Herpetological Review

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Herpetological Review

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Society for the Study of Amphibians and Reptiles

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The Society for the Study of Amphibians and Reptiles, the largest international herpetological society, is a not-for-profit organization established to advance research, conservation, and education concerning amphibians and reptiles. Founded in 1958, SSAR is widely recognized today as having the most diverse society-sponsored program of services and publications for herpetologists. Membership is open to anyone with an interest in herpetology—professionals and serious amateurs alike—who wish to join with us to advance the goals of the Society.

All members of the SSAR are entitled to vote by mail ballot for Society officers, which allows overseas members to participate in determining the Society's activities; also, many international members attend the annual meetings and serve on editorial boards and committees.

All members and institutions receive the Society's primary technical publication, the *Journal of Herpetology,* and its news-journal, *Herpetological Review*; both are published four times per year. Members also receive pre-publication discounts on other Society publications, which are advertised in *Herpetological Review*.

To join SSAR or to renew your membership, please visit the secure online ZenScientist website via this link:

http://www.ssarherps.org/pages/membership.php

Future Annual Meetings

2011 — Minneapolis, Minnesota, 6–11 July (with ASIH, HL)
2012 — Vancouver, British Columbia, 8–14 August (7th World Congress; also SSAR, HL, and ASIH)
2013 — Albuquerque, New Mexico, dates TBA (with ASIH, HL)

About Our Cover: *Drymarchon couperi*

Among the largest of colubrid snakes—reaching adult lengths of 1.6–2.95 m—are members of the genus *Drymarchon*, the indigo snakes. Collectively, their range spans some 55° degrees of latitude, extending from the southeastern United States to northern Argentina. Herpetologists have long considered *Drymarchon* as monotypic (*D. corais*) with up to eight subspecies. Currently, four species are recognized based on morphology and color patterns (Wüster et al. 2001. Herpetological Journal 11:157–165).

In sandy pineland habitats in Georgia/Florida, the Eastern Indigo Snake (*Drymarchon couperi*) has an intimate association with the Gopher Tortoise (*Gopherus polyphemus*), using the long, deep burrows of this turtle for winter dens, foraging, and nesting. Many landowners and outdoorsman revere Eastern Indigos because of their docile temperament and beauty. The colloquialisms "blue gopher" and "gopher snake" capture the species' predilection for tortoise burrows and the violet iridescence of the dorsal scales in sunlight. This North American icon was federally listed in 1978 as "Threatened" due to population declines attributable to habitat loss and overcollection for the pet trade. The practice of introducing gasoline into Gopher Tortoise burrows to evict Eastern Diamondback Rattlesnakes (*Crotalus adamanteus*) may still be employed by some snake hunters; doing so has been shown to be lethal to any Indigo Snake residing in a "gassed" burrow; currently, three rattlesnake roundups are held annually (two in Georgia, one in Alabama) at sites within or near the range of *D. couperi*.

Like other members of the genus, *D. couperi* are diurnal, active foragers that feed on a wide array of vertebrates, particularly snakes, including venomous species. Formidable and indiscriminate predators, they prowl wetland margins and probe their heads into burrows when searching for prey; snake prey are typically seized by the head, chewed until immobilized, then swallowed head-first. Interestingly, a number of the forms of *Drymarchon* commonly consume small turtles (H. W. Greene, Cornell University, pers. comm.). (And, somewhat ironically, Eastern Indigos frequently eat hatchling Gopher Tortoises [Stevenson et al 2010. Southeastern Naturalist 9:1–18]). Mark-recapture field studies in southern Georgia have documented that adult Eastern Indigo Snakes exhibit male-biased sexual size dimorphism, require 3–4 years to reach sexual maturity, display winter den site fidelity by returning to the same tortoise colonies in successive years, and commonly live to be 8–12 years of age on vast protected landscapes (Stevenson et al. 2009. Herpetological Conservation and Biology 4:30–42).

Our cover features a female *Drymarchon couperi* found basking in January 2009 near a Gopher Tortoise burrow in Longleaf Pine-Wiregrass sandhill habitat along the Canoochee River, Georgia. **Dirk J. Stevenson** recorded this image with a Sony MVC–CD500, equipped with a Zeiss macro lens at f22, ISO 400, 1/30 sec exposure, and auto fill flash. Stevenson is Director of Inventory and Monitoring with The Orianne Society (www.projectorianne.org), a non-profit organization dedicated to the conservation of imperiled amphibians and reptiles. Elsewhere in this issue (pp. 437–442), Stevenson and colleagues investigate the effectiveness of using wildlife detector dogs to locate Eastern Indigo Snakes.

PHOTO BY STELLA OSBORN

SSAR BUSINESS

2010 Annual Meeting, Providence, Rhode Island

The 53rd Annual Meeting of SSAR took place from 7–12 July 2010 at the Weston Providence Hotel, Providence, Rhode Island, USA. The Organizing Societies were Society for the Study of Amphibians and Reptiles (in conjunction with the International Society for the History and Bibliography of Herpetology), American Elasmobranch Society (celebrating its 26th annual meeting), American Society of Ichthyologists and Herpetologists (celebrating its 90th annual meeting), and The Herpetologists' League (celebrating its 68th annual meeting). The meeting was hosted by University of Rhode Island, Brown University, and University of Connecticut. The local hosts were Jacki Webb (Chair), Beth Brainerd, Eric Shultz, Kurt Schwenk, Cheryl Wilga, and Brad Wetherbee. Once again, the local hosts were ably assisted by the staff of KState University Division of Continuing Education and by many student volunteers (from University of Rhode Island, Brown University, and University of Connecticut).

There were 1031 herpetologists and ichthyologists from around the world at the 2010 JMIH. This number was down slightly compared with that in the previous year (1170). Attendees hailed from 25 different countries (e.g., Argentina, Australia, Austria, Belgium, Canada, Germany, Italy, Korea, Malawi, Malaysia, The Netherlands, Poland, New Zealand, Saudi Arabia, United Kingdom, United States, Venezuela). Approximately 45% of attendees were students, and around 520 papers and 260 posters were presented. Twenty-eight exhibit booths were staffed. Seven symposia, including one sponsored by SSAR and ASIH "Head-Starting Turtles—Learning from Experience" (Fig. 1), and three student workshops were scheduled. A workshop on grant writing was organized by Dawn Wilson and other members of the SSAR Graduate Student Participation Committee. The Henri Seibert Competition attracted 28 students in four categories this year.

The Annual Meeting began officially at 0900 h on Thursday, July 8th with welcomes from the Chair of the Local Host Committee, Jaqueline Webb (University of Rhode Island) and Nancy Fey-Yensen (Interim Dean, College of the Environment and Life Sciences, University of Rhode Island). Kentwood Wells, this year's ASIH speaker, gave a presentation on "The Social Behavior of Anuran Amphibians: What Have We Learned in the Last 35 years?" This was followed by the presentation of three ASIH Awards (Gibbs, Fitch, and Johnson awards) to John Lundberg, Tom Schoener, and Joe Nelson, respectively. The first winner of the new SSAR/ASIH/HL Meritorious Teaching Award in Herpetology, Whitfield Gibbons, was then announced by President Crother. ASIH Past-President John Lundberg spoke on "Authentic American Cryptoichthyology," followed by The Herpetologists' League's distinguished herpetologist for 2010, Indraneil Das from University Malaysia, Sarawak, who spoke on "Perceptions, Use and Conservation of Amphibians by Indigenous People Worldwide." The AES speaker, Gregor Cailliett gave an address on "Ageing, Age Validation, Growth and Aging: The Life Histories of Chondrichthyan and Deep-Sea Fishes" and the Plenary Session was closed by Jacqueline Webb.

Social and Professional Events

Robert Espinoza (California State University, Northridge) was this year's President's Travelogue speaker and gave his presentation ("The Herpetofauna of South America's Southern Cone: New Discoveries from the Andean Peaks to the Peruvian Steppe") on July 7th (Fig. 2). He spoke about the extremes of temperature and water availability and the great diversity of reptiles and amphibians in this area. Bobby acknowledged Richard Etheridge who introduced him to Argentina and Argen-

Fig. 1. Participants in this year's highly successful symposium, "Head-starting Turtles. Learning from Experience," organized by Russell Burke and co-sponsored by SSAR and ASIH. Standing (from left to right): Willem Roosenburg, Roger Wood, Slawomir Mitrus, Tom Herman, unknown, Tom French, David Taylor, Lisa Hazard, Ken Nagy, Russ Burke, Tracey Tuberville, Brian Windmiller, Stephanie Koch, Charles Innis, Matt Hinderliter, Maria Wojakowski, Peter Warny, unknown. Seated (from left to right): Thane Wibbels, unknown, unknown, unknown, Kurt Buhlmann. (Photo M. Preest)

Fig. 2. Beck Wehrle, Denita Weeks and Navasha Singh (L to R) students of this year's President's Travelogue Speaker Robert Espinoza (second from right). Denita was the 2010 Seibert Award winner in the Morphology/Physiology section. (Photo M. Preest)

tinian herpetofauna, as well as the many friends and contacts he and his students have developed over the years. Every year SSAR manages to find a great Travelogue speaker and this year was no exception.

On the evening of July 8th, SSAR joined with HL to host another very successful reception for student members of both Societies and invited professionals (Fig. 3). The Joint Meeting Reception was held immediately after the Student Reception at the Roger Williams Park Zoo. After a long wait for buses by most (Fig. 4a) and a detour to a casino for some, good barbeque and interesting exhibits were enjoyed by those who finally made it (Fig. 4b).

In addition to the planned gatherings, many meeting attendees felt the need for some "field work" and explored local dining establishments and pubs (Fig. 5).

Twenty two students attended a pizza lunch and student workshop on grant writing organized by the Student Participation Committee on July 9th. The workshop included a panel of professional herpetologists (Robert Espinoza, Al Savitzky, Rafael de Sá, Henry Mushinsky, Karen Warkentin, and Dawn Wilson) from a variety of types of institutions offering valuable advice, including how to set a proposal in a broader context, how important it is to stress the relevance and novelty of the proposed research, and how to include preliminary data. Al and Rafael spoke of their work at NSF, as well as their own experiences writing grant proposals.

The SSAR/HL Live Auction occurred on July 11th and raised $3759.50 to support graduate student travel ($1706 of this was the result of items from the Roger Conant library). Frank Burbrink served as auctioneer and was assisted by Greg Watkins-Colwell, Samantha Wisniewski (who has helped with several of the past few auctions), Ben Jellen, Phillip Skipwith, Heather Heinz, and Taryn Cazzolli among others (Fig. 6). Greg also served as onsite coordinator before the meeting began.

Matt Venesky and Cari Hickerson (co-Chairs, Student Travel Award Committee) again worked hard to pull together a successful Silent Auction. $727 was raised to support the SSAR Student Travel Fund. Thanks to this year's winners of SSAR Student Travel Awards who helped staff the exhibit desk.

A rather hastily organized evening session dealing with the ichthyological and herpetological implications of the oil spill in the Gulf of Mexico was held on July 10th. Close to standing-room-only in a large ballroom was an indication of the level of interest in this topic.

The Joint Meeting Banquet was held on the last evening of the meeting, with Lynn Parenti serving as Master of Ceremonies. SSAR was represented at the head table by Brian Crother (President), Kirsten Nicholson (Treasurer), Marion Preest (Secretary), and SSAR member Mary White. Five past-Presidents of SSAR were in attendance. At the end of the Banquet, an invitation was issued to attend the 2011 JMIH in Minneapolis, Minnesota, July 6–11. Pat Gregory (Chair, Local Committee) invited all the world's herpetologists as well as our ichthyological colleagues from ASIH and AES to the 2012 JMIH/World Congress of Herpetology meeting in Vancouver (August 8–14). A meeting website is already up and a call by WCH for symposia has been issued.

Board Meeting and Business Meeting Summaries

Society President Brian Crother called the Board Meeting to order at 0803 h on July 7th, 2010 in the Westin Providence Hotel, Providence, Rhode Island. In attendance were the following members of the Board of Directors, Editors, and Committee Chairs: Kraig Adler (Editor, *Contributions in Herpetology*), Aaron Bauer (Editor, *Facsimile Reprints in Herpetology*), Brian Crother (President; SSAR Rep MMPC; Chair, Standard English and Scientific Names Committee), David Cundall (Board Member, Reg. 2012), Kevin de Queiroz (Board Member, Reg. 2012),

Fig. 3. Jay Savage, Villanova student Alicia Kennedy, Mary White, and Treasurer Kirsten Nicholson enjoying the SSAR Student Reception. (Photo M. Preest)

FIG. 4a (top). A long wait for buses to the JMIH Picnic at the Roger Williams Park Zoo; 4b (lower) but worth it when we got there. (Photo M. Preest)

Tiffany Doan (Board Member, Reg. 2010), Pat Gregory (Board Member, non-US 2012), Roy McDiarmid (Past-President), Joe Mendelson, III (President-Elect), John Moriarty (Editor, *Herpetological Circulars*), Erin Muths (co-Editor, *Journal of Herpetology*), Kirsten Nicholson (Treasurer), Pat Owen (Chair, Seibert Award Committee), Ann Paterson (Board Member, Reg. 2012), Marion Preest (Secretary), Stephen Richter (Board Member, Cons. 2010), Betsie Rothermel (Chair, Conservation Committee), Al Savitzky (SSAR Rep to AIBS and BioOne), Greg Watkins-Colwell (Chair, Nominations Committee; Chair, SSAR/HL

FIG. 5. Matthew Morrill, Alex Pyron, Greg Watkins-Colwell, Meredith Mahoney, and Frank Burbrink (L to R) enjoying the "best beer in Rhode Island" at one of the many local pubs. (Photo M. Preest)

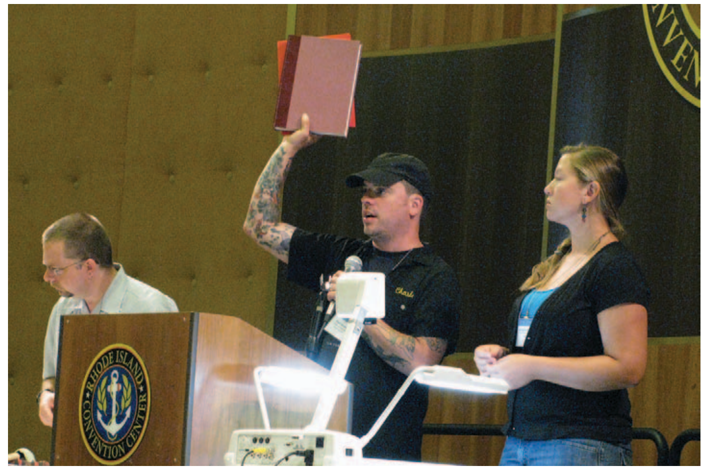

FIG. 6. Greg Watkins-Colwell (far left, the new Chair of the Live Auction Committee) was energetically and persuasively assisted by Frank Burbrink and Samantha Wisniewski at the auction. (Photo M. Mahoney)

Live Auction Committee), and Dawn Wilson (Chair, Student Participation Committee). Additional society members present included Robin Andrews and Henry Mushinsky. Minutes of the 2009 Board of Directors Meeting (Portland, Oregon) were approved.

Annual reports for 2009/2010 were submitted by all Officers, Editors, and Committee Chairs. President Brian Crother reported that SSAR became involved as a Festival Partner with the USA Science & Engineering Festival to be held in Washington D.C. in October, 2010. SSAR will have a booth at the festival and Joe Mendelson, III is in charge of our participation in this national event (see event report elsewhere in this issue). The editor of the *Journal of Herpetology*, Matthew Parris, unexpectedly stepped down in early 2010, but Brian noted that the Society was fortunate to find new editors, Gad Perry and Erin Muths, fairly quickly. It is anticipated that a two-editor system will improve our manuscript turnaround time. Welcome aboard to Gad and Erin and many thanks to them for stepping up to take this key position. Thanks also to Geoff Smith, a previous editor, for stepping in and helping smooth the transition.

President Crother reported writing or signing a number of letters pertaining to SSAR business over the past year, including various letters submitted by the Conservation Committee, letters of congratulations to national and international herpetological societies acknowledging significant landmarks, and letters of thanks to Maureen Donnelly (President's Travelogue speaker, 2009) and to the participants in the 2009 JMIH SSAR Student Workshop.

Treasurer Kirsten Nicholson reported that, overall, the finances of SSAR are fairly sound and doing well. The approved 2009 budget was balanced and the Society came in under budget by around $7,000. Costs for production of our journals are increasing and we may need to review the manner in which we produce them and develop our presence online. Membership management fees assessed by Allen Press have been much higher than anticipated. Membership management was taken over by Breck Barthlomew in October 2009 and our costs are expected to be half of those charged by Allen Press. Our membership is holding steady overall. Institutional subscriptions have fallen, however individual memberships have increased. Although growth in membership levels would be better, holding steady is very good, given the decrease in memberships experienced by most societies. It is not clear if institutions are dropping memberships to remove duplication of effort or to reduce costs by having a BioOne (or other similar) contract which would provide *Journal of Herpetology* to them without having a subscription directly with us. This would explain the huge increase in royalties we are enjoying, which is expected to continue to rise. A comment was made that SSAR needs to offer an electronic-only membership option. The Society's investments made a substantial rebound during 2009. Total market value increased

28% (from $383,743 to $496,004). Kirsten had considered a review and possible revamp of our investment portfolio, but considers it prudent to stay the course at present until conditions change.

Secretary Marion Preest provided Officers, Editors, and Committee Chairs with minutes of the 2009 Board Meeting and summarized the 2009 Annual Meeting for publication in *Herpetological Review*. She keeps track of changes in personnel and regularly updates SSAR letterhead, informs the Editors of *Journal of Herpetology* and *Herpetological Review* of these changes and provides various updates to Raul Diaz (webmaster). She routinely writes letters to student winners of various awards (e.g., Kennedy, GIH, etc.) and prepares announcements for publication in *Herpetological Review*.

The Secretary compiled the 2010 Annual Report and prepared agendas for the Board and Business Meetings for the 2010 JMIH. She was again involved in helping to organize a reception for student members of SSAR and The Herpetologists' League to be held at the JMIH.

A major task in 2009 was to contact all members who are entitled to *CAAR* as part of their membership and inform them of changes to the publication schedule and how we would deal with this. She corresponded with the Board regarding various issues that needed a vote, e.g., a proposal to accept a donation to fund increased use of color photos in *Herpetological Review* and *Journal of Herpetology*, a letter regarding the Natural Science Collections Alliance, a change in editorship for *Journal of Herpetology*, approval of JMIH symposia, etc. Marion framed the Special Libraries Association certificate that SSAR received last year and sent it to Matt Parris. Gad Perry has it currently and it will be passed on to new Editors as necessary. As an *ex officio* member of the Nominations Committee, the Secretary helped to identify and contact potential candidates for the four positions we need to fill in 2010.

Breck Bartholomew reported that total income from the Publications Office in 2009 was $64,651.90.

Editor of *Catalogue of American Amphibians and Reptiles* Andy Price, reported that accounts 861–880 (2 salamanders, 7 frogs, 2 turtles, 7 lizards, 2 snakes, 113 total pages) were published in January 2010 and mailed to subscribers in March. Every account in this issue had at least one color illustration. Andy has 12 accounts on hand in various stages of completeness but is unlikely to have an issue ready by the end of 2010. The frog section editorship is vacant, and the snake editorship will change soon. Andy considers the following as minimal qualifications for a section editor: 1) the ability to recruit authors for accounts, 2) a comprehensive knowledge of the literature not limited to systematics and taxonomy, 3) the ability to pay attention to detail including spelling, syntax, and punctuation, and 4) the ability to check bibliographic entries for accuracy and completeness, and to cross-match these with text citations. If anyone knows of a suitable candidate for either position, please contact Editor Price.

Editor of *Contributions to Herpetology* Kraig Adler reported that "Biology of the Reptilia, Volume 22, Comprehensive Literature of the Reptilia," by Ernest A. Liner was published in March 2010. "Snakes of Honduras" by James McCranie will be published in 2010/2011. A $5,000 donation has been received to support publication.

A "Guide to the Snakes of the Philippines" by Rafe Brown, Alan Leviton, Maren Gaulke, and Arvin Diesmos, "Field Guide to Amphibians and Reptiles of the West Indies" by S. Blair Hedges, and "Lizards of Southern Africa," edited by William R. Branch and Aaron Bauer are planned beyond 2010.

Editor of *Facsimile Reprints in Herpetology* Aaron Bauer reported that no new titles were published in the past year. "Gray's Catalogue of the Specimens of Amphibians and Reptiles in the Collection of the British Museum" is planned for late 2010. Duméril and Bibron's "Erpétologie Générale ou Histoire Naturelle Complète des Reptiles" (1834–1854) is planned for publication in late 2011. This is one of the most important of all herpetological works and a truly comprehensive summary of all amphibian and reptiles species known at the time. The original was nine volumes in 10, totaling over 7000 pages with a separate Atlas of 120 plates. The facsimile will be produced in the same format, with colored plates in the Atlas and black and white versions of the plates also bound into the volumes with which they are associated. The cost of the original work today is in the neighborhood of $20,000. Funding permitting, it is hoped that SSAR will be able to sell the full set at less than $300.

Editor of *Herpetological Circulars* John Moriarty reported that "Reptile Dealers and their Price Lists" was withdrawn by the authors. *Herpetological Circulars* 39 ("A Guide to Tissue Collection, Preservation, and Management for Reptiles and Amphibians" is in preparation and publication is planned for late 2010. Because *Herpetological Circulars* are print on demand, reprint costs are now a factor in the budget for this publication.

Joe Mitchell (Editor) reported that *Herpetological Conservation*, Volume 3 ("Urban Herpetology") has sold well. It was nominated for an award from The Wildlife Society.

Herpetological Review continues to operate smoothly according to Editor Robert Hansen. Volume 40 was slightly smaller (reflecting budget constraints) and the same is likely to be true for Volume 41. Personnel changes include Margaret Gunzberger, Marc Hayes, and Andy Holycross stepping down and Peter Lindeman, Jesse Brunner, Kerry Griffis-Kyle, Michael Benard, Jackson Shedd, and J.D. Wilson joining the staff.

As of late 2009, issues of *Herpetological Review* from 2007 onwards are available to SSAR members as PDF downloads from the ZenScientist website. The Board discussed electronic publishing of *Herpetological Review* again this year. It was felt unanimously that electronic publishing is essential for the future of this publication and for the Society, and must therefore happen sooner rather than later. The issue of indexing of past issues must be resolved. Increased use of color was also considered again. Hansen has obtained reduced color charges from Allen Press and has accessed the Beauvais Fund in support of color printing (evident in the first issue of 2010).

Matthew Parris stepped down as Editor of *Journal of Herpetology* in early 2010 and was replaced by Gad Perry and Erin Muths. Geoff Smith is serving as "Interim Editor" and processing all manuscripts submitted before 2010. There have also been some changes in the roster of Associate Editors. The current list partially reflects an interest in expanding the global reach of *Journal of Herpetology*.

Submission rates were markedly reduced in 2009 (down ~ 30%), but submissions to date for 2010 are higher than for comparable periods in 2009 and 2008. Rejection rate continues at around 60% and there is approximately a nine-month wait between acceptance and publication (down somewhat relative to the previous year). The change in journal leadership has resulted in longer than desired handling times for some manuscripts, however, the Editors have reduced the backlog drastically thanks to the work of Geoff Smith. They are hopeful that the entire process will be back to desired levels by the end of 2010.

The co-editors brought five issues to the attention of the Board.

1) Journal Format — There was discussion of a recommendation to convert *Journal of Herpetology* to an 8.5" x 11" trim size at the 2009 Board Meeting. Editors Muths and Perry are still waiting to receive relevant numbers and mockups from Allen Press. Once they receive them, this issue will be submitted to the Board for an electronic vote.
2) Electronic Publishing — They recommended that the Board continue consideration of electronic publishing of *Journal of Herpetology* with the expectation that this would happen by 2012. It is not obvious whether this would affect SSAR membership levels. The Editors are awaiting information from Allen Press on the financial implications of electronic publishing.
3) Rewarding Associate Editors — There was discussion of a suggestion that Associate Editors receive free membership as a token of appreciation for their efforts. There was also discussion of the fact that some Associate Editors are not members of SSAR. The sense of the Board was that membership should be an expectation, but not a requirement. The President could contact new Associate Editors

who are not members of the Society, and encourage them to join. Editor Muths will write a draft of this letter and send it to President Crother and President-Elect Mendelson.

4) Editorial Board — The Editors questioned the role of the Editorial Board. Their function is to serve as guaranteed reviewers and the Board recommended that they be used more in this manner.

5) Page Charges — Whether a strong policy regarding page charges should be developed and enforced was again discussed. In 2009, the Board asked Editor Parris to develop such a policy. As this was not done, the Board asked the current editors to develop a policy for its consideration. This policy needs to address the issue of charges for both black and white and color pages.

When *Journal of Herpetology* is published electronically, increased use of color plates will be possible. Some reservations were expressed about having two versions of each issue (electronic and hard copies). One version (likely the hard copy) will need to be designated as the official version.

Three new members were added to the Conservation Committee this past year. The Committee took action on a number of items: a) they supported a petition to list western U.S. populations of the Northern Leopard Frog as threatened, b) they sent a letter to U.S. Fish and Wildlife Service (USFWS) requesting re-initiation of an incidental take permit for a wind farm project which may affect the federally threatened Puerto Rican crested toad and contacted Puerto Rican authorities encouraging greater protection of remaining habitat for this species, c) they submitted a letter to USFWS urging federal listing and habitat designation for the coquí llanero, d) they expressed support for proactive strategies for curbing introduction and spread of invasive species (e.g., large constrictors) and stated their position that removal of these organisms (e.g., through controlled hunting) is unlikely to be effective, e) they wrote to the Florida Fish and Wildlife Conservation Commission (FFWCC) to encourage adoption of new rules regarding take and possession of native freshwater turtles.

Actions of the Committee contributed to several positive developments in the past year. For example, the local Planning Board in Puerto Rico temporarily suspended their decision to approve a wind farm project and allowed time for reconsideration, and the FFWCC approved new rules that prohibit commercial harvest and impose strict daily limits on the take of wild turtles in Florida. President Crother remarked on what 10 people can accomplish and congratulated the Committee on its efforts.

Betsie expressed some reservations about a small Committee representing the views of the entire Society and there was some discussion of soliciting greater input from the membership (e.g., via email, a web forum, or an online survey). The view of the Board was that this could be unwieldy and slow down the process and commended the Committee on its activities.

Joe Beatty (Chair, Dean Metter Award Committee) received 24 proposals this year and it was decided to choose two winners. They are: Matthew Niemiller (University of Tennessee, Knoxville) who is working on the maintenance of distinct cave and surface forms in the salamander genus *Gyrinophilus*, and Michael Reichert (University of Missouri, Columbia) who is studying acoustic communication in *Hyla versicolor*. Michael is the first student from University of Missouri in Columbia (which is where Dean Metter was a long time faculty member) to win this award. The Board encouraged Joe to advertise the Award via the SSAR website and an emailing to student members of the Society.

Erik Wild and Josh Kapfer (co-chairs, Grants-in-Herpetology Committee) received 55 proposals in 2010. Applications were sent from 19 states in the US and nine countries (including the U.S.). Most applications were received in the "Field Research" category. The winners each receive $500 and they are:

Conservation: James C. Cureton II, Sam Houston State University
Field Research: Karla Moeller, Arizona State University
Laboratory Research: Tara A. Pelletier, Louisiana State University
Travel: Lindsey Noel Swierk, Penn. State University
International: Paulo Fernando Guedes Pereira Montenegro, Universidade Federal da Paraíba (Brazil)

Eric is stepping down as co-chair of the committee.

The 18th annual Seibert Awards Competition was run at the 52nd Annual Meeting of SSAR in Portland, Oregon. There were 35 eligible presentations. The Seibert Award winners for 2009 were: **Systematics/Evolution**: *Jamie Oaks*, University of Kansas, "Objective partition choice and the phylogenetic systematics and biogeography of the true crocodiles." **Ecology**: *John Wilson*, Brian Todd, and Christopher Winne, University of Georgia, Savannah River Ecology Lab, Virginia Polytechnic Institute and State University, "Trap-happiness, temporary emigration and other factors affecting detectability and population estimation in aquatic snakes." **Physiology/Morphology**: *Victoria Arch*, T. Ulmar Grafe, Marcos Gridi-Papp, and Peter Narins, University of California, Los Angeles, University Brunei Darussalam, "An Old World frog communicates in pure ultrasound." **Conservation**: *Kristine Kaiser*, Menemsha Alloush, Robin Jones, Susanne Marczak, Katherine Marineau, Mark Oliva, and Peter Narins, University of California, Los Angeles, "When sounds collide: effects of anthropogenic noise on frog calling behavior."

Honorable mentions were: **Ecology**: *Javan Bauder*, Holly Akenson, and Charles Peterson, Idaho State University, University of Idaho, "Over the hills and far away: movements of prairie rattlesnakes across a mountainous landscape in a designated wilderness." **Conservation**: *Anna Savage*, Cornell University, "Experimental infection with *Batrachochytrium dendrobatidis* demonstrates genetic resistance to chytridiomycosis in *Lithobates yavapiensis*."

All winners received a check for US $200 from SSAR and a book from University of California Press, the latter compliments of UCP Editor Chuck Crumly.

The Herpetological Education Committee website has been active for a year and members respond to various enquiries submitted to the Herp Hotline. Members have also been active in developing and encouraging educational activities in herpetology. The Committee received support in 2009 from SSAR, HL, and ASIH for a proposal for a Meritorious Teaching Award in Herpetology. Ten nominations were received and considered by a Committee consisting of professional and student members of the three participating societies.

Lynnette Sievert (Chair, Kennedy Award Committee) announced that the winning paper for 2009 is by Ermin Schadich, "Skin peptide activities against opportunistic bacterial pathogens of the African clawed frog (*Xenopus laevis*) and three *Litoria* frogs. *Journal of Herpetology* 43:173–183." Ermin will receive a check for $200 or $400 equivalent in SSAR publications.

The Meeting Management and Planning Committee (MMPC) met in Providence in March 2010 to develop a meeting schedule and review conference facilities. President Crother and President-Elect Mendelson, who will replace Brian on the MMPC, attended the meeting as SSAR representatives. Almost 800 presentations (papers and posters) will be made at the 2010 meeting. Future meetings are to be held as follows:

- Minneapolis (2011)
- Vancouver (2012; with the WCH)
- Albuquerque (2013)

A survey conducted by the MMPC last year confirmed that many members thought the meetings were too expensive. Consequently, the MMPC invited two meeting management companies (KState and Experient, Inc.) to submit competitive bids for the 2013 meeting in Albuquerque. Experient's bids failed twice to provide costs for a number of services (e.g., web design and maintenance for registration and abstract submission, meeting announcement postcards, program book, abstract CD and book, reimbursements for MMPC, etc.). This process had two outcomes. It opened the eyes of the MMPC to the quality of service we receive from KState and it made KState aware of how serious the MMPC is in reducing meeting costs. Subsequently, KState joined with another meeting management company to reduce costs of site selection and hotel negotiations (e.g., reduced or eliminated room rental fees, eliminated the need for a food and beverage minimum required for free or reduced room rental fees, eliminated fees associated with not filling a certain percentage of our room block).

The MMPC presented a proposal to make the MMPC a JMIH, rather than an ASIH, Committee and a proposal to reduce expenses at future meetings. These proposals were discussed by the Board later under New Business.

The MMPC also considered, but took no action on, the issue of reduced registration rates for accompanying and retired persons. Lightning round talks and the future and format of the banquet were discussed. A competition for a JMIH logo, separate from the individual society logos and the local meeting logo is being run. It will reflect combined interests in cartilagenous and bony fishes, amphibians, and reptiles and act as a banner for the JMIH meeting websites.

Five symposia were approved for the 2011 meetings.

ASIH — Turtle Ecology on the Upper Mississippi River System, Then and Now: A Zeitschrift in Honor of the Career in Turtle Biology of Dr. John M. Legler

ASIH — Drawing Lines in the Sand: Comparative Phylogeography of the Gulf-Atlantic Coastal Plain

ASIH — Ranaviruses: An Emerging Threat to Ectothermic Vertebrates

SSAR — Assisted Reproductive Technologies and Genetic Resource Banking: Tools for Conserving Declining Amphibians

AES — Elasmobranch Telemetry

Greg Watkins-Colwell reported that no elections were held in 2009. In 2010, SSAR needs to elect a President-Elect, Secretary, Treasurer, and three Board Members (Regular, Conservation, Regional Herpetological Societies). The committee plans to submit suggestions to the Board on how to define (or re-define) some of the specialty Board positions such as "Regional Herpetological Societies."

Stu Nielsen presented resolutions at the SSAR Business Meeting in Portland in 2009. Stu stepped down as Resolutions Chair and was replaced by Rob Denton.

The 6th Edition of the Scientific and Standard English Names List was published two years ago and the web version is close to posting. Brian Crother, Chair of the Standard English and Scientific Names Committee, thanked Raul Diaz for his help in getting this accomplished. Kevin de Queiroz donated many photographs and has worked closely with Raul on the website version.

Dawn Wilson reported that SSAR held a pizza lunch and workshop ("How to Get a Job After Graduation: Advice from Experts") for students at the 2009 JMIH. A workshop will be offered in 2010 on a topic decided on the basis of an exit survey given to students at the 2009 workshop. For improvements, students suggested more specific workshops, longer workshops, holding different workshops for undergraduates and graduates, and not overlapping the workshop with other meeting activities. Dawn will contact students attending the 2010 JMIH and ask for ideas for future workshops. Roy McDiarmid suggested a workshop focusing on nomenclature.

New co-chairs of the Student Travel Awards Committee, Matt Venesky and Cari Hickerson, reported that the Silent Auction raised $733 at the JMIH in 2009. They hope to double this amount within two years. Proposed changes to the operation of the Auction include:

1) Placing auction items on tables in the registration lobby of the JMIH to increase visibility and bidding activity.
2) Requiring Travel Award winners to monitor the Auction table.
3) Actively soliciting donations from distinguished herpetologists.
4) Creating a Facebook page to promote donations and bidding and providing information regarding applications for Student Travel Awards.

A comment was made that although the Silent Auction has traditionally focused on objects of art, last year items in the Live and Silent Auctions were very similar. This reflected a decision made by the co-chairs to expand the types of items they would accept. Matt and Cari were encouraged to think creatively about new ways to raise funds for the Student Travel Awards, e.g., games, quizzes, photo competitions.

Anne Maglia stepped down as chair of the Web Oversight Committee in March 2010. Consequently, Raul Diaz (webmaster) summarized activity relating to the SSAR webpage.

1) Homepage updated with news.
2) ZenScientist has been added where needed as the link to the page for accessing membership information.
3) Constitution, Contacts/Committees, Chairs/Officers/Editors, award winners, and Annual Meetings information updated.
4) Publications list drop menu updated with addition of: *Catalogue of American Amphibians and Reptiles, Contributions to Herpetology, Facsimile Reprints in Herpetology, Herpetological Conservation, Herpetological Circulars*.
5) Scientific and Standard English Names List Circular added as a *gratis* PDF under RESOURCES drop down tab and online version is in preparation.
6) Working with Andy Mansker (Mansker Consultation, host of the ssarherps.org page) to control access to files on the SSAR Forum.
7) We received a free upgrade in server storage from 300 to 600MB and our bandwidth also increased from 8 to 24GB. This is necessary to host the photos that will accompany the Scientific and Standard English Names page.

Elections Officer Dan Noble reported that no elections were held in 2009.

In 2009, Henry Mushinsky stepped down after many years as Coordinator of the SSAR/HL Live Auction. After some discussion, a Live Auction Committee was formed and Greg Watkins-Colwell was appointed as chair. The Live Auction raised $4048 (split 50:50 with The Herpetologists' League) in 2009. A new bidding form was used which makes receipts available for donors. A high value item was stolen from the viewing room in 2009. The Auction Committee responded with increased security and will no longer leave high-end items out for viewing (but will provide photocopies of packaging, etc.).

Al Savitzky attended the AIBS Board of Directors Meeting and the BioOne Publishers and Partners Meeting. AIBS changed its meeting model and elected to forego a general annual meeting, although it retained the annual meeting of the Council and held an annual awards ceremony.

As with many of its member organizations, AIBS has experienced decreases in both individual memberships and investment revenues, and it has consequently downsized its staff. Despite the decline in individual members, however, AIBS has retained a large number of member societies and continues to provide a strong voice for organismal and environmental biology at the national level.

The AIBS Public Policy Office launched the AIBS Legislative Action Center (www.capwiz.com/aibs) in 2009, through which the society can alert registered individuals of important issues and facilitate their responses to legislators. AIBS also maintains an active Education Office, which was heavily involved in the 2009 Year of Science and the ongoing COPUS activities. In January, 2010 AIBS initiated intensive strategic planning, to determine the most important elements of its mission, to decide how to focus its activities for the furtherance of that mission, and to examine its business model.

This year's annual BioOne Publishers and Partners Meeting included presentations by David Remsen (Global Biodiversity Information Facility) on biodiversity informatics, by Amy Brand (Harvard University) on self-archiving mandates, and by Chuck Koscher (CrossRef) on accessing an electronic publication through several alternative websites and checking manuscripts for plagiarism.

SSAR received two symposium proposals in 2010 ("Assisted Reproductive Technologies and Genetic Resource Banking: Tools for Conserving Declining Amphibians" and "Herpetology and Ichthyology Collections—the Curation of Earth's Natural History"). Based on reviews, the SSAR Board's decision was to sponsor the first proposal by Jennifer Germano and Andy Kouba for the 2011 JMIH meetings in Minneapolis.

This concluded discussion of reports submitted, and the Board then turned to new business. The Meeting Management and Planning Committee (MMPC) made the following recommendations to convert the (ASIH) MMPC into a JMIH MMPC and to reduce expenses for future Joint Meetings:

1. Reconstruct the ASIH MMPC to be a JMIH Committee to make the committee equally responsible and responsive to the four sponsoring societies.
2. The reconstructed JMIH MMPC shall have equal representation of ichthyologists and herpetologists to ensure that we have the necessary expertise to schedule oral presentations, posters, and symposia sessions efficiently.
3. The JMIH MMPC will be composed of six voting members and one non-voting member; one voting member each appointed by the AES, HL and SSAR, and three voting members appointed by the ASIH (two ichthyologists and one herpetologist) and the non-voting Secretary of the ASIH. Other than the ASIH Secretary, each member serves a four-year term and may be reappointed as determined by the appropriate society. The Chair of the MMPC is elected from within the committee and serves a two-year term. The ASIH secretary is an *ex officio*, non-voting member and serves on the committee for the duration of the Office. Individuals serving on the ASIH MMPC shall assume their same role on the JMIH MMPC.
4. The JMIH MMPC reports directly to the four JMIH sponsoring societies.
5. All votes of the JMIH MMPC must be unanimous.
6. The reconstructed JMIH MMPC must be ratified by the four JMIH sponsoring societies.
7. Assuming that the four sponsoring societies ratify the proposed change to the MMPC, it shall become a recognized JMIH Committee.
8. Reduce the number of days of the meeting from five to four.
9. Limit the number of oral presentations to fit into the new meeting format.
10. Run seven (or at most eight) concurrent sessions (most recent past meetings have had six). Seven concurrent sessions will accommodate 630 oral presentations (eight concurrent sessions will accommodate 714 presentations).
11. Oral presentations are accepted on a first-come, first-served basis.
12. Invited presentations for approved symposia are protected (they will be included in the appropriate symposium).
13. The number of symposia will be limited to four (one per society). If a society fails to support a symposium, a replacement symposium can be offered by another society, if approved by the MMPC.
14. Oral presentations by students in award competitions are scheduled during meeting days one and two.
15. Winners of student awards are announced at the business meetings of each sponsoring society or another occasion as determined by each society. If the JMIH Banquet is retained, then each society should have the opportunity to work with the local committee and have input into the program.
16. Increase the number of poster presentations on meeting days two and three to accommodate approximately 300 poster presentations (150 per day).
17. Eliminate the end of meeting banquet (elimination of the banquet was supported strongly by the membership when polled about reducing meeting length and costs).
18. Authorize the Kansas State Division of Continuing Education to enter into a long-term agreement with a major hotel chain (e.g., Marriott, Sheraton, or Hilton) to reduce meeting costs.
19. Some proposed changes cannot take effect until 2014, because we are under contract to hold five-day meetings, others may be implemented as they become ratified by the four societies.

There was discussion of unequal representation of the participating Societies and of disciplines (i.e., three representatives from ASIH—two ichthyologists and one herpetologist) and the requirement that votes be unanimous. The argument for three ichthyologists centers around the need to have the expertise to schedule ichthyological presentations. Suggestions were made that ASIH could have three members on the Committee, but that only one would have voting privileges or that ASIH could have two voting members (an ichthyologist and a herpetologist) on the Committee. The Committee as it is currently comprised works well according to President Crother. However, concern was expressed that there was no guarantee this would continue as the committee composition changes. There was discussion of whether any decisions made by this committee could actually harm SSAR. The Board agreed that the Chair of the Committee should be an experienced member of the Committee and the position of Chair should rotate among disciplines and participating Societies. A motion to modify item 3 above such that the Committee would have five voting members (two from ASIH) was made and seconded. A vote was taken on items 1–8 above, with item 3 modified as noted (9 supported, 1 opposed). There was little discussion of most of the remaining items. Items 8, 9, 13, 14, 15, and 17 were supported unanimously (10 supported, 0 opposed). Item 16 received majority support (9 supported, 1 opposed). The Board decided that items 10, 11, and 12 did not require a vote. There was some discussion of the proposal to enter into a long-term agreement with a particular hotel chain. Questions were raised regarding the duration of such an agreement and whether the costs savings would be worthwhile. Concern was expressed that this would preclude having a university-based meeting. The Board did not support item 18 (0 supported, 10 opposed).

Discussion via email regarding the composition of the JMIH MMPC (item 3) and entering into a long-term agreement with a major hotel chain (item 18) ensued after the Annual Meeting. President Crother reported that the other three JMIH Societies (ASIH, HL and AES) approved the proposal regarding the composition of the JMIH MMPC and he recommended that SSAR should not oppose the proposal as written. He quoted from the memorandum of understanding that SSAR has previously approved: "To affirm willingness to cooperate with each other to every extent possible." President Crother also addressed the concern regarding item 18 that a long-term agreement could prevent SSAR from having a future meeting at a university. He reminded the Board that any society may meet separately with a three-year notice of its intention to do so. KState estimated that entering into an agreement with a hotel chain could result in savings of up to approximately $30,000/yr. A vote was held electronically. Eleven yes votes were received for item 3 (two votes were not received). Nine yes votes, one no vote, and one abstention were received for item 18 (two votes were not received).

The Board received a proposal for a Student Poster Award from Joe Mendelson, III and Pat Owen. Four awards each of $100 would be awarded to student members of SSAR in the following categories: Evolution, Genetics, and Systematics; Ecology, Natural History, Distribution, and Behavior; Conservation and Management; Physiology and Morphology. There was discussion of whether this award should target junior students (e.g., undergrads and Masters students), whether the Award should be money or SSAR publications, whether there should be a fifth category specifically for undergraduates, and what the grading criteria should be. A suggestion was made that the judges should factor in the status of the student (i.e., whether an undergrad or a finishing graduate student) when evaluating the poster. The Board voted to support the proposal (10 supported, 0 opposed).

Treasurer Nicholson presented a "Conflict of Interest" policy as required by the IRS. This policy was approved by the Board (10 supported, 0 opposed). Secretary Preest has since emailed this to the Board and to Editors for their signatures.

Treasurer Nicholson presented "Whistleblower," "Ethics," and "Document Destruction and Retention" policies as required by the IRS. A statement regarding timeliness in the "Ethics" policy will be modified to read "Editors and reviewers will not intentionally delay reviewing of manuscripts for their own benefit." These policies were approved by the Board (10 supported, 0 opposed) and the "Whistleblower" and "Ethics" policies will be made available on the SSAR website.

In response to several recent requests from outside parties to pay for access to our membership lists, there was discussion of whether SSAR wishes to continue to restrict access to this list. A suggestion was made that, when members join or renew subscriptions, they could indicate the level of access that they wish other members of SSAR or outside parties to have to their personal information. Breck Bartholomew will be queried as to how difficult this would be. The consensus was that the Board wished to continue restricting access to our membership list.

Subscription agencies are currently offered a small discount if they pay renewals without being invoiced. Breck Bartholomew recommended that we discontinue this practice. The Board approved this recommendation (10 supported, 0 opposed).

There was continued discussion of an issue raised at the 2009 Board Meeting, i.e., acceptance of donations by individuals who are not members of the Society or are unknown to the Society. Concern had been expressed regarding the credentials of these potential donors, whether there are any strings attached, etc. The Board decided that donations above $500 would need to be accompanied by a statement from the donor regarding why the donation is being made, would be evaluated on a case by case basis, and must be approved by the Board before being accepted. The President would act as an intermediary between the donor and the Board should the donor wish to remain anonymous.

There was brief discussion of how the Society should handle requests to provide financial support for meetings other than JMIH and WCH. The consensus was that we did not have the financial wherewithal to provide this support.

A proposal was received to establish "The Thomas Beauvais Fund" within SSAR. The purpose of this fund would be to increase the use of color photographs, primarily of living animals and unusual and especially new species, on the interior pages of *Journal of Herpetology* and *Herpetological Review*. The proposal came with some stipulations regarding how the fund would be used, e.g., the Fund may be used *only* as a supplement or add-on to the budgets, not as a substitute for funds allocated from the Society's regular budget. The Fund may *not* be used to increase the length of issues, but only to increase their quality and attractiveness. The Board voted unanimously to accept the proposal (10 supported, 0 opposed).

A proposal was received from EBSCO Publishing to include articles from *Journal of Herpetology* on their research databases. The Board voted to sign the License Agreement (10 supported, 0 opposed) which states that the copyright of the publication remains the Society's and that EBSCO are licensing the content for inclusion on their databases.

Complimentary subscriptions and receipt of *gratis* copies of SSAR publications were discussed. This was raised in part because of a request from the co-Editors of *Journal of Herpetology* that we consider offering complimentary memberships to Associate Editors. President Crother will draft a policy regarding complimentary memberships and publications and will email this to the Board and to the Editors for their consideration.

Three SSAR Board positions are reserved for representatives of special constituencies: 1) Regional Herpetological Societies, 2) Conservation, and, 3) Non-U.S. Members. There has been some difficulty of late filling the Regional Societies position and a request was received from the Nominations Committee early in 2009 that the Board redefine this position. At the time, the Board voted electronically to retain the Regional Societies position for the 2010 election, but agreed to consider the request at the 2010 Board Meeting. After some discussion, the Board voted (10 supported, 0 opposed) to reword the Regional Herpetological Societies position. It will now be referred to as "Member at Large" and could include, for example, representatives of regional herpetological societies, members of non-governmental organizations, governmental agencies, etc.

Formation of a Membership Committee and launching of a membership campaign has been discussed at the last several Board Meetings. In the past year, informal discussions among some Editors and Officers regarding an initiative have occurred and some ideas have been generated. President Crother asked Board member Ann Paterson if she would consider chairing and forming a Membership Committee, and she agreed to do so.

There has been some turnover in the Resolutions Chair position in recent years and there was discussion of whether such a chair is necessary. The chair presents resolutions written by the Secretary at the Business Meeting. It was decided that, because this is an easy way of getting students more involved in the Society, we would retain a Resolutions Chair.

SSAR still lacks copyright agreements with authors who have published recently in our journals. Treasurer Nicholson will develop a policy and distribute it to the Board for their consideration.

A request was received by the co-Editors of *Journal of Herpetology* from the SHERPA Services Development Officer at Centre for Research Communications to encourage authors to deposit research material into open-access repositories of "e-prints." Because of concern that this would cut into royalties that we already receive (e.g. from BioOne), the Board decided to deny this request.

A balanced budget for 2011 of $263,150 was approved, and the meeting was adjourned by President Crother at 1440 h.

An informal lunchtime meeting for a number of officers, editors, and interested SSAR members was held a few days later. The main topic for discussion was the future of SSAR and the important roles that *Journal of Herpetology* and *Herpetological Review* would play in that future. Additionally, time was spent considering the possible activities of the newly reformed Membership Committee.

The Annual SSAR Business Meeting was called to order by President Crother at 1802 h on July 10th. Approximately 70 members of SSAR were in attendance. Officers, Editors, and Committee Chairs who were at the Business Meeting introduced themselves to the other attendees and gave brief summaries of their annual reports and relevant information from the Board Meeting. Chuck Crumly generously volunteered to support the soon-to-be-established Student Poster Competition.

Winners of the 2010 Dean Metter Award, Kennedy Award, Henri Seibert Student Awards, Grants in Herpetology Awards, and Student Travel Awards were announced (Fig. 7).

Rob Denton (Resolutions Chair) read the following 2010 resolutions: "SSAR wishes to thank individuals who have resigned from positions of service to the Society in the past year. At *Herpetological Review*, Margaret Gunzburger (Associate Editor) stepped down at the end of 2009. Natural History Notes Section Editors Marc Hayes and Andy Holycross also stepped down in 2009 and Barb Banbury (Copy Editor) completed her service as of late 2009. There have also been some changes for *Journal of Herpetology*. Matt Parris stepped down as Editor in late 2009. We thank him for the service he provided to the Society. SSAR thanks Erin Muths and Gad Perry who are now co-Editors of the journal. Geoff Smith, who had been the Editor before Matt Parris, is serving as interim editor to help with the transition to the two new Editors. Erik Wild who was Chair, and then co-Chair, of the Grants in Herpetology Committee for 9 years is turning over the reins to his co-chair Josh Kapfer. Pat Owen who was chair of the Seibert Award Committee is stepping down after 3 years. Anne Maglia has finished several years of service as chair of the Web Oversight Committee. Raul Diaz continues as our very hard-working webmaster. Thanks to Stu Nielsen who served as Resolutions chair for 1 year. SSAR President's Travelogues are always something to look forward to at the JMIH, and this year was no exception. Thanks to Robert Espinoza for a great presentation on "The Herpetofauna of South America's Southern Cone: New Discoveries from the Andean Peaks to the Peruvian Steppe." SSAR received a proposal for a generous donation from Thomas Beauvais in the past year. At the Board Meeting, we accepted this proposal and are establishing "The Thomas Beauvais Fund."

FIG. 7. Some of the 2010 winners of the Henri Seibert Awards with President Brian Crother. Clockwise from top L. Scott Farnsworth (Honorable Mention, Conservation section), Dan Leavitt (Winner, Conservation section), Cameron Siler (Winner, Systematics/Evolution section), Brian Crother, Jennifer Stynoski (Winner, Ecology section), and Oliver Hyman (Honorable Mention, Ecology section). Denita Weeks was the winner in the Morphology/Physiology section (see Fig. 2)

The purpose of this fund is to increase the use of color photographs, primarily of living animals and of unusual and especially new species, on the interior pages of issues of *Journal of Herpetology* and *Herpetological Review*. The herpetological community is most grateful for this generosity, which will lead to greater appreciation of the scientific and

FIG. 8. The traditional passing of the gavel from President Brian Crother to President-Elect Joe Mendelson, III occurred at the end of the SSAR Business Meeting. (Photo M. Preest)

esthetic qualities of the animals we study. We also received a donation this past year from Tim Criswell towards the Grants in Herpetology Award. Thanks to Chuck Crumly of University of California Press for his continued support of Seibert Award winners. Congratulations to Whit Gibbons who is this year's winner of the new multi-Society Meritorious Teaching Award in Herpetology. SSAR reached the end of an era this year with the publication of Vol. 22 of *Biology of the Reptilia*. Carl Gans was the originator and senior editor of this series, that he envisioned as facilitating "future work" and proving "germinal in inducing additional study." One hundred sixty-nine authors from 21 countries contributed chapters on morphology, behavior, ecology, development, neurology, and physiology beginning in 1969 with the publication of Volume 1. SSAR was immensely proud to assume publication of this series in 1998 with Volume 19 (Morphology G: Visceral Organs). Since then, we have published Volume 20 (Morphology H: The Skull of Lepidosauria), Volume 21 (Morphology I: The Skull and Appendicular Locomotor Apparatus of Lepidoasuria), and then, in March of this year Volume 22 by Ernest A. Liner (Comprehensive Literature of the Reptilia). Kraig Adler was co-Editor (with Carl Gans and Abbot Gaunt) of several of the last volumes of *Biology of the Reptilia* and SSAR extends its gratitude to Kraig for seeing this series through to completion. Finally, SSAR thanks the many members who serve in various capacities—continuing officers, editors, and members of committees, judges of student competitions, reviewers of manuscripts submitted to our journals, contributors to the Live and Silent Auctions, as well as those who attend these Joint Meetings."

President Brian Crother, who comes to the end of his term in December, then turned over the SSAR gavel to President-Elect Joe Mendelson, III (Fig. 8), and the 2010 Business Meeting was adjourned at 1915 h.

—Respectfully submitted by Marion Preest, SSAR Secretary

Seibert Award Winners for 2010 Announced

The 19th annual Seibert Awards were presented at the 53rd Annual Meeting of the SSAR in Providence, Rhode Island, 7–12 July 2010. These awards are named in honor of Henri C. Seibert, an early and tireless supporter of SSAR (having served as an officer for over 20 years). In recognition of outstanding student presentations at the annual meeting, a single award was given in each of the following categories: Evolution/Systematics (9 presentations), Ecology (12 presentations), Physiology/Morphology (6 presentations) and Conservation (8 presentations). All awardees will receive a check for US $200 and a book from Chuck Crumly at University of California Press.

The Winners—Systematics/Evolution: **Cameron Siler** and Rafe Brown, University of Kansas, "Historical processes behind patterns of limb reduction and loss in an island radiation of fossorial lizards." Ecology: **Jennifer Stynoski**, Virginia Noble, Meredith Strider, University of Miami, Organization for Tropical Studies, University of Maryland, "To eat but not to be eaten: honest begging signals and visual detection of predators and mothers by tadpoles of the Strawberry Poison Frog (*Oophaga pumilio*)." Physiology/Morphology: **Denita M. Weeks** and Robert E. Espinoza, California State University, Northridge, "Geckos on ice: unexpected thermal tolerances and temperature-dependent performance of the world's southernmost gecko." Conservation: **Daniel Leavitt**, Texas A&M University, "*Sceloporus arenicolus*, an endemic lizard in an endangered ecosystem."

Honorable Mention—Systematics/Evolution: **Philip L. Skipwith**, Aaron M. Bauer, and Todd R. Jackman, Villanova University, "Molecular phylogenetics of New Caledonian diplodactylid geckos." Ecology: **Oliver Hyman** and James P. Collins, University of Arizona, "Negative influence of phosphorus on prevalence of the frog killing pathogen, *Batrachochytrium dendrobatidis*." **James Paterson**, Brad Steinberg, and Jacqueline Litzgus, Laurentian University, Algonquin Park, "Comparisons of hatchling survivorship and spatial ecology between two sympatric turtle species." Physiology/Morphology: **Travis Hagey**, Luke Harmon, and Kellar Autumn, University of Idaho, Lewis and Clark College, "Predicting adhesive capabilities in *Anolis* and *Phelsuma* lizards via the frictional adhesion model and critical detachment angle." Conservation: **Scott Farnsworth** and Richard Seigel, Towson University, "Short and long distance translocations of Eastern Box Turtles: Do fences make good neighbors or conservation practices?"

The judges were Cathy Bevier (Colby College), Rafe Brown (University of Kansas), Tiffany Doane (Central Connecticut State University), Nirvana Filoramo (Wesleyan University), Mac Given (Neumann College), Noah Gordon (University of Evansville), Eric Juterbock (The Ohio State University), and Patrick Owen (University of Cincinnati).

Metter Award Application Period Open

Dean E. (Doc) Metter (1932–2001) was a long-time member of the biology faculty at the University of Missouri-Columbia, where he taught zoology, comparative anatomy, evolution, and herpetology. A believer in putting knowledge to the test in the field, Doc provided frequent opportunities for students to engage in fieldwork. In addition, he frequently assisted his graduate students as they ventured out to collect data. Doc was a co-founder of the Bobby Witcher Society, the legacy of which is a scholarship fund. For many years, the interest earned served to reward outstanding herpetology students who intended to continue their education and seek a career in vertebrate biology. That fund now serves a similar purpose by honoring Doc's memory while helping to fund the SSAR-administered Dean E. Metter Memorial Award.

The deadline for receipt of applications for the 2011 Metter Awards is 30 March 2011. Successful applicants must be current members of SSAR as of 31 December 2010. For details of eligibility and application requirements, please check the SSAR web page: http://www.ssarherps.org/pages/metter.php

SSAR Participation at the USA Science & Engineering Festival, Washington, DC 23–24 October 2010

The Society for the Study of Amphibians and Reptiles participated in the recent inaugural USA Science & Engineering Festival by hosting an interactive booth highlighting SSAR and the animals we study. The event was massive, with many hundreds of booths and several stages stretching down the National Mall and occupying several other nearby sites. The 10 ft x 10 ft SSAR booth was outdoors in Woodrow Wilson Plaza next to the Ronald Reagan Building on Pennsylvania Avenue. Our booth was situated between booths sponsored by *Scientific American* and NASA, and just opposite a very large booth sponsored by Lockheed Martin. These booths were directly behind the main stage for the plaza, that featured everything from science-themed musical acts, scientific cuisine demonstrations, an Albert Einstein impersonator, and the Science Cheerleaders (science majors drawn from cheerleading squads of regional universities). So, we were ideally located in a very high traffic location.

Fig. 1. Novel SSAR logo created for souvenir stamp for the USA Science and Engineering Festival. Actual size of imprint is ½" x ½".

The booth displayed a representative selection of SSAR publications including *Journal of Herpetology, Herpetological Review, Urban Herpetology, Biology of the Reptilia* series, the standard names checklist, books from the facsimile series, and others. Distribution of brochures or other handouts was greatly discouraged by the organizers of the event (for reasons of litter control), so the newly printed SSAR Membership brochures were held back and handed individually only to persons who appeared genuinely interested in the society. The booth displayed a variety of real and replica skulls, shells, and fangs of reptiles. We also had a live American Toad, Corn Snake, and Eastern Box Turtle. As expected, the live animals and impressive skeletal specimens were a huge draw and we regularly had visitors lined up five-deep at the booth awaiting their turn to examine and touch them—and to discuss them with the SSAR members and officers in the booth. The publications received a bit less attention—it is hard for a book to compete with real, live animals!—but were of sufficient interest to some that a few copies "went missing" over the course of the weekend. However, the impressive cover images on *Herpetological Review* engendered considerable discussion, especially those of *Crotalus lannomi* (by Ginny Weatherman et al.) and the tadpoles of *Anotheca spinosa* filled with nutritive eggs (by Danté Fenolio).

The attendees were primarily families and, typical of the DC metropolitan area, represented many nations worldwide. Kids and parents interacted with our staff and exchanged questions and stories and generally marveled at the materials on display. A number of people marveled at the fact that it was possible to make a career out of the study of amphibians and reptiles; more than a few young people seemed truly inspired by that real possibility. The booth staff seemed proud to relate that they had the most exciting careers and hobbies imaginable; we truly held our own

FIG. 2. Kyle Miller Hesed and Steve Gorzula braving the mass attendance at the SSAR booth at the USA Science and Engineering Festival.

with the "competing" astronauts in the adjacent booth! Most of the attendees had festival-sponsored folios or "science passports" and were rabid in their efforts to collect stamps from as many booths as possible. We prepared a novel SSAR stamp for the occasion (Fig. 1), and many kids were thrilled to have the SSAR frog also applied to their hand (or even forehead!) as a "tattoo." Next year we need special SSAR T-shirts for the booth staffers, and stickers or buttons to decorate the young people!

FIG. 3. George Zug interpreting a live Corn Snake for a young woman attending the SSAR booth.

Given the contemporary popularity of herps as pets, and their ubiquity in classrooms and education programs at museums, nature centers, and zoos, it was surprising to see how many of the attendees had never touched or held a live reptile before. A great number of people touched their first snake or turtle at the SSAR booth at the Science Festival in 2010, an experience they are not likely to forget. At the other extreme, it was rewarding to meet so many people—especially young people—who were remarkably learned and respectful towards amphibians and reptiles. We met 12-year olds who knew the difference between elapids and vipers, or who knew about the amphibian chytrid fungus.

The evident success of the weekend event was bolstered by spectacularly beautiful Fall weather and extraordinarily smooth logistics and planning on the part of the organizers. The event was promoted by President Obama and covered by major media. The National Park Service has conservatively estimated an astounding attendance between 750,000–1,000,000 persons. We can be proud to truthfully say that SSAR, in keeping with its mission, reached out and "brought herpetology to the people" in a booth staffed by members including hobbyists, career academics, and students (Figs. 2, 3).

Credits: Brian Crother suggested and initiated SSAR participation in the event; Joe Mendelson handled pre-festival arrangements; Karen Lips led intra-DC logistics and volunteers for the booth; Joe Mendelson and Karen Lips managed daily set-up and break-down of the booth and staffed it for both days; use of live animals was facilitated by Jim Murphy and Robin Saunders, with animals courtesy of Long Branch Nature Center; viper fang displays were prepared and loaned by Jason Brock; skeletal specimens were loaned by Education Department at Zoo Atlanta; Breck Bartholomew selected and shipped representative SSAR publications. Volunteer staff at the booth were Anne Maglia, George Zug, Roy McDiarmid, Ted Kahn, Jake Li, Kyle Miller Hesed, Peter Uetz, Brian Gratwicke, Steve Gorzula, and Jim Murphy.

—Submitted by Joseph R. Mendelson, SSAR President-Elect

2011 Year of the Turtle

Partners in Amphibian and Reptile Conservation (PARC), along with many partners (IUCN Tortoise and Freshwater Turtle Specialist Group, Turtle Survival Alliance, Chelonian Taxonomic Advisory Group, The Turtle Conservancy, and a growing list of others) are designating 2011 as "Year of the Turtle." We invite SSAR members to join our efforts! This is an opportunity to raise awareness of efforts in research, conservation, and education to benefit these animals. Throughout the year there will be a number of activities including monthly newsletters featuring conservation or research efforts, local events and presentations, official reports and meeting highlights, a photo contest and release of monthly calendar pages with selected photos, and educational materials for teachers and children, including arts, humanities, and cultural values relating to turtles. Please contact Dede Olson (dedeolson@fs.fed.us) or Priya Nanjappa (pnanjappa@fishwildlife.org) if you'd like to assist or to contribute information toward the newsletter or related resources.

NEWSNOTES

2010 IUCN Crocodile Action Plan

The IUCN-SSC Crocodile Specialist Group recently released the 2010 Action Plan for Crocodiles, which includes summary accounts for the world's 23 crocodile species. Accounts for all species can be downloaded here:

http://www.iucncsg.org/ph1/modules/Publications/ActionPlan3/ap2010_index.html

The current IUCN Red List (http://www.iucnredlist.org/) descriptions for threatened crocodilians will eventually be updated with these accounts. Please note that the distribution maps for Tomistoma and Siamese Crocodile contain some errors which escaped the editing process, and the maps will be corrected and re-uploaded to the CSG website within the next few months.

Retirement of Wolfgang Böhme

Prof. Dr. Wolfgang Böhme, for 40 years head of the herpetology department at Museum A. Koenig in Bonn, Germany will retire on December 1, 2010. During his long tenure as curator, he advanced the Koenig to the first rank of herpetological collections in Germany and it became one of the most active herpetological research centers in the world. In addition to his curatorial duties, he supervised a large number of masters and doctoral students at the University of Bonn.

SSAR members will recall Prof. Böhme's outstanding keynote lecture on West African herpetology delivered at its 2002 meeting in Kansas City. This was his first visit to the United States. SSAR salutes Prof. Böhme on his retirement.

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (HerpReview@gmail.com) well in advance of the event.

11–14 January 2011—10th Conference of the Herpetological Association of Africa, Cape Town, South Africa. Information: https://sites.google.com/site/10haacapetown/

18–20 February 2011—36th Annual Symposium of the Desert Tortoise Council, Las Vegas, Nevada, USA. Information: www.deserttortoise.org

23–27 May 2011—Second Mediterranean Congress of Herpetology, Marrakech, Morocco. Information: http://www.ucam.ac.ma/cm2

19–22 June 2011—Sixth Hellbender Symposium, Ligoneer, Pennsylvania, USA. Information: mcmillan@buffalostate.edu

6–11 July 2011—Joint Meeting of Ichthyologists and Herpetologists (ASIH / HL / SSAR), Minneapolis, Minnesota, USA. Information: http://www.dce.k-state.edu/conf/jointmeeting/

2–7 September 2012—4th International Zoological Congress (IZC), Mount Carmel Campus, University of Haifa, Haifa, Israel. To receive the first and subsequent meeting announcements, contact the organizers at: izc2012@sci.haifa.ac.il.

CURRENT RESEARCH

The purpose of Current Research is to present brief summaries and citations for selected papers from journals other than those published by the American Society of Ichthyologists and Herpetologists, The Herpetologists' League, and the Society for the Study of Amphibians and Reptiles. Limited space prohibits comprehensive coverage of the literature, but an effort will be made to cover a variety of taxa and topics. To ensure that the coverage is as broad and current as possible, authors are invited to send reprints to the Current Research section editors, Joshua Hale or Ben Lowe; postal and e-mail addresses may be found on the inside front cover.

A listing of current contents of various herpetological journals and other publications is available online. Go to: http://www.herplit.com and click on "Current Herpetological Contents."

Surface Currents Assist Estuarine Crocodiles in Completing Long Distance Movements

The Estuarine Crocodile, *Crocodylus porosus*, is the largest living reptile and its wide geographic distribution throughout the southwestern Pacific and eastern Indian Oceans (including far-flung oceanic islands) suggests that it is capable of extended ocean travel. Further, no island speciation has occurred, suggesting that this type of movement is relatively common. *C. porosus* have been known to travel up to 30 km across the ocean in a single day, and are capable of consecutive days of more than 20 km, which is remarkable for an animal that is believed to have modest aerobic capacity. In this study, the authors have investigated long-distance movement in *C. porosus*. Acoustic telemetry was used to measure movement along the North Kennedy River, North Queensland, Australia. Results showed that long distance (greater than 10 km), single direction travel was restricted to when tidal currents were moving in the same direction. Further, when surface current direction became unfavorable, individuals would dive, or retire to the river bank. Satellite tracking of tagged crocodiles on ocean travel resulted similar findings, with a strong correlation between the direction of travel and the residual surface current. Using this strategy, one crocodile was able to complete a 560 km journey along the west coast of the Cape York Peninsula in only 25 days. Another satellite tracked individual made a significant ocean movement, only to return to its original home range. The discovery that these crocodiles use of surface currents for long distance movement has management consequences, particularly if changes in ocean currents result in them traveling to areas where there is no recent history of their presence and putting them into contact with humans, to which they pose a significant risk.

Furthermore, translocations of problem crocodiles, a common management strategy, need to take place where prevailing currents do not allow a rapid passage back to their original location.

Campbell, H. A., M. E. Watts, S. Sullivan, M. A. Read, S. Choukroun, S. R. Irwin and C. E. Franklin. 2010. Estuarine crocodiles ride surface currents to facilitate long-distance travel. Journal of Animal Ecology 79:955–964.

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Extreme Longevity in the Human Fish

The human fish or olm, *Proteus anguinus* (Proteidae), is an aquatic, paedomorphic, cave-dwelling salamander native to the European countries Slovenia and Croatia. As captive specimens have been known to live for over 70 years, this species has long been of interest to biologists studying aging and senescence. Extreme lifespan has been demonstrated in a number of taxa, including mammals, birds and reptiles, and is usually positively correlated with size. However, the Human Fish is small, generally less than 20 g. Longevity has also been associated with living in environments that are stable and/or free from predators, the possession of mechanisms that mitigate damage caused by free radicals, and slow metabolisms. It is cave dwelling and therefore lives in a stable environment, and is thought to not suffer from predation. Additionally, it has been shown not to possess advanced cellular oxidation defences; the metabolic rate of *Proteus* is unknown. A breeding colony, established in a cave in Saint-Girons, France in 1952, now has over 400 individuals of various age classes, allowing the authors of this paper to conduct a detailed investigation of the demographic and physiological characteristics of this species. Data on physical condition and instances of birth and death (collected weekly) reveal that the population is growing at a rate of 1.05, olms reach sexual maturity at roughly age 15, reproduce once every 12 years, and average adult lifespan is roughly 70 years. From these data, the researchers determined that the maximum lifespan for this species is 102 years. Furthermore, while salamanders exhibit reduced metabolic rates relative to other vertebrates, laboratory experiments found the metabolism of the human fish to not be markedly different from other salamanders. While the proximate mechanisms leading to longevity in the human fish remain elusive, it does represent an excellent model organism for studying longevity and senescence in vertebrates.

Voituron, Y., M. de Fraipont, J. Issartel, O. Guillaume and J. Clobert. 2010. Extreme lifespan of the human fish (*Proteus anguinus*): a challenge for ageing mechanisms. Biology Letters doi:10.1098/rsbl.2010.0539.

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Tadpoles Recognize Native but not Introduced Turtle Predators

The impact of introduced predators on prey populations is well known, but less research has been conducted on the negative effects on native species of having to compete with these alien species. On the Iberian Peninsula, the native freshwater turtles (the European pond turtle, *Emys orbicularis* and the Spanish terrapin, *Mauremys leprosa*), are being displaced by exotic species (principally the red-eared slider, *Trachemys scripta elegans* and the false map turtle, *Graptemys pseudogeographica*). Both native and introduced species feed on anuran tadpoles, which are able to recognize local predators and alter their behavior. In this study the authors have examined tadpole responses to both native and introduced species in order to determine whether they can recognize introduced species as well. Chemical cues of the four turtle species mentioned above were presented to tadpoles of four species of European anurans: Iberian green frog (*Pelophylax perezi*), western spadefoot (*Pelobates cultripes*), natterjack toad (*Bufo calamita*), and common gree frog (*Hyla arborea*). Three species (*P. perezi*, *P. cultripes* and *H. arborea*) reduced their swimming behavior in response to native, but not introduced species. The authors suggest that a lack of evolutionary experience with the introduced predators explains the inability of the tadpoles of these species to detect them and may confer a competitive advantage to the introduced turtle species.

Polo-Cavia, N., A. Gonzalo, P. López and J. Martín. 2010. Predator recognition of native but not invasive turtle predators by naïve anuran tadpoles. Animal Behaviour 80:461–466.

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Cane Toad Eggs Toxic to Tadpoles of Native Australian Anurans

The introduced Cane Toad, *Bufo* (= *Rhinella*) *marninus*, is inflicting a number of profound impacts on native species as it expands across Australia. Previous studies have shown cane toad eggs to be extremely toxic to the tadpoles of native Australian anurans and in this study, the authors have conducted a number of laboratory trials to determine if there is variation among tadpoles of Australian species in propensity to consume cane toad eggs or susceptibility to toad egg toxins. In each trial, individual tadpoles were presented ten cane toad eggs either with or without an additional food source (lettuce). At least some individuals of each of the 15 anuran species studied ingested toad eggs, with mortality following rapidly in most cases. While no interspecific difference in propensity to ingest eggs was observed, the high interspecific variance in survival rate (0 > 70%) was driven by a difference in feeding behavior (e.g., small size preventing efficient consumption of toad eggs) rather than physiological tolerance. Furthermore, alternative food sources did not reduce mortality from egg ingestion as most tadpoles foraged on both the eggs and the lettuce. The influence of overall body size on survival was also examined in four species. While three of the species did show an effect of body size on mortality, this was not in a consistent direction, and instead was a complex interaction related to alternate food availability. Interclutch affects were examined in one species, but none were observed. This study highlights the toxicity of toad eggs to native frogs and that frequency of mortality relates to a complex interaction between body size, species and other ecological factors.

Crossland, M. R. and R. Shine. 2010. Vulnerability of an Australian anuran tadpole assemblage to the toxic eggs of the invasive cane toad (*Bufo marinus*). Austral Ecology 35:197–203.

Correspondence to: Richard Shine, School of Biological Sciences A08, University of Sydney, New South Wales 2006, Australia; e-mail: rics@bio.usyd.edu.au.

How Much UV-B Should a Captive Reptile be Exposed to?

Ultraviolet-B (UV-B) exposure is important to the production of Vitamin D in many vertebrate species, including reptiles, and plays a part in calcium-phosphorous balance and immune function. The amount of UV-B to provide is therefore an important consideration to ensure the good health of captive reptiles. In this study, the authors have investigated voluntary UV-B exposure of a number of squamate species in the wild, in the US and Jamaica. In Jamaica, three species of *Anolis* (*A. lineotopus, A. grahami,* and *A. sagrei*) were investigated. In the US, *Agkistrodon piscivorous, Pantherophis obsoletus, Thamnophis proximus, Nerodia fasciata*, *N. erythrogaster*, *Uta stansburiana*, *Holbrookia maculata*, *Sceloporus olivaceus*, *S. consobrinus*, *S. undulatus*, *S. graciosus*, and *Anolis carolinensis* were studied. Animals encountered in the field were subjected to cloacal temperature readings and UV-B readers were employed to ascertain the level of UV-B exposure the animals were experiencing. The authors found significant variation among species in UV-B exposure; more extensive observations of two species of *Sceloporus* (*S. olivaceus* and *S. graciosus*) revealed seasonal and diel variation as well. The authors provide a number of guidelines for providing UV-B to these species in captivity. They also highlight the importance of providing a UV-B refuge in enclosures to allow behavioral regulation of UV-B exposure.

Ferguson, G. W., A. M. Brinker, W. H. Gehrmann, S. E. Bucklin, F. M. Baines and S. J. Mackin. 2010. Voluntary exposure of some Western-Hemisphere snakes and lizard species to ultraviolet-B radiation in the field: How much ultraviolet-B should a lizard or snake receive in captivity? Zoo Biology 29:317–334.

Correspondence to: Gary Ferguson, Department of Biology, Texas Christian University, Box 298930, Fort Worth, Texas 76129, USA; e-mail: g.ferguson@tcu.edu.

Behavioral Syndromes, or "Personalities" Investigated in a Lizard

Behavioral syndromes ("personalities") are increasingly being recognized as an important component of natural systems, having been observed in fish, invertebrates, mammals, and reptiles. In this paper, the authors have examined behavioral syndromes in the Namibian Rock Agama, *Agama planiceps*. To determine if individuals displayed consistent magnitudes of boldness or shyness, investigators measured flight initiation distance (the distance away a perceived threat, in this case an advancing experimenter, was from the lizard before it fled) for a number of individuals several times over a period of time. Next, male lizards were observed and their behavior (instances of head bobbing and push ups; collectively defined as "signaling") was documented. Finally, possible fitness consequences of boldness or shyness was investigated by measuring the home ranges, rates of tail loss, and feeding rates of several males. Individuals were found to exhibit consistent degrees of boldness. Bold males spent more time basking and moving and had larger home ranges and higher feeding rates than shy males. The rate of signaling behavior however, did not differ between bold and shy individuals. Males that had a third or more of their tale missing were more likely to be bold, suggesting that there may be an increased predation risk associated with being bold. The authors suggest that long term studies are required to fully understand the fitness consequences of animal personalities such as boldness.

Carter, A. J., A. W. Goldizen, and S. A. Tromp. 2010. Agamas exhibit behavioral syndromes: Bolder males bask and feed more but may suffer higher predation. Behavioral Ecology doi: 10.1093/beheco/arq036.

Correspondence to: Alecia Carter, The Fenner School of Environment and Society, The Australian National University, Acton, Canberra, ACT 0200, Australia; e-mail: alecia.carter@anu.edu.au.

Roads Act as Barriers to Seasonal Migration in Timber Rattlesnakes

Anthropogenic landscape modification, especially roads, can fragment habitats and act as dispersal barriers to wildlife. However, the degree to which a road acts as a barrier to dispersal is related to characteristics both of the road itself and the animal in question. In this study, the authors have examined the impact of recently constructed roads separating hibernacula (communal dens) of timber rattlesnakes, *Crotalus horridus* in four regions in New York State, USA. Microsatellites were used to examine population subdivision and gene flow across roads. It was found that hibernacula separated by roads had a higher degree genetic differentiation than hibernacula in contiguous habitat and also were less genetically diverse. This was further examined by completing genetic assignment analyses, which showed that disruption of seasonal migration was the cause of these patterns, with matings less likely to occur between snakes from hibernacula separated by roads. This study highlights the fragmenting nature of roads, even those that are relatively small, or recent in origin.

Clark, R. W., W. S. Brown, R. Stechert and K. R. Zamudio. 2010. Roads, interrupted dispersal, and genetic diversity in timber rattlesnakes. Conservation Biology 24:1059–1069.

Correspondence to: Rulon Clark, Department of Biology, San Diego State University, 5500 Campanile Drive, San Diego, California 92182, USA; e-mail: rclark@sciences.sdsu.edu.

The Island of Bermuda Preserves an Ancient Skink Lineage

Paleoendemism is the preservation of ancient, formerly widespread lineages in a restricted geographic area. Islands can be good sources of paleoendemism, with the most well known example being that of the Tuatara, which was once widely-distributed, but is now restricted to islands off the shores of New Zealand. The native fauna of the island of Bermuda includes only a single extant flightless terrestrial vertebrate: the endemic scinid lizard, *Plestiodon longirostris*. In this study, the authors have assembled a multi-locus molecular dataset which they used to reconstruct a phylogeny and estimate divergence times, which were in turn used to determine if colonization of Bermuda was recent or ancient. They found that the lineage occuring on Bermuda is indeed ancient, having split from the lineage containing its closest extant relatives before the bulk of the diversification events that led to the divirsity of skink species occurring in North America today (about 16 million years ago). Furthermore, the extant members of the clade from which the Bermuda Skink split occur in western North America (*P. skiltonianus* complex), with no extant eastern North American representatives. Even more interestingly, it is found only on Bermuda currently, which is itself only 2 million years old. Fossil evidence of *P. longirostris* on Bermuda from 400,000 years ago suggests that colonization occurred between 2 million and 400,000 years ago, possibly by rafting the 1000 km that separates Bermuda from the North American mainland (where they once existed). Following colonization, the lineage then disappeared from the mainland. Bermuda therefore, represents a unique 'life raft,' preserving one of the most ancient lineages of North American *Plestiodon*. Currently however, habitat destruction and degradation and pressure from non-native species has severely lowered population size, resulting in this unique lizard being highly endangered.

Brandley, M. C., Y. Wang, X. Guo, A. N. Montes de Oca, M. F. Ortíz, T. Hikida and H. Ota. 2010. Bermuda as an evolutionary life raft for an ancient lineage of endangered lizards. PLoS ONE 5: e11375.

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Newly Discovered Chameleon Species Highlights Importance of Preserving Biodiversity Hotspots

Madagascar has the dubious distinction of being among the most imperiled biodiversity hotspots on earth. However, despite a mere 17% of its original vegetation remaining, Madagascar continues to divulge species new to science. The authors of this paper describe a distinctive new species of chameleon, *Calumma tarzan*, from three localities on the eastern slope of the island (Anosibe An'Ala region). This species exhibits morphological traits consistent with the *Calumma furcifer* species group. However, it possesses a unique rostral spade, and males have a distinctive dorsal brown blotch on the head and neck. A molecular analysis confirms the phylogenetic placement of this new taxon, follows previous analyses in failing to resolve relationships within the *C. furcifer* species group, corroborates the evolutionary distinctiveness of these lizards, and suggests two genetically differentiated populations (north and south). The specific epithet is derived both from the former name of a nearby village, Tarzanville (now Ambatofotsy), and the fictional forest denizen, Tarzan. As *C. tarzan* is known to occupy less that 10 km^2, the authors posit that it should receive the IUCN's Critically Endangered listing. They also point out the lack of protected land in this region (amounting to a "reserve gap") and hope the patronym brings attention to this overlooked region and compels conservation efforts.

Gehring, P. S., M. Pabijan, F. M. Ratsoavina, J. Köhler, M. Vences, and F. Glaw. 2010. A Tarzan yell for conservation: A new chameleon, *Calumma tarzan* sp. n., proposed as a flagship species for the creation of new nature reserves in Madagascar. Salamandra 46:167–179.

Correspondence to: Philip-Sebastian Gehring, Division of Evolutionary Biology, Zoological Institute, Technical University of Braunschweig, Spielmannstr. 8, 38106 Braunschweig, Germany; e-mail: sebastiangehring@web.de.

Habitat Preferences and Home Range Size in a Colubrid Snake

Effective wildlife conservation plans should consider both the habitat needs and spatial requirements of the species in question. Studies that focus on the correlation between the habitat preferences and movement patterns of wildlife, particularly snakes, are uncommon. In this study, the authors attempted to determine how habitat preferences or quality influenced movement patterns of snakes. To answer this question, they used habitat preference or avoidance information obtained for Bullsnakes (*Pituophis catenifer sayi*) from 2003–2005 at a site in the upper-midwestern United States and compared it to minimum convex polygon estimates of home range size derived from data on radio-tracked snakes. They employed Geographical Information Systems to model the amount of preferred (open bluff faces) and avoided (agricultural fields and closed canopy forests) habitats within each estimated home range and compared them via multiple linear regression. They also tested the influence of gender, length and weight on home range size. The results of this study indicated that, among the investigated potential correlates, amount of avoided habitat was the most significant indicator of home range size. More specifically, home range size increased with amount of avoided habitat within the home range. As bullsnakes are large snakes, they are particularly susceptible to road mortality; therefore, fragmentation of suitable habitat forces snakes to wander further in the search for suitable habitat, exposing them to greater risk. In a broader context, this finding supports the hypothesis that habitat quality has an impact on wildlife movement patterns, and the relationship between habitat needs and spatial requirements should be considered when conserving or managing species.

Kapfer, J. M., C. W. Pekar, D. M. Reineke, J. R. Coggins, and R. Hay. 2010. Modeling the relationship between habitat preferences and home-range size: A case study on a large mobile colubrid snake from North America. Journal of Zoology 282:13–20.

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Multi-year Study of Toad Populations Reveals Demographic Implications of Chitrid Fungus

While many studies have implicated *Batrachochytrium dendrobatidis* (Bd) infection in population declines, few have studied natural populations for multiple years to elucidate the specific demographic impact of the disease. The authors of this study conducted a six-year capture-recapture study on three populations of western toad (*Bufo* [= *Anaxyrus*] *boreas*) in the Rocky Mountains of western US. Of these populations, two were infected with Bd and one was not. Captured animals were individually marked (if first capture), measured, swabbed to determine if the animal was infected with Bd, and released. From these data, population growth rates were obtained and analyses were conducted to determine if growth rates were correlated with various factors such as the presence or absence of Bd and climactic conditions (e.g., breading season temperature). Roughly 58% of individuals in the two Bd-infected populations were found to be infected with the disease. These infected animals were found to have an annual survival coefficient of about 0.47 (about 0.75 for uninfected individuals). Bd-infected populations were found to be declining by roughly 6% per year over the duration of the study while the Bd-free population exhibited stable population growth. Furthermore, population growth rates were not correlated with temperature. These findings reveal that in addition to causing rapid local extirpations, in some instances, Bd can also exhibit long-term persistence as a chronic disease (and that some species can persist with Bd). Furthermore, this study highlights the need for long-term monitoring of amphibian populations to determine the species-specific demographic impacts of pathogens.

Pilliod, D. S., and Colleagues. 2010. Effects of amphibian chytrid fungus on individual survival probability in wild boreal toads. Conservation Biology 24:1259–1267.

Correspondence to: David Pilliod. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Snake River Field Station, 970 Lusk Street, Boise, Idaho 83706, USA; e-mail: dpilliod@usgs.gov.

ZOO VIEW

Snake Versus Rabbit

This colorful excerpt was sent by Jon Coote about the Tower of London and the last director, Alfred Cops, who took over the operation in 1822.

Mr. Broderip, in the second volume of the *Zoological Journal*,

"Mr. Cops of the Lion Office in the Tower," writes Broderip, "sent to inform me that one of these reptiles had just cast his skin, at which period they, in common with other serpents, are most active and eager for prey. Accordingly I repaired with some friends to the Tower, where we found a spacious cage, the floor of which consisted of a tin case covered with red baize and filled with warm water, so as to produce a proper temperature. There was the snake, " positis novus exuviis," gracefully examining the height and extent of his prison as he raised, without any apparent effort, his towering head to the roof and upper parts of it, full of life, and brandishing his tongue.

A large buck rabbit was introduced into the cage. The snake was down and motionless in a moment. There he lay like a log without one symptom of life, save that which glared in the small bright eye twinkling in his depressed head. The rabbit appeared to take no notice of him, but presently began to walk about the cage. The snake suddenly, but almost imperceptibly, turned his head according to the rabbit's movements, as if to keep the object within the range of his eye. At length the rabbit, totally unconscious of his situation, approached the ambushed head. The snake dashed at him like lightning. There was a blow—a scream—and instantly the victim was locked in the coils of the serpent. This was done almost too rapidly for the eye to follow: at one instant the snake was motionless : in the next he was one congeries of coils round his prey. He had seized the rabbit by the neck just under the ear, and was evidently exerting the strongest pressure round the thorax of the quadruped ; thereby preventing the expansion of the chest, and at the same time depriving the anterior extremities of motion. The rabbit never cried after the first seizure:—he lay with his hind legs stretched out, still breathing with difficulty, as could be seen by the motion of his flanks. Presently he made one desperate struggle with his hind legs; but the snake cautiously applied another coil with such dexterity as completely to manacle the lower extremities, and, in about eight minutes, the rabbit was quite dead. The snake then gradually and carefully uncoiled himself, and, finding that his victim moved not, opened his mouth, let go his hold, and placed his head opposite to the fore part of the rabbit. The boa generally, I have observed, begins with the head ; but in this instance the serpent, having begun with the fore-legs, was longer in gorging his prey than usual, and in consequence of the difficulty-presented by the awkward position of the rabbit, the dilatation and secretion of lubricating mucus were excessive. The serpent first got the fore-legs into his mouth; he then coiled himself round the rabbit, and appeared to draw out the dead body through his folds; he then began to dilate his jaws, and holding the rabbit firmly in a coil as a point of resistance, appeared to exercise at intervals the whole of his anterior muscles in protruding his stretched jaws and lubricated mouth and throat at first against, and soon after gradually upon, and over his prey. The curious mechanism in the jaws of serpents which enables them to swallow bodies so disproportioned to their apparent bulk is too well known to need description; but it may be as well to state that the symphysis of the under jaw was separated in this case, and in others which I have had an opportunity of observing. When the prey was completely ingulphed, the serpent lay for a few moments with his dislocated jaws still dropping with the mucus which had lubricated the parts, and at this time he looked quite sufficiently disgusting. He then stretched out his neck, and at the same moment the muscles seemed to push the prey further downwards. After a few efforts to replace the parts, *the jaws appeared much the same as they did previous to the monstrous repast."*

Headline from *New York Times*:
Raymond L. Ditmars Urges "Suppression" of Immoral "Ragtime"

Raymond J. Novotny sent this letter written by Raymond L. Ditmars to the editor of the *New York Times*, published on 13 October 1912. I wonder which song he was referring to as the term "Ragtime" was used for many songs, especially those by Scott Joplin. If Ragtime tunes were unsettling to Ditmars, I wonder what his response would be watching and listening to today's rock bands. This letter offers a glimpse into the character of the man.

To the Editor of the New York Times:

Coming into town in a smoking car a few nights ago, I listened to a very suggestive song rendered by a crowd of young rowdies. I thought little of the matter at the time, as the song appeared to be their own composition. Yesterday morning I was startled to hear two little girls on their way to school singing the chorus of this song. Inquiry at a cheap music store brought me the information that this composition was one of the latest "popular" songs. It follows in the wake of objectionable portrayals of marital infidelity, risque situations, and crude twistings of coarse phrases.

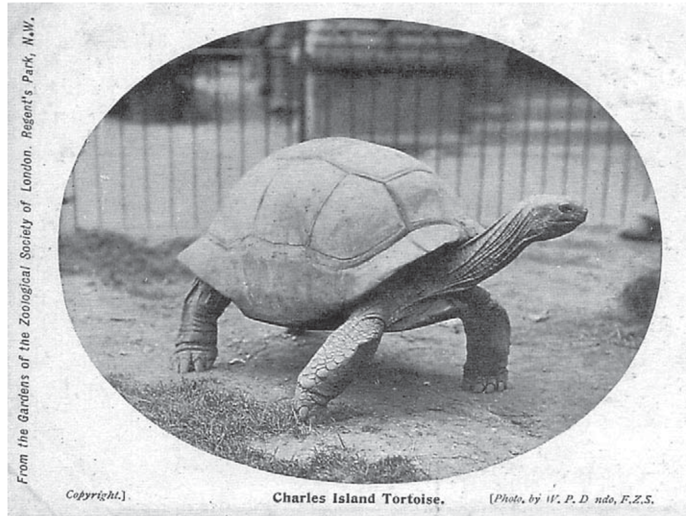
It seems remarkable to me that nothing is being done to stamp out the epidemic of these positively dangerous songs, the titles of which are now stock phrases around town, and all too common from the lips of children. There has been much ado about suppressing objectionable literature, cleansing the stage, even subjecting the motion picture playlets to a board of censorship. Yet songs that are clearly immoral are being issued with unabated energy—even sung by little girls on their way to school.

—RAYMOND L. DITMARS
New York, October 9, 1912

And Then There Was One

Whenever a book appears on the scene with a title like *The Last Tortoise: A Tale of Extinction in Our Lifetime* (2010, The Belknap Press of Harvard University Press, Cambridge, Massachusetts & London, England ISBN 978-0-674-04992-5) by Craig B. Stanford, it is clear that this will not be an uplifting read. In fact, tortoises are under siege worldwide, caused by a number of human-induced pressures, and Stanford covers all of these usual factors in depth: habitat alteration, collection for exotic animal pet trade, human food and medicine, climate change and so on. In Chapter 6 of the book called "Beloved Captives," he paints a grim picture of the future of these pet tortoises. One of the examples he gives is the discovery of several dozen Radiated Tortoises from Madagascar in a pet market in Thailand, probably illegally sent from the range country. A full review of this book appears elsewhere in this issue, prepared by John Moriarty.

Undated postcard of child riding a Galápagos Tortoise named "Grandpa" at New York Zoological Society. Zoos no longer offer tortoise "rides." Credit: provided by Brint Spencer.



Official postcard of Zoological Society of London depicting Charles Island [Santa María or Floreana] Tortoise (*Geochelone elephantopus*, now *Geochelone n. nigra*) at London Zoo from series of postcards available to the public in October 1904. This species is now extinct. Author Craig Stanford in his book *The Last Tortoise* describes how vulnerable tortoises are today, facing the real danger of disappearing from the planet for all time. Credit: photographed by W. P. Dando, provided by John Edwards.

Some years ago, the late John Behler from the Wildlife Conservation Society in New York called me after resurveying tortoise populations in Madagascar and discovering that hundreds, perhaps thousands, of Radiated Tortoises had been killed for their livers to make pâté for the Asian food market. Dead tortoises and empty shells were scattered throughout the habitat; virtually no living individuals were located and he characterized the locale as "The Tortoise Killing Fields." Poaching of the tortoises occurs throughout the year but predominantly in March. Populations of the other three indigenous tortoise species were near collapse as well. I asked Behler what the likely fate for these taxa would be in a decade or two in the wild and he said "They are doomed!" It seems as though he was right.

Endangered Iguanas

The Grand Cayman Blue Iguana (*Cyclura nubila lewisi*) was described in 1940 by Chapman Grant in *The Herpetology of the Cayman Islands* and was nearly extinct at that time. The lizard formerly was widely distributed in dry habitats over most of the island but is now restricted to a few remnant populations, a consequence of the introduction of feral animals, combined with habitat destruction and development. In 2002, the population

Green Iguanas (*Iguana iguana*) have been established on Cayman Island, posing a threat to the Blue Iguana. Illustration (top left) from Seba, Albertus. 1734–1765. *Locupletissimi rerum naturalium thesauri accurata descriptio, et iconibus artificiosissimis expressio, per universam physices historiam : Opus, cui, in hoc rerum genere, nullum par exstitit / / Ex toto terrarum orbe collegit, digessit, descripsit, et depingendum curavit Albertus Seba ...*

Imprint: Amstelaedami : Apud J. Wetstenium, & Gul. Smith, & Janssonio-Waesbergios.

crashed alarmingly, dropping to only 15–25 individuals.

Frederic J. Burton, a botanist formerly with the Caymans National Trust, began developing a captive population of iguanas in the Queen Elizabeth II Botanical Gardens on Grand Cayman in the early 1990s and expanded the program dramatically since that time. In those early days, Smithsonian National Zoological Park herpetological curator Dale Marcellini was instrumental in developing the program for radio-tracking these remarkable lizards and initiating a captive management program for reintroduction. In his lively and well-written book *The Little Blue Book. A Short History of the Grand Cayman Blue Iguana* (2010, The International Reptile Conservation Foundation, San Jose, California, ISBN 087-0-578-04308-1), Burton describes the massive challenges in radio-tracking the iguanas in the dry forest habitat favored by the lizards. To evaluate the eastern site, Burton and Quentin Bloxam from the Durrell Wildlife Conservation Trust arranged a field trip, hoping that iguanas would still be found; Bloxam nearly died in the effort (see Murphy, J. B. 2007. *Herpetological History of the Zoo and Aquarium World*. Krieger Publishing Co., Malabar, Florida). Burton and many dedicated colleagues have built a breeding and head-starting facility where iguanas have been bred and returned to the wild. This book chronicles the daunting obstacles and incredible flexibility needed to design and implement an *in situ* conservation project; every zoo person should read it before starting another one.

A zoo management plan has been formulated by Tandora Grant (Studbook Keeper & Population Manager, San Diego Zoo), Rick Hudson (Species Coordinator, Fort Worth Zoo), and Jamie Ivy (Advisor, San Diego Zoo); recommendations have been outlined in the recently published *Population and Breeding Plan. Grand Cayman Blue Iguana* Cyclura lewisi—*Rock Iguana* (Cyclura) *Species Survival Plan* on 30 October 2009.

The following article by Cathy Eser (Supervisor of Menagerie) and Ken Kawata (retired General Curator) describes the major renovation of the reptile and amphibian wing of the Staten Island Zoo in New York.

—James B. Murphy, Section Editor

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Renovation of the Reptile Wing at the Staten Island Zoo, New York

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At the bottom of the Great Depression in 1936, a small zoo opened in Staten Island, New York City (hereafter SIZ). Operated by the Staten Island Zoological Society on an eight-acre (3.2 hectare) Barrett Park, it presented a unique design of a one-building zoo in the shape of a large "T," consisting of an aquarium section behind the entrance and three "wings" exhibiting mammals, birds, and reptiles, respectively. The zoo established itself as a pioneer in education and in herpetology. The zoo was intimately tied to snakes from the beginning (Kawata 2003). In particular, thanks to the vision of legendary Carl Kauffeld (1911–1974; SIZ curator of reptiles 1936–1973, director 1963–1973) the zoo was globally known for its large rattlesnake collection, exhibiting several species for the first time in the United States and internationally (Kawata 2004). In addition to the large number of articles in popular journals, Kauffeld wrote two popular books, *Snakes: The Keeper and the Kept* (Doubleday & Company, 1969), *Snakes and Snake Hunting* (Hanover House, 1957), and co-authored a third with C. H. Curran, *Snakes and Their Ways* (Harper & Brothers, 1937); together, these books inspired a generation of young herpetologists. In 1977, the wing was officially dedicated to the memory of Kauffeld. By that time the focus and emphasis of the zoo world had changed fundamentally, and the zoo's exhibit style, consisting of rows of sterile cages, had become antiquated.

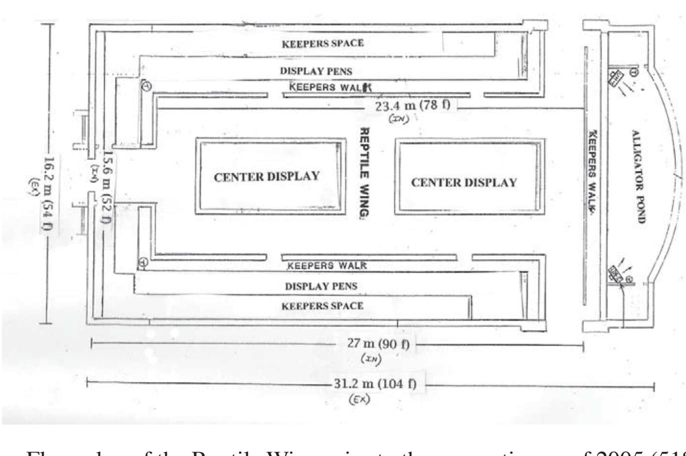
It was necessary to upgrade the entire structure to meet the challenges of our time. The massive renovation began first in 1986 to face-lift the aquarium area, followed by two of the wings, ending in 1997. The City of New York furnished the funds for the project through the Department of Design and Construction (DDC). That left the reptile wing the last of the wings to be renovated. Unlike the old mammal and bird wings that gave the impression of "naked cages" of metal and concrete, the reptile exhibits had still presented an amicable atmosphere. Yet, it could not erase the appearance of the aging glass-fronted boxes. As the news of the renovation plan spread, those who "cut their teeth" in zoo herpetology in the wing expressed their fond memories of the happy, bygone days; it was not merely an exhibit facility but also a classroom that nurtured many young enthusiasts. Robert

Zappalorti, a former SIZ staff member (currently the president of Herpetological Associates, Inc., in New Jersey), was one of them. "I guess modernizing the reptile wing means progress, which is a good thing, but on the other hand, there is so much history within the walls and cages of the old reptile wing," he noted, and wished that there were a recording device in the walls "that would have documented all the stories and conversations that were spoken over the years." (Zappalorti, pers. comm. 2005)

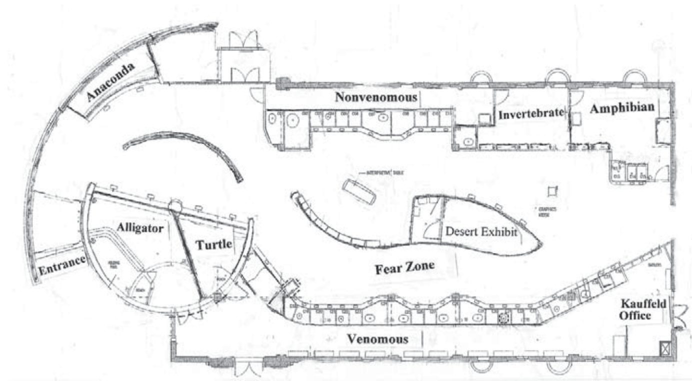
Early Planning Stage

A preliminary in-house review was made in 1999 to address the needs of SIZ with its unique history in education and reptiles. It was decided that, during the planning process, we should fully utilize expertise of the zoo staff who are intimately familiar with the needs of the visiting public, animal inhabitants, and daily husbandry procedures. At this juncture, an in-house committee was organized with representatives of administration, animal care, education, arts, as well as maintenance and grounds. It was the consensus of the group to invite well-experienced professionals from a prominent zoo to assist us in formulating an innovative plan. In the fall of 1999 David Jenkins and James Murphy of the Smithsonian National Zoo, Washington, D.C., were invited as consultants for concept development. The two men submitted a ten-page document in September, which established the foundation for the renovation project.

The document reminded the staff of the international recognition of SIZ generated by Carl Kauffeld. "It was certainly due to his writing skills that the reputation of the Staten Island Zoo was global," Jenkins and Murphy (1999) noted: "This history and positive reputation should be continued," and they recommended to develop Carl Kauffeld's memorial office in the new wing. Over the decades, education and exhibitry in zoos have improved markedly, they stated, but exhibitry involving reptiles and amphibians has not kept pace; it was time to develop an innovative design. As a central theme, "Use common fears as a psychological 'hook' as introduction: Confront fears and misconceptions and dispel them through science, beauty and art. Call the exhibit FEAR ZONE: A SNAKE ENCOUNTER. …An open and inviting atmosphere in the rest of the building should be light and airy." Also, "Create an exhibit of great expectations,



Floor plan of the Reptile Wing prior to the renovation as of 2005 (518 sq.m; 5.573 sq.f)



Floor plan of the Reptile Wing after the renovation as of 2007 (1,255 sq.m; 13,000 sq.f)

interaction, herpetological science," and "Develop a comfortable learning environment for both adults and children," they emphasized. In the process, they added, "Minimize excessive artificial structures and high maintenance equipment."

Once the course was established, the next step for SIZ was to select a general architectural firm. The senior staff decided to hire a local company instead of one of the out-of-state firms that specialize in zoo design; in our experience, the "specialist" designers do not necessarily meet the unique institutional needs. The zoo director was able to do this and hired the Manhattan-based architectural firm of Curtis + Ginsberg.

Design and Construction Process

Frequent progress meetings were held throughout the design and construction process with the DDC staff, architectural firm, general contractors, and members of the zoo's herpetology, maintenance, curatorial, and administrative staff. Internal meetings of the zoo staff included the graphics, education, curatorial, and herpetology departments.

The exhibit design was only one of the major aspects of the wing renovation project. There existed problems with the wear and tear of the seven-decade old facility such as a leaky ceiling, and compounding structural issues of the large auditorium located directly underneath the reptile wing. In that regard what started out as a renovation project became, in effect, a reconstruction project and general facility upgrade. The entire structure excluding the two original side walls was removed. All new HVAC, plumbing, and electrical network were installed along with a new electrical vault and generator.

General Layout

Because the location of the two side walls could not change, the remodeled wing had to retain the dimensions of the original along with an addition of a rotunda. This restriction involved creating a general layout of exhibits lining the two sides of the wing with only a portion of the center for exhibit space. (Yet, due to the added overall space we were able to increase the number of species and specimens of animals, and maintain a similar number of enclosures that we had prior to the renovation project, in addition to the new interpretive devices and exhibits.) It was decided to place inanimate interpretives on the opposite side of live animals to avoid competing exhibits, such as live animal cages facing each other. Due to the flexibility of "jewel box" type exhibits, "It's going to be the kind of exhibit where people will notice something new every time they come," said reptile keeper Cathy Eser (Platt 2007). An additional principle was to have the front lines of the exhibits and dividing walls form a gentle curve, where possible, to counteract the rigid and artificial appearance of a straight line and boxiness of the original structure.

The Rotunda

Another change is the traffic flow of visitors. It works better now that the formal entrance starts at the opposite end of the building from where it had been originally. The beginning of the exhibit would be excavated to include a rotunda that has a prominent introduction to the new wing. The same brick types that are on the surface of the other buildings help to blend the structure with the rest of the park. All construction projects by the City of New York require a portion of the funding to be designated for the Percent for Art Program. The result is a stylized bronze sculpture of a 9.6-m (32 ft) long Reticulated Python on the wall of the rotunda, coming in and out of the brick on the exterior of the building, designed by Steve Foust, a Staten Island artist.

The entrance to the wing has glass doors hung with a "Carl F. Kauffeld Hall of Reptiles" sign. Once inside the glass doors, a visitor is greeted with the following quote from Baba Dioum: "In the end, we will conserve only what we love, we will love only what we understand, we will understand only what we are taught." Next to the quote, a mural of a vernal pool was painted with native Staten Island species. Handouts are available with a key to the wildlife within the painting. A second painting by the same muralist depicting a cladogram may be found farther in the rotunda. An illuminated wooden ceiling with etched glass panels crowns the rotunda, adding to its beauty.

This area contains three large aquatic exhibits. Here, the animals can be viewed swimming in their naturalistic environments from above and below the water's surface. A 6-m (20 ft) high pane of glass is the only barrier separating the viewer from the animal. Each exhibit has its own in-line filtration and water heating elements. Because of the massive size of the rotunda, additional heaters are used to keep the ambient temperature warm enough for the animals and visitors during the cooler months. Water features in the two largest exhibits add to the serene ambiance of the rotunda. Alligators had been an all time favorite in the old wing, and were therefore chosen as one of the species for a larger exhibit. More specifically, the Chinese Alligator, *Alligator sinensis,* is featured and is part of a cooperative captive breeding program. A sandy beach area provides a nesting ground, and a holding area separated by a planter allows animals to be separated if aggression is observed. The other large exhibit was designed for aquatic turtles, so appropriate sand depths were chosen for that beach as well. The last exhibit houses anacondas but due to the live-bearing nature of the species, does not require a sandy beach area.

The large rotunda includes three of the largest exhibits, all of which are aquatic. Note the Chinese Alligator, *Alligator sinensis* exhibit that allows the visitor to view the animals from above and below the water or when basking on the beach area. (Photo by Cathy Eser)

The Fear Zone

The theme of the exhibits on the south side is the Fear Zone. While increased knowledge might prevent some people from being fearful of and indifferent to the fate of snakes, there is little evidence that instruction can help the truly phobic individual overcome their animal phobias (Burghardt et al. 2007). As discussed earlier, this novel approach was incorporated in the renovation plan (see Murphy and Chiszar 1989; Burghardt et al. 2007) to dispel the public's fear of snakes through a better understanding of the animals. The exhibits contain rows of mostly small "jewel box" cages consistent with the Kauffeld tradition. The majority of the exhibits contain venomous snakes and lizards with the exception of the large python exhibit in the beginning. It was believed by management that if the majority of venomous animals were housed in the same area, it would create a safer work environment for the keepers. In addition, the antivenom refrigerator could be kept in close proximity to the emergency snakebite station. Other safety features, such as alternating shift exhibits, allow keepers to move fast-moving elapids from one exhibit to another without having to be removed from the exhibit. The total number of "jewel box" exhibits is 22.

In the original wing the lights had to be accessed from within the cage, which meant the snake had to be removed whenever a light bulb needed to be changed. In the new design, the keeper has a separate access panel that opens for safe access to electrical units. An increased number of electrical outlets has led to improved husbandry practices. We are able to create more temperature gradients between exhibits by adding more basking lights, or to increase humidity by installing humidifiers and misting systems. The service areas behind the south side have also been considerably increased in size, giving the keeper more room to handle the dangerous animals housed in this section. This was a subject that former SIZ keeper Zappalorti (pers. comm., 2005) commented on: "I'm sure that the husbandry design will be more efficient and safe in the new wing, as the old keeper's alleys were much too narrow. I can't tell you how many times I was pinned against the wall, while a large hungry python, cobra, or rattlesnake struck at me." Each exhibit was installed with an alarm system including an intercom to reach the receptionist office, and would sound over the general PA system when activated. Other husbandry conveniences are permanent fiberglass pools and

The Fear Zone area begins with a giant snakes exhibit and continues with 22 "jewel box" exhibits containing venomous snakes and lizards. The push button interactive snake skull may also be seen in this photograph. (Photo by Cathy Eser)

radiant heat pads in alternating exhibits.

At the end of the Fear Zone a Carl Kauffeld memorial office was built. Historical artifacts such as hand-made tools including snake hooks, rippers, and scoops are displayed. His original desk, letter opener, documents, and art work were donated by various SIZ alumni or retrieved from other parts in the zoo and placed in the office. This is also an area to exhibit some of the smaller captive-bred animals in small tanks that would not be seen in a large exhibit. This office can be seen from inside of the wing as well as from the hallway that leads to other wings of the zoo.

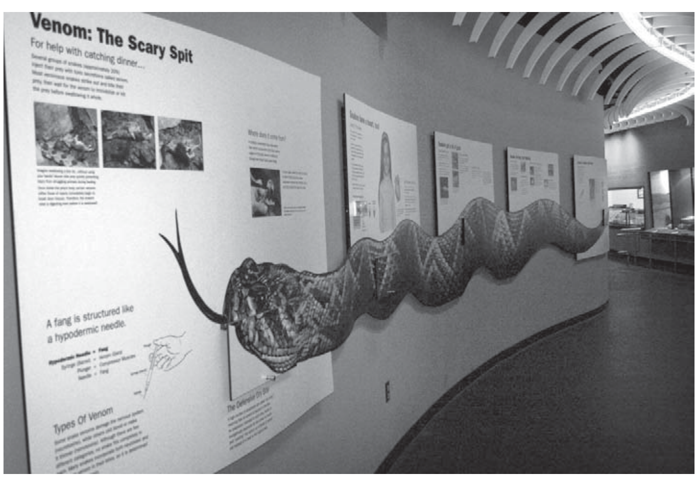
The graphics and interactive displays for the Fear Zone are numerous. To alert visitors that they are entering the area, there is a floor pad that activates the sound of a hissing snake when stepped on. Visitors are greeted with an illuminated snake skeleton that is suspended from the ceiling and runs the entire length of the Fear Zone. There is also a beautiful mosaic and panel showing cultural artwork of snakes. Next to the large snake exhibit, there is a functional replica of a viperid snake skull, activated by a push button. The exhibit was built by Peeling's Productions Inc. in Pennsylvania. There is also an informative panel that describes the methods by which snakes feed.

Across from the animal exhibits is a 7.5-m (25-ft) long Eastern Diamondback Rattlesnake graphic that contains various flip-up panels to allow the visitor to see inside of the snake. Some of these panels are activated when opened to make sounds, such as a snake's heartbeat and a rattlesnake rattle. Other flip-up panels show diagrams of the venom gland, heart, and a radiograph of a food item in the stomach. Many of the photographs were donated by SIZ alumni or taken by SIZ staff. Other flip-up panels include graphics located along the railing in front of the exhibits. Some of the topics covered are how many humans are harmed by automobiles or by non-reptilian venomous animals than are harmed by snakes. For example, one flip-up asks, "Still think snakes are the most dangerous animals around? Out of these, what is your guess?" There is a picture of a cobra, conesnail, and platypus. The answer is the conesnail.

Amphibian Area

Along the north side of the wing, an attempt was made to bring a more modern approach to the exhibits and types of species exhibited. Many people know of the global amphibian crisis, yet amphibians have historically been poorly represented in zoos. This is partly because they generally require more controlled environmental conditions than was made available in the old-styled exhibits. For this reason, a large area was allocated for an air-conditioned room with sufficient space for aquatic life support systems, water purification systems, food cultures and various other products needed for their care.

Two of the exhibits are large fish tanks that can house aquatic amphibians. The two species exhibited are Mexican Axolotls (*Ambystoma mexicanum*) and Mudpuppies (*Necturus maculosus*). The background of the tanks is covered to create a naturalistic appearance, and because of the delicate nature of amphibians we hired Petra Works, Inc. (New Jersey), a company that specializes in rockwork of amphibian exhibits. The filters in the tanks are polybead filters and a chiller cools the mudpuppy tank. A reverse osmosis unit feeds into a large reservoir and is hooked to a



A 7.5 m (25-foot) long Eastern Diamondback Rattlesnake graphic runs the entire length of the Fear Zone educating the visitor about snake anatomy, physiology and behavior. (Photo by Cathy Eser)

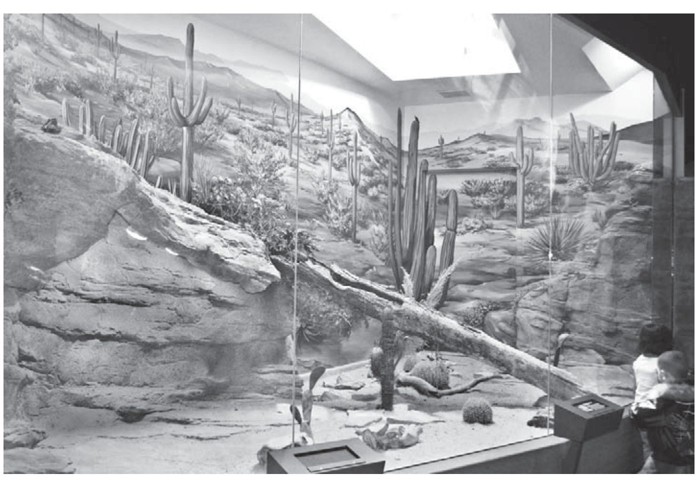
The amphibian and invertebrate exhibits add a diversity of new taxa that were not previously represented by the SIZ. The exhibits are modern in design and style. (Photo by Cathy Eser) pump and hose for water changes. Also, the water can be easily reconstituted with commercial products.

Two other exhibits are tall "jewel box" style that house various frog species. They are retrofitted with artificial rockwork that contains planters, so the exhibit could be lushly planted and the animals could be seen utilizing the various heights of the exhibit. They also have acrylic inserts with murals painted on them. The temperature and humidity can be adjusted by addition of lighting or humidifiers.

The last two exhibits in the amphibian room are custom-made modular units that were ordered from Waterdog Inc. (California). They were built with various ports so that water features could be added and with side and top access panels. In one of the exhibits is a Ridge-nosed Rattlesnake, *Crotalus willardi,* a mountain species that fares better in a cooler exhibit. This exhibit has a carved desert rockwork background done by Petraworks Inc. The second modular exhibit has a vernal pool background and holds Gray Tree-Frogs, *Hyla versicolor,* and Jefferson Salamanders, *Ambystoma jeffersonianum*. The design of the amphibian area and the adjacent invertebrate area was basically redone in the middle of the construction process due to the relative small size of the originally planned exhibits and the lack of graphics. The new plan incorporates a habitat and adaptations theme to coincide with the exhibit next to it. The topics that are covered are animals that live on mountains, in vernal pools, in trees, or underground. There is also a panel describing how invertebrates are responsible for creating certain types of habitat. Each panel also contains a conservation message called "Conservation Connection."

Invertebrate and Desert Exhibits

One of the objectives of the new exhibit was to have the potential to exhibit a broad range of species. That meant an area that adhered to containment specifications by the U.S. Department of Agriculture so that invertebrates could also be exhibited. The specifications included a second set of doors, separate air handlers, and responsible ways to decontaminate waste from the exhibits. Habitat graphics are matched with the animals on exhibit. Next to the graphic about fossorial animals, there are two exhibits that are 151-liter (40-gallon) fish tanks with plumbing hooked up to filters and chillers to house salamanders. These animals spend a majority of their lives underground near fresh springs. The exhibit that accompanies the graphic about arboreal animals houses Australian Walking Sticks, *Extatasoma tiaratum*.



There is a large center exhibit representing the Sonoran Desert fauna with naturalistic rockwork containing radiant heat and ultraviolet basking light bulbs. (Photo by Cathy Eser)

The keepers wanted to exhibit some species of social insects, which are generally very active and therefore visually interesting. We chose the Honey-Pot Ant, *Myrmecocystus mimicus*. This exhibit was designed and built by Work As Play Inc. (Arizona). The transport of the unit and the animals was a fun adventure for the keepers who drove them across the country from Arizona. The animals were the most delicate among the species housed in the wing, and eventually succumbed due to an infestation of mites that attacked the colony. They were not replaced and the exhibit now contains a Texas Patch-nosed Snake, *Salvadora grahamiae*.

The last exhibit in the invertebrate area housed another species of social insect, Pacific Dampwood Termites, *Zootermopsis angusticollis*. They also proved to be challenging to exhibit due to their fossorial nature.

A large, terrestrial exhibit features the Sonoran Desert, an arid region unfamiliar to the public in the eastern seaboard states. Due to the high ultraviolet light requirement of diurnal desert lizards, specific light bulbs are used in an outcropping of artificial rockwork that enables the animals to bask. Radiant heat is run under specific parts of the exhibit. The mural of the exhibit, depicting the arid habitat, was painted by the artist Amy Bartlett, and it represents the largest of her four mural projects in the wing.

Non-venomous Animals and Interpretive Area

There are still more reptile taxa on exhibit in addition to the snake-themed Fear Zone and the amphibian area. The turtles and lizards are represented in the remaining 12 exhibits of the north side of the wing. Some of the species on exhibit are Blue Tree Monitors, *Varanus macraei,* Wood Turtles *Glyptemys insculpta*, New Caledonia Gecko, *Rhacodactylus leachianus* and a Rhinoceros Iguana, *Cyclura cornuta*.

Across from those exhibits is an interpretive area where zoo volunteers can show live animals to the public. In part, this is a continuation of the Fear Zone where a visitor may encounter a volunteer holding a live snake. There is a table that volunteers use to set animals on that has a tabletop that is an educational tool and has footprints of different reptiles embedded in the resin. Inside of the table lies the shell of a Galapagos tortoise by the name of "Jalopy," who was well known in the 1980s for having the first recorded case of a malignant fibro-sarcoma in a reptile. Four display cases line the back of the interpretive area. The topics covered are shell differences, reptile and amphibian skulls and bones, radiotelemetry devices, and an archaeological dig about when early reptiles and amphibians began to evolve. A video monitor is also hung in this area.

A Timeline

SIZ has enjoyed a strong community support from its very beginning. Reflecting this tradition, what made the renovation project possible was the continuous efforts by elected officials, such as City Councilman (currently U.S. Congressman) Michael McMahon, for the allocation of city funds. However, due to the unforeseen financial situation of the city, the availability of the funds materialized later than expected. In order to mark the beginning of the project, a groundbreaking ceremony was held on 11 March 2005. At that time there were 45 exhibits in the original wing with 83 species of reptiles and 16 species of amphibians on the inventory, yet only four amphibian species were on exhibit. The large American alligators had been moved out by that time. The non-venomous reptiles were moved out of the wing on 14 March 2005 into holdings in the Animal Hospital, and the venomous reptiles were moved out of the wing on 23 March 2005 into the Animal Hospital as well. This left the Animal Hospital holding space filled to maximum capacity, with little space to quarantine new animals. Thus the acquisition and quarantine of new specimens had to be a carefully coordinated procedure over the next two years for the new exhibit opening. The last day that the wing was opened to the public was 27 March 2005. Demolition of the wing was started three days later.

The Carl F. Kauffeld House of Reptiles was opened by Michael Bloomberg, the Mayor of New York on 18 April 2007. At that date there were 127 reptile specimens in 66 species, and 97 amphibian specimens in 22 species with 12 of those species on exhibit. The $15 million project expanded the size of the wing to 1,255 square meters (13,000 square feet) which enabled us to increase the number of animals in the new wing.

After a "sneak preview" of the renovated wing, a local reporter observed that the refurbished wing "represents a renewal of Kauffeld's project and the institution's larger missions" and "Each section of the wing represents a feat of architecture and design -- a collaborative effort on the part of engineers, builders, artists, keepers and administrators—to create functional, educational and aesthetic exhibits that balance the needs of animals, Zoo workers and visitors." (Platt 2007) Likewise, zoo director John Caltabiano attributed the reconstruction to teamwork among city agencies, designers and zoo staff (Caltabiano et al. 2007). In terms of husbandry, 85% to 90% of the requirements suggested by the animal care staff, such as size of the service area, the microclimate control system, staff safety measures and utility needs materialized in the behind-the-scenes area.

Acknowledgments.—Without the concerted efforts by many individuals the Reptile Wing renovation project would not have been a successful endeavor. We would like to express our appreciation to Vincent Gattullo and John Caltabiano, the former directors of the Staten Island Zoo, for their support. Special thanks go to Amar Malla and Charles Orlando of the City of New York Department of Design and Construction; Darby Curtis, Partner, Curtis + Ginsberg LLP, Karen Mohlenbrok from Hill International, and former and current SIZ staff members (in alphabetical order) Frank Indiviglio, Bob Kurtz, Peter Laline, Matt Lanier, Jim McNiesh, Ellen Palm, Lisa Salmose, and Harry Strano.

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ARTICLES

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A Comparison of Carapace-Mounted and Body Cavity Implanted, Thermally-Sensitive Radio Transmitters with Implications for Thermoregulation in Free-Ranging Midland Painted Turtles (*Chrysemys picta marginata*)

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In ectotherms, the influence of environmental temperature (T_e) on body temperature (T_b), and resulting physiological processes (Peterson et al. 1993), makes thermal ecology essential to understanding energy acquisition and life histories (Congdon 1989). Investment in behavioral and physiological thermoregulation ranges from little or none (thermoconformity) to precise thermoregulation around a thermoregulatory set point (Christian et al. 2006; Hertz et al. 1993). Ultimately, the investment in thermoregulation is determined by the benefits of attaining T_b that is optimal for various physiological processes weighed against the costs of failing to invest in activities such as foraging or mate location (Blouin-Demers and Weatherhead 2001; Huey and Slatkin 1976). Freshwater turtles are ectotherms that thermoregulate within limits set by temporal variations in aquatic and atmospheric thermal environments (Spotila et al. 1990). In Painted Turtles (*Chrysemys picta*), for example, daily T_b cycling apparently results from behavioral and physiological modifications (Rowe and Dalgarn 2009). Edwards and Blouin-Demers (2007) concluded that field active *C. picta* are capable of at least moderate thermoregulation.

Because of the dynamic, cyclic nature of T_b in ectotherms, the study of T_b variation requires fairly constant acquisition of data points. In freshwater turtles, T_b variation is studied by surgical implantation of thermally-sensitive radio transmitters, or surface-mounted radio transmitters with thermal probes, coupled with remote data logging (Brown et al. 1990; Manning and Grigg 1997; Rowe and Dalgarn 2009), or by the surgical implantation of thermally-sensitive data loggers (Edwards and Blouin-Demers

2007; Plummer et al. 2005; Sajwaj and Lang 2000). However, surgical implantation of thermally-sensitive devices can require extended post-surgical recovery periods and runs the risk of adverse effects, particularly when individuals are relatively small. Alternatively, thermally-sensitive radio transmitters or data loggers can be mounted on the carapace and shell temperature (T_s) used as a proxy for T_b (Grayson and Dorcas 2004; Litzgus and Brooks 2000). However, T_s values presumably reflect not only thermal conduction from the shell, but also the influences of thermal radiation and water temperature directly on the radio transmitter. Therefore, T_s should reflect the temperatures of thermal patches selected by the turtle, including basking events (Grayson and Dorcas 2004; Plummer et al. 2005; Sajwaj and Lang 2000). Under variable controlled conditions, Grayson and Dorcas (2004) found that cloacal temperature of the relatively small-bodied Painted Turtle (*Chrysemys picta*) deviated from T_s by less than 1ºC and so T_s may be an acceptable estimator of T_b. In *C. picta* under field conditions, Edwards and Blouin-Demers (2007) found significant deviations of midday T_b from T_s under variable environmental temperatures. Similarly, Dubois et al. (2009) reported correlated midday T_b and T_s of free-ranging Wood Turtles (*Glyptemys insculpta*) but with T_s distributions that deviated from, and generally exceeded, T_b distributions. Apparently, thermal inertia associated with body mass buffers temperature changes of body cavity-implanted radio transmitters relative to carapace-mounted radio transmitters that are directly exposed to solar radiation and water and air temperatures. It could then be predicted that T_s values would be more extreme and variable than T_b values and, depending on the size of the turtle, the apparent initiation and duration of a thermoregulatory event (e.g. basking) could vary between T_b and T_s data sets.

We studied T_b and T_s variation in six free-ranging *Chrysemys picta marginata* at Miller's Marsh on Beaver Island, Michigan, using both body cavity-implanted and carapace-mounted radio transmitters. Miller's Marsh is a small north-temperate marsh system in northern Michigan that is subject to daily and seasonal fluctuations in water temperatures (Rowe 2003; Rowe and Dalgarn 2009). The two main goals of our study were the determination of: 1) how closely diurnal thermal events (e.g. basking) of the thermal profile are coupled temporally as measured as T_b vs. T_s, and 2) how, or if, T_b and T_s depart in value over time. To determine if the timing and durations of readily identifiable thermal events coincided over time as measured as T_b vs. T_s, we compared the initiation, termination, and duration of the pre-midday temperature decline and the midday temperature spike for T_b and T_s data. The pre-midday spike decline may represent movement through cool water, some physiological adjustment (Rowe and Dalgarn 2009), or evaporative cooling (Case 1972) at the initiation of some basking event. The midday spike may be a very important thermoregulatory event as it presumably represents aerial or aquatic basking (Grayson and Dorcas 2004; Plummer et al. 2005; Rowe and Dalgarn 2009). We expected that during the early morning hours, when solar energy would be minimal, mean hourly T_b and T_s values would closely coincide. During the late morning and afternoon, when available solar energy would be maximal, we expected that the initiations of the pre-midday spike temperature decline and the midday temperature spike would occur earlier in T_s data than in the T_b data. We had no *a priori* expectation for the durations of the pre-midday spike decline and midday spike. Due to thermal inertia associated with body mass, we anticipated that midday T_s values would exceed T_b values (Dubois et al. 2009; Edwards and Blouin-Demers 2007) and that T_s values would be more variable and extreme than T_b values.

Materials and methods.—We collected turtles in baited funnel traps or by hand beginning in early May 2006. We obtained carapace length (CL) and body mass (BM) and uniquely marked each individual. Eight individual turtles (4 F and 4 M) received both carapace-mounted and surgically implanted thermally sensitive radio transmitters (Advanced Telemetry Systems) that were calibrated together in a water bath (1–45°C). Radio transmitters (2.5 g) with whip antennae were adhered to the dorsal margins of the carapace using epoxy. Radio transmitters (2.8 g) with a coiled antenna were surgically implanted in the body cavities anterior to the left hind limb (Rowe and Dalgarn 2009). Turtles were allowed to recover for 4–5 days before returning them to the marsh. Of the original eight radio-tagged turtles, four females (mean CL ± SE = 151.5 ± 2.53 mm, min.–max. = 144–155 mm; mean BM = 411.3 ± 19.19 g, 355–440 g) and two males (mean CL = 136.5 ± 6.50 mm, 130–140 mm; mean BM = 276.0 ± 36.00 g, 310–240 g) were monitored throughout the summer months. One male moved beyond detection of our data-logging radio receiver early in the summer and the internal transmitter of another male failed soon after its release.

At a central location in the marsh, we placed a radio receiver (TR5, Telonics. Inc.) that was equipped with an omnidirectional antenna. We programmed the radio receiver to record pulse intervals (duration of time between pulses; mSec) for each turtle's radio transmitter every 15 min for a maximum of 96 observations per individual per day. Turtles were monitored between 10 May and 14 August for a total of 294 individual turtle observation days. We converted pulse interval values to T_b or T_s values for each individual using polynomial regression equations ($R^2 > 0.99$).

To determine whether T_b and T_s values obtained during readily identifiable thermal events coincided temporally, we manually recorded times (to the nearest 15 min, 0000 h = 0 min to 2345 h = 1425 min) at the initiation of the pre-midday spike temperature decline and of the midday temperature spike for each individual on each day. The average differences in time (min) between the initiation of basking for T_b and T_s and between the termination of basking for T_b and T_s were determined per individual and differences tested by Wilcoxon signed-rank tests.

We tested for differences in value between T_b and T_s overall and temporally in two ways. First, we examined residuals of T_b on T_s as plotted on T_s, as a predictor of T_b, and on each 15 min interval throughout the day. For the regression analysis, we determined mean values for each 15 min interval and then averaged them across individuals for both T_b and T_s. If T_s is a reasonable predictor of T_b, then residual plots should show an even distribution over values of T_s and over the course of the day. Second, we analyzed the difference between hourly T_b and T_s (T_b-T_s) by ANOVA with transmitter type (body cavity-implanted or carapace-mounted), hour-of-day (0000–2300 h), radio transmitter type x hour-of-day terms included as fixed effects. Hourly T_b-T_s values were averaged across 15 min intervals per hour (0000–0045 h, 0100–

0145 h, etc,) per individual, and then hourly values were averaged per individual over the entire study period. To assess relative variability of T_b vs. T_s, we calculated mean hourly coefficients of variation (CV x 100) for each variable (CV T_b and CV T_s) and for each individual over the summer and used ANOVA as described previously for analysis of T_b-T_s. Small sample size for males precluded the use of sex as a main effect. In both ANOVA models, we included turtle identification (ID) number and sex as random variables to account for autocorrelation and potential inter-sexual differences respectively. *Post-hoc* comparisons were made using least square means (LS means) multiple t-tests. Test statistics were considered significant at or below alpha = 0.05 unless otherwise specified.

Results.—For individual turtles, both T_s and T_b recorded at 15 min intervals showed diel cycling that included monotonic declines, pre-midday spike declines, midday spikes and oscillations, and late evening and early morning monotonic declines (Fig. 1A). Of the 190 total turtle observation days for which 96 observations per individual per day were obtained, well-defined midday spikes were observed on 70.0%, pre-midday spike declines occurred on 24.7%, and no discernable temperature cycling was observed on 5.3%.

The timing and durations of the pre-midday temperature spike decline and the midday temperature spike did not vary between data recorded by body cavity-implanted and carapace-mounted radio transmitters. For both T_b and T_s, pre-midday spike declines were initiated between 0500 and 1000 h (middle 50%: 0615–0815 h) and had durations of 118 ± 14.4 min (75–165 min, N = 6) and 122.2 ± 17.34 min (90–178 min, N = 6) respectively. Midday spikes were initiated between 0745 and 1530 h (middle 50%: 0945–1130 h for T_s and 1000–1145 h for T_b) and maximum values occurred between 0930 and 1815 h (middle 50% 1215–1430 h for T_s and 1230–1430 h for T_b). Mean durations of basking (time between initiation and peak of the mid-day spike) were 152.7 ± 9.50 min (118–181 min, N = 6) for T_b and 149.8 ± 9.30 min (124–178 min) for T_s. The initiations of the pre-midday spike decline and midday spike of T_s occurred slightly before those of T_b (8.3 ± 6.80 min, 0–16.4 min, N = 6, and 5.1 ± 4.11 in, 1.0–10.4 min, N = 6, respectively). However, Wilcoxon signed-rank tests of the timing of initiation and termination and of the durations of the pre-midday spike decline and midday spikes were not significant (P > 0.05 in all comparisons).

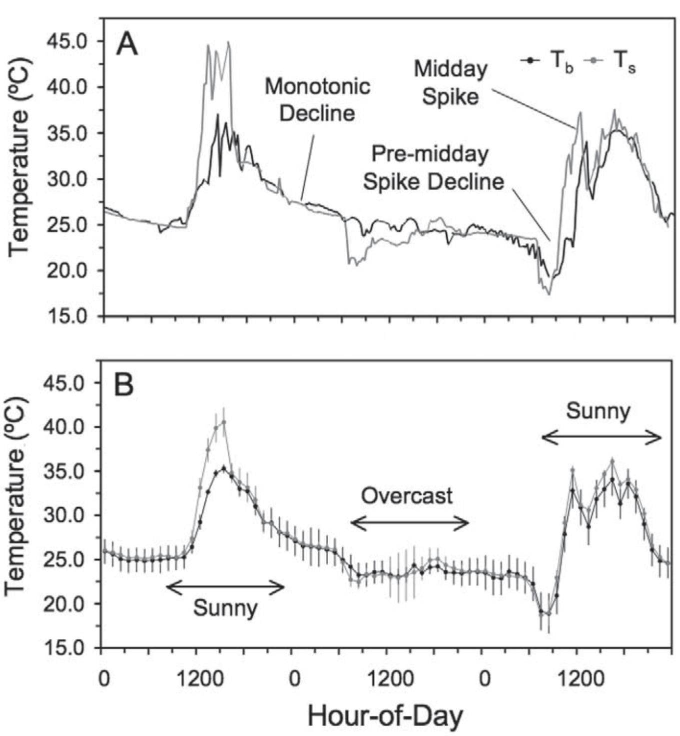

FIG. 1. A) Body temperature (T_b) and carapace surface temperature (T_s) measured in a single *Chrysemys picta marginata*, and B) mean T_b and T_s ± 1SE (vertical lines) measured at 15 min intervals in six individual *C. picta marginata* at Miller's Marsh, under variable weather conditions between 1 and 3 August, 2006.

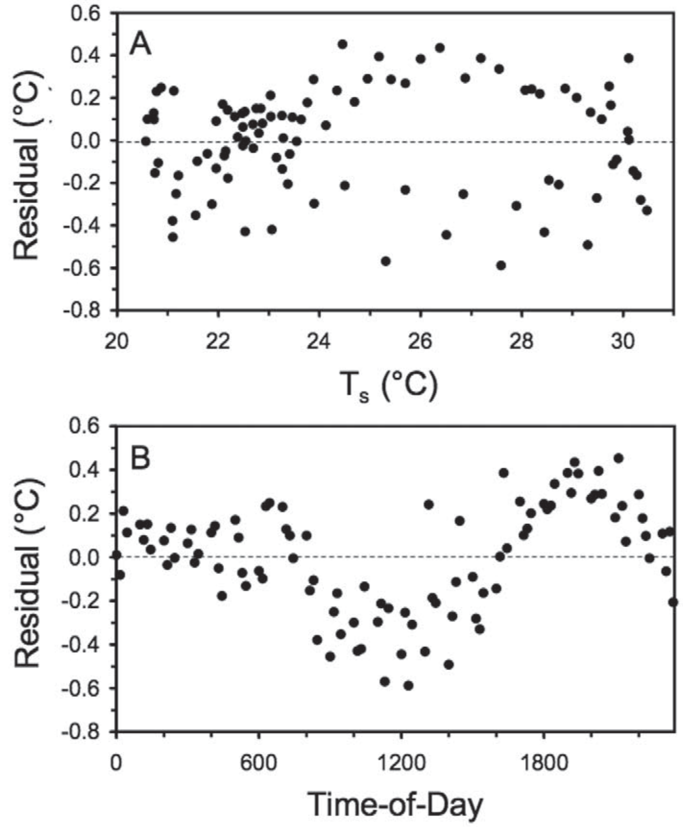

FIG. 2. Residual values from the regression of mean T_b on T_s (averaged per individual) plotted on A) T_s, and B) time-of-day at 15 min intervals in six *Chrysemys picta marginata*.

On sunny days, T_s increased more rapidly and attained higher maximal values, by as much as 10°C, than did T_b but such differences were not as pronounced on overcast and cool days (Fig. 1A). Averaged per individual, T_s and T_b values appeared largely concordant during most of the day but T_s exceeded T_b during the afternoon hours on sunny days (Fig. 1B). Mean minimum T_s and T_b values, averaged across individuals throughout the summer (N = 6), were roughly similar (mean minimum T_s = 11.8 ± 1.67°C versus mean minimum T_b = 12.5 ± 1.05°C) but mean maximum values were more dissimilar (mean maximum T_s = 44.6 ± 1.87°C vs. mean maximum T_b = 37.8 ± 0.24°C).

Overall, and on a diel basis, mean hourly T_s tended to exceed, and was more variable than, mean hourly T_b and the magnitude of difference was greatest during the afternoon. Averaged across all

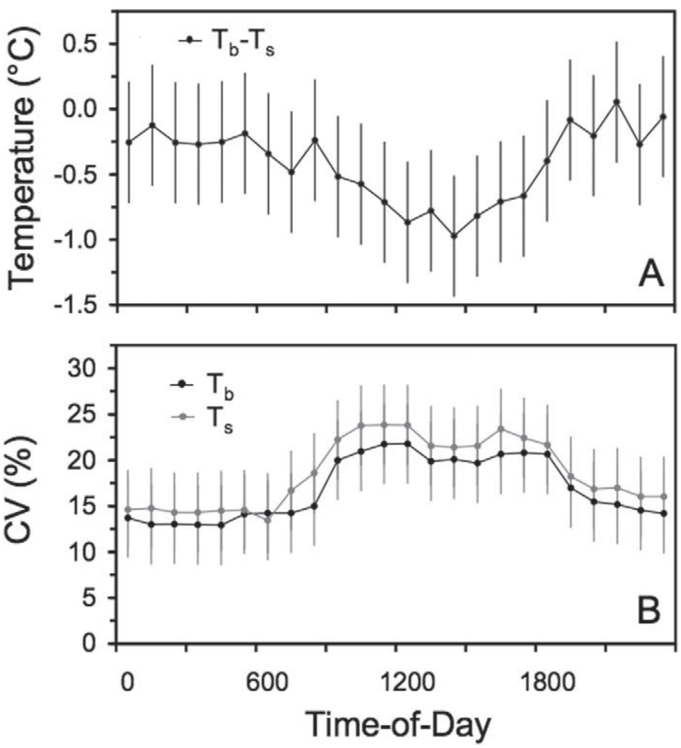

FIG. 3. A) LS mean (± 1 SE) hourly difference between T_s and T_b (T_s-T_b), and B) mean hourly coefficients of variation (CV) in six *Chrysemys picta marginata* at Miller's Marsh, 2006.

individuals at 15 min intervals, T_b regressed on T_s was significant and linear ($T_b = 1.60 + 0.94T_s$, $F_{1,94} = 13{,}687.7$, $P < 0.00001$, $R^2 = 0.99$). A residual plot indicated that observed T_b values tended to deviate from predicted T_b values as T_s values increased (Fig. 2A). Residuals plotted over the course of the day indicated that T_b values tended to be lower than predicted T_b values during the afternoon and exceeded predicted T_b values during early morning and late evening (Fig. 2B). In the ANOVA of the difference between T_b and T_s (T_b-T_s), hour-of-day as the main effect was significant ($F_{23,120} = 2.5$, $P = 0.0007$, $R^2 = 0.87$). The magnitude of difference was greatest between 1000–1700 h, lowest and near 0°C between 1900–2100 h, and intermediate during the early morning and late evening hours (Fig. 3A). Temperature variability, as measured by CV T_b and CV T_s, varied as a function of radio transmitter type ($F_{1,240} = 15.6$, $P = 0.0001$, $R^2 = 0.97$) and hour-of-day ($F_{23,240} = 157.7$, $P < 0.0001$), but the radio transmitter type x hour-of-day term was not significant ($F_{23,240} = 0.3$, $P > 0.05$). Overall, LS mean CV T_s (16.9 ± 5.67) was significantly more variable than LS mean CV T_b (15.3 ± 5.67). *Post hoc* comparisons indicated that, for both CV T_b and CV T_s, variability was relatively low between 0000–0600 h, increased sharply after 0600 h, attained maximal values between 1000–1800 h, and declined gradually during the late evening hours (Fig. 3B). Nonsignificant interaction terms in both ANOVA models indicated that the magnitude of differences between, and variability in, T_b and T_s remained approximately constant throughout the day (Fig 3A–B).

Discussion.—We tested whether T_s values, as recorded by carapace-mounted radio transmitters, accurately estimated T_b values that were recorded using body-cavity implanted radio transmitters in *Chrysemys picta*. On a daily basis, data from both types of transmitters oscillated in a similar way. As we expected, T_b and T_s values were similar during the early morning hours, when aquatic activity is reduced and when turtles were presumably submerged (Rowe 2003). That we detected pre-midday spike declines on the surface of the carapace in T_s data, which averaged over 2.5 h in duration, indicates either movement through cool water before basking or perhaps evaporative cooling at the initiation of aerial basking (Case 1972). Since evaporative cooling would be expected to occur each time that aerial basking was initiated, we suspect that the former explanation accounts for the pre-midday spike T_b decline. If, indeed, the midday spike represents an aerial basking event (Edwards and Blouin-Demers 2007; Plummer et al. 2005; Sajwaj and Lang 2000), the use of T_s as a proxy for T_b might be valid for determining the frequency, timing, and duration of basking events that occur during a specified time period (Grayson and Dorcas 2004). However, we suspect that with relatively large sample size and shorter time intervals between the acquisition of successive data points (<15 min), differences between T_b and T_s in the initiation of basking events could be detected.

We conclude that body cavity-implanted thermal data recording devices would be preferred for the estimation of T_b and the study of thermoregulatory precision in most species. Our T_s values were higher and more variable than T_b values, particularly when solar radiation levels were relatively high. Similarly, Edwards and Blouin-Demers (2007) found that when T_b values were relatively high, and exceeded instantaneously recorded T_s values, with the converse occurring when T_b values were relatively low. Because we detected T_s values greater than the thermal critical maximum for *Chrysemys picta* (41.5–42.3°C, Brattstrom 1965; Ernst 1972), carapace-mounted thermal data recording devices would not accurately estimate T_b at relatively high T_e. Yet, we found that mean T_b-T_s was maximal and less than 1°C during the afternoon hours and T_b and T_s values in *C. picta marginata* were far more concordant than in the relatively large-bodied *Emydoidea blandingii* (Sajwaj and Lang 2000). Therefore, T_s values might adequately estimate T_b in relatively small-bodied freshwater turtles or in juveniles whose relatively small bodies would respond more quickly to changes T_e than would those of adults.

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Geographic Variation in Philippine Mimicry System: Hypothesized Widespread Coral Snake (*Hemibungarus calligaster*) Mimicry by Lepidopteran Larvae (*Bracca* sp.) on Luzon Island, Philippines

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Aposematic Batesian mimicry of elapine coral snakes has been widely documented, with the most well-known and highly referenced phenomena occurring between the highly venomous coral snakes of the New World (*Leptomicrurus*, *Micruroides*, and *Micrurus*) and a number of relatively harmless colubrine snakes (e.g., *Lampropeltis triangulum* ssp.; Brodie 1993; Greene and McDiarmid 1981; Greene and McDiarmid 2005). Less common are similar cases of mimicry of the Old World coral snakes (*Hemibungarus*, *Calliophis*). A number of experimental studies have documented apparent increased fitness of relatively harmless species that, even to varying degrees, mimic the aposematic coloration of the highly venomous model species (Brodie 1993; Brodie and Janzen 1995). In such studies, correlations between the model species' abundance and the quality of mimicry indicate an underlying geographic variation in a given mimic's level of similarity to the model species (Harper and Pfennig 2007). Although this system of mimicry has been documented and studied with colubrine mimics, general Aposematic Batesian mimicry systems involving arthropods are much more common (Greene and McDiarmid 1981; Brodie and Moore 1995).

Brown (2006) reported a potential case of mimicry involving the larvae of a species of lepidopteran in the genus *Bracca* and the Philippine coral snake *Hemibungarus calligaster calligaster*. The larva possessed banding and color patterns highly similar to the coral snake where they are sympatric on two distinct mountain ranges of the Bicol Peninsula of southeast Luzon Island, Philippines (Fig. 1). Upon closer inspection of the *Hemibungarus* from the collection of Brown (2006), it is clear that the Bicol Peninsula subspecies is morphologically most similar to *H. c. mcclungi*, formerly believed to be endemic to Polillo Island (Leviton 1963). Brown (2006) questioned whether this example of mimicry was widespread across the Philippines, and whether morphological differences in banding patterns among subspecies of Philippine *H. calligaster* were mirrored in changes in banding pattern of sympatric lepidopteran larvae. In this note, we question the hypothesis of a widespread case of mimicry, report on additional observations of the sympatric association of *Bracca* and *Hemibungarus*, and compare banding and color patterns between two subspecies of *Hemibungarus* and the sympatric lepidopteran from Luzon Island, Philippines.

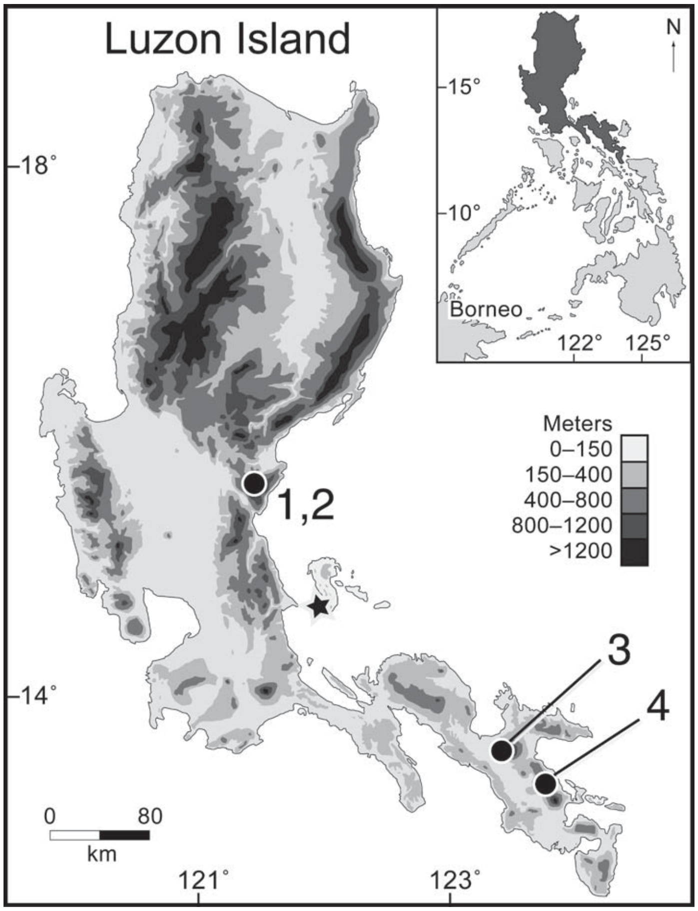

FIG. 1. Localities of observed occurrences of *Hemibungarus calligaster* cf. *mcclungi*, *H. c. calligaster*, *H. c. mcclungi*, and the lepidopteran larvae (genus *Bracca*) on Luzon Island, Philippines. Localities 1 and 2 represent sampling localities from this study, 3 and 4 represent sampling localities from Brown (2006), and the type locality of *H. c. mcclungi* marked with a star. The inset shows the location of Luzon Island (colored black) within the Philippines.

COLOR REPRODUCTION SUPPORTED BY THE THOMAS BEAUVAIS FUND

FIG. 2. (A) *Hemibungarus calligaster calligaster* (KU 323337) in life and unidentified species of *Bracca* moth larvae (RMB 10649, deposited in the KU teaching collection) in life. (B) *Hemibungarus calligaster* cf. *mcclungi* (TNHC 62483; Brown 2006) in life and unidentified species of *Bracca* moth larvae (not collected; Brown, 2006) in life. Arrows highlighting ventral banding differences between specimens collected by Brown (2006) and those from this study. Photographs by CDS and R. M. Brown.

Methods.—In June 2009 we conducted herpetological field surveys at two sites in Aurora Province, Luzon Island: Site 1, mid-elevation forest of Barangay Lipimiental, Municipality of San Luis (15.65366°N, 121.50734°E; WGS 84; Fig. 1); Site 2, mid-elevation forest of Mt. Dayap, Aurora Memorial National Park, local area "Siete," Barangay Villa Aurora, Municipality of Maria Aurora (15.680°N, 121.336°E; WGS 84; Fig. 1). Specimens were deposited in the Philippine National Museum and the University of Kansas Natural History Museum. We measured relative lengths of the color bands of *Bracca* larvae and *Hemibungarus* coral snakes from alcohol-preserved specimens using digital calipers to the nearest 0.1 mm and follow Brown (2006). Bands were measured from their anterior to posterior edges, with all measurements scored by LJW. The coral snake was keyed to species with reference to Leviton (1963), and genus-level identification of the lepidopteran larvae was provided by Brown (2006) and Holloway (1991, 1993).

Results and Discussion.—At Site 1, one individual of the coral snake, *H. c. calligaster* (KU 323337), and two *Bracca* sp. larvae were observed (one collected, deposited in the KU teaching collection). Both *Bracca* sp. larvae were observed suspended 0.5 meter above the ground from a thread of silk. The coral snake

Table 1. Summary of body and banding pattern measurements in *Hemibungarus calligaster calligaster* and *H. c.* cf. *mcclungi*, and the associated *Bracca* sp. from this study and Brown (2006). Sample size for each species and study are included for reference, and all measurements given as the range followed by mean ± standard deviation.

	Hemibungarus c. cf. *mcclungi* (N = 4; Brown 2006)	*Hemibungarus c. calligaster* (N = 2; this study)	*Bracca* sp. (N = 5; Brown 2006)	*Bracca* sp. (N = 1; this study)
Total body length	479–510 (498.5 ± 14.5)	525, 554	71–92 (78.8 ± 8.1)	56.2
Body width at midbody	9.0–17.0 (14.0 ± 0.2)	9.0, 9.1	7.0–11.0 (9.0 ± 0.2)	6
White annuli width	9.0–13.0 (11.0 ± 0.2)	2.8, 2.9	7.0–11.0 (9.0 ± 0.2)	1.5
Black band width	13.1–18.2 (15.8 ± 0.9)	6.6, 6.9	6.0–10.3 (7.5 ± 0.2)	5.9
Red band width	13.8–17.0 (15.8 ± 1.7)	10.7, 10.8	7.4–11.5 (9.2 ± 1.3)	5.1

was found under rocks near a stream. A second coral snake (KU 323337) was collected at Site 2 under rocks near a stream. No *Bracca* sp. larvae were observed at Site 2. When disturbed, both snake and caterpillar exhibited jerky movements, including body twisting and flipping, similar to the observations of Brown (2006).

Both subspecies of coral snake and the lepidopteran larvae possess brightly colored banding patterns (Fig. 2), as observed by Brown (2006). However, the order of colored bands and location of white annuli in the *Bracca* specimens most closely matches those of *H. c.* cf. *mcclungi* in the Bicol Peninsula of Luzon Island (Fig. 2B). In *H. c.* cf. *mcclungi*, the white annuli are clearly defined and divide the black bands into a pattern of black band-white annuli-black band. This pattern is bordered by red bands, and closely resembles the color and banding pattern of the lepidopteran larvae in the Bicol Peninsula as well as those observed in this study. In contrast, white annuli are absent or broken and indistinct ventrally with no division of black bands across the ventral surface in *H. c. calligaster* specimens from mainland Luzon (Fig. 2A). This results in the pattern of red and black bands separated by narrow or indistinct white annuli, dissimilar to the *Bracca* larvae and the Bicol Peninsula coral snake.

Other color patterns differences are also observed in *H. c. calligaster*, *H. c.* cf. *mcclungi*, and the *Bracca* sp. The lepidopteran larvae possess a greater number of black bands between red bands than either coral snake subspecies. Additionally, the red bands of the caterpillar encircle the entire body, whereas they are restricted to the ventral surface of the coral snakes. However, observed defensive movements of both snakes and caterpillars resulted in the flashing of the brightly colored red bands (Brown 2006; this study).

These observations suggest that a mismatch in color and pattern exists between the model (snake) and potential mimic (lepidopteran larvae) across their range of sympatry in the northern Philippines. While the lepidopteran larvae shares a general resemblance to both subspecies of *H. calligaster* on Luzon Island, its banding pattern is more similar to *H. c. mcclungi* than it is to *H. c. calligaster*. This may indicate that the model/mimic system evolved between a single subspecies of Philippine coral snake (*H. c. mcclungi*) and that the lepidopteran does not vary geographically in correspondence with separate subspecies of coral snake as was proposed as a possibility in Brown (2006). Despite the observed differences, the caterpillar's aposematic coloration may be similar enough to coral snakes on Luzon Island to reduce avian predation pressures. An innate prey avoidance behavior in the Bicol Peninsula may extend well past the range of close correspondence between the model and the mimic banding patterns.

Although experimental studies of coral snake mimicry have been successfully conducted (e.g., Brodie 1993; Brodie and Janzen 1995; Brodie and Moore 1995), no experimental confirmation of a model/mimic system has been made for these two species. The sympatric occurrence and striking morphological similarity between snakes and caterpillars seems to be restricted to the Bicol Peninsula of Luzon Island (Fig. 1). If the color pattern is in fact reducing avian predation on the caterpillar, it would be interesting to experimentally determine how quickly the learned avoidance behavior dissipates as geographic distance increases from regions of sympatry. Assuming the close resemblance of caterpillar to *H. c. mcclungi* is a case of mimicry, toxicity analysis should be conducted to determine whether *Bracca* sp. larvae are toxic, or if the caterpillar is a palatable mimic. It remains unknown whether a species of *Bracca* sharing similar color patterns co-occurs with the other Philippine coral snake subspecies, *H. c. gemiannulis* from Cebu, Negros, and Panay Island (Brown 2006; Leviton 1963).

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Australian Freshwater Crocodile (*Crocodylus johnstoni*) Attacks on Humans

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Both *Crocodylus johnstoni* (Australian Freshwater Crocodile) and *C. porosus* (Australian Saltwater or Estuarine Crocodile) occur in northern Australia. *Crocodylus porosus* is accepted as being dangerous, known to attack humans and responsible for at least 25 fatalities in Australia between 1971 and 2009 (Caldicott et al. 2005; C. Manolis, pers. comm.). *Crocodylus johnstoni*, on the other hand, is widely considered harmless to humans (e.g., Crocodile Specialist Group 2008; Webb and Manolis 2007). There are no recorded human fatalities from *C. johnstoni* (C. Manolis, pers. comm.) and locals frequently swim with this species, believing that it does not bite people (pers. obs.). Although it is acknowledged that *C. johnstoni* is capable of inflicting injury, both local people and experts are reluctant to believe they attack humans (Anonymous 2006; Caldicott et al. 2005; Crocodile Specialist Group 2008).

In September 2008, two *Crocodylus johnstoni* attacked one of the authors (KNH) in the Throssell River of the Kimberley Region of Western Australia in the presence of the second author (AS). This experience provides evidence contrary to the prevailing opinion that this species is harmless to humans. We have found additional accounts of *C. johnstoni* attacks on humans in northern Australia, but the difficulty we had in acquiring this information suggests that the widespread belief that *C. johnstoni* is harmless may in part be perpetuated by a lack of reporting, reluctance to lend credence to such accounts, and consequently a lack of media attention. These factors impede a full understanding of this species' behavior and jeopardize public safety. We discuss these issues further using our case study and compiled accounts of additional *C. johnstoni* attacks on humans in northern Australia.

Methods.—We compiled accounts of *C. johnstoni* attacks that were reported in northern Australia. Accounts were gathered between September 2008 and June 2010 from personal narratives brought to our attention, scientific literature, the internet (primarily online newspapers), and the Crocodile Attack Database (CAD) that was begun in 1971 and is maintained by Wildlife Management International in Darwin, Northern Territory of Australia (C. Manolis, pers. comm.). We included accounts where the attacking species was clearly identified as *C. johnstoni* and where there was no obvious human harassment of the animal prior to attack.

Results.—In addition to our encounter involving two *C. johnstoni*, we recorded ten other accounts of *C. johnstoni* attacks on humans in northern Australia between 1971 and 2009 (Table 1). This total is likely an underestimate given that three of the attack accounts were collected through chance personal communications (two relayed to the authors and one acquired by C. Manolis second hand [C. Manolis, pers. comm.]) and another two through personal experience, meaning that nearly half of the accounts were collected opportunistically rather than being available in the scientific literature or from news sources.

There was an average of 0.3 *C. johnstoni* attacks on humans reported annually in northern Australia between 1971 and 2009 (Table 1). The first reported attack was in 1988 and the annual number of reported attacks increased to 0.9 between 2000 and 2009. In all cases, the victims were engaged in water activities—swimming, treading water, or floating in an inner tube or on an inflatable mat—at the time of attack. Where gender of the victims was known, numbers were evenly divided between males and females. Crocodile size was estimated in five of the accounts and attacking crocodiles were reported as 1–2 m total length, with 2 m crocodiles being reported as responsible for three of those attacks. Attacks ranged from a quick bite and release to varying degrees of biting persistence until the victim escaped or resisted further bites. Most injuries were restricted to puncture wounds or cuts made directly by the teeth.

Case Study

The authors' *C. johnstoni* attacks occurred on 17 September 2008, along a remote section of the Throssell River in the Kimberley Region of Western Australia (17.43°S, 126.05°E). September is the dry season and the river was divided into a series of water holes. There was a high density of *C. johnstoni* along the river, but the water hole where the attack occurred had no visible individuals on the bank or at the surface of the water. The water hole was ca. 100 m x 20 m and contained deep, murky water. The bank was steep on both sides with boulders on one end of the river bed and a shallow bank adjoining the river bed on the other end. There was dense vegetation and a steep bank along the side of the hole where the authors entered the water.

Around noon KNH entered the water with a splash and was

FIG. 1. Hand and arm wounds from *Crocodylus johnstoni* less than an hour after attack.

followed about a minute later by AS. Moments after the second splash, KNH headed toward the bank along her previously clear path. She swam into the broadside of a crocodile. She stopped momentarily, then proceeded slightly to the left of her previous path. The crocodile circled and approached KNH from her right side, attacking at a sideways angle from the front and biting her left knee. KNH tried unsuccessfully to pull the jaws off her knee with both of her hands. KNH released the jaw to reach for an assisting hand offered by AS and the crocodile attempted a death roll. KNH successfully resisted and kept her head above water. KNH returned to the bank with the crocodile where both authors identified the species as *C. johnstoni* when the head was lifted out of the water and as being 2 m long (total length). AS gouged one of the *C. johnstoni*'s eyes until it released the knee.

Before KNH exited the water, a second crocodile bit her right arm. KNH freed herself by thrusting her arm down forcefully while twisting it to one side. This crocodile was ~1 m long and was identified as *C. johnstoni* based on shape and size of the teeth puncture wounds. Identification of the second crocodile was further supported by the abundance of this species along the river and no evidence suggesting the presence of *C. porosus*, which local people (pers. comm.) insisted do not occur in the area.

Combined injuries from the two attacks included puncture wounds on both hands and the right arm (Fig. 1), and around the left knee (Fig. 2). The left knee also sustained soft tissue damage including a small meniscus tear, sprains, and strains.

Discussion.—For many years, much attention has been focused on understanding and preventing *C. porosus* attacks on humans (e.g., Caldicott et al. 2005, Crocodile Specialist Group 2008, Gruen 2009). Little attention has been paid to the dangers of *C. johnstoni*, no doubt because of the prevailing notion that this species is harmless (e.g., Crocodile Specialist Group 2008; Webb and Manolis 2007). To the contrary, our case study, backed up by other reports we have gathered, indicates that *C. johnstoni* are capable of attack resulting in serious injury.

FIG. 2. Leg wounds from *Crocodylus johnstoni* five days after attack.

Table 1. Compiled accounts of *Crocodylus johnstoni* attacks on humans in northern Australia, 1971–2009.

Year	Month	Location	Estimated Crocodile Size	Victim Activity Prior to Attack	Resulting Injury	Victim Gender	Source
1988	N/A	Twin Falls, Kakadu National Park, Northern Territory	N/A	Floating on inflatable mat	N/A	N/A	CAD[1,2]
1990	N/A	Twin Falls, Kakadu National Park, Northern Territory	N/A	Floating on inflatable mat	N/A	N/A	CAD[1,2]
2003	September	Barramundi Gorge, Kakadu National Park, Northern Territory	1.5 m	Swimming	Puncture wounds on chest; cuts on hand	Male	ABC 2003
2006	April	Katherine River, Northern Territory	2.0 m	Swimming	Puncture wounds on back and arm	Male	Anon., 2006; CAD[1]
2007	January	Ivanhoe Crossing, Kimberley, Western Australia	2.0 m	Swimming	11 stitches on arm; four stitches on neck	Male	ABC 2007
2008	N/A	Kununurra, Western Australia	N/A	Swimming	Punctures wounds on arms	Female	CAD[1]
2008	September	Throssell River, Mt House, Western Australia	2.0 m	Treading water See case study.	Puncture wounds and soft tissue damage to knee. See case study.	Female	Authors, pers. obs.
2008	September	Throssell River, Mt House, Western Australia	1.0 m	Treading water See case study.	Puncture wounds on hand and arm. See case study.	Female	Authors, pers. obs.
2009	April	Adcock River, Mornington Wildlife Sanctuary, Western Australia	N/A	Floating in rubber tube with legs in water	Puncture wounds on leg	Male	Victim, pers. comm.
2009	April	Lake Argyle, Western Australia	N/A	Swimming	40 stitches on left arm and chest	Male	Australian Reptile Forum 2009
N/A	N/A	Adcock River, Mt House, Western Australia	N/A	Swimming	Puncture wounds on forearm	Female	Victim, pers. comm.
N/A	N/A	Edith Falls, Northern Territory	N/A	Floating on air mattress	Puncture wounds	Female	Amazing Australia 2009

[1]CAD = Crocodile Attack Database.
[2]We incorporate these accounts of *C. johnstoni* attacks into our analysis because they are included in the CAD and are cited by Anonymous (2006), Caldicott et al. (2005), and Crocodile Specialist Group (2008). The original source for these accounts is Lindner (2004), but this reference does not explicitly state that attacks occurred but rather that nuisance *C. johnstoni* were removed from this site.

Available data indicate that *C. johnstoni* attacks are not as common, nor usually as severe, as *C. porosus* attacks. From 1971 to 2009 there has been an average of 0.3 reported accounts of *C. johnstoni* attacks on humans per year compared to 1.95 average accounts reported per year for *C. porosus* (C. Manolis, pers. comm.). There are no known cases of human fatality from *C. johnstoni* compared to 25 recorded cases from *C. porosus* between 1971 and 2009 (C. Manolis, pers. comm.). Nevertheless, given the apparently limited reportage, acceptance, and recording of *C. johnstoni* attack accounts, one must wonder how many other attacks have occurred and are not known. In our data set there is a suggestion of an increase in the number of *C. johnstoni* attacks on humans in the last decade. This may indicate an actual rise in the number of attacks, but may also reflect easier access to more recent attack accounts.

Our analysis of available information suggests that improved data collection and access to that data is needed if information on *C. johnstoni* attacks are to be available and useful for both understanding this species' biology and for informing public safety. The IUCN Crocodile Specialist Group's recommended repository for crocodile attack information in Australia is Wildlife Management International's Crocodile Attack Database (CAD). Given that only a third of the attacks compiled here were also in the CAD, this resource appears to be severely underutilized with respect to *C. johnstoni*. While not an unusual situation for data bases of this sort (Fergusson 2002), it remains troubling. One problem is that the data base is not easy to find. Google searches using reasonable search criteria are unable to find a match within the first ten pages of search results. In addition, there is no online data sheet for easy submission and data contained within the CAD are not readily available online.

Equally critical is the encouragement of reporting in the first place. Our experience and findings suggest that *C. johnstoni* attacks deserve more initial credibility and reportage of their details needs to be encouraged. Whether there has been an actual increase in the number of *C. johnstoni* attacks in the last decade or not, the threat of more attacks in the future is real. The numbers of people visiting remote areas continues to rise as improved technology and infrastructure make more challenging locations increasingly accessible. Since *C. johnstoni* have been observed to be less wary of humans and more prone to aggressive displays in areas where they are not regularly exposed to humans (Webb 1985), increased visitation to remote areas could increase the number of attacks. Attacks may become more frequent across this species' range regardless of remoteness as human populations rise, increasing the probability of negative encounters. Clearly outlined safety guidelines exist for *C. porosus* (e.g., Queensland Government 2008). Similar guidelines should be developed and publicized for *C. johnstoni*. However, little is definitively understood in order to undertake such a task. Improved data will be needed to assess the triggers for *C. johnstoni* attack. The only clear evaluations from the data set compiled here is that all victims were in the water at the time of attack and there is no apparent gender bias. It appears that larger *C. johnstoni* are more prone to attack and that attacks are more likely to occur in April or September, but these conclusions are not much more than indicative. Standardized data collection is necessary to limit gaps in the data set and to ensure that the data being collected are useful for understanding *C. johnstoni* attack triggers.

We emphasize the importance of documenting all *C. johnstoni* attacks in a standardized, easily accessible format. Acquiring such data will require an educational campaign to alter the perception that *C. johnstoni* are harmless, to one of recognizing their potential to attack and the need to report such incidents. Future research should pay discerning attention to the details of each recorded attack to increase our understanding of *C. johnstoni* attack triggers. This information is essential to understanding the biology of *C. johnstoni*, improving its conservation and management and, as we have shown in this paper, human safety.

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Kälin's 12-12 as an Indicator of Size in Crocodylia

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The search for the biggest crocodile is a frequent endeavor not only for spectacle but also for the sake of science and evolutionary studies (Whitaker and Whitaker 2008). Crocodile skulls are more often than not the only preserved element of the skeleton. Since crocodile skulls grow in allometry with body size, they are frequently used as a proxy for physical size of a specimen (Greer 1974; Woodward et al. 1995). However, there is often confusion over the best location for determining size (Ross and Pearcy 2009). This article reexamines and suggests Kälin's 12-12 (Kälin 1933) as a best predictor of skull size in crocodilians and possibly an accurate and easily identifiable proxy for body size in crocodilians.

Previously, total skull length has been considered the independent variable indicating size (Radinsky 1981; Simpson et al. 1960). There has been debate on this assumption as width at the back of the jaw has also proven to vary considerably (Monteiro and Soares 1997). Most commonly used has been the ratio between the two aforementioned measurements (Busbey 1995; Verdade 2000).

These commonly used measurements, however, are often susceptible to notable variation within the ontogenetic process and change outside of this process. For example, hatchling skull shape, specifically in the rostrum, is different from that of the adult of the same species (Dodson 1975; Hall and Portier 1994; Verdade 2000). Outside of the ontogenetic process more problems tend to occur. Depending on physical environmental conditions and stress factors, skull shape as described by total length and total width can vary dramatically, as commonly seen in captive populations (Hutton 1987). Growth can be extremely variable within species (Hall and Portier 1994; Hutton 1987). This variability can be especially noted when comparing healthy vs. unhealthy and captive vs. wild specimens (Black and Loveridge 1975; Coulson et al. 1973; Joanen and McNease 1974; Whitaker and Whitaker 1977). While traditional measurements of total length and total width can be informative of how large an individual is, the disparity between size of individuals, caused by ontogenetic factors, and average size of the species can reduce application among comparative morphometric studies.

Based on a large dataset, I identify the most applicable and least variable indicator of skull size within and across species. Furthermore, I discuss this measurement as an applicable indicator of body size based on the criteria derived from a number of sources (Hall and Portier 1994; McIntosh 1955; Pierce et al. 2008; Verdade 2000): 1) low variability within species; 2) correlation with body size; 3) functional importance; and 4) repeatability.

Methods

Measurements were made from the jaw line at the center of the post-orbital bar across the head to the opposite jaw line at the same point (Fig. 1c,d; Kälin 12-12). On skin-covered specimens this area is identified as the space between the earflap and the back of the eye. The distance from midline at this width (Fig. 1g) to the tip of the snout (Fig. 1a) is Kälin's 12-3.

Only one traditional width measurement, cranial width (CW), was examined. That is the width of the jaw at Kälin 1 (1933) as defined by the widest point on the quadrojugal bone (Fig. 1:e,f). Total length of skull (TSL) is from the back of the cranial ridge (Fig. 1b) along the midline to the tip of the snout (Kälin's 6-3) (Fig. 1a). All measurements were taken in centimeters.

Data were collected from museum specimens (N = 152) of all 23 species of extant crocodilians. From these specimens, the four aforementioned measurements were taken. Juveniles and noticeably deformed specimens were not used if possible. A separate data set was used, where whole specimens, not only skulls, were examined for comparison of measurements to the total body. These measurements of total body length (TBL) and snout-vent length (SVL) were collected on 21 wild *Osteolaemus tetraspis* by a crocodile expedition throughout central Africa (Zoer 2010). A rope was used to take the measurement on the crocodile and then measured along a tape measure. TBL was taken on the dorsal surface, while SVL was measured along the ventral surface.

By using Pearson correlation analyses the Kälin 12 measurements were compared to traditional measurements using SPSS 16.0. One-way ANOVA's were run to test for the difference between ratios. Standard deviations and t-tests (Dinov 2005) were then calculated within each measurement type for each species in Microsoft Excel 2008. A principal components analysis was used to better define the difference between the Kälin 12 ratio and the

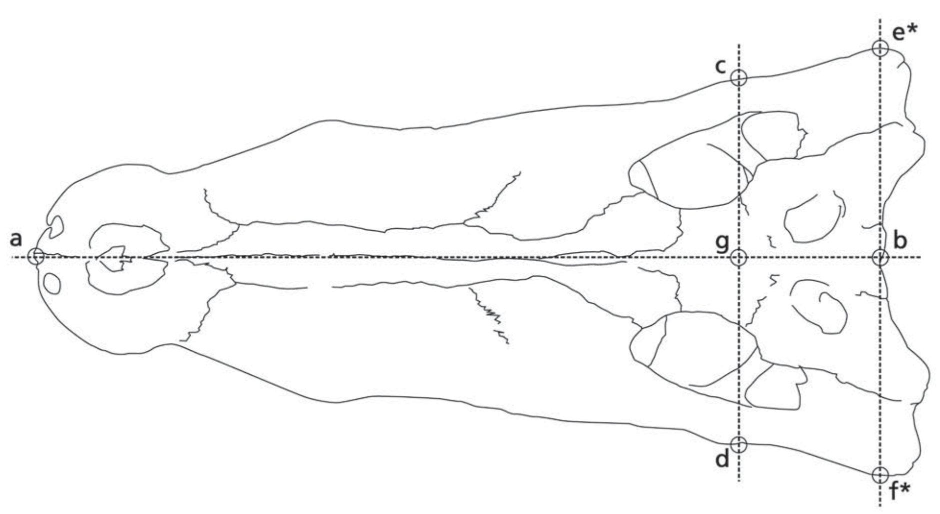

Fig. 1. Measurements taken from crocodilian skulls; a–b: total skull length, c–d: Kälin 12-12, e–f: total width of skull, a–g: Kälin 12-3. Asterisks mark traditional measurement.

traditional ratio as they relate to species differentiation.

Results

Correlation analyses of total length (TSL) and total width (CW), and TSL and Kälin 12-12 for all species show positive correlations between the Kälin 12 measurement ratio (R = 0.875) and the traditional measurement ratio (R = 0.908). The ratio of CW to TSL did not differ significantly from the ratio of Kälin 12-12 to Kälin 12-3 (ANOVA: F = 0.54, df = 1, p = 0.46).

Standard deviations for each measurement within each species (Table 1) were lower for Kälin 12 measurements than for traditional measurements. Kälin12-12 was significantly less than CW (t = -5.1, df = 20, p < 0.001) and Kälin 12-3 was significantly less than TSL (t = -4.320, df = 20, p < 0.001).

A principal components analysis of the Kälin 12 ratio and the traditional ratio found that 97.34% of the variation was accounted for in principal component 1. Case loadings show that PC1 was driven by the Kälin 12 ratio (0.82) rather than the traditional ratio (0.58) to separate by species.

Data from 21 *Osteolaemus tetraspis* revealed the standard deviation of the ratio of Kälin 12-12 to total body length (0.175) was lower than the standard deviation of the ratio of CW to body length (0.192). Within the same dataset, the standard deviation of width at Kälin 12 to snout-to-vent length (SVL) to (0.0138) was lower than that of cranial width to SVL (0.282). A correlation analysis showed slightly higher correlation between SVL and Kälin 12-12 (R = 0.977) than between SVL and CW (R = 0.958).

Discussion

The Kälin 12-12 and 12-3 measurements are a better indicator of skull size than cranial width and total skull length measurements. Through the PCA, the Kälin 12 measurement ratio is noted as a stronger driving force than the traditional ratio for species division. Four criteria were used to further investigate the usability of the Kälin 12 measurements as a measurement of skull and body size, finding it to be of value over the other measurements.

Low variability.—The best size measurement is the least variable one (McIntosh 1955). The Kälin 12-12 measurements had a lower standard deviation within species than did the measurements of total width and total length. The lower deviations within species support the hypothesis that the Kälin 12-12 and Kälin 12-3 measurements are less susceptible to growth outside of the ontogenetic process and exhibit less variation than other methods.

Kälin 12-12 also occurs in an area, near the orbits, of reduced allometric growth coefficient (Verdade 2000; Wu et al. 2006), which means that the growth rate of this area is reduced compared to snout length and width at the back of the jaw, which accounts for the lower deviation. The reduced growth of this portion of the

Table 1. Sample size, size range, and standard deviations within measurements by species.

			Standard deviations			
Species	N	Range CW (cm)	Kälin 12-12	CW	Kälin 12-3	TSL
Alligator mississippiensis	13	16.10–30.28	3.67	5.04	6.48	7.31
Alligator sinensis	4	9.60–15.10	2.24	2.33	3.02	3.61
Caiman crocodilus	12	12.37–16.55	0.99	1.21	2.03	2.19
Caiman latirostris	9	12.30–23.65	3.47	4.57	3.22	3.85
Caiman yacare	6	13.50–19.70	2.14	2.56	2.46	3.21
Crocodylus acutus	3	19.90–35.72	5.93	8.26	14.16	15.63
Crocodylus cataphractus	8	20.07–26.86	2.05	2.31	4.36	4.76
Crocodylus intermedius	9	20.00–35.50	4.44	5.75	8.73	10.08
Crocodylus johnsoni	2	12.20–14.10	0.99	1.34	2.26	2.69
Crocodylus mindorensis	1	–	–	–	–	–
Crocodylus moreletii	2	13.08–27.40	–	–	–	–
Crocodylus niloticus	17	20.90–37.40	5.15	6.41	9.11	10.47
Crocodylus novaeguineae	3	14.00–22.10	3.08	4.06	4.85	5.78
Crocodylus palustris	7	15.60–34.84	5.09	6.99	8.39	14.4
Crocodylus porosus	12	28.50–43.94	5.08	5.98	5.63	6.27
Crocodylus rhombifer	3	10.69–23.70	5.50	6.87	4.97	7.52
Crocodylus siamensis	2	15.22–23.10	4.26	5.57	7.89	9.89
Gavialis gangeticus	7	20.35–29.55	3.69	3.66	7.54	7.57
Melanosuchus niger	8	18.80–33.91	4.23	5.56	6.46	7.56
Osteolaemis tetraspis	10	8.50–11.28	0.75	0.92	0.92	1.23
Paleosuchus palpebrosus	3	9.70–15.49	2.25	3.00	3.65	4.69
Paleosuchus trigonatus	5	8.20–15.75	2.84	3.51	5.17	6.20
Tomistoma schlegelii	6	19.60–41.97	7.95	12.02	12.77	14.08

skull at later stages of crocodile development is visible through a study of *Crocodylus novaeguineae* (Hall and Portier 1994). These studies do not specify the exact position of Kälin 12-12, thus inferences are made from the orbital width and postorbital cranial ridge width to snout-vent length. One study on *C. niloticus* used a measurement from the point anterior to the orbits to the tip of the snout, finding that it grows isometrically relative to head width (Hutton 1987). This is the closest measurement comparable to Kälin 12-3. As the area around the orbits is less prone to growth extremes, it represents a more accurate figure for skeletal size. This can be especially important in captive populations where growth responds to temperature, population density, and food (Blake and Loveridge 1975; Coulson et al. 1973; Joanen and McNease 1974; Whitaker and Whitaker 1977), thereby creating a comparable database. For skin-covered specimens, the location of Kälin 12-12 is also an area of reduced soft tissue, which could prevent discrepancies in measurements based on the thickness of soft tissue.

Correlation with body size.—When compared to body length and snout-vent length, Kälin 12-12 has a lower standard deviation than CW. This shows that Kälin 12-12 is a viable measurement of size even for total body length in *O. tetraspis*. As *O. tetraspis* is the smallest crocodile, the lower standard deviation of Kälin 12-12 may be due in part to the crocodile's small size. However, the previous analysis shows the same positivity for Kälin 12 in skull size for all species. The direct proportions between the skull and body of crocodilians (Chentanez et al. 1983; Hutton 1987; Verdade 2000) supports the conclusion that Kälin 12-12 is a viable measurement relatable to total body size in species other than *O. tetraspis*.

There is a high level of integration of the differing parts of the skull meaning change in one part will result in the restructuring of the entire skull (Monteiro et al. 1997). We would, therefore, expect a similarity between the Kälin 12 measurements and CW and TSL and their respective ratios, as they are related measurements of length and width, which is a verifiable proportion within crocodilians (Chentanez et al. 1983; Hall and Portier 1994).

Functional importance.—Although functional importance is not always a necessity for determining a measurement point, it can be beneficial for application to ecology and functional morphology. The area of the skull surrounding the orbits has a reduced susceptibility to growth caused by environmental factors and it is a physically strong point on the skull. In battle, crocodilians have been known to bash heads (Webb and Manolis 1989) with the point of contact often near Kälin 12. In spite of the dangers to either side of the focal point such battles rarely seem to cause damage. Due to the closing of the secondary palate, the crocodilian rostrum is much stronger near the orbits. According to Busbey (1995) this leads to less tension from torsional loads associated with feeding behaviors.

Repeatability.—The post-orbital bar offers an area easily identifiable on skulls. On skin-covered specimens there is a minimum margin of error as the distance between the earflap and the eye is small. Although the widest part of the skull seems easier to identify than Kälin 12, in many skulls from collections, the bone is chipped or broken at the widest part. The widest part of the skull can also be open to interpretation ranging from anywhere between the back of the quadrojugal bone to the widest part of the quadrojugal.

Conclusion

Based on the aforementioned criteria, the Kälin 12 measurements prove to be slightly better than the traditional width measurement at the widest part of the skull for determining size of both skull and body. It offers an easily identifiable area which is less susceptible to growth due to environmental factors and the low amount of soft tissue in this area also reduces the bias already found in skin-covered vs. clean specimens. Kälin 12 measurements may also be better measurements within captive populations, where malnourishment and stressful conditions can lead to abnormal growth. Kälin 12-12 is also of physiological importance being one of the stronger areas of the crocodilian skull. The use of Kälin 12 could benefit comparative anatomical, evolutionary, and ecological studies of crocodilians by presenting a measurement meeting proven criteria for usability.

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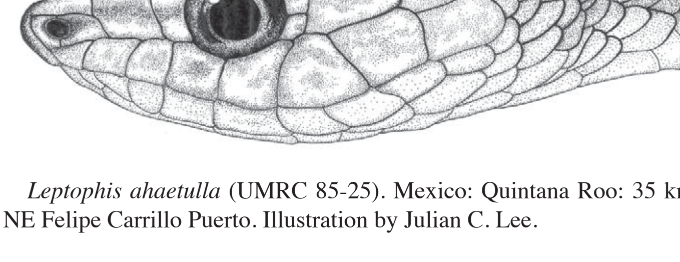

Leptophis ahaetulla (UMRC 85-25). Mexico: Quintana Roo: 35 km NE Felipe Carrillo Puerto. Illustration by Julian C. Lee.

TECHNIQUES

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Using a Wildlife Detector Dog for Locating Eastern Indigo Snakes (*Drymarchon couperi*)

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The Eastern Indigo Snake (*Drymarchon couperi*), a large (adults from 1.5–2.6 m total length [Stevenson et al. 2009]) diurnal species, is imperiled and federally listed as "Threatened" due to population declines attributable to habitat loss/fragmentation and declining Gopher Tortoise (*Gopherus polyphemus*) populations (United State Fish and Wildlife Service [USFWS] 2008). In southern Georgia and portions of its Florida range, *D. couperi* is closely associated with xeric sandhill habitats and Gopher Tortoise burrows, and adults often use tortoise burrows for overwintering sites (Diemer and Speake 1983; Hyslop et al. 2009a; Stevenson et al. 2003). The burrows of adult tortoises average 4.5 m long and 2 m deep (Diemer 1992), but in aeolian sand ridge habitats (see Ivester and Leigh 2003) adjacent to blackwater streams in southeastern Georgia, burrows are commonly 6.1–9.1 m in length (D. Stevenson, unpubl. data). Adult *D. couperi* are frequently surface-active during the winter and may bask or shed their skins near burrows, or move between burrows, during periods of mild (10.0–16.7°C) temperatures (Speake et al. 1978; Stevenson et al. 2009). Although habitat use is varied and less associated with sandy habitats in peninsular Florida, *D. couperi* occur in xeric uplands and regularly use tortoise burrows as far south as south central Florida (Layne and Steiner 1996). Because of the extensive time they spend in tortoise burrows and other below-ground refugia, adult *D. couperi* are difficult to locate during field surveys. Developing reliable survey methods for this species is an important priority for *D. couperi* research and monitoring efforts (USFWS 2008).

Recent studies demonstrate that detector dogs have potential as a non-invasive method for locating target wildlife species in their natural habitats (Nussear et al. 2008; Reindl-Thompson et al. 2006; Smith et al. 2003). However, few studies have used detector dogs to survey for snakes. Klauber (1956) mentions a "hound" from Florida that was trained to trail rattlesnakes (*Crotalus adamanteus*) and "bay" them when found; this dog located ca. 500 rattlesnakes in two years. Detector dogs located Brown Tree Snakes (*Boiga irregularis*) in cargo (Engemann et al. 1998, 2002), and, recently, the New Jersey Division of Fish and Game, Endangered Species Program used a trained dog to locate Northern Pine Snakes (*Pituophis m. melanoleucus*) adults and eggs (Dave Golden, pers. comm., 2007).

In an effort to develop an efficient and accurate survey method for locating *D. couperi* in the wild, we conducted a pilot study to test the effectiveness of a trained detector dog at locating Eastern Indigo Snakes. We conducted: 1) experimental field trials to evaluate a trained detector dog's ability to find live *D. couperi* and shed skins of *D. couperi* in the species' natural habitat; 2) actual field surveys, using a trained dog, to survey sites known to support *D. couperi*.

Methods

Dog Selection and Training.—We trained a dog (male, Labrador-mix, 5 years old, 30 kg) on loan from PackLeader Conservation Detector Dogs, Gig Harbor, Washington, USA 98329 to locate *D. couperi* using a combination of detection training techniques. We first introduced the dog to the odor of *D. couperi* at PackLeader in Washington State in October 2008. We randomly placed sections of shed skins (from multiple *D. couperi* collected from the wild in southern Georgia and central Florida) in a large field and allowed them to sit for up to 0.5 h. We then allowed the dog to roam the field, and when the dog showed interest in a shed skin the dog was commanded to sit and was rewarded with its play object (tennis ball). We continued similar shed-skin exercises with the dog over the next two weeks until the dog reliably located the samples.

Next, we trained a handler on the fundamentals of working the dog in the natural habitat of *D. couperi*. We conducted this training at the Orianne Indigo Snake Preserve, Telfair County, Georgia on 17 dates in November, 2008. Well-drained xeric sandhills on-site support resident populations of Gopher Tortoises and *D. couperi*. During this phase of training, we continued field exercises with shed skins and also introduced the dog to the scent of live *D. couperi*.

To train the handler, we set up area-search exercises wherein we hid varying numbers (7–14) of *D. couperi* shed skin sections. The trainer accompanied the handler to point out the dog's working style and to explain the effects of environmental factors on scent. In the first series of exercises, the handler and observer knew the location of the hidden shed skins. Gradually, sheds at undisclosed locations were added to the search area, and the size of the search area was increased (to add time and distance to the search).

When the handler had learned the various changes of behavior exhibited by the dog and could accurately determine when the dog was appropriately "indicating" the location of shed skin from a *D. couperi*, shed skins from several other snake species that are sympatric with *D. couperi* (Eastern Coachwhip [*Coluber f. flagellum*], Florida Pine Snake [*Pituophis melanoleucus mugitus*], and Eastern Diamondback Rattlesnake [*C. adamanteus*]) were added to the exercises. When the dog showed interest in the non-target odors (other than rattlesnake), the handler verbally corrected him off the non-target odor and reinforced on the target odor. When the dog showed interest in rattlesnake odor, the handler administered a physical correction and reinforced on the target odor. The dog quickly learned to avoid rattlesnake odor and to ignore non-target species odors. The dog's avoidance behavior (a "sideways look" at the rattlesnake [or rattlesnake shed] followed by a movement away from the area prior to returning to search mode) was clearly distinctive from the change of behavior it exhibited when expecting a reward for finding the target species. Upon locating the target (i.e., *D. couperi* shed skin), the dog "indicated" by expressing a suite of behaviors including sitting and/or remaining stationary, vigorous tail-wagging, and crouching. We continued training in this fashion until the handler was capable of working exercises independently. The handler and dog found more than 90% of the hidden shed skins during these training exercises.

We conducted several exercises near the end of the training period to introduce the dog to the odor of live *D. couperi* and to the holding cages that we used in the Phase 1 field trials (*see below*). As part of this training, we used both empty cages that never held snakes and occupied cages which held live *D. couperi*. We conducted this training so that the handler would have confidence in the dog's ability to separate these odors. In successful exercises, the dog positively "indicated" on the live *D. couperi* as he did above for shed skins of the species.

Phase 1 Trials.—To assess the dog's ability to recognize *D. couperi* scent, we conducted controlled field tests at one site each in Georgia (Joseph W. Jones Ecological Research Center [JERC], Baker Co., Georgia, USA) and in Florida (Apalachicola Bluffs and Ravines Preserve [ABR], Liberty Co., Florida, USA). To control for the possible effects of wild *D. couperi* present on-site, we selected sites not inhabited by *D. couperi* (Gunzberger and Aresco 2007; Smith et al. 2006; D. Printiss, pers. comm., 2008).

We conducted a total of 108 Phase 1 trials (52 at JERC on 23–25 November 2008; 56 at ABR on 3–5 December 2008). At each site, we evenly distributed trials among a total of four treatments for live *D. couperi* and *D. couperi* shed skins, as follows: 1) Above-ground: A live caged snake was placed on the ground surface within 10 meters of a tortoise burrow; 2) Above-ground: A shed skin (free, not caged) was placed on the ground surface within 10 meters of a tortoise burrow; 3) Below-ground: A live caged snake was placed flush with the entrance of a tortoise burrow, or situated a short distance (≤ 0.5 m or less) inside the burrow tunnel; 4) Below-ground: A shed skin (free, not caged) was placed flush with the entrance of a tortoise burrow, or a situated a short distance (≤ 0.5 m or less) inside the burrow tunnel.

For live snake trials, we used adult *D. couperi* (Total length: 140–200 cm) that we captured by hand from sites in Georgia (N = 3 ♂, 1 ♀) or in Florida (N = 2 ♂, 1 ♀). At our Georgia study site (JERC), we used snakes found in Georgia; similarly, we conducted trials at our Florida study site (ABR) using snakes found in Florida. For shed skin trials, we used recent (< 3 months old) shed skins from adult *D. couperi* found in the wild.

When conducting live-snake trials, we placed one *D. couperi* in a specially-designed, escape-proof holding cage (Herpetological Associates, Inc., Dunnellon, Florida, USA). We constructed two different sizes of holding cages so they would fit into tortoise burrows of varying widths. The smaller cages we made measured 18.3 cm wide, 11.2 cm high, by 61.5 cm in length, whereas the larger cage measured 21.0 cm, 13.0 cm, by 101.5 cm in length. We built holding cages with 15 cm plywood ends, and on one end of the cage we installed a small locking door. We made the walls of the cage of rubber-coated hardware cloth with 1.8 cm square openings. So they would fit into tortoise burrows, we constructed the cages so that the top was arched and the bottom was flat, thus approximating the shape of a tortoise burrow in cross-section.

We placed the cage holding the live snake (or the *D. couperi* shed skin) in the selected test location (i.e., on the ground within 10 m of a tortoise burrow, or just inside the entrance of a tortoise burrow). On field trial dates, we dedicated one individual of our study team to the handling and placement of cages holding live snakes and shed skins to minimize transfer of scent odors; forceps were used to position and retrieve shed skins between trials. We concealed our live-snake-in-cage sets by wrapping camouflage netting around the exposed portions of the cage. On above-ground trials, we positioned cages holding live snakes and shed skins so that they were partially or mostly concealed by ground cover vegetation and not readily visible to the dog survey team/handler.

On each individual trial, we had the dog handler, the handler's field assistant, and the dog visit three tortoise burrows: 1) one burrow with a hidden target (i.e., either a live snake above-ground, a live snake below-ground, a shed skin above-ground, or a shed skin below-ground); 2) one burrow that was empty (i.e., no hidden targets), and; 3) one burrow that was either empty (all shed skin trials) or, for all live snake trials, one burrow with a control (i.e., an empty cage hidden above or below-ground—to verify that the dog was not indicating on the cages). We conducted trials in sets of four, in varying order: snake above-ground; snake below-ground; shed skin above-ground; shed skin below-ground. To ensure that the dog was not following human scent or keying on flags, we marked all tortoise burrows used in these field trials with similar-colored flagging tape tied to nearby vegetation, and we had a supporting biologist introduce human scent at all burrows (by rubbing his hand over the sand inside the burrow and on the apron) while setting up trials. We removed the dog and handler from the immediate area (i.e., minimum 100 m distant) when preparing trial sets. We allowed our live snake and shed skin sets to sit for ca. 10–20 minutes to allow some airborne scent dispersal before bringing the dog and handler to the area.

Next, we had the handler lead the dog to each of the three burrows that constituted an individual trial. We classified a particular trial as successful if the dog correctly indicated the presence of an indigo snake or shed; those trials where the dog did not indicate at/near burrows where we had hidden a snake or shed skin we classified as errors of omission; trials where the dog indicated at/near burrows where we had not hidden a snake or shed skin we classified as commission errors. On all Phase 1 trials, the dog handler was accompanied by a field assistant who helped orient her and lead the dog to trial burrow locations.

We used data from these trials to calculate the proportion of trials where the dog successfully signaled on live *D. couperi* or shed skins. We used a Chi-square goodness of fit test to compare dog success among the four treatments (Above Ground-Live Snake, Above Ground-Shed Skin, Below Ground-Live Snake, Below Ground-Shed Skin). We further classified unsuccessful trials by calculating the proportions that were omission versus commission errors.

Phase 2 Trials.—For the second part of our study, the dog and handler conducted 1-h long field surveys for *D. couperi*. We surveyed non-overlapping xeric sandhill sites that supported numerous active/inactive tortoise burrows and resident, overwintering *D. couperi*. We conducted a total of 26 1–h long trials (2–4 trials per survey date) on nine dates from 8–23 January 2009 at a total of seven sites: Fort Stewart Military Installation (FSMI), Bryan Co., Georgia (N = 3); FSMI, Evans Co., Georgia (N = 3); Broxton Rocks Preserve, Coffee Co., Georgia (N = 5); General Coffee State Park, Coffee Co., Georgia (N = 3); Orianne Indigo Snake Preserve, Telfair Co., Georgia (N = 3); Withlacoochee State Forest, Citrus/Hernando counties, Florida (N = 7); Chassahowitzka Wildlife Management Area, Hernando Co., Florida (N = 2).

Prior to beginning the surveys, we presented the dog survey team (comprised of the dog, the dog handler and her field assistant) with an aerial photograph of the survey site, oriented them with respect to nearby primitive roads, wetlands, and other landmarks, and defined the area of potential habitat to be surveyed. We did not flag tortoise burrows. We then directed the dog survey team to search for one full hour; the dog team made a single pass through each survey area, attempting to visit and search all tortoise burrows they could locate. The field assistant used a compass and aerial photo to orient the dog and the dog handler and keep them on a steady compass bearing. The dog team began the survey at the downwind end of the survey area and progressed upwind, maximizing the dog's exposure to possible *D. couperi* scent. We conducted these surveys from mid-morning through mid-late afternoon on clear or rain-free days (i.e., weather conditions that would prove suitable for *D. couperi* surface activity).

If the dog indicated at the entrance of an individual tortoise burrow (suggesting the presence of a live *D. couperi* or recent shed skin within the burrow), we immediately scoped the burrow with a remote video camera attached to a 9 m section of tubing (Gopher Tortoise Burrow Camera, Southern Ecosystems Research, Auburn, Alabama, USA) in an effort to determine the presence of a live *D. couperi* or shed skin. If *D. couperi* were not documented, we placed a large single-opening funnel trap at the mouth of the burrow in an effort to capture any resident *D. couperi* as they exited the burrow. We shaded funnel traps and checked them 2–3 times per day during daylight hours.

Results

Phase 1 Trials.—The detector dog was correct on 91% (98 of 108) of the Phase 1 trials. Overall, the dog was more successful during shed skin trials than during live snake below-ground trials ($\chi^2 = 13.928$, Df = 3, P = 0.003). The dog was correct in all (100%) of 54 shed skin trials—both above-ground and below-ground. Of the live snake trials, the dog was correct 81% of the time (44 of 54 trials), with 88% success (23 of 26 trials) on above-ground trials,

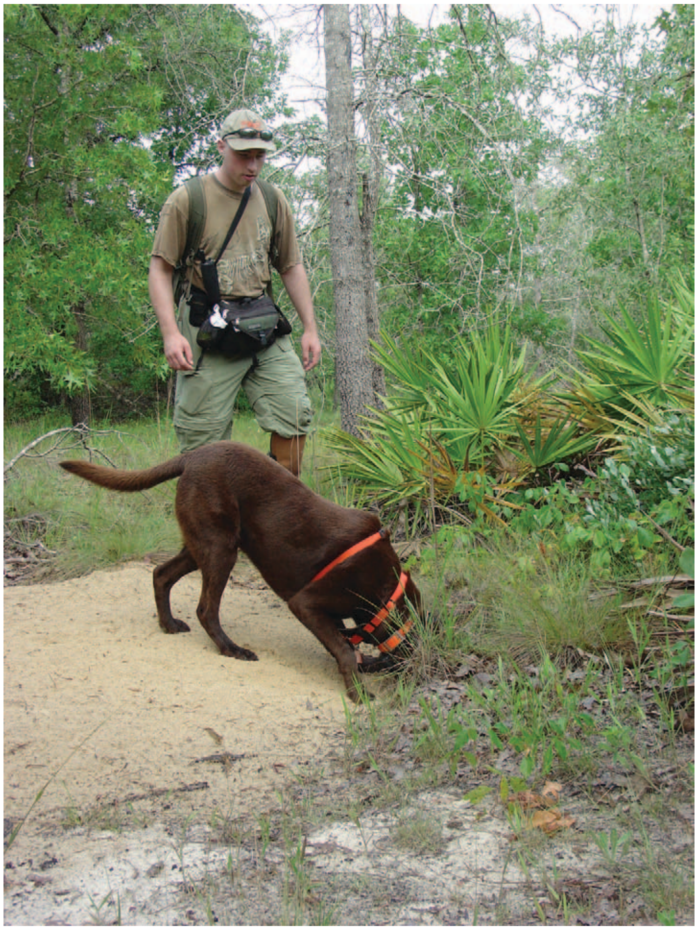

Fig. 1. A specially trained wildlife detector dog ("C.J.") surveys a Gopher Tortoise (*Gopherus polyphemus*) burrow for Eastern Indigo Snakes (*Drymarchon couperi*), Wheeler County, Georgia, USA. Photo by Dirk J. Stevenson.

and 75% success (21 of 28 trials) on below-ground trials. Thirty percent (3 of 10) of the unsuccessful trials were commission errors, all of which occurred on below-ground trials, while 70% (7 of 10) of the unsuccessful trials were omission errors, four of these were below-ground trials.

Phase 2 Trials.—On 26 1-h long Phase 2 trials, the dog team surveyed a total of 496 active/inactive Gopher Tortoise burrows at seven sites. During these surveys, the dog located 11 individual *D. couperi* shed skins and indicated at another 18 tortoise burrows. Seventeen of these 18 burrows were examined with the tortoise burrow camera; *D. couperi* were observed in three separate burrows at distances of 3.7, 6.7, and 7.0 m. All of the remaining burrows were trapped from 2–10 days; no *D. couperi*, or any other snakes, were captured by these efforts.

Discussion

Our study suggests that wildlife detector dogs have value as a field survey method for the Eastern Indigo Snake (*D. couperi*). During controlled field tests (Phase 1 Trials), the detector dog used in this study successful located 81% of live *D. couperi* and 100% of *D. couperi* shed skins.

The dog had very little field training with live *D. couperi* prior to Phase 1 trials, and we strongly suspect that the dog would have performed better with additional training with live snakes prior to these trials. During informal training exercises and field surveys conducted 10 December 2008–27 January 2009 at the Orianne Indigo Snake Preserve (Georgia), the dog found seven individual *D. couperi* (a total of 11 times) on the surface near tortoise burrows, and four *D. couperi* below-ground in tortoise burrows. Additionally, the dog indicated at the entrances of 12 tortoise burrows, four of which were confirmed (by scoping with the tortoise burrow camera) to contain *D. couperi*.

On Phase 2 Trials, the dog confirmed the presence of *D. couperi* at 6/7 sites surveyed, finding three *D. couperi* below-ground inside tortoise burrows and 11 *D. couperi* shed skins above-ground. However, the dog may have falsely indicated snake presence at some of those Phase 2 tortoise burrows where he signaled the presence of a snake below-ground inside the burrow (N = 15). Despite our lack of success in documenting *D. couperi* via burrow camera and trapping surveys, we cannot say conclusively that *D. couperi* were not present in these burrows. Although *D. couperi* are occasionally observed by tortoise burrow camera surveys, scoping burrows is unreliable at detecting the presence of *D. couperi* because the terminus of many burrows cannot be reached with a burrow camera due to burrow length, burrow curvature, inanimate obstacles (e.g., plugs of pine straw, tree roots), or the presence of the resident tortoise partway down the tunnel shaft blocking progress of the camera (Smith and Dyer 2003; Stevenson et al. 2003).

Eastern Indigo Snakes have been documented by the following field methods: 1) visual encounter surveys at or near tortoise burrows in sandhill habitats (Diemer and Speake 1983; Stevenson et al. 2009); 2) single-opening funnel traps placed at the entrances to tortoise burrows (Lips 1991); 3) motion-activated cameras placed at tortoise burrows (Alexy et al. 2003); 4) remote video cameras ("tortoise burrow cameras") to examine the interiors of tortoise burrows (Hipes and Jackson 1996; Stevenson et al. 2003); and 5) drift fence arrays using large "box" traps (Hyslop et al. 2009b). Except for visual encounter surveys, most of the survey methods listed above are either not particularly effective and/or are extremely labor-and-time-intensive (Hyslop et al. 2009b; Smith and Dyer 2003). In southern Georgia, visual encounter surveys at tortoise burrows conducted by experienced herpetologists are often effective in locating *D. couperi* (and *D. couperi* sheds) during the cooler seasons (Hyslop et al. 2009b; Stevenson et al. 2003, 2009). However, human searchers vary in the speed at which they visit burrows, their ability to accurately discern snake tracks, and their ability to spot snakes on the surface (Hyslop et al. 2009b).

Both canine surveys and visual encounter surveys may locate live *D. couperi* or shed skins on the ground near tortoise burrows. During field training, the dog found several live *D. couperi* under natural conditions on the surface that were basking cryptically (e.g., under branches or vegetation) near tortoise burrows. And, in both training and during trials the dog often located small fragments of old *D. couperi* shed skins (hidden under debris or vegetation) that went unnoticed by human surveyors. Our study also indicates that a trained detector dog may locate *D. couperi* deep inside tortoise burrows via olfaction. Our dog was able to survey for snakes ca. 4 hours/day; frequent hydration and rest breaks were needed, and the dog did not perform well in hot weather (i.e., > 23°C). Excessive panting during hot weather affects olfactory abilities and may lower detection rates (Smith et al. 2003). In some disturbed sandhill landscapes where native prickly pear cactus (*Opuntia* sp.) and blackberries (*Rubus* sp.) were especially abundant, the dog experienced difficulties due to abrasions to his paws from thorns. Experienced human searchers (i.e., visual encounter surveyors) often discern indigo snake tracks in the sand of tortoise burrow aprons (Stevenson et al. 2009), and visit and survey tortoise burrows at ca. twice the rate of a dog escorted by its handler and one field assistant (this study).

Possible explanations for dog errors in the field include insufficient training, mistakes due to handler errors (e.g., inadequate search), fatigue, and distractions due to encountering novel scents or wildlife species. Inappropriate weather (e.g., windless days and days following heavy rains) may also have influenced the dog's success.

Detector dog surveys were 61% and 64% successful in detecting the presence of Brown Tree Snakes planted in outbound cargo during 1998 and 1999, respectively (Engemann et al. 2002). In cases where the snakes were not located by dogs, twice as many were missed because the dog did not change its behavior in response to the snake rather than because the handler did not conduct an adequate search pattern (Engemann et al. 2002).

This study, a pilot effort, suggests that specially trained wildlife detector dogs are sometimes able to locate *D. couperi* in the wild, and the effectiveness of these "canine surveys" may be enhanced if conducted in concert with other techniques (e.g., visual encounter surveys of Gopher Tortoise burrows). Additional study will reveal whether canine surveys have value at sites where *D. couperi* is present in very low numbers, during periods when the species is not surface-active, or in habitats lacking Gopher Tortoise burrows. The detector dog used in this study located (under natural conditions) live *D. couperi* on the surface and below ground in Gopher Tortoise burrows, and frequently found shed skins that were overlooked by human searchers. Improved survey methods will enable researchers to better determine the distribution of this imperiled species, especially in regions where the species is now seemingly extremely rare or locally distributed (Florida panhandle [Gunzberger and Aresco 2007]), and may assist in developing a defensible presence/absence survey method for development projects.

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Visible Implant Elastomer: A Simple, Non-Harmful Method for Marking Hatchling Turtles

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Effectively marking hatchling freshwater turtles is challenging because hatchling turtles are typically small, but increase significantly in size by maturity (Plummer 1979). Ideal marks are minimally invasive, with zero or low impact on survival, are correctly identifiable upon recapture, do not affect recapture probability, remain recognizable for the length of the proposed study, and are reasonably affordable (Gibbons 1968; Plummer 1979). Marks must also remain detectable through significant growth, given turtles' dramatic increase in size between hatching and maturity. In reality, very few marking methods meet all of these criteria. Here, we discuss the merits and pitfalls of various marking methods for use in hatchling turtles. Also, we describe the use of visible implant elastomer (VIE) to mark hatchling turtles and summarize potential areas of concern regarding the use of VIE for hatchling turtles.

Why mark hatchling turtles?—Marking is useful for studying population dynamics and ecology of hatchling turtles. It is essential for monitoring "head-start" programs and related conservation endeavors. Turtle head-starting programs include *ex situ* incubation of eggs and may also involve maintenance of hatchlings in captivity until they reach a pre-determined size or age. Well-planned and carefully managed head-start programs mitigate nest predation and are potentially powerful tools for turtle conservation in populations threatened by limited recruitment (e.g., Moll and Moll 2000). Nonetheless, *ex situ* incubation and head-starting programs do not always include a post-release evaluation of their efficacy (Seigel and Dodd 2000). In the absence of post-release monitoring it is difficult or impossible to determine the effect of the program on the population(s) in question. Evaluating the success (or shortcomings) of such programs requires marking turtles to compare survivorship between nests incubated *in situ* and *ex situ*.

Consistent evaluation of the success of head-starting and other applied conservation programs (e.g., translocations, predation mitigation, and habitat restoration) allows researchers to adjust their methods to maximize success and address shortcomings as they are identified. In cases where a project is not having the desired effect, ongoing evaluation allows researchers to identify factors which merit further investigation. If a program is truly ineffective (for example, due to high mortality of released animals, or failure of head-started animals to function successfully in the wild), cancelling the program in a timely fashion minimizes the waste of precious resources. Program evaluation requires marking head-started hatchlings for post-release monitoring.

How should hatchling turtles be marked?—Several marking methods are used for adult turtles, including branding (Woodbury and Hardy 1948), paint-marking (Tinkle 1958), shell-notching (Cagle 1939), wiring metal identification plates through holes drilled in the marginal scutes (Carr 1967), tattooing (Breckenridge 1955; Woodbury 1948), flipper-tagging with plastic or metal livestock tags (e.g., Carr 1967), or passive integrated transponder (PIT) tags (e.g., Camper and Dixon 1988; McDonald and Dutton 1996). None of these methods are ideal for use with hatchling turtles.

Branding is not a reliable method, because if the brand penetrates the dermal layer, the shell may regenerate so efficiently that the brand is no longer clearly visible (Clark 1971; Woodbury and Hardy 1948). The rapid growth of hatchlings might enable them to heal over branding scars more quickly than adult individuals, further obscuring marks. Paint-marking is a useful short-term method, but the marks typically do not last longer than a few months and thus are not useful for long-term monitoring programs (Plummer 1979). Shell notching can be used on hatchlings, but their rapid growth may obscure the notch before they are re-encountered, and shell injuries sustained during growth may mimic a grown-out notch, thereby confounding individual identification (Plummer 1979). Hatchlings are too small to wire metal plates to the carapace. Thin wire tags with beads which were threaded through the marginal scutes of hatchling *Chelydra serpentina* were lost at a rate of 2.5% per week in the laboratory (Galbraith and Brooks 1984). Tattooing is useful with some adult turtles, but in hatchlings, the dye granules may spread as they grow, rendering the tattoo illegible (Plummer 1979). Flipper tags are widely used in adult marine turtles (e.g. Carr 1967), but they are of no use in species which do not have flippers, and they are too large and heavy for hatchling turtles. Finally, PIT tags have great potential for juvenile and adult turtles. However, it is debatable whether PIT tags are small enough to use safely in hatchlings of most species (Buhlmann and Tuberville 1998; Gibbons and Andrews 2004). Some studies have successfully applied PIT tags to small turtle hatchlings (e.g., Rowe and Kelly 2005), but regardless of researchers' opinion regarding their size, PIT tags are expensive. The very real possibility of low recapture rates make the financial investment required to obtain PIT tagging equipment difficult to justify when large numbers of hatchlings must be marked for release into the wild. Thus, the methods listed here have major drawbacks when used to mark hatchlings and as a result it can be difficult to accurately determine survivorship and recapture rates for hatchling and juvenile turtles.

We tested marking hatchling turtles using VIE (Northwest Marine Technology Inc., Shaw Is., Washington, USA), a biocompatible, flexible plastic originally developed for use in the fisheries industry. Marks made with VIE have been successfully used to study frogs, salamanders, snakes, and lizards (e.g., Bailey 2004; Daniel et al. 2006; Davis and Ovaska 2001; Hutchens et al. 2008; Moosman and Moosman 2006; Regester and Woosley 2005). No adverse effects have been recorded on these species and tag loss was generally low (Ferner 2007). Park et al. (2007) evaluated the use of VIE for marking adult Chinese Softshell Turtles (*Pelodiscus sinensis*) on a turtle farm in Korea. Marks placed in the webbing between the digits of adult *P. sinensis* were retained well and were clearly visible several months after application, although marks placed in the adipose tissue of the eyelid were either lost or obscured at a high rate. They observed no adverse effects from the marks.

The elastomer is prepared by mixing a curing agent with a brightly colored liquid polymer directly before application. A small amount of the mixture is injected under the skin, leaving a visible colored dot or short line. While visibility to the naked eye is highly dependent on the coloration of the study organism and the color and placement of the elastomer, the marks fluoresce under ultraviolet (UV) light and are easily visible.

A VIE mark is non-toxic, light-weight, and based on the studies listed above, it is unlikely to impact survivorship. Because a single color kit can mark at least 700 turtle hatchlings and currently costs US $252, the cost is less than US $0.40 per mark. Placing multiple VIE marks in the front and hind legs, plastron, tail or toe webbing and using a combination of differently colored marks allows for marking schemes that identify the clutch of origin, year of hatching, or even individual hatchlings. The availability of several different colors of fluorescent elastomer is also useful for marking multiple clutches uniquely for future identification: Northwest Marine Technologies currently offers ten colors, six of which fluoresce under UV light. Below, we evaluate the use of VIE as a marking method for hatchling turtles. To our knowledge, VIE has not been previously used to mark hatchling turtles.

Methods

Before applying VIE to hatchling turtles, the method was tried on two captive adult turtles at Reptilia (a reptile zoo in Vaughan, Ontario). We marked one adult female Loggerhead Musk Turtle (*Sternotherus minor*) and one adult female Red-bellied Short-necked Turtle (*Emydura subglobosa*) with red VIE. Marks were injected subcutaneously on the ventral surface of the left hind leg using a sterile 0.3 cc syringe with a 29-gauge needle. Both animals were monitored on a daily basis by zoo staff and no ill effects were reported. The *E. subglobosa* was moved out of the zoo nine months after the mark was injected, at which time the mark was still clearly visible. The mark on the hind leg of the *S. minor* was clearly visible to the naked eye 18 months after injection. Under fluorescent light it was extremely bright and could not be mistaken for anything else (Fig. 1).

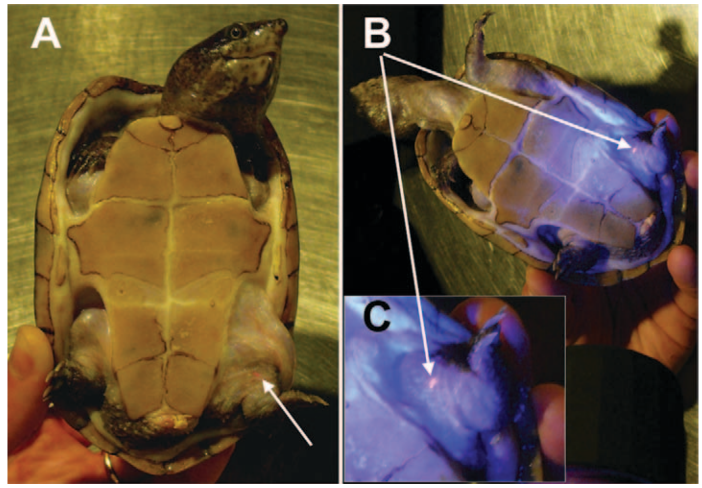

Fig. 1. Adult female Loggerhead Musk Turtle (*Sternotherus minor*) showing red visible implant elastomer mark in left hind leg (arrows). A) Mark is visible under standard room lighting or sunlight as a red dot. B) The mark fluoresces and is clearly visible under a hand-held ultraviolet light. C) Close-up of B.

We applied VIE marks to hatchling Snapping Turtles (*Chelydra serpentina*) during a research program conducted in part at the Pinery Provincial Park (Ontario, Canada) which involved *ex situ* incubation. After hatching, neonates were maintained in clean, humid tubs until they had completely absorbed their yolk sacs. They were then kept in shallow water with aquatic plants (*Elodea canadensis*) for shelter. Neonates (N = 301) were marked with red VIE within two days of hatching using a 0.3-cc syringe with a 29 or 30-gauge needle. Needles were cleaned with ethanol between applications. Enough elastomer was injected to leave a short line (approx. 2 mm long) or a small dot (approx. 1 mm diameter) beneath the skin in the underside of the hind leg or on the plastron.

Marked individuals were kept for a minimum of 24 h observation

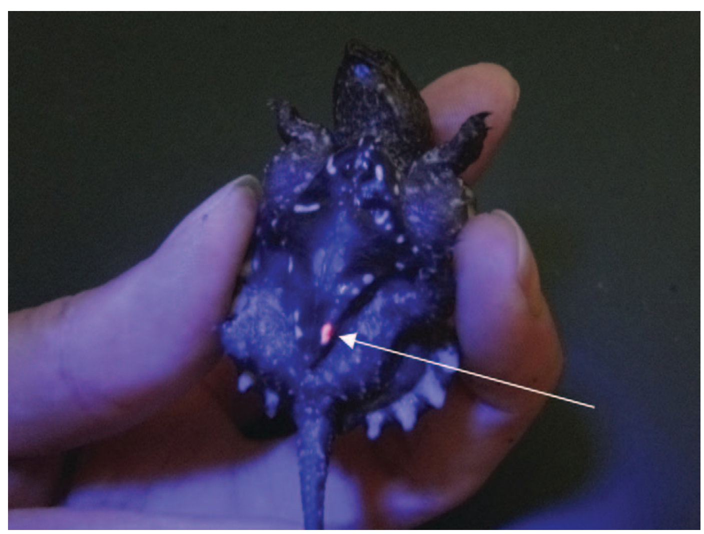

Fig. 2. Ventral view of a juvenile Snapping Turtle (*Chelydra serpentina*) found 11 months after hatching, marking and release. The red visible implant elastomer mark in the plastron (arrow) fluoresces under a handheld UV light.

(24–120 h; mean = 72 h) to monitor possible reactions to VIE marks. VIE marks may break apart, spread, move around under the skin, or be expelled (Heemeyer et al. 2007; Hutchens et al. 2008), so this period was also used to monitor for mark loss or changes in mark visibility or placement in the first few days post-marking. Hatchlings were released at the site of their original nest chamber within 24–72 h post-marking and allowed to enter the water themselves. In 2009, 301 hatchlings were marked and released. Eighty-four of these were released into the Pinery Provincial Park, where subsequent hatchling surveys were carried out, while the others were released at their original nest sites. The location of these releases varied, but all were sufficiently distant from the park (10–120 km) that dispersal back into the park was unlikely.

In 2009, two live embryos were found while opening unhatched eggs at the end of the season (unhatched eggs were opened a minimum of 30 days after the last successful hatch from the clutch). These embryos were kept in the same conditions as normally pipping hatchlings until they had absorbed their yolk sacs and both survived. By this point it was too late in the year to release them as frost had already set in. The hatchlings were marked and overwintered in a paludarium at the Pinery Provincial Park and both were released the following spring.

Results

No mortality or adverse reactions were observed following marking of hatchlings. No inflammation or tissue discoloration was observed around the marks. No evidence of mark breakdown, spread of VIE during curing, or mark expulsion was observed between marking and release and marks were clearly visible when fluoresced with a hand-held UV light (Northwest Marine Technology Inc., Shaw Is., Washington, USA) at the time of release. All hatchlings displayed normal behaviors when released. The two hatchlings which had overwintered in captivity grew quickly (as expected in captive turtles provided with high-quality food) and had doubled in straight-line carapace length by the time they were released in early May. The VIE marks in their hind legs were clearly visible under UV light at this time, despite their rapid growth.

During surveys for juvenile Snapping Turtles in Pinery Provincial Park from 23 June to 3 July 2010 (69.9 survey hours), we found 17 juveniles within the size range expected for hatchlings released in 2009. Four had VIE marks clearly visible in the left hind leg and two had been marked on the plastron (Fig. 2). None of the marks in the leg had broken down, but one of the plastral marks appeared to have split into several pieces, possibly due to the turtle's growth. Despite changing in shape, the plastral mark was still clearly visible.

It is possible that juveniles found in 2010 that did not have visible VIE marks were in fact released turtles which had lost their marks. We are currently incorporating Decimal Coded Wire Tags (Northwest Marine Technology Inc.) into our mark-recapture study to allow for more accurate estimations of the rate of VIE mark loss in turtles and we are not able to estimate exact rates of mark loss at this time. However, in our experience it would be unlikely to find only released juveniles during our surveys.

Fluorescent food for thought.—Researchers who plan to use VIE to mark hatchling turtles should consider the following in their experimental design. First, the rate of VIE mark loss in turtle hatchlings must be more accurately quantified and may differ among species. Second, it is possible that the rapid growth rate of juvenile turtles will cause the marks to be overgrown and obscured. Although the marks remained visible in both the two hatchlings that overwintered in captivity (which doubled in size), and although they were visible after ten months in recaptured hatchlings which had overwintered naturally, we have no way to accurately gauge the rate of mark loss at this time. Both of these concerns can be addressed by applying multiple marks to each hatchling (study in progress).

If mark loss were high in the first few days post-marking, application of Liquid Bandaid over the injection site might increase mark retention. Liquid Bandaid or cyanoacrylate glues are commonly used to increase PIT tag retention in snakes (e.g., Koons et al. 2009) and Liquid Bandaid has been suggested as a method of increasing VIE retention in snakes (Hutchens et al. 2008). However, we did not experience any mark loss during the first few days after marking. Therefore, we chose not to apply Liquid Bandaid to the injection site in order to avoid introducing further chemicals onto the hatchlings' skin and to avoid sealing potential pathogens into the healing injection sites.

In summary, VIE marks provide a simple, cost-effective way to quickly and non-harmfully mark large numbers of turtle hatchlings for mark-recapture studies, including evaluation of head-starting methods. Marks made with VIE are completely unambiguous; however, quantitative analyses of the rate of mark loss are still required. Marked turtles should be easily identifiable for at least the first year and if recapture rates are very low (or nonexistent), the VIE marks do not represent a significant loss of resources.

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Suggestions on Photographing Crocodile Skulls for Scientific Purposes

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In cranial morphometrics, an effective way of obtaining data for analyses is by using photographs or drawings. With an average digital camera, computer and software it is now possible to extract extensive information on size, shape, location, surface area, and color. Existing photographs or drawings, however, may not always be suitable for metric comparisons because of optical distortion, light conditions, the background used, or inconsistency in type and position of the camera or skull (Friess 2003). Ideally an applicable standardized method would be used in all photo-documentation and photographic research. For practical purposes, however, a proper and complete documentation of exact methods used would allow other authors to use the information or convert the acquired data to match theirs.

We describe and discuss a method, used successfully in previous morphological research on crocodile skulls (Pearcy, unpubl. data), with regard to applicability and effectiveness. Crocodilian skull morphometric studies are becoming more frequent (e.g., Pierce et al. 2008; Piras et al. 2009; Sadleir and Makovicky 2008), and therefore there is need for such methods' description. Object orientation with respect to the camera, optical distortion, and materials used are discussed.

GENERAL SETUP AND MATERIALS

Skulls were placed on a floor using a black towel as background. We used a Panasonic Lumix DMC-FX107 digital camera set to intelligent AUTO mode, 3072 x 2304 pixels, JPEG/Exif format. The camera was screwed on an adjustable aluminum tripod placed on the floor positioned directly over the skull. For each picture the camera was set to automatic-mode with a two-second timer to prevent movement blur from pressing the shutter button. The lens range was 28–102 mm and aperture range F2.8–F5.6. The grid in display option enabled a non-essential but convenient way of lining up specimens within the field of view.

The tripod's center column and head were inverted, so the camera on the saddle plate was centered between the legs of the tripod directly perpendicular to and facing the skull. Because crocodile skulls have a wide range of height, distance from specimens had to vary arbitrarily from 40–120 cm for convenience.

ORIENTATION OF SUBJECT AND CAMERA

Dorsal view cranium.—This view is most commonly used for comparative studies between crocodilian species (Fig. 1).

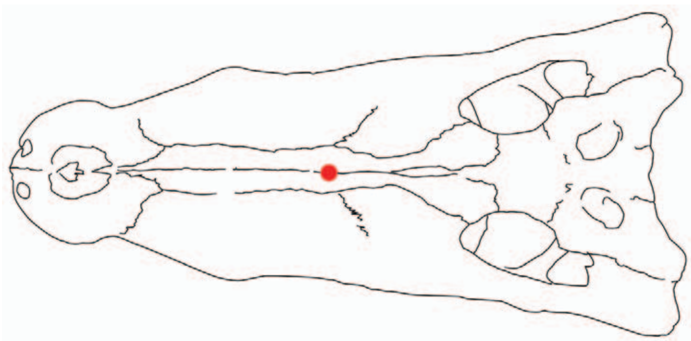

FIG. 1. Dorsal view of the cranium. The red dot shows the center point along the midline of the skull and the focus point of the camera.

The cranium rests upon its pterygoid flanges and front teeth or alveolus and is leveled along the midline from cranial table to tip of snout. Where necessary, the skulls were also leveled along the cranial table width-wise. Black towels were rolled up into appropriate thicknesses and placed under skulls to raise them to the desired height. The focus point (red dot) was on the center of the midline.

Ventral view cranium.—For this view of the skull, the tip of the snout posterior to the premaxillary tooth row is made level to the back of the skull along its midline (Fig. 2). Focus point remains the same as that of the dorsal view of the cranium.

Occipital view.—For this shot, the skull is leveled along its midline as it was for the dorsal view (Fig. 3 a–b). The lens focus point is the tip of the vertebral condyle.

Lateral view cranium.—The skull is laid flat without leveling, with its lateral axis perpendicular to the view of the camera (Fig. 4a). In this way, the snout and posterior portion of the skull can be compared. The focus point is halfway between the tip of snout and the back of cranium (Fig. 4b).

Dorsal/Ventral view lower jaw.—This view can be used for the study of the mandibular symphysis and other basic jaw studies (Fig. 5). For the dorsal view, the lower jaw is leveled from the inside of the front teeth to the inside of the back of the jaw, resting on the mandibular ramus indentions. For the ventral view, the leveling remains from the tip of snout to the back of jaw. Again, the focus point is the center of a virtual midline along the length between the mandibular symphysis and the back of the jaw.

DISCUSSION

In this discussion we will elaborate on the methods used and where applicable consider other options and improvement. Generally, methods chosen are based on the intended measurements of study. We state, however, that in many situations using a general standardized method when photographing crocodile skulls would optimize the use of a photograph and thus be preferable. The methods can, of course, be adapted for photographing dorsoventral topography of other large tetrapods.

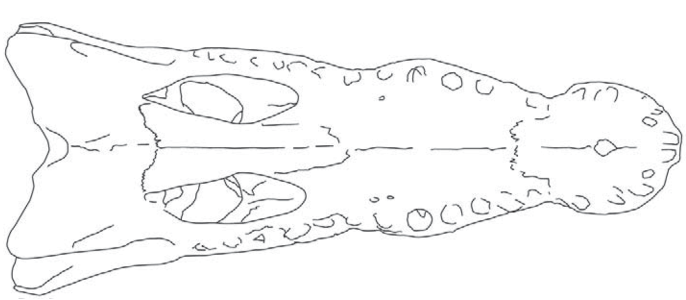

FIG. 2. Ventral view of the crocodile skull.

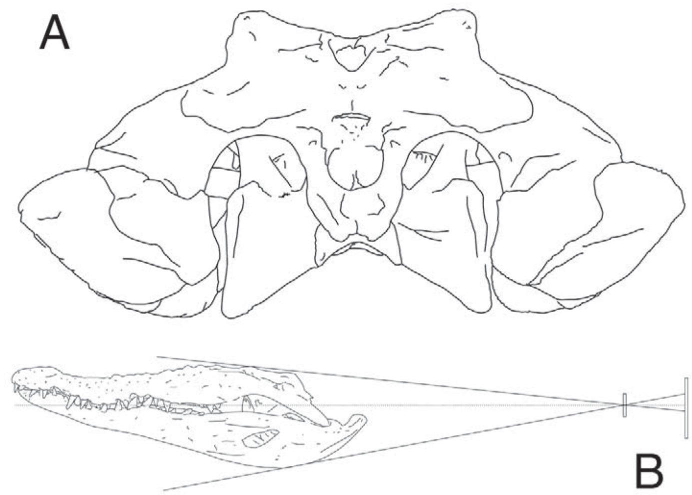

FIG. 3. Occipital view of the cranium (a) and the leveling of the skull for the focus point (b).

Leveling a skull in general makes for a repeatable method. The lifting of the skull in dorsal perspective allows for the view of the front end of the tip of the snout instead of just the top end of the snout. Error from not leveling the skull is dependent upon a skull's size. A *Crocodylus acutus* with a real maximum cranial length of 80 cm will appear to be about 2.5 cm shorter in any picture when not leveled; the same measurement on a *Crocodylus johnstoni* would only be off by about 1 cm. Not leveling the skull in ventral view, a technique applied often, is obviously more convenient and would show more of the skull; however, this makes extracting measurements from pictures nearly impossible due to depth differences. Positioning of the skull in occipital view is, as far as we are concerned, a matter of individual choice. Depth differences are relatively large, thus this view is not normally used. We chose to level the skull to have a better view of the tip of the vertebral condyle as a reference point. Artificially adapting the position of the skull when resting on a horizontal surface in side

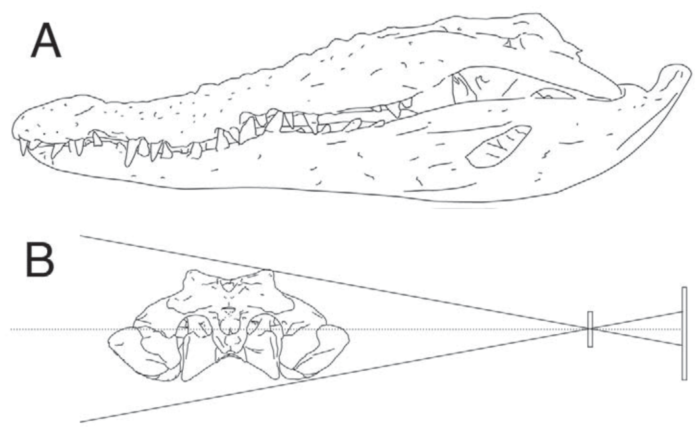

FIG. 4. Lateral view of the skull (a) and the aim of the camera (b).

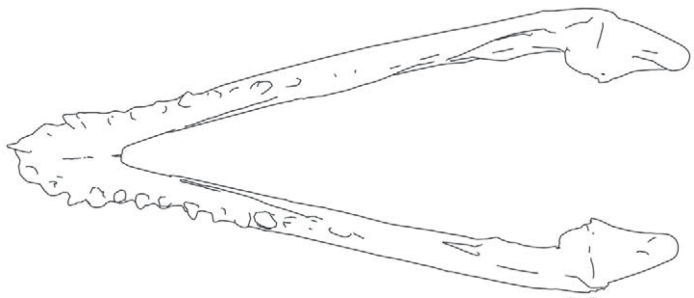

FIG. 5. The lower jaws of a crocodile skull. While this diagram is from the dorsal view, the ventral view is similar.

view would expose more of the lower jaw and less of the upper, although the effect is very minimal due to the flattened skull of a crocodile, rendering such actions virtually useless. In dorsal view of the lower jaw, we leveled the jaw in a repeatable way. Apart from enhancing accuracy of later distance measurements, this action also exposes an often researched subject—the teeth and their sockets—more evenly.

Any optical lens leads to distortion of the absolute and relative dimensions of an object like a skull. The outer edge of the skull will be invisible in a central projection, affecting absolute dimensions. Furthermore, objects that are closer to the focal point will appear relatively bigger than they are compared to portions that are further away, thereby affecting the proportions of the object. Practically speaking, taking a picture of a cranium with a distance of one meter results in a distortion of a maximum of 7.5% (Jacobshagen et al. 1988) and so-called barrel or pincushion distortion is negligible using everyday lenses. Most distortions can be avoided by applying stereophotographic techniques. Another commonly used technique relies on resorting to reference objects–a ruler for instance–from which sizes can be related to later, but the reference object must be at the same height as the surface being photographed in order to minimize error. We believe, however, that in the interest of applicability, increasing the distance between the camera and the object, which significantly reduces the photographic error, or resorting to mathematical solutions like a Generalized Procrustes Analysis (Bookstein 1996; Rohlf 1999) as we did, is a more preferable solution. Also, in many situations, adapting one's methods to render optical error irrelevant is the best solution.

Backgrounds, for most purposes, must be in contrast to the subject as much as possible. For the generally white skulls, we used a black towel. Contrast decreases ambiguity between skull and background, and darker backgrounds will reduce the number of artifacts caused by shadows or reflection. Both lead to more precise definition. However, in some situations using a background color that is unlikely to be present in the subject might be worth considering, as software would then be able to filter this color independent of the subject color.

With the accuracy of distance measurements roughly increasing with the square root of pixel depth, we consider a 7 Megapixel camera, giving an estimated error of 0.05 cm on an 80 cm specimen, about the minimum for most applications with crocodile skulls. The tripod may not always be a necessity. It does, however, lend stabilization to the camera, especially important in self-timed shots.

Not all studies have the funding to use stereographic techniques or even CT-scans, which would reduce distortion completely, and allow for a comprehensive assessment of measurements. The methods presented here are cost-effective, while reducing distortion. Museums and conservation groups can follow these methods for their databases in order to have a comparable method, repeatable by anyone with a digital camera and material for a background. If not applied, at least the description presented herein should serve as an example to the extent required to allow other researchers to convert their data into comparable material.

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PIT Tag Migration in Seaturtle Flippers

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Marking individual animals in wildlife studies is essential and plays a vital role in furthering our knowledge of animal populations. Mark and recapture studies delineate ranges and migratory movement patterns, help identify which populations use feeding and breeding grounds, and can contribute to vital rates where animals can be encountered across time during breeding events. Marine turtle studies also have benefited from marking of animals. External tags have long been used to mark individual nesting turtles, juvenile and adult turtles in benthic, oceanic and neritic foraging habitats (Godley et al 2003; Limpus et al. 2009; Mortimer and Carr 1987; Schmid 1998). However, some external tags have been found to cause harm or reduce the survival of an individual (Nichols et al. 1998). In addition, external tag loss is common and decreases the rate at which previously tagged individuals are identified (Balazs 1982; Bjorndal et al. 1996; Henwood 1986; Limpus 1992). Consequently, in recent years, use of Passive Integrated Transponder (PIT) tags, also termed Radio Frequency Identification tags, has increased (Balazs 1999; Broderick and Godley 1999). A PIT tag is a tiny electronic microchip encased in a glass capsule that is inserted under the skin or into muscle. It is passive until interrogated with an external tag reader, and then it briefly transmits a unique identification number to a receiver. Studies examining the feasibility and ease of PIT tag use determined that PIT tags have a much greater retention rate than external tags and increase the reliability of re-identifying tagged animals (Balazs 1999; Braun-McNeill et al. 2003; Dutton and McDonald 1994) when tag readers are on hand. Due to the subcutaneous placement of PIT tags, internal complications that result after insertion may occur. To date, surprisingly few studies have examined this aspect of PIT tag use in seaturtles (van Dam and Diez 1999).

The negative effects of PIT tags on wild animals are often difficult to determine. Once seaturtles have been tagged, they are released (usually immediately) back into the environment where they spend most of their lives beyond the reach of researchers. PIT tags are designed to minimize internal complications through the use of a glass protective coating. Although this glass casing serves to both protect the electronic components and prevent tissue irritation (Gibbons and Andrews 2004), there are some reports of visible infection and irritation at the PIT tag injection site despite proper use of disinfecting techniques during insertion in marine turtles (Dutton and McDonald 1994), manatees (Wright et al. 1998), and fish (McKenzie et al. 2006). Along the Atlantic Coast of the U.S., reports of tag-related infection and joint injuries appear in stranding data (New England Aquarium [NEAq], unpubl. data). While there are many advantages to using PIT tags (Balazs 1999; Gibbons and Andrews 2004), recognizing risks and advantages associated with different tagging sites will enhance the quality of studies relying on this marking method. As all seaturtle species are considered imperiled (IUCN listing varies with population), there remains a need to recognize impacts on the health, physiology, and ultimately the survival of PIT-tagged turtles.

The use of PIT tags is usually benign. When tags are placed into muscle, the cutting edge of the applicator needle makes a small circular cut that extends to the depth of the injection. The tags induce encapsulation by fibrous connective tissue, which stabilizes their placement. Encapsulation is most rapid and effective in highly vascular, resilient tissue such as muscle. While the injection causes a small cut in the muscle, it is the responses by fibroblasts and muscle cells to this minor damage that result in largely stable tags. When the tags do not stay where placed, they can be expelled from the body or migrate internally causing inflammation and damage and opening a route to infection. PIT tag movement has been documented in bats (Barnard 1989), young birds (turkey poults; Jackson and Bunger 1993), reptiles and amphibians (Camper and Dixon 1988; Keck 1994), and fish (Baras et al. 2000, Gheorghiu et al. 2010). Baras et al. (2000) found that PIT tags injected into perch migrated ventrally over time. PIT tag movement also has been reported in Hawksbill (*Eretmochelys imbricata*) seaturtles (van Dam and Diez 1999). Not only can the migration of the tag reduce the re-identification accuracy, it may cause injury. The risk of complications can be minimized by the location and method of tag placement (Germano and Williams 1993; Gibbons and Andrews 2004; Jackson and Bunger 1993). In cheloniids, PIT tags usually are inserted via injection using an applicator fitted with a sterile 12-gauge needle. The most common PIT tagging sites used in the U.S. Atlantic and Gulf of Mexico coasts are subcutaneously along the trailing side of the flipper blade (adjacent to the radius and ulna, wrist, and/or metacarpals; Fig. 1) or, for large species (*Dermochelys* and some cheloniids), in anterior shoulder muscles medial to the arm. Additionally, more than 9000 Kemp's Ridley (*Lepidochelys kempii*), Loggerhead (*Caretta caretta*), Green (*Chelonia mydas*) and Hawksbill turtles were released with PIT tags inserted into the ventrally located pectoral muscles (Fontaine et al. 1987). To date,

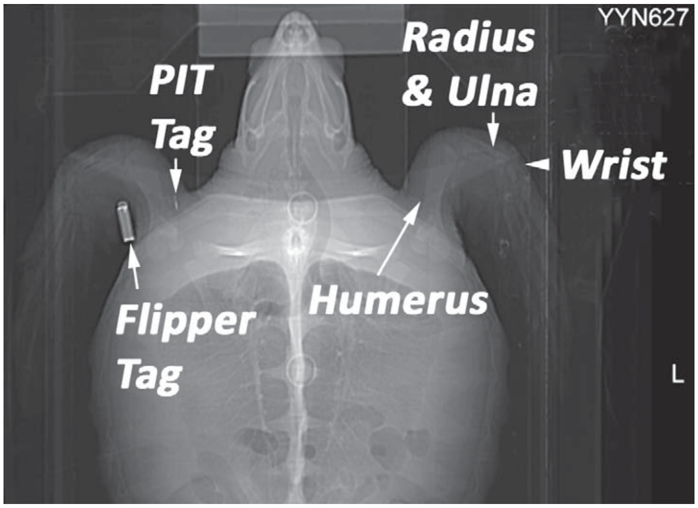

FIG. 1. The overall skeletal anatomy of the marine turtle forelimb and shoulder and several tags are shown in this two-dimensional dorsoventral view CT scan. The forelimb skeletal elements of relevance to this study are labeled. The small PIT tag is in the triceps muscle, an external flipper tag in attached to the trailing edge of the flipper. The light circles at mid-body and the base of the neck, as well as the lighter rectangle at the anterior head, are parts of the scanner's table.

studies of PIT tag placement in seaturtles focus on locations that maximize tag reader reception (Epperly et al. 2008).

In this study, we tested the null hypotheses that PIT tag movement does not differ between species or between two locations in the forelimb: the trailing side of the flipper blade (defined as the proximal manus and antebrachium) and the triceps muscle complex of the upper arm (the brachium). We assess whether PIT tags migrated once placed at the two locations in clinically healthy juvenile Loggerhead and Kemp's Ridley turtles. We report PIT tag movement in both species at the two tagging sites and recommend adoption of the triceps muscle site in seaturtle studies to reduce tag migration and potential complications.

Turtles and Maintenance.—The Loggerhead turtles for this study were wild-caught as hatchlings from marked nests in Clearwater, Florida, USA (emerged from nests 27 August 2000); Kemp's Ridley turtles originated as hatchlings from relocated nests incubated on the beach at Rancho Nuevo, Mexico (emerged 16 August 2000). The turtles were reared in captivity at the National Marine Fisheries Science (NMFS) Sea Turtle Facility in Galveston, Texas, USA. All turtles were juveniles and were similar in size (Loggerhead turtles, N = 21, 31.4–33.6 cm straight carapace length (SCL), mean ± SD = 32.6 ± 0.6 cm; 3.3–4.8 kg, mean = 4.0 ± 0.4 kg; Kemp's Ridley turtles, N = 24, 27.0–30.2 cm SCL, mean = 29.1 ± 0.7 cm; mean = 3.4 ± 2.0 kg). Turtles were held in individual rearing containers in a common raceway tank filled with seawater. Raceways were drained and re-filled with fresh seawater three times/week (described in detail elsewhere, Higgins 2003). Kemp's Ridley turtles were maintained in the Galveston facility prior to and for the duration of the study. Loggerhead turtles were maintained at the Galveston facility for two months, taken to Panama City, Florida and placed under semi-wild conditions for 30 days in communal, large open seawater pens. There they were used for fishing equipment research unrelated to this study, then returned to Galveston. In the Panama City pens, turtles were able to swim more vigorously and interact, potentially challenging the tags and the tag sites beyond what they might experience at the Galveston facility.

PIT Tag Placement and Tag Migration Assessment.—All turtles were tagged in the same forelimb, at both tagging locations, on the same day. Tagging sites were cleaned with 70% isopropyl alcohol and povidone iodine swabs, and then one PIT Tag (Model TX1406L, Destron-Fearing, 12.50 mm L x 2.07 mm diam) was inserted at each site via a pre-loaded sterile 12-gauge needle. One tag was placed deep to the dorsal skin adjacent to the fifth metacarpal and carpal bones on the caudal (postaxial) side of the flipper (Fig. 2a), while the other was placed within the cranial part of the triceps muscle complex in the upper arm on the same side of the turtle (Figs. 2b). Each tag site was sealed with a drop of surgical cement (VetBond™ ; 3M™ , St. Paul, Minnesota) to minimize the chances of tag loss and infection.

Initial MRI scans of the entire flipper were taken shortly after insertion (1 April 2002 for Kemp's Ridley turtles; 2 April 2002 for Loggerheads). Second MRI scans were taken at 104–106

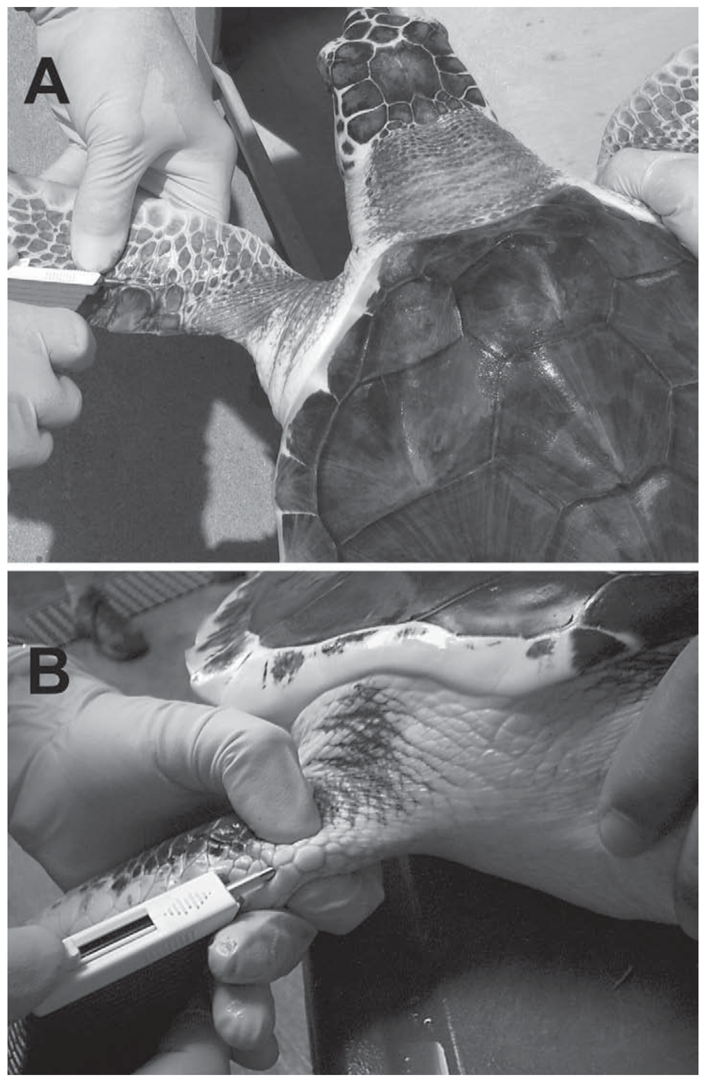

FIG. 2. (A) PIT tag insertion into trailing edge of flipper blade parallel to the fifth metacarpal and postaxial carpal bones. (B) PIT tag insertion in triceps muscle complex of the upper arm showing the method of manipulating the muscle and allowing the tagger to palpate the insertion of the tagging needle and tag.

days (16 July 2002 for Loggerheads, and 17 July 2002 for Kemp's Ridleys). Each turtle was anesthetized (0.15 mg/kg meditomidine, 5 mg/kg ketamine) administered IV in a cervical sinus (external jugular vein). Turtles were placed in ventral recumbency with the flipper positioned alongside the body in a standardized position, flippers were flexed so they rested along the lateral carapace with the blade's long-axis aligned with the scanner table axis, and flippers were held in place with Vet Wrap™ Bandaging Tape (3M™, St. Paul, Minnesota). Scans were taken in dorsoventral and axial planes so that the three-dimensional positions of the skin, muscles, tag, and bones could be visualized. After the scans, the anesthesia was reversed with 0.75 mg atipamezole administered IV in the external jugular vein.

Table 1. The fate of PIT tags in (A) Loggerhead (N = 21) and (B) Kemp's Ridley (N = 24) seaturtles over 104–106 days, showing the contingency tables for each species.

A. Loggerhead		Flipper blade		
		No movement	Movement	Row totals
Triceps muscle	No movement	11	7	18
	Movement	1	2	3
	Column totals	12	9	21
B. Kemp's Ridley		**Flipper blade**		
		No movement	Movement	Row totals
Triceps muscle	No movement	15	9	24
	Movement	0	0	0
	Column totals	15	9	24

The metal in each PIT tag produced a signal-void of characteristic size and shape. The maximum size of each signal-void (hereafter referred to as the PIT tag) was used to determine tag position. Each scan was evaluated to determine the distance of the PIT tag's longest axis end to nearest joint and/or bone (Fig. 3); the structure used as the landmark varied among individuals, but was consistent within an individual. Distances were measured using eFilm Lite v.2.1 (Merge Technologies Inc. 2005) and compared. Humerus length (from midpoint of the head to distal-most point, the radial facet) was also measured and compared between first and second scans to account for growth during the study. PIT tags were categorized as having moved or not moved. If the distance of the PIT tag void to the nearest joint and/or bone was greater than the increase in humerus length ± resolution error (defined as > 0.2 cm), the tag was considered to have moved. If the distance was not greater, the tag was assumed to have not moved. In the absence of three-dimensional reconstructions and scan intervals greater than the one we used, we could not measure actual paths traveled for each tag.

Statistical Analysis.—A 2 x 2 contingency table and McNemar's test for significance of changes, adjusted with Williams' correction, was used to assess whether PIT tag movement in one location was independent of movement in the second location. SAS v.9.2 was used to generate all statistics (SAS Institute, Inc. 2009).

Results.—In Loggerheads, three of the 21 tags (14%) placed in the triceps muscle complex migrated, while 9 tags (43%) placed in flipper blades displayed movement (Table 1). However, in the

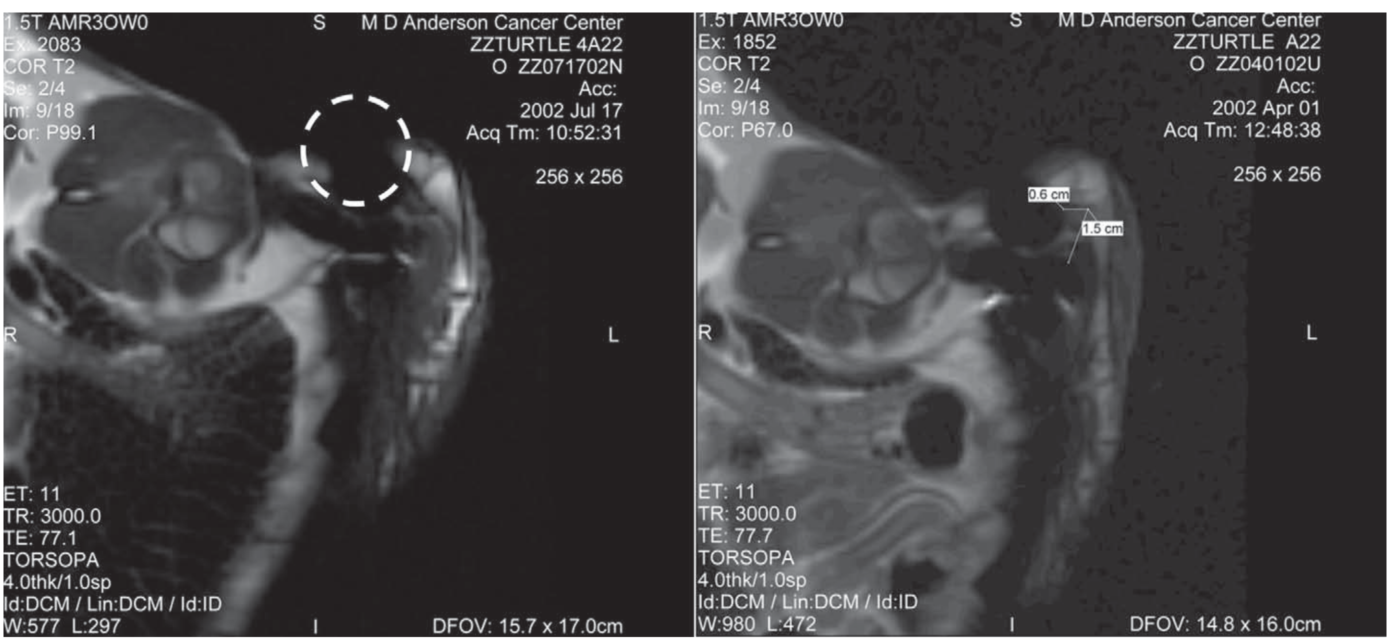

Fig. 3. (A) A dorsoventral plane MRI scan of the left turtle flipper and shoulder. The white dashed circle indicates a signal-void produced from PIT tag in the triceps during the MRI scans. The bone and fat are light colored, muscle is gray, and air in the lung is black. (B) MRI scan of a left turtle flipper with measurements taken from the long axes of the two signal-voids to the nearest joint. Humerus length (from midpoint of the head to the distal-most point, the radial facet) was also measured and compared between first and second scans to account for growth during the study.

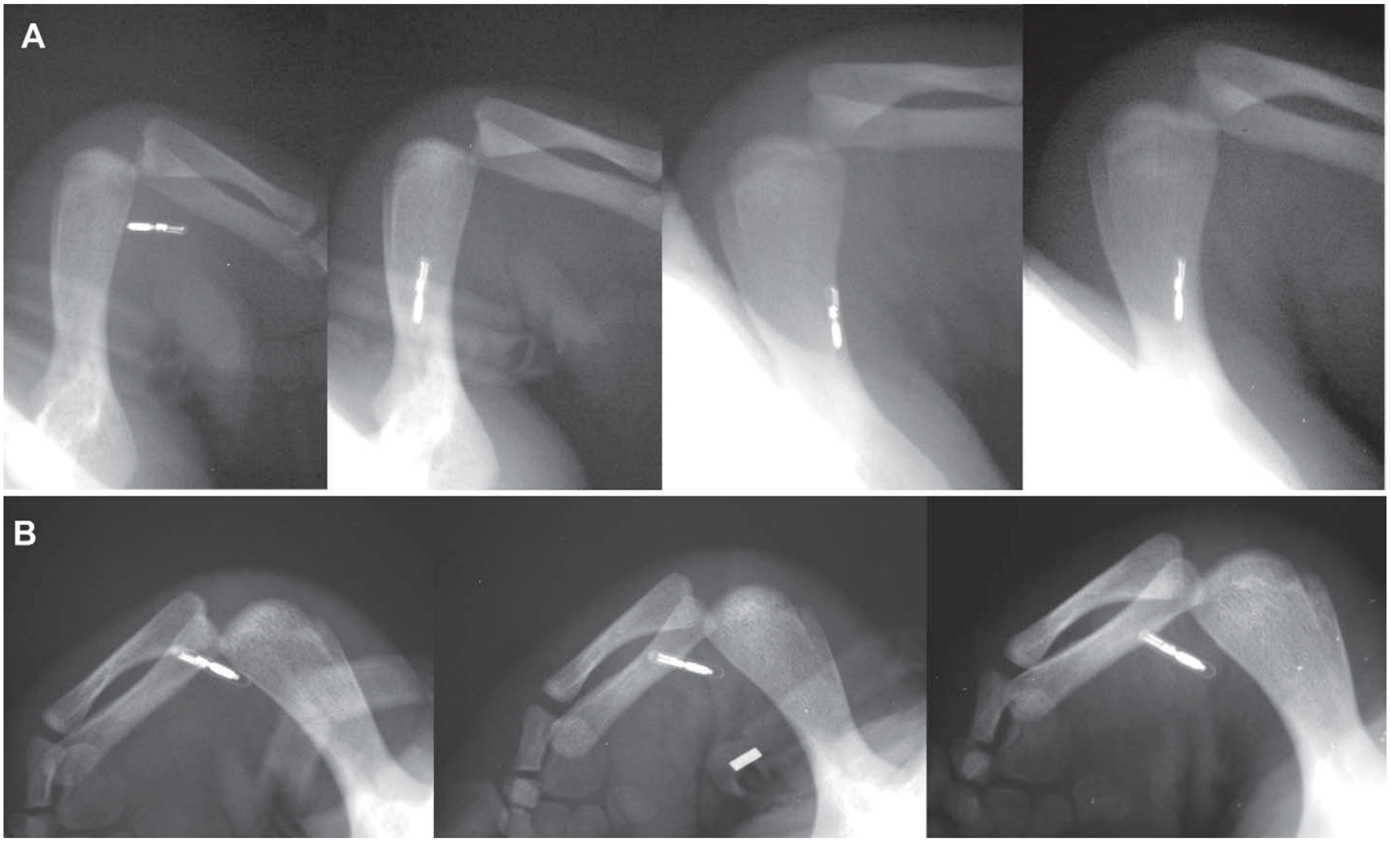

Fig. 4. (A). Migration of a PIT Tag in the right flipper of a cold-stunned Kemp's Ridley (ID No. 99-831). The top four images span 253 days. The greatest proximal movement occurred between the initial radiograph (28 days after the tag was inserted) and the second, a period of 58 days. Subsequent movement was more circumferential from the second to last images (from 58 days to 168 days to 253 days). While the tag migration was quite obvious, the site did not become infected, most likely due to several courses of systemic antibiotics administered to treat other health issues. (B) Botton row: radiographs taken of a second Kemp's Ridley (ID No. 99-842), also show PIT tag migration, however with less drastic movement than in 4A. While the migration of the tag appears shorter in distance, the impact to the animal's health was more significant. The PIT tag was initially placed in the anterior dorsal part of the left front flipper blade on 21 November 1999. The radiographs (left to right) were after two days, 73 days, and 89 days. The tag site became severely infected requiring surgical removal of the tag. The animal was treated topically at the wound site and with systemic antibiotics for several months following tag removal.

majority of cases (62%), both of an animal's tags performed similarly. We rejected the hypothesis that movement at the two sites was the same in Loggerheads ($S_{adj} = 4.2353$, $p < 0.05$). The maximum net tag migration that we could measure, in Loggerheads, was 5.2 cm in the flipper blade and 1.3 cm in the triceps muscle complex. In Kemp's Ridley turtles, none of the 24 tags placed in the triceps muscle complex migrated, whereas 9 of the tags (38%) placed in the flipper blade had moved (Table 1); the maximum net distance moved in the flipper blade of Kemp's Ridleys was 2.2 cm. The marginal proportions (e.g., the cases where both tags in a turtle did not have the same result) were identical (38%) in the two species (Table 1). In no case was infection noted.

Discussion.—We determined that the forelimb tagging locations used in two species of marine turtles differ in their tendency for PIT tags to migrate. Tag migration is an important factor to consider in minimizing risks to the turtles. Movement occurred more often in PIT tags that were inserted subcutaneously in the flipper blade, suggesting that this location can be problematic. The tag stability at one site was not related to tag performance at the other site. Our results are consistent with the tag loss results that vanDam and Diez (1999) found when tags were placed subcutaneously in Hawksbill turtles. Despite the short time frame of this project and the lack of three-dimensional reconstructions, we were able to detect migration by PIT tags in the subcutaneous hypodermal layer, which is rich in collagenous and elastic connective tissues. This site, adjacent to the ulnare, pisiform (carpals), and fifth digit metacarpal, has relatively thick, keratinous skin overlying a connective tissue network with little or no muscle tissue. The muscles of the manus are very reduced in this part of the flipper and may be missed entirely during PIT tag application. In contrast, PIT tags inserted into the triceps muscle complex with the muscle pinched outward (cranially or dorsally) during tag placement (Fig. 2b) clearly are embedded in muscle tissue. Muscle, a metabolically more active tissue, is more likely to encapsulate the tag quickly. While PIT tags may become encapsulated and stabilized in connective tissue, they appear to be more stable when placed in muscle. We presume that the tags placed in the shoulder muscles of large turtles as well as those placed in the hind flipper muscle (Balazs, unpubl. data), a tagging site used in some Pacific studies, are probably stable, however, direct comparisons with the hind flipper site were beyond the scope of this study.

The possibility exists that movement of the tag may occur well beyond the time frame of this study (104–106 days). It is possible that tag movement or loss may be greater in wild animals than those in captivity (Thomas 2006) associated with their potential exposure to more varied physical stressors, although we did not observe such in Loggerheads that were allowed 30 days of swimming in open pens (compared with Kemp's Ridleys that were maintained in tanks). PIT tag movement may also increase with the size of an animal (Gibbons and Andrews 2004), indicating that the tag movement measured in this study may be less than what might occur in larger juvenile or adult turtles.

In some cases, movement of a PIT tag may be detrimental to seaturtle health and survival. Several cases of PIT tag migration in the flippers of cold-stunned Kemp's Ridley turtles were documented by the NEAq while the animals were undergoing rehabilitation. In November 1999, more than 277 seaturtles stranded along the shores of Cape Cod Bay (Massachusetts, USA) during a large cold-stunning event. A total of 156 were recovered alive (Still et al. 2002) and transported to the NEAq for rehabilitation. Due to the overwhelming volume of cases admitted into the NEAq seaturtle clinic, turtles were rapidly transported to secondary facilities for rehabilitation. Many turtles were PIT tagged in the dorsal and cranial flipper blades prior to transport (N = 103 Kemp's Ridleys), while others were tagged prior to release. Tag migration was noted via radiographs of several turtles (Fig. 4). At least eight of those 103 turtles developed localized infection associated with the PIT tag, and surgical removal of the tag was required. It is likely that this number under-represents the true number of infections, due to the difficulty in following the clinical outcome of large numbers of turtles after relocation to multiple institutions. At least one of these turtles developed significant osteomyelitis of the humerus, radium, and ulna. While osteomyelitis and joint mobility issues are common in cold-stunned turtles (Wyneken et al. 2006), the proximity of the PIT tag to the sites of infections suggested further assessment of PIT tagging location was warranted. Infections of the skeleton and primary locomotor structures are likely to decrease survival probability.

Because our study tested the tendency of PIT tags to migrate in clinically normal turtles (both Kemp's Ridley and Loggerhead turtles) we were able to confirm that tags placed in the flipper blade may migrate even in the absence of infection or cold stress. Similarly, tag migration was observed in penguins both in the presence and absence of microbial growth around the tag and infection (Clarke and Kerry 1998).

It is likely that when physiologically stressed, such as by hypothermia, immune function decreases (reviewed by Jacobson 2007). Thus cold-stunned or otherwise stressed turtles may be at increased risk of infection in the PIT tag site (Baras et al. 2000). Infection and irritation have been reported in PIT tagged leatherback turtles as well (Dutton and McDonald 1994).

Studies of PIT tag placement in the skin of manatees (*Trichechus manatus latirostris*) showed that when the skin is thick, a plug of skin can be driven internally in front of the tag during the injection, increasing the risk of infection. This may, in turn, increase tag movement or rejection (Lambooij et al. 1995; Wright et al.1998).

PIT tags can also be expelled from animals, depending on where the tag is placed (Elbin and Burger 1994; Fontaine et al. 1987; Gibbons and Andrews 2004). Zimmerman and Welsh (2008) studied the placement of PIT tags in American Eels (*Anguilla rostrata*) and found that tag retention varied according to tag location, with the highest retention rates in tags placed into musculature. PIT tags placed in penguins and monitored over several years showed that tag movement can be substantial (> 5 cm; Clarke and Kerry 1998). We observed less movement in PIT tags placed into seaturtle triceps muscle than the trailing aspect of the flipper blade, thus its use may minimize the potential for tag migration, infection and loss. Risk of PIT tag movement and/or infection caused by PIT tags in seaturtles can be mitigated by combining standard skin cleaning with an antiseptic solution prior to application, the use of a sterile applicator and tag, and placement of the tag in a stable location where the keratinous skin layer is thin and the tag is most likely to be placed in muscle. In addition, the accuracy of seaturtle mark-recapture studies will increase because once placed in the triceps muscle, the tag is less likely to move; it remains within readable distance because of the location and size of the muscle, and should increase recognized recaptures.

There may be other advantages to placing the PIT tags into the triceps muscle over the flipper blade. The triceps muscle complex provides some soft tissue protection and so may decrease the likelihood of a tag failure due to shattering of the glass casing. When the glass encasing a PIT tag's electronics is broken, the transponder fails (Camper and Dixon 1988; Lambooij et al. 1995) and tags can migrate, breaking through skin (Germano and Williams 1993). Camper and Dixon (1988) report tag breakage and malfunction due to aggressive encounters between lizards. While we found no incidence of PIT tag failure in seaturtle flipper blades during this study, lack of "padding" in the flipper blade does little to minimize the risk of tag breakage.

While PIT tag location, consistency, and reliability are important aspects of any mark-recapture study, there has been relatively limited consideration of the efficacy of tag placement in seaturtles except for turtle size (Fontaine et al. 1987) and accommodating the limits of tag readers (Epperly et al. 2008). Consideration of tag migration risk in seaturtles is examined for the first time here.

The use of PIT tags is an integral part of much herpetological research. PIT tag use is clearly essential in understanding vertebrate populations worldwide and has greatly increased the reliability and ease of re-identification of individuals. PIT tag use is bolstering our knowledge of seaturtle populations, at sea and on land. Their use in seaturtles has increased recapture rates, which has improved understanding of turtle movements, growth rates, habitat use, nesting success, internesting intervals, migration and numerous other life-history attributes. In addition, the use of PIT tags has eliminated the need to mark turtles using tattooing, drilling or carapace scarring (Affronte and Scaravelli 2002; Hendrickson and Henrickson 1981). Our results support avoiding the flipper blade and applying tags in the triceps to minimize risks of compromising the well-being of the tagged animal.

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vice Endangered Species Act Section 10a(1)a Scientific Research Permit #TE-676379-4 and complied with all institutional animal care guidelines. The Florida Atlantic University (FAU) IACUC determined that the study is in compliance with IACUC guidelines; administratively it does not receive an approval number because FAU personnel worked with the data files alone, not the animals. The methods used were consistent with those the IACUC would approve had the animal part of the study been done by FAU personnel. At the time, the NMFS did not issue IACUC approvals, but always complied with USFWS and State of Florida requirements for holding seaturtles. J. Flanagan, DVM ensured that best practices were followed. All authors participated in one or more aspects of this study and edited the manuscript.

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AMPHIBIAN DISEASES

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Detecting the Western Limits for *Batrachochytrium dendrobatidis* in Southeastern Queensland, Australia

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The fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*) is implicated in the decline of worldwide amphibian populations (Berger et al. 1999), with new occurrences of the fungus being constantly reported (e.g., recent issues of *Herpetological Review*). Whereas the fungus has been detected in numerous locations, it is considered an invasive species (Weldon et al. 2004) and an emerging infectious disease (Daszak et al. 1999; Rosenblum et al. 2010), and hence its distribution is not at equilibrium. Niche modeling has predicted the potential of *Bd* to invade southern and central Africa, parts of south-east Asia, southern and central North America, Europe, and South America (Ron 2005). Within Australia the impact of the fungus is expected to be highest in the eastern and southeastern mountainous regions along the eastern seaboard (Rödder et al. 2008), however it is expected to reach its physiological limits approximately 300–400 km from the coastline (Rödder et al. 2008).

Although numerous studies within Australia have detected *Bd* along the eastern coastline (Kriger et al. 2007a; see Ron 2005 appendix) there have been no studies aimed at detecting *Bd* west of the mountain range known as the Great Dividing Range in southeastern Queensland. Considering the impacts that *Bd* has had on amphibian populations worldwide it is essential to determine the presence of this fungus in untested areas. The aim of our study was to sample for *Bd* in the unsampled western

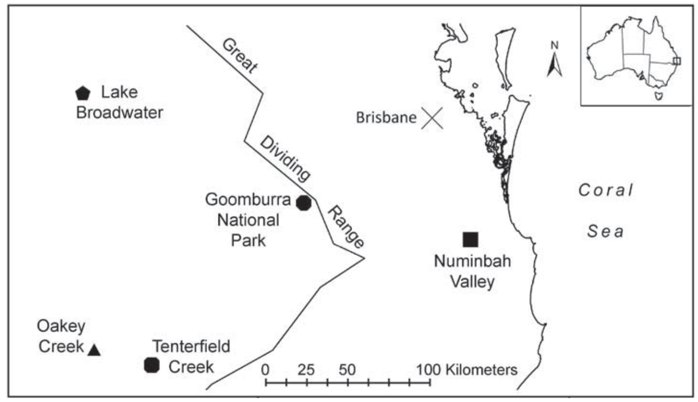

Fig. 1. Location of sites sampled for *Batrachochytrium dendrobatidis* east and west of the Great Dividing Range (approximate location represented by the left line), Queensland, Australia. The coastline (right line) and Queensland's capital city, Brisbane (X) are shown.

plains of southeastern Queensland, Australia.

We sampled for *Bd* in early September 2007 at four sites west of the Great Dividing Range (GDR) in southeast Queensland, including a previously known site of *Bd* on the GDR in Goomburra National Park (Ron 2005) (Fig. 1). We also sampled a well-studied site in Numinbah Valley (east of the GDR) as a reference site to address annual variation in prevalence (Kriger and Hero 2006; Kriger et al. 2007a) (Fig. 1). Sampling was carried out in spring (26 September 2007 to 10 October 2007) to maximize the probability of detecting *Bd* (Kriger and Hero 2007). We swabbed 212 adult frogs, with 145 sampled west of the Great Dividing Range and 67 sampled at Numinbah Valley (Table 1).

A standardized swabbing method was used (Kriger et al. 2007a), modified slightly as we did not swab the dorsal surface. Swabs were stored on ice and kept in a refrigerator until analysis (Van Sluys et al. 2008). Frogs were individually handled with clean 250 mm x 200 mm plastic bags, which were discarded after use to avoid the transfer of *Bd* and to minimize the chances of sample contamination. All frogs were swabbed by the same individual (JMH) to avoid swabber bias. To circumvent sampling the same frog twice, individuals were not released until all frogs had been swabbed at each site.

Quantitative polymerase chain reaction techniques (qPCR), as described by Boyle et al. (2004) with modifications described by Kriger et al. (2006), were used to determine *Bd* presence. A positive infection was considered any frog which produced a result of one or more zoospores in the triplicate PCR analysis procedure (Kriger et al. 2007b). Prevalence for each species per site was calculated.

The site with the highest prevalence (25.4%) was Numinbah Valley, located east of the GDR. This was followed by Goomburra National Park (12.5%), located just west of the GDR, Lake Broadwater (7.1%), and Tenterfield Creek (2.2%; Table 1). We detected *Bd* at only one site sampled at Lake Broadwater. This site consisted of 19 of the 28 individuals surveyed for the Lake Broadwater Conservation Park. All frogs detected with *Bd* were from water bodies that are either permanent or temporary riverine systems (Table 1).

Our study has extended the known range of *Bd* west of the GDR, in southeast Queensland, Australia, by approximately

Table 1. Sites where frogs were sampled for *Batrachochytrium dendrobatidis* (*Bd*), both west and east of the Great Dividing Range (GDR) in southeast Queensland, Australia. *Bd* prevalence per site and per frog species sampled is shown. Habitat types of sampling locations were either permanent or ephemeral water bodies (streams or ponds).

Location (habitat type)	Lat / Long ° (approx. distance west (+) or east (-) of GDR (km)	Species	No. *Bd*-positive / No. frogs swabbed	Prevalence (%)
Tenterfield Creek (permanent)	-28.8600 151.4852 (+52)	*L. wilcoxii*	1/43	2.2
		L. latopalmata	0/3	0
	Tenterfield Creek Total		**1/46**	**2.2**
Oakey Creek (permanent)	-28.7753 151.1705 (+80)	*L. wilcoxii*	0/17	0
		L. latopalmata	0/6	0
	Oakey Creek Total		**0/23**	**0**
Lake Broadwater Surveyor's Gully Site 1 (ephemeral) 100	-27.3765 151.1088 (+85)	*C. alboguttata*	0/1	0
		L. tasmaniensis	1/1	
		L. fletcheri	0/3	0
		L. latopalmata	1/14	7
	Surveyor's Gully Site 1 Total		**2/19**	**10.5**
Lake Broadwater Surveyor's Gully Site 2 (ephermal)	-27.3765 151.1088 (+85)	*C. alboguttata*	0/2	0
		L. tasmaniensis	0/1	0
Lake Broadwater Quarry Dam Site 3 (permanent)	-27.3765 151.1088 (+85)	*L. tasmaniensis*	0/5	0
Lake Broadwater Historical Farm Dam Site 4 (permanent)	-27.3765 151.1088 (+85)	*L. tasmaniensis*	0/1	0
	Lake Broadwater Total (all sites combined)		**2/28**	**7.1**
Goomburra N.P. Dalrymple Creek (permanent)	-27.9754 152.3153 (+6)	*L. wilcoxii*	6/48	12.5
Numinbah Valley Nerang River (permanent)	-28.1752 153.2258 (-60)	*L. wilcoxii*	17/67	25.4

85 km (Ron 2005). This range extension falls within the area predicted by the Rödder et al. (2008) model.

All *Bd*-positive samples were taken from frogs captured in riverine systems that have flowing water for at least some time of the year. The absence of detection of *Bd* from ponds/dams at Lake Broadwater may be due to low sample size (Table 1). However Kriger and Hero (2007) found low prevalence of *Bd* in anuran pond/dam breeders when compared with stream breeders. The low prevalence and lack of *Bd* within the other permanent river systems sampled in this study (Tenterfield and Oakey Creek) suggest the distribution of *Bd* in the drier inland parts of Australia may be patchy or absent.

Our results suggest that prevalence is lower at sites west of the GDR when compared with sites east or on the GDR, thus suggesting that prevalence decreases within populations of frogs with increasing distance west of the GDR in south-eastern Queensland. Prevalence was low west of the GDR when compared with our samples both east of (Nerang River, Numinbah) and on the GDR itself (Darlymple Creek, Goomburra). This is not surprising because *Bd* has been readily detected in areas with high rainfall and cooler temperatures (Kriger and Hero 2006; Kriger and Hero 2008, Kriger et al. 2007a), and the rainfall gradient decreases and average temperatures increase with increasing distance west of the GDR (Hijmans et al. 2005).

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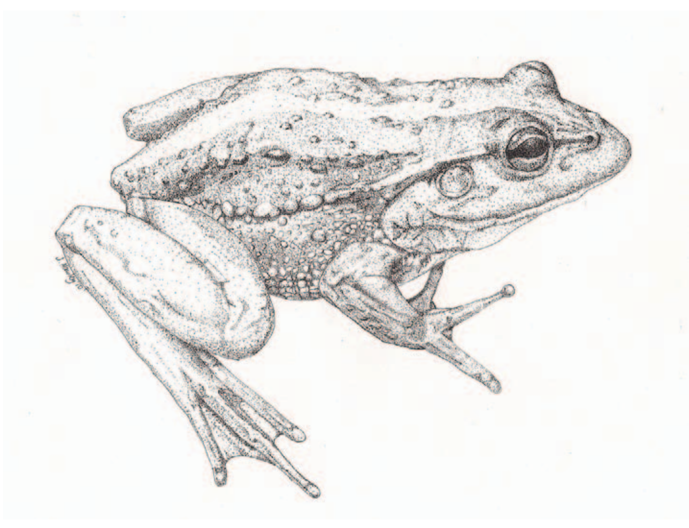

Litoria raniformis. Australia: South Australia, River Murry. Illustration by Jesse Hawley (Jess_H_91@hotmail.com), based on a photograph by Michael B. Thompson.

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Annual Variation of *Batrachochytrium dendrobatidis* in the Houston Toad (*Bufo houstonensis*) and a Sympatric Congener (*Bufo nebulifer*)

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The Houston Toad (*Bufo* [= *Anaxyrus*] *houstonensis*) is endemic to south-central Texas, USA, currently occupying suitable habitat in seven counties (Forstner and Dixon 2010). Population sizes are in steady decline, and the populations in Bastrop County are considered the most robust and sustainable of the remaining populations (Seal 1994), with current estimates of less than 500 adult individuals (M.R.J. Forstner, unpubl.). The Houston Toad was listed as endangered in 1970, and has been referred to as "probably the rarest and most endangered amphibian in the United States" (USFWS 1978). The factors linked to global amphibian decline (e.g., habitat alteration, global environmental change, environmental contaminants, introduced species, emerging infectious diseases) or combinations thereof are likely primary threats to the Houston Toad as well (Seal 1994; Peterson et al 2004). Yet, published information on infectious diseases of this endangered taxon is still lacking.

Chytridiomycosis is a recently emerged infectious disease caused by the fungus *Batrachochytrium dendrobatidis* (*Bd*). It has been implicated as a significant contributor to amphibian population declines worldwide (Berger et al. 1998; Garner et al. 2005; Ouellet et al. 2005). The presence of *Bd* has been confirmed in many states of the USA (Davidson et al. 2003; Ouellet et al. 2005; Rothermel et al. 2008) including south-central Texas near Bastrop County where it was detected in several endemic salamander species (*Eurycea nana*, *E. neotenes, E. pterophila*, *E. sosorum*, and *E. tonkawae*) and in Blanchard's Cricket Frogs (*Acris crepitans blanchardi*) (Gaertner et al. 2009a; Gaertner et al. 2009b).

The aim of this study was to expand the previous research on *Bd* in south-central Texas in order to assess the potential threat that the presence of *Bd* might pose to Houston Toads. These studies took advantage of existing DNA from toes of *B. houstonensis* and a sympatric toad, *Bufo* [*Anaxyrus*] *nebulifer* (Coastal Plain Toad) originally sampled for a long-term conservation study on *B. houstonensis* in Bastrop County and available from the M.R.J. Forstner Frozen Tissue Catalogue held at Texas State University-

San Marcos. Toads were sampled opportunistically and via drift fences around small ephemeral and semi-permanent reservoirs on the Griffith League Ranch (30.215390°N, 97.255320°W), Bastrop State Park (30.110745°N, 97.292980°W), and several other sites within federal designated Houston toad Critical Habitat in Bastrop County, Texas.

Toes were collected between 2001 and 2007 from January to May, a period prior to the average monthly temperature rising above 25°C. All samples were stored in 95% ethanol at –80°C: 105 *B. houstonensis* (2001, N = 8; 2002, N = 24; 2003, N = 16; 2004, N = 2; 2005, N = 7; 2006, N = 24; 2007, N = 24) and of 96 *B. nebulifer* (2001, N = 21; 2002, N = 3; 2003, N = 6; 2004, N = 18; 2006, N = 24; 2007, N = 24) (Table 1). DNA was isolated using a Wizard® SV 96 Genomic DNA Purification System (Promega) on a Biomek® 3000 Laboratory Automation Workstation (Beckman Coulter), a DNeasy™ Tissue Kit (QIAGEN Inc.), or a standard phenol-chloroform method (Sambrook et al. 1989). We tested for *Bd* using a nested PCR approach (Gaertner et al. 2009a). The nested PCR used primers ITS1f and ITS4 targeting conserved regions of the 28S and 18S rRNA to amplify the 5.8S rRNA gene and the flanking internal transcribed spacer (ITS) of all fungi (White et al. 1990). Purified PCR products were then used as a template for the second PCR reaction using the primer set Bd1a and Bd2a which is specific for *Bd* (Annis et al. 2004). Reactions were then examined for the presence of a 300-bp fragment (Annis et al. 2004) using gel electrophoresis (2% agarose in TAE buffer) (Sambrook et al. 1989).

Overall, 29 of 201 (14.4%) toads tested were positive for the 300-bp fragment, indicating *Bd* presence, including 6 of 105 *B. houstonensis* and 23 of 96 *B. nebulifer* (Table 1). More than 80% (24 of 29) of *Bd*-positive samples were obtained in year 2006. Samples obtained in 2003 (23 tested) and 2005 (7 tested) were all *Bd*-negative, whereas years 2001 (2/29 or 6.9%), 2002 (1/28 or 3.6%), 2004 (1/20 or 5.0%), 2006 (24/48 or 50%) and 2007 (1/48 or 2.1%) had positive samples though mostly at low percentages (Table 1). All amplicons of the appropriate size were purified, and then sequenced at the DNA Sequencing Facility of the Institute for Cellular and Molecular Biology at the University of Texas at Austin, TX. Sequences were compared to GenBank/EMBL databases and aligned using BLAST (Pearson and Lipman 1988) and alignment functions in Geneious 4.8.3 (Drummond et al. 2009). Sequence diversity was limited. Two haplotypes were discovered that shared more than 99% similarity to sequences in the databases representing *Bd*. Haplotype A (GenBank Accession HM153084) was detected in toads sampled in 2001, 2002, 2004 and 2006 and in both *B. houstonensis* and *B. nebulifer*. Haplotype B (HM153085) was not detected in samples collected prior to 2006 and was detected only in *B. nebulifer* (Table 1). These results demonstrate the presence of *Bd* in populations of *B. houstonensis* and *B. nebulifer* as early as 2001 and within federally designated Critical Habitat of the Houston Toad. Any further statements about the significance of this observation and consequences for current and future conservation efforts for *B. houstonensis* specifically remain speculative, and require additional studies.

Detection of *Bd* in zero or only a few individuals during most years may depend on seasonal and environmental conditions as is the case in other wild amphibians (Gaertner et al. 2009b; Kriger and Hero 2006; Voordouw et al. 2010). Although this situation does not correspond with the commonly viewed perception of disease dynamics, populations of frogs with low numbers of infected individuals have been reported (Voordouw et al. 2010). Populations of *Xenopus* frogs in South Africa, for example, have carried the fungus with a relatively low prevalence (about 2.7%) for as long as 65 years (Weldon et al. 2004). Alternatively, these results could underestimate the presence of *Bd* due to sampling bias as a consequence of low numbers or of preferential predation on infected toads in nature. Assuming a low prevalence of infection, approximately 60 individuals would need to be tested to provide a 95% certainty of detecting *Bd* on at least one animal (Skerratt et al. 2008).

Of particular interest are the results from year 2006. Despite populations from all other years lacking detections or with relatively low numbers of positive samples, 50% of the samples collected in 2006 (N = 48) were *Bd*-positive. Differences in the prevalence of *Bd* in anuran populations have been seen frequently but were attributed to seasonal differences in temperature (Kriger and Hero 2007; McDonald et al. 2005; Ouellet et al. 2005; Retallick et al. 2004) or precipitation (Gaertner et al. 2009b; Ron 2005). Weather data retrieved for 2001–2007 breeding seasons (January to June) from the National Climatic Data Center using the average for three sites surrounding Bastrop (Smithville, Station ID 20024578; Cedar Creek, Station ID 20024579 and Elgin, Station ID 20024696) reveal that 2006 was notably hotter and dryer for the period, with an increase in temperature by 1.5°C and a decrease in precipitation by 256 mm from the average for the period. The conditions were the inverse necessary for optimal growth of *Bd* (Berger et al. 2004; Lamirande and Nichols 2002), even though a significant negative relationship between the occurrence of *Bd* and precipitation has been reported (Kriger and Hero 2007). That relationship, however, was suggested to be affected more by low temperature conditions than by the concomitant dry conditions. The increase in occurrence of *Bd* during 2006 in our study might therefore not be a consequence of the environmental conditions in this year alone, but may be significantly affected by the environmental conditions in the preceding drought in 2005 with 204 mm below average precipitation. Environmentally stressed toads could be more susceptible to *Bd* which may consequently result in an increase in occurrence of *Bd* the following year. A similar scenario was discussed in one of our previous studies that suggested high occurrence of *Bd* on salamanders at specific sites was caused by environmental stress from pollution originating from urban runoff (Gaertner et al. 2009a). Relief from the drought with precipitation 91 mm above average during year 2007 and thus reduction in environmental stress could then have resulted in a reduction in occurrence of *Bd*. The fluctuation in occurrence of *Bd* on toads, however, could also be a function of sample size and sampling strategy that were originally designed to retrieve information on the genetic diversity of toads. Low sample numbers, but also the inability to conduct repetitive sampling of sites with high numbers of infected toads in consecutive years might therefore have influenced the detection of *Bd* through time.

Data obtained for 2006 showed not only much higher occurrence of *Bd* on toads, but also species-specific differences in occurrence, with a much higher detection in *B. nebulifer* (83%, 20 of 24 toads) than in *B. houstonensis* (17%, 4 of 24 toads). Differences in occurrence of *Bd* in sympatric amphibian species

Table 1. Prevalence of *Batrachochytrium dendrobatidis* in *Bufo houstonensis* and *Bufo nebulifer* at localities in Bastrop County, Texas, USA, from January to May 2001 to 2007.

Species by year	Locality[1]	Prevalence (No. infected / total)	Fungal haplotype (no. infected)
2001			
B. houstonensis	BAN02p	1/5	A (1)
	BAN04p	0/1	
	BAN15t	0/1	
	BAN18t	0/1	
B. nebulifer	BAN02p	0/7	
	BAN12t	1/8	A (1)
	BAN15t	0/2	
	BAN19t	0/2	
	BAN34t	0/1	
	BAN35t	0/1	
	GLR	0/1	
2002			
B. houstonensis	BAN02p	1/17	A (1)
	BAN12t	0/1	
	BAN14t	0/1	
	BAN19t	0/2	
	GLR	0/3	
B. nebulifer	BAN02p	0/2	
	GLR	0/1	
2003			
B. houstonensis	BAN01p	0/1	
	BAN12t	0/1	
	BAN13t	0/1	
	BAN21t	0/1	
	BAN23t	0/1	
	BAN24t	0/1	
	BAN26t	0/1	
	BAS06p	0/3	
	GLR	0/6	
B. nebulifer	BAN40s	0/6	
2004			
B. houstonensis	BAN13t	0/1	
	BAS15p	0/1	
B. nebulifer	BAN02p	0/7	
	BAN04p	0/2	
	BAN14t	1/4	A (1)
	BAN17t	0/1	
	BAN23t	0/1	
	BAN24t	0/1	
	BAN36t	0/1	
	GLR	0/1	
2005			
B. houstonensis	BAS10t	0/1	
	BAS11t	0/3	
	BAS12t	0/2	
	BAS13t	0/1	
B. nebulifer	n/a	0/0	
2006			
B. houstonensis	BAS01p	1/4	A (1)
	BAS07p	1/4	A (1)
	BAS09p	1/8	A (1)
	BAS15p	0/1	
	BAS17p	0/6	
	BAS18p	1/1	A (1)
B. nebulifer	BAN02p	5/5	A (3), B(2)
	BAN09p	2/4	B (2)
	BAPp	3/3	A (1), B (2)
	BAS01p	1/1	B (1)
	BAS09p	9/11	B (9)

Table 1. Continued

Species by year	Locality[1]	Prevalence (No. infected / total)	Fungal haplotype (no. infected)
2007			
B. houstonensis	BAN29s	0/3	
	BAS04p	0/6	
	BAS07p	0/6	
	BAS08p	0/6	
	BAS18p	0/3	
B. nebulifer	BAN09p	1/3	B (1)
	BAN11p	0/2	
	BAN28p	0/4	
	BAN38p	0/2	
	BAS01p	0/1	
	BAS14p	0/4	
	BAS15p	0/4	
	BAS18p	0/4	

[1]Sites with the prefix BAN (Bastrop Co. 'north,' see Forstner and Dixon [2010]) are located 8–11 km W and WSW of the TX21/US290 junction. Site BAPp (Bastrop County 'p12') is about 10 km WSW of TX21/US290 junction. Sites with the prefix BAS (Bastrop Co. 'south') are within a 9 km radius E of TX21/TX95 junction, mostly between TX21 and TX71, with few sites W of TX21. All locations are within federally designated Critical Habitat for the species.

have been observed (Goka et al. 2009; Peterson et al. 2007; Retallick et al. 2004), with few studies linking the occurrence of *Bd* to the disease (Retallick et al. 2004). The increase in occurrence of *Bd* in 2006 was coincident with the identification of a new haplotype (haplotype B) that differed from the previously identified one (haplotype A) by a 10 bp insertion after base number 64. Haplotype B was identical to the most prominent *Bd* haplotype found in *Eurycea* salamanders from central Texas (GenBank Accession numbers EU779859, EU779862, EU779864, and EU779867) (Gaertner et al. 2009a) suggesting strain-specific differences affect occurrence and potential virulence as demonstrated in other studies (Berger et al. 2005; Goka et al. 2009; Retallick and Miera 2007). Because haplotype B was not found in *B. houstonensis*, but only in *B. nebulifer* so far, differences in host specificity might be present. This may also be evidence of *B. nebulifer* acting as a vector for *Bd* similar to assumptions for the American Bullfrog (*Lithobates catesbeianus* [*Rana catesbeiana*]; Daszak et al. 2004; Hanselmann et al. 2004) as *B. nebulifer* dispersed into Houston Toad habitats during the spring of 2006 as the drought left no breeding ponds in the grassland patches.

In any case, these speculations need additional studies with more samples and a sampling strategy directed towards repeated and seasonal analyses of *Bd* at a site with high occurrence of *Bd*. These studies should include comparative analyses of water and sediment samples for presence and abundance of *Bd* and the respective haplotypes as a function of environmental characteristics during the season.

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Comparison of PCR and RT-PCR in the First Report of *Batrachochytrium dendrobatidis* in Amphibians in New Jersey, USA

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Batrachochytrium dendrobatidis fungus (*Bd*) has recently been implicated as a cause of massive amphibian declines and extinctions globally (Berger et al. 1998; Daszak et al. 1999; Bosch et al. 2001). *Bd* surveillance typically relies on direct sampling of amphibians using non-invasive molecular techniques to screen for the presence of *Bd* DNA on their skin. Histological exams are also used to microscopically examine amphibian skin, identify zoospores, and diagnose the extent of *Bd* infection (clinically known as chytridiomycosis). However, histological examination is invasive and may not show *Bd* infection if zoospores are not actively being shed by an infected animal (Annis et al. 2004). *Bd* is a water-borne pathogen, so it is also important to test environmental water samples for this fungus, but this has proven difficult using microscopy (Annis et al. 2004). However, several recent studies have used molecular methods to successfully screen for the presence of *Bd* DNA in water and soil samples (Lips et al. 2006; Kirshtein et al. 2007; Walker et al. 2007).

Molecular detection of *Bd* DNA typically involves traditional polymerase chain reaction (PCR) with *Bd*-specific primers followed by visualization using agarose gel electrophoresis (Beard and O'Neill 2005; Lips et al. 2006). Although this technique has been successfully used to detect the presence of *Bd* DNA, it may be ineffective at detecting *Bd* DNA if the DNA concentration is low (early stage of infection and/or diluted environmental samples) since low concentration of template DNA may lead to PCR failure. To address this lack of sensitivity, some researchers have turned to real time fluorescently-based PCR (RT-PCR) for detection of *Bd* DNA (Boyle et al. 2004; Knapp and Morgan 2006). RT-PCR has been shown in some studies to be significantly more sensitive to dilute concentrations of DNA than conventional PCR (Helps et al. 2001; Balamurugan et al. 2009), however this is not always the case (Bastien et al. 2008).

There are currently few data available regarding the distribution of *Bd* in amphibians in the state of New Jersey, USA, making the threat of this pathogen to local amphibians unknown. A recent study of the Pinelands of southern New Jersey did not detect *Bd* in animals or environmental samples (Di Leo 2010). In this study we tested 43 samples (27 animals and 16 water) from the New Jersey School of Conservation in Northern New Jersey for the presence of *Bd* DNA using a traditional PCR-based approach and species-specific primers designed by Annis et al. (2004). We then re-screened these samples using the same primers in an RT-PCR assay to compare the two methods and screen for the presence of *Bd* in New Jersey.

Sampling was carried out at the 97-ha (240-acre) New Jersey School of Conservation (NJSOC, Branchville, Sussex County, New Jersey, 41.22690°N, 74.74975°W), the environmental field campus of Montclair State University, which is surrounded by undeveloped land including Stokes State Forest, High Point State Park, the Delaware Water Gap National Recreation Area, and other properties held by nonprofit conservation organizations. The property is primarily mixed deciduous forest with streams, vernal pools, and a small (6 ha) artificial lake, Lake Wapalanne. The NJSOC is located within the Flat Brook watershed of the Delaware River basin, an area with relatively high water quality (Delaware River Basin Commission 2008). However, the region is heavily used for recreation (e.g., trout fishing and hiking), raising the possibility that disease could be introduced through movement of fishing gear or introduction of live amphibians used as bait, as reported elsewhere (Picco and Collins 2008). This potential connection, however, is speculative since there are currently no empirical data available. We sampled water and animals at Lake Wapalanne and several vernal pools located within 1 km of the lake, and opportunistically sampled animals elsewhere on NJSOC property.

Sampling was conducted between 26 June and 18 August 2009. Animals were caught by net or hand and swabbed with a sterile cotton swab over all body surfaces with additional attention paid to the ventral surface. Swabs were stored in sterile 1.5 ml Eppendorf tubes for 2 to 6 h until transported to the laboratory where they were frozen at -20°C. Tadpoles were put in a 1.5 ml Eppendorf tube with approximately 500 µ1 water that was collected from the tadpole's environment. The tadpoles were allowed to "swim" in the tube of water for 30 sec to 1 min. Tadpoles were removed from the tube and returned to the environment. Samples were stored at room temperature for 2 to 6 h until transported to the laboratory where they were frozen at -20°C. We collected samples from the following species and life stages: *Lithobates clamitans* (8 tadpoles, 3 juveniles, and 9 adults), *L. palustris* (2 adults), *L. sylvatica* (1 adult), *Notophthalmus viridescens* (2 adults), and *Ambystoma maculatum* (2 larvae) for a total of 27 animals. We considered these animals to belong to the same geographic site given the close proximity of their habitat, so we did not sterilize nets during sampling.

Environmental samples consisted of water from the same aquatic habitats where animals were caught. Approximately 500 µ1 water were collected from each of 11 ephemeral ponds and one small stream, and four locations from Lake Wapalanne (16 samples total). Water samples were stored separately in sterile 1.5 ml Eppendorf tubes as described above.

We added 200 µ1 deionized water to the tubes with swabs and vortexed the tubes for approximately 30 sec. No additional water was added to the water or tadpole samples. We thawed water and tadpole samples, then vortexed them for approximately 30 sec. All samples were boiled in a boiling water bath for 10 minutes to lyse open zoospores if present.

A sample of *Bd* preserved in ethanol provided by J. Longcore (University of Maine) was used to isolate positive control DNA. We centrifuged 100 µ1 of the culture at 13,000 RPM for one min, and resuspended it in 500 µ1 of deionized water twice to remove ethanol and dilute cells. The positive control was then boiled for

10 min to lyse open zoospores.

Traditional PCR.—Bd-specific primers (Bd1a and Bd2a) designed by Annis et al. (2004) were used to amplify an approximately 300-bp fragment of the 5.8S rRNA gene. Ten microliters of each test sample and 2 µ1 of positive control DNA were used in 25-µ1 PCR reactions that included the following components: 0.4 µM forward and reverse primers, 1.5 mM $MgCl_2$, 0.2 mM dNTPs, and 0.1 U/µl taq polymerase. PCR reactions were subjected to one cycle of 95°C for 5 min followed by 30 cycles of 95°C for 30 sec, 60°C for 30 sec, and 72°C for 30 sec, followed by a final 7-min extension at 72°C. All reactions were run in a GeneAmp 9700 Thermalcycler (Applied Biosystems). Appropriate negative controls using water in place of DNA were included with each PCR run. PCR products were checked for the presence of the *Bd*-specific 5.8S fragment on 2% 1XTAE gels followed by SYBR Safe (Invitrogen) staining and UV illumination.

Table 1. Results of traditional and RT-PCR for the presence (+/-) of *Batrachochytrium dendrobatidis* DNA from animals (A) and environmental samples (B) collected from the New Jersey School of Conservation, Branchville, Sussex County, New Jersey, USA.

Sample	N	Traditional PCR	RT-PCR
A. Animal Samples (Species/Life Stage)			
L. clamitans/tadpole	8	-	-
L. clamitans/juvenile	3	-	- (N = 1), + (N = 2)
L. clamitans/adult	9	-	-
L. palustris/adult	2	-	-
L. sylvatica/adult	1	-	-
N. viridescens/adult	2	-	-
A. maculatum/larvae	2	-	-
B. Environmental Samples			
Water	16	-	- (N = 15), + (N = 1)
C. Total	43		- (N = 40), + (N = 3)

RT- PCR.—We used 11.5 µl of each test sample in 25-µl PCR reactions that included the following components: 0.4 µM Bd1a and Bd2a primers (Annis et al. 2004) and 12.5 µl of Brilliant II SYBR Green qPCR Master Mix (Agilent Technologies). We used 11.5 µl of test sample to maximize the amount of *Bd* DNA used in the reaction if it was present in the test sample. We ran positive control reactions using 0.5 ng/µl *Bd* DNA and negative control reactions using water in place of DNA under the same conditions. PCR reactions were subjected to 1 cycle of 95°C for 10 min followed by 40 cycles of 95°C for 45 sec, 60°C for 30 sec, and 72°C for 30 sec. All RT-PCR reactions were run on a Stratagene Model Mx 3000 P Thermalcycler (Stratagene Technologies). We rescreened all positive samples in triplicate using RT-PCR to verify the results.

All animals used in this study were alive at the point of capture and none appeared to show obvious symptoms of chytridiomycosis. None of the 43 samples tested positive for *Bd* DNA using traditional PCR (Table 1). When these samples were retested using RT-PCR however, three tested positive for *Bd* DNA: two *L. clamitans* juveniles from separate sites and one water sample from Lake Wapalanne (Table 1). Results were repeatable for all three trials of the RT-PCR. Indeed, both of the *L. clamitans* juveniles that tested positive produced a fluorescence intensity that was comparable to the positive control (Table 2). All positive and negative controls yielded expected results for both traditional and RT-PCR.

To our knowledge, this is the first published account of the presence of *Bd* in New Jersey amphibians or environmental samples. It is not surprising that *Bd* is present in New Jersey given that it has been documented in New York and Connecticut (Longcore et al. 2007). If we had only used the traditional PCR-based method we would have erroneously determined that *Bd* might not be present at the New Jersey School of Conservation (although sample sizes were low), potentially missing an important opportunity to study the distribution and effects of this pathogen in native amphibians. Given that *Bd* was detected in two animals and one water source, all from different locations within the NJSOC, it is possible this pathogen is widespread at NJSOC. We are currently focusing our efforts on increasing sample sizes for all species and life stages present at the NJSOC to quantify infection loads and determine species-specific effects of infection.

Because we had negative results from all of the tadpole samples we cannot be sure that our protocol is sensitive enough to detect *Bd* in this life stage. Future studies will focus on substantially increasing tadpole sample size and verifying the efficacy of this screening method by comparing it with an established method of detection in tadpoles. Additionally, given the small sample size (<60) of all species and life stages it will be necessary to increase sample sizes to more accurately assess the prevalence of *Bd* at NJSOC (Skerratt et al. 2008).

We were able to detect the presence of *Bd* DNA without the use of a traditional DNA extraction protocol, even in an environmental sample. Simply boiling skin swab and water samples to lyse zoospores without the use of a costly and time-consuming DNA extraction method was sufficient. This was especially surprising given that environmental water samples may contain PCR-inhibitors. For a rapid presence/absence screen, this method is a viable

Table 2. Mean threshold cycle (Ct) and fluorescence (dR) values for samples testing positive for *Batrachochytrium dendrobatidis* DNA from samples collected from the New Jersey School of Conservation, Branchville, Sussex County, New Jersey, USA.

Sample	Ct	dR
Positive *Bd* DNA Control (1 ng DNA)	19.9	7304.3
L. clamitans juvenile 1	22.4	8160.6
L. clamitans juvenile 2	24.5	7844.1
Positive Water Sample	32.1	4572
Negative Control	>40	202.7

alternative to current methods, making it potentially important for rapid assessment or in situations where funds are very limited.

Perhaps more important however, are the results of our PCR technique comparison, which could have a potential impact on future molecular screening procedures throughout the *Bd* research community. In this study, we detected *Bd* in 3 of 43 samples using RT-PCR, but none using traditional PCR. Our results strongly support the need to use the more sensitive RT-PCR screening method when using a non-invasive PCR-based detection technique for *Bd* DNA.

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Batrachochytrium dendrobatidis is Present in Northwest Pennsylvania, USA, with High Prevalence in *Notophthalmus viridescens*

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Batrachochytrium dendrobatidis (*Bd*) has been found with varying prevalence on amphibians in the northeast, midwest, and southeast United States (Longcore et al. 2007; Zellmer et al. 2008; Green and Dodd 2007; Rothermel 2008), but surveys in Pennsylvania have failed to find infected individuals (Glenney et al. 2010). We studied between-pond variation in *Bd* infection levels in amphibians of northwestern Pennsylvania, USA. In doing so, we focused our sampling efforts on three species, Green Frogs (*Rana clamitans*), Red-spotted Newts (*Notophthalmus viridescens*) and Wood Frogs (*Rana sylvatica*). These species are locally abundant and, if commonly infected, could serve as an indicator species for assessing *Bd* presence in ponds.

Our surveys were designed to maximize the number of ponds sampled for *Bd* occurrence. We swabbed up to 12 individuals per species for *Bd* at 10 ponds containing Green Frog tadpoles, 8 ponds containing Red-spotted Newts and 2 ponds containing Wood Frog adults between 1 April and 28 May 2008 (Table 1). This sampling scheme has low statistical power to detect true negative results within a pond (e.g., Skerratt et al. 2008), but it is sufficient for *Bd* detection at ponds with moderate to high infection prevalence. For sampling efficiency, we visited each pond only once and limited the life stages that we sampled to larval Green Frogs, adult Red-spotted Newts and adult Wood Frogs. While adult frogs are more commonly sampled, we focused on larval

Table 1. Prevalence and infection levels of *Batrachochytrium dendrobatidis* in several species of amphibians sampled in northwestern Pennsylvania, USA. "-" indicates the species was not sampled at that site.

Site name and coordinates	Red-Spotted Newt (*Notophthalmus viridescens*)		Green Frogs (*Rana clamitans*)		Wood Frogs (*Rana sylvatica*)
	Sample size (No. *Bd*-positive), %	Infection level (zoospore equivalents, mean ± SE)	Sample size (No. *Bd*-positive), %	Infection level (zoospore equivalents, mean ± SE)	Sample size (No. *Bd*-positive), %
Dodds Road Beaver Pond 41.4760°N, 80.3193°W	1 (1) 100%	1639 ± 131	10 (0) 0%	-	-
Geneva Pond 41.5872 °N, 80.2432 °W	10 (6) 60%	259 ± 205	-	-	-
Housing Site 41.6229°N, 80.4551°W	-	-	-	-	9 (0) 0%
Mark's Pond 41.4607°N, 80.3059°W	7 (2) 28%	2.9 ± 2.6	9 (1) 11%	44.3 ± 24.9	- -
Mosquito Coast 41.6798°N, 80.4976°W	2 (0) **0%**	-	10 (1) 10%	27.8 ± 14.5	-
Mud Lake 41.5594°N, 80.3688°W	-	-	9 (0) 0%	-	- -
Oberdick Pond 41.6875°N, 80.4273°W	-	-	6 (0) 0%	-	-
Oxbow Lake, Shenango River 41.3161°N, 80.3209°W	7 (3) 42.9%	158.7 ± 130.7	8 (1) 13%	69.0 ± 19.1	-
Ravine by Shenango Oxbow 41.3214°N, 80.3228°W	-	-	-	-	-
State Game Land 69 41.6260°N, 79.1180°W	1 (1) 100%	66.2 ± 7.6	8 (1) 13%	3.8 ± 1.6	-
State Game Land 144 41.8419°N, 79.7169°W	9 (0) 0%	-	-	-	-
State Game Land 269 41.7969°N, 80.2114°W	-	-	5 (0) 0%	-	-
State Game Land 277 41.8166°N, 80.0250°W	9 (3) 33%	27.5 ± 22.2	9 (1) 11%	10.0 ± 2.4	-
Trailer Park Pond 41.5687°N, 80.4545°W	-	-	-	-	12 (0) 0%

Green Frogs because they often overwinter as tadpoles, which increases the opportunity for infection to occur, and because high sample sizes can be obtained. In addition to the three focal species, we also opportunistically sampled adult Northern Two-lined Salamanders (*Eurycea bilineata*), Northern Dusky Salamanders (*Desmognathus fuscus*), and adult Spring Peepers (*Psuedacris crucifer*) for *Bd*. All Red-spotted Newts and Green Frogs were collected in permanent ponds, whereas Wood Frogs and Spring Peepers were sampled in ephemeral ponds. Salamanders were sampled in an ephemeral stream. Sites were surveyed until 10 individuals of a species were collected or no more animals could be found in a reasonable time frame.

To sample *Bd*, animals were swabbed thirty times along keratinized tissues where *Bd* zoospores are highly concentrated (Marantelli et al. 2004). Tadpoles were swabbed (Medical Wire Company MW113) across mouthparts, adult frogs were swabbed along the drink patch, inside lower thighs and foot webbing, and newts were swabbed on the ventral side, back legs, and feet. Swabs were stored in 95% ethanol and DNA was extracted and analyzed for *Bd* presence and quantity using quantitative PCR

(Boyle et al. 2004). This method is highly sensitive and can detect very low-level infections that might be missed with other methods (Hyatt et al. 2007). Samples were run in triplicate and were re-run from the same extraction in cases where results yielded only one or two positive results. A re-run sample was considered positive if at least 3 of 6 wells tested were positive. Such variability between wells is common in samples with low infection levels (personal observation). Quantitative estimates of infection levels were made by averaging positive results within a sample.

To minimize cross-contaminating animals, gloves and equipment that contacted frogs were sterilized with 70% ethanol and dried between handling of individuals and all other equipment was sterilized with a 10% bleach solution or discarded after leaving a pond (Johnson et al. 2003).

Our results suggest that *Bd* is widespread throughout northwestern Pennsylvania, USA, yet infection prevalence and intensity varies among species (Table 1). Red-spotted Newts had the highest prevalence of the three species that could be surveyed with sufficient sample sizes. We did not find infected newts in 2 of the 9 ponds, however, the sample size was not sufficient to confidently demonstrate that these ponds were infection-free. Among tested individuals, infection loads (measured in terms of zoospore equivalents) varied over three orders of magnitude among sites. There are few other data examining *Bd* infection loads in Red-spotted Newts, but infection has been reported for museum specimens in eastern North America and more recently in field-collected Red-spotted Newts from the southeastern USA (Ouellet et al. 2005; Rothermel et al. 2008). This suggests that *Bd* infection in Red-spotted Newts is not uncommon. Interestingly, the closest area to our study site that has been surveyed for *Bd* (Delaware Water Gap National Recreation Area) did not find infections in Red-spotted Newts or any other tested species (e.g., *Rana sylvatica, Pseudacris crucifer, Hyla versicolor*; Glenney et al. 2010). Many of the newts collected in our study also exhibited cysts indicating infection by the mesomycetozoan *Amphibiocystidium viridescens* (pers. obs.), and newts in the surrounding area have been shown to carry infections of other parasites, including trematodes, nematodes, trypanosomes, acanthocephelans, helminths and bacteria (Raffel et al. 2009). This raises the question as to whether co-infection with other pathogens alters *Bd* infection rates in Red-Spotted Newts.

Bd infection also was found in Green Frog tadpoles (Table 1). Although infection prevalence was lower than that found in Red-spotted Newts, infection was detected in more than 50% of ponds and sample sizes were not large enough to confidently detect low-level infections in the other ponds. On average, infection loads of Green Frog tadpoles were lower than that found in newts. This may reflect the fact that tadpoles possess less keratinized tissue than newts (Marantelli et al. 2004). Other surveys examining *Bd* infection in Green Frog adults and metamorphs with qPCR and histology have found higher infection levels (18–36% in Maine from 2000–2002; Longcore et al. 2007), which also may reflect less keratinized tissue in tadpoles (Marantelli et al. 2004). It is likely that *Bd* has been prevalent in Green Frogs for some time; the earliest evidence for *Bd* in North America came from a museum specimen collected in 1961 in Quebec (Ouellet et al. 2005). The tadpoles sampled in our study were in their second larval year, allowing ample time for animals to be infected. Since newts co-occur in ponds with Green Frogs, *Bd* may have been transmitted across species.

No individuals of the four other species sampled were *Bd*-positive: Northern Two-lined Salamanders (N = 2, ravine by Shenango Oxbow); Northern Dusky Salamanders (N = 4, ravine by Shenango Oxbow); Spring Peepers (N = 2, Trailer Park Pond); and Wood Frogs (Table 1). However, our sample sizes were small and sample sizes >59 are recommended to detect *Bd* when prevalence is low (Skerratt et al. 2008). Past studies of Wood Frogs in New England and Michigan, USA show low to moderate prevalence of *Bd* (>1 % to 16.7% with qPCR and histology; Longcore et al. 2007; Zellmer et al. 2008), but previous studies of Wood Frogs in eastern Pennsylvania (N = 28) did not find infected individuals, despite using sensitive testing techniques (i.e., qPCR, Glenney et al. 2010). *Bd* also has been found in the Northern Two-Lined Salamander and the Dusky Salamander, suggesting that these species are susceptible to infection (Byrne et al. 2008; Grant et al. 2008). We failed to find any records of infected Spring Peepers, although they have been previously surveyed for *Bd* infections (Byrne et al. 2008; Longcore et al. 2007; Ouellet et al. 2005; Rothermel et al. 2008; Glenney et al. 2010).

Overall, our results correspond with other studies showing that *Bd* is present in areas where amphibian population declines have not been documented (Green and Dodd 2007; Longcore et al. 2007; Rothermel 2008; Zellmer et al. 2008). Though we only sampled at a single point in time, high prevalence of infection and relatively low infection intensities in both Green Frogs and Red-spotted Newts suggest that *Bd* is not uncommon in northwest Pennsylvania and both species might be good indicators for *Bd* presence in this region. Although no pathology was observed in infected individuals we suggest that further monitoring is necessary to test whether this observation is consistent.

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HERPETOLOGICAL HUSBANDRY

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Observations on the Captive Reproduction of Gaige's Rain Frog *Pristimantis gaigeae* (Dunn 1931)

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Gaige's Rain Frog, *Pristimantis gaigeae* (Strabomantidae) is a direct-developing anuran species ranging from the Atlantic lowlands in extreme southeastern Costa Rica through eastern Panama and on the Pacific versant in central Colombia (Savage 2002). The species is considered a mimic of dendrobatid species, exhibiting a pair of red, orange, or golden dorsolateral stripes on a black body, similar to the two toxic species *Phyllobates aurotaenia* and *P. lugubris* (family Dendrobatidae) with which some populations of *Pristimantis gaigeae* are sympatric (Fig. 1).

It is the intent of the authors to present methods that have been utilized to successfully maintain and reproduce *Pristimantis gaigeae* in captivity. As little information is currently available on the captive husbandry and reproduction in species of *Pristimantis*, we believe the information provided herein may prove useful in future attempts to maintain *ex situ* populations of this and other species of the genus.

Specimen Acquisition and Husbandry Methods

The group of *P. gaigeae* at the Atlanta Botanical Garden (ABG) consisted of one male and two females collected in 2005 from the vicinity of El Valle de Antón and one male collected from the vicinity of El Copé, both in Provincia de Coclé, Panamá. The specimens were collected and exported as a part of the Amphibian

Recovery and Conservation Coalition (ARCC) project. This was a collaborative effort between ABG and Zoo Atlanta aimed at learning the logistics of an ex situ response to the rapid spread of chytridiomycosis through amphibian populations in Panama (Lips et al. 2006; Gagliardo et al. 2008).

After importation, specimens were put through a quarantine period of thirty days during which all were prophylactically treated for *Batrachochytrium dendrobatidis* infection following the protocol suggested by Dr. Brad Lock (Zoo Atlanta) and Dr. Brad Wilson (The Veterinary Clinic West, Marietta, Georgia). Post-quarantine and treatment, the three specimens from El Valle were housed in an enclosure measuring 60 x 30 x 90 cm with live plants (*Philodendron* and *Calathea*), substrate consisting of moistened sphagnum moss, and pieces of cork bark for cover. The single male from El Copé was housed in an enclosure measuring 25 x 30 x 50 cm and furnished as for the El Valle group. Light was provided by one 55-watt power compact fluorescent fixture over each enclosure and temperatures were maintained between 18–28°C. A 12-hour on and 12-hour off light cycle was maintained throughout the year. Humidity and moisture were maintained through use of an automated misting system. The diet of the adults consisted almost exclusively of domestic crickets (*Acheta domestica*) that were gut loaded with a varied fresh vegetable diet and dusted at alternate feedings with Rep Cal D3® and finely powdered Men's Health® vitamins. Occasionally, nymphs of the Turkistan Roach (*Blatta lateralis*) and Lobster Roach (*Nauphoeta cinerea*) were offered.

COLOR REPRODUCTION SUPPORTED BY THE THOMAS BEAUVAIS FUND

Fig. 1. Adult male *Pristimantis gaigeae* collected from El Valle De Anton, Provincia De Coclé, Panama. Photo by Robert Hill.

In May 2006, the three El Valle specimens were transferred to the private collection of Paul Crump in Houston, Texas, USA. The specimens were housed together in an enclosure measuring 60 x 30 x 90 cm. Furnishings consisted of moistened sphagnum moss substrate, live plants, and pieces of cork bark as refugia. Misting occurred four times daily, with the longest misting event taking place for five minutes each day at 00:00 then gradually decreasing to one minute by 12:00 and increasing gradually back to five minutes. Temperatures were maintained from 21–24°C. Light was provided by two 1.2 m fluorescent full spectrum bulbs on a 12-hour on and 12-hour off cycle. Specimens were fed a diet of domestic crickets and fruit flies (*Drosophila hydei*) that were dusted at each feeding with Miner-All I®.

In April 2008, the three adult El Valle specimens and one captive offspring were returned to ABG. Upon return, specimens were put through quarantine procedures as described above. They were then transferred to a temporary enclosure measuring 50 x 25 x 30 cm that was furnished with a moistened sphagnum moss substrate, live plants, and plastic refugia. This enclosure was misted once daily by use of a spray bottle.

In 2008, a modified shipping container was acquired by ABG and outfitted for use as a holding and breeding facility for amphibians (Fenolio et al. 2009). This included the group of four adult *P. gaigeae*. The El Valle group was split, with the male and one female kept together, and the additional female placed with the El Copé male. Each pair of frogs was housed in a Zoo Med® terrarium measuring 30 x 30 x 45 centimeters. Each was furnished with lighting, live plants, substrate, and refugia as above. Humidity and moisture were regulated through the use of an automated misting system operating six times daily during a simulated wet season from November–April and two times daily during a simulated dry season from May–October. Individual misting events ranged from three to 10 minutes each with the shortest misting events taking place during the simulated dry season.

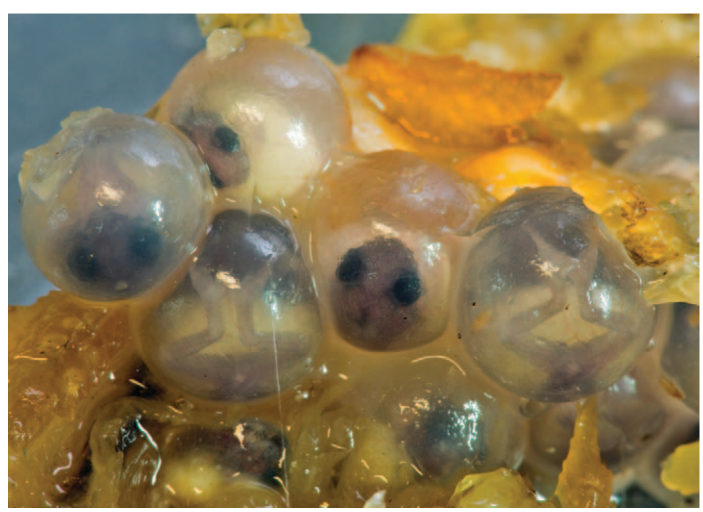

Fig. 2. Late stage eggs of *Pristimantis gaigeae*. Photo by Brad Wilson.

Breeding

Axillary amplexus has been observed in *P. gaigeae*, though further observations are necessary to determine duration before oviposition and fertilization. No calls have been noted or recorded and, according to Savage (2002), this species does not have an advertisement call. Egg attendance behavior has been observed in both sexes and occurs in other members of the Strabomantidae (Ryan 2005).

Multiple breeding events have occurred at ABG; the first being in May 2006 with 36 eggs deposited on a piece of cork bark. The male was observed in attendance of the egg clutch. Viability was low and none of the resultant offspring survived. Several breeding events were observed in 2009 with clutch sizes ranging from 22–37 eggs. Eggs measured approximately 5 mm in diameter and typically were buried in the substrate under one of the plastic cover objects or within the root systems of the plants; typically, one or more eggs did not get covered with the rest of the clutch and in more than one instance, were observed up to several centimeters from the main egg mass. These scattered, isolated eggs typically failed to hatch. However, eggs were deposited on top of a plastic cover object on more than one occasion by each female. Both sexes have been observed attending clutches, however never together or at the same time. In instances where egg clutches have been observed in the open and uncovered, viability appeared to be lower in comparison to the typically covered clutches. However, even under these exposed circumstances, an adult was observed in attendance. The time period between clutches during peak breeding activity was from six to eight weeks.

Handling of Eggs and Hatchlings

Eggs were carefully removed from the adult enclosure and incubated on a 5–10 cm layer of moistened sphagnum moss in plastic quart-size deli cups until hatching, which occurred from 28–39 days post-oviposition (Fig. 2). The incubation cups are maintained at 21–26°C with all eggs completely covered with moss so that they were not exposed to light. Interestingly, in a recent manipulation, a portion of an egg mass was left completely exposed to light and development continued normally and unimpeded (R. Hill, pers. obs.). Newly hatched *P. gaigeae* measured approximately 5 mm in length. Because of this small size, and the propensity of injury during movement, eggs were separated and placed two each into rearing containers late in development. Rearing containers consisted of quart-size plastic deli cups containing a layer of moistened sphagnum moss and a vented lid. To prevent desiccation of the tiny young, roughly 50% of the lid was covered with plastic wrap to maintain high humidity.

Hatchlings proved difficult to rear successfully and often began showing what appeared to be signs of calcium deficiency within the first several weeks. The diet at this stage consisted nearly exclusively of springtails (*Collembola* sp.). Anecdotal observation suggests that the use of liquid and powdered vitamin supplementation added to the diet of the springtails may potentially increase hatchling survivorship (J. Kaylock, pers. obs.). Desiccation proved to be a major concern. Some specimens were observed to dry out on the sides of their enclosures. The covering of at least 50% of the vented lid of the rearing container combined with daily misting mitigated this issue. Another method utilized was to maintain the hatchlings as stated above, but without the plastic wrap and placed inside a larger enclosure with automated misting. In this arrangement, we found that the mist soaks and penetrates the vented lid to provide additional moisture and ambient humidity. Both rearing methods have proven successful thus far. Once the young frogs moved onto larger food items such as flightless fruit flies (*Drosophila melanogaster* and *D. hydei*) and newly hatched domestic crickets, growth was rapid.

Conclusions

Pristimantis gaigeae is listed as a species of Least Concern by the World Conservation Union (IUCN Red List, 2009). Of the 426 currently recognized species of *Pristimantis* considered by the IUCN Red List, 67 are listed as Endangered, Critically Endangered, or Vulnerable with 38 listed as Data Deficient. Very few species of *Pristimantis* are currently held in managed collections and even fewer have been routinely reproduced. While *P. gaigeae* may not be a species of particular conservation concern at this point in time, the methods and techniques used in the successful husbandry and reproduction of this species may prove useful for other members of the genus for which *ex situ* management programs may eventually be deemed necessary.

Acknowledgments.—This manuscript is dedicated in gratitude and to the memory of Julia Beth Kaylock (1980–2009), whose dedication to and passion for amphibian conservation and husbandry helped bring about the current successes with *P. gaigeae* and other Panamanian amphibians. Special thanks to the personnel and government of the Republic of Panama. Permits were granted by the Autoridad National del Ambiente (permit SEX/A-81-05). Acknowledgments also to Joseph R. Mendelson, III and Jennifer Cruse-Sanders for assistance during the editorial process and to Brad Wilson for providing images. Further gratitude goes to George Rabb, Cynthia Jeness, and Bill and Claire Simmons for their support of *ex situ* conservation efforts for Panamanian amphibians.

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NATURAL HISTORY NOTES

The Natural History Notes section is analogous to Geographic Distribution. Preferred notes should 1) focus on observations in the field, with little human intrusion; 2) represent more than the isolated documentation of developmental aberrations; and 3) possess a natural history perspective. Individual notes should, with few exceptions, concern only one species, and authors are requested to choose a keyword or short phrase which best describes the nature of their note (e.g., Reproduction, Morphology, Habitat, etc.). Use of figures to illustrate any data is encouraged, but should replace words rather than embellish them. The section's intent is to convey information rather than demonstrate prose. Articles submitted to this section will be reviewed and edited prior to acceptance.

Electronic submission of manuscripts is requested (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Figures can be submitted electronically as JPG files, although higher resolution TIFF or PDF files will be requested for publication. Please DO NOT send graphic files as imbedded figures within a text file. Additional information concerning preparation and submission of graphics files is available on the SSAR web site at: http://www.ssarherps.org/HRinfo.html. Manuscripts should be sent to the appropriate section editor: **Jackson D. Shedd** (crocodilians, lizards, and *Sphenodon*; jackson.shedd@gmail.com); **Charles W. Painter** (amphibians; charles.painter@state.nm.us); **John D. Willson** (snakes; hr.snake.nhn@gmail.com); and **James Harding** (turtles; hardingj@msu.edu).

Standard format for this section is as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother [ed.] 2008. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico*. SSAR Herpetol. Circ. 37:1–84, available from SSAR Publications Secretary, ssar@herplit.com; for Mexico as it appears in Liner and Casas-Andreu 2008, *Standard Spanish, English and Scientific Names of the Amphibians and Reptiles of Mexico*. Herpetol. Circ. 38:1–162), KEYWORD. DATA on the animal. Place of deposition or intended deposition of specimen(s), and catalog number(s). Then skip a line and close with SUBMITTED BY (give name and address in full—spell out state names—no abbreviations). (NCN) should be used for common name where none is recognized. References may be briefly cited in text (refer to this issue for citation format).

Some further comments. The role of the "Standard Names" lists (noted above) is to standardize English names and comment on the current scientific names. Scientific names are hypotheses (or at least represent them) and as such their usage should not be dictated by a list, society, or journal.

Recommended citation for notes appearing in this section is: Medina, P., and R. L. Joglar. 2008. *Eleutherodactylus richmondi*: reproduction. Herpetol. Rev. 39:460.

CAUDATA — SALAMANDERS

PLETHODON CINEREUS (Eastern Red-backed Salamander). **WETLAND HABITAT.** *Plethodon cinereus* are noted for their ability to live and breed in terrestrial "forest litter habitats in deciduous, northern conifer, and mixed deciduous-conifer forests" (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). However, although "many individuals are found far from any visible water supply and the species is less dependent on water than many others, [*P. cinereus* can be found] in greatest numbers in fairly damp situations" (Bishop 1941. The Salamanders of New York. New York State Mus. Bull. 324). Scattered reports in the literature confirm the species' use of moist habitats, for example, two dead *P. cinereus* were observed in leaves of the bog-dwelling Purple Pitcher Plant (*Sarracenia purpurea*; Hughes et al. 1999. Herpetol. Rev. 30:160). We observed *P. cinereus* in moss along shorelines of wetlands and also observed the species under rocks and leaf litter in stream channels in Maine. We are aware of no previous literature documenting the occurrence and breeding of *P. cinereus* in wetland shoreline. Two publications document *P. cinereus* presence in stream channel habitat: 25 *P. cinereus* were detected under rocks (18–30 cm in diameter, 30% embedded in substrate) in ≥ 6 streams in Maine (Perkins and Hunter 2006. J Wildl. Manag. 70[3]:657–670) and the species was observed beneath stones in small streams in Maryland (Cooper 1956. Herpetologica 1956:165–166). Our observations further describe the stream channel habitat used by *P. cinereus*. The occurrence of *P. cinereus* in wetland and stream habitat has relevance to managers and biologists surveying for the species.

We thoroughly searched the vegetation growing in wetlands and on the shoreline of palustrine wetlands (N = 67) in Maine, USA (Acadia National Park, Massabessic Experimental Forest, U.S. Fish and Wildlife Service Sunkhaze Meadows National Wildlife Refuge, University of Maine Foundation Penobscot Experimental Forest, University of Maine Demeritt Forest) during 2001–2003. We searched by parting vegetation growing <30 cm from water with methods described by Chalmers and Loftin (2006. J. Herpetol. 40:479–486). We detected 49 *P. cinereus* (of which at least 12 were gravid) and one clutch of eggs in vegetation in wetlands (N = 26; 39% of wetlands surveyed). We typically observed the *P. cinereus* located directly above water and in *Sphagnum* or *Thuidium* (feather moss). Twice we observed *P. cinereus* with Four-toed Salamanders (*Hemidactylium scutatum*). We observed an adult of each species entwined at one wetland. We found eggs of *P. cinereus* and *H. scutatum* within <8 cm of each other at another wetland. The *P. cinereus* clutch was located in *Sphagnum* along the shoreline of a slow moving stream in a palustrine wetland with a Red Maple (A*cer rubrum*) canopy, alder (*Alnus incana*) understory, and herbaceous layer of Blue-joint Reed Grass (*Calamagrostis canadensis*). The *P. cinereus* clutch (detected 20 June 2002 by J. Bertman) was on the underside of a rotten, leaning stump surrounded by *Sphagnum*. The clutch was attended by a female and contained six eggs. We observed the *P. cinereus* on 1 July attending two eggs attached to the stump and two eggs attached to *Sphagnum*. Twice, we observed *P. cinereus* in a wetland >10 m from the wetland edge on islets (<2 m^2) that the salamanders may have reached during low water. The species can swim (Bishop 1941, *op. cit.*); however we observed *P. cinereus* placed in water initially sink, then surface and swim to shore.

We surveyed stream salamanders in Acadia National Park, Mount Desert Island, Maine, 15 May–21 June 1999 and in August 2001–2003. The only stream salamander species currently vouchered on the island is the Northern Two-lined Salamander (*Eurycea bislineata bislineata*; Brotherton et al. 2004. Acadia National Park Amphibian and Reptile Inventory: March–September 2001. Tech. Rep. NPS/NER/NRTR-2005/007. National Park Service, Woodstock, Vermont). We detected *P. cinereus* with two survey methods: 25-m long transects parallel to the stream with width 1 m onto shore and 1 m into water, and "belt" transects perpendicular to the stream for length spanning the stream bed plus 1 m onto each shore and 1 m width. We made 72 observations of juvenile and adult *P. cinereus* (≥ 26 individuals) in transects at four (Breakneck Stream, Duck Brook, Hadlock Brook, Kebo Stream) of six streams surveyed. *Plethodon cinereus* were observed in stream bars and bank face. Microhabitat used by individuals on stream bars typically was under rock cover and on a moist substrate of sand, gravel, or cobble. Salamanders occupying the stream bank face typically were under wet leaf litter and on soil or bedrock substrate. Salamanders were occasionally found on substrate with pooled water. *Plethodon cinereus* were observed in stream channel habitat during both periods of flow and periods of low water in which intermittent flow was interspersed with pools in the stream channel.

Plethodon cinereus are found in Maine along the vegetated shoreline of wetlands and the channels and banks of streams as well as in habitat farther from water. Individuals could be moving into wet habitat temporarily during dry conditions (e.g., summer drought) when the forest floor is otherwise too dry for the species. Alternately, *P. cinereus* may use wet habitats for a longer duration if the conditions of the surrounding terrestrial habitat (shallow, rocky, well-drained soil) are typically too dry for the species. Large numbers of Eastern Red-backed Salamanders migrate towards wetlands with *Hemidactylium scutatum* and Blue-spotted Salamanders (*Ambystoma laterale*) in the spring in Vermont (J. Andrews, unpubl. data). The timing of these migrations is too early for seasonal drying of the forest floor, which typically occurs in late summer, and Andrews suggests that at these wetlands, the salamanders may leave the wetlands only for overwintering (J. Andrews, pers. comm.) Streams in our study area annually decrease in surface water area in the summer and subsequently expose cover rocks in the stream channel. We observed *E. bislineata* moved to those cover rocks closest to the remaining surface water. *Plethodon cinereus* may have an increased opportunity to use stream bed habitat during summer drought because of a greater number of cover objects available and a simultaneous decrease in interspecific competition for cover. *Plethodon cinereus* typically are displaced from moist habitats by other plethodontid species via competitive interactions (Hairston 1949. Ecol. Monogr. 19:47–73) and depredation (Hairston 1980. Am. Nat. 115:354–366). The relatively few amphibian species (*Eurycea bislineata bislineata*, *Desmognathus fuscus fuscus*, *Gyrinophilus porphyriticus*, in streams, and *Hemidactylium scutatum* along wetland shoreline) occupying these habitats in Maine may improve the opportunity for *P. cinereus* to colonize these habitats with less interspecific competition than present in more southerly regions.

Further study is necessary to determine the spatial extent, duration, and seasonal patterns of stream- and wetland-habitat use by *P. cinereus* in Maine. *Plethodon cinereus* also may use wetland habitats elsewhere in its range, although this had not been reported in published literature. Researchers and surveyors of *P. cinereus* should consider the possibility that this species may occur in wetland habitats in northern portions of the species' range.

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PLETHODON PETRAEUS (Pigeon Mountain Salamander). **PREDATION.** *Plethodon petraeus* is a large (to 84 mm SVL) scansorial plethodontid salamander endemic to karst areas of a single mountain slope in Walker and Chatooga counties in northwest Georgia, USA (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, DC. 587 pp.; Wynn et al. 1988. Herpetologica 44:135–143). Due in part to its restricted range and recent discovery, no predators have been reported for *P. petraeus* (Jensen and Camp 2005. *In* M. Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 833–834. Univ. California Press, Berkeley). We report the first account of predation on *P. petraeus*, though by what is likely an insignificant and opportunistic predator.

At 1430 h on 17 April 2010, one of us (GJB) found a live juvenile *P. petraeus* suspended in a spider web >30 cm deep in a narrow rock crevice on the Lost Wall, on Pigeon Mountain, Walker Co., Georgia, USA (34.6592°N, 85.3717°W, WGS 84). The spider was not present at the web, so the species could not be determined, but based on the shape and location of the web we tentatively identify the family as Agelenidae (North American funnel-web spiders). Other examples of spider predation on salamanders include a wolf spider (*Hogna helluo*) feeding on a Blue-spotted Salamander (*Ambystoma laterale*; McLister and Lamond 1991. Can. Field-Nat. 105:574) and experimental data from a challenge of phyletic bias in predator-prey interactions in which adult wolf spiders (*Gladicosa pulchra*) were offered and preyed upon juvenile Spotted Salamanders (*Ambystoma maculatum*; Rubbo et al. 2003. J. Zool. Lond. 261:1–5). Both species of wolf spiders (Lycosidae) are generalist cursorial ambush predators and do not use webs to trap their prey, so this report repre-

Fig. 1. Juvenile *Plethodon petraeus* tangled in an agelenid spiderweb. Walker Co., Georgia, USA.

sents the first example of entrapment of a salamander in a spider web.

We thank J. Perry of the North Carolina State Museum of Natural Sciences for assistance with identification of the spider web.

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PSEUDOEURYCEA GIGANTEA (Giant Salamander). **MAXIMUM SIZE.** *Pseudoeurycea gigantea* is one of Mexico's largest plethodontids, reaching 161 mm SVL (Parra-Olea et al. 2005. Herpetologica 61:145–158). On 20 Nov 2009, we collected an adult male *Pseudoeurycea gigantea* in cloud forest, 0.7 km S and 0.2 km W of San Juan de las Flores, municipality of San Bartolo Tutotepec, Hidalgo, Mexico that exceeds the total length of earlier records (161 mm SVL, 228 mm TL; Parra-Olea et al. 2005, *op. cit.*). The specimen measured 149 mm SVL and 314 mm TL which represents the largest total size of this species reported. The specimen is deposited in the Colección Herpetológica, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB-UAEH 2549). *Pseudoeurycea gigantea* is an endemic salamander restricted to a small area of eastern Mexico, found in the states of Puebla, Hidalgo, and Veracruz (Parra-Olea et al. 2005, *op. cit.*).

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***SIREN* SP.** (Mudpuppy). **PREDATION.** Although wading birds are likely predators of *Siren* (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.), records of specific sirenid predation events are scarce. On 15 January 2010, at approximately 1636 h a Great Egret (*Ardea alba*) was observed eating a *Siren* in the Audubon Swamp Garden in Magnolia Plantation and Gardens, Charleston County, South Carolina, USA. The egret took at least three minutes after being seen with the siren in its beak to consume it. The siren was approximately the length of the bill of the Great Egret and could have been either a Greater Siren (*S. lacertina*) or Lesser Siren (*S. intermedia*). Although previous records are available for "large, eel-like salamanders" being robbed from Great Egrets and White Ibis (*Eudocimus albus*) by American Crows (*Corvus brachyrhynchos*), these records could be for Two-toed Amphiuma (*Amphiuma means)* or *S. lacertina* (Kilham 1984. Colonial Waterbirds 7:143–145). This observation provides additional evidence of wading birds as predators of sirenids and further narrows confirmed predation by Great Egrets to members of the *Siren* genus.

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SIREN INTERMEDIA (Lesser Siren). **EXTRALIMITAL INTRODUCTION/REPRODUCTION.** The natural range of *Siren intermedia* is confined to the Atlantic and Gulf Coastal Plain from Virginia to Mexico, and extends north in the Mississippi Valley to Illinois, Indiana, and southwestern Michigan (Conant and Collins 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Co., Boston, Massachusetts).

On 25 March 2005 at least one *S. intermedia* individual was released into a permanent man-made backyard pond (500 gal, 90 cm deep) in San Mateo Co., California via an aquatic plant shipment from Arkansas. The pond had previously been stocked with Fathead Minnows (*Pimephales promelas),* which were likely the main source of prey, and various aquatic plants which provided sufficient cover. On 10 April 2008, I discovered larval *S. intermedia* in the pond. I proceeded to drain the pond and collected approximately 40 larvae and two large putative adult individuals. Multiple adult Bullfrogs (*Rana catesbeiana)* were also recovered. All sirens were transferred to the Department of Evolution and Ecology, University of California, Davis, California and maintained in aquaria (HBS188896–906).

Although constrained mostly to the eastern United States, this event demonstrates that *S. intermedia* have the potential to reproduce in a California coastal climate even in the presence of aquatic predators such as the Bullfrog. Furthermore, breeding populations could potentially result from individuals released into permanent hydroperiod aquatic habitats in California. The transition of California's aquatic resources from vernal pools to large stock ponds has previously facilitated the establishment of the non-native Tiger Salamander (Fitzpatrick and Shaffer 2004. Evolution 58:1282–1293).

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ANURA — FROGS

BUFO BOULENGERI (African Green Toad). **CANNIBALISM.** *Bufo boulengeri* (Stöck et al. 2006 Mol. Phylogenet. Evol. 41:663–689; Stöck et al. 2008 BMC Evol. Biol. 8:56) is a prolonged breeder which typically inhabits temporary and shallow water bodies (Bologna and Giacoma 2006. *In* Sindaco et al. [eds.], Atlante degli Anfibi e dei Rettili d'Italia, pp. 306–311. Ed. Polistampa). In arid areas, similar to those used for reproduction in southern Morocco, *B. boulengeri* seems to be unevenly distributed, with dense populations in oases widely separated by unsuitable dry areas. Due to the coexistence of different developmental stages in the same wetland, levels of intraspecific competition are high.

A wetland situated near Tiznit, Morocco (28.123164°N, 11.296131°W, 87 m. elev.) was examined on 4 April 2010. The

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FIG. 1. Female *Bufo boulengueri* exhibiting cannibalism behavior.

wetland was located in a stony plain. The plant community, within the inframediterranean belt, was a scrubland dominated by *Euphorbia echinus*, *Lycium intrincatum*, *Launaea arborescens*, *Frankenia* spp., *Witthania frutescens*, *Fagonia cretica*, and *Lavandula multifida*. A high density of several dozen individual *B. boulengeri* metamorphs were observed per m^2. Adults were found along the banks of the wetland and the cannibalistic behavior of an adult female was observed (Fig. 1). The total length of the adult was 84 mm and the total length of the recently metamorphosed *B. boulengeri* was 31 mm.

Both in natural or experimental conditions, many anurans frequently exhibit cannibalistic behavior, and these interactions are thought to be relatively common, at least in larval stage (Alford 1999. *In* McDiarmid and Altig [eds], Tadpoles: The Biology of Anuran Larvae, pp. 240–278. Univ. Chicago Press, Chicago, Illinois; Crump 1992. *In* Elgar and Crespi [eds.], Cannibalism: Ecology and Evolution Among Diverse Taxa, pp. 256–276. Oxford Univ. Press, London, UK). Our observation is the first record of cannibalism for this species and contributes to our knowledge of the ecology of *B. boulengeri*.

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CERATOPHRYS CRANWELLI (Cranwell's Horned Frog). **DIET**. *Ceratophrys cranwelli* is a large terrestrial frog endemic to the Gran Chaco ecoregion of South America. Anurans have been noted as comprising a large proportion of this species' diet, but the only anuran diet items confirmed have been *Physalaemus biligonigerus* and an unidentified *Leptodactylus* sp. (Scott and

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FIG. 1. *Ceratophrys cranwelli* metamorph consuming a *Leptodactylus bufonius* metamorph.

Aquino 2005. *In* Donnelly et al. [eds.], Ecology and Evolution in the Tropics: A Herpetological Perspective, pp. 243–259). Here I confirm an anuran in the diet of *C. cranwelli*.

On 15 March 2009 at 2100 h I discovered a metamorph *C. cranwelli* preying upon a small anuran around a temporary pond in the Isoceño community of Yapiroa, Province Cordilleria, Department Santa Cruz, Bolivia (19.6000°S, 62.5667°W; WGS 84). I identified the anuran as a *Leptodactylus bufonius* (Fig. 1). Though the *L. bufonius* was still alive (indicated by its multiple attempts to push itself out of the *C. cranwelli*'s mouth), the *C. cranwelli* proceeded to force the *L. bufonius* into its mouth using its hands. After ca. 20 min, the *L. bufonius* had been completely consumed by the *C. cranwelli*. To my knowledge, this is the first report confirming *L. bufonius* in the diet of *C. cranwelli*.

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CORYTHOMANTIS GREENINGI (Casque-headed Tree Frog). **EGG PREDATION**. *Corythomantis greeningi* has a wide distribution in the Caatinga of northeastern Brazil where it occupies temporary water bodies in this semiarid region. The species generally reproduces in lotic environments in stony river beds (Juncá et al. 2008. Zootaxa 1686:48–56). On 29 March 2009 at 900 h we observed eggs of *C. greeningi* being predated by tadpoles of *Proceratophrys cristiceps* (about 30 individuals in Gosner stages 40–42), in a small puddle formed in a streambed, situated in Olho d'água, municipality of Santa Cruz da Baixa Verde, State of Pernambuco, Brazil (8.58889ºS, 38.176944ºW; WGS 84; 852 m elev). Such predation of eggs has been reported in other studies (Rodrigues and Filho 2004. Herpetol. Rev. 35:373–373; St. Peter et al. 2008. Mus. Biol. Mello Leitão 24:111–118). This is the first record of oophagy reported for *P. cristiceps*. Specimens of tadpoles and images of the predation were deposited in the Herpetological Collection of Universidade Federal Rural de Pernambuco / Unidade Acadêmica de Serra Talhada - UFRPE / UAST (Lot 31), Recife, Pernambuco, Brazil.

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DENDROPHRYNISCUS CARVALHOI (Carvalho's Tree Toad). **DEFENSIVE BEHAVIOR**. Thanatosis is a defensive behavior by which an animal feigns death to escape predation. As many predators pursue only live prey, this behavior may be very effective.

The genus *Dendrophryniscus* is native to South America occurring in the Atlantic Rainforests of Brazil, Amazonian Colombia, Ecuador, Peru, and Brazil, and at Guianas (Frost 2009. Amphibian Species of the World: an Online Reference. Version 5.3 accessed 12 Feb. 2009. Electronic database accessible at http://research.amnh.org /herpetology/amphibia/. American Museum of Natural History, New York). *Dendrophryniscus carvalhoi* is known from the type locality in Santa Tereza municipality and ca. 130 km SW at the Parque Nacional do Caparaó, both in Espírito Santo state, Brazil (Cassimiro et al. 2008. Herpetol. Rev. 39:362). Herein we describe thanatosis in *D. carvalhoi*.

During a herpetological survey between 27 Oct and 3 Nov 2006, in Parque Nacional do Caparaó, Fazenda Pico da Bandeira, Santa Marta municipality, Minas Gerais State (20.467222°S, 41.733889°W; WGS 84; elev. ca. 1135 m), we observed defensive behavior of *D. carvalhoi*. One individual displayed thanatosis with stiff-leg behavior in response to hand capture. This species defends itself by stiffening its legs in the same way as was recently described for *D. brevipollicatus* and *D. leucomystax* (Bertoluci et al. 2007. Alytes 25:61–67). The frog assumes the stiff-legged posture when touched and remains immobile for almost one minute. Other specimens collected when disturbed for the first time in the field assumed this same behavior, and also sometimes under laboratory conditions.

Thanathosis with stiff-leg behavior maybe more common than previously thought and widespread among frogs living in forest litter. The behavior may be underestimated considering that certain species only exhibit thanathosis under specific conditions, with predator-specific responses (Gibbons and Gibbons 2009. Herpetol. Rev. 40:440). Moreover, the congruence among thanathosis behaviors among different species of *Dendrophryniscus* (Bertoluci et al. 2007, *op. cit.;* Russell 2002. Herpetol. Rev. 33:302) may reflect a closer relationship among *D. leucomystax*, *D. brevipollicatus*, and *D. carvalhoi* relative to *D. minutus*, in which thanathosis involves flipping over and presenting the ventral surface (Bertoluci et al. 2007, *op. cit.;* Russell, *op. cit.*).

We thank Lilian Duarte de Matos, and our field guide Paraíba, for field assistance. The Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) provided support and collecting permits (numbers 185/2005, and 238/2006). Estevão José Marchesini Fonseca, Director of the Parque Nacional do Caparaó, provided lodging facilities and support.

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EUPHLYCTIS CYANOPHLYCTIS (Indian Skipper Frog). **ALBINISM.** During field collections, we observed two albino tadpoles of *Euphlyctis cyanophlyctis*, one at an early stage of development (Gosner Stage 28; 31 mm in length; Gosner 1960. Herpetologica 16:183–190) and the other near metamorphosis (Gosner Stage 43; 61.8 mm in length) in a pond on the University of Pune Campus (18.554925°N, 73.86335°E), Maharashtra, India. These tadpoles were present with large numbers of conspecifics having normal pigmentation and were very conspicuous. The tadpoles were unique in that they had golden yellow color throughout and had no black pigmentation (Fig. 1A) compared to the normal tadpoles (Fig. 1B). In the early stage tadpole, although black pigmentation was absent throughout the body, the oral appara-

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FIG. 1. Albino tadpoles of *Euphlyctis cyanophlyctis* along with normal tadpoles at different stages of larval development.

tus with jaw sheaths and tooth rows were black (Fig. 1C). From the ventral side, blood vessels, gills, and the heart were visible through the transparent skin due to a lack of pigmentation. The eyes were pink and very prominent, especially during darkness when one of the tadpoles was caught. The pond is permanent, although mostly dry during the summer months. The albino tadpole at metamorphic climax (Fig. 1D) was conspicuous in the group of normal tadpoles (Fig. 1E) when collected. This tadpole metamorphosed in the laboratory within 3–4 days and the frog was normal except for pigmentation (Fig. 1F; 24.2 mm body length, 1.3 g mass). We observed behavioral aspects of its feeding and habitat sharing with normal tadpoles and observed no differences. One of the froglets matured around 4 months after metamorphosis in the laboratory and was found to be a male. We do not know the factors responsible for this phenomenon in nature. Although we have observed tadpoles from this pond for four years this is our first observation of albino tadpoles of *E. cyanophlyctis*.

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EXERODONTA SUMICHRASTI (Sumichrast's Treefrog). **SEMITERRESTRIAL LARVAE.** Except for species where the male or female frog transports the tadpoles (e.g., dorsally, marsupial pouch, etc.), free-living anuran tadpoles typically are aquatic during the entire larval period. The tadpoles of a very few species are known to be semiterrestrial, moving about on tree branches and/or rocks near water (Lawson 1993. Herpetol. Nat. Hist. 1:27–90; Wells 2007. The Ecology and Behavior of Amphibians. Univ. Chicago Press, Chicago, Illinois, 1148 pp.). Of the genera listed by Wells (2007, *op. cit.*), this behavior has been noted in but three genera in the Neotropics, the South American taxa *Leptodactylus rugosus*, *Cycloramphus*, and *Thoropa*. On 27 June 2000 I observed many tadpoles later identified as *Exerodonta sumichrasti* in a stream crossing Hwy 196, 14.2 rd km N Atoyac, Guerrero, Mexico, 610 m elev. (17.32445°N, 100.2474167°W). Most of the tadpoles were resting on rocks in splash pools below small waterfalls, while some were observed in the actual course of the stream. A small number of tadpoles (ca. 10) were observed moving across wet surfaces of rocks in the splash zone, ca. 1 m above the water line, and continuing to move vertically away from the water line. There were some lichens on the rock surfaces where the tadpoles were located, but no evident algae or moss. The tadpoles appeared to be using their enlarged mouthparts as the primary locomotor organ; larvae of this species are not gastromyzophorous. A small number of tadpoles were collected (vouchers deposited at Facultad de Ciencias, Universidad Autónoma de México: MZFC-JRM 4563), and photographic images of the semiterrestrial behavior were deposited at University of Texas at Arlington (UTA slide no. 38677–78). I believe this is the first report of semiterrestrial larvae in any Mesoamerican anuran.

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FEJERVERYA LIMNOCHARIS (Paddy Field Frog). **DIET.** *Fejerverya limnocharis* is widely distributed throughout the Indian subcontinent and feeds mainly on small insects (Chanda 2002. Handbook of Indian Amphibians. ZSI., Kolkata, India; Daniel 2002. The Book of Indian Reptiles and Amphibians. BNHS and Oxford Univ. Press, Mumbai, India; Dutta 1992. Amphibians of India and Sri Lanka [Checklist and Bibliography]. Odyssey Pub. House, Orissa, India), but there is little information on the ecology of the species.

During herpetological surveys on 16 July 2009 at 2322 h, we heard the distinct advertisement calls of anurans. Based on spectrum-homologies of our anuran sound bank as well as on morphological features we identified *Fejerverya limnocharis* in the chorus. During call recordings we observed a *F. limnocharis* feeding on a large earthworm. The frog was holding the earthworm in its jaws and pushing it into its mouth with the help of its forelegs, repeating this motion follow short intervals. Other anurans of larger size such as *Hoplobatrachus tigerinus* readily feed on earthworms (Danials 2004. Amphibians of Peninsular India. Indian Academy of Science and University Press, Hyderabad, India), although there is no report of such feeding behavior for *F. limnocharis*. The *F. limnocharis* under observation was only 3 cm SVL, while it was feeding on an earthworm measuring ca. 10 cm. Reports of *F. limnocharis* feeding on small insects are available, although this is the first report on such an unusual feeding behavior of this anuran.

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HYLA WRIGHTORUM (Arizona Treefrog). **PREDATION**. *Hyla wrightorum* is discontinuously distributed from Arizona and New Mexico, south into northern México. The population of *H. wrightorum* in and near Arizona's Huachuca Mountains, Canelo Hills, and adjacent northern Sonora are isolated from the nearest populations along the Mogollon Rim to the north in Arizona and the Sierra Madre Occidental in Sonora, México (Gergus et al. 2004. Copeia 2004:758–769; Maldonado Leal et al. 2009. Herpetol. Rev. 40:108). Recently, the U.S. Fish and Wildlife Service (USFWS) assigned the Huachuca/Canelo population of *H. wrightorum* the status of Candidate for listing as Threatened or Endangered under the U.S. Endangered Species Act as a Distinct Population Segment (DPS; USFWS 2007. Fed. Register 72:234). Among the threats to the DPS identified by USFWS was the potential for predation by introduced species, particularly American Bullfrogs (*Lithobates catesbeianus*), but empirical data were lacking (USFWS, *op. cit.*). We report the first documented instance of predation by *L. catesbeianus* on *H. wrightorum*.

On 14 July 2008, from 1245–1520 h MST, in Scotia Canyon, Huachuca Mountains, Cochise Co., Arizona, USA (31.4572°N, 110.3976°W, NAD 83, ca. 1890 m elev.), we were engaged in a larger effort to remove American Bullfrogs from aquatic habitats throughout the canyon, including a permanent, spring-fed pond near the head of the canyon where American Bullfrogs had bred for the past several years. Thunderstorms were moving through the area, and male *H. wrightorum* were calling sporadically from a well-known breeding site; a small, temporary pond ca. 50 m from the permanent pond. At that time we collected an adult male *L. catesbeianus* (SVL = 140 mm) that was calling from the temporary pond, and discovered remains of four adult *H. wrightorum* in its stomach; three were males (SVL = 30, 31, 32 mm), one was too decomposed to be measured or sexed. We returned to the site on 17 July 2008, and at 1540 h collected a female *L. catesbeianus* (SVL = 120 mm; with developing ova) at the same site. Her stomach contained three adult *H. wrightorum*, one male (SL = 34 mm); two could not be measured or sexed. Weather was overcast and a single *H. wrightorum* called at 1602 h.

Although the indiscriminate predatory habits of *L. catesbeianus* are well known and widely published (Casper and Hendricks. 2005. *In* M. Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 540–546. Univ. California Press, Berkeley), it is clear from our data that a few adult *L. catesbeianus* can have a profound impact on small, isolated populations of rare species such as *H. wrightorum* in the Huachuca Mountains where breeding sites might comprise only 2–30 adults (Gergus et al. 2005. *In* M. Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 461–463. Univ. California Press, Berkeley). In addition, since each of the *H. wrightorum* for which sex could be identified were adult males, it raises the possibility that the *L. catesbeianus* might have used acoustical cues to target their prey (Casper and Hendricks 2005, *op. cit.*), although it might simply be the case that females had not yet moved to the breeding site.

American Bullfrogs are known to be capable of moving quickly over relatively large distances during Arizona's summer monsoon (pers. obs.; Suhre et al. 2006. Unpubl. abstract. Joint Meeting of Ichthyologists and Herpetologists, New Orleans, Louisiana; C. Schwalbe and P. Rosen, pers. comm.). Thus, it is not unreasonable to predict that *L. catesbeianus* could temporarily occupy other nearby *H. wrightorum* breeding sites in the Huachuca Mountains and seriously deplete those populations as well, and could do so without that impact being quickly or readily identifiable.

Our fieldwork adhered to guidelines outlined in Beaupre et al. (2004. Guidelines for Use of Live Amphibians and Reptiles in Field and Laboratory Research, 2nd ed. Herpetological Animal Care and Use Committee, American Society of Ichthyologists and Herpetologists).

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HYLODES cf. AMNICOLA (NCN). **PREDATION.** Kingfishers are preferentially fish predators, although they may also include arthropods, crabs, amphibians, and reptiles in their diet (Sick 1997. Ornitologia Brasileira. Editora Nova Fronteira, Rio de Janeiro. 912 pp.). At ca. 1000 h on 17 Oct 2008, during a field trip to "Mata da Prefeitura" (22.2180556°S, 45.2569444°W; 1150 m elev.), in the municipality of Cristina, Minas Gerais State, southeastern Brazil, we observed an adult Ringed Kingfisher, *Megaceryle torquata*, preying on an adult torrent-frog, *Hylodes cf. amnicola*. After capture, the frog was beaten repeatedly on the bird's perch; after the frog was consumed the bird flew away. This is the first report of predation of this species.

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HYPSIBOAS SEMILINEATUS (NCN). **ALBINISM**. *Hypsiboas semilineatus* is a treefrog widely distributed in the Atlantic Forest of Brazil (Haddad et al. 2008. São Paulo: Editora Neotropica). Tadpoles of this species are found in lentic bodies of water forming large schools (D'Heursel and Haddad 2002. Iheringia 92:99–104). On 20 October 2007 at 1900 h and on 19 July 2008 at 1400 h we collected albino tadpoles of *H. semilineatus* at two localities in the Atlantic Forest in northeast Brazil: Reserva Particular Frei Caneca, municipality of Jaqueira (8.721667ºS, 35.850833ºW) and Reserva Particular da Usina São José, municipality of Igarassu (35.000556ºS, 7.817778ºW). These were 39.3 mm SVL/Gosner Stage 33 and 52.1 mm SVL/Gosner Stage 37, respectively. Albinism in anuran larvae is rare in nature (Rodrigues and Filho 2004. Herpetol. Rev. 35:373–373). This is the first record of albino tadpoles for this species.

The tadpoles were deposited in the herpetological collection of the Universidade Federal Rural de Pernambuco/Unidade Acadêmica de Serra Talhada - UFRPE/UAST (lot 30 and 31), Serra Talhada, Pernambuco, Brazil.

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LEPTODACTYLUS LATRANS (Criolla Frog). **PREDATION.** *Leptodactylus latrans* has a wide distribution in South America, occurring east of the Andes from Venezuela to Argentina (Heyer et al. 2010. IUCN. Red List of Threatened Species. Ver. 2010.1). The species inhabits a wide variety of environments including open habitats in dry areas, tropical rainforests and disturbed areas (Izecksohn and Carvalho e Silva. 2001. Amphibians of Rio de Janeiro, Editora UFRJ, Rio de Janeiro, RJ, 148 pp.). Formerly known as *L. ocellatus* this species was renamed by Lavilla et al. (2010. Zootaxa 2346:1–16). The only record of predation on tadpoles of *L. latrans* refers to the Great Kiskadee (*Pitangus sulphuratus*; Vaira and Coria 1994. Herpetol. Rev. 25:118). There are no records of predation of *L. latrans* tadpoles by invertebrates. At 2120 h on 27 Oct 2009 we observed two predation events of *L. latrans* tadpoles by aquatic invertebrates. The observations were made in wetland habitat associated with a coastal sand dune (32.1654°S, 52.1523°W, Corrego Alegre, sea level) in the municipality of Rio Grande, RS, southern Brazil. Both events were observed simultaneously in a school of tadpoles in a temporary pond colonized by macrophytes (mainly *Juncus acutus* and *Spartina ciliata*). One of the tadpoles (21 mm body length) was preyed upon by a juvenile aquatic spider (*Diapontia* sp., Lycosidae) and the second tadpole (23 mm body length) by a juvenile water-bug (*Belostoma* sp., Belostomatidae). Most amphibians have a close dependence on water bodies for reproduction, thus making them vulnerable to aquatic predators (Toledo 2003. Phyllomedusa 2:105–108; Fulan and Almeida 2010. Acta. Sci. Biol. Sci. 32:121–124). This observation adds two new predators of *L. latrans* suggesting that the role of invertebrates in the population dynamics of anurans is still insufficiently known, especially in the Neotropics. Tadpoles were deposited in the Collection of the Laboratório de Ecologia de Vertebrados Terrestres of FURG (AMRG46; AMRG47). We thank CNPq and Fapergs for financial support and ICMBio for collecting permits.

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LITHOBATES AREOLATUS CIRCULOSUS (Northern Crawfish Frog). **PREDATION.** Raccoons (*Procyon lotor*) are known to consume a wide variety of prey items. They often forage at the edge of shallow water in search of their preferred prey, crayfish (Zeveloff 2002. Raccoons: A Natural History. Smithsonian Institute Press, Washington, D.C. 200 pp.). Amphibians typically do not constitute a large part of their diet. Zeveloff (2002, *op. cit.*) examined raccoon scat and found that 9% was composed of Tiger Salamander (*Ambystoma tigrinum*) remains. Whitaker and Mumford (2009. Mammals of Indiana. Indiana Univ. Press, Bloomington. 661 pp.) examined the stomach contents of 41 raccoons in Indiana and found that amphibians composed 1.7% of the raccoons' diet; both Green Frog (*Lithobates clamitans*) and Fowler's Toad (*Anaxyrus fowleri*) remains were identified. Wright (1966. Herpetologica 22:127–128) witnessed a raccoon kill and eat five Colorado River Toads (*Anaxyrus alvarius*). The raccoon avoided consuming the toxic parotoid glands by turning the animals over and eating the viscera though the anterior abdominal wall. Schaaf and Garton (1970. Herpetologica 26:334–335) reported similar findings in which raccoons preyed upon American Toads (*Anaxyrus americanus*) and often left the head and the upper back.

Parris and Redmer (2005. *In* Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 526–528. Univ. California Press, Berkeley) state that natural predators of Crawfish Frogs (*Lithobates areolatus*) are unknown. Here we report the first known incidents of raccoon predation on Crawfish Frogs, one in Indiana, one in Illinois. During a telemetry study in southwestern Indiana, an adult male Crawfish Frog was found freshly dead the morning of 2 April 2010 along the edge of a breeding wetland where it had migrated the week before. All that remained was the top of the skull and the dorsal skin. The previously intraperitoneally implanted transmitter was a meter away, and within 50 cm, along the shoreline, were fresh raccoon tracks. On 20 March 2010, a recently predated adult male Crawfish Frog was observed at a breeding wetland in southern Illinois. The carcass consisted of a single, nearly-complete piece of skin connected to the top of the skull. The uneaten skin, which included the vocal sacs, was comprised of the dorsum, both sides, most of the venter, and one hind limb. The frog had the appearance of having been skinned.

Crawfish Frog skin, similar to that of toads, is "studded with numerous glandular warts" (Goin and Netting 1940. Ann. Carnegie Mus. 38:137–168); and like several other species of ranids, secretes antimicrobial peptides from granular glands (Ali et al. 2002. Biochimica et Biophysica Acta 1601:55–63). It is possible that skin secretions are distasteful and raccoons avoid eating the skin of Crawfish Frogs, similar to their behavior when preying upon toads.

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LITHOBATES CATESBEIANUS (American Bullfrog). **DIET.** The American Bullfrog was introduced in Brazil in the 1930s for commercial breeding. However, escapes from farms and intentional introductions have allowed this species to establish invasive populations in wild habitats, especially in the Atlantic Rainforest (Giovanelli et al. 2008. Biol. Invasions 10:585–595). Here we report data on the diet of the American Bullfrog obtained by stomach content analysis of 50 specimens collected in a reservoir located in Viçosa (20.75764°S, 42.86075°W), Minas Gerais State, southeastern Brazil. The site is known as Represa do Belvedere, and is composed of a group of small connected dams surrounded by a secondary forest fragments and a grassplot. The dams have abundant aquatic vegetation, mostly *Salvinia* sp. and Nympheaceae.

American Bullfrogs were collected during September–December 2003. After collection, specimens were fixed in 10% formalin and preserved in 70% alcohol; SVL was measured to the nearest 0.05 mm and the stomach contents tabulated. Prey items were identified to the lowest known taxonomic level; plant remains were considered to be accidently ingested.

Only 4 individuals (8%) had empty stomachs, and 16 (32%) had nothing but undetermined remains in their stomachs. Plant remains were found in 22 stomachs (44%), and two individuals

TABLE. 1. Stomach contents of 44 *Lithobates catesbeianus* from "Represa do Belvedere," municipality of Viçosa, Minas Gerais State, Brazil, collected from September to December 2003. Np = number of prey; Nbf = number of American Bullfrogs.

Prey Items	Np	% Np	Nbf	% Nbf
DIPLOPODA	1	0.88	1	2.27
ARACHNIDA				
Araneae	4	3.51	4	9.09
INSECTA				
Blattodea	1	0.88	1	2.27
Coleoptera (adults)	22	19.30	13	29.55
Coleoptera (larvae)	2	1.75	1	2.27
Diptera (adults)	2	1.75	2	4.55
Diptera (larvae)	4	3.51	3	6.82
Ephemeroptera (adults)	1	0.88	1	2.27
Ephemeroptera (larvae)	1	0.88	1	2.27
Hemiptera (Cicadellidae)	1	0.88	1	2.27
Hemiptera (Heteroptera)	12	10.53	6	13.64
Hymenoptera (Formicidae)	26	22.81	16	36.36
Hymenoptera (others)	10	8.77	8	18.18
Isoptera	3	2.63	3	6.82
Lepidoptera (adults)	2	1.75	2	4.55
Lepidoptera (larvae)	2	1.75	2	4.55
Odonata (adults)	5	4.39	3	6.82
Odonata (naiads)	6	5.26	5	11.36
ARTHROPOD REMAINS	0	0	23	52.27
AMPHIBIA				
Rhinella pombali (juvenile)	1	0.88	1	2.27
Scinax fuscovarius	1	0.88	1	2.27
Unidentified anurans	6	5.26	5	11.36
Undetermined remains	0	0	16	36.36
Plant material	0	0	21	45.65

had only plant material in the stomach. Thirty-four individuals (68%) had at least one identifiable prey in their stomachs, and prey number by frog varied from 1–16 (mean ± SD: 3.47 ± 3.07). The majority of the individuals measured (N = 28; 56%) were <50 mm SVL (range: 36.8–48.8; 43.92 ± 3.0). Sixteen frogs were between 51.5 and 84.2 mm SVL (65.65 ± 10.81), and the remaining six frogs were >90 mm SVL (range: 90.10–116.05; 100.96 ± 9.05).

Among the 114 prey items identified, the most common were ants, adult Coleoptera, and Heteroptera which represented 52.64% of the total prey ingested (Table 1). Besides these three insect groups, non-ant hymenopterans, naiads of Odonata, and anurans were also frequent prey items (occurring in >10% of the samples). Insects dominanted the diet likely due to the small size of the majority of frogs. These data add *Scinax fuscovarius* to the list of anurans reported as prey of the invasive American Bullfrog not reported by Silva et al. (2009. S. Am. J. Herpetol. 4:286–284).

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LITHOBATES SYLVATICUS (Wood Frog). **EGG PREDATION**. Predation by tadpoles on eggs and larvae of heterospecifics has been reported for a number of amphibian species (Ehrlich 1979. Bull. Maryland Herpetol. Soc. 15:25–26; Kiesecker and Blaustein 1998. Conserv. Biol. 12:776–787; Petranka et al. 1994. Copeia 1994:691–697). Among these are tadpoles of large-bodied ranids, including Bullfrogs (*Lithobates catesbeianus*) and Green Frogs (*L. clamitans*), which can overwinter in permanent wetlands and pose a serious threat to the reproductive success in pond-breeding amphibians. Vasconelos and Calhoun (2006. Wetlands 26:992–1003) reported that colonization by *L. clamitans* drastically reduced the number of emerging *L. sylvaticus* juveniles in restored wetlands. Here I report daily observations of predation on communal egg masses of *L. sylvaticus* by *L. clamitans* tadpoles contributing to total reproductive failure in a stormwater retention pond.

On 13–15 March 2010, *L. sylvaticus* breeding and oviposition occurred in a stormwater retention pond in suburban Owings Mills, Maryland, USA (39.425758°N, 76.813538°W). This pond typically dries in late summer, but significant rain during 2009 created a permanent water source allowing *L. clamitans* to successfully overwinter in the pond. A complete census of *L. sylvaticus* egg masses was conducted on 16 March and 21 total egg masses were identified: 16 in a communal mass in the northernmost section of the pond ("N Mass") and five in a separate communal mass in the easternmost section of the pond ("E Mass"). On 17 March at 2100 h, 40–60 large ranid tadpoles were observed feeding voraciously on eggs deposited in the deepest area of N Mass (ca. 60 cm water depth). On 18 March, 14.5 egg masses remained, and ca. 12.5 partially intact masses were present on 19 March at N Mass; all of which were deposited in the shallow margin of the pond. During that survey predation was first observed on E Mass eggs by 20–30 tadpoles, and only 4 partial egg masses remained. At this time no remaining eggs had developed past Gosner Stage 17, so it is unlikely that any embryos had successfully developed to free-swimming larvae (Gosner 1960. Herpetologica 16:183–190). The final survey was conducted on 20 March, four days after the first census, when only one egg mass was located at each of the two communal areas. Both egg masses had become partially stranded on woody vegetation as the pond's water level dropped, though lower remnants of each egg mass were still submerged and being consumed by ca. 20 tadpoles.

On 20 March, ten tadpoles were collected and euthanized for further analysis. All tadpoles were identified as *L. clamitans* in Gosner stages 30–37 and dissected for evidence of egg predation. Jelly coating was found in the tadpoles' guts but no discernable embryos were discovered. Therefore, it is unknown if *L. clamitans* tadpoles were feeding exclusively on the jelly coating or on the embryos too, though no exposed embryos were observed in the general areas of the communal masses. My observations suggest that this pond might serve as an ecological trap for *L. sylvaticus* following abnormally wet years due to predation by overwintered *L. clamitans* tadpoles.

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ODONTOPHRYNUS CARVALHOI (Carvalho's Escuerzo). **DEFENSE**. Amphibians can reduce the chances of being eaten either by avoiding being found by a predator or by avoiding being consumed once they have been found (Wells 2007. The Ecology and Behavior of Amphibians. Univ. Chicago Press, Chicago, Illinois. 608 pp.). During a study of anuran diet in the Serra de Baturité, a relictual area of Atlantic Forest in the State of Ceará, northeast Brazil, between March and October 2009, we observed several defensive responses by *Odontophrynus carvalhoi*, a poorly studied leaf litter frog restricted to northeastern Brazil (Frost 2009. Amphibian Species of the World: an Online Reference. Ver. 5.3, accessed 16 October 2009). Electronic database accessible at http://research.amnh.org/vz/herpetology/amphibia/ American Museum of Natural History, New York). The first defensive response observed in all *O. carvalhoi* (N = 20) was to flee in response to the approach of the collector. However, when captured, all individuals inflated their bodies, increasing their width considerably. One individual (SVL 69.8 mm) increased its body width almost 40% (36.4 to 50.9 mm) between capture and after having being handled for one minute. While inflated they would lock their mouths very tightly, making it difficult to open them in comparison with individuals of other species included in the same study, including Bufonidae and Leptodactylidae. Some individuals (N = 8), after being stomach-flushed, remained motionless with their legs held close to their bodies. This behavior, interpreted as "death-feigning"(Abbadic-Bisogno et al. 2001 Herpetol. Rev. 32:247), would persist after being placed on the ground with their belly up. They would remain in this position for a variable period of time (10 sec to 5 min), after which they would flip themselves with a fast kick against the substrate. The act of inflating the body to look bigger has been reported for many anurans and is believed to discourage attack by predators or make ingestion more difficult, especially by snakes that swallow their prey whole. Death-feigning has also been reported for many anurans and although its significance remains poorly understood, we believe that it would represent a defense mechanism against visually oriented predators that consume live prey. *Odontophrynus carvalhoi* seems to have a diverse behavioral repertoire to avoid predation, besides its cryptic coloration. Those behavioral responses act in different steps of the predation process and probably vary according to the predator and to other variables of the environment. Some of the collected individuals are deposited at the Laboratório de Zoologia Experimental.

FIG. 1. *Odontophrynus carvalhoi* inflated after being manipulated. Notice transparency of skin.

COLOR REPRODUCTION SUPPORTED BY THE THOMAS BEAUVAIS FUND

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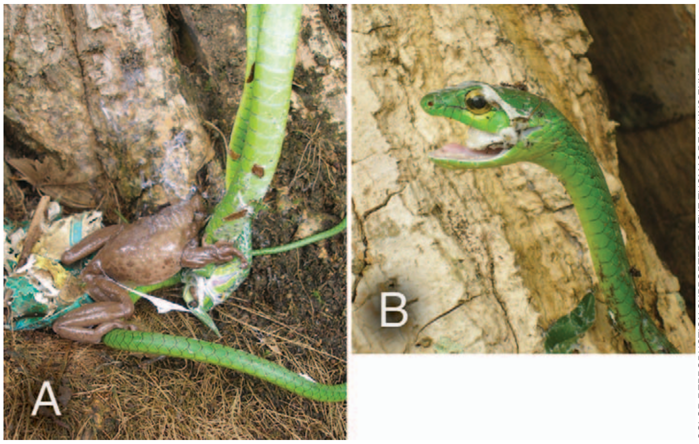
PHRYNOHYAS VENULOSA (Milky Tree Frog). **PREDATION**. *Phrynohyas venulosa* is a large and common hylid frog occurring in Middle and South America. It uses a poisonous skin secretion as a defense against predators. This secretion can produce extreme irritation, swelling, and pain if rubbed in the eyes or mucus membranes (Savage 2002. The Amphibians and Reptiles of Costa Rica. A Herpetofauna Between Two Continents, Between Two Seas. Univ. Chicago Press, Chicago, Illinois. 934 pp.). Here I offer an eyewitness account of a *Phrynohyas venulosa* that actively and manually transferred skin secretions onto a predatory snake.

On 9 Dec 2007 I was guiding a group of birdwatchers in the Cano Negro area in Costa Rica. Near the river, in an agricultural area bordering a small forest, we were standing on a road next to a couple of large, free standing trees, when we heard a rustling noise above our heads. A few seconds later, a Green Parrot Snake (*Leptophis ahaetulla*), ca. 1.5 m total length, fell from a tree and landed on a piece of barbed wire that was nailed to the tree. While still hanging on the wire, we observed the *L. ahaetulla* to have an adult *P. venulosa* in its mouth. The *P. venulosa* was held by its left front leg and while struggling to get loose it emitted a large amount of white mucus from its upper side. While it tried to control its position with its right arm, the *P. venulosa* frantically moved its legs over its back to the head of the *L. ahaetulla*. With each movement the frog smeared mucus from its back towards the snake's head (Fig. 1A). These movements seemed to alter the state of the mucus, because the mucus hardened and stiffened, forming tough threads like chewing gum, while the untouched mucus on the head of the *P. venulosa* was fluid. In about two minutes, the head of the *L. ahaetulla* received more of the rubbery mucus. The mucus seemed to shrink while drying, making it harder for the *L. ahaetulla* to manipulate and see its prey. At some



COLOR REPRODUCTION SUPPORTED BY THE THOMAS BEAUVAIS FUND

FIG. 1A. About one minute into the attempted predation of a *Phrynohyas venulosa* by a *Leptophis ahaetulla*: fresh secretion is still coming off the frog's back. Two coils of dried secretion can clearly be seen tightly wrapped around the snout of the snake, limiting the movements of its mouth and obscuring its view.

FIG. 1B. About one minute after the predation attempt: by rubbing its head against treebark and by chewing movements of its jaws, the snake got rid of most of the secretion. The last coil of dried secretion is just hanging on, including a big chunk inside the snake's mouth.

point it appeared as if the head of the *L. ahaetulla* was tightly bound with plastic rope. Suddenly the *P. venulosa* freed itself and hopped to safety. The *L. ahaetulla* was still hanging from the barbed wire and trying to get rid of the hardened mucus. The mucus had accumulated mainly on the snake's nose, around its head, and in its mouth and was very sticky and tough. The *L. ahaetulla* had to rub its head against the tree and move its jaws horizontally and vertically again and again to remove it. After about two minutes the *L. ahaetulla* got rid of most of it, except for a big chunk in its mouth. Then it became aware of our presence and moved up the tree. When it reached a height of 3 m, its mouth seemed fully free of dried mucus.

It appeared as though the *P. venulosa* was deliberately shoving the mucus towards the snake's head, as its feet collected mucus when moving towards the snake. I am unaware if there are reports of poisonous amphibians that actively transfer their skin secretions, but that appears to be the case in this observation.

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PLATYMANTIS VITIANA (Fiji Ground Frog). **FROGLET MORPHOLOGY.** *Platymantis vitiana* is an endangered anuran found only on four small outer islands in Fiji including Viwa, Taveuni, Gau, and Ovalau. On Viwa Island (a 60-ha island, 30 km NE of Suva and 0.95 km from mainland Viti Levu, Fiji), *P. vitiana* shares its natural habitat with invasive *Bufo marinus*. *Bufo marinus* is a prolific breeder while *P. vitiana* is a seasonal breeder (Narayan et al. 2010. Gen. Comp. Endocrinol. 166:172–179). Eradication plans for *B. marinus* on Viwa include chemical use and trapping of toadlets and adults. As a precautionary conservation measure, translocation of a sub-population of *P. vitiana* adults and froglets will be necessary prior to eradication of *B. marinus*. In this process and during eradication, misidentification of *B. marinus* toadlets with froglets of *P. vitiana* is likely to affect the *P. vitiana* population and also shadow the outcome of the eradication programs. Therefore, we attempted to find morphological features of *P. vitiana* froglets for rapid identification in the field.

A clutch of *P. vitiana* eggs was monitored on Viwa Island up to hatching of froglets on 12 Dec 2007. Simultaneously, tadpoles of *B. marinus* were also monitored in a nearby natural pond on Viwa Island up to four weeks.

Bufo marinus eggs typically underwent a tadpole metamorphosis while eggs of *P. vitiana* metamorphosed directly into newly hatched froglets without a tadpole stage. Morphologically, the hatchlings of both *P. vitiana* and *B. marinus* are of similar size (mean = 8 mm SVL) and have the second digit of both the anterior and posterior limbs longer than the rest of the digits. Each anterior limb has four digits while each posterior limb has five digits. Furthermore, the hatchlings of both species have blackish-brown or greenish striped patterns on the upper surfaces of both anterior and posterior limbs. However, a morphological feature diagnostic of *P. vitiana* froglets was identified. A butterfly pattern of five brown raised warts on the dorsal head region, forming a circle with one brown raised wart in the center, was observed in all *P. vitiana* froglets (Fig. 1). However, metamorphs of *B. marinus* of similar age only have greenish raised warts distributed along the head–vent margin.

These morphological features thus can be used to identify metamorphs of *P. vitiana* in the field and help to avoid misidentification with those of invasive *B. marinus*. This study is the first record of morphological characteristics of *P. vitiana* froglets and


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FIG. 1. A group of newly hatched *Platymantis vitiana* froglets (N = 5) on soil substrate on Viwa Island. Note the characteristic butterfly pattern on the dorsal head region of each froglet.

it has useful implications for future eradication efforts of *B. marinus* in the Fiji Islands.

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PROCERATOPHRYS MELANOPOGON (Black-bearded Horned Leaf Toad). **DEFENSIVE BEHAVIOR.** *Proceratophyrs melanopogon* is a small to medium-sized cycloramphid anuran that belongs to the *Proceratophyrs appendiculata* complex (Prado and Pombal 2008. Arq. Zool. 39:1–85). Species within this complex are characterized by the presence of palpebral appendages and cryptic coloration resembling fallen leaves (Prado and Pombal 2008, *op. cit*.; Toledo and Haddad 2009. Int. J. Zool. 2009:1–12). *Proceratophyrs melanopogon* mainly inhabits leaf litter on the forest floor in Atlantic Rainforest areas of southeastern Brazil (Izecksohn et al. 1998. Rev. Univ. Rural, Sér. Ciênc. Vida 20:37–54; Prado and Pombal 2008, *op. cit*.).

On 4 Dec 2009 at 1430 h, we observed defensive behavior displayed by *P. melanopogon* upon capture. After grasped with the hand, the specimen flattened its body and stretched out its legs, keeping this position until being released on the ground (Fig. 1). The observation took place near a permanent pond in Serra do Brigadeiro State Park, an area of montane rainforest in municipality of Araponga, state of Minas Gerais, Brazil (20.7219ºS, 42.4786ºW, elev. 1320 m, SAD1969).

This defensive behavior has been called stiff-legged (Sazima 1978. Biotropica 10:158) and was reported for other horned leaf toads, including *P. appendiculata* (Sazima 1978, *op. cit*.) and *P. boiei* (Toledo and Zina 2004. Herpetol. Rev. 35:375). Similar behaviors for other leaf-litter anurans (e.g., *Dendrophryniscus leucomystax*, *D. brevipollicatus*, *Scythrophrys sawayae*, *Stereocyclops parkeri*) has been regarded as behavioral convergence given that leaf-litter inhabiting species are subject to similar predation pressures (Bertoluci et. al 2007. Alytes 25:1–2; Garcia 1999. Herpetol. Rev. 30:224; Sazima 1978, *op. cit*.; Toledo and Zina 2004, *op. cit*.).

Fig. 1. *Proceratophrys melanopogon* (25.9 mm SVL) from Minas Gerais, Brazil displaying stiff-legged defensive behavior.

The adaptive value of this behavior might be in enhancing crypsis among fallen leaves, confusing visually oriented predators (Sazima 1978, *op. cit*.; Toledo and Zina 2004, *op. cit*.), and/or inhibiting ingestion by predators (Angulo and Funk 2006. Herpetol. Rev. 37:203–204; Azevedo-Ramos 1995. Rev. Bras. Biol. 55:45–47).

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RHINELLA MARGARITIFERA (NCN). **PARASITES.** The *Rhinella margaritifera* complex is widely distributed in Latin America, occurring throughout the Amazon Basin and parts of Panama (IUCN, Conservation International, and NatureServe 2004. Global Amphibian Assessment. <www.globalamphibians.org>. Accessed 03 Dec 2004). Although amphibians are known to be parasitized by larvae of numerous fly species, this is a poorly studied area of amphibian biology. In Europe, North America, and India, amphibians are commonly attacked by larvae of several blow flies (Calliphoridae) and flesh flies (Sarcophagidae; Bolek and Coggins 2002. J. Wildl. Dis. 38:598–603; Dasgupta 1967. Parasitology 52:63–66; James and Maslim 1947. J. Washington Acad. Sci. 37:366–368; Strijbosch 1980. Oecologia 45:285–286), and in Australia amphibians are infected with larvae of grass flies (Chloropidae; Schell and Burgin 2001. J. Parasitol. 87:1215–1216).

In Neotropical regions, cases of flesh fly parasitism in anurans have been recorded from *Atelopus* spp. in Costa Rica (Crump and Pounds 1985. Parasitology 75:588–591), *R. granulosa* in Venezuela (Lopes and Vogelsang 1953. An. Acad. Brasil. Ciências 25:139–143), *Rana catesbeiana* in Brazil (Souza et al. 1990. Mem. Inst. Oswaldo Cruz 84:517–518), *Eleutherodactylus* sp. in Panama (Dodge 1968. Ann. Entomol. Soc. America 61:421–450), *Proceratophrys* in Brazil (Lopes 1981. Rev. Brasil. Entomol. 41:149–152), and *Epipedobates* spp. (Hagman et al. 2005. Phyllomedusa 4:60–73). Here, we offer a first report of parasitism of *R. margaritifera* by flesh flies.

On 16 August 2007 at 1000 h, we found an adult *R. margaritifera* (42.9 mm SVL, 6 g) in Floresta Nacional de Caxiuanã, near the municipality of Portel (1.96000°S, 51.6152778°W; elev. 20 m), State of Pará, Brazil. The specimen was hidden within the dry leaves and twigs of *terra firme* forest ground. During preservation we observed 21 flesh fly larvae leaving the body of *R. margaritifera* through the cloaca. The larvae were preserved in 70% alcohol.

We deposited the *R. margaritifera* and flesh fly larvae in the herpetological (MPEG 21938) and entomological collections, respectively, of the Museu Paraense Emílio Goeldi, Belém, State of Pará, Brazil. Marinus S. Hoogmoed verified identification of the frog.

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SCAPHIOPUS COUCHII (Couch's Spadefoot). **PREDATION**. Predation on adult *Scaphiopus couchii* has rarely been reported in the literature, despite numerous studies of predation on larvae of this species and other spadefoots (Duellman and Trueb 1986. Biology of Amphibians. McGraw-Hill, New York. 670 pp.). On 1 May 2008 a road-killed American Badger (*Taxidea taxus*) was salvaged from US Hwy 87 in Tom Green Co., Wall, Texas, USA (31.371819°N, 100.313141°W; WGS 84). Habitat in the area adjacent to the highway is primarily cultivated cotton fields with small areas of grassland. Analysis of stomach contents of the badger revealed the remains of four adult *S. couchii*, in addition to one Texas Spotted Whiptail (*Aspidoscelis gularis*) and three unidentified juvenile rodents. Toxic skin secretions of the spadefoots apparently were no deterrent to the predator. The multiple *S. couchii* taken by the badger suggests a high activity for spadefoots at that time. On 27 April there had been thunderstorms with accumulations of rain of 1.24 cm at the nearest weather station at San Angelo Airport. This precipitation might have been sufficient to bring about reproductive activity for adult spadefoots and the badger opportunistically preyed on these. Published accounts of the diet of *Taxidea taxus* rarely include amphibians, but to our knowledge only unidentified *Rana* species and Eastern Tiger Salamanders (*Ambystoma tigrinum*) have been reported (Errington 1937. J. Mammal. 18:213–216; Snead and Hendrickson 1942. J. Mammal. 23:380–391; Sovada et al. 1999. Amer. Midl. Nat. 142:410–414). Specimens have been deposited in the Collections of Amphibians and Reptiles, Angelo State Natural History Collections, Angelo State University, as ASNHC 14270 (*S. couchii*) and ASNHC 14271 (*A. gularis*).

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SCAPHIOPUS COUCHII (Couch's Spadefoot). **DEVELOPMENTAL MORPHOLOGY**. *Scaphiopus couchii* from the deserts of the American southwest exhibit the shortest larval period duration known among amphibians, developing from hatching to forelimb emergence in as little as 8 days (Newman 1987. Oecologia 71:301–307). Here, we report a morphological observation representing a contributing mechanism to achieve short larval periods, namely the elimination from its ontogeny of Gosner developmental stages 24 and 25 (Fig. 1; Gosner 1960. Herpetologica 16:183–190). Gosner Stage 23 (G23) is defined by the presence of external gill filaments on both sides of the body. At G24, the operculum (skin covering) covers the right gill filaments. At G25, the operculum covers the gill filaments on both sides. At G26, the hind limb buds appear. In *S. couchii* (two-day-old embryos from adults collected in Cochise Co., Arizona USA), the hind limb buds became visible prior to operculum formation on either side of the body (Fig. 1). This developmental situation does not occur in the spadefoot relatives, *Spea multiplicata* or *Pelobates cultripes*, which follow the typical Gosner stages. Other species of *Scaphiopus* should be examined. We did not observe any instance in *S. couchii* where neither the right and left nor just the right gill filaments were covered by the operculum in the absence of hind limb buds. However, G23 individuals were observed, where right and left external gills were visible in the absence of hind limb buds. Interestingly, *S. couchii* still has G26, indicating a lag in hind limb growth after its first appearance at G23. This lack of limb bud growth during operculum formation may correspond to the time lag in stage advancement during G26 in *S. multiplicata* (Buchholz and Hayes 2002. Copeia 2002:180–189). It appears that hind limb development in *S. couchii* has been heterochronically shifted to initiate at an earlier stage (from G26 to G23). The elimination of developmental stages may enable *S. couchii* to achieve subsequent stages at earlier time points, contributing to its extremely short larval periods. This divergence of *S. couchii* from the typical developmental sequence found in anuran tadpoles precludes comparing *S. couchii* to other species at these developmental stages. The developmental modification reported here accompanies two other evolutionary modifications underlying the short larval periods in *S. couchii*. First, *S. couchii* has extremely rapid cell division cycles during the embryonic period (Zweifel 1968. Bull. Am. Mus. Nat. Hist. 140:3–64), perhaps due to their relatively small genome size (www.genomesize.com). Second, increased levels of thyroid hormone tissue content and heightened sensitivity and responsivity to thyroid hormone contribute to their accelerated metamorphic period (Buchholz and Hayes 2005. Evol. Develop. 7:458–467).

Fig. 1. *Scaphiopus couchii* within a day after hatching showing developing hind limb bud and external gill filaments on the right side of the body (gills and hind limb bud are present on left side also, but not visible here). This developmental stage is not compatible with the Gosner staging table.

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SCINAX FUSCOVARIUS (NCN). **PREDATION**. Snakes are commonly known to prey on anurans (Michaud and Dixon 1989. Herpetol. Rev. 20:39–41) including species of *Scinax* (Bernarde et al. 2000. Rev. Brasil. Biol. 60:695–699). At 2000 h on 26 Nov 2005, at Fazenda Jatobá (Buritizeiro Municipality, State of Minas Gerais, Brazil; 17.1269444°S, 44.8788889°W), we found an adult *Xenopholis undulatus* (300 mm SVL, not collected) during a heavy rainfall, foraging among the wet grass near a temporary pond. When captured, the snake regurgitated an adult *Scinax fuscovarius* (35.6 mm SVL; AAG-UFU 3574, Museu de Biodiversidade do Cerrado, Minas Gerais, Brazil). This is the first record of *X. undulatus* preying on an anuran. Only *X. scalaris* is known to prey on anurans (Cunha and Nascimento 1993. Ofídios da Amazônia. As Cobras da Região Leste do Pará. Boletim Museu Paraense Emílio Goeldi 9:1–191). Other anurans present in the area that could be potential prey of *X. undulatus* and other snake species include *Pseudopaludicola mystacalis*, *Dendropsophus cf. marmoratus*, *Physalaemus centralis*, and *P. cuvieri*.

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SCINAX FUSCOVARIUS (Snouted Treefrog). **PREDATION.** *Scinax fuscovarius* are frogs of medium size, widely distributed in Brazil and also in Paraguay, Argentina, Bolivia, and Uruguay (Haddad et al. 2008. Anfíbios da Mata Atlântica: Guia dos Anfíbios Anuros da Mata Atlântica. São Paulo. Editora Neotropica. 244 pp.; Frost 2010. Amphibian Species of the World: an Online Reference. Version 5.4 [8 April 2010]. Electronic database accessible at http://research.amnh.org/vz/herpetology/amphibia/ American Museum of Natural History, New York). During the day the species can be found sheltered in burrows, crevices, trees, soil, and human construction (Araujo et al. 2009. Biota Neotrop. 9:77–98).

Domestic Cats (*Felis catus*) have been associated with humans for thousands of years and have accompanied humans to nearly every part of the world (Brickner 2003. Tel Aviv University report. http://www.tau.ac.il/lifesci/zoology/members/yom-tov/inbal/cats.pdf). Because they form a domestic species distinct from their wild ancestral species, Domestic Cats are considered to be an exotic, or non-native, species in all environments in which they occur (Dauphiné and Cooper 2009. Proc. Fourth International Partners in Flight Conference, pp. 205–219). Because of their ability to overwhelm existing native species and natural ecosystem processes in environments in which they have been introduced, Domestic Cats are classified as an invasive species (Dauphiné and Cooper 2009, *op. cit.*). Invasive species, particularly predators, together with habitat destruction, have been a major cause of declines and extinctions of native species throughout the world for the past few centuries (Clavero and García-Berthou 2005. Trends Ecol. Evol. 20:110). Here we report the predation of a juvenile *S. fuscovarius* by a juvenile male *F. catus*.

On 17 April 2010 at 1900 h, in a back yard of a house at the Araçatuba city, São Paulo State, a *F. catus* was observed preying upon a juvenile *S. fuscovarius*. The frog was ingested by the cat, and thus we were unable to collect the frog. The next day, we found the remains of the frog along with ants. *Felis catus* is considered a generalist mammal, including in its diet insects such as bumblebees and grasshoppers, rodents, amphibians, reptiles, and ground nesting and ground roosting birds which are particularly vulnerable (Ogan and Jurek 1997. *In* Harris and Ogan [eds.], Mesocarnivores of Northern California: Biology, Management, and Survey Techniques, workshop manual, pp. 87–92. The Wildlife Society, California North Coast Chapter, Arcata, California). However, this is the first record of *Felis catus* as a predator of *S. fuscovarius*.

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SPEA INTERMONTANA (Great Basin Spadefoot). **ALGAL SYMBIOSIS.** The occurrence of epizoic algal symbiosis has been reported in tadpoles of the American Toad (*Bufo americanus)* found in Arkansas and Missouri, USA (Drake et al. 2007. Herpetol. Rev. 38:435–436; Tumlison and Trauth 2006. Herpetol. Cons. Biol. 1:51–55), as well as those of the Gray Treefrog (*Hyla versicolor*) and the Cricket Frog (*Acris crepitans*) in Arkansas, USA (Tumlison and Trauth 2006, *op. cit.*), and was surmised to be more widespread geographically and among species with aquatic anuran larvae. Observations reported herein indicate that is indeed the case. On 15 June 2009, at 1430 h, DLD observed tadpoles of *Spea intermontana* in three natural pools and tanks in the Grand Wash Gorge, Capital Reef National Park, Wayne Co., Utah, USA, bearing bright green patches on the dorsal and lateral sides of their bodies, and tails. The ambient temperature at time of observation was 26°C with partly cloudy skies; water temperature in the large tank was 22°C. All three tanks were within 50 m of one another in the same sand and bedrock drainage.

The two smaller pools in which tadpoles were observed were 2 m diameter, 0.3–0.4 m deep, and 3 m x 6 m, max. depth 0.3 m, and had clear water and a sandy substrate with abundant algal growth. *Triops* (tadpole shrimp), fairy shrimp (Chirocephalidae), and hydrophilid beetle larvae were present, as were a few larger, later stage, non-cannibalistic morphs of *S. intermontana* tadpoles. DLD examined six of the tadpoles of *S. intermontana* (Gosner stages 34–36 [Gosner 1960. Herpetologica 16:183–190],

FIG. 1. Tadpoles of *Spea intermontana*, Wayne Co., Utah, USA, with varying degrees of epizoic algae seen as green patches on the skin.

total length 7–8 cm), in the smaller pool, four of which exhibited extensive algal patches, two did not (Fig. 1).

The largest of the tanks encountered at the site measured about 6 m in diameter and was 1–1.5 m deep. Algae were abundant on the bedrock sides of the tanks, although the bottom of the tank was not visible. Hundreds of cannibalistic and omnivorous tadpoles of *S. intermontana* were present in these tanks, as were some tadpoles of *H. arenicolor*. Bright green patches were visible on both morphotypes of the larvae of *S. intermontana,* but were not visible on those of *H. arenicolor*. Many of the larger, later stage tadpoles of *S. intermontana* in this tank exhibited extensive green patches, especially on the tails and laterally and dorsally on the body, but smaller, earlier stage tadpoles (Gosner stages 30–33, total length ca. 4–5 cm) did not appear to have algal colonies on their skin.

Tadpoles were collected and preserved in 10% formalin, then examined by SET with a scanning electron microscope. Examination of the green patches revealed a biflagellated alga, *Chlorogonium*, which was found on the tadpoles of *Bufo americanus* from Missouri and Arkansas. This finding adds a new species, family (Pelobatidae), and ecoregion (Great Basin Desert) to the list of larval anurans with algal symbionts and their distribution. There will surely be more amphibian species and the occurrence more ubiquitous as researchers continue to take notice of such phenomena.

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TOMOPTERNA CRYPTOTIS (Cryptic Sand Frog). **ALBINISM.** While conducting research on Turkana conceptions of snakes, we observed an albino adult male *Tomopterna cryptotis* (SVL 45 mm) calling from a temporary pool left from torrential rains from the previous week, where the A1 "Lodwar" road crosses the Lokichar River near the town of Lokichar, Turkana District, northwest Kenya. The specimen had red eyes with blood vessels visible through the skin (Fig. 1). Only the terminal tips of the warts exhibited light yellow coloration, therefore, this frog could be considered a partial albino with xanthophores (Dyrkacz 1981. SSAR Herpetol. Circ. 11, 131 pp.), otherwise, the specimen was entirely white with a pinkish tinge where the typical coloration would have exhibited very dark blotches. Over 50 other *T. cryptotis* with typical coloration were observed, with several pairs in amplexus. Whether this albinism could reduce its chances of getting a mate was not established. Only one other species of anuran was observed, a lone male *Bufo lughensis*. This report corroborates the contention of Sazima and Di Bernado (1991. Mem Inst. Butanantan 53:167–173) that albinism may occur with more frequency in nocturnal or fossorial animals (of which *T. cryptotis* is both), that theoretically are less dependant on camouflage to survive. To our knowledge this is the first report of albinism for the genus *Tomopterna*.

Fig. 1. Adult male albino *Tomopterna cryptotis*. Photographed in the field in Lokichar, Turkana District, Northwest Kenya, 8 January 2009.

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ZACHAENUS CARVALHOI (Carvalho's Bug-eyed Frog). **DEFENSIVE BEHAVIOR**. Amphibians are subject to predation by an array of invertebrates and vertebrates, and are known to display a wide variety of defensive behaviors (Wells 2007. The Ecology and Behavior of Amphibians. Univ. Chicago Press, Chicago, Illinois. 1148 pp.). *Zachaenus carvalhoi* is a small leaf-litter frog known from few localities in the Atlantic Forest biome in south-


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FIG. 1. An adult *Zachaenus carvalhoi* (25.3 mm SVL) in death feigning behavior.

eastern Brazil (Motta et al. 2010. Herpetol. Notes 3:85–86). It is categorized as Data Deficient in the IUCN redlist, due to the lack of information on its occurrence and biology. On 19 Feb 2010, an adult *Z. carvalhoi* was captured in a pitfall trap with drift fences, inside a forested area in the Serra do Brigadeiro State Park, an area of montane rainforest in the municipality of Araponga, state of Minas Gerais, Brazil (20.7219ºS, 42.4786ºW, elev. 1380 m, SAD 1969). During handling, the frog displayed a defensive behavior in which it stretched out its four limbs and closed its eyes, keeping this position until being released on the ground (Fig. 1).

Similar defensive behaviors have been described for other leaf-litter frogs including *Dendrophryniscus leucomystax*, *D. brevipollicatus* (Bertoluci et al. 2007. Alytes 25:1–2), *Scythrophrys sawayae*, (Garcia 1999. Herpetol. Rev. 30:224), *Stereocyclops parkeri*, *Proceratophrys appendiculata* (Sazima 1978. Biotropica 10:158), and *P. boiei* (Toledo and Zina 2004. Herpetol. Rev. 35:375), although in these species only their hind legs are stretched out, not all four limbs, as in *Z. carvalhoi*. The observation of this behavior in several leaf-litter anurans suggests behavioral convergence reflecting similar predation pressures (Sazima 1978, *op. cit.*). The adaptive value of this behavior might reside in improving the frog's appearance as fallen or dead leaves, confusing visually oriented predators (Sazima 1978, *op. cit.*; Toledo and Zina 2004, *op. cit.*).

A voucher specimen was deposited in the herpetological collection of Museu de Zoologia João Moojen, Universidade Federal de Viçosa, in Viçosa, Minas Gerais, Brazil (MZUFV 10339). We thank the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) and Instituto Estadual de Florestas (IEF) for collecting permits (IBAMA 20857-1, IEF 071/09), the Universidade Federal de Viçosa for logistic support, the Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG, CRA-APQ-02370-09) for financial support, and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for fellowships granted to MRM.

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GYMNOPHIONA — CAECILIANS

GYMNOPIS MULTIPLICATA (NCN). **MATERNAL ATTENDANCE**. Post-birth parental care by a viviparous caecilian has been reported previously only once: altricial young of *Geotrypetes seraphinii* are reported to feed on the skin of the attending maternal female (O'Reilly et al. 1998. Amer. Zool. 38:187A). We report an instance of a maternal female of a viviparous species guarding her recently born young, similar to that of the maternal guarding reported for several oviparous and direct-developing species (e.g., *Ichthyophis glutinosus*: Sarasin and Sarasin 1887. Ergebnisse naturwissenschaftlichen. Forschungen auf Ceylon. C. W. Kreidel's Verlag, Wiesbaden; Breckenridge and Jayasinghe 1979. Ceylon J. Sci. 13:187–202; *Idiocranium russelli*: Sanderson 1937. Animal Treasure. Viking Press, New York. 325 pp.; *Caecilia orientalis*: Funk et al. 2004. Herpetol. Rev. 35:128–130 [a female and two males with a clutch]).

On 16 July 2008, JRM collected an adult female *Gymnopis multiplicata* (MVZ 263798; 363 mm total length; 117 primary annuli, 103 secondaries; each ovary containing many small early vitellogenic ova) and four young *G. multiplicata* (MVZ 263800, 263802, 263804, 263805; total lengths 110–126 mm) under a large log at Rawa Kiamp (15.100°N, 84.4333333°W), Gracias a Dios, at 60 m elev in the Mosquitia of northeastern Honduras. The young were apparently recently born, still having several rows of teeth of fetal morphology on the lower jaw, the labial-most row of very small teeth emerging from the skin of the jaw at the lipline, consistent with the typical aggregation of the rows of fetal teeth before all are shed shortly after birth (Wake 1976. J. Morphol. 148:33–64; Wake 1980. J. Morphol. 166:203–216). The fetal teeth are markedly different (crowns with multiple cusps and different shapes) from the arrow-shaped tooth crowns of the maternal female and other adult *G. multiplicata* (Wake and Wurst 1979. J. Morphol. 159:331–342). The adult was in direct contact with all four young with the adult looped above and around the young, forming a ball. Immediately on exposure, the adult tried to escape by quickly crawling away. The young also tried to escape, but were not as quick as the adult. The young did not follow the adult, but crawled in different directions. All caecilans in the ball were collected. There is no indication that the skin of the female is physically modified or abraded in any way, nor does there appear to be any skin in the mouths of the young, so skin-feeding is unlikely. This is consistent with their relatively large size at birth, the neonates of the direct-developing skin-feeders (*Boulengerula taitanus* and *Siphonops annulatus*) reported being smaller relative to maternal size (Kupfer et al. 2006. Nature 440:926–929; Wilkinson et al. 2008. Biol. Let. 4:358–361).

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OSCAECILIA OSAE (NCN). **PREDATION**. The coral snake *Micrurus alleni* and the endemic caecilian *Oscaecilia osae* both occur in the lowland wet rainforest of the National Park Piedras Blancas (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. Univ. Chicago Press, Chicago, Illinois. 934 pp.), which is located in the Pacific lowlands of Costa Rica (Weissenhofer et al. 2008. Cultural and Natural History of the Golfo Dulce Region. OÖ Landesmuseum Linz, Biologiezentrum, Johann-Wilhelm Kleinstraße). The prey of *Micrurus alleni* is comprised largely of the eeliform freshwater fish *Synbrachus marmoratus* and some lizards (Roze 1996. Coral Snakes of the Americas: Biology, Identification, and Venoms. Krieger Publ. Co., Malabar, Florida. 328 pp.). During a visit to the Tropical Research Station La Gamba (www.lagamba.at), a biological field station in the NP Piedras Blancas operated by the University of Vienna, WH observed *M. alleni* preying on the caecilian *O. osae*. Around midday on 8 July 2009 a *Micrurus alleni* was seen to have an *Oscaecilia osae* in its mouth. The observation occurred directly on the "Birds Trail" (Sendero Bajaros), not far from the Esquinas Rainforest Lodge (8.6977778°N, 83.2052778°W, ca. 80 m elev.). The snake was holding the caecilian—which was still alive—in its mouth and was trying to move the prey away from the trail to the forest litter close by. It appeared as though the snake had caught the caecilian with the intention of consuming it. Until this observation, *Micrurus alleni* was not known to prey on the caecilian *Oscaecilia osae*.

COLOR REPRODUCTION SUPPORTED BY THE THOMAS BEAUVAIS FUND

Fig. 1. *In situ* photographs of an adult *Micrurus alleni* with a living *Oscaecilia osae* in its mouth. See text for dates and location. Photos by W. Huber.

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TESTUDINES — TURTLES

CHELONOIDIS CARBONARIA (Red-footed Tortoise). **SIZE AND THERMAL BIOLOGY.** From 4–19 June 2010, we had 62 encounters with Red-footed Tortoises on Union Island (St. Vincent and the Grenadines). *Chelonoidis carbonaria* is found throughout much of Central and South America (Ernst and Leuteritz 1999. Cat. Amer. Amphib. Rept. 690:1–6), and populations on West Indian islands might be descendants of ancestors that arrived via natural over-water dispersal, as a consequence of intentional introductions by Amerindians or early colonial Europeans (perhaps for food), more recently transported pets and ornamentals, or some combination thereof (e.g., Censky 1988. Florida Sci. 51:108–114; Powell and Henderson 2005. Iguana 12:62–77). The origin of the Union Island population is unknown.

Tortoises were abundant in a variety of habitats that ranged from coastal scrub and variously disturbed dry forests to dramatically altered situations on the grounds of hotels and in urban areas at elevations ranging from sea level to 258 m (on an island with a maximum elevation of 305 m). Although dogs might take small individuals (e.g., Hodge et al., 2003. The Reptiles and Amphibians of Anguilla, British West Indies. Anguilla Natl. Trust, The Valley), the abundance of tortoises in the Grenadines in general and on Union in particular might be attributable to the fact that local residents scorn them as food because of their willingness to consume fecal matter and carrion (Daudin and de Silva 2007. Appl. Herpetol. 4:163–176).

Carapace lengths of tortoises large enough for accurate determinations of sex were 248–334 mm (301 ± 25.1 mm) for males (N = 11) and 152–330 mm (264 ± 56.9 mm) for females (N = 17). Carapace lengths of ten 6–8 week-old juveniles hatched in an outdoor enclosure were 45–63 mm (55 ± 5.1 mm). Ernst and Leuteritz (1999, *op. cit.*) listed a maximum carapace length of 400 mm for females and 600 mm for males. The smaller maximum sizes of the Union Island turtles are suggestive of insular dwarfism (e.g., Keogh et al. 2007. Evolution 59:226–233), but also might merely reflect food limitations on a xeric island.

We encountered active turtles during the morning (0538–0919 h, N = 6) and afternoon/evening (1500–2256 h, N = 22), suggesting that they avoid the heat of the day (although one individual was active at 1205 h). Unlike most squamates, turtles generally lack a narrow preferred temperature range (e.g., Weathers and White 1971. Amer. J. Physiol. 221:704–710). To test the prediction that tortoises on Union Island did not actively thermoregulate, we used a Fluke model 52 Digital Thermometer with Type K thermocouple (Fluke Corp., Everett, Washington, USA) to record cloacal and adjacent ambient (air) temperatures in the field. We measured cloacal temperatures of 26.0–34.6°C (28.1 ± 1.3°C, N = 19) at air temperatures of 25.3–30.8°C (28.9 ± 1.8°C).

Differences between ambient and cloacal temperatures were -7.0–1.5°C (-0.78 ± 1.44°C), with 30 of 41 records above and two at ambient temperatures.

We also placed nine individuals (carapace length 45–172 mm, 88 ± 56 mm) in a thermal gradient (90 x 30 cm) with extreme temperatures of 24° and 40°C. Although most individuals spent more time near the cooler end of the gradient, possibly because they heat faster than they cool under laboratory conditions (Weathers and White, *op. cit.*), cloacal temperatures after 2 h were 23.9–31.6°C (26.5 ± 2.7°C). The considerable variation in individual temperatures in both the field and the gradient was suggestive of little more than an avoidance of extremely high temperatures.

Permits to conduct research on Union Island were issued by Mr. Brian Johnson, Director, Department of Forestry, St. Vincent and the Grenadines. Protocols were approved by the Avila University Animal Care and Use Committee. Fieldwork was funded by a grant from the National Science Foundation (USA) to Robert Powell (DBI-0851610). All tortoises were released at original sites of capture.

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GOPHERUS POLYPHEMUS (Gopher Tortoise). **DIET.** Consuming scat of conspecifics and other animals may provide species of *Gopherus* with symbiotic gut microbes and/or direct nutritional benefits (Bjorndal 1987. Copeia 1987:714–720; Lance and Morafka 2001. Herpetol. Monogr. 15:124–134; Walde et al. 2006. Herpetol. Rev. 37:77–78). In addition to scat of conspecifics, *G. polyphemus* occasionally eats fox (*Vulpes vulpes* or *Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), and rabbit (*Sylvilagus* spp.) feces (Anderson and Herrington 1992. Herpetol. Rev. 23:59; Garner and Landers 1981. Proc. Ann. Conf. S.E. Assoc. Fish & Wildl. Agencies 35:120–134; MacDonald and Mushinsky 1988. Herpetologica 44:345–353). Here, we report a juvenile *G. polyphemus* consuming deer pellets.

At approximately 1700 h (CST) on 4 October 2008, one of us (JRL) observed a 13-month-old *G. polyphemus* at the Camp Shelby Joint Forces Training Center (CSJFTC), Perry Co., Mississippi, USA consume the pellet of a White-tailed Deer (*Odocoileus virginianus*). Upon swallowing the pellet, the young tortoise ate another. Platt et al. (2009. Southeast. Nat. 8:335–346) reported a single deer pellet in the feces of a Florida Box Turtle (*Terrapene carolina bauri*), but to our knowledge, this is the first account of *Gopherus* eating deer droppings. It should be noted that the tortoise in the above observation was head-started in a large outdoor enclosure for most of its first year of life before being released back to its nest site only 10 days prior to our observation.

We thank the Mississippi Army National Guard for their continued support of tortoise conservation efforts on CSJFTC.

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KINOSTERNON SONORIENSE (Sonoran Mud Turtle). **PREDATION**. In much of the arid American Southwest, stock tanks (= earthen cattle ponds) are a common landscape feature, and in the Atascosa/Pajarito Mountains, Santa Cruz Co., Arizona, stock tanks that hold water throughout the year often support breeding populations of *Kinosternon sonoriense* as well as populations of invasive American Bullfrogs (*Lithobates* [*Rana*] *catesbeianus*; Jones and Akins, unpubl.). While engaged in a large-scale effort to eliminate Bullfrogs from this landscape, we routinely examined stomach contents of captured frogs, and herein provide the first documented evidence of predation by Bullfrogs on *K. sonoriense*.

On 8 May 2009, 1230–1600 h MST, we removed six large adult Bullfrogs (SVL 150–185 mm) from Yank Tank (31.42534°N, 111.18330°W; datum = NAD 83, 1252 m elev.). Two Bullfrogs, one male and one gravid female (both SVL = 180 mm) had each ingested a juvenile *K. sonoriense* (CL = 56 mm, PL = 47 mm, and CL = 59 mm, PL = 49 mm, respectively). Size and development of plastron annuli suggest these turtles were each in their second year (F. R. Hensley and T. R. Jones, unpubl.). On 18 and 19 August 2009, one of us (CMA) visited two other sites: Salty Tank (31.46360°N, 111.18866°W; 1298 m elev.) and Frog Tank (31.47352°N, 111.19686°W, 1317 m elev.), respectively. At Salty Tank (1525–1615 h MST) four subadult Bullfrogs (SVL 90–95) were removed, one of which (male, SVL = 91 mm, mass = 60 g) contained a hatchling *K. sonoriense* (CL = 23.6 mm, PL = 18.9 mm, mass = 2.11 g). At Frog Tank (1000–1130 h MST), three subadult Bullfrogs (SVL 99–115) were removed, one of which (male, SVL = 115 mm, mass = 135 g) also contained a hatchling *K. sonoriense* (CL = 25.0 mm, PL = 20.4 mm, mass = 2.75 g). The sizes and collection dates are consistent with the conclusion that these two turtles had hatched within a few weeks or less (Stone 2001. Southwest. Nat. 46:41–53; F. R. Hensley and T. R. Jones, unpubl.). Although such predation had been predicted to occur (Schwalbe and Rosen 1999. Sonoriensis 19:8–10), to our knowledge, this is the first documented report of Bullfrog predation on *K. sonoriense*.

In stock tanks in southeastern Arizona with large breeding populations of Bullfrogs we have observed a pattern in which *K. sonoriense* populations almost exclusively consist of large adults (Jones and Akins, pers. obs.), suggesting a lack of recruitment consistent with the predation reported here. This hypothesis was also suggested by Schwalbe and Rosen (1988. pp. 166–173. In Szaro et al. [eds.], Management of Amphibians, Reptiles and Small Mammals in North America, pp. 166–173. U.S. Forest Service Gen. Tech. Rep. RM-166, Fort Collins, Colorado) to explain a similar demographic pattern at San Bernardino National Wildlife Refuge in extreme southeastern Arizona. Thus, although it might be unsurprising to document Bullfrog predation on yet another species of turtle (e.g., reviews in Bury and Whelan 1984. U.S. Department of the Interior Fish and Wildlife Service Res. Publ. 155. Washington, D.C.; Casper and Hendricks 2005. *In* Lannoo [ed.], Amphibian Declines: The Conservation Status of United States Species, pp. 540–546. University of California Press, Berkeley), the impacts of the predation reported here have important conservation implications. Our data suggest that Bullfrogs can seriously affect population dynamics of relatively small, geographically separated populations of *K. sonoriense*, by severely limiting or even eliminating annual recruitment. Further, with the expanding range of *L. catesbeianus* in the American Southwest, it is likely that we will continue to see these effects, unless steps are taken at landscape scales to address this issue.

We greatly appreciate field assistance from P. Klink, B. Stewart and R. J. Timmons. Our fieldwork adhered to guidelines outlined in Beaupre et al. (2004. Guidelines for Use of Live Amphibians and Reptiles in Field and Laboratory Research, 2nd ed. Herpetological Animal Care and Use Committee, American Society of Ichthyologists and Herpetologists).

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MACROCHELYS TEMMINCKII (Alligator Snapping Turtle). **AERIAL BASKING AND CLIMBING ABILITY**. *Macrochelys temminckii* is the largest freshwater turtle in North America (Ernst and Lovich 2009. Turtles of the United States and Canada. Smithsonian Institute Press, Washington D.C. 827 pp.), but they are seldom encountered due to their secretive nature. There are previous reports for aerial basking of *M. temminckii* hatchlings (Shelby and Jenson 2002. Herpetol. Rev. 33:304), juveniles/subadults (Ewert 1976. Herpetologica 32:150–156; Farr et al. 2005. Herpetol. Rev. 36:168; Thomas 2009. Herpetol. Rev. 40:336), and adults (Selman et al. 2008. Herpetol. Rev. 40:79). Here we report another rare aerial basking observation of a juvenile *M. temminckii*.

On 24 August 2009 (1300 h), while floating a popular recreational canoeing stretch of Black Creek (near Brooklyn, Forrest County, Mississippi, USA), we observed a juvenile *M. temminckii* (approx. 10 cm SCL) basking on a tangled root snag in the middle of the creek channel (approx. 20 m wide). The water was approximately 1.5 m deep at the site and was clear enough to see the bottom substrate (sandy gravel bottom). The tangled root snag emerged vertically out of the water approximately 50 cm and the turtle was basking near the terminus of the snag which was 5 cm in diameter at the basking site. Its head was extended completely and resting on the tip of the snag. Directly below the basking site of the turtle (approx. 15 cm from the top of the snag) was another limb (2–3 cm in diameter) that crossed perpendicular to and was touching the basking snag; from the position of the turtle, we presume it had to climb over the obstacle to get to its desired basking location. The conditions were mostly sunny (air temperature 29°C) with water discharge at 36.5 m^3/sec, well below median daily stream flow (51.8 m^3/sec; USGS Real-Time water data, Black Creek Station [station 02479130] near Brooklyn). We were unable to determine water temperatures, but at a nearby gauging station at a similar-sized creek (Tallahala Creek at Laurel, Mississippi [station 02437500]), water temperature fluctuated between 25–28°C for 24 August 2009.

The individual was initially thought to be a Razor–backed Musk turtle (*Sternotherus carinatus*) due to the similarity in basking site choice (vertical snags) and basking posture. It was only after we canoed past the individual did WS realize that it was a *M. temminckii*. Thereafter, we canoed back upstream to get a closer look and the individual dove into the water when we were within 5 m of the basking site; unfortunately, we were unable to get a photograph of the individual. Furthermore, the climbing ability of this species at this size appears to be similar to *S. carinatus* since the observed individual climbed a nearly vertical snag and maneuvered over an obstacle to get to its preferred basking site. Farr et al. (2005, *op. cit.*) also observed an individual *M. temminckii* (~35–40 cm CL) that climbed 1 m above the water and 3–4 m along a tree trunk, which also highlighted the climbing ability of this species.

Even though aerial basking is now reasonably well documented for this species, it appears to be an uncommon behavior. We suggest that future observations of this behavior should still be noted to assist in understanding the life history of this secretive turtle.

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PSEUDEMYS NELSONI (Florida Red-bellied Turtle). **TRAUMA SURVIVAL**. Chelonians are known to be capable of surviving severe trauma (Cagle 1945. Copeia 1945:45; Landberg et. al. 2010. Herpetol. Rev. 41:70). On 15 July 2008 an adult female *P. nelsoni* was brought to Miami Metrozoo by a fisherman who collected it in Biscayne Bay near Turkey Point Nuclear Power Plant east of Homestead, Florida, USA. The turtle was missing the frontal portion of its head including both eyes. Skin had grown over the traumatized area leaving the mouth as a small, circular opening with a vestige of the tongue visible (Fig. 1). Nasal openings were not visible. Radiographs revealed that the skull had been cleanly severed over the eye sockets and the anterior portion of both lower mandibles was also missing. The turtle appeared healthy in spite of its injury and held its head up, rotating it from side to side in the same manner as a normal, sighted turtle would. The turtle weighed 2.78 kg. As it had apparently been feeding on its own since the injury, it was decided to release the animal into the semi-natural conditions of one of the zoo exhibit moats where its condition could be monitored. The moat was approximately 450 m in length (with 170 m of this dry land) by 4 m wide with water a depth of up to 1 m. Potential food available in the moat for this aquatic species included aquatic vegetation (Jackson 2006. *In* Meylan [ed.], Biology and Conservation of Florida Turtles, pp. 313–324. Chelonian Research Monographs No. 3), aquatic invertebrates, and small fish. The turtle's weight was monitored over time and increased to 3.07 kg in early October. This indicates that it was capable of ingesting food, but no observations were made

FIG. 1. Close up of *Pseudemys nelsoni* head after healing from severe trauma. Mouth opening and tongue are visible. Photo by Adam Stern.

on feeding behavior. On 9 December 2008 it was treated for a minor wound to its left foreleg. Two days later it was found dead and weighed 3.04 kg. It is surprising that this turtle was able to survive and feed with such a traumatic injury.

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STERNOTHERUS ODORATUS (Eastern Musk Turtle). **NESTING**. The nesting behavior of *Sternotherus odoratus* has apparently not been previously documented in Ohio and this species has been recorded in fewer than half of the state's 88 counties (Wynn and Moody 2006. Ohio Turtle, Lizard and Snake Atlas. Ohio Biol. Surv. Misc. Contrib. No. 10). While *S. odoratus* is known to use a variety of nest locations, we believe the site described herein to be unique, as most reports are of nests in or under rotten stumps and fallen trees (Ernst 1986. J. Herpetol. 20:341–352).

On 18 September 2009 near North Chagrin Nature Center in Cleveland Metroparks, Cuyahoga County, Ohio, USA, a hatchling *S. odoratus* was observed at the edge of a small pond. In the following days, the nest location was identified as more hatchlings were found. A total of 81 hatchlings were captured, measured, and released, with a mean (range) mass of 2.66 g (1.6–3.7 g, N = 80*)* and mean (range) carapace length of 22.75 mm (19–25 mm, N = 81*)*. The nest location was 1.5 m from the edge of the shallow 6.1-acre (2.5-ha) pond, under sandstone slab decking. The hatchlings were observed exiting from a small opening in the sandstone decking (Fig. 1) to which they were most likely drawn by the bright sunlight. It is believed that the adult females entered through an opening below the waterline (which was observed when the pond was drawn down). Under the sandstone, a hollow cavity was discovered to be serving as a communal nest chamber (Fig. 2). It is uncertain whether the cavity was formed by erosion or possibly excavated by muskrats. This area was protected from predators and presumably provided a constant warm and humid environment for incubation. Additionally, there were older egg shells present in the cavity, indicating that nesting had occurred at this site in the past.

FIG. 1. Aboveground view of the sandstone walk where the *Sternotherus odoratus* nest was located and crack where hatchlings were observed exiting.

The sandstone decking containing the communal nest chamber was slated for demolition and renovation at the time of the emergence of the hatchlings and this allowed for exploration of the site. On 30 September 2009 the sandstone was removed and the nest site was explored for additional eggs and hatchings. Twenty-one live and four dead hatchlings were found in the substrate, and a remaining intact portion of the nest contained several unhatched eggs. These eggs were removed and placed into a plastic tub to complete incubation. From the eggs collected, 18 hatchlings emerged and were released and 5 eggs were not viable. The

FIG. 2. Underground view of *Sternotherus odoratus* nest where the concentration of eggs were deposited.

nest material consisted of a damp, coarse, sand mixture combined with soil and root material from nearby plants.

Sternotherus odoratus is a documented communal nester (Doody et al. 2009. Q. Rev. Biol. 84[3]:229–252) and in Pennsylvania Ernst (1986, *op. cit.*) reported a mean clutch size of 3.25, indicating that this nest location was the result of numerous females contributing eggs. Hatchlings that did not survive when the nest was excavated will be deposited at the Cleveland Museum of Natural History as vouchers for Cuyahoga County.

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TERRAPENE CAROLINA TRIUNGUIS (Three-toed Box Turtle). **SHELL ABNORMALITY**. We collected a live adult female (SCL 148 mm) *Terrapene carolina triunguis* on 1 October 2009 with a shell abnormality at the Sam Houston State University's Center for Biological Field Studies, Huntsville, Texas, USA. This specimen lacks the nuchal scute and all vertebral and pleural scutes; one abdominal scute is partially detached. There are small patches of abnormal keratinization surrounding previously healed bite wounds in the region of the third left and right pleural scutes. The absence of scutes completely exposes the carapacial bones. Although the cause of scute loss is unknown, we suspect that it is related to a past predation attempt, evidenced by the healed bite-impressions within the carapace. The carapacial bones are in good condition, and all previous damage appears superficial; there is no recent shell damage observed. Despite this shell abnormality, this individual was active and appeared otherwise healthy.

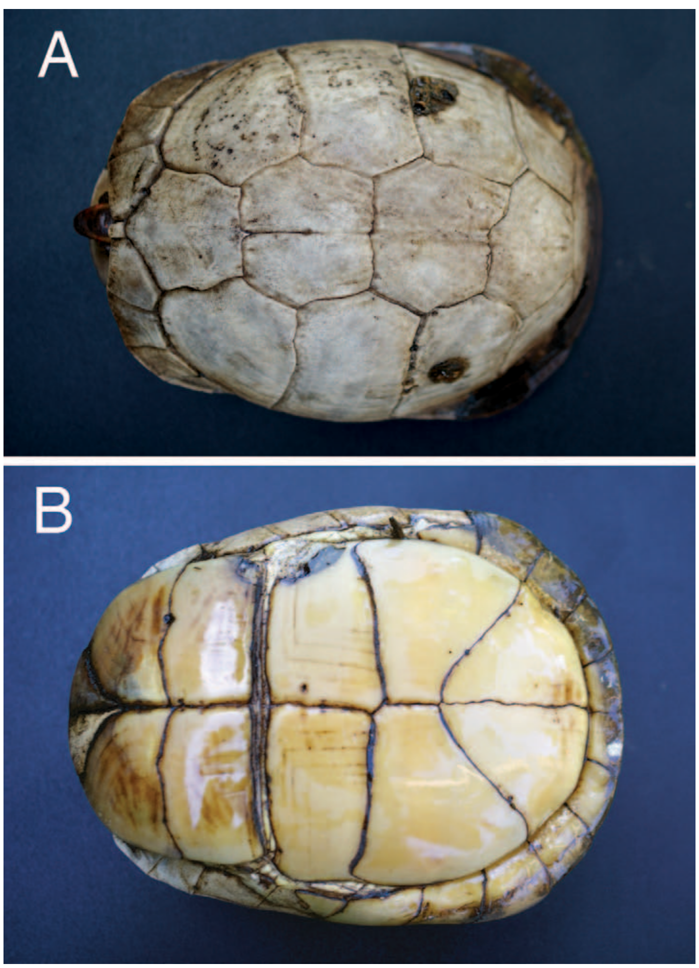

FIG. 1. *Terrapene carolina triunguis* carapace (A) and plastron (B) displaying missing and damaged scutes.

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TERRAPENE ORNATA ORNATA (Ornate Box Turtle). **MUSKING**. Musking behavior in *Terrapene ornata ornata* has been seldom reported in wild turtles and its function is yet unknown. This behavior may serve defensive, social, or other purposes (Legler 1960. Univ. Kansas Publ., Mus. Nat. Hist. 11:527–669; Dodd 2001. North American Box Turtles: A Natural History. Univ. Oklahoma Press, Norman. 231 pp.). While conducting field research on a population of Ornate Box Turtles on the sand hills of Weld Co., Colorado, USA, we have observed 14 instances of musking during the 2007, 2008, and 2009 field seasons. We also observed musking in two captive *T. o. ornata,* one a known wild specimen originating ~25 km W of the Kansas border and one found stray within the city limits of Longmont, Colorado.

During three seasons of field research, 12 of 34 (35.3%) juveniles (SCL < 100 mm) and 2 of 48 (4.2%) adult males were observed musking. Musking turtles ranged greatly in size from yearlings (34.2 mm SCL, 10 g) to full-grown adult males (122.1 mm SCL, 397 g). Observations of two musking adult males is contrary to Neill's (1948. Copeia 1948:130) speculation in *Terrapene carolina carolina* that turtles lose the ability to musk when the plastral hinge becomes functional and Patton's observations of musking only in recently hatched juvenile *T. c. triungius (*Patton et al. 2004. Proc. Louisiana Acad. Sci. 65:22–25).

A wild adult female box turtle (SCL = 102.3 mm) collected from Cheyenne Co., Colorado was obtained in 2008 after participation in the county fair's turtle races. This turtle was housed outdoors in a naturalistic setting. On presentation of a respiratory infection during 2009, this turtle received injections of antibiotics. On three occasions, musking occurred when restraining a front leg to deliver the injection. In May 2010, the same turtle also musked during restraint. Additionally, a stray juvenile (SCL = 95.1 mm) *T. o. ornata*, found in the city limits of Longmont, Colorado in 2009, musked during gentle handling.

Turtles emitted musk as they were handled for data collection, medical treatment, and observation, presumably because of induced stress. This strong odor, distinct from urine or fecal excrement and similar to that emitted by the Common Musk Turtle (*Sternotherus odoratus*), often came in "waves" of oscillating pungency. In several turtles, we observed liquid exuded below the 4th marginal in the axillary region. The liquid was more viscous than water, taupe in color, and slightly opaque.

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TERRAPENE ORNATA ORNATA (Ornate Box Turtle). **DIET AND MICROHABITAT.** *Terrapene o. ornata* is described as omnivorous, eating a broad range of animal and plant material and requiring access to water within its home range. However, within our study site standing water is generally not available and permanent water sources are well outside the typical home range areas of *T. o. ornata*. Here we provide information on one food choice, *Tradescantia occidentalis* (Prairie Spiderwort) from a wild population of Ornate Box Turtles in the sand hills of eastern Colorado that may also operate as an important water source. We also show the ready acceptance of this food item by two captive populations of wild-collected *T. o. ornata* housed in naturalistic habitats.

The present study site in Weld Co., Colorado encompasses approximately 50 ha of sand hills. The site is crossed with single-lane unpaved roads facilitating access to gas and oil wells. The property has been cattle ranched for more than 20 years; grazing is rotated with a water-pumping windmill as the focal point of each grazing section. The study area lacks any natural free-standing water and the windmill is only sporadically operated; overflow that may be used by turtles is thus unpredictable.

Average yearly precipitation at the nearest available weather station, about 16.6 km W of the study site, is 360 mm. Though more than 95% of precipitation occurs from April through October, natural ephemeral water is rarer than agriculturally related runoff. Precipitation from April though October 2009 was 32 mm greater than during the same period in 2008, and 100.6 mm greater than 2007. While 2009 precipitation was near average for the study season, the two previous years had decreased precipitation during the field study period. In 2009, *T. occidentalis* was seen during every field outing, in more areas within the study site, and in greater concentrations than in previous years.

Prairie Spiderwort is a smooth, subsucculent, perennial monocot up to 50 cm tall. Stems are often tufted, and when pulled apart, the copious mucilaginous slime inside forms what somewhat resembles a spider's web. These plants are known as "cow slobber" because of the gooey, stringy sap they produce. Given the absence of free water sources, we hypothesize that Spiderwort may be an important source of water for *T. o. ornata* in sand hills habitat. The study site also contains *Opuntia* cactus species and a variety of forbs and grasses. Ohio Spiderwort (*Tradescantia ohiensi*) has been listed as part of the floral community in *T. o. ornata* habitat in Iowa (Bowen at al. 2004. J. Herpetol. 38:562–568) and Wisconsin (Doroff and Keith 1990. Copeia 1990:387–399).

On 13 June 2008, we observed evidence of two adult turtles eating Spiderwort. The female was observed with a purple plant in her mouth, most likely *T. occidentalis* petals, and the male was observed with a chewed *T. occidentalis* stem directly in front of him and green vegetation on his beak. Several days later we located another adult female sitting in crushed Spiderwort stems with foliage stuck to her beak. During 2009, we found increased evidence of *T. o. ornata* eating Spiderwort, as well as characteristic crushed stems that may indicate turtle feeding, with three adult turtles (two females and one male) observed eating *T. occidentalis*. All observations of Spiderwort consumption occurred in the month of June.

Several specimens of *T. occidentalis* were planted into two naturalistic box turtle habitats, each more than 60 m^2. Wild-collected *T. o. ornata* readily ate this plant, often cropping it to the ground and inducing dormancy until the next growing season. This was in spite of other available food items provided on a regular basis, typically a mix of grocery-store produce (greens, vegetables, and berries). Other habitat plants including mallow (*Malva neglecta*) and common dandelion (*Taraxacum officinale*) were rarely observed being consumed. In neither captive population did we make any attempt to introduce occupants to the presence of *T. occidentalis*; turtles located and consumed this food item by free choice, often traveling 1–5 m from routine feeding locations.

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CROCODYLIA — CROCODILIANS

CROCODYLUS ACUTUS (American Crocodile). **ADULT MASS**. Few data exist on the body mass of large reptiles, due in part to the difficulties of handling and weighing these animals (Minton and Minton 1973. Giant Reptiles. Charles Scribner's Sons, New York, New York. 345 pp.). In particular, few reliable data exist regarding body size of large crocodilians (Richardson et al. 2002. Crocodiles: Inside Out: A Guide to the Crocodilians and their Functional Morphology. Surrey Beatty and Sons, Ltd., Chipping Norton, NSW. 172 pp.; Webb and Manolis 1989. Crocodiles of Australia. Reed Books Pty. Ltd., Frenchs Forest, NSW. 160 pp.; Woodward et al. 1995. J. Herpetol. 29:507–513). However, crocodile research and management rely on knowledge of individual body size and size-class structure of populations (Webb and Smith 1987. *In* Webb et al. [eds.], Wildlife Management: Crocodiles and Alligators, pp. 199–210. Surrey Beatty & Sons, Ltd, Sydney) because demographic and reproductive variables are functionally dependent on body size rather than age, and population models are generally based on the former (Nichols 1987. *In* Webb et al., *op. cit*., pp. 177–187). Here, we report the body mass of a large *Crocodylus acutus* from Costa Rica.

On 13 September 2007, we captured an adult male *C. acutus* in the lower Tarcoles River, Costa Rica (9.79906389°N, 84.615278°W) during a study of ocular disease in this crocodile population. Total length (TL; anterior tip of the snout to the posterior tip of the tail, measured along the dorsal surface) and snout–vent length (SVL; anterior tip of the snout to the anterior margin of the cloacal vent, measured along the ventral surface) of the crocodile were measured with a tape as 482.6 cm and 237.5 cm, respectively. The crocodile was wrapped in an industrial cargo net and weighed using an electronic crane scale (Dynafor LLX/LLTR; Schumann GmbH, Sillerup, Germany) and manual chain hoist secured to the limb of a tree on the bank of the river. The mass of the crocodile was 537.45 kg, after subtracting the mass of the cargo net (29.54 kg).

In 2003, two of us (BRB, JRBM) captured a large *C. acutus* (TL = 395.0 cm) for translocation during a radio-tracking project in Costa Rica and determined that it weighed 500 kg (Barr 2003.

Crocodile Spec. Newsltr. 23:19). To our knowledge, these measurements of body mass are the largest yet reported for *C. acutus*, however they do not represent a maximum value for this species. *Crocodylus acutus* is known to reach lengths of 600–700 cm (Alvarez del Toro 1974. Los Crocodylia de Mexico [Estudio Comparativo]. Recursos Naturales Renovables, Mexico City. 70 pp.; Schmidt 1924. Fieldiana 12:77–96). Using an equation derived from the relationship of TL to body mass for the morphologically similar Morelet's Crocodile (*C. moreletii*) (Platt et al. 2009. Carib. J. Sci. 45:80–93), the estimated body mass of these large *C. acutus* is predicted to range from 900 to 1283 kg.

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SQUAMATA — LIZARDS

AMEIVA FESTIVA (Central American Whiptail Lizard). **CANNIBALISM**. *Ameiva festiva* is a broadly distributed, dietary generalist that consumes diverse arthropod prey including crickets, spiders, roaches, and katydids (Vitt and Zani 1996. J. Herpetol. 30:110–117; Vitt and Zani 1998. J. Trop. Ecol. 14:537–559; Whitfield and Donnelly 2006. J. Trop. Ecol. 22:409–417). Lizards, however, have been recorded infrequently in their diet (Vitt and Zani 1998, *op. cit.*) and accounts identifying the lizard species taken are lacking. Hence, here we report an *A. festiva* preying on a conspecific in the Gandoca-Manzanillo Wildlife Refuge, Costa Rica.

At 1127 h on 21 July 2008, while walking the grounds at the Iguana Verde Foundation (09.63818°N, 82.70496°W, datum WGS84; elev. 3 m), we observed, photographed, and videotaped one adult female *A. festiva* (ca. 9 cm SVL) grasping a conspecific (ca. 4 cm SVL) by its head. The smaller lizard was alive but missing half its tail, which was seen ca. 7 cm away. The adult was biting the head of the smaller conspecific continually until a probable male (ca. 10 cm SVL) *A. festiva* approached and began undulating its tail. The adult female fled 2.5 m away and began manipulating her prey in a head-first orientation. The adult female *Ameiva* took one minute to swallow its prey, and then performed an undulating maneuver with its torso, and completed its consumption at 1134 h.

This is the first observation of cannibalism in this frequently observed species, and augments our knowledge of trophic relationships for *Ameiva* lizards and their behavioral ecology. This observation was made while conducting *Iguana iguana* research supported by the San Diego Zoo's Institute for Conservation Research.

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APHANIOTIS ACUTIROSTRIS (Indonesia Earless Agama). **REPRODUCTION.** *Aphaniotis acutirostris* is known from Indonesia (Uetz and Hallermann 2010. The Reptile Database http://www.reptile-database.org, accessed 22 July 2010). To my knowledge, the only information on *A. acutirostris* is a report of clutch sizes of two eggs deposited every 30–100 days and hatching 48–63 days later (Das 2006. A Photographic Guide to Snakes & Other Reptiles of Borneo. Ralph Curtis Publishing, Sanibal Island, Florida. 144 pp.). The purpose of this note is to provide additional information on the reproductive biology of *A. acutirostris*.

A sample of 18 *A. acutirostris* (nine males, mean SVL = 53.4 mm ± 2.2 SD, range = 51–56 mm; four females, mean SVL = 50.3 mm ± 2.1 SD, range = 48–53 mm; four subadults, mean SVL = 31.0 mm ± 4.8 SD, range = 28–38 mm; and one neonate, SVL = 23 mm, collected July 1975 at Bohorok, North Sumatra, Indonesia (3.516667°N, 98.133333°E; WGS84, 255–1390 m elev.) was examined from the herpetology collection of the Field Museum of Natural History (FMNH): FMNH 209533, 209534, 209536–209539, 209541–209545, 209552–209554, 209556, 209557, 209559, 209564. For histological examination, the left gonad was removed to check for yolk deposition in females and spermiogenesis (sperm formation) in males. Counts were made of enlarged ovarian follicles (> 4 mm length) or oviductal eggs. Tissues were embedded in paraffin and stained with hematoxylin followed by eosin counterstain. Histology slides are deposited in FMNH.

All males examined were undergoing spermiogenesis; the lumina of the seminiferous tubules were lined by clusters of sperm or groups of metamorphosing spermatids. The smallest reproductively active male measured 51 mm SVL. One female contained two vitellogenic follicles (2 mm length); two females each contained two enlarged ovarian follicles (4 mm diameter) and one female contained two oviductal eggs. The smallest reproductively active female (oviductal eggs) measured 48 mm SVL. The presence of the neonate (23 mm SVL), plus three slightly larger juveniles (28, 28, 30 mm SVL) indicates they were born earlier in the year and that *A. acutirostris* has a prolonged period of reproduction. Inger and Greenberg (1966. Ecology 47:1007–1021) reported continuous reproduction in five agamid species (*Draco melanopogon*, *D. obscurus*, *D. quinquefasciatus*, *Gonocephalus grandis*, *G. liogaster*) from a Bornean rain forest. Whether *A. acutirostris* breeds throughout the year will require examination of additional monthly samples.

I thank Alan Resetar (FMNH) for permission to examine *A. acutirostris*.

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ASPIDOSCELIS TIGRIS (Western Whiptail) **DIET.** *Aspidoscelis tigris* is a common lizard of North American arid lands. Active forager, whiptails generally forage on the ground, often near vegetation, where they dig in leaf litter or probe cracks and crevices in search of prey (Pianka 1970. Ecology 51:703–720). Whiptails feed primarily on diverse ground-dwelling arthropods (Best and Gennaro 1985. Great Basin Nat. 45:527–534), but are not recorded to take honey bee (*Apis mellifera*) prey. Here, I present the first record of *A. tigris* attacking and consuming a honey bee.

At 1200 h on 29 July 2002, I observed three adult *A. tigris* foraging beneath a stand of saltcedar (*Tamarix* sp.) in a dry wash in the northwest portion of the Glen Canyon National Recreation Area, Garfield Co., Utah, USA (37.642614°N, 111.067225°W, datum WGS84; elev. 1510 m). The lizards seemed unaware of my presence as they foraged in the leaf litter. The saltcedar was in full flower, and many bee species were visiting the flowers. A honey bee flew down from a low-lying flower, landing on the ground ca. 1 m from one of the *A. tigris*. The lizard immediately ran over to the bee, caught it, and began chewing it rapidly. As the *A. tigris* began ingesting the bee, it rubbed its snout on the ground several times. It is unknown whether it was trying to avoid being stung or if the hairy body of the bee was irritating the inside of its mouth. Other whiptails have been reported to rub their snout on the ground when attacking hairy arthropods, like some caterpillars (Burt 1928. J. Kansas Ent. Soc. 1:50–68). The entire attack and ingestion episode lasted <1 min. I continued to watch the lizards forage under the saltcedar for ca. 15 min, and the *A. tigris* that had ingested the bee behaved normally, showing no adverse effects from the encounter.

This record merits comment given the potentially toxic nature of this insect. Feeding experiments have revealed that the Eastern Fence Lizard (*Sceloporus undulatus*) always refused honey bees when offered them, and in one instance, a lizard was stung by a bee and died minutes later (Burt 1928. J. Kansas Entomol. Soc. 1:50–68). Whether the *A. tigris* individual was stung by the bee in this instance is unknown, but the fact that the lizard was able to attack and eat the bee without harmful consequence is noteworthy.

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GONATODES HUMERALIS (Trinidad Gecko). **ENDOPARASITES.** *Gonatodes humeralis* is widespread in northern South America and occurs in French Guiana, Suriname, Ecuador, Guyana, Peru, Bolivia, NE Venezuela, Colombia, Brazil, as well as Trinidad and Tobago (Uetz and Hallermann 2010. http.reptile-database.org, accessed 20 May 2010). The purpose of this note is to add to the helminth list of *G. humeralis*.

Fifteen *G. humeralis* (mean SVL = 36.9 mm ± 2.0 SD, range = 34–40 mm) collected from 1905 to 1973 from Peru, Loreto Department, Moropon (3.748056°S, 73.246933°W; WGS84; 107 m elev.) and deposited in the Texas Cooperative Wildlife Collection (TCWC), Texas A & M University, were examined for helminths (TCWC 36674, 36684, 36737, 36739, 38996, 41173, 41226, 41761, 41801, 41910, 41911, 41920, 41922, 42714, 42715).

The body cavities were opened and the digestive tracts removed. Contents were examined under a dissecting microscope. Digeneans were regressively stained in hematoxylin and mounted on glass slides in Canada balsam. Nematodes were cleared on glass slides in glycerol. All were cover-slipped, studied under a compound microscope and identified. Found were one species of Digenea, *Mesocoelium monas* (N = 173, small intestine, prevalence = number infected lizards/number lizards examined x 100 = 7%; mean intensity, mean number helminths per infected lizard ± 1 SD = 173) and three species of Nematoda, *Parapharyngodon scleratus* (large intestine, N = 2, prevalence = 7%, mean intensity = 2), *Physaloptera retusa* (stomach, N = 6, prevalence = 20%, mean intensity = 2.0 ± 1.0, range = 1–3), *Skrjabinelazia galliardi* (small intestine, N = 2, large intestine, N = 2, prevalence = 20%, mean intensity = 1.3 ± 0.6, range = 1–2). Voucher helminths were deposited in the United States National Parasite Collection, USNPC, Beltsville, Maryland: *Mesocoelium monas* (103203); *Parapharyngodon scleratus* (103204); *Physaloptera retusa* (103205); *Skrjabinelazia galliardi* (103206).

Mesocoelium monas is cosmopolitan in distribution and has been recorded from fishes, amphibians, and reptiles from the New and Old Worlds (Goldberg et al. 2009. Comp. Parasitol. 76:58–83). *Parapharyngodon scleratus* has been reported in a variety of lizards from Brazil and also occurs in Peru (Bursey et al. 2005. Comp. Parasitol.72:50–68). *Physaloptera retusa* is widely distributed in lizards and a few amphibians in the western hemisphere and has been reported from Mexico, North and South America, and the West Indies (Bursey et al. 2007, *op. cit.)*. *Skrjabinelazia galliardi* was originally described from *G. humeralis* collected in Brazil (Chabaud 1973. Ann. Parasitol. Hum. Comp. 48:329–334). *Gonatodes humeralis* represents a new host record for *Mesocoelium monas, Parapharyngodon scleratus,* and *Physaloptera retusa*. Peru is a new locality record for *Skrjabinelazia galliardi*

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HELODERMA SUSPECTUM (Gila Monster). **TREE-CLIMBING**. *Heloderma suspectum* occupies a variety of terrestrial habitats in all deserts of the United States and northern mainland Mexico (Beck 2005. Biology of Gila Monsters and Beaded Lizards. University of California Press, Berkeley and Los Angeles. 247 pp.; Campbell and Lamar 2004. Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York. 870 pp.). Despite the fact these regions substantially differ with respect to environmental factors and habitats (Brown 1994. Biotic Communities of the American Southwest—United States and Mexico. University of Utah Press, Salt Lake City. 342 pp.), *H. suspectum* selects similar types of microhabitats and shelters (Beck 2005, *op. cit*.; Beck and Jennings 2003. Herpetol. Monogr. 17:111–129), which are commonly bushes and structures with subterranean components (e.g., rock formations and small mammal burrows). Rarely, *H. suspectum* exhibits arboreal activities, particularly with regard to tree climbing (Beck 2005, *op. cit*.;

Cross and Rand 1979. Southwest. Nat. 24:703–705).

Here, we provide additional information on tree climbing of an adult *H. suspectum* from a population in the Sonoran Desert of south-central Arizona. The individual we discuss herein is the subject of an ongoing radio-telemetric study in which various features of behavior, physiology, and spatial ecology have been investigated since March 2001 (Kwiatkowski et al. 2008. J. Zool. 276:350–357; Repp and Schuett 2009. Herpetol. Rev. 40:343–345).

The present study site, located in Pinal Co., is 40 km SSE of the city of Florence, 8 km W of State Route 79, and encompasses an area of ~3 km^2 at the extreme western edge of the Suizo Mountains (Iron Mine Hill). The region is ecologically designated as Arizona Upland Desertscrub subdivision (Brown 1994, *op. cit.*).

On 25 April 2010, at 1205 h, in an area interfacing bajada (Phillips and Comus 2000, *op. cit.*) and desert flats, an adult male *H. suspectum* (HS-15: SVL = 291 mm; TL = 133 mm; tail volume = 49 ml; body mass = 470 g) was radio-tracked and located (site 5, elev. 826 m) beneath a moderate-sized (4 m H x 4 m W) Yellow Paloverde (*Cercidium microphyllum*; Fig. 1). The dominant vegetation directly beneath the tree was a dense stand of Fiddleneck (*Amsinckia intermedia*) with limited Triangle Bursage (*Ambrosia deltoidea*). Additional vegetation nearby included Engelmann's Prickly Pear (*Opuntia engelmannii*) and Buckhorn Cholla (*Opuntia acanthocarpa*). HS-15 was originally collected and processed on 12 March 2010, and has been radio-tracked on a weekly basis. Upon detection on 25 April, HS-15 began a deliberate (non-erratic) and consistent ascent into the tree that continued for about 1 min; he stopped and remained on a large (35 mm circumference) main branch angled at 20–35º and approximately 1.2 m above the ground (Fig. 1). He was outstretched facing eastward, in diffuse sunlight, and remained in that position, sometimes with his eyes closed, until we left (1230 h). Cross and Rand (1979, *op. cit.*) observed two adult *H. suspectum* ascended into Desert Willows (*Chilopsis linearis*) at similar heights (90 cm and 2.5 m) and attained similar postures on branches, as we report herein. However, they did not report dates and times of day, other than morning and evening.

The core body temperature of HS-15 (obtained via an implanted 9.0 g temperature-sensitive radio transmitter; Holohil Systems Ltd., Ontario, Canada) while he was at his final location in the tree was 32.3ºC. Ambient temperature (1 m above the ground in shade) was 28.0ºC; ground temperature in direct sunlight beneath the tree was 51ºC. Cloud cover was 0%, relative humidity was < 10%, and wind speed was slight (0–8 kph) and intermittent.

We are unable to determine whether HS-15 made his ascent to escape our presence or for other reasons, such as avoiding high ground temperatures. Support for the latter view is that we were unable to locate burrows, woodrat (*Neotoma albigula*) middens, or any other shelters often used by *H. suspectum* (see Beck and Jennings 2003, *op. cit.*). Moreover, in a nearby (4 km S) population, Davis and DeNardo (2010. J. Herpetol. 44:83–93) determined the mean activity body temperature of *H. suspectum* to be 26.4 (± 0.83°C), which indicates that the core body temperature of 32.3°C present in HS-15 was approaching the voluntary maximum of 35–37°C (D. Beck and D. DeNardo, pers. comm.). The critical thermal maximum for *H. suspectum* is believed to be ~44°C (Beck 2005, *op. cit.*).

COLOR REPRODUCTION SUPPORTED BY THE THOMAS BEAUVAIS FUND

Fig. 1. Tree climbing by an adult male, wild-living Gila Monster, *Heloderma suspectum*. This individual (HS-15) is shown at his final location in a Yellow Paloverde (*Cercidium microphyllum*). Photograph by R. A. Repp.

We did not locate bird nests in the tree used by HS-15; thus, it appears unlikely that foraging was a motivation to climb. Unlike Beaded Lizards (*H. horridum* sensu lato; see Douglas et al. 2009. Mol. Phylogenet. Evol. 55:153–167), which often forage in trees (Beck 2005, *op. cit.*), *H. suspectum* predates mostly on ground-nesting avian and mammalian species (Beck 2005, *op. cit.*; Repp and Schuett 2009, *op. cit.*). To date, there are no observations to support arboreal foraging in *H. suspectum*.

Our field studies at Suizo Mountain have been funded by Arizona State University, Zoo Atlanta, Georgia State University, and Dr. David L. Hardy, Sr. Since 2001, many individuals provided assistance in radio-tracking, but most noteworthy are Hans-Werner Herrmann and Ryan Sawby. Also, Ryan Sawby provided invaluable assistance with photography and identification of plants and invertebrates. We thank Dan Beck, Dale DeNardo, Matt Goode, Jim Jarchow, and Brian Sullivan for various favors. This study was approved by the IACUC of Arizona State University (98-429R), and appropriate scientific permits were obtained from the Arizona Game and Fish Department.

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HEMIDACTYLUS MABOUIA (Tropical House Gecko). **PREDATION.** *Hemidactylus mabouia* is a broadly distributed species in the tropics and has been introduced to the New World, with populations having successfully colonized southern areas of North America and Central and South America (Federico and Cacivio 2000. Herpetol. Rev. 31:53). The Roadside Hawk (*Buteo magnirostris*) is a medium-sized hawk that often is associated with thinned forests, forest edges, and natural or anthropogenic clearings (Bierregaard 1994. *In* Hoyo [org.], Handbook of the Birds of the World, Vol. 2, p. 179). Its diet can contain a variety of organisms including large invertebrates and small vertebrates (Haverschimidt 1962. Condor 64:154–158; Panasci et al. 2002. Wilson Bull. 114:114–121). This note reports an observation of predation on *H. mabouia* by *B. magnirostris*.

At 1654 h on 2 November 2009, in the Central Campus of Universidade Federal do Rio Grande do Norte (UFRN), municipality of Natal, State of Rio Grande do Norte, Brazil (256117.385°E, 9354212.344°N; datum WGS84), elev. 34.5 m, BRMM observed a Roadside Hawk on a tree branch within remnant forest with a *H. mabouia* in its bill. The lizard was not moving, indicating it was no longer alive. BRMM observed the hawk closely, using binoculars (SUMAX 12-45x70 BS Ventura), to make a positive identification of the gecko. The hawk flew away with the prey item.

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HEMIDACTYLUS TURCICUS (Mediterranean Gecko). **HERMAPHRODITISM.** Many sexual anomalies have been reported in lizards including hermaphroditism caused by radiation exposure in *Lacerta vivipara* (Semenov and Ivanova 1995. Russ. J. Herpetol. 2:166–169), sexual development anomalies caused by varying incubation temperatures in *Lacerta viridis* (Raynaud and Pieau 1985. *In* C. Gans and F. Billet [eds.], Biology of the Reptilia, Vol. 15, Development B, pp. 149–300. John Wiley and Sons, New York), and development of hemipenes in female Leopard Geckos (*Eublepharis macularius*; Holmes et al. 2005. Horm. Behav. 47:439–445). However, few reports of hermaphrodite lizards from wild populations exist (but see Darevsky et al. 1978. Copeia 1978:201–207; Goldberg 1989. Copeia 1989:486–488). As part of a study of the accumulation of potential pollutants in the tissues of Mediterranean Geckos (*Hemidactylus turcicus*; Kinney et al. 2008. Herpetol. Conserv. Biol. 3:247–253), we histologically examined the gonadal tissues of specimens collected from buildings at several sites in southwestern Louisiana, USA. This study discovered a hermaphroditic Mediterranean Gecko which we describe herein.

Collections of geckos were made between June and August 2006, representing the middle of the gecko reproductive season in Louisiana, to ensure that the gonadal tissue was well developed (i.e., males would have sperm cells and females would have developing eggs). Sex of adults (SVL > 42 mm; Selcer 1986. Copeia 1986:956–962) was initially determined in the field: males were identified by the presence of pre-anal pores in a chevron pattern. Specimens were sacrificed by pithing; testes and epididimides were dissected from the males, ovaries (including eggs) were dissected from the females, and all tissues were placed in 10% neutral buffered formalin. Tissues were dehydrated in alcohol, cleared in xylene and paraffin embedded. Seven-micron-thick sections were made and slides stained with hematoxylin and eosin. Six adult male and seven adult female specimens collected from five sites in Beauregard and Calcasieu parishes, Louisiana were examined.

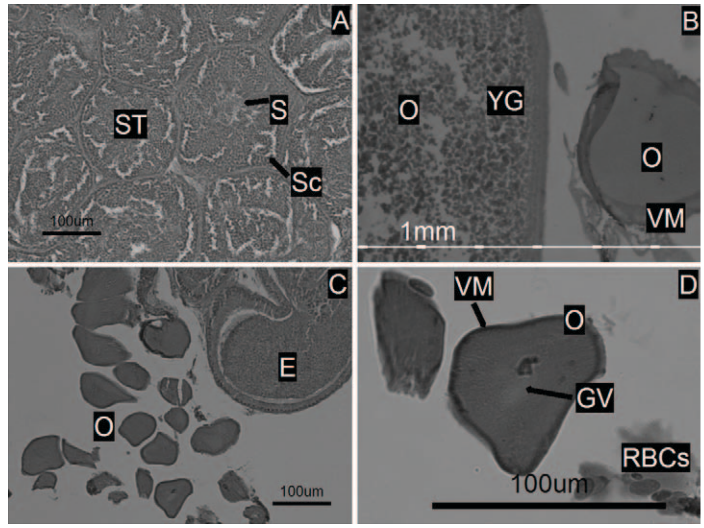

Fig. 1. **A**. Normal male *Hemidactylus turcicus*: testis with seminiferous tubules filled with all stages of germ cells. **B.** Normal female *Hemidactylus turcicus*: oocytes at various stages of development. **C.** Hermaphrodite *Hemidactylus turcicus*. Note oocytes associated with epididymis. **D.** Close-up of oocytes of hermaphrodite *Hemidactylus turcicus*. ST = seminiferous tubule; S = spermatozoa; Sc = spermatocytes; O = oocytes; YG = yolk granules; VM = vitelline membrane; E = epididymis; GV = germinal vesicle; RBCs = red blood cells.

A specimen initially identified as a male collected 13 June 2006 from the clubhouse at Lake Charles Country Club in Calcasieu Parish was found to have both testicular/epididymal and ovarian tissue (Fig. 1). The testicular tissue appeared normal and all stages of sperm development were present (including mature sperm in the epididymis, Fig 1C). The ovarian tissue was separate from the testes and appeared intimate with the epididymis (Fig. 1C). The oocytes were all immature (stage one development indicated by lack of perinucleoli or yolk development). The germinal vesicle (nucleus), as well as the vitelline membrane surrounding the eggs can also be seen (Fig. 1D). Because this individual possesses both male and female gonadal tissues, it is a true hermaphrodite (or intersex). To our knowledge, this is the first report of a hermaphroditic Mediterranean Gecko captured from a wild population.

This study was carried out in accordance with the McNeese State University Institutional Animal Care and Use Regulations. Specimens were collected under the authority of Louisiana Department of Wildlife and Fisheries Scientific Collecting Permit LNHP-06-052.

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IGUANA IGUANA (Green Iguana). **NESTING**. In Central America, female *Iguana iguana* deposit large clutches of eggs from February through April (Stafford and Meyers 2000. A Guide to Reptiles of Belize. Academic Press, New York. 356 pp.). Eggs are laid in burrows, which females often construct in sandbanks along creeks and rivers (Stafford and Meyers, *op. cit.*). In Panama, female *I. iguana* reportedly construct nesting burrows in close proximity to American Crocodile (*Crocodylus acutus*) nests (Rand 1968. Copeia 1968:552–561; Dugan et al. 1981. J. Herpetol. 15:409–414). Here we report observations of *I. iguana* using crocodile nests as oviposition sites in southern Belize. Crocodile embryos obtained from these nests, through genetic analysis, were determined to be *C. moreletii* × *acutus* hybrids (Hekkala 2004. Conservation Genetics at the Species Boundary: Case Studies from African and Caribbean Crocodiles [Genus: Crocodylus]. PhD dissertation, Columbia University, New York. 92 pp.).

On 20 April 1997, we found two crocodile nests 240 cm apart on a sandbar along Paynes Creek, Paynes Creek National Park, Toledo District (16.35830°N, 88.56604°W, datum WGS84; elev. ca. 10 m). Each crocodile nest consisted of a sand mound ca. 140 cm wide × 90 cm high. One nest contained 25 *I. iguana* eggs, but no crocodile eggs, and the other contained one *I. iguana* egg and 42 crocodile eggs. In the latter nest, the *I. iguana* egg was buried beneath the crocodile eggs. Remains of at least five more *I. iguana* eggs were scattered around the second nest, implying that the female crocodile had unearthed them during oviposition. The extent of banding visible on the crocodile eggs (Platt et al. 2008. J. Zool. 275:177–189) indicated the clutch was deposited about five days earlier. Because crocodile nests are generally constructed 5–7 days prior to egg laying (Platt et al., *op. cit.*), the *I. iguana* clutches were likely deposited in early April. On 15 May 1997, we found two additional crocodile nests on sandbars along the Swasey Branch of Monkey River, Toledo District. The first nest (16.41888°N, 88.53466°W, datum WGS84; elev. ca. 15 m), a large sand mound measuring approximately 300 cm wide × 100 cm high, contained 38 crocodile eggs and 17 *I. iguana* eggs; the latter were buried about 5 cm beneath the crocodile eggs. We estimated the crocodile eggs to be about three weeks old. Hence, the *I. iguana* eggs were likely deposited in mid-April. A second crocodile nest (16.42833°N, 88.54361°W, datum WGS84; elev. ca. 32 m) found on a sandbar downstream from the previous nest contained 23 crocodile eggs, but no *I. iguana* eggs. However, abundant tracks and excavations indicated *I. iguana* were nesting on the sandbar adjacent to the crocodile nest.

Given an incubation period of ca. 90 days (Hirth 1963. Ecology 44:613–615; Rand 1972. Herpetologica 28:252–253), *I. iguana* eggs deposited early-to-mid April are expected to hatch early-to-mid July, a period coinciding with the onset of the wet season (Platt et al., *op. cit.*). In Belize, *Crocodylus acutus* eggs hatch after an incubation period of 78–81 days, and hatchlings emerge from the nest during the same period as *I. iguana* (Platt and Thorbjarnarson 2000. Copeia 2000:869–873). *Crocodylus moreletii* has a similar incubation period (ca. 75 days), though clutches are not deposited until after the wet season commences in late June and July (Platt et al., *op. cit.*). Although the incubation period of *C. moreletii* × *acutus* hybrids has yet to be determined, it is expected to be similar to both parental species. Thus, hatchling *I. iguana* and hatchling crocodiles probably emerge from the nest at about the same time. To our knowledge, these are the only reports outside of Panama of *I. iguana* depositing eggs in crocodile nests. Presumably, fitness advantages in the form of increased nest and hatchling survival accrue to female *I. iguana* from the nest defense behavior of female crocodiles (Dugan et al., *op. cit.*). However, female crocodiles occasionally unearth *I. iguana* eggs when excavating nests, and female *I. iguana* also risk being captured and consumed by female crocodiles defending nests (Dugan et al., *op. cit.*).

We thank Eloy Quevas for bringing the crocodile nests to our attention, Travis Crabtree, Steve Lawson, and Lewis Medlock for field assistance, and Bruce Cullerton and Rainforest Mechanics, Inc. for transport. Jacob and Kelly Marlin and the Belize Foundation for Research and Environmental Education provided logistical support. Richard Montanucci and Chris Pipes provided useful references and assistance.

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MABUYA ARAJARA (NCN). **DEATH-FEIGNING.** Death-feigning (thanatosis) is a state of immobility in response to external stimuli that has been considered a defense mechanism against predators shared by various animals, including snakes and lizards (Gehlbach 1970. Herpetologica 24–34; Rocha 1993. Cienc. Cult. 45:116–122). This defensive behavior been observed in several different families of lizards, including Dibamidae (Torres-Cervantes et al. 2004. Herpetol. Rev. 35:384), Crotaphytidae (Gluesing 1983. Copeia 1983:835–837), Tropiduridae (Bertoluci et al. 2006. Herpetol. Rev. 37:472–473; Galdino and Pereira 2002. Herpetol. Rev. 33:54; Gomes et al. 2004; Kohlsdorf et al. 2004. Herpetol. Rev. 35:390–391), but has been less documented in Scincidae (Langkilde et al. 2003. Herpetol. J. 13:141–148). *Mabuya arajara* is a skink found only in high elevation areas of northeastern Brazil (Joventino and Loebmann 2010. Herpetol. Bull. 113:4–10; Rebouças-Spieker 1981. Pap. Avul. Zool. 34:121–123; Ribeiro et al. 2008. Cad. Cult. Ciênc. 1:67–76). Little information exists on the natural history of *M. arajara*. Here, we report thanatosis in *M. arajara* during a collecting expedition in Araripe Mountain Plateau, municipalities of Barbalha (07.3186111°N, 39.4011111°W, WGS84) and Crato (07.2552778°N, 39.4680556°W, WGS84), Ceará. Three specimens were hand captured between 1500–1600 h on 11–12 May 2010. Every time the skinks were handled, they promptly exhibited death feigning, although their eyes remained open; these behaviors lasted for about 3 min, even after being placed on the ground. Among lizard species, thanatosis is a behavior rarely observed in natural situations (Greene 1988. *In* Gans and Huey [eds.], Biology of the Reptilia, Vol. 16, Ecology and Defense, pp. 1–52. Alan R. Liss. Inc., New York) but handling may induce this behavior in many lizard species (Rocha 1993, *op. cit.*). Thanatosis in *M. arajara* may cause predators to lose interest in the potential prey and give them an additional opportunity to escape. The three skink specimens were deposited in the zoological collection of the Universidade Regional do Cariri/LZ-URCA, Ceará, Brazil as LZ-URCA 779, 780, and 783. We thank CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for the scholarship to SCR. We are also grateful to IBAMA (Brazilian Institute for the Environment and Natural Resources) for permission to collect samples from protected areas (permit 154/2007 and process 20388-1)

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OPHISOPS ELEGANS (Snake-eyed Lizard). **ENDOPARASITES.** *Ophisops elegans* is a widely distributed lacertid in the Middle East occurring from the Bosphorus through Iran, south to the Sinai Peninsula and Red Sea Coast of Egypt, Jordan, Iraq, and the Transcaucasian republics where it is commonly found on stony plains and hillsides (Anderson 1999. The Lizards of Iran. SSAR Contrib. Herpetol. 15:1–442). We know of no published accounts of helminths from this lizard. The purpose of this note is to establish the initial helminth list for *O. elegans*.

Six *O. elegans* (mean SVL = 45.0 ± 3.3 SD, range = 42–49 mm) from The Islamic Republic of Iran, Khuzestan Province, Shalgahi (32.416667°N, 48.866667°E, WGS84, elev. 12 m) were examined for helminths from the herpetology collection of the Museum of Comparative Zoology (MCZ), Harvard University: (MCZ R-56694, 56695, 56697, 56699, 56705, 56737).

The body cavity was opened and the digestive tract was removed and examined under a dissecting microscope for helminths. Seven cestodes were found in the small intestines of four *O. elegans* (prevalence, number infected lizards/number examined lizards × 100 = 67%; mean intensity, average number helminths per infected lizard = 1.8 ± 0.96 SD, range: 1–3). Cestodes were regressively stained in hematoxylin and identified under a compound microscope as *Oochoristica tuberculata*. They were deposited in the invertebrate collection at MCZ as IZ-95760–95763.

Oochoristica tuberculata is widely distributed in the Old World and occurs in a variety of lizards and some snakes; distribution and hosts are summarized in Yildirimhan et al. (2006. Comp. Parasitol. 73:257–262). Although the life cycle of *O. tuberculata* is unknown, the congener *O. anolis* utilizes beetles as intermediate hosts (Conn 1985. J. Parasitol. 71:10–16). *Ophisops elegans* represents a new host record for *Oochoristica tuberculata*. The Islamic Republic of Iran is a new locality record.

We thank Jonathan B. Losos and Jose Rosado (MCZ) for permission to examine *O. elegans* and Cecilia Nava (Whittier College) for assistance with dissections.

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POTAMITES JURUAZENSIS (NCN). **ENDOPARASITES.** *Potamites juruazensis* (Gymnopthalmidae) is known from Acre Province, Brazil (Avila-Pires and Vitt 1998. Herpetologica 54:235–2450) and Peru (Doan and Castoe 2005. Zool. J. Linn. Soc. 143:405–416). There are, to our knowledge, no reports of helminths from *P. juruazensis*. In this report we establish an initial helminth list for *P. juruazensis*.

Twenty *P. juruazensis* (9 females, 11 males), mean SVL = 40.3 mm ± 11.1 SD, range = 24–58 mm) from ca. 5 km N of Porto Walter (8.25861°S, 72.77694°W; WGS 84; elev. 198 m) Acre State, Brazil collected by LJV and Teresa C. Ávila-Pires and deposited in the Sam Noble Oklahoma Museum of Natural History, Norman, Oklahoma as OMNH 36861–36880 were examined for endoparasites.

The body cavity was opened and the intestines removed and examined under a dissecting microscope. Because these specimens had previously been used in an ecological study (Vitt and Avila-Pires 1998. Copeia 1998:570–582), the stomachs were not available for examination. Ten nematodes were found in the small (N = 5) and large intestines (N = 5). They were cleared in glycerol on a microscope slide, studied under a compound microscope and identified as *Cosmocerca vrcibradici,* prevalence = number infected individuals/number individuals examined × 100 = 30%; mean intensity mean number parasites per infected lizard = 1.67 ± 0.52 SD, range = 1–2. Voucher specimens were deposited in the United States National Parasite Collection, Beltsville, Maryland as USNPC 103198.

Cosmocerca vrcibradici was described from the gymnophthalmids *Prionodactylus eigenmanni* and *P. oshaughnessyi* from Brazil and Ecuador (Bursey and Goldberg 2004. J. Parasitol. 90:140–145) and has subsequently been reported from *Uranoscodon superciliosus* from Brazil (Bursey et al. 2005. J. Parasitol. 91:1395–1398), *Norops fuscoauratus* from Brazil (Goldberg et al. 2006. Phyllomedusa 5:83–86), *Alopoglossus angulatus* and *A. atriventris* from Brazil and Ecuador (Goldberg et al. 2007. Herpetol. J. 17:269–272), and *Arthrosaura reticulata* from Ecuador (Goldberg et al. 2010. Herpetol. Rev. 41:349–350). The report of *C. vrcibradici* in *Chalcides ocellatus* from Egypt by Ibrahim and Soliman 2005 (Parasite 12:317–323) requires verification. *Potamites juruazensis* represents a new host record for *Cosmocerca vrcibradici*.

We thank Cecilia Nava (Whittier College) for assistance with dissections.

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SCELOPORUS MINOR (Minor Lizard). **PREDATION.** *Sceloporus minor* is a colorful phrynosomatid restricted to saxicolous habitats in central México (Wiens et al. 1999. Evolution 53:1884–1897). To date, there are few published reports on the ecology of this species (Ramírez-Bautista et al. 2008. Herpetol. J. 18:121–127) and to our knowledge, nothing regarding predation. Between 2005 and 2008 we studied a population of *S. minor* in the Los Mármoles region of NW Hidalgo state (Stephenson 2010. Unpubl. Ph.D. dissertation, University of Miami, Coral Gables, Florida. 187 pp.) near the community of La Manzana (20.87°N, 99.22°W, WGS84; elev. 2400 m). Here, mixed oak-pine forest (primarily *Quercus crassipes* and *Pinus greggii*) is interrupted by sharp limestone outcroppings. These rocky outcrops represent the primary habitat for *S. minor* in this area, and both adults and juveniles are commonly observed basking and displaying on boulders and rock piles (Stephenson 2010, *op. cit.*). In the southern part of its range *S. minor* is sympatric with the Querétaro Dusky Rattlesnake, *Crotalus aquilus* (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York). Near La Manzana, adult *C. aquilus* are active during the day (Armstrong and Murphy 1979. Spec. Publ. Mus. Nat. Hist. Univ. Kans. [5]:1–88), and commonly observed on and around exposed boulders used by *S. minor* (Stephenson 2010, *op. cit.*). In this report we describe two observations of predation on *S. minor* by *C. aquilus*, representing the first descriptions of predation on *S. minor* by any species and extending knowledge pertaining to the diet of *C. aquilus*.

On 12 August 2006 three of us (BPS, ELMV, and NI) observed and followed an adult *C. aquilus* tracking and ultimately consuming a previously marked subadult female *S. minor* (measured 47.7 mm SVL on 28 July 2006). The lizard was found on a small dirt trail in a hillside dominated by low-growing (<1 m) shrubby vegetation. Because this encounter was lengthy (almost 3 h), we provide a detailed summary:

- 1144 h: Lizard found motionless on ground in normal upright posture; *C. aquilus* located ~10 cm away (air temperature at breast height = 17.2°C).
- 1150 h: Snake began to approach lizard from rear, and lizard began to move away slowly from snake; both stopped after a few seconds.
- 1157 h: Lizard resumed moving away from snake, stopping about 50 cm from snake.
- 1217 h: Lizard opened and closed mouth several times in quick succession.
- 1222 h: Snake resumed approach toward lizard (with occasional tongueflicks), approaching to within 10 cm.
- 1234 h: Lizard did not move; snake retreated.
- 1237 h: Snake approached again, closing to within 1 cm of the lizard.
- 1245 h: Lizard pushed its head into head of *C. aquilus*; no overt response from snake. Lizard shifted position, settling its head on midsection of snake.
- 1250 h: Snake began to encircle lizard, which briefly settled over the body of the snake more fully, then moved away from the snake again.
- 1253 h: Snake bit lizard on head; lizard shook its body and the snake retreated.
- 1258 h: Snake bit lizard again on the head; female lizard shook its body again and placed its body over snake.
- 1316 h: Snake began to move again; lizard started to move away again.
- 1330 h: Lizard moved off of dirt path into nearby shrubby vegetation, climbing onto top of cluster of small herbaceous plants (*Salvia* sp.). Snake was about 10 cm away.
- 1348 h: Snake briefly moved toward lizard again.
- 1351 h: Lizard began to lose grip on vegetation.
- 1402 h: Lizard fell onto ground, ventral side up and was motionless.
- 1404 h: Leg of lizard began to twitch. Spasms lasted about three minutes.
- 1410 h: Snake resumed approach to lizard with tongueflicks.
- 1420 h: Snake bit head of lizard again, and began to consume it headfirst.
- 1436 h: Swallowing of lizard complete.

The behavior of the lizard when found suggests that it was envenomated prior to discovery. However, the lengthy duration between a probable initial strike and lizard death (≥ 3 h) suggests that relatively little venom may have been injected. (The bites that we observed did not appear to be feeding strikes, but perhaps attempts to determine whether the prey was ready to be consumed.)

The second observation occurred on 25 August 2008 in similar open, shrubby habitat. At 1135 h, two of us (BPS and NI) found a *C. aquilus* adult consuming an adult male *S. minor* (air temperature = 16.2°C). When discovered, the snake had swallowed approximately 50% of the lizard, which was oriented ventral-side up as in the previous observation. The snake was found at the base of a limestone boulder, but retreated into nearby vegetation upon approach. By 1147 h the snake had consumed the lizard down to the base of the tail.

On several other occasions we found individuals of *S. minor* or the sympatric congener *S. torquatus* lying motionless on the ground or on rock piles with no visible wound. Close inspection of the immediate area often revealed a *C. aquilus* nearby (< 1 m) suggesting that these individuals had been recently envenomated but not yet consumed. Overall, these observations are consistent with several other reports of predation by *C. aquilus* on *Sceloporus* lizards (Klauber 1997. Rattlesnakes: Their Habits, Life Histories, and Influence on Mankind. 2nd ed. University of California Press, Berkeley, California; Mociño-Deloya et al. 2008. Herpetol. Bull. 105:10–12), indicating that *Sceloporus* lizards are probably an important food source throughout the range of *C. aquilus*.

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STENOCERCUS GUENTHERI **(Günther's Whorltail Iguana). REPRODUCTION.** *Stenocercus guentheri* is known from the Andes of Ecuador and Colombia (Torres-Carjaval 2000. Sci. Pap., Nat. Hist. Mus. Univ. Kansas 15:1–38). Information on *S. guentheri* reproduction consists of clutch size reports of two eggs deposited in May and June (Fritts 1974. San Diego Soc. Nat. Hist. Mem. 7:1–89; Torres-Carjaval, *op. cit*.). The purpose of this note is to report a minimum SVL for maturity in females and the first information on the testicular cycle for *S. guentheri*.

Six females (mean SVL = 64.8 mm ± 5.9 SD, range = 58–70 mm) and three males (mean SVL = 73.3 mm ± 5.8 SD, range = 70–80 mm) of *S. guentheri* were borrowed for histological gonad examination from the herpetology collection of the Natural History Museum of Los Angeles County (LACM). The specimens were collected in 1977 (Colombia) Tangua, Nariño Province (1.08333°N, 77.30000°W, datum WGS84; elev. 2286 m) (LACM 131492) and in 1970 (Ecuador), El Quinché, Pichincha Province (0.25000°S, 78.41666°W, datum WGS84; elev. 2591 m) (LACM 58782–58789).

The left gonad was removed for histological examination and embedded in paraffin. Histological sections were cut at 5 μm, mounted on glass slides and stained with Harris hematoxylin followed by eosin counterstain. Histology slides were deposited in LACM.

Four of the six females (SVL = 63–70 mm) each (from May) contained clutches of two oviductal eggs. The remaining two females (each SVL = 58 mm) contained quiescent ovaries with no yolk deposition. The minimum size for female reproductive activity was 63 mm SVL (LACM 58783). Previous records of clutch sizes of two (Fritts, *op. cit*.; Torres-Carjaval, *op. cit*.) suggest this may be typical for *S. guentheri*. However, there are reports of congeneric species of *Stenocercus* producing larger clutches: *S. humeralis* (four eggs) (Torres-Carvajal, *op. cit*.); *S. azureus* (six eggs) (Torres-Carjaval 2004. Herpetol. Rev. 35:172); *S. doellojuradoi* (six eggs) (Pelegrin and Bucher 2010. Herpetol. Rev. 41:86–87).

The three male *S. guentheri* (SVL = 70–80 mm, two from May and one from November) exhibited spermiogenesis. Lumina of the seminiferous tubules were lined by spermatozoa and clusters of metamorphosing spermatids. The minimum size for reproductive activity was 70 mm SVL (LACM 58784, 131492). The presence of males undergoing spermiogenesis at opposite ends of the year (May and November) suggests *S. guentheri* exhibits a prolonged period of sperm formation.

I thank Christine Thacker (LACM) for permission to examine *S. guentheri*.

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STENOCERCUS GUENTHERI (Günther's Whorltail Iguana). **ENDOPARASITES.** *Stenocercus guentheri* is known from the Andes of Ecuador and Colombia (Torres-Carjaval 2000. Sci. Pap., Nat. Hist. Mus. Univ. Kansas 15:1–38). To our knowledge, there are no reports of endoparasites from *S. guentheri*.

Five specimens of *S. guentheri* (mean SVL = 72.4 mm ± 8.9 SD, range = 63–82 mm) were borrowed for helminthological examination from the herpetology collection of the Natural History Museum of Los Angeles County (LACM). They were collected in May 1970 from El Quinché, Pinchincha Province, Ecuador (0.25000°S, 78.41666°W, datum WGS84; elev. 2591 m): LACM 58782, 58784, 58790, 58807, 58808.

The body cavity was opened and the digestive tract was removed, opened by a longitudinal incision, and examined under a dissecting microscope. One species of Cestoda, two species of Nematoda, and one species of Acanthocephala were found. All were studied under a compound microscope and identified. The cestodes (N = 3, from the small intestines) were regressively stained in hematoxylin, mounted in Canada balsam, and identified as *Oochoristica travassosi*, prevalence = number infected lizards/number lizards studied × 100 = 60%; mean intensity = mean number parasites per infected lizard = 1.7 ± 0.58 SD; range = 1–2. Nematodes and acanthocephalans were cleared in glycerol on a microscope slide, cover-slipped, and identified as *Physaloptera retusa* (N = 48 from the stomach, N = 1 from the small intestine) prevalence = 100%; mean intensity = 9.8 ± 6.8 SD; range = 4–21; acuariid larvae (N = 9 from the body cavity) prevalence = 20%; and acanthocephalan cystacanths (N = 7 from the body cavity) prevalence = 20%.

Helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as: *Oochoristica travassosi* (103199); *Physaloptera retusa* (103200): acuariid larvae (103201), acanthocephalan cystacanths (103202).

Oochoristica travassosi was described from *Leiocephalus* sp. from Peru by Rego and Ibáñez (1965. Mem. Institut. Oswaldo Cruz 63:67–73). It has previously been found in *Liolaemus vallecurensis* from Argentina (Goldberg et al. 2004. Comp. Parasitol. 71:208–214) and *Phyllodactylus johnwrighti* from Peru (Goldberg and Bursey 2010. Comp. Parasitol. 77:91–93). Conn (1985. J. Parasitol. 71:10–16) reported beetles served as intermediate hosts for the congeneric *O. anolis*. *Physaloptera retusa* is widely distributed in New World lizards and has been reported from both North and South America (Goldberg et al., *op. cit*.). Like other members of the Physalopteridae, it utilizes insect intermediate hosts (Anderson 2000. Nematode Parasites of Vertebrates. 2nd ed. CAB International, Oxfordshire, UK. 650 pp.). Adults of the Acuariidae occur in the gizzard of terrestrial birds; insects are intermediate hosts (Anderson 2000, *op. cit*.). Lizards likely serve as paratenic (transport) hosts with development completed in an avian final host. Acanthocephalans require an invertebrate intermediate host in which the cystacanth develops, infective to the final host (Kennedy 2006. Ecology of the Acanthocephala. Cambridge Univ. Press, Cambridge, UK. 249 pp.). Because no further development occurs, lizards most likely are paratenic hosts. *Stenocercus guentheri* represents a new host record for *Oochoristica travassosi, Physaloptera retusa,* acuariid larvae, and acanthocephalan cystacanths.

SRG thanks Christine Thacker (LACM) for permission to examine *S. guentheri* and Cecilia Nava (Whittier College) for assistance with dissections.

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TROPIDURUS TORQUATUS (Lagartixa, Calango). **DIET**. *Tropidurus torquatus* is a common and widespread lizard that occurs in many habitats in central and southern regions of Brazil and neighboring countries (Rodrigues 1987. Arq. Zool. S. Paulo 31:105–230), including urban areas. It is a sit-and-wait predator that preys mainly on arthropods, but also consumes plant material and vertebrates (Bergallo and Rocha 1994. Austral. J. Ecol. 19:72–75; Teixeira and Giovanelli 1999. Rev. Bras. Biol. 59:11–18). However, few dietary studies have included data from within urban environments. Herein we report the diet of *T. torquatus* in an urban area in Brazil.

Lizards were collected between August and October of 2006, in four urbanized sites in the city of Itabira, Estado de Minas Gerais, southeastern Brazil (19.665ºS, 43.212ºW). Itabira harbors a human population of about 100,000 (IBGE 2006, available at http://www.ibge.gov.br/cidadesat/) settled in the Atlantic Rainforest domain, but the surrounding areas are highly impacted by anthropogenic activities, especially mining. All four sites are characterized by housing, paved surfaces, vacant lots, and trash consisting of construction materials. The stomachs of 20 lizards (12 male, 8 female), with SVL averaging 87.5 mm ± 23.5 SD (range 51.8–133.8 mm), were examined by dissection; all specimens had food remnants in their stomachs. Eusocial insects (ants and termites) were by far the most important prey both in numbers (N = 261, 48.6% of total prey items and N = 224, 40.7% of total prey items, respectively) and frequency in which prey was recorded (N = 17, 85% and N = 11, 55%, respectively). Ants and termites were followed by bees in number (N = 33, 6%) and frequency (N = 8, 40%). Also found were remains of beetles (number: N = 7, 1.3%; frequency: N = 2, 10%), crickets (number: N = 3, 0.5%; frequency: N = 1, 5%), cockroaches (number: N = 3, 0.5%; frequency: N = 1, 5%), unidentified arthropods (number: N = 12, 2.2%; frequency: N = 2, 10%), and insect pupae (number: N = 2, 0.4%; frequency: N = 1, 5%). Plant material was represented by flowers (number: N = 1, 0.2%; frequency: N = 1, 5%).

The predominance of eusocial insects in the diet of *T. torquatus* is in accordance with previous studies (Bergallo and Rocha, *op. cit.*; Fialho et. al. 2000. J. Herpetol. 34:325–330). This species seems to be a generalist lizard that invests in the most abundant prey available (Arruda et al. 2007. *In* Anais do VIII Congresso de Ecologia do Brasil: 1–2). Ants and termites, being highly mobile and normally locally abundant, are usually predominant in its diet (Fialho et al., *op. cit.*), which seems to hold true for this study in an urban environment.

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SQUAMATA — SNAKES

ACANTHOPHIS PYRRHUS (Desert Death Adder). **FORAGING BEHAVIOR.** *Acanthophis pyrrhus* is a short-bodied terrestrial elapid restricted to hummock grassland habitats across Australia's arid to semi-arid zone (Wilson and Swan 2003. A Complete Guide to Reptiles of Australia. New Holland Publishers. Sydney, New South Wales. 512 pp.). Both in morphology and ecology, members of this genus are highly convergent with vipers (Shine 1980. Herpetologica 36:281–289). One similarity is the presence of a pale tail tip on some species which is reportedly used to lure prey (Chiszar et al. 1990. J. Herpetol. 24:253–260). However, to my knowledge, caudal luring has only been reported in two species of death adder (*A. antarcticus, A. praelongus*) and has not been reported in the wild for any species (Carpenter and Carpenter 1978. J. Herpetol. 12:574–577; Hagman et al. 2008. Funct. Ecol. 22:1134–1139; Chiszar et al., *op. cit.*). Here, I report on two possible examples of caudal luring observed in wild *A. pyrrhus* encountered on Namatjira Drive (west of Alice Springs in the Northern Territory, Australia) while road-cruising as part of a broader study of arid-zone snakes.

On the 18 September 2009, at 1909 h, I encountered a small adult female *A. pyrrhus* (SVL = 389 mm) coiled on the road surface with its entire tail extending vertically into the air. The animal remained motionless in this position for several minutes before lowering its tail and attempting to move off the road surface, presumably in response to my presence. No independent movement of the tail tip was observed. On the following night, at 2022 h, I encountered a larger adult female *A. pyrrhus* (SVL = 560 mm) exhibiting the same posture as the animal from the previous night (Fig. 1). I observed the snake for approximately 10 minutes during which time the tail tip was wriggled intermittently while the remainder of the tail was maintained in the vertical

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FIG. 1. Adult female *Acanthophis pyrrhus* coiled on the road surface with its tail extending vertically into the air.

position. After 10 min the snake lowered its tail and moved off the road. In both situations I find it unlikely that the snake's tails were extended into the air in response to the approach of my vehicle, as they were spotted in this position at considerable distance (approximately 50 m).

Holding the tail in an erect position has been reported for captive *A. antarcticus* and was considered to be a posture related to caudal luring (Carpenter and Carpenter, *op. cit.*). By lying in an exposed situation (road surface) with the tail erect, *A. pyrrhus* may attract prey from a greater distance than they would by laying among dense vegetation or with their tail on the ground. However, the potential cost (predation risk and road mortality) of such behavior may also be high. Alternative hypotheses for the behavior include reproduction (e.g., broadcasting for males), predator warning, or predator diversion (Greene 1973. J. Herpetol. 7:143–161).

Work was carried out under scientific permit no. 33584 from the Northern Territory Government and was approved by the Animal Care and Ethics Committee (ANZCCART) of Charles Sturt University (Ref: 09/064).

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AGKISTRODON BILINEATUS (Cantil). **ENDOPARASITES.** *Agkistrodon bilineatus* occurs from near sea level to about 1500 m elevation along the Pacific Coast from Sonora, Mexico, southward through northern Costa Rica, but is disjunctly distributed along the Atlantic Coast from the Yucatan Peninsula through Guatemala (Lee 2000. A Field Guide to the Amphibians and Reptiles of the Maya World. Cornell Univ. Press, Ithaca, New York. 402 pp.). We know of no helminths reported from *A. bilineatus*. The purpose of this note is to establish the initial helminth list for *A. bilineatus*.

The coelomic cavities of two female *A. bilineatus* from Mexico (SVLs = 543, 563 mm) were examined from the herpetology collection of the Los Angeles County Natural History Museum (LACM): LACM 59184, Tamaulipas, 84 km N Mante (22.7500°N, 99.0000°W, datum WGS84; elev. 104 m) collected June 1965; and LACM 74046, Sinaloa, Coyotitán (23.7833°N, 106.5833°W, datum: WGS84; elev. 91 m) collected November 1964. Two nematodes (LACM 74046) and one larval acanthocephalan (LACM 59184) were found. Nematodes and the acanthocephalan were cleared in a drop of glycerol on a microscope slide, coverslipped, and identified: one female *Hastospiculum onchocercum*; one third stage ascaridid (Angusticaecinae) larva, and one oligacanthorhynchid acanthocephalan cystacanth. Helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as *Hastospiculum onchocercum* (USNPC 102284), ascaridid (Angusticaecinae) larva (USNPC 102285), and acanthocephalan cystacanth (USNPC 102286).

Hastospiculum onchocercum is limited to a variety of snakes from the New World tropics (Goldberg and Bursey 2004. Carib. J. Sci. 40:62–69). *Hastospiculum* is a member of the Diplotriaenoidea, which utilizes insects as intermediate hosts (Anderson 2000. Nematode Parasites of Vertebrates. Their Development and Transmission. CABI Publishing, Wallingford, UK. 650 pp.). Snakes presumably acquire *H. onchocercum* when they ingest prey which have eaten infected insects.

Three genera of ascaridid nematodes have been reported from snakes collected in Central America (Baker 1978. Synopsis of the Nematoda Parasitic in Amphibians and Reptiles. Memorial University of Newfoundland, Occas. Pap. Biol. 11:1–325). Third stage larvae of these three genera are morphologically indistinguishable. *Agkistrodon bilineatus* likely serves as a final host. Infection was most likely acquired by ingestion of an infected transport (paratenic) host, such as a grasshopper, frog, lizard, or rodent (Anderson, *op. cit.*).

Oligacanthorhynchid acanthocephalan cystacanths are frequently found in the coelomic cavities of snakes (Goldberg and Bursey, *op. cit.*). Snakes are inappropriate final hosts for cystacanths and likely serve as transport hosts. *Agkistrodon bilineatus* represents a new host record for *Hastospiculum onchocercum,* ascarid larva, and oligacanthorhynchid acanthocephalan cystacanths.

We thank Christine Thacker (LACM) for permission to examine *A. bilineatus*.

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COLUBER* (= *MASTICOPHIS*) *FLAGELLUM TESTACEUS (Western Coachwhip). **DIET**. *Coluber flagellum testaceus* feeds on lizards, small mammals, snakes, birds and their eggs, and large arthropods (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. 431 pp.; Werler and Dixon 2000. Texas Snakes. Univ. Texas Press, Austin. 437 pp.). It has also been reported that *C. f. testaceus* feed upon small lagomorphs including *Lepus californicus* and nestling *Sylvilagus* rabbits (Whiting et al. 1992. The Snake 24:157–160) Here, we report our observation of a *C. f. testaceus* feeding upon

FIG. 1. Adult *Coluber* (= *Masticophis*) *flagellum testaceus* on first attempt at feeding upon a juvenile *Sylvilagus audubonii* (Desert Cottontail) in Big Bend National Park, Texas, USA.

a juvenile *Sylvilagus audubonii* (Desert Cottontail).

Before noon on 29 April 2006, we discovered an adult *C. f. testaceus* apparently perched 1 m off the ground in the midsection of a mesquite bush (*Prosopis glandulosa*) near the Panther Junction Visitor Center in Big Bend National Park, Texas, USA (29.3281°N, 103.2064°W, datum WGS 84; elev. 1138 m). The snake was slightly moving its head near the branching point of one of the limbs. Upon closer investigation we noticed that it was consuming a juvenile *S. audubonii* (Fig. 1). The snake attempted to consume the rabbit, though the branch obstructed its success twice. Eventually, the snake turned its head to the other side of the branch and fully consumed the young rabbit. The observation lasted for more than 30 minutes before the snake finally crawled to the ground and slowly slithered away. This observation documents the first record of *C. f. testaceus* feeding upon *S. audubonii*.

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CONOPHIS LINEATUS (Road Guarder). **DIET**. *Conophis lineatus* is a rear-fanged, diurnal Central American colubrid with a varied diet. Though *C. lineatus* is likely an opportunistic predator, field observations and dissections of museum specimens are mostly of lizard prey (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna between Two Continents, between Two Seas. University of Chicago Press, Chicago, Illinois. 954 pp.; Stafford and Henderson 2006. S. Am. J. Herpetol. 1:210–217). On 21 June 2002, at ca. 1500 h, in Santa Rosa National Park, Guanacaste Province, Costa Rica (10.8392°N, 85.6184°W, datum NAD83), I observed an adult *C. lineatus* in an open lowland dry forest adjacent to a gravel road. The snake had struck a toad, *Bufo luetkenii*, and was grasping it in its mouth (Fig. 1). The snake kept the toad pinned to the ground for ca. 15 min and then began ingesting it head first. Ingestion took ca. 25 min, after which the snake crawled away into denser vegetation. I believe this observation represents the first time *C. lineatus* has been reported feeding on *B. luetkenii* and may represent the first record of *C. lineatus* feeding on any toad species in the wild. Photographic vouchers were verified by Twan Leenders and deposited at Yale Peabody Museum of Natural History, Herpetology media records YPM M 1211–1214.

FIG. 1. *Conophis lineatus* feeding on a toad, *Bufo luetkenii*, in Guanacaste National Park, Costa Rica.

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CROTALUS CATALINENSIS (Santa Catalina Island Rattlesnake). **REPRODUCTION.** *Crotalus catalinensis* is endemic to Isla Santa Catalina, Baja California Sur, Mexico. Although observations exist of wild female *C. catalinensis* in various reproductive states (Grismer 2002. Amphibians and Reptiles of Baja California, Including its Pacific Islands and the Islands in the Sea of Cortés. Univ. California Press, Berkeley. 399 pp.), reproductive data for *C. catalinensis* are limited. To date, the only published accounts of litter size for *C. catalinensis* include: a female collected in early August that produced two young (Grismer, *op cit*.); seven young born at Fresno Zoo on 8 July 1980 (Tremper 1981. *In* 5th Annual Reptile Symposium on Propagation and Husbandry, pp. 70–75. Oklahoma City Zoo, Oklahoma City); a single *C. catalinensis* born on 1 October 1964 at the San Diego Zoo (San Diego Zoonooz, November 1964); nine young born at the Frankfurt Zoo (Anonymous 1988. Aquarien-und Terrarien-Zeitschrift 41:328); seven young born to a captive female (G. Keasler, pers. comm. 2009); and three young born at the San Diego Zoo from a wild collected female (Boyer and Kinkaid, pers. comm. 2009). Herein, we describe a litter born to a wild collected *C. catalinensis* maintained in captivity at the Los Angeles Zoo and Botanical Gardens.

On 23 April 2009, we collected an adult (SVL = 71.12 cm; 272 g) gray phase female *C. catalinensis* on the southwest side of Isla Santa Catalina, 25.6023°N, 110.7791°W, WGS 84; elev. 0 m. This animal was transferred to Los Angeles Zoo and Botanical Garden and placed into the zoo's quarantine facility and maintained in a 20-gallon terrarium supplied with a 24-h sub-floor heated basking area and a hide box. Between 3 May and 10 June 2009 she consumed eight whole pre-killed adult mice. She refused to feed on 21 June and continued to refuse food until parturition. On 9 August a dorsal whole body radiograph was taken and showed several embryonic skeletons. On 13 August 2009, six neonates (one male, five female; mean mass 15.2 g; range 14.8–16.3 g), were found inside the hide box with the female. The litter consisted of three brown phase and three gray phase neonates.

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EPICRATES CENCHRIA (Salamanta; Rainbow Boa). **DIET**. Snakes in the genus *Epicrates* are dietary generalists, feeding on both endothermic and ectothermic prey, particularly lizards, mid-sized mammals, and birds (Henderson et al. 1987. Amphibia-Reptilia 8:251–258). The genus is endemic to the New World Neotropics and contains 14 species (Passos and Fernandes 2008. Herpetol. Monogr. 22:1–30). *Epicrates cenchria* occurs in forested regions of the Amazon Basin of Colombia, Ecuador, Peru, Bolivia, Venezuela, Guyana, Suriname, French Guyana, and Brazil and in a disjunct population in the Atlantic rainforest of Brazil, from Alagoas to Rio de Janeiro states (Passos and Fernandes, *op. cit*.). Until recently, *E. cenchria* was subdivided into nine subspecies (McDiarmid et al. 1999. Snakes Species of the World: A Taxonomic and Geographical Reference, Vol. 1. The Herpetologist's League, Washington, DC), but a taxonomic revision based on external morphology, osteology, and hemipenis characters rearranged this complex into five species that inhabit the South American continent: *E. alvarezi, E. assisi, E. cenchria, E. crassus*, and *E. maurus* (Passos and Fernandes, *op. cit*.). The remaining species in the genus are restricted to islands in the West Indies (Kluge, *op. cit*.; McDiarmid et al., *op. cit*.).

Several works have documented ontogenetic shifts in the diet of some species in this genus. Diet of larger species varies ontogenetically, from specializing on anoline lizards when young to widely generalist feeding as adults (e.g., Chandler and Tolson 1990. J. Herpetol. 24:151–157; Henderson et al., *op. cit*.; Sheplan and Schwartz 1974. Ann. Carnegie Mus. Nat. Hist. 45:57–143; Wiley 2003. Carib. J. Sci. 39:189–194). For the newly split *E. cenchria* complex, *E. assisi* from the Caatinga biome of Brazil eats mammals, bird eggs, and lizards. *Epicrates crassus* from the Brazilian Cerrado biome feeds on birds and mammals. *Epicrates cenchria* preys on mammals, mainly rodents, birds, bird eggs, bats, frogs, and lizards (see Pizzato et al. 2009. Amphibia-Reptilia 30:533–544, and references therein). There are no records on the diet of the other continental species. Herein, we record an additional and unusual prey item for the genus *Epicrates*.

On a morning in March 2001, JC collected a large (total length = 175 cm; tail length 20.8 cm) *E. cenchria* crossing a trail in a remnant of Atlantic rainforest (19.735914°S, 41.824673°W, datum WGS84; elev. ca. 455 m) at Reserva Particular do Patrimônio Natural Feliciano Miguel Abdala (RPPN-FMA), Caratinga municipality, Minas Gerais state, southeastern Brazil. Examination of the stomach contents of this specimen revealed an unusual food item, a quill of an unidentified porcupine (Erethizontidae: Rodentia: Mammalia). This represents a new diet record for the genus *Epicrates*. Predation on porcupines has been described for several other snakes, mostly in the family Boidae (Cherubini et al. 2003 J. Venom. Anim. Toxins 9:117–124; Duarte 2003 Phyllomedusa 2:109–112). The snake was deposited in the herpetological collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP 14474; J. Cassimiro field number JC 517).

We are grateful to Bárbara N. Costa for help in the identification of the prey item. Felipe F. Curcio verified snake identification. JC also thanks Karen B. Strier for providing facilities during fieldwork and for funding during his work in the RPPN-FMA through the following institutions: Margot Marsh Biodiversity Foundation, Liz Claiborne and Art Ortenberg Foundation, National Geographic Society, and Graduate School of the Wisconsin-Madison University.

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LEPTOTYPHLOPS AUSTRALIS (NCN). **PREDATION**. Burrowing Owls (*Athene cunicularia*) are known to include snakes and other reptiles in their diet (König et al. 1999. Owls: A Guide to the Owls of the World. Yale Univ. Press, New Haven, Connecticut. 462 pp.). On 25 October 2008, on Provincial Road 7, 20 km E Paso Cordova, Departamento El Cuy, Rio Negro Province, Argentina (39.1818ºS, 67.4053ºW, datum WGS84; elev. 405 m), a set of regurgitated *A. cunicularia* pellets was collected near an active owl burrow. Laboratory study revealed remains of four snakes in the pellets, all identified as *Leptotyphlops*. The damage inflicted to the heads of the specimens made identification to species level difficult, but the coloration, morphometrics, and scale patterns of the individuals were consistent with *L. australis* (Cei 1986. Reptiles del Centro, Centro-Oeste y Sur de la Argentina. Mus. Reg. Sci. Nat. Torino, Mon. 4. 527 pp.). This represents the first record of predation on *L. australis* by Burrowing Owls.

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MICRURUS FULVIUS (Harlequin Coralsnake). **DIET**. *Micrurus fulvius* is known to prey upon amphisbaenids, anguids, scincids, elapids, and colubrids (Jackson and Franz 1981. Herpetologica 37:221–224), however it has not been documented preying upon nonindigenous species. Herein, we document *M. fulvius* preying upon a *Ramphotyphlops braminus* (Brahminy Blindsnake).

On 1 September 2009, a *M. fulvius* (female; SVL = 38.7 cm) was found dead-on-road (DOR) at the Pine Island maintenance area in Everglades National Park, Miami-Dade Co., Florida, USA (25.384178°N, 80.594128°W, datum WGS84; elev. <1 m), and was deposited in the Florida Museum of Natural History, University of Florida (UF 156838, EVER 40584). Upon taking a tissue sample from an opening likely caused by vehicle impact, we noticed a foreign body protruding from the snake's abdomen.

This object was removed and identified as a nonindigenous *R. braminus*. In Florida, Wilson and Porras (1983. Univ. Kansas Mus. Nat. Hist., Spec. Publ. No. 9) first reported *R. braminus* from Miami-Dade Co., and this species has been reported to be preyed upon by *Lampropeltis extenuata* (Short-tailed Snake; Godley et al 2008. Herpetol. Rev. 39:473–474) and both the nonindigenous *Rhinella marina* (Cane Toad) and *Anolis cristatellus* (Puerto Rican Crested Anole; Meshaka et al. 2004. The Exotic Amphibians and Reptiles of Florida. Krieger Publ. Co., Malabar, Florida. 155 pp.). This is the first record of *M. fulvius* consuming a nonindigenous snake in Florida.

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OPISTHOTROPIS KUATUNENSIS (Chinese Mountain Keelback). **ENDOPARASITES.** *Opisthotropis kuatunensis* occurs in Zhejiang, Fujian, Jiangxi, and Hong Kong, China (Zhao and Adler 1993. Herpetology of China. SSAR, Oxford, Ohio. 522 pp.). It was first reported in Hong Kong in 1974 (Karsen et al. 1986. Hong Kong Amphibians and Reptiles. The Urban Council, Hong Kong. 136 pp.). To our knowledge, there are no reports of helminths from *O. kuatunensis*. The purpose of this note is to establish an initial helminth list for *O. kuatunensis*.

One female *O. kuatunensis* (SVL = 30.5 cm) was collected at New Territories, Hong Kong (22.24°N, 114.07°E, datum WGS 84; elev. 644 m) on 23 September 2009. The snake died the next day and was preserved in 70% ethanol. Sixteen swellings (5–10 mm) were noted along the length of the *O. kuatunensis*. Four of these were opened and each contained a yellowish, elongate parasite. Each was cleared in a drop of glycerol on a slide, cover slipped, studied under a compound microscope, and identified as nymphs of the pentastome *Kiricephalus pattoni*. Voucher helminths were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland, USA as USNPC (102414).

Adult *K. pattoni* inhabit the lungs of various snakes, and nymphs have been reported in a wide variety of amphibians and reptiles (Riley and Self 1980. Syst. Parasitol. 1:127–140). John and Nadakal (1988. Invert. Repro. Devel. 14:295–298) proposed a probable three-host life cycle for *K. pattoni*, amphibian/lizard first intermediate host, snake second intermediate host, and snake definitive host. *Opisthotropis kuatunensis* represents a new host record, a probable second intermediate host, for *Kiricephalus pattoni*.

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PANTHEROPHIS OBSOLETUS (Texas Ratsnake). **DIET AND FEEDING BEHAVIOR**. *Pantherophis obsoletus* is a common colubrid that feeds extensively on birds and mammals in the wild (Weatherhead et al. 2003. Am. Midl. Nat. 150:275–281) and will feed on dead rodents in captivity (MLM, pers. obs). However, observations of this species feeding on non-living anthropogenic sources of food are lacking. Each evening from mid-March through 25 April 2004, a single *P. obsoletus* (37 cm total length) returned to the back porch of the home at 2347 Pamela Dr., Chandler, Smith Co., Texas, USA (32.217°N, 95.506°W; NAD 1983), where it ate canned dog food from the dog's bowl and then departed. This observation adds to our understanding of the opportunistic nature of this species.

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SISTRURUS CATENATUS (Massasauga). **FEMALE SPERM EVACUATION**. During mating, a single male transfers more sperm than necessary to fertilize the available ova of a female (Halliday and Arnold 1987. Anim. Behav. 35:939–941). This, coupled with the fact that females typically mate with several males during a single mating period (Uller and Olsson 2008. Mol. Ecol. 17:2566–2580), results in an abundance of sperm in the female reproductive tract. In many taxa, including reptiles, females often store this sperm for long periods (months to years) in specialized receptacles, sperm storage tubules (SST), in the infundibulum prior to fertilization (Sever and Hamlett 2002. J. Exp. Zool. 292:187–199). However, the fate of unsuccessful sperm within the female reproductive tract remains largely unknown. A detailed description of sperm evacuation from SSTs is restricted to one study on *Thamnophis sirtalis parietalis* (Halpert et al. 1982. J. Morphol. 174:149–159) in which the authors noted that sperm in infundibular SSTs from fall matings were evacuated within six hours after a spring mating. Halpert et al. (*op. cit.*) state that sperm from the spring matings replaced the sperm from fall matings within the SSTs. The fate of the evacuated fall sperm was undetermined, though the authors noted that fall sperm stained less intensely with fast green; a phenomenon they believed indicative of sperm degradation. Blanchard and Blanchard (1941. Pap. Michigan Acad. Sci., Arts Lett. 26:177–193) and Schuett and Gillingham (1986. Copeia 1986:807–811) however, observed that sperm from fall matings can be used in fertilization the following spring in *T. s. sirtalis* and *Agkistrodon contortrix*, respectively.

Siegel and Sever (2008. J. Morphol. 269:189–206) provide the only detailed description of sperm transport and storage in a viper, *Agkistrodon piscivorus*, during the fall and subsequent spring mating periods. Siegel and Sever (*op. cit.*) found that sperm remained in *A. piscivorus* SSTs for up to 22 months following ovulation until the subsequent reproductive year at which time they were no longer observed. They hypothesized the mechanism for this disappearance to be either from spermiophagy by the SST epithelium or by the natural degradation of sperm; however, neither of these processes were observed. Additionally, Siegel and Sever (*op. cit.*) failed to observe the evacuation of sperm from SSTs following the spring mating season as described by Halpert et al. (*op. cit.*). The following account adds to the scant literature above by providing an incident of sperm evacuation in a female *Sistrurus catenatus*.

As part of a long-term study focusing on the conservation of *S. catenatus* in Butler Co., Pennsylvania, USA, free-ranging individuals were implanted with radio transmitters and monitored for a suite of ecological, behavioral (including mating activities), and physiological variables three times weekly. One female was initially encountered in May 2005 at which time an ultrasound revealed the presence of enlarged vitellogenic follicles indicating that she would likely give birth later in the year (birthed 19 August 2005). A fecal sample collected on 11 July 2005 to assess her general health and parasite load revealed something striking: numerous sperm (Fig. 1). Though isolated incidents of spring reproductive behavior have been reported in *S. catenatus* (Wright 1941. Am. Midl. Nat. 25:659–672; Jellen et al. 2007. J. Herpetol. 41:451–457), mating predominately occurs in the late summer–early fall period (Jellen et al., *op. cit.*; Johnson 2000. J. Herpetol. 34:186–192; Reinert 1981. Am. Midl. Nat. 105:393–395). If this sperm represents sperm from a recent mating, it would pre-date the earliest recorded date of summer reproductive behavior in *S. catenatus* by approximately two weeks (24 July; Jellen et al., *op. cit.*). Additionally, though male *S. catenatus* have been observed to engage in reproductive behaviors with pregnant females (Jellen et al., *op. cit.*), this female was never observed in the vicinity of a male nor exhibited any mating behaviors throughout the course of the year. However, because this individual was free-ranging, and consequently not under constant surveillance, an unobserved copulation during the active season prior to 11 July 2005 cannot be ruled out. A more plausible explanation, however, is that this observation represents the systematic oviductal evacuation of sperm from matings during (or prior to) the 2004 late summer–early fall mating period, which were unsuccessful in fertilizing ova in the spring of 2005.

Siegel and Sever (*op. cit.*) report that sperm degrade in the posterior oviduct prior to ovulation in vipers and describe the only storage site for sperm during pregnancy as within SSTs. Although a definitive mechanism for sperm evacuation was not observed in *A. piscivorus*, densities of sperm decreased in the SST over time until the subsequent mating season (Siegel and Sever, unpubl. data). A similar decrease in the presence of oviductal sperm following oviposition was observed in *Tantilla coronata* (Aldridge 1992. Amphibia-Reptilia 13:219–225). We propose that after ovulation, sperm are intermittently evacuated from SSTs. This process undoubtedly takes an extended period of time due to the lack of contractile elements associated with SSTs in snakes (for review see Siegel and Sever, *op. cit.*), and culminates with the eventual collection of sperm in the cloaca (a structure previously ignored in histological studies on sperm transport in snakes). Normal defecation then provides a proximate outlet for unsuccessful sperm in the female reproductive tract. We suggest that further histological and behavioral studies on sperm transport, storage, and evacuation are needed to confirm this phenomenon.

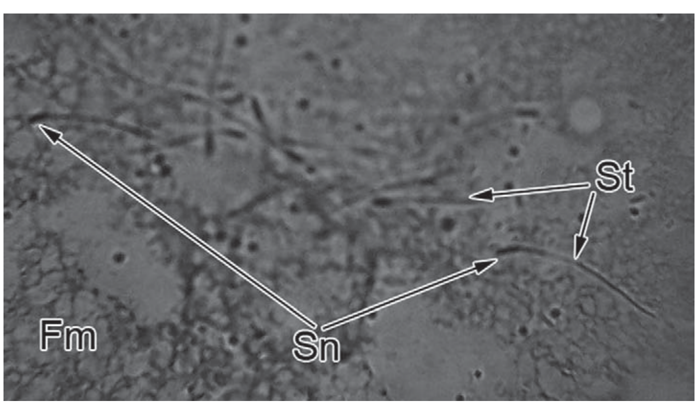

FIG. 1. Sperm in a pregnant female *Sistrurus catenatus* fecal sample collected 11 July 2005. Sn, sperm nucleus; St, sperm tail; Fm, fecal material.

We thank M. Kowalski, B. Levine, the Pittsburgh Zoo, Game Commission, and Department of Conservation of Natural Resources.

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THAMNOPHIS ATRATUS HYDROPHILUS (Oregon Gartersnake). **MAXIMUM ELEVATION**. *Thamnophis atratus* has been recorded at elevations up to 1920 m (6297 ft; St. John 2002. Reptiles of the Northwest. Lone Pine Publishing, Renton, Washington. 272 pp.). Here we report a population of *T. a. hydrophilus*, occurring entirely above this reported elevational limit in the Klamath Mountains, California, USA. Our observations occurred in upper Deep Creek Basin, Trinity Alps Wilderness, Trinity Co., California, USA (40.9176°N, 122.8876°W, datum NAD83). Deep Creek Basin is a medium-sized glacial characterized cirque (342 ha) encompassed by steep jagged peaks reaching elevations up to 2497 m, which are among the highest in the Klamath Mountains.

We captured and individually marked 56 individual *T. a. hydrophilus* of various age classes during 2003–2006. We recaptured many of these individuals, with total captures reaching 127 over the four years of the study. All snakes were found in streams, ponds, and Echo Lake, at elevations ranging from 1960 to 2215 m. These observations expand the known vertical limit of *T. atratus* by 295 m (968 ft). Much of the Klamath Mountains including the Trinity Alps, Russian, Marble Mountain, and Siskiyou Wilderness areas contain similar aquatic habitats that exceed the known previous elevational limit for this species.

In lower elevation streams, native salmonid fishes are an important component of *T. a. hydrophilus* diet (Welsh and Lind 2000. J. Herpetol. 34:67–74). Over the last century, nonnative salmonids have been introduced into most of the naturally fishless high-elevation aquatic habitats in the Klamath Mountains (Welsh et al. 2006. Divers. Distrib. 12:298–309). Introduced salmonid prey in the region may have allowed *T. a. hydrophilus* to expand into these high-elevation habitats (Pope et al. 2008 Biol. Conserv. 141:1321–1331).

We are grateful for the expert field assistance of R. Bourque, C. Wheeler, and M. Larson. This research was supported by the US Forest Service and through grants from California Department of Fish and Game, the National Fish and Wildlife Foundation, and the Declining Amphibian Populations Task Force.

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THAMNOPHIS PROXIMUS (Western Ribbon snake). **REPRODUCTION**. On 16 May 2008, we collected a DOR *Thamnophis proximus* 1.61 km N of the intersection of FM508 and FM1420 on FM1420, Cameron Co., Texas, USA (26.27957°N, 97.58657°W, datum NAD83). The snake was a gravid female (SVL = 786 mm; total length = 1059 mm) and appeared to have been killed less than 12 h previously. Removal of offspring revealed a fetal clutch size of 27. Offspring appeared well developed and just days away from parturition. The litter consisted of eleven males (mean ± SD SVL = 194.9 ± 4.2 mm, range = 188–201 mm) and sixteen females (mean ± SD SVL = 189.4 ± 5.63 mm, range = 179–199 mm). Female volume before removal of offspring was 200 mL and total offspring volume was 75 mL.

The clutch is remarkable for its large numerical size and large fetal clutch volume as well as the potential early parturition date. The earliest published date for *T. proximus* parturition is 23 June (Lancaster and Ford 2003. Texas J. Sci. 55:25–32). A fetal clutch size of 27 is reported as the maximum clutch size (Klein 1949. Herpetologica 5:17). Average clutch size is 10–15 (Werler and Dixon 2000. Texas Snakes: Identification, Distribution, and Natural History. Univ. Texas Press, Austin. 437 pp.). Although the preparturitient state of this litter precluded accurate assessment of relative clutch mass, the relative clutch volume (calculated as volume of offspring divided by volume of female without offspring; Shine 1980. Oecologica 46:92–100) for this female was 0.6. Female and offspring were deposited at the Texas Cooperative Wildlife Collection at Texas A&M University (TCWC 93027–93054). Identification was verified by Toby Hibbits.

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GEOGRAPHIC DISTRIBUTION

Instructions for contributors to Geographic Distribution appear in Volume 41, Number 1 (March 2010, p. 102). Please note that the responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extension reports unless a thorough literature review has been completed.

CAUDATA — SALAMANDERS

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: ARKANSAS: Nevada Co.: Hwy 24, 0.9 km E of junction with Hwy 268 (33.75412°N, 93.14896°W; no datum available). 2 April 2010. Tobin Fulmer. Verified by Renn Tumlison. Henderson State University Museum of Zoology, Arkadelphia, Arkansas (HSU 1478). New county record. One adult was collected AOR during rain. Fills a distributional gap between Columbia and Clark counties (Caldwell and Tumlison 2005. Herpetol. Rev. 36:88; Trauth et. al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.).

Submitted by **TOBIN FULMER**, Arkansas Natural Heritage Commission, 1500 Tower Building, 323 Center Street, Little Rock, Arkansas 72201, USA (e-mail: frogman1975@yahoo.com); and **KASIDY FULMER**, 28 South Barrow Road, Arkadelphia, Arkansas 71923, USA.

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: NORTH CAROLINA: Transylvania Co.: terrestrial adult caught by hand and gilled larvae caught by net in breeding pool at DuPont State Forest, 9.35 km airline SSE Penrose (35.19090ºN, 82.61878ºW; WGS 84). 21 April 2010 and 20 May 2010. Alan Cameron and Steven O'Neil. Verified by Jeffrey C. Beane. North Carolina State Museum of Natural Sciences photo voucher (accession #12559). First documented record for Transylvania Co. Closest previous historical record is one occurrence from Lake Summit in Henderson Co., North Carolina, 18.13 km airline ENE (Beane et al. 2010. Amphibians & Reptiles of the Carolinas and Virginia, 2nd ed. University of North Carolina Press, Chapel Hill. 274 pp.)

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AMPHIUMA MEANS (Two-toed Amphiuma). USA: GEORGIA: Baldwin Co.: Bartram State Forest, ca. 0.63 km SW of the intersection between SR 112 and Carl Vinson Road SE, (33.016978°N, 83.207808°W; WGS84) 20 August 2010. Houston C. Chandler. Florida Museum of Natural History photo voucher (UF 159215).Verified by Dennis Parmley and John B. Jensen. First county record. Found on the piedmont at the northern edge of expected range (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens. 575 pp.) and the northernmost county record in the Oconee River drainage.

Single juvenile captured and photographed at the shallow edge of a large pond.

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AMPHIUMA TRIDACTYLUM (Three-toed Amphiuma). USA: ARKANSAS: Calhoun Co.: ~6 km N of Ouachita River off US 167 (33.388195°N, 92.496846°W; WGS 84). 11 June 2010. M. B. Connior. Verified by S. E. Trauth. Arkansas State University Museum of Zoology Herpetology Collection (ASUMZ 31557). New county record (Trauth et. al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.). Juvenile was hand captured under a log in a small slough. This species has also been collected from Union Co. in southern Arkansas (Trauth et al. 2004, *op. cit.)*

Submitted by **MATTHEW B. CONNIOR**, Health and Natural Sciences, South Arkansas Community College, 300 S. West Avenue, El Dorado, Arkansas 71730, USA; e-mail: mconnior@southark.edu.

CRYPTOBRANCHUS ALLEGANIENSIS (Eastern Hellbender). USA: TENNESSEE: Grundy Co.: Collins River, specific local withheld. 6 August 2010. J. M. Butler, S. D. Layne, and K. J. F. Dunn. Verified by K. L. Krysko. UF 159136 photo voucher. New county record which fills gap between Warren and Marion counties (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Austin Peay State University, Clarksville, Tennessee). Specimen observed beneath large rock in shallow river run.

Submitted by **J. MICHAEL BUTLER** (e-mail: scutatum@gmail.com), **SHANE D. LAYNE** and **K. J. F. DUNN**, U.S. Forest Service, London, Kentucky 40744, USA**.**

EURYCEA GUTTOLINEATA (Three-lined Salamander). USA: GEORGIA: Murray Co.: jct. of Carters Rd. and Old U.S. Hwy 411, ca. 19 air km SSE Chatsworth (34.60750°N, 84.69378°W; NAD83). 22 May 2010. Christopher E. Skelton. Verified by John B. Jensen and Kenneth Krysko (UF 157837). First county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens. 575 pp.). Single adult collected in a flooded wheel rut within a mowed field, on NW side of Old US 441. This area was probably an active part of the floodplain of the Coosawattee River which is less than 400 m SSE of the field. The river is highly regulated now (rarely floods) but the water table is very near the ground surface and the presence of numerous crayfish burrows suggests it is wet for much of the year.

Submitted by **CHRISTOPHER E. SKELTON** (e-mail: chris.skelton@gcsu.edu); and **HOUSTON C. CHANDLER**, Department of Biological and Environmental Sciences, Georgia College & State University, Milledgeville, Georgia 31061,USA.

EURYCEA QUADRIDIGITATA (Coastal Plain Dwarf Salamander). USA: ARKANSAS: Grant Co.: 3.2 km S of Grapevine off St. Hwy 35 (34.112373°N, 92.309875°W; WGS 84). 27 April 1991. H. W. Robison. Henderson State University Herpetological Collection (HSU 1553). Verified by R. Tumlison. New county record; partially fills a hiatus among Dallas, Hot Spring, and Saline counties (Trauth et al. 2004. Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.). This is the first new county record for *E. quadridigitata* in the state since Trauth et al. (*op. cit*.); the species is now known from 18 counties of south Arkansas.

Submitted by **CHRIS T. McALLISTER**, Science and Mathematics Division, Eastern Oklahoma State College, 2805 NE Lincoln Road, Idabel, Oklahoma 74745, USA (e-mail: cmcallister@se.edu); and **HENRY W. ROBISON**, Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, USA (e-mail: hwrobison@yahoo.com).

NOTOPHTHALMUS VIRIDESCENS LOUISIANENSIS (Central Newt). USA: ARKANSAS: Cleburne Co.: 2.4 km SW of Quitman, roadside ditch (35.361336°N, 92.231255°W; WGS 84). 12 May 2003. B. Deeds. Henderson State University Herpetological Collection (HSU 1555). Verified by R. Tumlison. New county record. Fills a distributional gap among Independence, Van Buren, and White counties (Trauth et al. 2004. Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.). Since the publication of Trauth et al. (*op. cit*.), no less than nine new county records have been documented for this species in the state.

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OEDIPINA TAYLORI (Taylor's Worm Salamander). GUATEMALA: ZACAPA: Municipality of Cabañas: El Arenal, vicinity of Zootropic Reserve for protection of *Heloderma horridum charlesbogerti* (14.8628°N, 89.7974°W, NAD27; elev. 612 m). 18 October 2008. Michael Dix and Gilberto Salazar. Verified by Sean Rovito and Theodore Papenfuss. Museo de Historia Natural de la Universidad de San Carlos de Guatemala (CRVA 1719) and Colecciones de Referencia de la Universidad del Valle de Guatemala (A1778). First record for Cabañas, extending the range ca. 70 km SW from the nearest locality in the Motagua Valley at Doña María, Gualán, Zacapa, and 112 km NE of the type locality at Finca La Trinidad, Jutiapa (Frost 2010. Amphibian Species of the World: an Online Reference. Version 5.4 [8 April 2010]. Electronic database accessible at http://research.amnh.org/vz/herpetology/amphibia/, American Mus. Nat. Hist., New York). The salamanders were found at 1000 h on a rainy morning under rotting logs within tropical dry forest dominated by Zacapan False Oak Trees (*Bucida macrostachya*) and the columnar cactus, *Stenocereus pruinosus*.

Submitted by **DANIEL ARIANO** (e-mail: darianosanchez@gmail.com) and **MICHAEL DIX**, Universidad del Valle de Guatemala, 18 avenida 11-95 zona 15. V.H. III, Guatemala City, Guatemala (e-mail: michaelwdix@gmail.com).

SIREN INTERMEDIA NETTINGI (= *SIREN INTERMEDIA TEXANA*) (Western Lesser Siren; Rio Grande Lesser Siren). USA: TEXAS: McMullen Co.: Escondido Ranch, Pond No. 11 (28.0950°N, 098.7543°W). 19 March 2010. C. Giggleman, P.

Clements, A. Miller, J. Ingold, R. Hooten, and N. Mitton. Verified by Michael R. J. Forstner. TCWC 94269. New county record (Dixon 2000. Amphibians and Reptiles of Texas, 2nd ed. Texas A&M University Press, College Station, Texas. 421 pp.). Eleven specimens were seined at ca. 1 m depth from a seasonal lentic system surrounded by brush-dominated vegetation.

Submitted by **AMBER MILLER**, U.S. Fish and Wildlife Service, Corpus Christi Ecological Services Office, 6300 Ocean Drive, Classroom West, Corpus Christi, Texas 78412-5837, USA.

ANURA — FROGS

ANAXYRUS AMERICANUS (American Toad). USA: TENNESSEE: Warren Co.: Tennessee Amphibian Monitoring Program (TAMP) Route 820515, Stop 4, Lawson Mill Road, 1.22 km NW of intersection with Hwy 127 (35.629081°N, 85.803814°W; WGS 84). 12 March 2010. Amy Tolley. Verified by A. Floyd Scott. Austin Peay State University Museum of Zoology (APSU 19013 audio). New county record (Redmond and Scott 1996. Austin Peay St. Univ. Center Field Biol. Misc. Publ. 12:1–94). Individual heard calling from a field with pond on residential land.

Submitted by **AMY TOLLEY**, 446 NYU Place, Murfreesboro, Tennessee 37128, USA.

ANAXYRUS DEBILIS (Green Toad). USA: NEW MEXICO: Curry Co.: Melrose, 0.11 km S of US Hwy 60/84 and 0.24 km W of State Route 267 (34.42276°N, 103.61801°W; NAD83/WGS84; elev. 1342 m). 13 August 2008. Ian W. Murray. Verified by J. Tomasz Giermakowski. University of New Mexico Museum of Southwestern Biology (MSB 75398, 75399). New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. 431 pp.). At ca. 2300 h during intermittent showers, thunder, and lightning, a large pool had formed, centered on a low portion of a dirt road immediately south of the railroad tracks. At least 15 male *A. debilis* and a lone *Scaphiopus couchii* were heard calling, and one amplectant pair of *A. debilis* was seen. Two males were collected.

Submitted by **IAN W. MURRAY**, MSC03 2020, Department of Biology, 1 University of New Mexico, Albuquerque, New Mexico 87131-0001, USA (e-mail: imurray@unm.edu); and **PETER E. HUMPHREY**, Harvard Medical School, Brigham & Women's Hospital Boston, Massachusetts 02115-6110, USA (e-mail: phumphrey@partners.org).

BRACHYCEPHALUS HERMOGENESI. BRAZIL: PARANÁ: Municipality of Guaraqueçaba: Reserva Natural Salto Morato (25.1666ºS, 48.2892ºW, WGS84; elev. 250–300 m). 26–29 November 2009. F. B. Oliveira and M. S. Pereira. Museu Nacional, Rio de Janeiro (MNRJ 67312–13). 27 April 2010. A. Candaten. MNRJ 67314. All verified by J. P. Pombal, Jr. This species was previously known to occur in Atlantic Rainforest areas from extreme southern Rio de Janeiro State (municipality of Parati) to southern São Paulo State (Verdade et al. 2008. J. Herpetol. 42:542–549). This note provides the first record for the state of Paraná and the southernmost for the species, extending its distribution ca. 120 km S of Ribeirão Grande and 130 km SW of the Estação Ecológica de Juréia-Itatins, the two previous southernmost confirmed records, both in the state of São Paulo (Verdade et al., *op. cit*.). Verdade et al. (*op. cit*.) also mentioned one specimen possibly referable to *B. hermogenesi* from Ilha do Cardoso, in extreme southern São Paulo State, but could not confirm the species identity because the specimen was "young and in poor condition," and thus refrained from extending the species' distribution further south. As Ilha do Cardoso lies only ca. 30 km east of the locality reported in the present note, and at about the same latitude, we consider it highly probable that the aforementioned specimen indeed represented *B. hermogenesi*.

Submitted by **MANUELA DOS SANTOS PEREIRA**, **ADRIANE CANDATEN**, **DOUGLAS MILANI**, **FREDERICO BATISTELLA DE OLIVEIRA**, **JOANA GARDELIN** and **CARLOS FREDERICO DUARTE ROCHA,** Departamento de Ecologia, Universidade do Estado do Rio de Janeiro, Rua São Francisco Xavier 524, Maracanã, 20550-011, Rio de Janeiro, RJ, Brazil; and **DAVOR VRCIBRADIC**, Departamento de Zoologia, Universidade Federal do Estado do Rio de Janeiro. Av. Pasteur 458, Urca, 22240-290, Rio de Janeiro, RJ, Brazil.

CHIROMANTIS SIMUS (Annandale's Pigmy Tree Frog). BANGLDESH: MYMENSINGH DIVISION: Tangail District: Madhupur National Park (24.6886°N, 90.1489°E, elev. 135 m). 22 June 2010. M. K. Hasan, M. Kamal Hossain, M. M. Kabir, and Fahim Hassan. Wildlife Museum, Department of Zoology, Jahangirnagar University, Savar, Dhaka, Bangladesh (JUHG 0325). Photograph voucher, Raffles Museum of Biodiversity Research, National University of Singapore (ZRC [IMG] 1.32a–1.32b). Verified by Indraneil Das. First record for Mymensingh Division, and westernmost record for Bangladesh. Other Bangladesh populations are recorded from Chittagong Hill Tracts (ca. 320 km to SE) (Asmat et al. 2003. Univ. J. Zool., Rajshahi, Bangladesh 22:141–143), and Sylhet Division (ca. 200 km to NE) (Kabir et al. 2009. Encyclopedia of Flora and Fauna of Bangladesh. Vol. 25. Amphibians and Reptiles. Asiatic Society of Bangladesh, Dhaka. 204 pp.) with no locality details, specimen number, or voucher photographs. Nearest records are from Assam (ca. 500 km to E), Mizoram (ca. 600 km to SE), and West Bengal (ca. 500 km to NW), all in India (Ahmed et. al. 2009. Amphibians and Reptiles of Northeast India. A Photographic Guide. Aaranyak, Guwahati. 168 pp.) Males observed calling between 1955–2040 h from bushes at ca. 1.7 m height, over harvested paddy field with stagnant rainwater at edge of mature *Shorea robusta* forest. Bangladesh Forest Department issued permits (CCF [Wildlife] 2M-37 [Part-3] / 2010/ 409) for this work.

Submitted by **MD. KAMRUL HASAN** (e-mail: hasan_wildlifeju@yahoo.com); **MD. KAMAL HOSSAIN** (e-mail: kamal_zool@yahoo.com); **MD. MOFIZUL KABIR** (e-mail: mofizulkabir@yahoo.com), Department of Zoology, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh; and **FAHIM HASSAN**, Department of Economics, University of Alberta (e-mail: fahim_hassan169@yahoo.com).

CRAUGASTOR TABASARAE (Tabasara Rainfrog). PANAMÁ: VERAGUAS: Distrito de Santa Fe: Parque Nacional Santa Fe, El Cinco (08.641664ºN, 81.022368ºW; NAD27), 1200 m elev. 05 October 2008. Daniel Medina. Verified by Jay M. Savage. Museo de Vertebrados de la Universidad de Panamá (MVUP 2261). First record for Veraguas. Extending the range in Panamá ca. 48 km (airline) W of the nearest locality in the Pintada district of Coclé Province (Savage et al. 2004. Herpetologica 60:519–529). *Craugastor tabasarae* is endemic to Panamá and was previously known only from three localities. The frog was found 2 m above the ground on a leaf in submontane tropical forest. To view a photograph of the live frog visit the Smithsonian Tropical Research Institute - Digital File Manager at http://biogeodb.stri.si.edu/bioinformatics/dfm.

Submitted by **DANIEL MEDINA** (e-mail: daniel_medina1984@hotmail.com), **CÉSAR A. JARAMILLO A.,** and **ROBERTO IBÁÑEZ D.,** Smithsonian Tropical Research Institute, Apartado 0843-03092, Balboa, Ancón Panamá, República de Panamá.

HYLA EUPHORBIACEA (Southern Highland Treefrog). MÉXICO: HIDALGO: Municipality of Acaxochitlán: Lindero de San Mateo (20.1008°N, 98.1443°W; WGS84), elev. 2400 m. 24 January 2009. Raciel Cruz Elizalde, Uriel Hernández Salinas, and Gustavo Rivas Granados. Verified by Adrian Leyte Manrique. Colección de Anfibios y Reptiles del Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB 2788). First record for Hidalgo and a range extension of ca. 62 km N of the closest known record in Tlaxcala (Fernández et al. 2006. Acta Zool. Mexicana [n.s.] 22:159–162). Adjacent records for this species are from the Sierra Madre Oriental of central Veracruz and Puebla (Duellman 2001. The Hylid Frogs of Middle America, Vol 2. Contributions to Herpetology, SSAR 18:i–x + 695–1159).

We acknowledge the support of Diversidad Biológica del Estado de Hidalgo, FOMIX-CONACYT- HIDALGO 43761, 95828, and S52552-Q.

Submitted by **RACIEL CRUZ ELIZALDE** (e-mail: cruzelizalde@gmail.com), **URIEL HERNÁNDEZ SALINAS** (e-mail: uhernndez3@gmail.com), and **AURELIO RAMÍREZ BAUTISTA,** Centro de Investigaciones Biológicas (CIB), Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, C.P. 42001, Pachuca, Hidalgo, México (e-mail: aurelior@edu.uaeh.mx).

HYLA GRATIOSA (Barking Treefrog). USA: FLORIDA: De Soto Co.: State Road 72, 2.0 miles W Arcadia (27.225°N, 81.8894°W, WGS84), elev. 4.9 m. 15 September 1968. Richard M. Blaney. Verified by Paul E. Moler. Florida Museum of Natural History (UF 158879). New county record (Ashton and Ashton 1988. Handbook of Reptiles and Amphibians of Florida. Part III. The Amphibians. Windward Publ., Inc., Miami, Florida. 191 pp.).

Submitted by **SARAH REINTJES-TOLEN** and **KENNETH L. KRYSKO**, Division of Herpetology, Florida Museum of Natural History, Dickinson Hall, University of Florida, Gainesville, Florida 32611, USA.

HYPSIBOAS CAINGUA (Striped Treefrog). BRAZIL: MATO GROSSO DO SUL: Municipality of Naviraí: 54.07678ºS, 22.94482ºW (SAD69). 19 July 2007. C. Aoki and P. Landgref-Filho. Museu Nacional do Rio de Janeiro, Rio de Janeiro, Brazil (MNRJ 67516) and Coleção Zoológica de Referência da Universidade Federal de Mato Grosso do Sul, Mato Grosso do Sul, Brazil (ZUFMS-AMP 1189). Municipality of Tacuru (55.12371ºS, 23.52010ºW). 05 May 2010. C. Aoki (MNRJ 67515). All verified by J. P. Pombal Jr. and C. A. G. Cruz. First state record and the northernmost occurrence, about 450 km W from the previous record in São Paulo and more than 250 km NNE from records in Paraguay and Argentina. The distribution of *H. caingua* encompasses Misiones (type locality) and adjacent Corrientes provinces in northeastern Argentina (Carrizo 1990. Cuad. Herpetol. 5:32–39) and in adjacent southeastern Paraguay (Brusquetti and Lavilla 2006. Cuad. Herpetol. 20:3–79) as well as isolated populations in São Paulo (Brassaloti et al. 2010. Biota Neotrop. 10[1]: 275–292; Condez et al. 2009. Biota Neotrop. 9[1]: 157–185; Melo et al. 2007. Biota Neotrop. 7[2]:93–102) and Rio Grande do Sul states, Brazil (Kwet 2001. Frösche im Brasilianischen Araukarienwald. Anurengemeinschaft des Araukarienwaldes von Rio Grande do Sul: Diversität, Reproduktion und Ressourcenaufteilung. Münster. Natur und Tier-Verlag. 192 pp.).

Submitted by **CAMILA AOKI**, Programa de Pós Graduação em Ecologia e Conservação, Universidade Federal de Mato Grosso do Sul, Cidade Universitária, s/n, Bairro Universitário, CEP 79070-900, Campo Grande, MS, Brazil (e-mail: aokicamila@yahoo.com.br); **PAULO LANDGREF FILHO** and **DAIENE L. HOKAMA SOUSA**, Centro de Ciências Biológicas e da Saúde, Universidade Federal de Mato Grosso do Sul, Laboratório de Zoologia, CEP 79070-900, Campo Grande, MS, Brazil; **FABRÍCIO HIROIUKI ODA**, Programa de Pós-Graduação em Ecologia de Ambientes Aquáticos Continentais, Universidade Estadual de Maringá, Nupélia - Núcleo de Pesquisas em Limnologia, Ictiologia e Aqüicultura, Laboratório de Ictioparasitologia - Bloco G-90, Av. Colombo, 5790, CEP 87020-900. Maringá, PR, Brazil; **ROBERTO MACEDO GAMARRA**, Programa de Pós Graduação em Ecologia e Conservação, Universidade Federal de Mato Grosso do Sul, Cidade Universitária, s/n, Bairro Universitário, CEP 79070-900, Campo Grande, MS, Brazil; and **FRANCO LEANDRO DE SOUZA**, Departamento de Biologia, Centro de Ciências Biológicas e da Saúde, Universidade Federal de Mato Grosso do Sul, CEP 79070-900 Campo Grande, MS, Brazil.

LITHOBATES CATESBIANUS (Bullfrog). USA: ARKANSAS: Jefferson Co.: 0.8 km N of Pinebergen off US 63 at Sandy Bayou (34.109371°N, 91.993198°W; WGS 84). 30 June 2010. H. W. Robison. Verified by R. Tumlison. Henderson State University Herpetological Collection (HSU 1538). New county record. Fills a distributional gap between Arkansas and Grant counties (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.). This frog has now been reported from 74 of 75 Arkansas counties, leaving only Perry Co. remaining undocumented (Connior 2008. Herpetol. Rev. 39:234; Trauth et al. 2004, *op. cit*.).

Submitted by **CHRIS T. McALLISTER**, Science and Mathematics Division, Eastern Oklahoma State College, 2805 NE Lincoln Road, Idabel, Oklahoma 74745, USA (e-mail: cmcallister@se.edu); and **HENRY W. ROBISON**, Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, USA (e-mail: hwrobison@yahoo.com).

LITHOBATES MONTEZUMAE (Montezuma Leopard Frog). MÉXICO: TLAXCALA: Municipality of Atlangatepec: Ecatepec-Atlangatepec road (19.52375ºN, 98.16772ºW, WGS84; elev. 2575 m). 19 August 2007. Christopher Duifhuis Rivera and Jorge García Bocardo. Verified by Luis Canseco Márquez. Colección Herpetológica, Museo de Zoología, Facultad de Ciencias, UNAM (MZFC 14314). First record for Tlaxcala and bridges the distributional gaps among recorded localities in Puebla, Morelos, Distrito Federal, and Veracruz (Uribe-Peña et al. 1999. Anfibios y Reptiles de las Serranías del Distrito Federal, México. Instituto de Biología, Universidad Nacional Autónoma de México. 119 pp.). The specimen was caught in a pond located in oak forest.

Submitted by **CHRISTOPHER DUIFHUIS RIVERA** (e-mail: christopherduifhuis@gmail.com) and **URI OMAR GARCIA VAZQUEZ**, Laboratorio de Herpetología, Museo de Zoología, Facultad de Ciencias, UNAM, A. P. 70-399, México D.F. 04510, México (e-mail: urigarcia@gmail.com).

PSEUDACRIS CRUCIFER (Spring Peeper). USA: TENNESSEE: DeKalb Co.: Vaughn Lane, 0.42 km SW of jct Hwy 56 (35.933683°N, 85.814194°W; WGS 84). 12 March 2010. Amy Tolley. Austin Peay State University Museum of Zoology (APSU 19015 audio). New county record (Redmond and Scott 1996. Austin Peay St. Univ. Center Field Biol. Misc. Publ. 12:1–94). A chorus of multiple individuals was heard calling at a pond on agricultural land. Warren Co.: Tennessee Amphibian Monitoring Program (TAMP) Route 820515, Stop 1, Lawson Mill Road, 0.51 km NE of intersection with Hwy 127 (35.615157°N, 85.810378°W; WGS 84). 12 March 2010. Amy Tolley. APSU 19016 audio. New county record (Redmond and Scott 1996, *op. cit.*). A chorus of multiple individuals was heard calling in the vicinity of a pond on residential land. All identifications were verified by A. Floyd Scott.

Submitted by **AMY TOLLEY**, 446 NYU Place, Murfreesboro, Tennessee 37128, USA.

PSEUDACRIS FERIARUM (Upland Chorus Frog). USA: TENNESSEE: DeKalb Co.: Vaughn Lane, 1.03 km SW of jct Hwy 56 (35.929983°N, 85.809125°W; WGS 84). 12 March 2010. Amy Tolley. Austin Peay State University Museum of Zoology (APSU 19014 audio). New county record (Redmond and Scott 1996. Austin Peay St. Univ. Center Field Biol. Misc. Publ. 12:1–94). A small chorus was heard calling from a drainage ditch in an agricultural field along the road. Warren Co.: Tennessee Amphibian Monitoring Program (TAMP) Route 820515, Stop 1, Lawson Mill Road, 0.48 km NE of the intersection with Hwy 127 (35.613992°N, 85.811122°W; WGS 84). 20 February 2010. Amy Tolley. APSU 19012 audio. New county record (Redmond and Scott 1996, *op. cit.*). A chorus of multiple individuals was heard calling in the vicinity of a pond on residential land. All identifications were verified by A. Floyd Scott.

Submitted by **AMY TOLLEY**, 446 NYU Place, Murfreesboro, Tennessee 37128, USA.

RHINELLA MARINA (Cane Toad). USA: FLORIDA: St. Lucie Co.: Port Saint Lucie, 1692 SW Biltmore Street (27.29007°N, 80.36546°W; WGS84), elev. 5 m. 16 June 2010. Kenneth L. Krysko, Catherine A. Smith, Joseph P. Burgess. Verified by Kevin M. Enge. Florida Museum of Natural History (UF 157938–39). New county record (Meshaka et al. 2004. The Exotic Amphibians and Reptiles of Florida. Krieger Publ. Co., Malabar, Florida. 155 pp.). Two individuals (2.0 and 2.2 cm SVL, respectively) found under debris at 1200 h.

Submitted by **KENNETH L. KRYSKO** (e-mail: kenneyk@flmnh.ufl.edu), **CATHERINE A. SMITH**, Division of Herpetology, Florida Museum of Natural History, Dickinson Hall, University of Florida, Gainesville, Florida 32611, USA (e-mail: hellcat@ufl.edu); and **JOSEPH P. BURGESS**, Florida Department of Environmental Protection, GTM NERR, Ponte Vedra, Florida 32082, USA (e-mail: Joseph.Burgess@dep.state.fl.us).

SCAPHIOPUS HOLBROOKII (Eastern Spadefoot). USA: TENNESSEE: Warren Co.: Tennessee Amphibian Monitoring Program (TAMP) Route 820515, Stop 5, Lawson Mill Road, 0.79 km NNW of intersection with Hwy 127 (35.626944°N, 85.799339°W; WGS 84). 11 June 2009. Amy Tolley. Verified by A. Floyd Scott. Austin Peay State University Museum of Zoology (APSU 18973 photograph). New county record (Redmond and Scott 1996. Austin Peay St. Univ. Center Field Biol. Misc. Publ. 12:1–94). Individual observed on side of the road.

Submitted by **AMY TOLLEY**, 446 NYU Place, Murfreesboro, Tennessee 37128, USA.

SCINAX STAUFFERI (Stauffer's Long-nosed Treefrog). MÉXICO: OAXACA: Municipality of Villa de Tututepéc de Melchor Ocampo: Lagartero (16.052432°N, 97.646336°W; WGS 84), elev. 9 m. 31 January 2005. Aurelio Ramírez-Bautista and Vicente Mata-Silva. Verified by Uriel Hernández-Salinas. Laboratory for Environmental Biology, Centennial Museum, University of Texas at El Paso photographic collection (G 2010.1.1). First municipality record that fills a 340 km gap between the closest published localities, 130 km to the ESE in the vicinity of San Pedro Pochutla, Oaxaca, and 210 km to the WNW near San Marcos, Guerrero (Duellman 2001. The Hylid Frogs of Middle America, Vol. 2. SSAR Contributions to Herpetology 18:i–x + 695–1159). The frog was found in grass on the floor of a coconut grove, ca. 200 m from a marsh.

Submitted by **VICENTE MATA-SILVA**. Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: vmata@utep.miners.edu); **AURELIO RAMÍREZ-BAUTISTA**, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, Pachuca, Hidalgo, C.P. 42001, México (e-mail: aurelior@uaeh.reduaeh.mx); and **JERRY D. JOHNSON**, Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: jjonhson@utep.edu).

SCAPHIOPUS COUCHII (Couch's Spadefoot). USA: NEW MEXICO: Curry Co.: Melrose, New Mexico, 0.11 km S of Hwy 60/84 and 0.24 km W of State Route 267 (34.42305°N, 103.61838°W; NAD83/WGS84), elev. 1342 m. 3 July 2003. Ian W. Murray and Peter E. Humphrey. Verified by J. Tomasz Giermakowski. University of New Mexico Museum of Southwestern Biology (MSB 75697). New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. 431 pp.). The specimen was found buried ~5 cm deep in moist sandy soil at the edge of a rain-filled pool in a rutted dirt road on the north side of the railroad tracks.

Numerous tadpoles, probably *S. couchii*, were evident in the puddle, but they were not keyed out.

Submitted by **IAN W. MURRAY**, University of New Mexico Biology Department, Albuquerque, New Mexico 87131, USA (e-mail: imurray@unm.edu); and **PETER E. HUMPHREY**, Harvard Medical School, Brigham & Women's Hospital, Boston, Massachusetts 02115, USA (e-mail: phumphrey@partners.org).

TESTUDINES — TURTLES

CHRYSEMYS PICTA (Painted Turtle). USA: MINNESOTA: McLeod Co.: On CR 9 just south of Lester Prairie (44.86563ºN, 94.03034ºW; NAD83). 12 September 2010. Noah J. Anderson, Jeffery B. LeClere, Tessa L. Whitemarsh, and Randy E. Blasus. Verified by Benjamin Lowe. Bell Museum of Natural History (JFBM P362). New county record (Oldfield and Moriarty 1994. Amphibians and Reptiles of Minnesota. University of Minnesota Press, 237 pp.; Gamble and Moriarty 2006. Herpetol. Rev. 37:114–116). Found DOR on road ca. 115 m E of man-made pond surrounded by agricultural fields.

Submitted by **NOAH J. ANDERSON**, Department of Biological Sciences, University of Wisconsin-Baraboo/ Sauk County, 1006 Connie Road, Baraboo, Wisconsin 53913, USA (e-mail: noah.anderson@uwc.edu); **JEFFERY B. LECLERE**, 878 Galtier Street, Saint Paul, Minnesota 55117, USA (e-mail: reptilia74@aol.com); **TESSA L. WHITEMARSH**, 6869 Taylor Road, Sauk City, Wisconsin 53583, USA (e-mail: whitemar.tess@uwlax.edu); and **RANDY E. BLASUS**, 3224 Idaho Avenue South, Saint Louis Park, Minnesota 55426, USA (e-mail: blasus@comcast.net).

DEIROCHELYS RETICULARIA RETICULARIA (Eastern Chicken Turtle). USA: MISSISSIPPI: George Co.: Gum pond immediately to the southwest of MS Hwy 57 and Salem Rd. intersection (31.9805167°N, 89.7787667°W; no datum available). 7 July 2008, 0915 h. Will Selman and Thomas Bocek. Verified by Kurt Buhlmann. Florida Museum of Natural History Herpetology Department photographic archive (UF 159536). New county record. This record fills a distributional gap among three surrounding Mississippi counties (Jackson, Stone, Perry) and Mobile Co., Alabama (Mississippi Museum of Natural Science Collections database, http://mdwfp.com/museum/database/bio_collections_online_data.html; Mount 1975. The Reptiles and Amphibians of Alabama. Alabama Agricultural Experiment Station, Auburn, Alabama. 347 pp.; J. Iverson and K. Buhlmann, pers. comm.). Two adults (one female and one male) were observed basking in gum pond on a floating log; two *Pseudemys concinna* (River Cooter) were also observed.

Submitted by **WILL SELMAN**, Rockefeller Refuge, Louisiana Department of Wildlife and Fisheries, 5476 Grand Chenier Hwy, Grand Chenier, Louisiana, 70643, USA (e-mail: wselman@wlf.la.gov); and **THOMAS BOCEK**, Department of Biological Sciences, Box 5018, University of Southern Mississippi, Hattiesburg, Mississippi 39401, USA.

GRAPTEMYS GEOGRAPHICA (Northern Map Turtle). USA: ALABAMA: Jackson Co.: Paint Rock River at Whitaker Nature Conservancy Preserve (34.66450°N, 86.32524°W; no datum available). 25 August 2009. Gregory B. Pauly. Verified by Jim Godwin. Auburn University Museum photographic voucher AHAP-D 267–268. First county record. Adult female (214 mm straightline carapace length, 195 mm straightline plastron length, 1374 g) photographed and released. This species is known to occur elsewhere in the Tennessee River watershed (Mount 1975. Reptiles and Amphibians of Alabama. Agricultural Experiment Station, Auburn University. 347 pp.). Tuscaloosa Co.: Blue Creek at Watermelon Road bridge (33.45045°N, 87.41248°W; no datum available). 17 August 09. Gregory B. Pauly. Verified by Jim Godwin. Auburn University Museum photographic voucher AHAP-D 269–271. First county record and the most southwestern record in Alabama. Juvenile (52 mm straightline carapace length, 44 mm straightline plastron length, 25 g) photographed and released. Previously reported from elsewhere in the Black Warrior River watershed. (Mount 1975, *op. cit*.).

Fieldwork carried out under Alabama Conservation License 68-680 issued by the Alabama Department of Conservation and Natural Resources.

Submitted by **GREGORY B. PAULY**, Department of Evolution and Ecology, University of California, Davis, California 95616, USA.

GRAPTEMYS GIBBONSI (Pascagoula Map Turtle). USA: MISSISSIPPI: Lamar Co.: Black Creek, U.S. Highway 11 bridge crossing southwest of Hattiesburg (31.190224°N, 89.376778°W; no datum available). 12 May 2010, 1515 h. Will Selman and Aaron Holbrook. Verified by Peter Lindeman. Florida Museum of Natural History Herpetology Department photographic archive (UF 159527). New county record (Selman and Qualls 2009. Herpetol. Cons. Biol. 4[2]:171–184; P. Lindeman, pers. comm.). Extends known range in Black Creek upstream by ca. 12 river km (Mississippi Museum of Natural Science, specimen #4176 collected near Camp Dantzler, Forrest Co.). A single adult female was observed basking on a deadwood snag 50 m downstream of bridge crossing.

Submitted by **WILL SELMAN,** Rockefeller Refuge, Louisiana Department of Wildlife and Fisheries, 5476 Grand Chenier Hwy, Grand Chenier, Louisiana 70643, USA (e-mail: wselman@wlf.la.gov); and **AARON HOLBROOK**, Department of Biological Sciences, Box 5018, University of Southern Mississippi, Hattiesburg, Mississippi 39401, USA.

GRAPTEMYS OUACHITENSIS OUACHITENSIS (Ouachita Map Turtle). USA: OHIO: Hamilton Co.: Miami Township: Great Miami River at Cleves Community Park. (39.1615°N, 84.7625°W; WGS 84). 18 August 2010. Paul J. Krusling. Verified by Peter V. Lindeman. Cincinnati Museum Center Herpetology Collection (CMC HP 5231, 5232 and 5267 [digital files and prints]). New county record. First confirmed records from the Great Miami River system in over 130 years. These records partially fill a wide gap in the distribution of *Graptemys ouachitensis* in the Ohio River Basin. The closest known extant upstream populations have been documented from the Scioto River, Scioto Co., Ohio, ca. 136 river miles. The closest downstream populations are from Jefferson Co., Kentucky, ca. 112 river miles (Lindeman, *in press*. The Map Turtle and Sawback Atlas: Ecology, Evolution, Distribution, and Conservation of the Genus *Grapte-*

mys. University of Oklahoma Press, Norman).

Submitted by **PAUL J. KRUSLING** (e-mail: pkrusling@gmail.com)**, JEFFREY G. DAVIS**, Cincinnati Museum Center- Frederick and Amye Geier Collections and Research Center, 1301 Western Avenue, Cincinnati, Ohio 45203, USA (e-mail: anura@fuse.net); and **RICK LISI**, Audubon Society of Ohio, 3398 West Galbraith Road, Cincinnati, Ohio 45239, USA.

GRAPTEMYS PSEUDOGEOGRAPHICA PSEUDOGEOGRAPHICA (False Map Turtle). USA. OHIO: Hamilton Co.: Miami Township: Great Miami River at Cleves Community Park. (39.1615°N, 84.7625°W; WGS 84). 18 August 2010. Paul J. Krusling. Verified by Peter V. Lindeman. Cincinnati Museum Center Herpetology Collection (CMC HP 5230 [digital files and prints]). The first confirmed record from the state of Ohio. Extends the range ca. 350 river miles upstream from known extant populations in the Wabash River in Indiana. (Lindeman, *in press*. The Map Turtle and Sawback Atlas: Ecology, Evolution, Distribution, and Conservation of the Genus *Graptemys*. University of Oklahoma Press, Norman).

Submitted by **PAUL J. KRUSLING** (e-mail: pkrusling@gmail.com), **JEFFREY G. DAVIS**, Cincinnati Museum Center- Frederick and Amye Geier Collections and Research Center, 1301 Western Avenue, Cincinnati, Ohio 45203, USA (e-mail: anura@fuse.net); and **RICK LISI**, Audubon Society of Ohio, 3398 West Galbraith Road, Cincinnati, Ohio 45239, USA.

KINOSTERNON SUBRUBRUM HIPPOCREPIS (Mississippi Mud Turtle). USA: ARKANSAS: Lincoln Co.: 0.8 km S of Nebo off St. Hwy. 81 at Flat Creek (34.019088°N, 91.814117°W; WGS 84). 6 July 2010. H. W. Robison. Verified by R. Tumlison. Henderson State University Herpetological Collection (HSU 1539). New county records; helps fill a distributional hiatus in southeastern Arkansas between Cleveland and Desha counties (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.).

Submitted by **CHRIS T. McALLISTER**, Science and Mathematics Division, Eastern Oklahoma State College, 2805 NE Lincoln Road, Idabel, Oklahoma 74745, USA (e-mail: cmcallister@se.edu); and **HENRY W. ROBISON**, Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, USA (e-mail: hwrobison@yahoo.com).

PSEUDEMYS CONCINNA (River Cooter). USA: ARKANSAS: Howard Co.: 11.3 km W Umpire at US 278 bridge, Cossatot River (34.295923°N, 94.177680°W; WGS 84). 28 April 2010. H. W. Robison. Verified by R. Tumlison. Henderson State University Herpetological Collection (HSU 1523, photographic voucher, released). Sevier Co.: off US 70 at Red Wing (34.047529°N, 94.237976°W; WGS 84). 4 July 2010. C. T. McAllister. Verified by S. E. Trauth. Arkansas State University Museum of Zoology, Herpetological Collection (ASUMZ 31537, photographic voucher, DOR). New county records (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.). Help fill a distributional hiatus in southwestern Arkansas among Little River, Pike, and Polk counties.

Submitted by **CHRIS T. McALLISTER**, Science and Mathematics Division, Eastern Oklahoma State College, 2805 NE Lincoln Road, Idabel, Oklahoma 74745, USA (e-mail: cmcallister@se.edu); **HENRY W. ROBISON**, Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, USA (e-mail: hwrobison@yahoo.com); and **STAN SPEIGHT**, Cossatot River State Park Natural Area, 1980 Highway 278 West, Wickes, Arkansas 71973, USA (e-mail: Stan.Speight@arkansas.gov).

TERRAPENE NELSONI (Spotted Box Turtle): MÉXICO: CHIHUAHUA: Municipio de Uruachi: Palo Amarillo (27.859594°N, 108.520464°W; NAD 27; elev. 1640 m). 1 July 2006. Paulino Ponce-Campos. Verified by John Iverson. Bosque Tropical photographic collection (BT, M 035a–f). New municipality record and second verified locality in Chihuahua, the first record being located 120 km SE of Palo Amarillo in Arroyo El Camuchil, Batopilas (Lemos-Espinal and Smith 2002. Herpetol. Rev. 32:274.). The closest known locality for this species is from 61 km NNW at Maycoba, Sonora (photographic collection UAZ 55581-PSV). The juvenile reported herein is the smallest (42 mm carapace length) on record for this species and was depicted along with the habitat where it was found (transitional oak woodland and *Acacia* thornscrub) in Franklin and Killpack (2009. The Complete North American Box Turtle. ECO Herp. Publ. Distrib., Rodeo, New Mexico. 242 pp). The locality also appears to be at the highest elevation known for this species. We thank Peter Reinthaler, John M. Legler, and Hans Meijer for details regarding the Maycoba specimen.

Submitted by **PAULINO PONCE-CAMPOS,** Bosque Tropical, A.C. Apartado Postal 5-515 Guadalajara, Jalisco 45042, México (e-mail: poncecp@hotmail.com); and **JAMES BUSKIRK,** San Antonio Neighborhood Health Center, 1030 International Blvd., Oakland, California 94606, USA.

TRACHEMYS VENUSTA (Mesoamerican Slider). HONDURAS: ISLAS DE LA BAHÍA: Cayos Cochinos, Cayo Cochino Pequeno, SE side of island near a freshwater outlet (15.949722ºN, 86.499722ºW; WGS84), elev. 1 m. 15 June 2006. J. A. Frazier. Verified by Steve Gotte. USNM 570530. First record for Cayo Cochino Pequeno (McCranie et al. 2005. Amphibians and Reptiles of the Bay Islands and Cayos Cochinos, Honduras. Bibliomania, Salt Lake City, Utah. x + 210 pp.).

Field work on Cayos Cochinos was supported by the Honduran Coral Reef Foundation, Operation Wallacea, and Disney Wildlife Conservation Fund.

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SQUAMATA — LIZARDS

ACANTHODACTYLUS CANTORIS (Indian Fringe-fingered Lizard). IRAN: SISTAN & BALOUCHESTAN PROVINCE: Bazman: Mar-abad Valley (27.81451ºN, 60.15781ºE; no datum available), elev. 970 m. 16 May 2010. Omid Mozaffari and Kamran Kamali. Verified by Muhammad Sharif Khan. Pars Herpetologists Institute (PHIM 00217). First country record, nearest reported locality is Ormara, Pakistan, 550 km to southeast (Minton 1966. Bull. Am. Mus. Nat. Hist. 134:27–184). Two males, one female, and one juvenile found at 1030 h near stream at Valley of Mar-abad; vegetation dominated by *Tamarix* and annual shrubs.

Submitted by **OMID MOZAFFARI,** Pars Herpetologists Institute, Tehran, Iran; e-mail: omozaffari@yahoo.com.

AMEIVA UNDULATA (Rainbow Ameiva). MÉXICO: OAXACA: Municipality of Villa de Tututepéc de Melchor Ocampo: Lagartero (16.050608°N, 97.648250°W; WGS 84), elev. 7 m. 22 December 2007. Aurelio Ramírez-Bautista and Vicente Mata-Silva. Verified by Uriel Hernández-Salinas. Colección Herpetológica del Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB 2694). First published municipality record that fills a gap between the closest reported localities ca. 250 km E in the vicinity of Tehuantepec, Oaxaca (Hartweg and Oliver 1937. Occas. Pap. Mus. Zool. Univ. Michigan 359:1–8) and ca. 222 km WNW in the vicinity of Barra Vieja, Guerrero (Flores-Villela et al. 1991. Ser. Cat. Mus. Zool. "Alfonso L. Herrera" Cat. [3]:1–222). Casas-Andreu et al. (2004. *In* A. J. Garcia-Mendoza et al. [eds.], Biodiversidad de Oaxaca, pp. 375–390. Inst. Biol. UNAM, Mexico D.F.) reported, without naming specific sites, that this species occurs in floristic-faunistic areas 1, 7, and 9 of the state. The geographic location reported herein is within floristic-faunistic area 8 in the southern coastal region of the state. The lizard was found crawling in leaf litter of tropical deciduous forest ca. 30 m from a marsh

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ANELYTROPSIS PAPILLOSUS (Mexican Blind Lizard) MÉXICO: TAMAULIPAS: Municipality of Ocampo: 11 air km WNW of Ocampo near Nicolas Bravo, Ejido Protacio F. Guerra (22.877222°N, 99.4425°W; WGS84; elev 501 m). 17 March 2007. Elí García-Padilla. Verified by David Lazcano-Villareal. Universidad Autónoma de Nuevo León, Facultad de Ciencias Biológicas, Laboratorio de Herpetología (UANL-6827). First municipality record and first from the Tamaulipas coastal plain, filling a distributional gap between previous records from the state (Axtell 1958. Herpetologica 14:189–191; Farr et al 2007. Herpetol. Rev. 38:226–233) and areas in neighboring San Luis Potosí (Campbell 1974. Cat. Amer. Amphib. Rept. 156.1–156.2). The lizard was found underneath a rock in tropical deciduous forest.

We thank David Lazcano for assistance. Fieldwork was conducted under SEMARNAT permit 01085/07.

Submitted by **ELÍ GARCÍA-PADILLA,** Centro de Investigaciones Biológicas del Noroeste, Mar Bermejo 195, Colonia Palo de Santa Rita, La Paz, Baja California Sur, 23090 México (e-mail: eligarcia_18@hotmail.com); and **WILLIAM L. FARR,** Herpetology Department, Houston Zoo, Inc., 1513 North MacGregor Drive, Houston, Texas 77030-1603, USA (e-mail: wfarr@houstonzoo.org).

ANOLIS CAROLINENSIS CAROLINENSIS (Northern Green Anole). USA: ARKANSAS: Yell Co.: 6.4 km W Aly on Ouachita National Forest Rd. 66430 (34.796325°N, 93.584290°W; NAD 83). 08 May 2010. H. W. Robison. Verified by R. Tumlison. Henderson State University Herpetological Collection (HSU 1524, photographic voucher). New county record. Fills a distributional gap between Perry and Scott counties (Trauth et al. 2004. Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.).

Submitted by **CHRIS T. McALLISTER**, Science Department, Eastern Oklahoma College, 2805 NE Lincoln Road, Idabel, Oklahoma 74745, USA (e-mail: drctmcallister@aol.com); and **HENRY W. ROBISON**, Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, USA (e-mail: hwrobison@yahoo.com).

ANOLIS SAGREI (Brown Anole). USA: HAWAII: Hilo, 511 W Kawailani Street (19.68342°N, 155.08233°W, WGS84), elev. 102 m. 14 July 2010. Kenneth L. Krysko and Michael C. Granatosky. Verified by Kevin M. Enge. Florida Museum of Natural History (UF 158227–29, 158231, 158233–36; BPBM 36043, 36044). New island record (Kraus 2005. Bishop Mus. Occas. Pap. 88:61–62; Kraus 2009. Alien Reptiles and Amphibians: A Scientific Compendium and Analysis. Springer Science+Business Media B.V.. 564 pp.). Ten individuals, including four females (40.4, 41.3, 41.4, and 45.4 mm SVL), five males (56.0, 59.4, 60.3, 61.2, and 65.2 mm SVL), and one neonate (21.3 mm SVL) found sleeping on vegetation and a wooden fence between 2100–2120 h. On 15 July 2010 at 1545 h, an additional adult male *A. sagrei* was observed (not collected) basking on lava rocks at guard gate to Kuki'o Beach (19.81329°N, 155.98829°W, WGS84; elev. 53 m).

Submitted by **KENNETH L. KRYSKO** (e-mail: kenneyk@flmnh.ufl.edu) and **MICHAEL C. GRANATOSKY**, Division of Herpetology, Florida Museum of Natural History, Dickinson Hall, University of Florida, Gainesville, Florida 32611, USA (e-mail: mgranato@ufl.edu).

CNEMASPIS ASSAMENSIS (Assamese Day Gecko). INDIA: MEGHALAYA: Ri-bhoi: District: Nongkhellym Wildlife Sanctuary (25.9494°N, 91.8706°E), elev. 247 m. 4 April 2008. Arya Vidyapeeth College Zoological Museum (AVC A1035) (SVL 29.6 mm; TL 35.2 mm). Collected from exposed roots of teak plant (*Tectona grandis*) of a forest roadside slope, ca. 1 m above ground. Nongpoh (25.9244°N, 91.8756°E; elev. 554 m). 21 June 2010. AVC A1034; SVL 32.3 mm, TL 39.8 mm. On rock within a teak plantation, close to National Highway 40. Digital image is deposited at zoological image collection of the Raffles Museum of Biodiversity Research (ZRC [IMG] 2.124). Species described from Mayeng Reserve Forest (25.8153°N, 91.3589°E, 90 m elev.), Kamrup District, Assam (Das and Sengupta 2000. J. S. Asian Nat. Hist. 5[1]:17–23) and reported from Garbhanga Reserve Forest, Kamrup District, Assam (Sengupta et al. 2000. J. Assam Sci. Soc. 41[4]:372–378), and Diffolu camp (26.5951°N, 93.0772°E, elev. 86 m), Ghorakhati Range, Kaziranga National Park, Assam (Das and Ahmed, 2007. Zoos' Print J. 22[6]:27–30). Southernmost locality for species and first record for Meghalaya State. Species identification verified by Saibal Sengupta.

Submitted by **JAYADITYA PURKAYASTHA**, Zoology Department, Arya Vidyapeeth College. Guwahati 781 016, Assam, India (e-mail: jaya_ditya@rediffmail.com); and **ABHIJIT DAS**, Division of Herpetology, Aaranyak, 50 Samanwoy Path, Survey, Beltola, Guwahati 781 028, Assam, India (e-mail: protobothrops@gmail.com).

DRYADOSAURA NORDESTINA (NCN). BRAZIL: SERGIPE: Municipality of Itabaiana: National Park Serra de Itabaiana (10.7488ºS, 373447ºW, SAD69; elev. 240 m), 17 January 2009. M. V. Noronha-Oliveira. Herpetological Collection of the Federal Univeristy of Sergipe, Sergipe, Brazil (C240). Verified by D. Oliveira Mesquita. First state record, extending the distribution of *D. nordestina* ca. 250 km from Maceió, Alagoas (Rodrigues et al. 2005. Zool. J. Linn. Soc. 144:543–557). The species is restricted to a few remnants of Atlantic forest of northeastern Brazil, specifically between the states of Rio Grande do Norte and Alagoas (Rodrigues et al., *op. cit.*; Santana et al. 2008. Biotemas 21[1]:75–84; Sales et al. Cuad. Herpetol. 2009 23[2]:77–88), with only one record from the state of Bahia (Guerrero and Rodrigues 2007. Herpetol. Rev. 38:218). However, large distributional gaps remain, indicating the need for additional field surveys.

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EUBLEPHARIS MACULARIUS (Indian Leopard Gecko). INDIA: DELHI STATE: South Delhi, Aravalli Biodiversity Park (28.558333ºN, 77.149167ºE; no datum available), elev. 240 m. 20 June 2006. Aisha Sultana and Stephen Sequiera. Verified by Indraneil Das. USDZ photographic voucher, ZRC (IMG) 2.126. Juvenile under rock in ditch. Two additional adults were found at same locality ZRC(IMG) 2.127. First report for the Union Territory of Delhi (Anon. [ed.] 1997. Fauna of Delhi. Zoological Survey of India, Kolkata. 903 pp.).

Submitted by **AISHA SULTANA** (e-mail: aishasultana28@yahoo.com); and **M. SHAH HUSSAIN,** Biodiversity Parks Programme, Centre for Environmental Management and Degraded Ecosystems, University of Delhi, Delhi 110007, India (e-mail: mshahhussain@rediffmail.com).

GERRHONOTUS OPHIURUS (Snake Lizard). MÉXICO: TAMAULIPAS: Municipality of Gómez Farías: El Cielo Biosphere Preserve, in Gómez Farías near Hotel Posada Campestre (23.0303222°N, 99.1479361°W; WGS84), elev. 353 m. 03 October 2008. Felipe Villegas Ruiz. Verified by Luis Canseco-Márquez. UANL 7114. First record for Tamaulipas and a range extension of 83 km N from the nearest locality in Cd. del Maíz, San Luis Potosí (Tihen 1948. Trans. Kansas Acad. Sci. 51:302–305). The lizard was found AOR in an area containing tropical deciduous forest. Presently, three species of *Gerrhonotus* (*G. farri, G. infernalis,* and *G. ophiurus*) are known to occur within Tamaulipas.

Submitted by **ELÍ GARCÍA-PADILLA,** Centro Interpretativo Ecológico, Gómez Farías, Tamaulipas, México (e-mail: eligarcia_18@hotmail.com); and **FELIPE VILLEGAS RUIZ,** Hotel Posada Campestre, Gómez Farías, Tamaulipas, México (e-mail: posadaenelcielo@hotmail.com).

HEMIDACTYLUS FRENATUS (Common House Gecko). PANAMÁ: COCLÉ: El Copé, small house ca. 30 m E of road to Barrigon (08.62151°N, 80.57864°W; WGS84), elev. 404 m. 17 December 2009. R. C. Jadin, J. M. Ray, and S. A. Orlofske. Verified by Eric N. Smith. UTA digital image library at the Amphibian and Reptile Diversity Research Center (UTADC 6520–23). First record for Coclé (Köhler 2008. Reptiles of Central America, 2nd ed. Herpeton, Verlag Elke Köhler, Offenbach, Germany. 400 pp.). This introduced species appears to be common in El Copé and its expansion into the area was predicted by Rödder et al. (2008. NW J. Zool. 4:236–246).

Submitted by **ROBERT C. JADIN** (e-mail: rcjadin@gmail.com), and **SARAH A. ORLOFSKE**, Department of Ecology and Evolutionary Biology, University of Colorado at Boulder, Boulder, Colorado 80309, USA; and **JULIE M. RAY**, La MICA Biological Station, El Copé de La Pintada, Coclé, Republic of Panamá.

HEMIDACTYLUS TURCICUS (Mediterranean Gecko). USA: GEORGIA: Muscogee Co.: Captured at private residence (2524 52nd Street) within Columbus city limits (32.51487ºN, 84.95584ºW; WGS 84). 26 July 2010. C. McClure. Verified by Craig Guyer. AUM 38918. New county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, Georgia. 575 pp.).

Submitted by **CHRISTOPHER J.W. McCLURE** (e-mail: cjm0007@auburn.edu), and **DAVID A. STEEN**, Auburn University Department of Biological Sciences, 331 Funchess Hall, Auburn University, Alabama 36949.USA.

HEMIDACTYLUS TURCICUS (Mediterranean Gecko). USA: TEXAS: Austin Co.: Farm to Market 949 ca. 3.0 km S of Cat Springs, Texas (29.87236°N, 96.84928°W; WGS 84). 11 October 2008. Romey Swanson and Vincent Farallo. Verified by Travis LaDuc. Texas Natural History Collection (TNHC 82802). First county record (Dixon 2000. Amphibians and Reptiles of Texas: with Keys, Taxonomic Synopses, Bibliography, and Distribution Maps. Texas A&M University Press. 421 pp.). Several individuals were observed on window screens at a private farmhouse near Bellville, Texas. A single adult was captured by hand. Measurements were: 11.3 cm total length and 5.2 cm SVL.

Submitted by **ROMEY L. SWANSON** (e-mail: romeyswanson@gmail.com), **VINCENT R. FARALLO**, and **THOMAS R. SIMPSON** (e-mail: r_simpson@txstate.edu), Department of Biology, Texas State University, San Marcos, Texas 78666, USA.

MABUYA AGMOSTICHA. BRAZIL: RIO GRANDE DO

NORTE: Municipality of Santa Maria: Fazenda Tanques (5.854ºS, 35.701ºW; datum WGS84), elev. 137 m. 10 October 2009. J. da Silva Jorge. Coleção Herpetológica do Departamento de Botânica, Ecologia e Zoologia, Universidade Federal do Rio Grande do Norte, Natal, Rio Grande do Norte (CHBEZ 2882, 2883). Verified by M. T. Rodrigues. Species previously known only from three localities: municipalities of Cabaceiras (type locality; Rodrigues 2000. Pap. Avul. Zool. 41 [21]:313–328) and São José dos Cordeiros/Sumé (Reserva Particular do Patrimônio Natural Fazenda Almas), both in the State of Paraíba (Freire et al. 2009. *In* Freire [ed.], Répteis Squamata das Caatingas do Seridó do Rio Grande do Norte e do Cariri da Paraíba: Síntese do Conhecimento Atual e Perspectivas, pp. 51–84. EDUFRN, Brazil) and Xingó in the border between the states of Alagoas and Sergipe (Rodrigues 2003. *In* Leal et al. [eds.], Herpetofauna da Caatinga. pp. 181–236. Ed. Universitária UFPE, Brazil). First state record, extends the distribution ca. 250 km NW from the municipality of Cabaceiras, state of Paraíba, Brazil.

Submitted by **JAQUEIUTO S. JORGE** (e-mail: queilto@yahoo.com.br) and **ELIZA M. X. FREIRE,** Laboratório de Herpetologia, Departamento de Botânica, Ecologia e Zoologia, Centro de Biociências, Universidade Federal do Rio Grande do Norte, Campus Universitário, Lagoa Nova, CEP 59072-970, Natal, Rio Grande do Norte, Brazil (e-mail: elizajuju@ufrnet.br).

LIOLAEMUS GRACILIS (Striped Slender Lizard). ARGENTINA: CHUBUT: Telsen Department: Provincial Route 4, 3.5 km W of Telsen City (42.44106°S, 66.98072°W, WGS84; elev. 432 m). 2 February 2003. L. J. Avila, K. Dittmar, M. Morando, C. H. F. Pérez. Herpetological collection of Centro Nacional Patagónico, Puerto Madryn, Chubut, Argentina (LJAMM-CNP 5486, adult male). Provincial Route 61, 40.3 km from junction with Provincial Route 11, between Ranquilhuao and San Manuel Ranches (42.74689°S, 66.99856°W, WGS84; elev. 117 m). 29 September 2004. L. J. Avila and N. Frutos. (LJAMM-CNP 5947, adult male). Both verified by L. E. Martínez. First department records, extending the known distribution of this species about 160 km W (straight line distance) from the nearest known record (Morando et al. 2007. Mol. Phylogenet. Evol. 43[3]:952–973), representing the westernmost locality for Chubut Province and southwesternmost locality for Argentina. Southernmost citation for this species is the type locality (Puerto Deseado, Santa Cruz Province), but actual collections between Península de Valdés in northeastern Chubut province and the type locality along the Atlantic coast or inland are not known. Present confirmed distribution includes San Luis, Mendoza, La Pampa, southern Buenos Aires, eastern Neuquén, Río Negro, and northeastern Chubut provinces (Avila et al. 2000. Ed. Esp. Asoc. Herpetol. Arg. 5:51–74).

Submitted by **IGNACIO MINOLI** (e-mail: minoli@cenpat.edu.ar), and **LUCIANO JAVIER AVILA,** Centro Nacional Patagónico, Boulevard Almirante Guillermo Brown 2915, Puerto Madryn, Chubut, Argentina (e-mail: avila@cenpat.edu.ar).

PHELSUMA MADAGASCARIENSIS (= P. GRANDIS) (Madagascar Day Gecko). USA: FLORIDA: Monroe Co.: Saddlebunch Keys, Baypoint, Palm Drive (24.62185°N, 81.59293°W, WGS 84), elev. < 1 m. 15 July 2010. Pam Gimson. Verified by Catherine A. Smith. Florida Museum of Natural History (photographic voucher UF 159376). New island record and eighth known island in the Florida Keys from which this species has been independently introduced (Krysko and Sheehy 2005. Carib. J. Sci. 41:169–172, Krysko and Hooper 2007. Gekko 5:33–38).

Submitted by **KENNETH L. KRYSKO**, Division of Herpetology, Florida Museum of Natural History, Dickinson Hall, University of Florida, Gainesville, Florida 32611, USA; e-mail: kenneyk@flmnh.ufl.edu.

PLESTIODON ANTHRACINUS PLUVIALIS (Southern Coal Skink). USA: MISSISSIPPI: Perry Co.: De Soto National Forest (31.153478°N, 89.012830°W; NAD83). 12 March 2009. James R. Lee. Verified by Robert L. Jones. Mississippi Museum of Natural Sciences (MMNS 16010). New county record (Walley 1998. Cat. Am. Amphib. Rept. 658:1–6 and references therein) that fills the void between Forrest (Smith and List 1955. Am. Midl. Nat. 53:115–125) and Greene (Burt 1937. Trans. Kansas Acad. Sci. 40:349–366) counties, positioned to the west and east, respectively. This specimen and two individuals not collected (all males) were found in a pitcher plant wetland.

Submitted by **JAMES R. LEE**, The Nature Conservancy, Camp Shelby Joint Forces Training Center, CSJFTC-ENV Building 622, Camp Shelby, Mississippi 39407, USA; e-mail: jlee@tnc.org.

PLESTIODON LATICEPS (Broad-headed Skink). USA: WEST VIRGINIA: Berkeley Co.: Sleepy Creek Wildlife Management Area, adjacent to Sleepy Creek Lake (39.531389°N, 78.151111°W; WGS84), elev. 337 m. 20 May 2010. Jeffrey W. Tamplin, Alexa D. Dostart, Derek J. Miller, and Jamie L. Thomas. Verified by Jeffrey Parmelee. Photo vouchers in Drake University Research Collection (DURCPC 135a,b,c). *Plestiodon laticeps* occurs in Fairfax, Loudoun, Prince William, and Warren counties in northern Virginia, and Jefferson Co., West Virginia, but has not previously been recorded from adjacent Berkeley or Morgan counties in the West Virginia eastern panhandle (Mitchell 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington, DC. 352 pp.; Green and Pauley 1987. Amphibians and Reptiles in West Virginia. University of Pittsburg Press, Pittsburg, Pennsylvania. 241 pp.; T. K. Pauley, pers. comm.). New county record is 25.1 km W of the Jefferson Co. line, and extends the species' range ca. 63.8 km farther N from the Warren Co., Virginia locality, and 81.7 km NW from the closest Loudoun Co., Virginia locality. One adult male and one juvenile *P. laticeps* were captured and released at ca. 1430 h. Habitat was deciduous woodland with a rocky substrate, ca. 1.4 km E of the Berkeley and Morgan county line.

Submitted by **JEFFREY W. TAMPLIN**, **ALEXA D. DOSTART, DEREK J. MILLER,** and **JAMIE L. THOMAS,** Department of Biology, University of Northern Iowa, 1227 W 27th Street, Cedar Falls, Iowa 50614, USA; e-mail: jeff.tamplin@uni.edu.

PODARCIS SICULUS (Italian Wall Lizard). USA: CALIFORNIA: Los Angeles Co.: San Pedro (33.7169ºN, 118.3022ºW; datum not available). 23 April 2010 and 7 May 2010. Gary Nafis and Guntram Deichsel. Verified by Werner

Mayer. Museum of Natural History in Vienna, Austria (photo voucher and tissue sample; catalogue number: NULA-1). Two additional voucher specimens are deposited at the Natural History Museum of Los Angeles County (LACM 180482–180483). First verified record of *P. s. siculus* from the USA. Burke and Deichsel (2008. *In* Mitchell et al. [eds.], Urban Herpetology, pp. 347–353. Herpetological Conservation Vol. 3. SSAR, Salt Lake City, Utah) present an overview of occurrences of *P. siculus* in the U.S. and mention introduced *P. siculus campestris* only for New York, Pennsylvania, and Kansas. Stebbins (2003. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co., Boston, Massachusetts. 544 pp.) does not mention *P. siculus* in the area covered in this book.

Werner Mayer analyzed mtDNA from the tissue sample and submitted the result to GenBank (accession number HQ154646). A sequence of 887 bp of the mitochondrial cytochrome b gene differed only by 1% mismatches from respective sequences of *P. s. siculus* from both the city of Agrigento (on the SW coast of Sicily) and from the Monti Peloritani mountains in the northeast of the island. The difference Agrigento–Peloritani is 0.9% mismatches. Sequences from Sicily differ by 1.9–2.4% from sequences from the opposite Italian mainland, i.e., extreme southern Calabria (W. Mayer, pers. comm.).

Approximately 50% of the Californian individuals are of the "concolor" (syn. "olivacea") morph characterized by plain green dorsa. Intergrades with faded, mid-dorsally lined (females) or faded checkered dorsa (males) are also present. Venters are plain white, orange, red, or white with beige spots. This inter-individual variation of coloration is consistent with a Sicilian origin: on the Italian mainland all *P. s. siculus* have plain white venters whereas on Sicily both plain white and colored venters occur (Henle and Klaver 1986. *In* W. Böhme [ed.], Handbuch der Reptilien und Amphibien Europas vol. 3 [Lacertidae III: *Podarcis*], pp. 254–342. Aula Verlag, Wiesbaden).

JH surveyed the area several times after 7 May 2010, confining the occurrence to a ca. 300 m (NW–SE) x 400 m (NE–SW) rectangle centered at South Leland & West 34th streets. We estimate the total population size as over 1,000 animals. By interviewing residents, JH identified the person who originally introduced four females and three males, all adults, from Taormina on Sicily in September 1994. According to this person, "20 male and 24 female adult Southern Italian Wall Lizards, many juveniles, and lots of hatchlings co-exist together with 2–3 Southern Alligator Lizards and 4-5 Western Fence Lizards, all adults" in his/her yard as of 29 June 2010. The total area of the person's lot minus house footprint is 474 m^2, yielding a population density of adult Southern Italian Wall Lizards of roughly one per 10 m^2. In another resident's garden measuring 72 m^2, GD counted nine *Podarcis*, yielding a similar local density. In its home range, *P. s. siculus* can reach much higher densities. We recommend that the expansion of this alien species be monitored and possible interactions with native lizard species should be investigated.

Submitted by **GUNTRAM DEICHSEL**, Friedrich-Ebert-Str. 62, Biberach an der Riss, Germany DE-88400 (e-mail: Guntram.Deichsel@gmx.de); **GARY NAFIS,** PO Box 34628-89546 Seattle, Washington 98124, USA (e-mail: grynaf@yahoo.com); and **JONATHAN HAKIM**, 937 W. 57th Street, Los Angeles, California 90037, USA (e-mail: hakim.ndmva@gmail.com).

PODARCIS SICULUS CAMPESTRIS (Italian Wall Lizard). USA: NEW JERSEY BURLINGTON CO.: Mt. Laurel, 128 Hooton Road (39.9559833ºN, 74.9299944º W; no datum available). September 2008. Russell L. Burke. Verified by D. Kizirian. American Museum of Natural History (AMNH 163007–163019). New county and state record. The closest previously reported populations of this subspecies are Philadelphia (apparently now extirpated [Burke and Deichsel 2008. *In* Mitchell et al. (eds.), Urban Herpetology, pp. 347–353. Herpetological Conservation Vol. 3. SSAR, Salt Lake City, Utah]) and New York City (Burke et al. 2010. Herpetol. Rev. 41:85–86). The population is distributed over a 0.5 km^2 area. An anonymous source claims to have started this population by releasing about 120 *P. siculus* purchased from a Bronx commercial importer/dealer in 1984, and that they were parasitized with mites at the time.

Submitted by **RUSSELL L. BURKE**, Department of Biology, Hofstra University, Hempstead, New York 11549,USA; e-mail: biorlb@hofstra.edu.

PTYCHOGLOSSUS BILINEATUS (Largescale Lizard). COLOMBIA: NARIÑO: BARBACOAS MUNICIPALITY: corregimiento de Altaquer, Reserva Natural Río Ñambi (1.29631°N, 78.07183°W; Bogotá WGS 84). 16 October 2009. G. F. Medina-Rangel and M. L. Calderón-Espinosa. Verified by R. A. Moreno-Arias. Colección de Reptiles, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá, Colombia (ICN 12011). This species was known only from an unspecified locality in Ecuador (Harris 1994. Herpetol. Monogr. 8:226–275). This is the first record for Colombia, and extends species range to the Western Cordillera of Colombia.

Submitted by **GUIDO F. MEDINA-RANGEL** (e-mail: gfmedinar@unal.edu.co), and **MARTHA L. CALDERÓN-ESPINOSA** (e-mail: mlcalderone@unal.edu.co), Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado Aéreo 7495, Bogotá D.C., Colombia.

SCELOPORUS CLARKII (Clark's Spiny Lizard). USA: ARIZONA: COCONINO CO.: Hwy 89A, approx. 1.5 rd mi. NE Uptown Sedona (34.88538056ºN, 111.74339444ºW, WGS84; elev. 1390 m). 8 September 1984. Brian Hubbs. Verified by Phil Rosen. Natural History Museum of Los Angeles County photo voucher (LACM PC 1524). New county record (Brennan and Holycross 2006. A Field Guide to Amphibians and Reptiles in Arizona. Arizona Game and Fish Department. Phoenix, Arizona. 150 pp.; Stebbins 2003. A Field Guide to Western Reptiles and Amphibians, 3rd ed. Houghton Mifflin Co., Boston, Massachusetts. 533 pp.). Two earlier vouchered specimens from this county (SDNHM 68106, UAZ 33885) apparently have not been referenced in any publication.

I thank Phil Rosen for sharing information concerning distribution of *Sceloporus clarkii* in northern Arizona.

Submitted by **BRIAN HUBBS,** P.O. Box 26407, Tempe, Arizona 85285, USA; e-mail: tricolorbrian@hotmail.com.

SCELOPORUS MELANORHINUS (Black-nosed Lizard). MÉXICO: OAXACA: MUNICIPALITY OF VILLA DE TUTUTEPÉC DE MELCHOR OCAMPO: Lagartero (16.051227°N, 97.643845°W; WGS 84), elev. 8 m. 28 December 1999. Aurelio Ramírez-Bautista and

Vicente Mata-Silva. Verified by Uriel Hernández-Salinas. Colección Herpetológica del Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB 2692). First published municipality record that fills a gap between the closest reported localities in Oaxaca ca. 73 km NNW, ca. 22 km N of Santiago Pinotepa Nacional (Flores-Villela et al. 1991. Serie Cat. Mus. Zool. "Alfonso L. Herrera" Cat. [3]:1–222) and ca. 130 km ESE near San Pedro Pochutla (Smith 1939. Field Mus. Nat. Hist., Zool. Ser. 26:1–397). The lizard was found on a tree of a living fence along an unpaved road, next to a lime grove.

Submitted by **VICENTE MATA-SILVA**, Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: vmata@utep.miners.edu); **AURELIO RAMÍREZ-BAUTISTA**, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, A. P. 1-69 Plaza Juárez, Pachuca, Hidalgo, C.P. 42001, México (e-mail: aurelior@uaeh.edu.mx); and **JERRY D. JOHNSON**, Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: jjonhson@utep.edu)

SCELOPORUS SINIFERUS (Long-tailed Spiny Lizard). MÉXICO: OAXACA: Municipality of Villa de Tututepéc de Melchor Ocampo: Río Grande (16.042186°N, 97.420338°W; WGS 84), elev. 43 m. 25 December 1998. Aurelio Ramírez-Bautista and Vicente Mata-Silva. Verified by Uriel Hernández-Salinas. Colección Herpetológica del Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB 2693). First published municipality record that fills a gap between the closest reported localities ca. 105 km ESE in the vicinity of Puerto Angel, municipality of San Pedro Pochutla, Oaxaca and ca. 270 km WNW near Acapulco, Guerrero (Smith 1939. Field Mus. Nat. Hist., Zool. Ser. 26:1–397). The lizard was found crawling adjacent to an unpaved road in leaf litter in remnant tropical deciduous forest next to a pasture.

Submitted by **VICENTE MATA-SILVA**, Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: vmata@utep.miners.edu); **AURELIO RAMÍREZ-BAUTISTA**, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, A. P. 1-69 Plaza Juárez, Pachuca, Hidalgo, C.P. 42001, México (e-mail: aurelior@uaeh.edu.mx); and **JERRY D. JOHNSON**, Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: jjonhson@utep.edu).

UROSAURUS ORNATUS SYMMETRICUS (Colorado River Tree Lizard). USA: CALIFORNIA: San Bernardino Co.: city of San Bernardino, Kendall neighborhood near NW end of College Avenue, 475 m elev. (34.178879°N, 117.343117°W; WGS84). 26 May 2010. Jonathan Hakim. Natural History Museum of Los Angeles County, LACM 179866. Verified by Neftali Camacho. Introduced population discovered in August 2007 by JB; lizards have continued to be seen in abundance at multiple life stages as of 16 July 2010. Lizards have been observed in an area of ca. 50 acres from Highway 215 northeast to Kendall Drive and from Jasmine Street northwest to the flood control channel that runs parallel to Campus Parkway. The lizards are exclusively found on residential fences and walls in a developed suburban neighborhood. The extent of the population and presence of juvenile lizards suggests the population is established and reproducing. This record is 205 km W of the westernmost native population, in the Corn Spring area on the northeast slope of the Chuckwalla Mts., Riverside Co., California (Stebbins 2003. A Field Guide to Western Reptiles and Amphibians. 3rd ed. Houghton Mifflin Co., Boston, Massachusetts. 533 pp.). Many of the local homeowners own boats, suggesting that the lizards may have been stowaways from boating trips to Lake Havasu or other nearby areas of the Colorado River where this species naturally occurs, or intentional releases from captures made on such trips.

Submitted by **JIM BASS**, 16933 Mission Avenue, Hesperia, California 92345, USA (e-mail: jimbass2001@yahoo.com); and **JONATHAN HAKIM**, 937 W. 57th Street, Los Angeles, California 90037, USA (e-mail: hakim.ndmva@gmail.com).

SQUAMATA — SNAKES

BOA CONSTRICTOR (Boa Constrictor). MÉXICO: HIDALGO: Municipality of Eloxochitlán: Reserva de la Biosfera de Metztitlán, San Juan Amaque (20.71449°N, 98.94825°W; WGS84), elev. 916 m. 18 April 2010. María Eugenia Mendiola. Verified by Jesús M. Castillo. Herpetological Photographic Collection, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CH CIB 2). First record for Eloxochitlán and Reserva de la Biosfera de Metztitlán, extending the range within the state ca. 38 km S of its closest known locality at Tepehuacán de Guerrero (Mendoza, et al. 2006. Publ. Espec. Soc. Herpetol. Mexicana [3]:99–109), and ca. 95 km W of Huehuetla (Goyenechea et al. 2009. Herpetol. Rev. 40:364). The snake was found on a tree in tropical deciduous forest.

Fieldwork was funded by CONACyT- 95828.

Submitted by **IRENE GOYENECHEA** (e-mail: ireneg@uaeh.edu.mx), **VICTOR D. VITE**, Centro de Investigaciones Biológicas (CIB), Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, Pachuca, Hidalgo, México; and **MA. EUGENIA MENDIOLA-GONZALEZ**, Reserva de la Biosfera Barranca de Metztitlán, Comisión Nacional de Áreas Naturales Protegidas, Loc. 61 y 62, Núcleo E, Plaza de las Américas, Fraccionamiento Valle de San Javier, C.P. 42086 Pachuca, Hidalgo.

CROTALUS TRANSVERSUS (Cross-banded Mountain Rattlesnake). MÉXICO: DISTRITO FEDERAL: Delegación Tlalpan, Volcán Xitle, San Andres Totoltepec (19.2462°N, 99.2070°W; WGS 84), elev. 2870 m. 21 July 2009. Eric Centenero Alcalá and Uri García. Verified by Luis Canseco Márquez. Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México (MZFCID-04). Second record for Distrito Federal and first record for Delegación Tlalpan, extending the known range of the species ca. 9 km from Cerro Panza, Valle del Tezontle, Delegación Magdalena Contreras (García-Vázquez et al. 2008. Herpetol. Rev. 39:484). The snake was found under a rock in oak forest.

Submitted by **ERIC CENTENERO-ALCALÁ**, Laboratorio de Ecología, Unidad de Biotecnología y Prototipos, Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México. Av. de los Barrios s/n, Los Reyes Iztacala, Tlalnepantla, México. C.P. 54090 (e-mail: eca_46@hotmail.com); **URI OMAR GARCÍA-VÁZQUEZ**, **ANDRÉS ALBERTO MENDOZA-**

HERNÁNDEZ, **JOAN GASTÓN ZAMORA-ABREGO**, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, Distrito Federal 04510, México; and **VÍCTOR HUGO JIMÉNEZ-ARCOS**, Laboratorio de Herpetología, Instituto de Biología, Universidad Nacional Autónoma de México. 3er Circuito exterior s/n, Ciudad Universitaria, Coyoacán, México, D.F. C.P. 04510.

EPICTA GOUDOTII (Black Threadsnake). MÉXICO: HIDALGO: Municipality of Hazalingo: Tepalcahuac (20.95852°N, 98.48527°W; WGS84), elev. 315 m. 01 September 2007. Victor D. Vite Silva and Alejandro Ramírez-Pérez. Verified by Raciel Cruz Elizalde. Colección de Anfibios y Reptiles del Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB 2181–2183). Municipality of Huautla: Tamayon (21.03457°N, 98.2886°W; WGS84), elev. 506 m. 10 November 2007. Victor D. Vite Silva and Alejandro Ramírez-Pérez. Verified by Raciel Cruz Elizalde. CIB 2184. First records for Hidalgo, extending the range ca. 147 km SW from the closest known locality, 2 km W of La Loma, Tamaulipas (Flores-Benabib and Flores-Villela 2008. Biol. Soc. Herpetol. Mexicana 16:13–14).

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Submitted by **URIEL HERNÁNDEZ SALINAS** (e-mail: uhhernandez3@gmail.com), **JUDITH PAMPA RAMÍREZ** (e-mail: judithpampa@gmail.com), **IRENE GOYENECHEA** (e-mail: ireneg@uaeh.edu.mx), **AURELIO RAMÍREZ BAUTISTA** (e-mail: aurelior@edu.uach.mx), and **VÍCTOR VITE SILVA,** Centro de Investigaciones Biológicas (CIB), Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, C.P. 42001, Pachuca, Hidalgo, México

FARANCIA ABACURA (Red-bellied Mudsnake). USA: GEORGIA: Peach Co.: DOR, State Rt. 49 at Mule Cr. (32.60278ºN; 83.79815ºW; no datum available). 8 May 2010. Digital image AHAP-D 246. First county record. Taylor Co.: DOR, State Rt. 96, 1 km E of Reynolds, at Flint River floodplain (Magnolia Swamp) (32.55267ºN; 84.05382ºW; no datum available). 08 May 2010. Digital image AHAP-D 245. First county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens. 575 pp.). Both specimens collected by S. Graham and verified by Craig Guyer. Decimal degrees of localities were determined using ACME Mapper 2.0 software (http://mapper.acme.com).

Submitted by **SEAN P. GRAHAM,** Auburn University, Department of Biological Sciences, 331 Funchess Hall, Auburn, Alabama 36849, USA; e-mail: grahasp@auburn.edu.

HETERODON PLATIRHINOS (Eastern Hognose Snake). USA: TEXAS: Caldwell Co.: Farm to Market Road 713 near the Caldwell/Bastrop Co. Line Road (29.82858°N, 97.39533°W; WGS 84). 12 April 2008. Romey Swanson. Verified by Travis LaDuc. Texas Natural History Collection (TNHC 82800). A single DOR was collected from the road shoulder. First county record (Dixon 2000. Amphibians and Reptiles of Texas: with Keys, Taxonomic Synopses, Bibliography, and Distribution Maps. Texas A&M University Press, College Station, Texas. 421 pp.). The individual measured 48.4 cm SVL and 60.0 cm total length and had a reddish base coloration often seen in specimens collected from Bastrop Co.

Submitted by **ROMEY L. SWANSON** (e-mail: romeyswanson@gmail.com) and **THOMAS R. SIMPSON** (e-mail: r_simpson@txstate.edu), Department of Biology, Texas State University, San Marcos, Texas 78666, USA.

LAMPROPELTIS CALLIGASTER (Mole Kingsnake). USA: GEORGIA: Putnam Co.: Burtom Rd. near Lake Sinclair (33.224543°N, 83.419154°W; WGS84). 18 April 2010. Alfred J. Mead. GCH 5280. Verified by Christopher E. Skelton. First county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens. 575 pp.). Single adult collected DOR on road flanked by mature pine forest and recently established pasture land.

Submitted by **ALFRED J. MEAD** (e-mail: al.mead@gcsu.edu) and **DENNIS PARMLEY**, Department of Biological and Environmental Sciences, Georgia College & State University, Milledgeville, Georgia 31061, USA.

LAMPROPELTIS GETULA (Common Kingsnake). USA: GEORGIA: Wilkes Co.: Tignall, Newtown Road, 1.6 km NW Elam Lunceford Road (33.87554°N, 82.83697°W, WGS84), elev. 163 m. 06 June 2009. Justin T. Oguni and Matthew A. King. Verified by Kenneth L. Krysko. Florida Museum of Natural History (photographic voucher UF 158417). New county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens. 575 pp.). Found AOR at 2145 h in mixed hardwood forest with residential homes.

Submitted by **JUSTIN T. OGUNI**, College of Veterinary Medicine, University of Georgia, Athens, Georgia 30602, USA; e-mail: goonie16@gmail.com

LAMPROPELTIS GETULA NIGRA (Eastern Black Kingsnake). USA: GEORGIA: Dade Co.: field ca. 100 m NE of jct of Higdon Creek and CR 13, ca. 5.9 air km W of Trenton (34.87262°N, 85.57365°W; NAD83). 17 May 2010. Houston C. Chandler. UF 157836. Verified by John B. Jensen and Kenneth Krysko. First county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens. 575 pp.). Single adult captured and photographed on the bank of a small farm pond. Rural area with mix of forest and pasture and a ca. 5 ha clearcut within sight of capture area.

Submitted by **HOUSTON C. CHANDLER** and **CHRISTOPHER E. SKELTON**, Department of Biological and Environmental Sciences, Georgia College & State University, Milledgeville, Georgia 31061, USA; e-mail: chris.skelton@gcsu.edu.

LEPTOTYPHLOPS HUMILIS (Western Threadsnake). USA: ARIZONA: Mohave Co.: Virgin River valley (36.841538°N, 113.982881°W, NAD 83), elev. 513 m. 24 July 2010. Steven Anderson. Verified by Tom Giermakowski. University of New Mexico Museum of Southwestern Biology (MSB 77882). This is the first record from the Arizona Strip and fills an important gap in the known distribution of the species. Other specimens have been recorded further south, along the lower Colorado River and from the Grand Canyon, Arizona (Brennan and Holycross 2006. Amphibians and Reptiles in Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 150 pp.) and to the northeast in Washington Co., Utah (A. Holycross, pers. comm.). NEVADA: Clark Co.: Virgin River Valley, Gold Butte recreation area (36.665935°N, 114.306052°W, NAD 83), elev. 396 m. 22 July 2010. Danny Nielsen. Verified by Andy Holycross. University of Arizona Museum of Natural History (UAZ 57242-PSV, photo voucher). This is the eighth record from southern Nevada and ca. 20 km from nearest known record in Overton, Nevada from 1939 (Grater 1981. Snakes, Lizards and Turtles of the Lake Mead Region. Southwest Parks and Monuments Association, Globe, Arizona. 48 pp.; P. Conrad, Nevada Department of Wildlife, pers. comm.), and ca. 40 km downstream from the Mohave Co., Arizona specimen reported above. Both specimens were collected from pitfall traps in upper riparian habitat of mesquite (*Prosopis* sp. and saltcedar (*Tamarix* sp.).

Collecting permits were issued by the Arizona Game and Fish Department (No. 195230) and Nevada Department of Wildlife (No. S32027).

Submitted by **HEATHER L. BATEMAN** (e-mail: heather.bateman@gmail.com) and **DANNY NIELSEN,** Arizona State University at the Polytechnic Campus, Department of Applied Sciences and Mathematics, 6073 S. Backus Mall, Mesa, Arizona 85212, USA (e-mail: dannynielsen0@gmail.com).

NERODIA ERYTHROGASTER FLAVIGASTER (Yellow-bellied Watersnake). USA: ARKANSAS: Calhoun Co.: DOR ~6 km N of Ouachita River on US 167 (33.392396°N, 92.493676°W; WGS 84). 09 September 2010. M. B. Connior. Verified by S. E. Trauth. Arkansas State University Museum of Zoology Herpetology Collection (photo voucher ASUMZ 31555). First county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. University of Arkansas Press, Fayetteville. 421 pp.). The species has also been collected from neighboring Bradley, Ouachita, and Union counties in southern Arkansas.

Submitted by **MATTHEW B. CONNIOR,** Health and Natural Sciences, South Arkansas Community College, 300 S. West Avenue, El Dorado, Arkansas 71730, USA; e-mail: mconnior@southark.edu.

OXYBELIS AENEUS (Mexican Vine Snake). MÉXICO: HIDALGO: Municipality of Tlahuiltepa: Boca de León (20.99139°N, 98.99193°W; WGS84), elev. 464 m. 18 November 2009. Victor D. Vite-Silva, Alejandro Ramírez-Pérez, and Oscar González-Solís. Verified by Norma Manríquez-Morán. Colección Herpetológica, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB-UAEH 2538). First record for the municipality, extending the range in Hidalgo ca. 43 km S from the closest known record at La Vega de Metztitlán, Municipality of Metztitlán (Gelover-Alfaro et al. 1999. Rev. Zool. [10]:6–8). The snake was found near a river in tropical deciduous forest.

Fieldwork was funded by CONACyT- 95828.

Submitted by **VICTOR D. VITE-SILVA, ALEJANDRO RAMÍREZ-PÉREZ, OSCAR GONZÁLEZ-SOLÍS, JESÚS M. CASTILLO,** and **IRENE GOYENECHEA**, Centro de Investigaciones Biológicas (CIB), Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, Pachuca, Hidalgo, México; e-mail: ireneg@uaeh.edu.mx.

OXYRHOPUS CLATHRATUS (False Coral Snake). BRAZIL: BAHIA: Municipality of Camacan: Uiraçu Farm, Serra Bonita (15.39405°S, 39.56887°W; Córrego Alegre 24S), elev. 930 m. 26 February 2010. I. Dias, T. Medeiros, and M. Vila Nova. Verified by M. Solé. Museu de Zoologia da Universidade Estadual de Santa Cruz, Ilhéus, Bahia, Brazil (MZUESC 8047). Known from Misiones, Argentina, and southeastern Brazil, from Rio Grande do Sul to Bahia (Argôlo 2001. Herpetol. Rev. 32:61; Peters and Orejas-Miranda 1986. Bull. U.S. Nat. Mus. 297:231). In the state of Bahia the species was known only from Barra do Choça municipality on the Planalto Sulbaiano, a plateau with elevations between 700 and 900 m. The specimen reported here was collected on a mountain ca. 115 km SE, far away and completely isolated from that plateau. The species has never been detected in the low adjacent areas, despite twenty years of intensive study, suggesting that at this latitude the taxon has isolated populations in mountains (Argôlo 2004. As Serpentes dos Cacauais do Sudeste da Bahia, Ilhéus, Editus. 260 pp.; Argôlo 2009. Composição faunística e distribuição geográfica de serpentes na Mata Atlântica do sul da Bahia. Tese de Doutorado, Museu Nacional, Universidade Federal do Rio de Janeiro. 274 pp.). Altough it is a terrestrial species, the specimen was found ca. 2.5 m above ground on vegetation.

Submitted by **TADEU TEIXEIRA MEDEIROS, IURI R. DIAS, MARCOS FERREIRA VILA NOVA,** and **ANTÔNIO JORGE SUZART ARGÔLO,** Universidade Estadual de Santa Cruz, Departamento de Ciências Biológicas, Rodovia Ilhéus-Itabuna, km 16, Salobrinho, CEP 45662-900, Ilhéus, BA, Brazil (e-mail: ajargolo@gmail.com).

PANTHEROPHIS SPILOIDES (Gray Rat Snake). USA: ALABAMA: Henry Co.: County Road 57 NE of Abbeville (31.637933°N, 85.172217°W; WGS84/NAD83). 01 June 2010. R. Birkhead. Verified by Craig Guyer. AUM 38896. New county record. Found dead on road. *Pantherophis spiloides* has been previously documented in all surrounding counties of Alabama, but the related *P. alleghaniensis* has not been documented in adjacent Clay Co., Georgia (Jensen et al.. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, Georgia. 575 pp.; Mount 1996. The Amphibians and Reptiles of Alabama. University of Alabama Press. xi+347 pp.).

Submitted by **ROGER D. BIRKHEAD**, Alabama Science In Motion, Auburn University, Alabama 36849-5414, USA; e-mail: birkhrd@auburn.edu.

PITUOPHIS CATENIFER SAYI (Bullsnake). USA: WISCONSIN: Pepin Co.: Township of Lima (44.673181°N, 91.871867°W; no datum available.). Verified by Christopher Phillips. Voucher photograph, Illinois Natural History Survey(INHS 2010i). New county record. Fills a gap in the currently known range of this species in Wisconsin (Casper 1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin. Milwaukee Public Museum, Milwaukee, Wisconsin. 87 pp.). Several adults were photographed near a possible den location on 26 April 2010, and had been observed in the same general area during the spring of previous years (BB). Old egg remnants encountered near the individuals photographed in 2010 suggest that this may also be a nesting site for females. The property where the observations were made is an open grassland habitat parcel currently enrolled in the U.S. Department of Agriculture-Farm Service Agency's Conservation Reserve Program. Most adjacent land parcels appear to be dominated by active agriculture. This observation supplements unverified reports from near the township of Durand (Pepin Co.) taken in 2004 and 2008 by Wisconsin Department of Natural Resources employees. It also complements a specimen from adjacent Pierce Co. vouchered in 1988 by J. Moriarty, B. Oldfield, and D. Jones (James Ford Bell Museum 13235), and voucher photographs from adjacent Eau Claire Co. taken by J. Polk in 1988 (Milwaukee Public Museum photograph catalogue number 195-98), and Dunn Co. taken by J. Polk in 1995 (Milwaukee Public Museum photograph catalogue number 561).

Submitted by **BRENT BAUER**, W4292 State Hwy 85, Durand, Wisconsin 54736, USA; **JOSHUA M. KAPFER**, Departments of Environmental Studies and Biology, Elon University, Elon, North Carolina, 27244, USA; **RICHARD A. STAFFEN**, Wisconsin Department of Natural Resources-Bureau of Endangered Resources, 101 S. Webster St., PO Box 7921, Madison, Wisconsin, 53707-7921, USA; and **GARY S. CASPER**, University of Wisconsin-Milwaukee Field Station, 3095 Blue Goose Rd, Saukville, Wisconsin, 53080, USA.

RAMPHOTYPHLOPS BRAMINUS (Brahminy Blind Snake). USA: CALIFORNIA: San Diego Co.: City of Chula Vista, Norman Park, 270 F Street (32.64101ºN, 117.07806ºW; NAD 83). 07 November 2006. Marcos Dominguez, Sarmed D. Alzubaidi, and Stanley O'Gara. A second specimen was collected on 28 September 2009 by Daniel D. Palmer, Tony E. Garcia, Trevor H. Jordan. Verified by Jens Vindum. California Academy of Sciences (CAS 244221–244222). This is the first record for California and the west coast of the USA (Kraus 2009. Alien Reptiles and Amphibians: A Scientific Compendium and Analysis. Invading Nature: Springer Series in Invasion Ecology 4. Springer-Verlag. 563 pp.). Apparently reproducing and established given that the first specimen was an adult collected in 2006 and the second specimen collected in 2009 was a small juvenile. Both were found in an urban setting. It is not known if this species will invade native habitats in southern California or presents a risk to native species. Urban Chula Vista is dominated by invasive Argentine Ants (*Linepithema humile*) and it is assumed that this invasive will be abundant prey for the snake.

Submitted by **DANIEL D. PALMER**, Wildlife Research Institute, 18030 Highland Valley Road, Ramona, California 92065, USA; and **ROBERT N. FISHER** U.S. Geological Survey, San Diego Field Station, 4165 Spruance Road, Suite 200, San Diego, California 92101-0812, USA; e-mail: rfisher@usgs.gov.

RAMPHOTYPHLOPS BRAMINUS (Brahminy Blindsnake). FEDERATED STATES OF MICRONESIA: KOSRAE: Malem Municipality: 5.302888˚N, 163.028277˚E (WGS 84), elev. 10 m). 22 September 2009. Kenneth R Wood and Wayne Law. Verified by Allen Allison. Bernice P. Bishop Museum (BPBM 36041). New island record for Kosrae. Nearest previous recording ca. 560 km west on Lenger Island, Pohnpei, Federated States of Micronesia (Wallach 2009. Hamadryad 34:34–61). Individual, 65 mm long, collected near house adjacent to swamp forest with associated vegetation of *Horsfieldia irya*, *Neubergia celebica*, *Cocos nucifera*, and *Hibiscus tiliaceus*.

Submitted by **KENNETH R. WOOD**, National Tropical Botanical Garden, 3530 Papalina Road, Kalāheo, Kaua'i, Hawai'i 96741, USA (e-mail: kwood@ntbg.org); and **WAYNE LAW**, The New York Botanical Garden, 2900 Southern Blvd, Bronx, New York 10458, USA (e-mail: wlaw@nybg.org).

RAMPHOTYPHLOPS BRAMINUS (Brahminy Blindsnake). HONDURAS: SANTA BÁRBARA: 1 km S of San José de Colinas (15.05°N, 88.30°W; WGS84), elev. 380 m. 30 July 2008. Mario R. Espinal and Leonel Marineros. Verified by Steve W. Gotte. USNM 562754. First record for Honduran mainland and second for Honduras. The only previous Honduran record was from Isla de Utila, Islas de la Bahía (Vesely and Köhler 2009. Herpetol. Rev. 40:116). The snake was found under a rock in leaf litter on a hillside in subhumid forest.

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RAMPHOTYPHLOPS BRAMINUS (Brahminy Blind Snake). KIRIBATI: GILBERT ISLANDS: Tarawa Island: Banreaba Village, South Tarawa (1.3457ºN, 173.0357ºE; WGS 84). July 2009. Ross Craven. AMS R174495. Nabeina Islet: North Tarawa (1.4457ºN, 173.0779ºE; WGS 84). 2007. Ross Craven. AMS R1744496. Verified by R. Sadlier. First confirmed records for Kiribati (Bonin and Shea 2009. Herpetofauna 39:74–77). Only previous record for Kiribati is inclusion of Gilbert Islands in a statement of extralimital distribution in an account of Sumatran snakes, without details, voucher, or bibliographic reference (David and Vogel 1996. The Snakes of Sumatra. An Annotated Checklist and Key with Natural History Notes. Edition Chimaira, Frankfurt am Main. 260 pp.). Nearest records are for Marshall Islands (Knight 1984. Herpetol. Rev. 15:115), and Nauru (Buden 2008. Pacific Sci. 62:499–507).

Found while digging in top 15–30 cm of soil (well drained coral sands with organic matter) adjacent to houses. Dominant vegetation consists of coconut (*Cocos nucifera*), *Guettarda speciosa, Morinda citrifolia*, *Pandanus tectorius*, and *Premna serratifolia* in upper and middle stories, with grass *Dactyloctenium aegyptium* at ground level. Other plants present are Breadfruit (*Artocarpus altilis*), Frangipani (*Plumeria obtusa*), *Calophyllum inophyllum*, *Ficus tinctoria*, and *Heliotropum foertherianum*, and several grasses including *Cenchrus echinatus*, *Digitaria setigera*, *Eragrostis amabilis*, *Eleusine indica*, *Lepturus repens*, *Paspalum distichum*, *Stenotaphrum micranthum*, and *Thuarea involuta*.

Submitted by **ROSS CRAVEN**, Banraeaba Village, Tarawa, Kiribati (e-mail: ross.craven@unifem.org); and **GLENN M. SHEA**, Faculty of Veterinary Science B01, University of Sydney, New South Wales 2006, Australia (e-mail: glennshea@sydney.edu.au).

RAMPHOTYPHLOPS BRAMINUS (Brahminy Blind Snake). MÉXICO: HIDALGO: MUNICIPALITY OF TASQUILLO: Tzindeje (20.56394°N, 99.31800°W; WGS84), elev. 1617 m. 12 July 2008. Luis Alberto Trejo Corona. Verified by Adrian Leyte Manrique. Colección de Anfibios y Reptiles del Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo (CIB-2346). First record for Hidalgo, extending its known range ca. 125 km airline NW from the nearest record in Distrito Federal (Mancilla-Moreno and Ramírez-Bautista 1998. Herpetol. Rev. 29:54). The snake was found during the day among fallen logs and sand in thornscrub.

We received support from Diversidad Biológica del Estado de Hidalgo and FOMIX-CONACYT- HIDALGO 43761, 95828, and funding for fieldwork by S52552-Q.

Submitted by **URIEL HERNÁNDEZ SALINAS** (e-mail: uhernndez3@gmail.com) and **AURELIO RAMÍREZ BAUTISTA,** Centro de Investigaciones Biológicas (CIB), Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, C.P. 42001, Pachuca, Hidalgo, México (e-mail: aurelior@edu.uaeh.mx).

SISTRURUS MILIARIUS (Pygmy Rattlesnake). USA: GEORGIA: BARTOW CO.: SR 293, 0.3 mi W of Todd Rd. NW (34.24231ºN, 85.01112ºW; WGS84; Coord Precision: 50; Georef Source: Google Earth ver. 4.0.2091). 10 August 2010. Grover J. Brown. Verified by Kenneth L. Krysko. UF 154935. New county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, Georgia. 575 pp.).

Submitted by **GROVER J. BROWN**, University of Georgia, Odum School of Ecology, Athens, Georgia 30602, USA; e-mail: Turtles328@gmail.com

STORERIA OCCIPITOMACULATA (Red-bellied Snake). USA: GEORGIA: BULLOCH CO.: 0.5 km S of East Main Street along Willie McTail Trail in Statesboro (32.26604°N, 81.46927°W; datum not available). 26 June 2010. Submitted by Daniel May and Lance McBrayer. Verified by Ray Chandler. Georgia Southern University Herpetology Collection. GSU 9731, 9732. New county record (Jensen et al. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, Georgia 404 pp.). Originally captured on 01 February 2010 and released; then recaptured in the same location (~10 m from creek) under rotten hardwood log covered with kudzu. The gravid female, (GSU 9731; 152 mm SVL, 195 mm TL) gave birth to five offspring in captivity (GSU 9732; mean SVL 57 mm, 75 mm TL). Each animal was photographed and released.

Submitted by **DANIEL MAY** and **LANCE McBRAYER**, Department of Biology, Georgia Southern University, Statesboro, Georgia 30460, USA.

STORERIA OCCIPITOMACULATA OCCIPITOMACULATA (Northern Red-bellied Snake). USA: ARKANSAS: GRANT CO.: 1.6 km N of Leola off St. Hwy 46 (34.184684˚N, 92.582645˚W; WGS 84). 15 June 2005. H. W. Robison. Verified by R. Tumlison. Henderson State University Herpetological Collection (HSU 1556). New county record. Helps fill a distributional hiatus in central Arkansas between Jefferson and Hot Spring counties (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.).

Submitted by **CHRIS T. McALLISTER**, Science and Mathematics Division, Eastern Oklahoma State College, 2805 NE Lincoln Road, Idabel, Oklahoma 74745, USA (e-mail: cmcallister@se.edu); and **HENRY W. ROBISON**, Department of Biology, Southern Arkansas University, Magnolia, Arkansas 71754, USA (e-mail: hwrobison@yahoo.com).

SYMPHOLIS LIPPIENS (Mexican Short-tailed Snake). MEXICO: JALISCO: MUNICIPALITY OF PUERTO VALLARTA: 1 km W Quimixto (20.50289°N, 105.37747°W; WGS84), elev. 91 m. 29 July 2008. Marko Antonio Guzmán Vargas. Verified by Luis Canseco Márquez. Colección Herpetológica del Museo de Zoología Alfonzo L. Herrera, Facultad de Ciencias, UNAM (MZFCID 03). First record from Puerto Vallarta, which bridges a distributional gap between 16.8 miles (26.88 km) E of San Blas, Nayarit (Zweifel 1959. Am. Mus. Novit. 1949:1–9) and Guadalajara, Jalisco, the type locality for the species (Smith and Taylor 1945. U.S. Nat. Mus. Bull. 187:iv + 1–239). The snake was found in tropical deciduous forest.

Submitted by **IVÁN T. AHUMADA CARRILLO** (e-mail: lepidus320@hotmail.com.) and **MARKO ANTONIO GUZMÁN VARGAS**, Centro Universitario de Ciencias Biológicas y Agropecuarias, Universidad de Guadalajara, Carretera a Nogales Km. 15.5, Las Agujas, Nextipac, Zapopan, Jalisco, México; and **URI OMAR GÁRCIA-VÁZQUEZ**, Laboratorio de Herpetología, Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México, A.P. 70-399, México, D.F. 04510, México.

TANTILLA OOLITICA (Rim Rock Crowned Snake). USA: FLORIDA: MONROE CO.: Big Pine Key, Ixora Drive (24.6814°N, 81.3519°W; NAD 83). 18 December 2007. Michael A. Yirka, Joseph Flowers, Michael D. Martin, Kevin R. Messenger, and Nathan A. Shepard. Verified by Kenneth L. Krysko. Florida Museum of Natural History (UF photograph 152546). Island record. Extends the range 26.7 km west of the closest known locality on Vaca Key (Krysko and Decker 1996. Herpetol. Rev. 27:215). Only known Lower Keys record outside of questionable Key West specimen (Telford 1966. Bull. Florida St. Mus. Biol. Ser. 10:261–304).

Submitted by **MICHAEL A. YIRKA**, 6016 Countryview Ln, Raleigh, North Carolina 27606, USA; **JOSEPH N. FLOWERS**, 4325 Inwood Road, Raleigh, North Carolina 27603, USA; **MICHAEL D. MARTIN**, University of South Carolina, Department of Biological Sciences, Coker Life Sciences Room 706, Columbia, South Carolina 29208, USA; **KEVIN R. MESSENGER**, Marshall University, Department of Biological Sciences, One John Marshall Drive, Huntington, West Virginia 25703, USA; and **NATHAN A. SHEPARD**, Marshall University, Department of Biological Sciences, One John Marshall Drive, Huntington, West Virginia 25703, USA (e-mail: nathan.zoology@gmail.com).

TROPIDOCLONION LINEATUM (Lined Snake). USA: NEW MEXICO: OTERO Co.: 1.93 km E of Mayhill on US Hwy 82 and 0.32 km N on Cherry Lane (32.90860°N, 105.46993°W; NAD83/WGS84), elev. 2016 m. 07 July 2006. Ian W. Murray and Christopher Newsom. Verified by J. Tomasz Giermakowski. University of New Mexico Museum of Southwestern Biology (MSB 72651). New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. New Mexico Press, Albuquerque. 431 pp.). The specimen was found under a small board on moist soil. Other reptile species noted nearby included *Diadophis punctatus*, *Opheodrys vernalis*, *Sceloporus poinsettii*, *S. cowlesi*, and *Phrynosoma hernandesi*. During September 2005 EM found and photographed an adult female *T. lineatum* at this location, but it was not collected.

Submitted by **IAN W. MURRAY**, MSC03 2020, Department of Biology, 1 University of New Mexico, Albuquerque, New Mexico 87131-0001, USA (e-mail: imurray@unm.edu); **ERIK McCORMICK**, 1011 S Yates St., Artesia, New Mexico 88210-2747, USA (e-mail: nmherper@hotmail.com); and **CHRISTOPHER NEWSOM**, 5519 Amistad Rd. NE, Albuquerque, New Mexico 87111-1549, USA (e-mail: herpsofnm@comcast.net).

TROPIDODIPSAS FASCIATA (Banded Snail Sucker). MÉXICO: GUERRERO: MUNICIPALITY OF ZIHUATANEJO: 27 km SW Vallecitos de Zaragoza, on México Hwy 134 (17.782°N, 101.478°W; WGS84), 333 m elev. 02 September 2008. William H. Mertz. Verified by Coleman M. Sheehy III. UTA digital collection (UTADC 3702). New municipality record, which extends the range of the species ca. 200 km W of its closest known localities in central Guerrero (Kofron 1987. J. Herpetol. 21:210–225). The snake was found AOR at night in tropical deciduous forest.

Submitted by **WILLIAM H. MERTZ**, Avenida La Playa, Troncones, La Union, Guerrero, México 39270 (e-mail: Crotalus_mx@yahoo.com); **JACOBO REYES-VELASCO**, Centro Universitario de Ciencias Biológicas y Agropecuarias, Carretera a Nogales Km. 15.5. Las Agujas, Nextipac, Zapopan, Jalisco, México (e-mail: jackobz@gmail.com); and **CHRISTOPH I. GRÜNWALD**, Casa Mexico Real Estate, Ajijic Plaza #1, Ajijic, Jalisco, México (e-mail: cgruenwald@switaki.com).

TROPIDOPHIS GREENWAYI GREENWAYI (Big Ambergris Cay Dwarf Boa). TURKS AND CAICOS ISLANDS: BIG AMBERGRIS CAY: N end of island (21.317°N, 71.630°W; WGS84), elev. 3 m. 20 March 2009. J. Burgess, G. Gerber, and G. Reynolds. Verified by J. Iverson. Color photographic voucher, Austin Peay State University (APSU 19018). First published record for Big Ambergris Cay, the type locality, since 1936 and only the third individual ever encountered on the island. Because it had not been found since 1936, despite a great deal of herpetological investigations, the species was thought to have been extirpated from the Island (Iverson 1986. Carib. J. Sci. 22:191–198). The male snake was encountered at night, during a light rain, on a dirt road at the base of a rocky hillside.

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Noteworthy Distribution Records of Reptiles from Western Panamá

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Despite of its small size, Panamá is home to 251 species of reptiles, including 89 lizards and 143 snakes (Jaramillo et al. 2010; Köhler 2010; Köhler et al. 2010). The descriptions of new reptiles continue at a steady pace (e.g., Cadle and Myers 2003; Hulebak et al. 2007; Köhler 2010; Köhler et al. 2010, 2007; Köhler and Sunyer 2008; Myers 2003; Poe and Ibañez 2007; Poe et al. 2009; Savage and Watling 2008; Savage et al. 2008), indicating that our knowledge of the Panamanian herpetofauna is still fragmentary and investigative work remains to be done. This applies to taxonomic issues as well as to biogeography. Additionally, the distributions of many species occurring within Panamá are poorly documented. Apart from information scattered among local checklists and publications on single species, only four comprehensive works exist for the country. Pérez-Santos (1999) presented distribution maps with precise collecting localities for 129 snake species. Köhler (2008) provided distribution maps for 238 reptile species occurring in Panamá. Some of the maps pinpoint actual collection sites, but most reflected areas of generalized distribution. The only work considering distribution of the herpetofauna among Panamá's political subdivisions was by Young et al. (1999), therein summarizing the distribution of 228 species at the province level. However, their distributional records were not supported by reference to voucher material, and they did not include the results of two extensive regional inventories by Martínez and Rodriguez (1992) and Martínez et al. (1994). Recently, Jaramillo et al. (2010) summarized the distribution of the Panamanian herpetofauna within physiographic regions and vegetation zones.

During field work on reptiles conducted in western Panamá between May and August 2008, we visited localities within the provinces of Bocas del Toro, Chiriquí, Veraguas, and Comarca Ngöbe-Buglé (a recently established indigenous autonomous region that comprises areas formerly belonging to the other three provinces) (Fig. 1). We collected 217 samples representing 72 species and 17 of those constitute extensions of their known distributions in Panamá. We herein report distribution extensions of

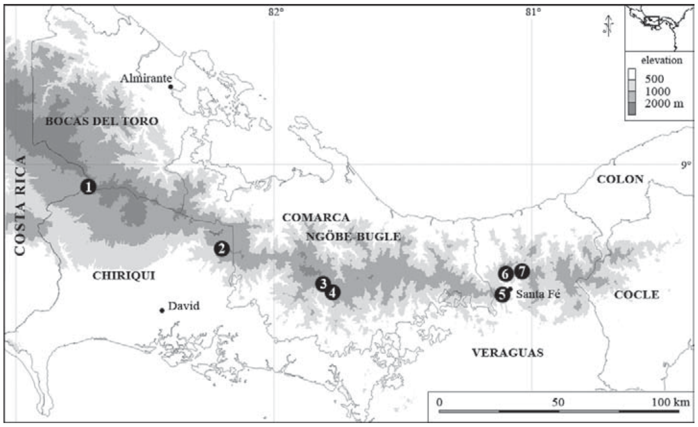

FIG. 1. Generalized localities in western Panamá visited by the authors in 2008: 1) Jurutungo, Chiriquí; 2) Reserva Forestal La Fortuna, Chiriquí; 3) road to Cerro Colorado, Comarca Ngöbe-Buglé; 4) La Nevera, Comarca Ngöbe-Buglé; 5) Cerro Mariposa (= Cerro Tute), Veraguas; 6) Cerro Negro, Veraguas; 7) Río Chilagres, Veraguas.

those 17 species, 11 of which are new provincial records; other accounts list new elevational parameters for the species.

Abbreviations for museum collections follow those of Leviton et al. (1985). Elevations were rounded to the next tenth. The map (Fig. 1) was created using DIVA-GIS and the NASA elevation datasets processed by Jarvis et al. (2006); map datum is WGS84. All vouchers were verified by Javier Sunyer. Common names came from Frank and Ramus (1995), except for *Leposoma southi* (Uetz 2008), *Urotheca guentheri* (Solórzano 2004), and by us herein for *Anolis fortunensis* and *A. pseudopachypus,* two species for which there are no published common names. We decided that for those two species, the common names should denote their type localities; Reserva Forestal La Fortuna, Panamá, and La Nevera, Panamá, respectively.

Squamata — Lizards

Sphaerodactylidae

Lepidoblepharis xanthostigma (Costa Rica Scaly-eyed Gecko). VERAGUAS: Cerro Mariposa, near Alto de Piedra, ca. 3.5 km W of Santa Fé (8.5161°N, 81.1185°W), 880 m elev. 12 May 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89576. Cerro Negro, ca. 6 km NNW of Santa Fé (8.5690°N, 81.0989°W), 700 m elev. 28 July 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89963. Martínez and Rodriguez (1992), in their inventory of "Cerro Tute" (= Cerro Mariposa) and Martínez et al. (1994) in their species list of the nearby mountains, Narices and La Anselma, both reported the presence of *Lepidoblepharis* sp., and considered them to resemble *L. xanthostigma*. However, because the specific identities of these geckos were not made and the respective voucher specimens were lost (V. Martínez pers. comm.), our records represent the first confirmed occurrence for the species in Veraguas. The records also fill the gap between records to the west in Chiriquí and Bocas del Toro and the east in Coclé and Colón (Young et al. 1999).

Gymnophthalmidae

Leposoma southi (Northern Spectacled Lizard). VERAGUAS: Cerro Mariposa, near Alto de Piedra, ca. 3.5 km W of Santa Fé (8.5095°N, 81.1173°W), 900 m elev. 2 August 2008. Leonhard Stadler and Nadim Hamad. SMF 89577. This record extends by 200 m, the upper confirmed elevational limit for the species previously reported by Savage (2002) and Köhler (2008). The presence of *L. southi* around Alto de Piedra was documented by Martínez and Rodriguez (1992). However, elevational distribution for their individual records was unspecified; only a general elevational range of between 800 m and 1450 m was given.

Hoplocercidae

Enyalioides heterolepis (Bocourt's Dwarf Iguana). VERAGUAS: Cerro Negro, ca. 6 km NNW of Santa Fé (8.5690°N, 81.0989°W), 700 m elev. 30 July 2008. Sebastian Lotzkat. SMF 89558. Cerro Negro, 6 km NNW of Santa Fé (8.5693°N, 81.1022°W), 713 m elev. 28 June 2008. Arcadio Carrizo. SMF 89955–56. First records for Veraguas, extending the range more than 50 km W of the formerly westernmost record from El Copé, Coclé (Lips 1999). Köhler (2008) mentioned a record of *E. heterolepis* from Bocas del Toro, which as far as we can tell is not supported by a voucher specimen. A now lost individual from Cerro Narices (between Cerro Negro and Río Chilagres, see Fig. 1) that was listed as *Sceloporus squamosus* by Martínez et al. (1994), actually represented an *E. heterolepis* (A. Rodriguez, pers. comm.).

Polychrotidae

Anolis auratus (Grass Anole). VERAGUAS: road between Santiago and Santa Fé, ca. 8 km N of Santa Fé; (8.1796°N, 80.951°W), 80 m elev. 14 May 2008. Andreas Hertz. SMF 89444. First record for Veraguas, bridging the gap between localities in Chiriquí to the west and Los Santos, Colón, and Panamá to the east (Köhler et al. 2008; Young et al. 1999).

Anolis capito (Bighead Anole). CHIRIQUÍ: Reserva Forestal La Fortuna (8.6744°N, 82.2161°W), 1460 m elev. 16 June 2008. Andreas Hertz. SMF 89449. This record increases the known elevational limit for the species by 160 m (Köhler 2008).

Anolis fortunensis (La Fortuna Anole). CHIRIQUÍ: Reserva Forestal La Fortuna (8.6776°N, 82.1981°W), 1750 m elev. 27 June 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89466. This record extends the known elevational range of the species by 550 m (Köhler 2008).

Anolis humilis (Humble Anole). CHIRIQUÍ: Reserva Forestal La Fortuna (8.6761°N, 82.2006°W), 1660 m elev. 27 June 2008. Sebastian Lotzkat. SMF 89480. This record increases the known elevational range by 60 m (Köhler 2008).

Anolis pseudopachypus (La Nevera Anole). CHIRIQUÍ: Reserva Forestal La Fortuna (8.6761°N, 82.2006°W), 1660 m elev.; (8.6793°N, 82.193°W), 1800 m elev. 25 and 27 June 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89523, 89526, respectively. First records for Chiriquí, and extends the range ca. 50 km WNW of the type locality (La Nevera, Comarca Ngöbe-Buglé; Köhler et al. 2007). COMARCA NGÖBE-BUGLÈ: Valley north of La Nevera, ca. 5.5 km N of Hato Chamí (8.5018°N, 81.7689°W), 1560 m elev. 9 August 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89519–89521. Ridgetop NE of La Nevera, ca. 5.5 km N of Hato Chami (8.4954°N, 81.7673°W), 1810 m elev. 18 August 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89522. These records, near the type locality of *Anolis pseudopachypus*, represent the lowest and highest elevational records, respectively, for the species, which was previously known only from 1600 m elevation (Köhler et al. 2007).

Anolis salvini (Salvin's Anole). CHIRIQUÍ: Jurutungo, near border with Costa Rica (8.912°N, 82.7182°W), 1980 m elev. 8 July 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89527. This record extends the known elevational distribution of the species upward ca. 150 m (Köhler 2008; Savage 2002).

Anolis vittigerus (Garland Anole). VERAGUAS: Río Chilagres, ca. 9 km NE of Santa Fé (8.5872°N, 81.0363°W), 480 m elev. 3 June 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89528. First record for Veraguas, extending the range ca. 50 km W of the formerly westernmost record from north of El Copé, Coclé (Poe and Ibañez 2007).

Squamata — Snakes

Colubridae

Dipsas articulata (American Snail-eater). VERAGUAS: Cerro Negro, ca. 6 km NNW of Santa Fé (8.5756°N, 81.0976°W), 1000 m elev. 29 July 2008. Arcadio Carrizo. SMF 89552. Since locality data for the holotype of *D. articulata* is imprecise (see remarks in Peters 1960), this is the first validated record for Veraguas. The record reconfirms the species' occurrence at 1000 m, reported as its upper elevational limit by Solórzano (2004).

Dipsas temporalis (Temporal Snail-eater). VERAGUAS: Cerro Mariposa, near Alto de Piedra, ca. 3.5 km W of Santa Fé (8.5107°N, 81.1207°W), 990 m elev. 10 July 2008. Leonhard Stadler and Nadim Hamad. SMF 89552. First record for Veraguas, and a range extension of ca.130 km W of the South slope of Cerro La Campana, the formerly westernmost record in Panamá (Pérez-Santos 1999). Another specimen (SMF 89553) found nearby (8.5245°N, 81.1332°W), 700 m elev., on 5 August 2008 was acquired at the lowest elevation reported for this species (Pérez-Santos 1999).

Imantodes cenchoa (Blunt-headed Tree Snake). COMARCA NGÖBE-BUGLÈ: road to Cerro Colorado west of La Nevera, ca. 10 km NNW of Hato Chamí (8.5303°N, 81.7987°W), 1660 m elev. 10 May 2008. Andreas Hertz. SMF 89573. The locality is situated at an elevation 160 m above that reported for the species by Solórzano (2004).

Oxyrhopus petola (Calico False Coral Snake). VERAGUAS: Río Chilagres, ca. 9 km NE of Santa Fé (8.5872°N, 81.0363°W), 480 m elev. 3 June 2008. Andreas Hertz and Sebastian Lotzkat. SMF 89585. First record for Veraguas, which bridges a distributional gap between localities in the provinces of Chiriquí and Bocas del Toro to the west and Colón and Panamá to the east (Young et al. 1999).

Urotheca guentheri (Striped Glasstail). VERAGUAS: Cerro Mariposa, near Alto de Piedra, ca. 3.5 km W of Santa Fé (8.5002°N, 81.1175°W), 1250 m elev. 5 June 2008. Leonhard Stadler and Nadim Hamad. SMF 89603. First record for Veraguas, filling a gap between localities in the provinces of Bocas del Toro (La Loma, ca.120 km NW) and Coclé (about 110 km E) (Myers 1974).

Viperidae

Bothriechis nigroviridis (Black-speckled Palm Viper). COMARCA NGÖBE-BUGLÈ: La Nevera, ca. 5.5 km N of Hato Chamí (8.4996°N, 81.77°W), 1650 m elev. 11 May 2008. Andreas Hertz, Leonhard Stadler, Nadim Hamad, and Sebastian Lotzkat. SMF 89534. First record for Comarca Ngöbe-Buglé, and an 80 km E range extension from the formerly easternmost record in Boquete, Chiriquí (Dunn 1947).

Bothriechis schlegelii (Eyelash Palm Viper). VERAGUAS: Cerro Mariposa, near Alto de Piedra, approx. 3.5 km W of Santa Fé (8.5157°N, 81.1197°W), 860 m elev. 13 May 2008. Gunther Köhler. SMF 89535. First record for Veraguas, which fills the gap between Isla Escudo de Veraguas, Comarca Ngöbe-Buglé (ca. 85 km NW), and El Valle de Anton, Coclé (ca. 105 km E) (Pérez-Santos 1999).

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BOOK REVIEWS

Herpetological Review, 2010, 41(4), 523–525.
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Agamid Lizards of Southern Asia — Agamen des südlichen Asien — Draconinae 2, Leiolepidinae, by Ulrich Manthey. 2010. Terralog Vol. 7b. Edition Chimaira, Frankfurt am Main. 168 pp. Hardcover. 39,80 Euros (approximately US $50.00). ISBN 978-3-89973-375-4.

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Only a handful of researchers work on South Asian agamids. Synthetic works on this group are scarce, and a new book on this subject is hence very welcome. It follows a first volume in the Terralog series on South Asian agamids, that included only part of the Draconinae (Manthey 2008), and it aims to list and illustrate the remaining taxa that were not dealt with in that first volume. Taxa newly dealt with are all currently recognized Draconinae belonging to genera starting with the letters G to S (*Gonocephalus*, *Harpesaurus*, *Hypsicalotes*, *Japalura*, *Lophocalotes*, *Lyriocephalus*, *Mantheyus*, *Mictopholis*, *Oriocalotes*, *Otocryptis*, *Phoxophrys*, *Psammophilus*, *Pseudocalotes*, *Pseudocophotis*, *Ptyctolaemus*, *Salea,* and *Sitana*), the Leiolepidinae (*Leiolepis*) and the genus *Physignathus* (whose subfamilial position is still unclear), as well as several undescribed taxa. The book, well bound and with high-quality glossy paper, is bilingual (English-German). It is divided mainly into a table of contents (pp. 3–5), an introduction in which the author gives his point of view on the taxonomic status of various taxa (pp. 6–8), a section on how to use the book, which provides brief advice on captive maintenance (pp. 9–11), literature references (pp. 12–14), and the main section, the species illustrations (pp. 16–168). The front and back covers are finely illustrated and the inner covers provide geographical and political maps of the area covered.

The literature section is short (147 references) and does not provide an exhaustive list of publications on the species concerned, but rather useful references to original descriptions. The most recent references date from 2009.

Color illustrations are provided for each species and represent the strongest point of the book. We counted a total of 524 photographs (not including the nine images on the front and back covers). Twenty-nine of them are biotope photographs. Besides these color photographs, there are four drawings. Only ten species are not illustrated alive, but by drawings or through photographs of preserved type material (clearly indicated as such). All photographs are of very high quality (the whole book is a real delight for the eyes), and many of them, taken *in situ*, provide useful information on biotopes. One of the photographs, showing a *Mantheyus* hatching *in situ*, deserves a special mention. Nearly all of the photographs are accompanied by locality data, which increases their value. Each picture is also associated with a unique coded number, facilitating reference to it, and under each species' pictures, symbols (explained on a folded page) add ecological information. Maps are provided for all species, generally with several species per map. Thirty-three species' geographical distribution maps are distributed throughout the illustrations section. They are not always complete (i.e., some published localities were sometimes omitted), but are generally very good. A very good point is that they include specific dots for the type localities of the species as well as of their synonyms. When for a given species the map is not in direct proximity to the corresponding photograph(s) there is a reference to the map page, which greatly facilitates the use of the book.

One hundred described taxa are included and illustrated, plus eleven populations whose status is unresolved, among them some representing taxa new to science. The most remarkable undescribed taxon photographed is a beautiful green arboreal agamid from Sumatra, provisionally called 'Genus X sp. A'. The others belong to *Gonocephalus*, *Phoxophrys*, *Pseudocalotes*, and *Sitana*. The photographs of these possibly undescribed taxa were smartly included directly near the most similar described species in order to facilitate visual comparisons. Some readers might wonder why the book does not mention *Physignathus lesueurii*, while it has a section on *P. cocincinus*. It is due to the fact that both species were recently shown to be distant and not congeneric, *P. lesueurii* belonging to the *Amphibolorus* group (Hugall et al. 2008).

The book proposes a new generic reallocation '*Pseudocalotes kakhienensis* nov. comb.,' for a species previously included in *Salea*; the rationale for this new placement is briefly mentioned on page 8. Such a reallocation should have deserved a more detailed explanation, but more details can be found in Mahony (2010) who reached the same conclusion in a paper published shortly after the book discussed here. It is to be noted that the monotypic genus *Mictopholis*, recognized as valid by Manthey in the presently reviewed book, is synonymized with *Pseudocalotes* by Mahony (2010). This latter author moreover synonymized *Japalura kaulbacki* with *Calotes kingdonwardi* and transferred it to the genus *Pseudocalotes*. The species had been illustrated under *Calotes k. kingdonwardi* and its synonym *C. kingdonwardi bapoensis* in the first Terralog volume on Draconinae (Manthey, 2008, pages 72–73). '*Pseudocalotes* sp. A' (pp. 144–145) was described as *Pseudocalotes ziegleri* Hallermann, Nguyen, Orlov & Ananjeva, 2010 (Hallermann et al. 2010) just after the book was published. It is a pity that such important changes could not be taken into account in the book.

Several individuals of 'Genus X sp. A' were preserved and currently are under study by one of us (DTI). Unfortunately only females are so far available. The individual in photograph RA02341-4 on page 54, identified as '? *Harpesaurus brooksi,*' is not a *Harpesaurus* (or *Thaumatorhynchus*), but more likely a *Pseudocalotes tympanistriga*; compare with the female of that latter species on photograph RA03696-4 on page 143, showing the very same color pattern. We are unclear as to Manthey's basis for regarding the genus *Thaumatorhynchus* as a synonym of *Harpesaurus*, in spite of striking differences in habitus—roundish body section in *Thaumatorhynchus* versus triangular in *Harpesaurus*, and the absence of dorsal and nuchal crests in *Thaumatorhynchus* versus presence in *Harpesaurus*. The individual in photograph RA02905-4 on page 105, identified by U. Manthey as *Lophocalotes ludekingi*, more likely belongs to the very rare species *Pseudocalotes* (or *Pseudocophotis*) *sumatrana*. The assumption that this latter species has a prehensile tail (see page 7) remains unverified. The '*Leiolepis belliana ocellata*' in photograph RA04712-4 on page 161 is apparently actually a *Leiolepis peguensis* (J. L. Grismer pers. comm. to U. Manthey). This would be good news since that latter species is otherwise illustrated in the book only through a photograph of a faded, preserved paratype of the species. We take the opportunity to mention that the '*Bronchocela* sp. A' illustrated in Manthey (2008, pages 55–56) has since been described as *B. rubrigularis* Hallermann, 2009, and that '*Acanthosaura* cf. *crucigera*' (see Manthey, 2008: 27) was since described as *A. cardamomensis* Wood, Grismer, Grismer, Neang, Chav & Holden, 2010 (see Wood et al. 2010).

Such excellent book quality is no surprise given that the author is already well known for having co-authored a remarkable synthetic opus on Southeast Asian reptiles and amphibians (Manthey and Grossmann 1997), and for his taxonomic studies on agamids (see the literature cited in the volume discussed here). He has described, among other agamid taxa, the enigmatic *Ptyctolaemus phuwuanensis* Manthey & Nabhitabhata, 1991, which was so unique that it was later placed in the distinct genus *Mantheyus* Ananjeva & Stuart, 2001, a name that was coined in recognition of the author's significant herpetological contributions.

The book's price indicated on the Chimaira website, 39.80 Euros (ca. 50 USD) excluding shipping costs, is a bit high, but is largely compensated by the excellent printing and binding quality, and the numerous beautiful photographs. We highly recommend it to all herpetologists and natural history lovers.

We moreover look forward to reading the following opus on agamids in the Terralog series, whose provisionally planned title is 'Agamid Lizards of Africa – Agaminae 1 and Uromastycinae,' by Philipp Wagner and Ulrich Manthey due to appear in 2012 (U. Manthey, pers. comm.). We are very grateful to Ulrich Manthey for kindly answering our numerous questions about his latest book.

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Herpetological Review, 2010, 41(4), 525.
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The Last Tortoise: A Tale of Extinction in Our Lifetime, by Craig B. Stanford. 2010. Harvard University Press (www.hup.harvard.edu). Hardcover. viii + 210 pp., 16 pp. pls. US $23.95. ISBN 978-0-674-04992-5.

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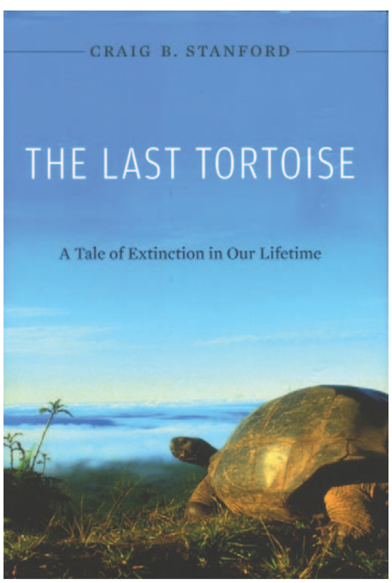

The Last Tortoise is the reptilian version of Kathryn Phillips, *Tracking the Vanishing Frogs* (1994). It is a well written book by a non-specialist that covers various aspects of the conservation and survival issues surrounding a group of animals. Stanford travels the world to visit the tortoise hotspots the same way Phillips did at the beginning of the declining amphibian phenomenon, highlighting the work of leading tortoise conservationists at various locations.

The chapters of *The Last Tortoise* cover the decline, conservation and, in some cases, the successes of tortoises across multiple continents. The initial chapters, 'What Exactly Are Tortoises and Turtles' and 'Live Long and Prosper,' provide a good background on tortoise biology and ecology. Descriptions of shell evolution, fossil record, and species diversity are written for the layperson, but provide enough depth for a biologist.

In 'No Respect for the Ancient Lands' Stanford highlights the issues of habitat destruction, human population growth and the impact of invasive and introduced species on tortoises. The results of these activities lead to increased road kill, predation of nests and young, and loss of quality forage. The 'Eating Tortoises' chapter diverges from tortoises and covers the use of freshwater turtles in the food trade, both historic and recent. The author details how the Diamondback Terrapin fishery of the eastern United States lead to the collapse of an abundant species, which is still trying to recover, more than a half century after the end of the commercial harvest. Stanford also covers modern turtle use in China and the impact it is having around the world; although freshwater turtles are mainly at risk, many southeast Asian tortoises are also being consumed.

Many cultures have been keeping and eating tortoises for millennia. Prior to the 20th century population levels of humans were low enough to allow for sustainable use of mainland tortoises. The effect of whalers on island forms are detailed later in the book. The exponential growth of the human population starting in the 20th Century will continue to lead to the extinction of tortoises and other flora and fauna until we can control our population levels.

'Such Huge Deformed Creatures' covers the giant tortoises of the Galapagos and Aldabra. The whaling fleets of the 1800's were able to quickly decimate the populations of these unique tortoises. Several species and subspecies were harvested to extinction. Besides just taking the tortoises the whalers also left rats and goats, which decimated the nests and vegetation. Stanford covers the recovery programs on both island groups to increase and stabilize the populations.

The appendices at the end of the book provide a quick reference to the largest vs. smallest tortoises, the most endangered species and a complete listing of all tortoise species with general distributional information.

The Last Tortoise is a fun and interesting read on the disturbing subject of the potential extinction of tortoises. I would recommend this book to anyone interested in turtles and tortoises. I encourage those of us who are aware of the plight of tortoise to share this book with friends and colleagues who are not. Stanford's engaging writing style will make them advocates for tortoises by the time they are done with the last chapter.

Literature Cited

Phillips, K. 1994. Tracking the Vanishing Frogs. St. Martin's Press, New York. x + 244 pp., 8 pp. pls.

Herpetological Review, 2010, 41(4), 526.
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Lizards and Crocodilians of the Southeast, by Whit Gibbons, Judy Greene, and Tony Mills. 2009. University of Georgia Press (www.ugapress.org). Softcover. US $24.95. ISBN 978-0-8203-3158-4.

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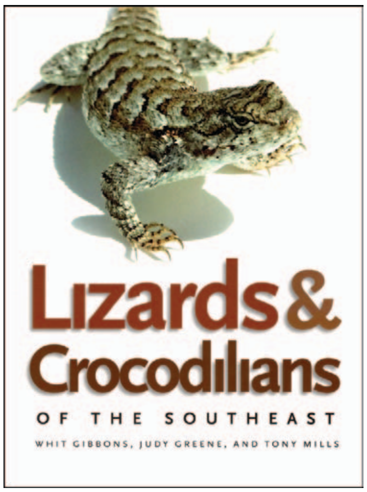


Niche partitioning is readily observable in books focused on regional treatments of amphibians and reptiles. *Lizards and Crocodilians of the Southeast* by Gibbons, Greene, and Mills occupies an underexploited niche, albeit a very important one, being a valuable learning source for beginning naturalists and budding herpetologists. This book also places the southeastern herpetofauna within the larger context of conservation.

The authors initially provide an overview of saurian and crocodilian global diversity, systematics, and taxonomy. Native and exotic species are clearly and concisely juxtaposed with respect to numbers, geographic ranges, and known and potential interspecific interactions. "Did you know?" boxes, which are scattered throughout the book, provide the reader with relevant interesting facts about lizards and crocodilians. Pictures are worth a thousand words, and the numerous photographs are high in quality and effectively illustrate such topics as predation and thermoregulation. I liked looking for the five Green Anoles near their hibernaculum, even though I could only find four of them!

Accounts are provided for each species that will allow a person unfamiliar with a species, such as the Southeastern Five-lined Skink, to identify it as well as learn about its biology. The approach and level of detail are appropriate not only for novices, but also for professionals and serious naturalists inexperienced with the southeastern herpetofauna. Each species account nicely covers various aspects of ecology and concludes with the conservation status of that species. Unfortunately, even some geographically wide-ranging species are no longer abundant and their futures cannot be considered secure.

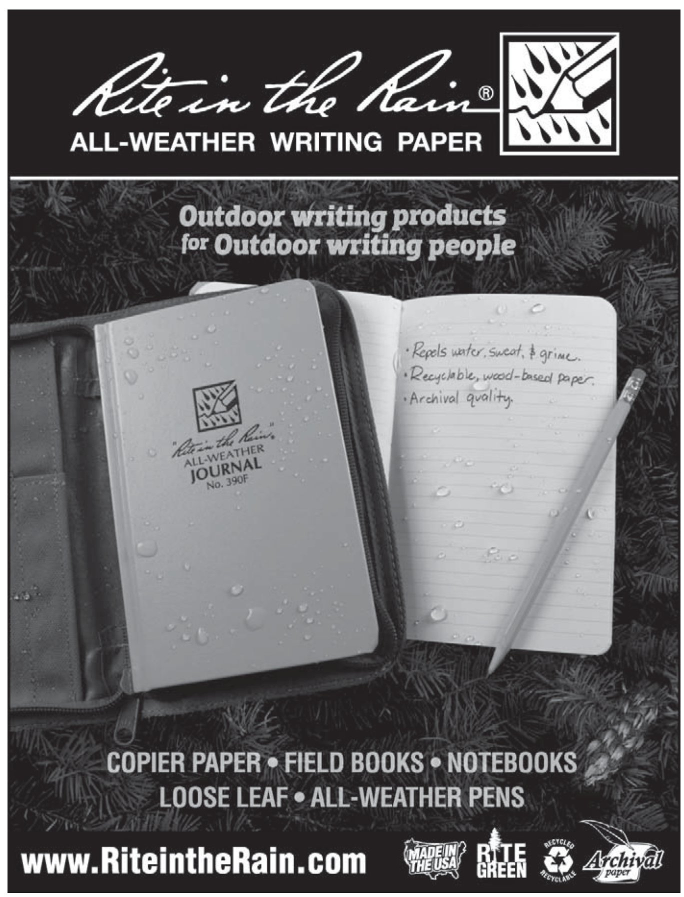
Distribution maps of both the Southeast and the United States as a whole are useful to the reader and species identifications are facilitated by numerous color photos as well side by side drawings of adults and hatchlings giving body sizes in inches. Accompanying "How do you identify a …" side bars also clearly introduce readers to the most useful and reliable key characteristics for each species.

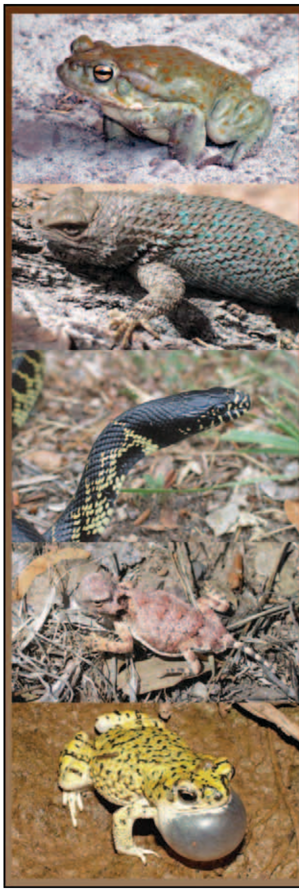
The treatment of the exotic species is slightly different than that of native species. For example, although geographic ranges are discussed, maps are not included because of the dynamic nature of the colonization process. The topics within the exotic species accounts are fewer in light of the information gaps surrounding many of them. The authors have done an excellent job summarizing ecological data and highlighting impacts of the exotic species.

After the species accounts, the authors discuss the "Why" and "How" of studying these reptiles. A section on husbandry follows with a discussion on practical and ethical considerations. With these in mind the authors discuss which species to keep, how to feed and house lizards, and the implications of taking animals from the wild. The last section, "Conservation of Lizards and Crocodilians," concisely encapsulates the theme that permeates the entire book and argues for herpetological education as a means to achieve conservation goals.

Separate tables of the state-by-state occurrence of exotic and native species, a short list of sources for further reading, a glossary, and an index to scientific and common names are all valuable components that round out this work. The "Further Reading" section could have been enhanced by the inclusion of a few quality books on the husbandry of lizards and crocodilians.

Lizards and Crocodilians of the Southeast gets my vote as a useful and inspiring regional source for naturalists from beginners onwards. Its effective integration of perspectives on both conservation and global reptile diversity sets it apart from most other regional reptile guides.





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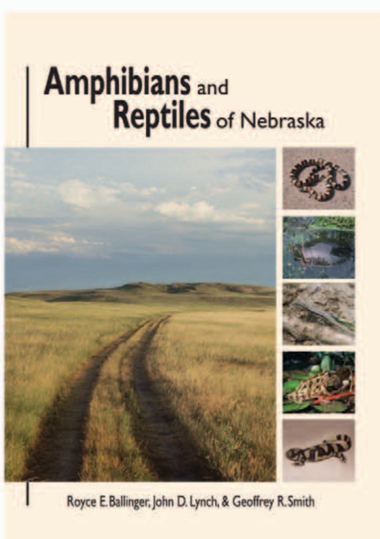

Royce E. Ballinger, John D. Lynch, and Geoffrey R. Smith

This is a 400 page authoritative review and reference to the 61 species of amphibians and reptiles known to occur within the boundaries of the state of Nebraska. It is the first comprehensive summary of Nebraska's herpetofauna since George Hudson's 1942 book on the same topic which covered the 56 species then known to occur in Nebraska. The book is well illustrated with 251 color photographs and 136 maps and diagrams. Documented with over 970 references, the text provides both an introduction for the amateur and a review for the professional herpetologist. With over 60 years of combined research experience on Nebraska amphibians and reptiles, the authors share many new records, observations, and insights on these fascinating animals.

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"A model of what should be done to tackle animal conservation problems on a sound foundation." —Jean-Christophe de Massary, Paris (*Alytes*)

"A true advance in our understanding of Mesoamerican amphibians." —Joseph Mendelson, Atlanta (*Copeia*)

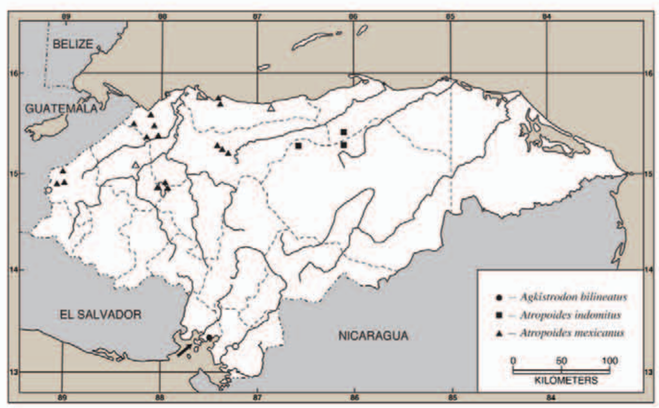
HONDURAS IS THE SECOND LARGEST OF the seven Central American countries. Its snake fauna, however, has been one of the least known in the region and numerous studies have referred to the "Honduran hiatus" in distribution and in our understanding of the systematics of indigenous species. James R. McCranie, who began field work in Honduras in 1976, has made an intensive study of the herpetofauna and has now produced a book that will serve to make the snake

fauna of Honduras one of the best known in the world. He has spent a total of more than 1600 days in the field and has personal field experience with nearly every species. He has examined nearly 6200 specimens in researching this book. The result is a model faunal study that will be a welcome reference for scientists and conservationists alike. It will be a reminder of the potential loss of biodiversity in a country in which deforestation and loss of habitat have greatly accelerated over the last two decades. This book is a companion to "The Amphibians of Honduras," by McCranie and Larry David Wilson, also published by SSAR (2002).

The Honduran snake fauna consists of 136 species in nine families: Anomalepididae (1 genus: 1 species), Leptotyphlopidae (1:2), Typhlopidae (2:4), Boidae (2:2), Loxocemidae (1:1), Ungaliophiidae (1:1), Colubridae (50:108), Elapidae (2:6), and Viperidae (7:11). The book has extensively illustrated identification keys in both English and Spanish, a discussion of the Honduran envi-

ronments, a brief history of reptilian study in Honduras, distribution, and essays about the conservation of the Honduran snake fauna. The bulk of the book consists of detailed accounts of the species (each one includes synonymy, range, diagnosis, description, references to published illustrations, remarks, ecological distribution, natural history, etymology, and specimens examined).

There is a gazetteer of Honduran localities, a glossary, a comprehensive literature cited section, and indexes to authors and taxa. Finally, there are **20 COLOR PLATES** including 22 photographs of habitats and 158 of snakes.



Map 101. Localities for Agkistrodon bilineatus, Atropoides indomitus, *and* Atropoides mexicanus.

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