Amazonia, Manaus, Amazonas, Brazil, 69083-000
[vogt@inpa.gov.br]

Prior to European contact in the Amazon Basin, the dispersed indigenous tribes lived for millennia exploiting turtle populations for meat and eggs. Freshwater river turtles were one of the principle protein sources for the early Portuguese settlers in the Amazon Basin, and remain a sporadic income source for some riverine people and a delicacy for rich city dwellers. The problem is NOT habitat loss or limited food resources; it is direct consumption and domestic sale of wild turtles. In the late 1800s an estimated 6 million turtles were slaughtered yearly in Brazil due to the demand for turtle oil which was exported to Portugal and used as fuel to burn in the street lights of Manaus and cooking. This unrestrained and
unsustainable use of turtles persisted until the law prohibiting the use or sale of wildlife was passed in 1967. However, a black market sale of turtles continues. The development of the Brazilian government Turtle Project for protecting the nesting beaches of the largest species, *Podocnemis expansa* in 1979, and numerous smaller conservation projects, has helped to maintain populations in many areas. These projects have released about 50 million hatchlings since 1989, but it is unclear that this has been enough to replenish populations of this species. However, the problem of unsustainable use still exists. The establishment of legal turtle ranches in 1994 opened the door for consumers to purchase legally raised turtles for home consumption in the cities. However, there continues to be a black market in turtles, which is directly affecting natural populations in protected areas. Only protecting the nesting beaches does not work. We must involve the local communities in the conservation effort in order to be successful. We are developing a management program involving all of the communities along the Trombetas River, conservation through participation, and developing other alternative income sources for these riverine people so that they can live comfortably without selling turtles to the black market. Only through large scale, long term conservation efforts from the bottom up and the top down can this species be maintained in its ecological function in nature.

**South American Turtles – Brazil: Oral**

The critically endangered Madagascar Spider Tortoise (*Pyxis arachnoides*) and Radiated Tortoise (*Astrochelys radiata*): What We Now Know Through Three Years of Field Operations

RYAN C.J. WALKER¹,² AND TSILAVO H. RAFELIARISOA³,⁴

¹Nautilus Ecology, Oak House, Pond Lane, Greetham, Rutland, LE15 7NW, United Kingdom
²Department of Life Sciences, The Open University, Milton Keynes, MK7 6AA, United Kingdom
³Département de Biologie Animale, Université d’Antananarivo, BP 906, Antananarivo 101, Madagascar
⁴Madagascar Biodiversity Partnership, Omaha’s Henry Doorly Zoo, Grewock’s Center for Conservation and Research, 3701 South 10th Street, Omaha, NE 68107, USA

[ryan@nautilusecology.org]

The critically endangered Madagascar Spider Tortoise (*Pyxis arachnoides*) and Radiated Tortoise (*Astrochelys radiata*), endemic to the coastal dry forests of southern Madagascar, face a significant risk of extinction within the next 20–50 years, as a result of habitat loss and poaching. Here we present the results of a three year TSA and TCF funded field study detailing the current conservation status of these two species. A GIS database using Arc/GIS 9.0 was produced documenting the range contraction and subsequent threats facing both species. All available published maps detailing the historical range of both species were scanned, georeferenced and the range digitized, with resulting shapefiles added to the database. Shapefiles detailing current and proposed protected areas and proposed mineral extraction sites were also added to the database. Following this, aerial imagery was used to identify 131 areas of remaining, suitable habitat across what was thought to be the species’ ranges. During February and March 2009, 2010 and 2011 each of these 131 survey points were systematically surveyed for tortoises using a 1 km conventional line transect distance sampling technique and a time dependent search technique for both species. Results allowed an accurate, real time, duplication of both species range to be established and added to the database. *Pyxis arachnoides*’ range has been reduced by as much as 70.7% and the species is now confined to eight fragmented populations occupying a total of 2,464 km², of which 18.3% of this remaining population is threatened by proposed mineral extraction. *Astrochelys radiata* has undergone range contraction of 65% to 15,019.8 km². A conventional distance sampling model produced global, wild population estimates of 664,980 (95% CI; 492,680–897,550) and 6,307,900 (95% CI 4,028,500–9,877,000) for *Pyxis arachnoides* and *Astrochelys radiata* respectively. Of greatest concern is the population crash of 47.4% suffered by *Astrochelys radiata radiata* in just 11 years, mostly attributed to the local bush meat trade. The authors propose that targeted, community based conservation initiatives be established within the remaining core areas of both species’ range in an effort to prevent the extinction of both species.

**Chelonian Conservation: Oral (Student)**

Box Turtles at the Edge of Their Range: Population Densities and Movement Patterns of *Terrapene carolina* in Fragmented Landscapes in Massachusetts and the Florida Everglades

LISARETH L. WILLEY, PAUL R. SIEVERT, AND MICHAEL T. JONES

U.S.G.S. Massachusetts Cooperative Fish and Wildlife Research Unit, Department of Environmental Conservation, University of Massachusetts, Amherst, MA 01003, USA

[lwilley@cns.umass.edu]

9th Annual Symposium on the Conservation and Biology of Tortoises and Freshwater Turtles | Orlando, Florida
**Terrapene carolina** is a wide-ranging species-complex that occupies a variety of habitat types from New England to eastern Mexico. We established sites in two widely separated geographic areas to evaluate the spatial ecology of box turtles at their range limits. From 2005 – 2008, we radio-tracked 91 box turtles for up to four years at eight study sites in Massachusetts. Using mark-recapture methods, we estimate that densities varied seasonally within sites and ranged from 0.3 to 3.8 to a turtles/ha. Home range sizes varied from 140 – 2145 m straight line and 0.5 – 136 ha. These densities are lower and home range sizes larger than reported throughout much of the species’ range, highlighting the need for local and regional information when planning for rare species conservation. We characterized seasonal movement and activity patterns, evaluated overwintering and nesting habitat at multiple scales, and estimated reproductive parameters and adult mortality rates. Radio-telemetry revealed that incidental collection was the largest threat to populations at these predominantly protected sites, and could be the largest threat to Massachusetts populations after habitat loss. We also evaluated the influence of landscape composition and structure on box turtle movement patterns across study sites. Eastern Box Turtles have smaller home ranges in more urbanized landscapes and move further in more forested, less fragmented areas. Densities also varied by site, with the highest densities occurring at moderately fragmented sites. This variability underscores the importance of evaluating effects across multiple sites. To further evaluate spatial ecology at the boundaries of Terrapene carolina’s range, we conducted surveys on 12 off-shore islands in the Ten Thousand Islands region in Florida. We found turtles on four shell mounds constructed by the Calusa Indians, but no turtles were detected on smaller, natural islands. We estimate the population density on one island to be about 3.5 turtles/ha (2.5 – 5.2) of upland habitat, similar to the highest densities we observed in Massachusetts. We propose additional work to evaluate behavioral and demographic differences and meta-population dynamics in these and other fragmented systems.

**North American Box Turtles: Oral**

**Chelonian Operations at Zoo Atlanta**

**LUKE WYRWICH**

*Zoo Atlanta, 800 Cherokee Ave., Atlanta, GA, 30315, USA*

{lwyrrwich@zooatlanta.org}

Zoo Atlanta's herpetology collection is comprised of more than 200 specimens of chelonia representing more than 25 species. Zoo Atlanta is a supportive component in TSA's mission of conservation through living collections, with a focus centering on threatened Southeast Asian species. To date, Zoo Atlanta has successfully bred more than a dozen species of chelonia and lists a number of American Zoo Association firsts for captive reproduction: *Heosemys spinosa* (1991), *Heosemys depressa* (2005), and *Manouria impressa* (2010). We employ a varied range of husbandry practices, strategies, and philosophies that have led to our success and have helped us overcome various challenges. We also are involved in numerous research projects such as Temperature Dependant Sex Determination (TSD), utilizing endoscopy for gender determination and medical diagnostics, egg developmental studies, veterinary Galapagos Tortoise conservation, and regional conservation projects including head-start programs for species in southeastern USA.

**Role of Zoos in Turtle Conservation: Oral**
| Subject Index |

<table>
<thead>
<tr>
<th>Animal Specie</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acanthochelys radiolata</td>
<td>24</td>
</tr>
<tr>
<td>Acanthochelys spixii</td>
<td>14, 24</td>
</tr>
<tr>
<td>African Spurred Tortoises ..................................</td>
<td>See Geochelone sulcata</td>
</tr>
<tr>
<td>Alabama Red-bellied Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Pseudemys alabamensis</td>
<td></td>
</tr>
<tr>
<td>Aldabra Giant Tortoise ...................................</td>
<td></td>
</tr>
<tr>
<td>Aldabrachelys gigantea</td>
<td>32, 37</td>
</tr>
<tr>
<td>Alligator Snapping Turtles</td>
<td></td>
</tr>
<tr>
<td>........................................... See Macrochelys temminckii</td>
<td></td>
</tr>
<tr>
<td>Amazon River Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Podocnemis erythrocephal</td>
<td></td>
</tr>
<tr>
<td>Apalone ferox</td>
<td>39</td>
</tr>
<tr>
<td>Astrochelys radiata</td>
<td>12, 37, 38, 41, 46</td>
</tr>
<tr>
<td>Astrochelys yniphora</td>
<td>31</td>
</tr>
<tr>
<td>Batagur</td>
<td>29, 47, 50, 51</td>
</tr>
<tr>
<td>Blanding’s Turtle</td>
<td>44</td>
</tr>
<tr>
<td>Bolson Tortoise .........................................</td>
<td>See Gopherus flavomarginatus</td>
</tr>
<tr>
<td>Box Turtles .............................................</td>
<td>See Terrapene</td>
</tr>
<tr>
<td>Chelodina burrengandjii</td>
<td>21</td>
</tr>
<tr>
<td>Chelodina oblonga</td>
<td>25</td>
</tr>
<tr>
<td>Chelodona ...............................................</td>
<td>13, 20, 32, 37, 38</td>
</tr>
<tr>
<td>Chelus fimbriatus</td>
<td>24</td>
</tr>
<tr>
<td>Chelydra acutirostris</td>
<td>30</td>
</tr>
<tr>
<td>Chelydra serpentina</td>
<td>36, 39</td>
</tr>
<tr>
<td>Chinese Yellow Headed Box Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Cuora aurocapitata</td>
<td></td>
</tr>
<tr>
<td>Chitra indica</td>
<td>12, 50</td>
</tr>
<tr>
<td>Chrysemys nelsoni</td>
<td>39</td>
</tr>
<tr>
<td>Chrysemys picta</td>
<td>36, 47, 48</td>
</tr>
<tr>
<td>Colombian Slider .........................................</td>
<td>See Trachemys callirostris</td>
</tr>
<tr>
<td>Cuora auropunctata</td>
<td>15</td>
</tr>
<tr>
<td>Cuora flavomarginata</td>
<td>24, 25</td>
</tr>
<tr>
<td>Cylindraspis</td>
<td>37</td>
</tr>
<tr>
<td>Dahl’s Toad Headed Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Mesocoellemys dahli</td>
<td></td>
</tr>
<tr>
<td>Deirochelys reticularia miara</td>
<td>36</td>
</tr>
<tr>
<td>Dermatemys mawii</td>
<td>23, 52, 53</td>
</tr>
<tr>
<td>Diamondback Terrapin ....................................</td>
<td>See Malaclemys terrapin</td>
</tr>
<tr>
<td>Eastern Box Turtle</td>
<td></td>
</tr>
<tr>
<td>Elusor macrurus</td>
<td>19, 21</td>
</tr>
<tr>
<td>Emydoidia blandingii</td>
<td>44</td>
</tr>
<tr>
<td>Emydura australis</td>
<td>21</td>
</tr>
<tr>
<td>Florida Peninsula Cooter</td>
<td></td>
</tr>
<tr>
<td>........................................... See Pseudemys peninsularis</td>
<td></td>
</tr>
<tr>
<td>Florida Red-bellied Cooter ..................................</td>
<td>See Pseudemys nelsoni</td>
</tr>
<tr>
<td>Florida Snapping Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Chelydra serpentina osceola</td>
<td></td>
</tr>
<tr>
<td>Florida Softshell</td>
<td></td>
</tr>
<tr>
<td>........................................... See Apalone ferox</td>
<td></td>
</tr>
<tr>
<td>Galápagos Tortoises</td>
<td>13, 20, 25</td>
</tr>
<tr>
<td>Geochelone elegans</td>
<td>32</td>
</tr>
<tr>
<td>Geochelone sulcata</td>
<td>32</td>
</tr>
<tr>
<td>Geoemyda spengleri</td>
<td>35</td>
</tr>
<tr>
<td>Giant Tortoise</td>
<td></td>
</tr>
<tr>
<td>........................................... See Chelidonidis nigra</td>
<td></td>
</tr>
<tr>
<td>Glyptemys muhlenbergii</td>
<td>33</td>
</tr>
<tr>
<td>Gopher Tortoise</td>
<td></td>
</tr>
<tr>
<td>........................................... See Gopherus polyphemus, Gopherus agassizii</td>
<td></td>
</tr>
<tr>
<td>Gopherus berlandier</td>
<td>17</td>
</tr>
<tr>
<td>Gopherus flavomarginatus</td>
<td>17, 48</td>
</tr>
<tr>
<td>Gopherus polyphemus</td>
<td></td>
</tr>
<tr>
<td>........................................... 12, 17, 28, 33, 34, 35, 48, 53, 54</td>
<td></td>
</tr>
<tr>
<td>Graptemys flavimaculata</td>
<td>35, 49</td>
</tr>
<tr>
<td>Graptemys geographica</td>
<td>36</td>
</tr>
<tr>
<td>Heosemys annandalei</td>
<td>32</td>
</tr>
<tr>
<td>Heosemys depressa</td>
<td>56</td>
</tr>
<tr>
<td>Heosemys spinosa</td>
<td>35, 56</td>
</tr>
<tr>
<td>Hicotaera</td>
<td></td>
</tr>
<tr>
<td>Hoge’s sideneck turtle</td>
<td></td>
</tr>
<tr>
<td>Hyderomedsa ............................................</td>
<td>14, 24</td>
</tr>
<tr>
<td>Hyderomedsa tectifera</td>
<td>14, 24</td>
</tr>
<tr>
<td>Kinosternon dunnii</td>
<td>30</td>
</tr>
<tr>
<td>Kinosternon .............................................</td>
<td>40</td>
</tr>
<tr>
<td>Kinosternon .............................................</td>
<td>30</td>
</tr>
<tr>
<td>Kwangtung River Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Mauremys nigricans</td>
<td></td>
</tr>
<tr>
<td>Large Rainforest Tortoise</td>
<td></td>
</tr>
<tr>
<td>........................................... See Chelidonidis denticulata</td>
<td></td>
</tr>
<tr>
<td>Loggerhead Musk Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Sternotherus minor minor</td>
<td></td>
</tr>
<tr>
<td>Loggerhead Musk Turtles</td>
<td></td>
</tr>
<tr>
<td>........................................... See Pyxis arachnoides</td>
<td></td>
</tr>
<tr>
<td>Malaclemys terrapin</td>
<td>12, 18, 27, 50</td>
</tr>
<tr>
<td>Manouria impressa</td>
<td>56</td>
</tr>
<tr>
<td>Map Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Graptemys geographica</td>
<td></td>
</tr>
<tr>
<td>Mary River Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Elusor macrurus</td>
<td></td>
</tr>
<tr>
<td>Mauremys nigricans</td>
<td>13, 35</td>
</tr>
<tr>
<td>Meiolania</td>
<td>37, 38</td>
</tr>
<tr>
<td>Mesocoellemys dahli</td>
<td>26</td>
</tr>
<tr>
<td>Mesocoellemys hogeii</td>
<td>14, 23</td>
</tr>
<tr>
<td>Mesocoellemys tuberculata</td>
<td>14, 24</td>
</tr>
<tr>
<td>Mesocoellemys vanderhaeget</td>
<td>14, 24</td>
</tr>
<tr>
<td>Mojave Desert Tortoise</td>
<td></td>
</tr>
<tr>
<td>........................................... See Gopherus agassizii</td>
<td></td>
</tr>
<tr>
<td>Musk Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Sternotherus elleratus</td>
<td></td>
</tr>
<tr>
<td>Nilssonia leitii</td>
<td>51</td>
</tr>
<tr>
<td>Northern River Terrapin</td>
<td></td>
</tr>
<tr>
<td>........................................... See Batagur Baska</td>
<td></td>
</tr>
<tr>
<td>Ornate Box Turtle</td>
<td></td>
</tr>
<tr>
<td>........................................... See Terrapene ornata, Painted Turtle</td>
<td>See Chrysemys picta</td>
</tr>
</tbody>
</table>
Pelochelys cantorii ................................................. 51
Pelodiscus sinensis ............................................... 26
Phrynops hilarii ...................................................... 24
Pinzon Island Tortoise ........................................... See Chelonoidis duncanensis

Ploughshare Tortoises .......................... See Astrochelys yniphora
Podocnemis erythrocephala ........................................ 16, 54
Podocnemis expansa ........................................ 12, 16, 25, 44, 54, 55
Podocnemis lewyana ........................................ 28, 43
Podocnemis sextuberculata ........................................ 44, 54
Podocnemis unifilis ........................................ 16, 44, 54
Podocnemis ......................................................... 54
Pseudemys alabamensis ........................................ 31
Pseudemys concinna ........................................ 31
Pseudemys floridana ........................................ 31
Pseudemys nelsoni ........................................ 43
Pyxis arachnoides .................................................. 55
Redfoot Tortoises ........................................... See Chelonoidis carbonaria
Rhinoclemmys annulata ........................................ 30
Rhinoclemmys melanosterna ..................................... 30
Rhinoclemmys nasuta ........................................ 30
Sacalia bealei ...................................................... 35
Sacalia quadriocellata ........................................... 35
Sandstone Long-necked Turtle ................................. See Chelodina burrungandjii
Snapping Turtle ........................................... See Chelydra serpentina
Softshell Turtles ............................................... See Chitra indica
Sonoran Desert Tortoise ........................................ See Gopherus morafkai
Spiny Turtle ........................................... See Heosemys spinosa
Spotted Turtle ........................................... See Clemmys gutatta
Spur-thighed Tortoises ........................................ See Testudo graeca
Star Tortoises ........................................... See Geochelone elegans
Sternotherus minor ........................................ 13, 43
Sternotherus odoratus .................................... 13, 22, 43
Stinkpots ........................................... See Sternotherus odoratus
Temple Turtles ........................................... See Heosemys annandeleii
Terrapene carolina ........................................... 21, 29, 32, 34, 38, 40, 41, 55, 56
Terrapene carolina triunguis ................................... 38, 41
Terrapene ornata ........................................ 12, 38, 41, 45
Testudo graeca ........................................ 14
Texas Tortoise ........................................... See Gopherus berlandieri
Three-toed Box Turtle ........................................ See Terrapene carolina triunguis
Three-toed Box Turtle ........................................ See Terrapene carolina triunguis
Trachemys callirostris ........................................ 17, 18
Trachemys dorbigni ........................................ 15
Trachemys scripta ........................................ 22, 33
Trachemys venusta ........................................ 18, 23
Western Chicken Turtle ........................................ See Deirochelys reticularia miara
Wood Turtle ........................................... See Glyptemys insculpta
Yellow Mud Turtle ........................................ See Kinosternon flavescens
Yellow Spotted River Turtle ..................................... See Podocnemis unifilis
Yellow-blotched Sawback ........................................ See Graptemys flavigula
Yellow-margined Box Turtle ................................... See Cuora flavomarginata