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SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES

www.ssarherps.org

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.

ANNUAL DUES AND SUBSCRIPTIONS: Annual membership dues for the year 2007 in the Society for the Study of Amphibians and Reptiles are as follows: **REGULAR** membership US$60 (Student $30)—includes *Journal of Herpetology* and *Herpetological Review*; **PLENARY** membership US$80 (Student $45)—includes *JH*, *HR*, and annual subscription to the *Catalogue of American Amphibians and Reptiles*; **INSTITUTIONAL SUBSCRIPTION** $115—includes JH and HR. Additional fee for airmail postage outside USA $35 for one year. Additional membership categories available on the SSAR webpage: http://www.ssarherps.org/pages/membership.html.

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*.

Payment must be made in USA funds, payable to "SSAR," or by International Money Order, or with VISA or MasterCard (account number and expiration date must be provided). Payment should be sent to: Breck Bartholomew, SSAR Membership Office, P.O. Box 58517, Salt Lake City, Utah 84158, USA. Fax: (801) 453-0489; e-mail: ssar@herplit.com.

Future Annual Meetings

2007 — Saint Louis, Missouri, 11–16 July (with ASIH, HL)
2008 — Montreal, Canada (with ASIH, HL)
2009 — Portland, Oregon (with ASIH, HL)

About Our Cover: *Cruziohyla craspedopus*

Amazon and Western Leaf Frogs were recently placed in the phyllomedusine genus *Cruziohyla* (Faivovich et al. 2005. Bull. Amer. Mus. Nat. Hist. 294:1–240). The Amazon Leaf Frog, *Cruziohyla craspedopus* (Funkhouser, 1957), occurs in the upper and central Amazon Basin where it is locally common but seldom observed by humans owing to its habitat, the understory and canopy of primary and transitional rainforest. Syntopic anurans include *Phyllomedusa bicolor*, *Ecnomiohyla tuberculata, Trachycephalus resinifictrix*, and *Nyctimantis rugiceps*. Amazon Leaf Frogs possess the remarkable ability to alter the color on the periphery of the iris from tan to yellow. Dermal fringes adorn the lips and shanks, and the dorsal pattern is reminiscent of a leaf laced with fungi or lichens. They rest by day on leaf surfaces with their appendages tightly adpressed and the eyes concealed by reticulate palpebra. This crypsis is advantageous in evading two of their principal predators: monkeys of the genus *Pithecia* and *Cebus*.

In the upper Amazon Basin, *A. craspedopus* is most easily observed in *várzea*, seasonally flooded forest (including *bajial* and *tahuampa* in Peru), comprised of *Ficus* sp. (*Renaco*) – *Attalea butyracea* (*Shapaja)* associations, and marginal habitat (*restinga)* where alluvial soils support an understory of *Guadua, Heliconia*, *Phytelephas*, and *Bellucia*, and a mixed canopy including *Pourouma, Clusia, Pausandra*, *Couma*, and *Couratari*. The advertisement call, a soft "wort," is produced infrequently as males converge upon communal nesting sites during the dry season. Suitable sites include stagnant water in buttress pans and branch axils of *Renacos*; hollow stumps; logs with catch basins; rot holes; isolated pools; and artificial habitats caused by cutting. Up to two dozen large eggs are deposited in adhesive masses on twigs, bark, and over-hanging vegetation. The larvae grow in water stained with tannin from rotting leaves. Adults and eggs are consumed by Cat-eyed Snakes, *Leptodeira annulata*. Tadpole predators include larval odonates, lycosid and ctenid spiders, and aquatic hemipterans and coleopterans. Metamorphs are tan, pale lavender, or bluish dorsally. Upon emerging, they ascend to the canopy, where they feed on diminutive arthropods.

The cover image was made in 1993 in the río Chambira drainage system, Loreto, Peru, by **William W. Lamar** with a Pentax LX 35mm SLR camera, a Vivitar Series 1 105mm macro lens stopped down to f/22, and a Vivitar Series 1 flash with Fujichrome Velvia film pushed to ISO 100. Lamar's fieldwork in the Neotropics spans 35 years, and his efforts in northeastern Peru have produced nearly 400 species of amphibians and reptiles. Lamar is an Adjunct Professor of Biology at the University of Texas at Tyler. He coauthored *The Venomous Reptiles of Latin America* and *The Venomous Reptiles of the Western Hemisphere* with Jonathan A. Campbell. He leads natural history tours for GreenTracks, Inc., http://www.greentracks.com. Recent travel has taken him to Amazonian Brazil and several islands in the tropical Pacific.


PHOTO BY AUSTIN STEVENS

SSAR BUSINESS

Open Letter to Membership

SSAR will celebrate its 50th Anniversary in 2007. Special activities will take place during the Joint Meeting of Ichthyologists and Herpetologists (JMIH) in St. Louis, 11–16 July. The major events associated with SSAR's Anniversary are scheduled for 13 July. These events feature a symposium organized by Jonathan Losos entitled "Herpetology in the Age of Genomics." Jim Murphy and Kraig Adler will be the Masters of Ceremonies for a special SSAR Banquet that evening. The SSAR/HL auction will follow the banquet. And, of course, everyone is invited to attend the Business meeting on July 15. A link to registration on our website (http:www.ssarherps.org) will be available in January. Registration can be for the entire meeting or only for the day of the SSAR celebration.

—Roy McDiarmid, SSAR President
—Robin Andrews, SSAR Immediate Past President

SSAR Election Results

Results of the 2006 SSAR election are as follows:

President-Elect: Brian Crother
Secretary: Marion Preest
Treasurer: Kirsten Nicholson
Board Members (Regular): Paul Chippendale, Tiffany Doan
Board Member (Conservation): Stephen Richter
Board Member (Regional Society): Travis LaDuc

Thanks to all of the nominees who agreed to stand for positions and to Maureen Kearney (Elector).

Student Travel Awards Silent Auction

The SSAR STAC announces the Twelfth Annual Frameable Art Silent Auction to be held at the 2007 SSAR meeting in St. Louis, Missouri from 11–16 July. Preferred donations include herp-related photos, line drawings, prints, paintings, plates, engravings, or anything frameable, if not already framed. If you are interested in donating an item (tax deductible for U.S. residents), please email ALDRIDGE@SLU.EDU. If you will be bringing silent auction items with you to the meeting, you may drop them off at the service desk with Sharon Brookshire. Make sure you specify SSAR silent auction.

SSAR Student Travel Awards: Call for Applications

Ten awards of US $200 each are available. An applicant for a travel award must be a student and a member of SSAR, must not have previously received a travel award from SSAR, and must be the first author of a paper or poster to be presented. Application package must include: 1) letter signed by his/her major advisor or department chair that states: he/she is not completely funded for travel from another source; 2) an official copy of the poster or paper abstract to be presented; 3) a self-addressed, stamped envelope. If the research is co-authored, the applicant must also include a letter from his/her advisor stating that the work was primarily the product of the applicant. Qualified applicants are pooled and winners are drawn at random. Students from local meeting site and current members of the SSAR Travel Awards Committee are excluded from applying for a travel award. Applications must be postmarked by 15 April 2007. Award checks will be disbursed at the meeting. Send application package to: Dawn S. Wilson, Southwestern Research Station, P.O. Box, 16550, Portal, Arizona 85632, USA, or for further information email: dwilson@amnh.org.

NEWSNOTES

NAI Honors Conant and Stebbins in Albuquerque

The National Association for Interpretation (NAI) is an organization made up of 5000 members dedicated to advancing the profession of heritage interpretation. Individual members include those who work at parks, museums, nature centers, zoos, botanical gardens, aquariums etc.

Interpreters of natural history have relied on the two herpetological Peterson Field Guides for decades. For this and many other reasons, at its 2006 meeting, held 7–11 November, NAI bestowed awards to both Roger Conant (posthumously) and Robert C. Stebbins.

NAI's president Evelyn Kirkwood decided to create the first-ever Lifetime Achievement Award for Conant. The NAI professional awards committee chose Stebbins for the Senior/Retired Interpreter Award.

At the award banquet, the 400 members in the audience enjoyed historical photos of both awardees projected on screen, and a video segment of Roger Conant accepting his David S. Ingalls, Jr. Award of Excellence at the Cleveland Museum of Natural History in 1996. Dr. Stebbins chose not to make the long trip, so his friend and colleague, Alan Kaplan of East Bay Regional Park District in California, accepted on his behalf.

For more information about NAI, visit the website at: www.interpnet.com.

Robert Inger Honored in Malaysia

Robert Inger, Curator Emeritus at Chicago's Field Museum of Natural History, was honored recently with the Panglima Setia Bintang Sarawak (PSBS) award. A special investiture was held in January 2007 at Kuching, during which Inger was presented the award from the Yang di-Pertua Negeri Tun Datuk Patinggi Abang Muhammad Salahuddin. Inger received the award in recognition for 50 years of research on Sarawak, much of which has focused on cataloguing the enormous diversity of the Bornean herpetofauna. Beginning in 1956, Inger's field work at Sarawak, often in collaboration with graduate students and fellow scientists, has resulted in the description of more than 50 new species, nearly all of which are Bornean endemics. As noted in the press release accompanying the award ceremony: "His work has been a vibrant source of inspiration to a great throng of herpetologists, students and field biologists from all over the world. His most outstanding characteristic, however, is his unflagging kindness and generosity in helping generations of young herpetologists, including many from Malaysia."

Salahuddin confers the PSBS award to Dr. Inger. Penerangan photo, courtesy of the Field Museum of Natural History.

MEETINGS

Meetings Calendar

Meeting announcement information should be sent directly to the Editor (rwh13@csufresno.edu) well in advance of the event.

16–20 April 2007—First Mediterranean Herpetological Congress, Marrakech, Morocco. Information available from the Congress website: www.ucam.ac.ma/cmh1.

14–18 April 2007—14th ARAV Conference, Association of Reptile and Amphibian Veterinarians, New Orleans, Louisiana, USA. Information: http://www.arav.org/.

31 May–2 June 2007—Southwest Partners in Amphibian and Reptile Conservation, First Annual Regional Meeting, Albuquerque, New Mexico, USA. Information: http://chelydra.unm.edu/swparc/.

20–23 June 2007—31st International Herpetological Symposium, Toronto, Canada. Information: http://www.kingsnake.com/ihs/.

11–16 July 2007—50th Annual Meeting, Society for the Study of Amphibians and Reptiles; 87th Annual Meeting, American Society of Ichthyologists and Herpetologists; 65th Annual Meeting, The Herpetologists' League. St. Louis, Missouri, USA. Information: http://www.dce.ksu.edu/jointmeeting/.

3–6 August 2007—5th Conference on the Biology of Plethodontid Salamanders: Symposium in Honor of David B. Wake. Instituto de Biologia, UNAM and ECOSUR, San Cristobal de la Casas, Chiapas, México. Information: http://www.ibiologia.unam.mx/barra/congresos/salamandra/salamandra.html.

3–7 September 2007—Venom Week 2007. Tucson, Arizona, USA. Information: http://www.ocme.arizona.edu.

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, **Michele Johnson** or **Josh Hale**; postal and e-mail addresses may be found on the inside front cover.

The current contents of various herpetological journals and other publications can be found at: http://www.herplit.com/contents.

Ontogenetic Color Changes in Lizards Driven by Behavioral Changes

Tails with conspicuous coloration are a common feature in juveniles of reptiles, amphibians and fish, a characteristic that is usually lost in adults. Most studies have associated the presence of conspicuous tails with deflection of predators to a less vulnerable body part or with visual signaling for social behavior. The authors questioned why juveniles lose that coloration if it provides a specific advantage. Previous studies suggested that differences in threats encountered by juveniles and adults could explain the change in coloration; the authors propose a new alternative: changes in behavior may change the costs and benefits of bright coloration. They studied whether changes in body pattern and tail color in *Acanthodactylus beershebensis* are associated with behavioral differences before and soon after the ontogenetic color changes. Foraging mode and microhabitat use of one-week-old hatchlings (with bright blue tail and yellowish stripes on dorsum) and 3 week-old juveniles (that have already loss the bright coloration) were recorded in the Northern Negev desert (Israel). During 20-minute observation intervals, movements per minute (MPM) and proportion of time spent moving (PTM) were calculated to estimate foraging mode, and the proportion of time spent in open gaps between shrubs (PTO) was used to quantify microhabitat use. Two additional sympatric lacertid species (*Mesalina guttulata* and *Acanthodactylus boskianus*) that do not exhibit an ontogenetic coloration change were also studied. A MANOVA found significant differences in MPM, PTM, and PTO between hatchlings and juveniles of *A. beershebensis*; newly hatched lizards with conspicuous blue tails move more and spend more time in the open microhabitat than brown-tailed juveniles. No significant differences were found between MPM and PTM in hatchlings and juveniles of *M. guttulata*. However, a significant difference was found in PTM in *A. boskianus*: juveniles move less than adults (i.e., exhibit a safer foraging mode). The authors suggest that predation risk is a possible explanation for the behavioral change associated with the ontogenetic changes in color and body pattern in *A. beershebensis*; in addition they discuss alternative hypotheses and the possibility that multiple factors could be operating together.

Hawlena, D., R. Boochnik, Z. Abramsky, and A. Bouskila. 2006. Blue tail and striped body: why do lizards change their infant costume when growing up? Behavioral Ecology 17:889–896.

Correspondence to: Dror Hawlena, Department of Life Sciences and Mitrani Department of Desert Ecology, Blaustein Institute for Desert Research, Ben-Gurion University of the Negev, PO Box 653, 84105 Beer-Sheva, Israel; e-mail: hawlena@bgu.ac.il.

Dietary Changes in the Cannibalistic Morphs of *Ambystoma* Salamanders

In salamanders, cannibalistic morphology is an example of phenotypic plasticity, expressed as the development of prominent teeth and a larger head. The benefits of cannibalism are associated with faster growth rate and larger size, while the costs are associated with the fitness loss from eating relatives and being more vulnerable to predators. In most cases studied, cannibalistic morphs ate mostly conspecifics; however, is has been found that some cannibal morphs do not eat conspecifics at all. It appears that the degree of cannibalism depends on the density of heterospecific vs. conspecific prey. Still, it is unknown if cannibal morphs are obligatory cannibals or if they can change their diet through time. The authors studied a population of *Ambystoma tigrinum nebulosum* located at Kettle Pond, Colorado, which includes cannibalistic morphs. The dietary components of cannibalistic and typical morphs were sampled four times, at one-week intervals. Each individual sampled was measured and weighed, and their stomachs were flushed. Stomach contents were identified by prey type and prey length, and later quantified by dry weight. MANOVA found differences between typical and cannibalistic forms in the consumption of chironomid larvae, mollusks, and terrestrial invertebrates; also, only cannibalistic forms ate conspecifics. However, after the second week of the study period, the diet of cannibal forms changed, decreasing the amount of conspecifics and showing a composition more similar to the typical forms. A significant difference in prey size was also found between the two groups, but only in the first week of sampling; during weeks 2-4, there was no size difference found given the decrease of prey size in cannibal forms. In conclusion, the authors found that cannibalistic forms are not obligatory cannibals and that diet components changed through time. The authors discussed the increase of dietary niche overlap between the two morphs, the impacts on resource partitioning and the evolutionary advantages of alternative trophic morphologies.

Denoël, M., H. H. Whiteman, and S. A. Wissinger. 2006. Temporal shift of diet in alternative cannibalistic morphs of the tiger salamander. Biological Journal of the Linnean Society 89:373–382.

Correspondence to: Mathieu Denoël, Laboratory of Fish and Amphibian Ethology, Behavioural Biology Unit, Department of Environmental Sciences, University of Liège, 4020 Liège, Belgium; e-mail: mathieu.denoel@ulg.ac.be.

Functional Trade-Off Between Swimming and Running in *Triturus* Salamanders

Structural requirements for multiple competing functions often result in a compromised morphology that does not optimize the performance of either function. Aquatic vs. terrestrial trade-offs in locomotor performance are common, as the same functional system must perform dissimilar tasks under different environmental conditions, and a single phenotype cannot maximize different traits at the same time. Theory predicts that morphological adaptations for efficient locomotion in aquatic environments will reduce terrestrial locomotor ability and vice versa. *Triturus* salamanders are an especially interesting case, given that different species spend different amounts of time in water or on land, predicting different degrees of trade-off between optimal terrestrial or aquatic phenotypes. The authors compared body elongation, head width, fore- and hindlimb length, tail length and height in females of 10 species of *Triturus,* in addition to swimming and running speed from trials performed in a linear track. Data were analyzed using non-phylogenetic correlation tests, and by incorporating phylogenetic information using independent contrasts and phylogenetic generalized least squares; morphological variables were corrected for body size using Mossimann's (1970) multivariate method. Axillary-groin distance was negatively correlated with forelimb length and head width, but no association was found between relative axilla-groin distance and tail length or height. Species with longer tails and shorter axilla-groin distances swam faster, and surprisingly, species with shorter axilla–groin distances also ran faster. No negative correlation between running and swimming speed was found; that is, there was no evidence of a trade-off between swimming and running speed at the interspecific level. The authors discuss the lack of association between body elongation and swimming speed, considering the current understanding of mechanics of movement in water. In addition, alternative scenarios are considered: the association of body elongation with a swimming characteristic other than speed, and the association of body elongation with a function outside locomotion.

Gvozdík, L., and R. Van Damme. 2006. *Triturus* newts defy the running-swimming dilemma. Evolution 60:2110–2121.

Correspondence to: Lumír Gvozdík, Department of Population Biology, Institute of Vertebrate Biology AS CR, Studenec 122, 67502 Konesín, Czech Republic, e-mail: gvozdik@brno.cas.cz.

Parthenogenesis in Captive Komodo Dragon Females

Parthenogenesis, the production of offspring without fusion of male and female gametes, is rarely seen in vertebrates. In this study, the authors report findings of parthenogenetic offspring in Komodo Dragons (*Varanus komodoensis*) from captive females kept in isolation from males. Genetic fingerprinting was used to identify the parentage of the offspring of two females kept in separate UK zoos, one of which had never been in contact with a male. In both, all produced offspring were homozygous for all loci, although not each other's identical clones. One of the females later resumed sexual reproduction after mating with a male, suggesting that parthenogenesis in Komodo Dragons is facultative and not a fixated state, and that asexual reproduction occurred when mating was not possible. Results provide evidence for previously overlooked threats for the Komodo Dragon populations that are already under strong extinction pressures: 1) the reduction of genetic variability, as parthenogenesis entails complete homozygosity of the entire genome, and 2) sex ratio bias in the population, in this case favoring males, as females are the heterogametic sex (WZ). The authors explore the consequences for maintaining genetic variability in the reproduction program based on captive individuals, and describe the need for further studies on the genetic load of the parthenogenetic offspring, the frequency of parthenogenesis in captivity and in wild populations, and its consequences on fitness.

Watts, P. C., K. R. Buley, S. Sanderson, W. Boardman, C. Ciofi, and R. Gibson. 2006. Parthenogenesis in Komodo dragons. Should males and females be kept together to avoid triggering virgin birth in these endangered reptiles? Nature 444:1021–1022.

Correspondence to: Phillip C. Watts, School of Biological Sciences, University of Liverpool, Liverpool L69 7ZB, United Kingdom; e-mail: p.c.watts@liv.ac.uk.

Population Status of the Black Caiman: Towards a Conservation Strategy

The Black Caiman (*Melanosuchus niger*) was once an abundant, wide spread predator present in the entire Amazon basin and neighboring river drainages. In the last century there has been an estimated 90% reduction of its population due to the strong hunting pressure and habitat loss in the area. To increase the amount of information available to establish a conservation program, the authors studied microsatellite polymorphisms in 169 individuals from seven populations in Brazil, Ecuador, and French Guiana. Allelic diversity and heterozygosity levels were used to estimate current population status. Isolation by distance was measured using a Mantel test and a Reduced Major Axis (RMA) regression between genetic and geographic distances, and population structure was assessed using F_{IS} and F_{ST} coefficients. Genetic diversity and heterozygosity was high in all populations (highest in two populations in central Amazon of Brazil and lowest at the Ecuadorian population), despite the absence of hatchlings and large breeders in some populations, evidence of population decline. The authors discuss the difficulty of assessing loss of genetic diversity after significant but recent threats and the effect of migration on the observed results. An overall differentiation in the allelic variation was found among populations, with tests indicating a significant population structure at all loci. Even those populations in close proximity were significantly different at the genetic level, a result probably associated with differential occupation of habitats (e.g., black water swamps vs. estuarine waters) and/or sex-biased dispersal. The authors highlight the necessity of collecting more data on the biology and ecology of the black caiman and recommend concentrating the management efforts on the protection of key sites and the implementation of sustainable habitat use programs to ensure ecological functions and gene flow.

de Thoisy, B., T. Hrbek, I. P. Farias, W. R. Vasconcelos, and A. Lavergne. 2006. Genetic structure, population dynamics, and conservation of black caiman (*Melanosuchus niger*). Biological Conservation 133:474–482.

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Differences in Tropical vs. Temperate Diversity: An Integrated Evolutionary and Ecological Approach

The higher species diversity observed in tropical versus temperate regions has been a pattern subject of multiple studies, but is still not completely understood. Most research addressing this pattern has focused on the differences between the two regions in ecological processes, diversification rates, and/or environmental variables. Recently, the tropical conservatism hypothesis was proposed as an explanation that combines ecological factors that are correlated with species richness patterns with the evolutionary and biogeographic processes that ultimately shape these patterns. In this paper, the authors present an empirical test for the three major predictions of the tropical conservatism hypothesis: 1) groups with high tropical diversity originated in the tropics and have dispersed to the temperate zones only recently, 2) dispersal of tropical groups in temperate areas is limited by their inability to tolerate freezing temperatures in the winter, and 3) a large number of extant groups originated in the tropics, because the tropics were more geographically extensive until ~30–40 millions years, when the temperate zones expanded. Phylogenetic analysis (based on combined mitochondrial and molecular data), ancestral area reconstruction (using parsimony and likelihood reconstructions), molecular dating methods (combining molecular branch length information and fossil calibration points, using penalized likelihood analysis) and ecological niche modeling (based on museum locality records and 19 climatic variables) were used to test these predictions in hylid frogs. Among other results, the authors found that hylids have low species richness in areas that have been colonized more recently, independently of whether those regions are tropical or temperate, supporting the time-for-speciation effect: more species accumulate in regions where a group has been present longer. No significant relationship was found between diversification rates in clades and the latitudinal midpoint of those clades. Also, they found that the northern limit ranges of many tropical clades converge in Middle America; however, the ecological niche modeling suggests that the climatic variable shaping geographical limits is not the extreme freezing temperatures, but the temperature seasonality over the year. The authors further discuss the extent and limitations of the tropical conservatism hypothesis and the caveats found based on their results.

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Evolution of Acoustic Communication in Amazonian Dendrobatid Frogs

Studies on the evolution of anuran communication have examined the relationship between calling features, geographic variation, receivers' (usually females) preference, and breeding success of the senders and receivers. However, before the receivers can react to a signal, it first must be detected over the background noise, and in species that breed together, heterospecific signals can be considered as masking noise. A possible outcome of the selective effects of masking interference is the spectral partitioning between calls of co-occurring species. Yet, masking interference depends not only on the call's frequency, but the range of sensitivity of the receiver. In addition, as body size constrains calling frequency, selection of call frequency can be confounded with selection on body size. To test the masking interference effects on communication traits, the authors studied the variation in the Amazonian frog *Allobates femoralis* in relation to the presence of *Epidedobates trivittatus* (which has a similar calling activity and an overlapping call frequency). Eight sites, four with both species present and four with only *A. femoralis* were studied in Brazil, Colombia, French Guiana, and Perú. To characterize calls, the authors recorded males of *A. femoralis* and all active species at each site and calculated temporal and spectral parameters for each population. To establish response-frequency curves, the authors recorded male *A. femoralis* phonotactic reactions towards conspecific synthetic calls representing variations in frequency of the average call of the population, but keeping the temporal properties constant. In addition, they examined the correlation between variation in communication traits of *A. femoralis* and the presence of acoustically coactive species, and studied the geographic covariation between call frequency traits, response-frequency traits and body size. The authors found that the occurrence of *E. trivitattus* was a significant predictor of the variance in the traits associated with the frequency-response curve: when *E. trivitattus* was present the curve was narrower due to an increase in the response low frequency and asymmetric due to a decrease in the response of the high frequency. In addition, the variation of the communication traits was not associated with the number of coactive species and the geographic covariation was correlated with call frequency or response-frequency range.

Amézquita, A., W. Hödl, A. Pimentel Lima, L. Castellanos, L. Erdtmann, and M. C. De Araújo. 2006. Masking interference and the evolution of the acoustic communication system in the amazonian dendrobatid frog *Allobates femoralis*. Evolution 60:1874–1887.

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Color Variation and Alternative Reproductive Strategies in *Lacerta vivipara* Females

In reptiles, color variation within sexes is usually associated with the existence of alternative behavioral strategies in males, and with thermoregulation or predator avoidance in females. However, as females have been observed to play an active role in mate choice, it has been suggested that their differences in coloration might also reflect different reproductive strategies. The authors studied *Lacerta vivipara* females, which exhibit a ventral color variation ranging from pale yellow to bright orange. The population studied is located on Mont Lozère, Southern France, and is divided into two adjacent zones: one with high structural microhabitat diversity and high lizard density and the other with low structural diversity and low density. Females were captured annually from 1989 to 2002 and kept in the laboratory until parturition; weight and snout-vent length of females and hatchlings were recorded. Color phenotype was determined by comparison with a color reference and then confirmed using discriminant analysis based on several parameters measured with a spectrophotometer. Color variation throughout life and heritability of this variation were estimated, and reproduction success and survival were compared between phenotypes in relation to year of capture and density of each phenotype. Results show differences in clutch size, clutch hatchling success and clutch sex-ratio among females of different phenotypes. The authors discuss the diverse responses to density and environmental conditions and suggest alternative strategies that could maintain the color variation in females in this population.

Vercken, E., M. Massot, B. Sinervo, and J. Clobert. 2007. Colour variation and alternative reproductive strategies in females of the common lizard *Lacerta vivipara*. Journal of Evolutionary Biology 20: 221–232.

Correspondence to: Elodie Vercken, Laboratoire d'Ecologie, Université Pierre et Marie Curie, Båtiment A, 7 quai Saint Bernard, 75252 Paris Cedex 05, France; e-mail: evercken@snv.jussieu.fr.

Effects of Machinery and Modern Agricultural Practices on *Glyptemys insculpta*

The expansion of the agricultural frontier has reduced natural habitats and displaced many species, while many others have become an active part of the transformed landscape. Although disturbance-resistant species have persisted in agricultural landscapes for a long time, the introduction of modern machinery has created new threats for them. The authors studied the impact of current agricultural practices on *Glyptemys insculpta* turtles in 330ha that include deciduous forest, cattle pastures and crop fields in southern Québec, Canada. Turtles were captured during 1995, 1998–1999, and marked, aged, sexed, measured and photographed. Injuries on the limbs and carapace were recorded, and a carapace mutilation index is proposed to standardize and quantify severity of injuries. In addition, a total of 30 individuals were equipped with transmitters for radio-telemetry tracking; each turtle was located once or twice a week during the 1998–1999 period. Results indicate that turtles are being strongly affected by the new machinery as determined by the type and severity of the injuries found. Six of the 30 individuals tracked died as a result of agricultural activities. Estimated annual mortality rates for adults were 0.10 and 0.13, and for juveniles 0.18 and 0.17, for 1998 and 1999 respectively. Mutilation rates in the carapace reached 90±3%, while mutilation in the limbs reached 21.2%. Differences in carapace injuries were found between juveniles and adults, probably associated with differences in body size and habitat use. In addition, most of the injuries were found on the right side, probably related with habitat preferences and movement patterns. The authors argue that estimated mortality rates are evidence that the population is unsustainable in the long term and suggest that slight changes in the height of the machinery (disc mowers) used will not only make a significant difference in the effect of harvesting in turtles, but will also provide some benefits to agricultural production.

Saumure, R. A., T. B. Herman, R. D. Titman. 2007. Effects of haying and agricultural practices on a declining species: The North American wood turtle, *Glyptemys insculpta*. Biological Conservation 135:581–591.

Correspondence to: Raymond A. Saumure, Research Division, The Springs Preserve, 1001 South Valley View Boulevard, Las Vegas, Nevada 89107, USA; e-mail: insculpta@hotmail.com.

Back Issue Clearance for Publications of The Herpetologists' League

In an effort to reduce the need for storage space, The Herpetologists' League will be holding a clearance sale of back issues of its publications at the Joint Meetings in St. Louis in July 2007. Single issues of *Herpetologica* or *Herpetological Monographs* ($5°°) or complete volumes of *Herpetologica* ($20°°) will be available for purchase as long as supplies last. Only cash or checks (USD$, drawn from a US bank) will be accepted, and these sale prices are valid only when purchasing back issues in person at JMIH'07. Sale hours will be from 1330–1700 h on 12–15 July. Please contact Steve Mullin (<sjmullin@eiu.edu>) with any questions.

ZOO VIEW

Not every zoo keeper begins the day collecting rattlesnakes on the grounds of their place of employment. In this article by Jan Johnson on the Arizona-Sonora Desert Museum, one of her most interesting descriptions (in my view) is the remarkable number of rattlesnakes found over a fourteen year span (once, 177 snake encounters in a single year). What a wonderful setting for the zoo herpetologist.

Jan and I worked together at the Dallas Zoo years ago before she went to Arizona, but we never found a single rattlesnake on zoo grounds, even though Western Diamondback rattlers were relatively common in outlying areas at that time . . . no wonder she left for greener snake pastures!

Another interesting feature in Jan's article is the new daily venomous reptile presentation, which reminds me of the earlier exhibit at Tierpark Berlin-Friedrichsfelde in Germany. In 1956, the snake farm or vivarium opened, housing a large number of venomous snakes. Werner Krause started working at the Tierpark shortly after the building opened and was known as "Snake Farmer Krause." Krause accumulated many varieties of venomous snakes, some from his private collection, which were "milked" in front of zoo visitors (Fig. 1). This exhibit was unique in a zoological garden for it was a combination research center, educational display and venom extraction laboratory. The venoms extracted were made available for medical research at Leipzig University.

Fig. 1. "Snake Farmer" Werner Krause and wife Pia extracting venom from water moccasin or cottonmouth (*Agkistrodon piscivorus*) at Tierpark Berlin Snake Farm on 25 November 1959. Photograph by Gerhard Budich, courtesy of Falk Dathe and Gisela Petzold.

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—James B. Murphy, Section Editor

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Herpetology at the Arizona-Sonora Desert Museum

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The humble beginnings of the Arizona-Sonora Desert Museum (ASDM) originated with the visions of William Carr and Arthur Pack. Modeled after Bear Mountain State Park in New York, the Arizona Desert Trailside Museum, as it was originally named, was formally approved by the Pima County Board of Supervisors in March of 1952. Carr's appeal to the board stated his desires for this new museum: "…To establish Tucson Mountain Park and the buildings known collectively as 'The Mountain House' as a leading educational center for the purpose of acquainting the public with their rich but vanishing heritage in wildlife, plant life and scenic values, to the end that, through knowledge, will come appreciation and a better attitude toward all resource conservation …" (Carr 1982). The museum opened Labor Day weekend 1952. A binational institution focusing on the plants, animals, geology, and people of the Sonoran Desert, ASDM flies the national flags of Mexico and the United States at the entrance to illustrate the concept that the Sonoran Desert knows no political boundaries.

Facilities.—The original 'Mountain House' buildings, built and funded by the federal government's Civilian Conservation Corps and Works Progress Administration during the 1930's, consisted of a main building, a small house and a stable. By 1952, these buildings, formerly used for overnight camping by church groups and scout troops, had become termite ridden and dilapidated. Prior to opening day, the lounge of the 'Mountain House' was repaired and became the small animal exhibit room. It is still home to the main reptile exhibit area, although reptile and amphibian exhibits are found throughout the grounds. The original wooden, top-opening exhibit enclosures that were hurriedly built during the five months prior to the grand opening continue to house exhibit specimens to this day. For many years, adjoining areas to the main exhibit hall served as reserve holding for reptiles and invertebrates.

Since 1952 numerous new reptile and amphibian exhibits have been added. In 1953 fiberglass dioramas were incorporated into the small animal exhibit room. These dioramas depict Sonoran Desert scenes and include innovative burrows for bi-level viewing of the enclosure residents. These large dioramas sit on wheeled dollies and can be pulled away from the wall for servicing. Additionally, the hinged lobby wall can be opened to allow the diorama to be wheeled outside for extensive cleaning.

Opening in 1957, a 46-m long exhibit area, called "The Tunnel," allowed visitors to walk along an underground path to view "where the animals go when it gets too hot to be outside." Visitors could peer at rattlesnakes face-to-face as the ophidians sought shelter in packrat middens. The tunnel closed in 1978, reopening after renovations were completed in 1989.

Unheard of in 1958, because amphibians were rarely exhibited in zoos, an amphibian room opened in another of the 1930s-era Mountain House buildings. Utilizing the best in museum and zoo exposition techniques, a variety of toads, frogs, and salamanders resided in beautiful dioramas, with painted backdrops, constantly circulating water and simulated rocks and plants. The four large amphibian dioramas represent different Sonoran Desert aquatic environments: temporary rain pool, permanent pond, Mexican river and canyon stream. Always pushing the innovation envelope, these unique, glass-fronted dioramas sit on fixed bases and have hydraulically controlled walls. To service an enclosure, a flip of a switch raises the entire semi-circular back of the diorama!

In addition to the above exhibit halls, there are several large outdoor reptile enclosures. One such enclosure houses the Desert Tortoise (*Gopherus agassizi*). Another enclosure, the showpiece exhibit at the museum's front entrance, contains several native lizard species. The lizards are quite active and provide ample opportunity for interpreting lizard behavior to the visiting public. They readily breed in this enclosure.

In the early 1990s a new master plan was created. This plan focused on representing the different habitats within the Sonoran Desert. The first of these habitats opened in 1992 and illustrates a desert grassland. While there are cages for prairie dogs and burrowing owls, the bulk of the enclosures house reptiles and amphibians, including: Mojave Rattlesnake (*Crotalus scutulatus*), Prairie Rattlesnake (*C. viridis viridis*), Desert Massasauga (*Sistrurus catenatus edwardsi*), Common Kingsnake (*Lampropeltis getula*), Desert Box Turtle (*Terrapene ornata luteola*), Tiger Salamander (*Ambystoma tigrinum*), and Green Toad (*Bufo debilis*).

Through a generous donation from the Olsen family, in memory of their son Glenn Charles Olsen, an off-exhibit facility was built in 1998 to house reptiles, amphibians, fish, and invertebrates. This modern facility has rooms along the eastern wall equipped with ultraviolet penetrating glass to provide ultraviolight light for the animals (Fig. 1). It also has a quarantine wing with separate air ventilation for each room. The Olsen building has ample room for holding reserve exhibit specimens and is spacious enough for breeding groups of animals as well as the accommodation of small research projects. Behind the Olsen building are numerous, large breeding enclosures for species such as Tarahumara Frog (*Rana tarahumarae*), San Esteban Chuckwalla (*Sauromalus varius*), and horned lizards (*Phrynosoma* spp.).

With a planned opening in Fall 2006, "Life-on-the-Rocks" will focus on the plants and animals of the Arizona Upland subdivision of the Sonoran Desert. Several large enclosures in this exhibit are outdoor, open-air enclosures with glass fronts. A few species to look for include, but are not limited to: Western Diamond-backed Rattlesnake (*Crotalus atrox*), Tiger Rattlesnake (*C. tigris*), Black-tailed Rattlesnake (*C. molossus*), and Western Lyresnake (*Trimorphodon biscutatus*). One large enclosure will have Gila Monster (*Heloderma suspectum*), Coachwhip (*Masticophis flagellum*), and Gophersnake (*Pituophis catenifer*).

Animal collection.—Animal records dating back to ASDM's first few years are scant. Carr (1982) stated that of the 35 animals exhibited on opening day, it was heavy on the side of reptiles. By ASDM's second anniversary, 80 reptiles were on exhibit. In the early years Chuck Lowe, Merv Larson, and Bill Woodin were responsible for collecting many of the reptiles, and donations from the public were widely accepted as well. For an institution focusing on the Sonoran Desert, it is odd that historical records show the following animals entered the collection at one time or another: Lance-headed Rattlesnake (*Crotalus polystictus*), Copperhead (*Agkistrodon contortrix*), Texas Tortoise (*Gopherus berlandieri*), and American Alligator (*Alligator mississippiensis*). It is unknown what became of these specimens. Several ASDM specimens may represent longevity records. One wild-caught File-tailed Snake (*Sonora aemula*) lived nearly 17 years, a wild-caught Mexican Rosy Boa (*Lichanura trivirgata trivirgata*) lived slightly over 33 years, and a wild-caught Western Green Toad (*Bufo debilis insidior*) lived 17 years. One captive born Sinaloan Milksnake (*Lampropeltis triangulum sinaloae*) lived for 30 years. Over the years the collection has grown from 97 reptiles and 13 amphibians in 1959 to its current size of 81 reptile species (464 specimens) and 21 amphibian species (112 specimens).

FIG. 1. Reptile holding room in Olsen Building, 2005.

Because of constraints placed on the disposition of surplus animals by both the American Zoo and Aquarium Association (AZA) and the Arizona Game and Fish Department (AGFD), the ASDM staff only attempts to reproduce species where there is a demand for the offspring. In 1958 ASDM had the first known captive reproduction of a "coral kingsnake" (presumably a Sonoran Mountain Kingsnake, *Lampropeltis pyromelana*). In 1981, a reproduction program was initiated for the insular chuckwallas found in the Sea of Cortez, with a primary focus on the San Esteban Chuckwalla (*Sauromalus varius)* resulting in over 200 hatchlings. Although some hatchlings did not survive for long, many were sent out on loan to other institutions. Since 1990, ASDM has had reproductive success with several rattlesnakes including: Western Twin-spotted Rattlesnake (*Crotalus p. pricei*), Banded Rock Rattlesnake (*Crotalus lepidus klauberi*), Northern Black-tailed Rattlesnake (*Crotalus m. molossus*), and Arizona Black Rattlesnake (*Crotalus viridis cerberus*).

Staff.—Stewart Thomas served as Curator of the Small Animal Department (SAD) in 1959, leaving two years later for college. Hired, at the age of 17, to care for the fish, arachnids, and reptiles, Merritt Keasey was ASDM's youngest employee during its first year of operation (Fig. 2). Keasey left ASDM in 1954 to work at Cobra Gardens in New Mexico, returning after Thomas' departure to become ASDM's SAD Curator until retiring in 1979. Serving as Keasey's assistant, Steve Prchal worked from 1970 until 1985, when he resigned to run Sonoran Arthropod Studies Institute (SASI). Arriving in 1980, Howard Lawler, previously of Knoxville Zoo and Zoo Atlanta, took over as Curator of SAD. Lawler was instrumental in establishing accurate record keeping policies, as well as initiating captive breeding programs with insular chuckwalla species. Lawler departed the museum in 1996. Hugh McCrystal, a former keeper at the Bronx Zoo, arrived in 1985 for the position of Keeper Supervisor. When Prchal left the museum, McCrystal accepted the position of Assistant Curator. Upon McCrystal's departure from the museum in 1991, Craig Ivanyi took over as Assistant Curator. At Lawler's parting, Ivanyi became departmental curator. In 1997, the ichthyology and invertebrate zoology portion of the department became a separate department, rejoining herpetology in 2002, when the department was renamed Herpetology, Ichthyology and Invertebrate Zoology (HIIZ). As HIIZ Curator, Ivanyi has been instrumental in establishing numerous departmental research projects and collaborative projects with outside institutions. Currently, Ivanyi serves as both HIIZ Curator and General Curator for the entire museum.

The current HIIZ staff is composed of five highly trained keepers coming to ASDM from many other zoological institutions. They are: Warren (Ken) Wintin (Jacksonville and Knoxville Zoos), Renée Lizotte (Columbus Zoo), Janice Johnson (Dallas and Audubon Zoos), Bill Altimari (Philadelphia Zoo), and Stéphane Poulin (Ecomuseum, Montreal, Canada). ASDM does not have a staff veterinarian. However, the contract veterinarian for the herpetological collection, since 1979, is Dr. James Jarchow. Prior to veterinary school, Jarchow worked as a herpetology keeper under Louis Pistoia at the Columbus Zoo.

Although venomous reptile bites are rare in zoological institutions, ASDM has had two venomous reptile bites in its history. The first bite, in September 1953, was from a Gila Monster (*Heloderma suspectum*). The victim reported that he sat down, applied suction and liberal amounts of ice to the bite site, and took copious notes on the bite's symptoms. The second bite, in June 1994, was from an Arizona Black Rattlesnake (*Crotalus viridis cerberus*). Suction was applied to the bite site and the victim was transported to the nearest hospital. Neither bite had any long-term effects other than acute embarrassment on the victim's part.

Programs.—As a service to the Arizona Game and Fish Department, ASDM coordinates a "Tortoise Adoption Program" for southern Arizona. This program focuses only on the Desert Box Turtle (*Terrapene ornata luteola*) and the Desert Tortoise (*Gopherus agassizi*). Protected in 1989, it is illegal to collect Desert Tortoises. However, there are many "grandfathered" (pre-legislation exemption) tortoises in captivity born to "grandfathered" tortoises which need homes. To this end ASDM assists with the transfer of these unwanted or surplus captive tortoises to qualified private custodians. The tortoises remain the property of the State of Arizona.

Fig. 2. Merritt Keasey with Gila Monster, circa 1975.

In 1998, as an across-the-border educational outreach, Poulin and Ivanyi worked with the Seri Indians of Sonora, Mexico, to build an enclosure for San Esteban Chuckwallas in their native village of Punta Chueca in Sonora, Mexico. The enclosure assists the Seri in teaching their children about their cultural history as well as to encourage ecotourism in their impoverished village. The enclosure has been quite successful for breeding chuckwallas, however it is not known whether it has attracted visitors to their village.

As stated earlier, education has always been a primary focus of ASDM. While many of the early education programs focused on the desert and its inhabitants at large, reptiles were frequently represented. The first of these early educational outreach programs was a television show, *Desert Trails*, which first aired in 1953. This show, hosted by ASDM employee Hal Gras, featured residents of the Sonoran Desert, many of them reptiles, and continued until 1985. For several decades Gras, and his Desert Ark, made frequent visits to local classrooms. He was instrumental in introducing generations of Tucson school children to reptiles. To this day, the name Hal Gras is synonymous with the desert museum among native Tucsonans. For many years a weekly column in the Tucson newspaper featured ASDM mascot George L. MountainLion, Research Associate in Human Behavior. Readers could write to George asking questions concerning the desert and its inhabitants. His column, simple and straightforward, was initially ghost written by Carr, with the task taken on by other staff as time went by.

FIG. 3. Janice Johnson giving "Live and *sort of* on the Loose" presentation, 2005.

In keeping with its education focus, the HIIZ department takes rattlesnakes and gila monsters, as well as arthropods, on the road to many different venues. Most notable of these is the yearly safety day at Fort Huachuca Military Base. Tens of thousands of army personnel get a close up view of the rattlesnakes occurring on the base.

On Labor Day weekend in 2003, the exciting new daily venomous reptile presentation "Live and *sort of* on the Loose" (LOTL) made its debut (Fig. 3). This hour long presentation gives ASDM visitors a close-up view of venomous reptiles supplemented with a lecture about their biology, natural history, venom, and snakebite. This sometimes humorous, sometimes serious, show features a helodermatid (either Gila Monster or Beaded Lizard) and two rattlesnake species. LOTL is extremely popular, with over 200 attendees daily during peak season.

Publications.—ASDM administers three AZA North American Regional Studbooks. Janice Johnson and Craig Ivanyi are co-studbook keepers for the Mexican Beaded Lizard (*Heloderma horridum*). Janice Johnson is also the studbook keeper for the Arizona Ridge-nosed Rattlesnake (*Crotalus willardi willardi*). Stéphane Poulin is the studbook keeper for the San Esteban Chuckwalla (*Sauromalus varius*). The Bibliography details much of the staff-authored publications in recent years.

Research.—The natural desert setting at ASDM is home to several rattlesnake species. The public and staff encounter rattlesnakes every year on grounds, with 25 rattlesnakes encountered on grounds during the first year of operation. Luckily no guest has been bitten while visiting, including those visitors who actually stepped on rattlesnakes! When the public encounters rattlesnakes on the paths HIIZ staff frequently hear comments about our 'loose snakes' or, as a visitor once stated, " . . . that rattlesnake on the walk. It looked just as if it were real!" (Carr 1982). Whenever a rattlesnake is spotted on the grounds, staff members remove the snake. Records dating back to 1967 show rattlesnakes were identified by species and capture date prior to being moved out of harm's way. In 1991, a more thorough study was initiated where all rattlesnakes are identified, sexed, measured, and marked with a unique identification number. Techniques for marking the snakes varied over the years from scale clipping in the early years, to inserting PIT-tags in later years. All Western Diamond-backed Rattlesnakes and Mojave Rattlesnakes have their tail band patterns photocopied. For quick visual recognition, all rattlesnakes initially have the three anterior rattle segments painted with their unique ID number according to a color-coded system, whereby each color represents a number (0–9). This also provides information about shedding frequency as the painted segments move down the rattle with each successive shed, necessitating repainting the ID number on occasion. Capture location and date are recorded prior to release at a designated release area. Release sites varied over the years. Early in the study, release sites ranged from on property in non-public areas to 3.5 km away from grounds. Current protocol divides the grounds into four quadrants. When a rattlesnake is found in one quadrant, it is released in non-public areas within the same quadrant. Since 1991, the four species encountered are: Western Diamond-backed Rattlesnake (*Crotalus atrox*), Tiger Rattlesnake (*C. tigris*), Black-tailed Rattlesnake (*C. molossus*), and Mojave Rattlesnake (*C. scutulatus*). Snake-human contacts on grounds have numbered as high as 177 encounters a year by visitors and staff, with some individual snakes captured 35 times over the years (Fig. 4). Snakes originally captured in 1994 are still encountered. In 2005, several male *C. atrox* were fitted with radio transmitters and are tracked several times a week. Radio implanted snakes move on and off grounds at their own discretion with the most movement seen during the warmer months of the year. They have been observed out in the open, basking on winter days.

Another research project involves an introduced population of Spiny-tailed Iguanas (*Ctenosaura hemilopha*) on ASDM grounds. During the mid 1970s, staff released approximately seven lizards at the bighorn sheep exhibit. Since 1998, a volunteer staff of trained 'lizard-watchers' walk the grounds and areas adjoining the grounds, several times a week to identify all native lizards and Spiny-tailed Iguanas they encounter. These volunteers document all lizards observed on-and-off grounds. Blood for genetic analysis was also taken from several iguanas. This study is intended to demonstrate whether or not the lizards have become established into the surrounding desert, as well as determine the relatedness of the population. The lizard watchers have noted approximately 30 *C. hemilopha* currently living on grounds, however, none has been observed roaming significant distances off grounds.

The ASDM is involved with a conservation project on

FIG. 4. Stéphane Poulin and crowd around wild Western Diamondback Rattlesnake, 2005.

Tarahumara Frogs (*Rana tarahumarae*), a species extirpated from Arizona in the early 1980s. As part of a multi-agency reintroduction program begun in 1992, ASDM was critical in hatching egg masses brought from Mexico, raising them to adulthood, and subsequently breeding the adult frogs. In spring 2005 tadpoles, froglets and adult frogs raised at ASDM were released into the Santa Rita Mountains of southern Arizona. Observations the following year at the same time indicate the introduced population survived the horrific Florida fire that burned 23,183 acres in the Santa Rita Mountains during July 2005 and the anurans appear to be reproducing.

In conjunction with the beaded lizard studbook, Johnson and Ivanyi have been assisting Dr. Michael Forstner, of Southwest Texas University, in a genetic analysis to determine the subspecific status of the captive beaded lizard population. Initial results have been surprising, with *Heloderma horridum* subspecies showing a greater genetic diversity than *Cyclura* species.

The HIIZ staff assists with outside research requests when feasible. We have supplied *Crotalus* and *Heloderma* venom, as well as blood and shed skins for genetic research.

Acknowledgments.—I thank Peggy Larson for her stories about the early days of the desert museum and her assistance in locating historical photographs. Thanks also go to Craig Ivanyi for compiling a list of staff members and employment dates. Finally, I am grateful to the herpetology staff for providing the recent photos accompanying the article.

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LETTERS TO THE EDITOR

Herpetological Review, 2007, 38(1), 12.

Editorial Linguistic Deficiency Causes a Superfluous Nomen Nudum in the Gekkonid Genus *Ptyodactylus* (Squamata: Gekkonidae)

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In his “Gekkotan lizard taxonomy” Kluge (2001) listed not only all species names of gekkotan lizards but also included an alphabetical listing of all the authors of these names. Recently, I happened across the citation of Leptien (1996:20) as the author of *Ptyodactylus keinerlei*, which was considered a nomem nudum referring to *Ptyodactylus hasselquistii* Donndorff, 1798 (Kluge 2001:124). The cross-reference (Kluge 2001:54) reads: “*keinerlei* [n.n.] Leptien 1996 (see *Ptyodactylus hasselquistii* Donndorff, 1798).”

I was surprised by this obviously invalid species description because I have long known Rolf Leptien as an expert of lizards of Africa and the Middle East. Moreover, the name “*keinerlei*” is a German word meaning “not of any sort, not any.” Because I could not imagine Rolf Leptien applying such a strange and senseless name, I referred to his 1996 article (which deals with the natural history and husbandry of Arabian leaf-toed geckos, genus *Asaccus*) and found the sentence: “... no difficulties arose when the *A. elisae* were housed in terraria with the larger *Ptyodactylus keinerlei*” (p. 20). Still, no sense emerged from this sentence upon which I asked the author directly. He was absolutely surprised because he was never told by the respective journal (*Dactylus*, now defunct, but then published by the International Gecko Society) that this article had been published. It was in 1994 that he had submitted a short report on *Asaccus* in the United Arab Emirates. He was told by the editor that he could submit a manuscript written in German because it would be translated into English by the journal’s staff. The original German version of the respective sentence reads: “Terrarienversuche ergaben, dass sie sich auch mit dem im gleichen Biotop lebenden, größeren *Ptyodactylus hasselquistii* ausgezeichnet vertragen, auch hier kam es zu **keinerlei** Aggressionen.” The correct translation is: “Terrarium experiments revealed that they were excellently sociable with the syntopic, larger *Ptyodactylus hasselquistii*; also here, **not any** aggression occurred.”

This brief note aims (1) to clarify the origin of the presumed species name “*keinerlei*,” (2) to note that it was not Rolf Leptien’s fault to have become the involuntary author of a new albeit invalid gekkonid name, and (3) to emphasize that pet journals like *Dactylus* should maintain minimum editorial standards when handling scientific names.

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ARTICLES

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Breeding Behavior of the Cane Toad *Bufo marinus* (Bufonidae): A Successfully Invasive Species

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Habitat destruction and invasive species are the most important threats to native biodiversity. However, invasive species also provide one of the few opportunities to see population establishment in nature. Thus, the study of ecological and behavioral characteristics of invasive species can provide useful information for increasing the effectiveness of control strategies while also providing an opportunity to study basic aspects of population and evolutionary biology (Sakai et al. 2001).

The Cane Toad, *Bufo marinus* (Amphibia: Anura: Bufonidae), has been introduced in several countries around the tropics for the control of insect plagues in agriculture yet has resulted in negative impacts to native fauna (Lever 2001). For example, native populations of snakes and birds in Australia have declined or disappeared following the expansion of *B. marinus*. These predators are possibly being poisoned when they prey upon this introduced toad (Lever 2001, 2003). However, *B. marinus* also offers an excellent opportunity for understanding the population and evolutionary dynamics of invasive species. This is due to: 1) the history of *B. marinus* invasions is known (date, number, and origin of individuals introduced; Easteal 1981; Lever 2001); 2) aspects of its natural history and demography have been studied both in native and introduced populations (e.g. Lever 2001; Zug and Zug 1979); and 3) *B. marinus* is relatively abundant and easy to see, catch, and mark for monitoring.

Knowledge of the breeding behavior of *B. marinus* is largely anecdotal (except see Lee 2001; Lee and Corrales 2002). These accounts lack information on sex ratio in breeding aggregations, mating patterns, and female mate selection. Understanding these aspects is important because they affect the direction and strength of sexual selection, including the quality/quantity of offspring produced, genetic variation, population growth rate, and evolutionary dynamics of populations (Blumstein 1998; Caro 1998; Parker and Waite 1997). I studied an invasive population of *B. marinus* in a permanent pond located in northwestern Puerto Rico, West Indies. My aims were: 1) describe the breeding behaviors of males and females; 2) investigate potential mating patterns; and 3) assess relationships between toad body size and clutch size and fertilization success.

Materials and Methods.—I conducted the study in a permanent pond located in the municipality of Quebradillas, northwestern Puerto Rico (18º25.113'N; 66º54.266'W). The pond was in a grassy area, but bordered by a 4–6 m margin of high-density shrubs. Only in the southern part of the pond was the shrub margin wider (up to 20 m), where it connected to a farm with diverse second growth trees. The size of the pond varied with rainfall from <100 m^2 to >500 m^2. When the pond was small, there was a mud bank between the water's edge and the shrubs. When the pond size increased, the mud bank was submerged and the water extended several meters into the shrubs. The mean precipitation in the study area is >1500 mm/year, with the highest rainfall occurring in April–May and August–November.

From March 2003 to April 2004, except in January and February 2004, I made one or two visits per month to the study area to assess breeding activity. I also assessed breeding in May and August 2004. During wet seasons, I monitored rainfall in the study area through the web page <www.wunderground.com>. When there was heavy rain (radar reflectivity > 40 dBZ; estimates of rainfall > 75 mm/h; see web page for details), I went to the study area. During site visits I looked for breeding events (males in the pond, arriving females) and made behavioral observations.

During nights with breeding events, I first divided the pond into eight sections of similar shore length. These sections were useful to record abundance of males around the pond, and location of mating pairs and oviposition. Because the pond size was variable, those sections were redetermined on each breeding event by using several points of reference with known distances. Second, I walked along the shoreline of the pond recording a visual count of the number of individuals per pond section. Third, I caught cane toads, marked them by toe clipping, measured snout-vent length (SVL), recorded sex, and released them in pond section of capture. Lastly, I made behavioral observation for the remainder of the night.

I made behavioral observations from static points and from walks around the pond (2–4 per hour). It was possible to see most breeding individuals from any place in the shoreline of the pond. Because *B. marinus* is a large toad and its eyes turn red and conspicuous with the headlamp light, it was easy to observe individuals swimming, calling, and clasping. I captured pairs to establish their identity and sizes for mating pattern assessments.

I investigated two potential mating patterns, size-dependent mating and size assortative mating (Arak 1983), and spatial patterns of breeding toads among pond sections. First, I examined size-dependent mating by comparing the number of mating and non-mating males between small and large SVL categories per breeding event using a Fisher exact test. Small and large male size categories were determined using the median SVL of all males per breeding event as a cutoff point between small and large. While a greater number of male SVL categories can give more accurate results (Sullivan 1983), few females arriving to mate in each breeding event supported the use of two categories in my study. Second, I examined size-assortative mating by SVL with a Spearman correlation. To see if males aggregated in certain pond sections during breeding, the spatial distribution of males (number of calling and non-calling males) around the pond was analyzed per breeding event using chi-square test. Similarly, to examine whether pairs in amplexus or clutches were aggregated, the numbers of pairs and oviposition episodes in each pond section were analyzed with chi-square tests, pooling the records of all breeding events.

Toad SVL also was examined relative to clutch size and fertilization rate. To examine for a relationship between female SVL and number of eggs oviposited, clutch sizes were counted from six mating pairs collected in a breeding event and put inside containers (45 × 44 × 42 cm of high) with 18 L of water, and regression analysis was conducted. I assessed fertilization rate of mating pairs observed in oviposition in the pond by recording the identity and SVL of mating pairs and flagging their oviposition location. Eggs of each pair were allowed to develop for 24–36 h. Then, I recorded the number of embryos and the number of non-fertilized eggs in a random sample of ± 1000 eggs per clutch. Regression was used to assess relationships between the ratio of male to female SVL and fertilization success, and male SVL and fertilization success. All analyses followed Sokal and Rohlf (1981) and Zar (1999), using STATISTICA (StatSoft Inc., 2000; available at <http://www.statsoft.com> and Statistix (Analytical Software, 1996; available at <http://www.statistix.com>).

Results.—I recorded six breeding events (Table 1); each lasted only one night and occurred after heavy rains, especially at the beginning of wet seasons (March–May and August). Males were abundant during breeding events (23–52 individuals), but on other nights none or very few (1–7 males) were observed around the pond. Females were only present during breeding (Table 1), however on 16 September 2003, I recorded one pair (SVL male: 100 mm, SVL female: 134 mm). There was no evidence (heavy rains, clutches, tadpole congregations) suggesting I missed a breeding event during the period of study. During breeding events, males were observed for the first time from 1900 h, while females were observed from 2000–2330 h, with most of them in amplexus. The breeding event sex ratio was male biased (3.25 to 11.5, Table 1). One male (SVL = 120 mm) mated twice but not in a same breeding event (events 24 and 31 August 2003), and one female (SVL = 129 mm) mated twice (events 24 August 2003 and 20 April 2004).

Males exhibited behavioral plasticity between breeding events (Table 1). When the pond was small (~100 m^2), with a mud bank between the water's edge and the shrub vegetation, the males exhibited scramble competition. Males actively searched for mates, either swimming or jumping on the mud bank. Males seemed to

TABLE 1. *Bufo marinus* breeding events observed in Puerto Rico, West Indies. Each breeding event lasted one night.

Date	Pond size (m^2)	Male behavior	No. males	Mean male SVL ± SD (mm)	No. females	Mean female SVL ± SD (mm)	Male distribution around pond
9 March 2003	~170	Chorus	39	113.4 ± 7.52	8	127.6 ± 8.90	$\chi^2 = 25.6$; $P < 0.01$
24 August 2003	~100	Scramble	43	113.5 ± 7.86	7	122.0 ± 14.78	$\chi^2 = 6.30$; $P < 0.50$
31 August 2003	~190	Chorus	40	114.7 ± 7.92	8	135.5 ± 14.10	$\chi^2 = 11.8$; $P < 0.10$
20 April 2004	~220	Chorus	35	115.4 ± 8.84	5	132.8 ± 5.97	$\chi^2 = 12.30$; $P < 0.09$
7 May 2004	~160	Chorus	23	114.9 ± 7.91	2	132.5 ± 0.71	$\chi^2 = 12.11$; $P < 0.10$
13 August 2004	~130	Chorus-active searching	52	116.60 ± 8.74	16	129.88 ± 15.40	$\chi^2 = 4.62$; $P > 0.71$

be alert to any movement or vibration source close to them. When unpaired males detected a movement, they usually jumped or swam vigorously and attempted to clasp its source. Males clasped tree trunks, mud monticules, turtles, a dead female bullfrog (*Rana catesbeiana*) and swam to clasp birds on the water surface. The interaction between males was frequent, but clasping quickly ended when the male being clasped gave a release call. I conducted several tests which consisted of hitting the ground, moving the water and/or touching the males with my hand and several inanimate objects; males reacted quickly to approach and clasp. Occasionally, a few males (up to 6) gave advertisement calls from the edge of the pond, but only for a few minutes before stopping. During these scramble competition breeding events, the number of males per pond section followed a random pattern (Table 1).

Females arriving at the pond during scramble competition were detected and clasped as soon as they entered the water. I observed several males (up to 5) struggling for the possession of a female and those females trying to move away from the pond (Fig. 1). Unpaired males often tried to dislodge an amplectant male, but most were left behind when the females reached the shrub around the pond. Later, these pairs were immobile among stems and roots of the bank vegetation for the rest of night. The pairs remained among vegetation without going back to water for oviposition until I collected pairs at 0430–0530 h for placement into containers and determination of clutch size counts.

When the pond increased in surface area (>100 m^2), the mud bank was flooded and the water penetrated into the abundant vegetation surrounding the pond. Male searching behavior appeared disrupted by shrub vegetation along this wetted shoreline. Some males (up to 9) formed choruses that persisted for several hours during the night. These calling males were located on mounds of leaves and branches, separated from one another by > 2 m. I did not observe agonistic interactions between males for a calling place. Most males were non-calling; they were floating in the water, but with a tendency to be in the same portion of the pond as calling males (Table 1, nonrandom spatial distribution of males was observed).

The interaction between males was reduced in breeding events with choruses. Males appeared to be much more discriminating about what they clasped; in no case was a male clasping an inanimate object. I conducted the same series of tests with males in these breeding events, but males never responded by clasping objects. The SVL of calling males tended to be larger than that of non-calling males (Table 2). Pairs were observed immobile on the ground or in the water within emergent vegetation; this behavior was contrary to that recorded in scramble breeding events in which the females left the pond rapidly after being clasped. Displacements attempts were rarely seen and were always unsuccessful. Pairs were recorded in oviposition by 0430 h, and most were in the same pond section as the initial pairing record. Overall, there was no particular section of the pond with a disproportionate number of pairs ($\chi^2 = 2.248$; $P = 0.938$) or clutches ($\chi^2 = 1.579$; $P = 0.979$).

The scramble behavior and chorus formation were two extremes of a behavioral continuum in male *B. marinus*. An intermediate behavior was recorded on 13 August 2004. During this breeding event, some males formed a chorus (9 males) and others (43 males) were in the water actively searching but without a scramble behavior characterized by frequent male-male interactions and misdirected male clasping of various objects (Table 1). Also, in contrast to the other breeding events with chorus formation, the number of males among pond sections followed a random pattern (Table 1).

Size-dependent mating and size-assortative mating were not observed during any breeding event (Table 3). Large female *B. marinus* produced more eggs than small females ($Y = -15390 + 206X$; $N = 6$; $r = 8.4$; $P = 0.023$). The ratio of male to females sizes within pairs did not affect fertilization ($Y = -0.9011x + 100.15$; $R^2 = 0.029$; $F = 0.42$; $P = 0.528$; Fig. 2a), and male SVL did not affect fertilization rate ($Y = -0.0142x + 101$; $R^2 = 0.015$; $F = 0.22$; $P = 0.649$; Fig. 2b).

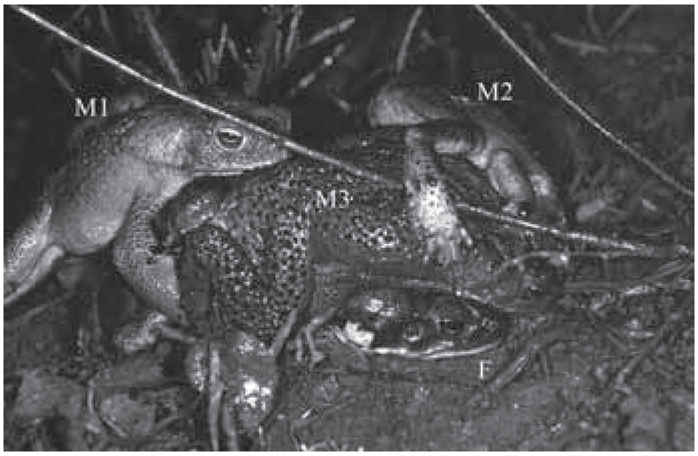

FIG. 1. Mating struggles in *Bufo marinus*. Three males (M1, M2, and M3) compete for a gravid female (F).

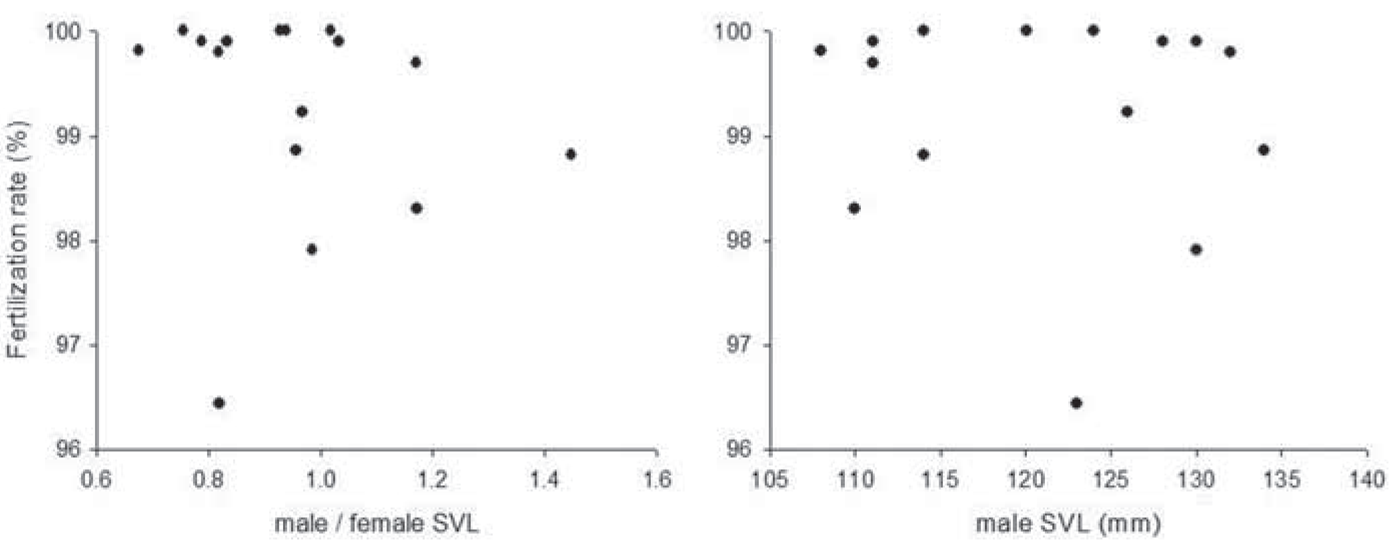

FIG. 2. The ratio of male to female body size (A) and male body size (B) did not appear to affect egg fertilization success in *B. marinus (*N = 16).

Discussion.—In anurans, when the density of males is high and arrival of females is synchronous, the active searching for mates by males appears to be favored (Arak 1983). Under these conditions, the strategy of calling from stationary places may produce very little or no reproductive success because active males intercept females and the advantage of first encountering a female likely outweighs the disadvantage of clasping mistakes (Arak 1983; Wells 1977). Males, however, may change their mating strategies from scramble to chorus formation if they experience a reduction in density (e.g., *Bufo calamita*, Arak 1988a,b; *B. bufo*, Hoglund and Robertson 1987; *B. americanus*, Sullivan 1992; *Rana sylvatica*, Woodbright et al. 1990). In my study, males were not dispersed when the pond increased in size (Table 1). Thus, a reduction in density is not likely the main factor promoting the change in behavior of males in this population; the vegetation around the pond appears to play a more important role. Calling may be favored rather than searching actively among barriers imposed by the vegetation. Other studies also point out the role of vegetation in different aspects of the mating behavior of anurans (Arak 1988a; Gerhardt 1994; Wells and Schwartz 1982).

Explosive breeding in anurans such as *B. marinus* imposes limits to male and female behavior that affect their reproductive success (Emlen and Oring 1977; Sullivan et al. 1995). In explosive breeders, males mate simultaneously. Hence, the rapid acquisition of females is crucial for male reproductive success and it is not expected that male *B. marinus* discriminate among females to further increase their fitness, such as searching for larger females with more eggs (Arak 1983; Wells 1977). Similarly, an abundance of single males actively clasping moving objects likely results in few opportunities for females to select particular males as mates (Sullivan et al. 1995). In summary, time restrictions and male-biased sex ratios during breeding events of *B. marinus* may explain the non-random mating and the non-assortative mating by size I found, and limits the opportunity for a male to mate many times. Also, male-biased breeding congregations promote a strong intra-sexual competition among males, which may promote diverse male mating strategies (Halliday and Tejedo 1995). In *B. marinus*, those strategies were associated with male spatial distribution patterns around the pond: scramble behavior (random distribution), chorus and non-calling males (aggregated distribution).

Displacement of paired males by single males is common in species of the genus *Bufo* and could produce a change from random mating to non-random mating (Lamb 1984, Halliday and Tejedo 1995). According to Lee (2001) and Lee and Corrales (2002), amplexus displacements in *B. marinus* are commonly successful and can produce non-random mating; however, commentaries by Savage (2002) suggest the contrary. Differences in breeding environment may reduce the success of amplexus displacements in *B. marinus* and thus, reduce consequent effects on mating patterns. While my results do not show a large male mating advantage in *B. marinus*, there was a tendency (P = 0.1) for non-random mating in the breeding event with scramble behavior, which is attributed to successful displacement performed by two large males (Vargas 2005a). In contrast, when pond size was large (>100 m^2) females in amplexus appeared to easily avoid intruder males by diving bellow the surface of the water, and moving in the emer-

TABLE 2. Body size, mean SVL ± SD (N), of calling and non-calling male *Bufo marinus* at a pond in Puerto Rico, West Indies. There are no data for the 24 August 2003 breeding event because the males were in scramble competition and calling males were intermittent.

Date	Male SVL (mm)		Student's t-test
	Calling	Non-calling	
9 March 2003	116.4 ± 10.26 (7)	112.8 ± 6.82 (32)	t = 1.149, P = 0.257
24 August 2003	—	—	—
31 August 2003	118.8 ± 6.85 (9)	113.6 ± 7.91 (31)	t = 1.787, P = 0.082
20 April 2004	118.9 ± 8.26 (8)	114.39 ± 8.89 (27)	t = 1.272, P = 0.212
7 May 2004	121.4 ± 9.32 (7)	112.6 ± 6.32 (16)	t = 3.043, P = 0.116
13 August 2004	122.1 ± 8.06 (9)	115.6 ± 8.56 (43)	t = 2.002, P = 0.050

TABLE 3. No size-dependent mating patterns were observed for *Bufo marinus*. There is no analysis for the 7 May 2004 breeding event because only two pairs were recorded.

Date	Median male SVL (mm)	No. small males Paired	No. small males Unpaired	No. large males Paired	No. large males Unpaired	Size-dependent mating (Fisher Exact test)	Size-assortative mating (Spearman correlation)
9 March 2003	114	5	10	3	21	P = 0.442	$r_s = 0.55$; P = 0.159
24 August 2003	112	2	22	5	14	P = 0.121	$r_s = 0.04$; P = 0.939
31 August 2003	116	4	17	4	15	P = 0.592	$r_s = -0.23$; P = 0.575
20 April 2004	114	2	16	3	14	P = 0.472	$r_s = 0.30$; P = 0.624
7 May 2004	113	1	8	1	13	—	—
13 August 2004	115.5	7	19	9	17	P = 0.382	$r_s = 0.122$; P = 0.651

gent vegetation. Moreover, intruder males appeared to need to lean on a hard substrate to gain sufficient leverage to dislodge the paired male (Vargas 2005a), and that load point was absent in the water.

At oviposition, larger single males may challenge smaller paired males and displace them from females (Davis and Halliday 1977, 1979). It is curious that at 0430 h females started oviposition during breeding events with choruses but not in the breeding event with scramble competition. It is possible that during chorus breeding events females started oviposition earlier because they were hidden among emergent vegetation and were not disturbed by single males. In contrast, in scramble breeding events there was not emergent vegetation for females to use as refuge if they returned to water for oviposition. It is possible that females might delay oviposition until sunrise when single males stopped activity and left the pond (F. Vargas, pers. obs.) and thus avoid risk of suffocation if multiple males were to clasp them. This hypothesis needs further study in *B. marinus* but behavioral plasticity in breeding behavior of females has been recorded in many species (Jennions and Petrie 1997).

When explosive breeders form choruses, females could have more opportunity to express their mating preferences because they are less likely to be intercepted by searching males (Sullivan et al. 1995). In my study, female *B. marinus* could be attracted to or have mating preferences for calling males with particular phenotypes, but as a female approached a calling male, non-calling males in the water had an opportunity to intercept her. However, if a female approached by ground or within emergent vegetation to a calling male, she appeared to reduce the possibility of being intercepted by non-calling males (FV, pers. obs.). From the male's perspective, calling can increase the chance of attracting females, but calling males could be susceptible to predators such as rats (Fitzgerald 1990; FV, pers. obs.). Non-calling males in the water may have a lower risk of predation, but they do not readily attract females. Non-calling males can clasp females they detect but due to the high number of non-calling males the probabilities of mating may be low for each male in the water. A possible difference in the reproductive success between calling and non-calling males is still an unresolved aspect in *B. marinus* (Lever 2001).

Mate choice is expensive, and it is expected that the level of female's selectivity will correspond to the benefits obtained if mated with particular males (Andersson 1994; Grafe 1997). The absence of direct benefits in *B. marinus* such as territories with abundant resources, parental care (Vargas 2005b) and/or differential egg fertilization rate (Fig. 2) does not suggest high selectivity by females. Female *B. marinus* might move to the male that is easiest to find (Arak 1988a; Parker 1983). This behavior may be beneficial if it reduces the risk of predation, disease and/or parasitism, which may be associated with time spent in the water. In many anurans, more time in the pond also increases the risk of dangerous interactions with unpaired males (Arak, op cit.). These take-over attempts imply a cost to females in terms of energy, and also expose them to death by suffocation by the conspecific males (e.g., *B. bufo*, Davis and Halliday 1979). I did not observe this extreme case in *B. marinus* but it cannot be discarded due to the physical constraints multiple male clasping could have on a female (Fig. 1). Also, the hypothesis of beneficial rapid pairing is supported by the random spatial pattern of pairs and clutches around the pond.

Studies of breeding behavior in different populations of a same species under different environmental characteristics are useful for understanding ecological determinants of the breeding behavior, the strength and direction of sexual selection (Sullivan et al. 1995), and the role of reproduction in the population ecology, which is particularly relevant for invasive species. This study shows how characteristics of breeding locations can change in just days or weeks, and affect breeding behavior. Behavioral plasticity may increase adaptability to novel breeding conditions (Sakai et al. 2001), such as those conditions experienced by invading species as they enter new areas. Also, low female selectivity could reduce the strength of the Allee effect (reduction in fitness of individuals in small populations) when few individuals invade new habitats (Blumstein 1988; Møller and Legendre 2001). Lastly, high female fecundity and the high fertilization rate can optimize the recruitment of abundant juveniles with the subsequent positive effect on population growth rate and recovery of genetic variation (Nei et al. 1975). The Cane Toad, *B. marinus*, appears to have all these attributes, contributing to its successful invasion of many tropical areas worldwide.

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Reference Hematology and Serum Chemistry Values for the Diamondback Terrapin (*Malaclemys terrapin*)

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Health assessment of turtles is important in order to successfully manage wild animal populations and knowledge of hematologic and serum chemistry values for apparently normal wild individuals are an essential part of this evaluation (Jacobson et al. 1999; Werner et al. 2002). Evaluation of blood samples can provide information on red and white blood cell distribution, electrolyte levels, waste products, and selected enzyme activity. An apparently healthy looking turtle could have serious internal disease that would likely be missed without examining a blood profile. In order to accurately evaluate turtle blood samples, a reference range of values must be established for each species. Blood reference values have been established for less than 5% of all known turtle species (McArthur et al. 2004). The present study was undertaken to establish reference ranges for various blood parameters in the Diamondback Terrapin, *Malaclemys terrapin*. It should be emphasized that the term "reference" is preferred over the mostly obsolete term "normal" since it is virtually impossible to determine whether or not each sampled individual in a wild population is "normal" (Solberg 1994). The goals of the present study were: to establish reference ranges for diamondback terrapin hematology and serum chemistry values, to determine if differences in blood values exist between males and females, to determine if variations exist due to the time of year, and to find out if the blood parameters reported by veterinary clinical pathology laboratories are of any diagnostic value in *M. terrapin*.

Malaclemys terrapin is found in brackish marshes of the eastern and Gulf Coasts of the United States. Although seven subspecies have been identified, this study only looked at the Northern Diamondback Terrapin. Various factors have led to a decline in the numbers of Diamondback Terrapins over the years and conservation efforts are now needed to protect this species. It has been well known as one of the best tasting turtles in the world, which almost led to its extinction at the beginning of the 20th century (Garber 1990a). This turtle is once again resurging as a desirable food delicacy in Asian communities (Garber 1990b). Exhibitors and hobbyists are also attracted to this colorful, intriguing reptile and it often appears in both public and private collections. Oil spills (Burger 1994), heavy metals (Burger 2002), traffic (Wood and Herlands 1993), commercial crabbing (Garber 1990b), predation (Feinberg and Burke 2003) and coastal development have taken their tolls on local diamondback populations. Regulations to protect diamondbacks vary widely among the coastal states and range from limited hunting seasons to designations such as special concern, threatened, or endangered.

An extensive search of the literature uncovered two references for blood values in *Malaclemys terrapin*. One paper examined hemoglobin values in two specimens (Goin and Jackson 1965). The other reference evaluated red blood cell (RBC) counts that were obtained from three animals (Hutchison and Szarski 1965).

Other studies have examined a few parameters of Diamondback Terrapin blood. One paper reported on the percentage of RBCs in blood smears from one individual (Englebert and Young 1970) and another article evaluated changes in hemoglobin and RBC counts for one to six captive terrapins over a one year period (Gilles-Baillien 1973). Changes in sodium, potassium, and urea were noted in three different experiments involving salinity manipulations (Bentley et al. 1967; Dunson 1970; Gilles-Ballien 1970). Serum chemistry reference values for *Malaclemys* are not available.

Materials and Methods.—From June through August of 2003 and May through August of 2004, 103 apparently normal *M. terrapin* were captured, bled, and released in Stone Harbor, New Jersey (ca. 39.05°N, 74.80°W) and Wellfleet (Cape Cod), Massachusetts (ca. 41.90°N, 70.03°W). Salinity at both collection sites was a constant 28–30 parts per thousand (ppt). The sample population consisted of 76 females and 27 males of various sizes (Table 1). In Stone Harbor, all terrapins were captured in baited crab traps that were checked within six hours of being set. The terrapins in the Wellfleet group were caught with hand nets from a kayak. In both locations, the turtles were transported in dry, plastic pails to a laboratory for blood collection and then released the same day or the following morning at the area of capture. Blood samples were obtained from one to fourteen hours following capture. In May 2004, only three terrapins were sampled. For June 2003–2004, 23 blood specimens were obtained while July 2003–2004 produced 33 specimens and August 2003–2004 yielded an additional 44 blood samples. All turtles were examined, weighed, and the carapace length was recorded.

Blood was obtained from the femoral vein using a disposable one milliliter syringe with a 26 gauge 3/8 inch needle. The collection site for blood testing must be carefully selected because of the extensive lymphatic network in turtles (Ottavaini and Tazzi 1977). In a study by Werner and Lindley (2005) on the effects of lymph dilution on blood samples in *Malaclemys*, the femoral vein was found to be the most accessible and reliable collection site for obtaining undiluted blood samples.

Part of the sample was immediately placed into one or two heparinized microhematocrit tube(s). Two drops of blood were used two make two blood smears, and a drop of blood was hemolyzed by vigorous stirring for hemoglobin analysis. The remainder of the sample (ca. 0.3–0.6 ml) was placed in a Microtainer® lithium separator tube and immediately spun down in a Statspin RP® centrifuge. Only one sample was hemolyzed and it was discarded. All samples were immediately refrigerated and remained that way until processed.

A commercial laboratory (Antech Diagnostics, 1111 Marcus Avenue, Lake Success, New York 11042, USA) did white blood cell counts (WBC) from blood smears, hematocrits, and serum chemistries, which included glucose, serum urea nitrogen (SUN), total protein (TP), albumin, aspartate aminotransferase (AST), calcium, phosphorous, sodium, potassium, chloride, globulin, creatine phosphokinase (CPK), and uric acid (UA). This panel of tests is offered by Antech as a Comprehensive Reptilian Profile. Hemoglobin was measured by the author utilizing a BMS® hemoglobinometer.

Means, medians, standard deviations, ranges, and histograms were calculated for each blood value. The only subset analyses performed were male versus female and time of the collecting season. The males and females were compared by two-tailed t-tests ($\alpha = 0.05$). The blood values were tested for correlations with collection date (Spearman Rank Correlation test).

Results.—Of the total 103 terrapins sampled there was not always enough blood to perform all tests on each individual. There were 56 serum chemistries, 61 hematocrits, 87 white blood cell (WBC) counts, and 85 hemoglobins that made up the final results. The values are given as means, standard deviations, and ranges.

The mean hematocrit value for 61 samples was 31.8% ± 7.5.

TABLE 1. Size data for male (M) and female (F) *Malaclemys terrapin* from New Jersey (NJ) and Cape Cod (CC).

Sex	Site	Carapace L (cm)			Weight (gm)		
		mean	median	range	mean	median	range
M (N = 26)	NJ	10.8	10.7	8–13	216	216	114–351
M (N = 1)	CC	10.9			218		
F (N = 60)	NJ	15.6	13.1	9.8–19.8	537	369	166–1600
F (N = 16)	CC	17.3	17.4	13.2–21	851	885	349–1705

The range was from 15–55%. Hemoglobin concentration averaged 9.6 g/dL ± 1.1 with a range of 7–11.7 g/dL. The WBC counts for 87 terrapins had a mean of 11.3 × 10^3/μL ± 4.5 and a range of 3.5–28 ×10^3/μL (Table 2). Males (N = 21) had significantly higher WBC values ($P < 0.05$) with an average of 13.9 × 10^3 /μL ± 4.8. Female (N = 66) WBC values had a mean of 11.3 × 10^3/μ/L ± 4.5 (Table 3). The predominant WBC was the heterophil (74.6%). The next most common cell type was the lymphocyte (17.7%). Azurophils averaged 3.8% and the mean for monocytes was 2.3% (Table 2).

Serum chemistry values for 56 terrapins are tabulated in Table 4. Analysis of male (N = 8) and female (N = 48) values using a two tailed t-test revealed that males had significantly lower ($P < 0.05$) calcium, phosphorous, chloride, total protein, and albumin levels than females (Table 3). A significant positive correlation (values increased as the season progressed) was demonstrated for SUN and CPK, while a negative correlation was seen for both calcium and phosphorous.

Discussion.—Establishing reference blood and serum chemistry values for a species presents several problems. Reptiles do not precisely regulate serum constituents as do mammals so results from free living reptiles must be evaluated in light of age, reproductive status, environment, and overall condition (Mautino and Page 1993). The data presented here were obtained from 76 female and 27 male wild Diamondback Terrapins. One reason for this sex disparity is that obtaining femoral vein blood from smaller specimens, which were mostly males, was often unsuccessful. In *M. terrapin* the femoral vein is not visible so venipuncture was "blind" and, at times, unproductive. The second reason that there were fewer males in the sample group is that in both collecting areas captured females outnumbered males by approximately two to one.

Hematocrit, hemoglobin, and WBC ranges were very similar to published values for other turtle species (Anderson et al. 1997; Dessauer 1970; Dickinson et al. 2002; Frye 1991; Fudge 2000; Gaumer and Goodnight 1957; Marks and Citino 1990; Mader 1996; McArthur et al. 2004; Rosskopf 1982). One exception was a hematologic study of Aldabra Giant Tortoises (*Aldabrachelys gigantea)* where hemoglobin, hematocrit, and WBC means were lower than for most other species (Hart et al. 1991). This disparity was most likely the result of lymph dilution, as previously noted, because blood was taken from the dorsal coccygeal vein and a clear fluid was often noted in the syringe prior to obtaining blood (Hart et al. 1991). No differences were seen in the hematocrits and hemoglobins of males and females nor were there any significant differences as the collecting season progressed as have been reported in some other turtle species (Anderson et al. 1997; Dickinson et al. 2002; Gilles-Baillien 1973; Lawrence and Hawkey 1986; McArthur et al. 2004; Pages et al. 1992). Male *M. terrapin* in this study had higher average WBC numbers than their female counterparts. A similar disparity was noted in Desert Tortoises (*Gopherus agassizii)* (Dickinson et al. 2002). A possible explanation is a more pronounced stress response in captured males but it might also just be due to variation in a small sample size. While azurophils were the third most commonly observed WBC type, their function in turtles in unknown (Christopher et al. 1999) and even their existence in chelonians is clouded (McArthur et al. 2004). Eosinophils and basophils were not found very often and, combined, only made up about 2.7% of the total WBC popula-

TABLE 2. Values for red blood cells (RBC) and white blood cells (WBC) for *Malaclemys terrapin* from New Jersey and Cape Cod. RBC values based on 16 males and 45 females; WBC values based on 21 males and 66 females.

Test	Mean	SD	Range	Units
Hematocrit	31.8	7.6	15–55	%
Hemoglobin	9.6	1.1	7–11.7	g/dL
WBC	11.3	4.5	3.5–28	10^3/μL
Heterophils	74.6	13.4	29–91	%
Lymphocytes	17.7	12.6	4–63	%
Monocytes	2.3	3.0	0–16	%
Eosinophils	1.1	1.9	0–7	%
Basophils	1.6	2.1	0–14	%
Azurophils	3.8	3.5	0–14	%

TABLE 3. Blood and chemistry values significantly different between male and female *Malaclemys terrapin* ($P < 0.05$).

	Male		Female		
Test	Mean	SD	Mean	SD	Units
WBC	13.9	4.8	10.6	3.9	10^3/μL
Calcium	9.2	1.3	13.6	5.1	mg/dL
Phosphorous	4.1	0.7	5.5	1.7	mg/dL
Chloride	99.7	11.2	108.0	9.1	mEq/L
Total protein	3.6	1.1	4.2	0.7	g/dL
Albumin	1.0	0.3	1.3	0.3	g/dL

TABLE 4. Serum chemistry values for male (N = 8) and female (N = 48) *Malaclemys terrapin* from New Jersey and Cape Cod. Refer to Table 3 for gender differences.

Test	Mean	SD	Range	Units
Glucose	100.9	69.0	10–267	mg/dL
SUN[1]	104.7	54.0	27–258	mg/dL
Uric acid	1.3	0.9	0.3–5.3	mg/dL
TP[2]	4.1	0.8	1.8–5.7	g/dL
Albumin	1.3	0.3	0.4–2	g/dL
Globulin	2.8	0.6	1.4–3.9	g/dL
Calcium	13.0	5.0	6.6–30	mg/dL
Phosphorous	5.3	1.7	2.8–11.1	mg/dL
Sodium	148.7	11.0	120–174	mEq/L
Potassium	4.9	1.0	3.4–7.5	mEq/L
Chloride	106.9	9.7	86–123	mEq/L
AST[3]	218.1	130.1	75–681	U/L
CPK[4]	4194.1	3849.4	261–21570	U/L

[1] Serum urea nitrogen
[2] Total protein
[3] Aspartate aminotransferase
[4] Creatine phosphokinase

tion. This agrees with other published values for turtles (Anderson et al. 1997; Dickinson et al. 2002; Fudge 2000; Marks and Citino 1990; Mader 1996; Mader 2000; McArthur et al. 2004; Rosskopf 1982).

Serum chemistries in many instances had extremely large ranges. A lack of references on normal *M. terrapin* physiology makes interpretation of these data difficult.

In this study glucose levels fluctuated widely. Frye (1991) summarized glucose concentrations for 12 species of turtles. The average was 65 mg/dL with a range of 33–99 mg/dL. Glucose levels in chelonians do not seem to be related to diet (Anderson 1997) but they might be related to reproductive activity. In *Lissemys punctata,* the Indian Soft-shelled Turtle, fasting glucose values in reproductively active males were 91.4 ± 2.8 mg/dL while in females the glucose values were 119.3 ± 1.7 mg/dL (Chandavar and Naik 2004). The reverse was seen in the Pancake Tortoise (*Malacochersus tornieri*), where glucose levels were reported higher in males than in females (Raphael et al. 1994). In addition, seasonal glucose variations have been shown to occur in turtles from temperate zones (Christopher et al. 1999; McArthur et al. 2004). An experiment with Argentine Sideneck Turtles (*Phrynops hilarii*) found that plasma glucose was not affected by starvation or re-feeding (DaSilva and Migliorini 1990). It seems that glucose levels in chelonians are not well understood (Chandavar and Naik 2004) and therefore are difficult to interpret.

Urea nitrogen levels in this study varied widely. Similar results were found in 30 *Aldabrachelys gigantea* (Ghebremeskel et al. 1991). Raphael et al. (1994) found that urea nitrogen in *M. tornieri* was below the limit of sensitivity of their test method. Other studies have reported SUN values that ranged from <1–80 mg/dL (Anderson et al. 1997; Dickinson et al. 2002; Pages et al. 1992; Rosskopf 1982). A five year study of *G. agassizii* noted that urea nitrogen concentrations were highest when the turtles emerged from hibernation and then decreased significantly (Christopher et al. 1999). The present study showed the opposite—a significant ($P = 0.002$) increase in SUN from June through August. The reason for this increase is unknown. In a study of osmoregulation in *M. terrapin*, urea was found to be one of the major regulators of osmolarity and was likely reabsorbed from the bladder or excreted as the surrounding water salinity changed (Gilles-Ballien 1970). Serum urea nitrogen does not seem to be very useful for assessing renal disease in reptiles and this would seem especially true in *M. terrapin* (Fudge 2000; Mader 1996; McArthur et al. 2004).

The uric acid levels of *M. terrapin* were similar those of eight other species of chelonians (Mader 1996). Uric acid is primarily the end product of protein and purine metabolism, and thus increases following a meal. Uric acid is influenced by other variables precluding its use as an indicator of renal failure in turtles (Fudge 2000; Mader 1996; McArthur et al. 2004).

The mean total protein results in this study are similar to values reported for 13 different turtle species (Frye 1991). I found that albumin was lower in males but globulin levels were the same in both sexes. The reference laboratory (Antech) uses a colorimetric assay for total protein and the bromcresol green dye (BCG) method for albumin determination. Globulin is then calculated as the difference. The BSG method of albumin determination can overestimate this protein due to lack of specificity (Clase et al. 2001; Stokol et al. 2001) so it is possible that albumin values for both sexes are artificially elevated. Dessauer (1974) noted that the highest reptilian protein values are most likely to be found in females during estrous. Estrogen has been shown to increase serum protein levels (Clark 1967) and one study has reported higher TP values in female Gopher Tortoises (*Gopherus polyphemus*) (Taylor and Jacobson 1982). The plasma protein, vitellin, can also alter plasma protein values in egg-producing females (Dessauer 1974). Since most of the blood in the present study was collected during the egg-laying season, it seems probable that the higher TP concentration in females was probably due to albumin and vitellin.

Although sodium concentration was similar for both sexes, chloride values were higher in female *M. terrapin*. Another study noted the same male/female chloride disparity in *Elseya novaeguineae*, the New Guinea Snapping Turtle (Anderson et al. 1997). The sodium, potassium, and chloride values for 14 other turtle species were comparable to this study (Frye 1991). Because these three electrolytes and urea are involved in the regulation of osmolarity in *Malaclemys* their concentrations should increase or decrease as local water salinity increases or decreases (Bentley et al. 1967; Dunson 1970; Gilles-Baillien 1970). Diamondback Terrapins also possess a "salt gland" that helps to rid the body of excess sodium in a saline environment since their kidneys lack the ability to excrete hyperosmotic urine relative to blood plasma (Dunson 1970). In a study by Dunson (1970), sodium averages went from 100.7 mEq/L for terrapins spending a year in fresh water to 154.0 mEq/L for those in sea water. Gilles-Baillien (1970) found similar results. The conclusion is that sodium values (along with potassium, chloride, and urea) must be interpreted in light of environmental salinity. Although the salinity of both collecting sites was similar (28–30 ppt) little is known about the water routes of this species. Preliminary radio telemetry studies at the Stone Harbor collecting site indicate that individual *M. terrapin* travels between areas of varying salinity during the day (pers. obs.).

The sex disparity in chloride may be due to the low number ($N = 8$) of males in this part of the study. Another possibility is that nesting females leaving the water to lay eggs become somewhat dehydrated.

Calcium and phosphorous were both significantly elevated in female *M. terrapin*. The samples collected during this two-year study were during the breeding/nesting season and often were from females that were producing (or had just deposited) eggs. Several other sources have documented increased calcium levels in ovulatory chelonians (Anderson et al. 1997; Christopher et al. 1999; Clark 1967; Dessauer 1970; Dickinson et al. 2002; Fudge 2000; McArthur et al. 2004; Raphael et al. 1994). It was found however that as the season progressed the calcium and phosphorous values declined, which may be the result of continual egg production from June to August.

The two serum enzymes, AST and CPK reported by the diagnostic laboratory are included in their Comprehensive Reptilian Profile. Antech does not provide reference values for either of the two enzymes and they do not seem to be of much diagnostic value. Aspartate aminotransferase (AST) is present in all body tissues so it is not specific for any particular organ (Duncan et al. 1994; Mader 1996). Creatine phosphokinase (CPK) is primarily found in skeletal and cardiac muscle. The average AST values were similar to those observed in pancake tortoises (*M. tornieri*) (Raphael et al. 1994). Aspartate aminotransferase values for Desert Tortoises (*G.*

agassizii) were much lower (Dickinson et al. 2002). The Radiated Tortoise (*T. radiata*) also had relatively low AST values (Marks and Scott 1990). Such a large range and standard deviation of AST and CPK in the present study of apparently healthy Diamondback Terrapins makes interpretation difficult. The highest ten values for AST and CPK were scattered throughout both populations and collection days so specific capture and/or handling techniques did not seem to be a factor. The most likely explanation for the high enzyme values in the Diamondback Terrapin and Pancake Tortoise studies is that probing for a vein with a needle caused tissue trauma and resulted in the release of these two enzymes which in turn contaminated the blood sample (Duncan et al. 1994; McArthur et al. 2004). It is unlikely that the relatively high diamondback values were due to massive muscle (or other tissue) damage since all terrapins appeared healthy at the time of capture and were not obviously injured during handling. The significant (P = 0.03) increase in CPK with the time of year is hard to explain. It would seem that blood collection techniques would improve as the season continued which should lower CPK values.

Stress is reported to cause an increase in heterophils (Fudge 2000) but changes in other blood parameters due to stress are mostly unknown (McArthur et al. 2004). An inspection of the highest ten values for heterophils, glucose, and SUN showed no pattern with regards to collection date or site. This would tend to preclude specific capture, holding, or collection techniques as being responsible for the elevations. It is reasonable to assume that all wild chelonians are under stress when captured, restrained, and sampled for blood and thus all results are going to be "stress" values to some degree.

The reference ranges reported here are for terrapin populations in two areas of the northeastern United States. Blood testing of terrapins throughout their natural range will provide information on any differences that may exist in various geographic locations or subspecies. Finally, examination of blood from diseased diamondbacks may uncover valuable diagnostic markers to aid in assessing health status.

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Egg Clutch Characteristics of the Barking Treefrog, *Hyla gratiosa*, from North Carolina and Florida

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Information on the basic life histories of many species of amphibians is lacking in the literature. This deficiency can hinder comparative studies and contribute to a poor understanding of broad patterns of life-history variation. A striking example of this deficiency is the minimal amount of published information on egg clutch characteristics of *Hyla gratiosa*. Published data for this species consists of an estimate of 2084 eggs from a single clutch collected in 1921 in the Okefenokee Swamp in southern Georgia (Livezey and Wright 1947; Wright 1932). In addition, a study evaluating the influence of time spent in amplexus on oviposition behavior of *H. gratiosa* in northern Florida found an average clutch size of 867.2 (SD = 330.5, N = 11) for females in the longest amplecting group, which were allowed to remain in amplexus for 1.5 h prior to separation (Scarlata and Murphy 2003). Here we report characteristics of egg clutches for *Hyla gratiosa* in two areas in the southeastern United States: Scotland Co., North Carolina and Leon Co., Florida, and evaluate relationships between female body size and clutch size and geographic variation in clutch size. These data contribute to baseline reproductive information for this species and suggest some interesting questions for future studies.

Materials and Methods.—Seventeen clutches were collected from two localities in Leon Co., Florida (FL; 30.375°N, 84.37°W, elevation 7 m and 30.389°N, 84.329°W, elevation 9 m) from April through June 2003, and 13 clutches were collected from Grassy Pond in Scotland Co., North Carolina (NC; 35.009°N, 79.422°W, elevation 80 m, Travis 1983) in 1979. Amplexed pairs were collected, transported to the laboratory, and placed in separate covered buckets filled with well water (FL) or pond water (NC) for oviposition (as described in Gunzburger 2006). The following morning, adult size was measured using wet mass (g) in NC or tibio-fibula length (TFL, in mm) in FL. Number of eggs in each clutch was counted (NC) or photographed in a small container and eggs counted later from the photograph (FL). Diameter of the vitellus of 9–18 eggs from each clutch collected in NC was also measured using a dissecting microscope. Vitellus diameter data are presented, but no analysis was performed, because a small proportion of the eggs in each clutch were measured and variation in vitellus diameter may have arisen due to variation in development time. All analyses were performed for each population separately because the data for the two populations were collected at different time intervals separated by almost 30 years.

TABLE 1. Summary data (± SD, minimum – maximum in parentheses) of clutch characteristics and adult size [tibio-fibula length (TFL, mm) or mass (g)] from two populations of *Hyla gratiosa*. ND indicates no data was collected on that characteristic for that location.

Location	Sampling Interval	N	Clutch Size	Egg Diameter	Female TFL	Female Mass	Male TFL	Male Mass
Scotland Co., North Carolina	1979	13	2826 ± 842 (1825–4381)	1.39 ± 0.10 (1.19–1.55)	ND	14.72 ± 2.40 (11.01–17.28)	ND	15.71 ± 2.60 (13.50–20.28)
Leon Co., Florida	2003	17	1008 ± 249 (459–1492)	ND	22.63 ± 1.01 (21.5–25)	ND	24.00 ± 1.47 (22–26.4)	ND

Results.—Clutch size of *H. gratiosa* ranged from 459–4381, covering a two- to three-fold range even when considered among females from a single location (Table 1). Clutch size was significantly larger in NC than FL (t-test, t = -8.48, P < 0.001, Table 1). For the FL population, TFL of female *H. gratiosa* was significantly smaller than males (t-test, t = -3.13, P = 0.004, Table 1). Female TFL was not strongly correlated with the TFL of the male with which they were in amplexus (Pearson r = -0.08) or clutch size (r = 0.06, Fig. 1). For the NC population, mass was similar in males and females (t-test, t = -1.01, P = 0.32). Female mass was not strongly correlated with mass of the male with which they were in amplexus (Pearson r = -0.06). Larger females produced larger clutches (r = 0.59, Fig. 1). The diameters of individual eggs varied widely among the NC females, with the largest size being 30% larger than the smallest (Table 1).

Discussion.—Clutch size was larger for *H. gratiosa* in NC than in FL; this could be due to larger body sizes in NC (Travis, unpubl. data), temporal changes, or independent geographic variation, all of which are confounded in these collections. The published data on intraspecific geographic variation in body size in anurans suggests a trend toward larger sizes at higher latitude and elevation, but further study is needed to determine if this is the case for *H. gratiosa* (Ashton 2002; Berven 1982; Morrison and Hero 2003). *Hyla gratiosa* is the largest native hylid in the southeastern United States (Mount 1975), and in comparison to other closely-related hylids, has both a higher maximum and a greater range of variation in clutch size. In this study, *H. gratiosa* clutch size was found to range from 459 to 4381 eggs. In comparison, *H. cinerea* average clutch size ranges from 700 to 1472 (Garton and Brandon 1975; McAlpine 1993) and *H. squirella* average clutch size ranges from 957 to 1059 (Brugger 1984; Wright 1932). Limited evidence indicates that *Hyla gratiosa* females may oviposit more than one egg clutch each season (Perrill and Daniel 1983), so it is possible that some of the variation in clutch size for *H. gratiosa* is due to females ovipositing smaller second clutches.

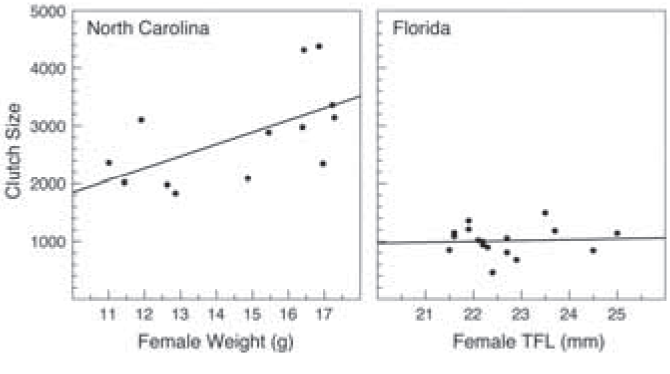

FIG. 1. Female body size and clutch size for *Hyla gratiosa* from the Florida population (N = 17) and North Carolina (N = 13).

Female size was more strongly correlated with clutch size for *H. gratiosa* from NC relative to FL. This could be due to differences in the measurement of adult size between the two data sets (mass and TFL, respectively) or differences between locations in the range of female body size. Future studies of reproductive ecology of this species should include both measurements of body size. Mean egg diameter was similar in this study in NC (Table 1) to that measured from a single clutch in the Okefenokee Swamp (mean = 1.37, SD = 0.19, N = 29, Wright 1932). The relationship between clutch size and egg size warrants further investigation as this study suggests that, at least in the NC population, larger females lay larger clutches of larger eggs. Although limited in scope, this study suggests there may be significant variation in reproductive characteristics of *H. gratiosa*.

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Herpetofauna of Mount Roraima, Guiana Shield Region, Northeastern South America

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The Guiana region of northeastern South America is an area of high biodiversity, and the varied habitats on the tepuis of the region support a significant portion of this diversity. The zoogeography of the pantepui region has been a recent topic of interest, with several sources of published data (Duellman 1999; Gorzula and Señaris 1999; Hollowell and Reynolds 2005a; Hoogmoed 1979a; McDiarmid and Donnelly 2005).

The herpetofaunal communities of several tepuis have been described (Donnelly and Myers 1991; Gorzula 1992; McDiarmid and Paolillo 1988; Myers 1997; Myers and Donnelly 1996, 1997, 2001). Mount Roraima, the most famous of these table mountains, has been explored extensively (McDiarmid and Donnelly 2005). Although numerous specimens have been collected on Roraima, these collections have never been summarized or analyzed.

Roraima (05º12'N, 060º44'W) is one of the highest points in northeastern South America, and it marks the boundary between Guyana, Venezuela, and Brazil. The summit plateau, from 2600 to 2810 m elevation, is some 34 km^2 in area. The plateau is known for its varied rock formations, and for its very sparse vegetation. The summit is at the top of steep walls which extend from below 2000 m up to 2600–2700 m; these walls are occasionally broken by more gradual slopes. At the bottom of the vertical walls, below about 2000 m, the tepui is surrounded by forested slopes. The forest is most extensive below 1500 m, with only a narrow band encircling the mountain above this elevation. Descriptions of the physical features and vegetation of Roraima are in Huber (1995a, b).

Herpetofaunas on tepui summits often differ in species composition from faunas on tepui slopes. Summit faunas are often more depauperate than slope faunas (Myers and Donnelly 2001). Both elevation and microhabitat can affect species distributions, and many species occur over a range of elevations (McDiarmid and Donnelly 2005). It is therefore worthwhile to have a compilation of slope and summit species, for comparison with faunas on other mountains.

The first aim of this paper is to compile a list of the known herpetofauna of Roraima, from both summit and slopes. The second aim is to compare the Roraima herpetofauna with those of other tepuis in the Guiana Shield (following Hollowell and Reynolds 2005b, p.1); this consists of 1) comparison using criteria developed by McDiarmid and Donnelly (2005), and 2) the hypotheses of tepui zoogeography of Myers and Donnelly (2001), who enumerated five general points about the composition of tepui herpetofaunas. Such comparisons can provide valuable insight about the zoogeography of the region.

Methods.—Information was taken from museum records or published literature. Amphibian taxonomy follows Faivovich et al. (2005), Frost et al. (2006) and Grant et al. (2006); reptile taxonomy follows Avila-Pires (2005). Institutional abbreviations follow Leviton et al. (1985), with the following additions: CSBD – Centre for the Study of Biological Diversity, University of Guyana, Georgetown, Guyana; MHNLS – Museo de Historia Natural La Salle, Caracas, Venezuela (formerly SCNLS); ULABG – Laboratorio de Biogeografia, Universidad de Los Andes, Mérida, Venezuela.

The aims of this study require that two points be defined. First, what are the boundaries of Roraima? Second, what are highland species? These questions were resolved as follows:

Roraima: We defined the boundaries of Roraima as that part of the mountain which is above 1500 m. Although some studies of the Guiana Shield region have used 1000 m as a minimum elevation (e.g., Hoogmoed 1979a), the use of this criterion at Roraima would necessitate the inclusion of the extensive surrounding uplands, and would increase the boundaries of Roraima to an unrealistic extent. We therefore adopted the 1500 m criterion, as have other studies of the Guiana fauna (Gorzula and Señaris 1999; McDiarmid and Donnelly 2005).

Because of the potentially great difference between faunas on tepui summits and faunas on forested tepui slopes, we have indicated the location from which each species was recorded, in order to determine whether each is part of the summit or slope faunal assemblages. The habitat on the slopes of Roraima is varied, ranging from steep rocky walls to more gently sloping forested areas (Huber 1995a, b).

Highland Species: Highland species are those which typically occur above 1500 m; any such species is here considered a highland species, although it may have been occasionally collected below 1500 m. McDiarmid and Donnelly (2005) followed a similar procedure. Although a highland species may occasionally occur at elevations below 1500 m, it will not be widespread below that elevation. Table 1 contains all species reported from above 1500 m, plus several highland species collected slightly below

TABLE 1. Amphibians and reptiles collected from Mount Roraima. G = Guyana, V = Venezuela. Species marked with (^{h}) are considered to be highland species, seldom occurring below 1500 m.

Family	Species	Country	Location	Latitude	Longitude	Elevation (m)	Institution	Citation
AMPHIBIA								
Aromobatidae	*Anomaloglossus praderoi* ^{h}	V	Third valley from base	05º10'	060º47'	1800, 1950	MHNLS, ULABG	La Marca 1997
	Anomaloglossus roraimae ^{h}	V	Paso de la Muerte just below summit			2700	ULABG	La Marca 1997
	Anomaloglossus roraimae ^{h}	G	North slope			1860–2350	USNM	Grant et al. 2006
Brachycephalidae	*Eleutherodactylus marmoratus* ^{h}	V	Summit Plateau			2600	UMMZ	
	Eleutherodactylus sp.	G	Summit	05º 12'	060º 44'	2600	USNM	
Bufonidae	*Oreophrynella macconnelli* ^{h}	G	North slope			1477–1800	BMNH	Warren 1973
	Oreophrynella quelchii ^{h}	V	Summit	05º 12'	060º 44'	2650	BMNH	Boulenger 1900b
	Oreophrynella quelchii ^{h}	V	Summit, west	05º 11'	060º 48'	2750	EBRG, MHNLS	
	Oreophrynella quelchii ^{h}	V	Summit	05º 12'	060º 44'		MCZ, UMMZ	Rivero 1961
	Oreophrynella quelchii ^{h}	V	Slope	05º 09'	060º 46'	1700	MHNLS	
	Oreophrynella quelchii ^{h}	G, V	Summit				USNM	
Cryptobatrachidae	*Stefania roraimae* ^{h}	G	North slope			1402	CSBD	Duellman and Hoogmoed 1984
Hylidae	*Hyla warreni* ^{h}	G	North slope	05º 17'	060º 44'	1480	BMNH, CSBD, KU	Duellman and Hoogmoed 1992
	Hypsiboas roraima ^{h}	G	North slope	05º 17'	060º 44'	1430–1480	BMNH, CSBD, KU	Duellman and Hoogmoed 1992
	Hypsiboas sibleszi ^{h}	G	North slope			1476	BMNH, CSBD	Hoogmoed 1979b
	Myersiohyla kanaima ^{h}	G	North slope	05º 17'	060º 45'	1430	BMNH, CSBD, KU, USNM	Duellman and Hoogmoed 1992
Leiuperidae	*Pseudopaludicola* sp. ^{h}	V	Slope	05º 10'	060º 47'	1550	MHNLS	
Leptodactylidae	*Leptodactylus fuscus*	V	Philipp Swamp			1570	AMNH	
Microhylidae	*Otophryne steyermarki* ^{h}	V	Slope	05º 10'	060º 44'	1550	MHNLS	
REPTILIA								
Gymnophthalmidae	*Arthrosaura versteegei*	V	Southeast slope	05º 11'	060º 43'	1920	MHNLS	
	Riolama leucosticta ^{h}	V	Summit			2700	BMNH	Boulenger 1900a
Polychrotidae	*Norops chrysolepis*	V	Slope	05º 10'	060º 45'	1920	MHNLS	
Scincidae	*Mabuya nigropunctata*	V	Slope	05º 09'	060º 47'	1550	MHNLS	
Tropiduridae	*Tropidurus hispidus*	V	Slope	05º 09'	060º 47'	1550	MHNLS	
Colubridae	*Liophis breviceps*	V	Slope	05º 10'	060º 45'	1950	MHNLS	
Viperidae	*Bothriopsis taeniata*	V	Slope	05º 09'	060º 47'	1550	MHNLS	
	Crotalus durissus	V	Slope	05º 09'	060º 47'	1550	MHNLS	

1500 m (between 1400 and 1500 m) on Roraima.

Comparisons: Not all species in Table 1 are included in that part of the Discussion concerning comparisons among tepui faunas. In order to make the comparisons as valid and accurate as possible, we used the same criteria as those used by other studies to which we compare the Roraima fauna. Two types of comparisons are made. The first is based on elevational and distributional ranges of species occurring on each mountain as defined by McDiarmid and Donnelly (2005). These authors (2005, p. 483) examined the elevational ranges (ER) and distribution patterns (DP) of tepui species. Elevation ranges and distribution patterns are weighted according to their extent, and the weighted results are added to produce two values: Sum of elevational ranges (SUMER) and Sum of distribution patterns (SUMDP), which reflect the composition of each tepui community. Only those species which occur above 1500 m are used in this comparison. The second type of comparison is based on the hypotheses of tepui herpetofaunas proposed by Myers and Donnelly (2001); only those species which fit the above definition of highland species are used in this comparison.

Results.—The search of institutional records and published literature turned up 14 amphibian and 8 reptile species in 18 genera and 13 families occurring on Roraima. These taxa are shown in Table 1. Where data such as coordinates, elevation and precise location are known, they are provided in the table.

Several changes have been made to information from the literature. These are as follows:

1) Phelps (1938) determined that the specimens collected by McConnell and Quelch, reported in Boulenger (1900a, b) as being from Guyana, were actually collected in Venezuela. Table 1 follows this determination.

2) Rivero (1961) reported two species of *Leptodactylus* from the summit of Roraima in the AMNH collection: *L. sibilatrix* AMNH 39752 and *L. podicipinus petersi* AMNH 39753. However, according to AMNH records, 39752 is *L. fuscus* from Philipp Swamp and 39753 is *L. sabanensis* from a location below 1500 m. Table 1 follows this determination.

3) Gorzula and Señaris (1999, p. 255) reported *Tepuihyla edelcae* from Roraima. However, although *T. edelcae* is reported from Roraima on p. 255, the more detailed species account (p. 49) contains no mention of its presence on Roraima. This species has been collected only from several tepuis to the west of Roraima (Auyán, Chimantá, Los Testigos). Table 1 follows this determination, as do McDiarmid and Donnelly (2005).

4) The latitude given for the north slope of Roraima in Duellman and Hoogmoed (1992) corresponds to a location some 35 km N of Roraima. Following Warren (1973) we have amended this latitude to 05º17'N.

In addition to *Norops chrysolepis*, which has also been recorded above 1500 m (Table 1), 39 additional species, *Chaunus granulosus, C. marinus, Rhinella margaritifer*, *Anomologlossus* sp., *Stefania scalae*, *Dendropsophus minutus*, *Hypsiboas boans*, *H. crepitans*, *H. multifasciatus*, *Scinax ruber*, *Adelophryne gutturosa*, *Eleutherodactylus* sp., *Leptodactylus bolivianus*, *L. pallidirostris*, *L. petersi*, *L. sabanensis*, *Otophryne robusta*, *Synapturanus* sp., *Lithobates palmipes*, *Norops auratus*, *N. fuscoauratus*, *Polychrus marmoratus*, *Mabuya nigropunctata*, *Ameiva ameiva*, *Arthrosaura guianensis*, *Cnemidophorus lemniscatus*, *Kentropyx calcarata*, *K. striata*, *Neusticurus rudis*, *Boa constrictor*, *Leptodeira annulata*, *Liophis lineatus*, *Liophis typhlus*, *Mastigodryas bifossatus*, *M. boddaerti*, *Oxybelis aeneus*, *Tantilla melanocephala*, *Micrurus lemniscatus,* and *Bothrops atrox*, were collected on the slopes of Roraima below 1500 m (Barrio 1998; Boulenger 1900a, b; Campbell and Clarke 1998; Heyer 1994; Hoogmoed 1979b; Rivero 1961).

Discussion.—Seventeen species have been collected from above 1500 m on Roraima. Numbers of species collected on Roraima are compared to collections from some other tepuis in Table 2. In order to ensure that such comparisons are as meaningful as possible, only large, frequently-visited tepuis in the eastern Guiana region are included in the table. There are few such tepuis; for this reason we include Guaiquinima, even though it does not reach 1500 m.

Roraima's diversity is lower than that on other comparable tepuis (Table 2), despite having been visited by collectors at least as often as have other tepuis. While other large tepuis have forested slopes which support considerable faunal diversity, Roraima's slopes are mostly steep rocky walls, with only a narrow forested band above 1500 m. The summit of Roraima also supports little vegetation, and its area is smaller than the summits of other tepuis (Huber 1995a). Thus, the limited amount of suitable habitat on Roraima may account for its low faunal diversity.

Faunal composition on the slopes of Roraima changes with elevation, and there is no overlap between the slope and summit faunas. The faunal changes are summarized in Table 3. Specimens have never been collected systematically along an elevational transect on the slopes of Roraima; most are from the vicinity of locations which are suitable for camping. It is possible that elevational changes in faunal composition are partly an artefact of

TABLE 2. Species diversity on frequently visited large tepuis of the eastern Guiana Shield.

Location	Elevation (m)	Number of Species Collected	Season of Visit(s)	Reference
Auyán	1600–2100	24	various	Myers 1997 McDiarmid and Donnelly 2005
Chimantá	1800–2600	18	various	Gorzula 1992 McDiarmid and Donnelly 2005
Guaiquinima	1030–1380	21	February–April	Donnelly and Myers 1991 Gorzula and Señaris 1999
Roraima	1500–2810	17	various	Table 1, this paper

TABLE 3. Elevational distribution of families on Mount Roraima.

Family	> 1500 m	Summit
Aromobatidae	2	0
Brachycephalidae	2	2
Bufonidae	2	1
Leptodactylidae	2	0
Microhylidae	1	0
Gymnophthalmidae	2	1
Polychrotidae	1	0
Scincidae	1	0
Tropiduridae	1	0
Colubridae	1	0
Viperidae	2	0
Total	17	4

collecting efforts. For example, the Hylidae, which are very diverse at lower elevations, are not represented above 1500 m. However, several highland species (*Hyla warreni*, *Hypsiboas roraima*, *H. sibleszi*, *Myersiohyla kanaima*, *Stefania roraimae*) were collected between 1400 and 1500 m on Roraima. All of these have been collected above 1500 m on other tepuis, and it is possible that they occur above 1500 m on Roraima as well.

Only four species (*Oreophrynella quelchii*, *Eleutherodactylus marmoratus*, *Eleutherodactylus* sp. [USNM], *Riolama leucosticta*) are known from the summit of Roraima, with *Anomaloglossus roraimae* collected from a location just below the summit. Tepui summit faunas are typically depauperate, but nonetheless this number is somewhat lower than the numbers of species collected on the summits of other frequently-visited tepuis (McDiarmid and Donnelly 2005; Myers and Donnelly 2001).

The remaining species (Table 1) were recorded from a variety of habitats on the slopes of Roraima. Some slope species have been reported only from higher elevations elsewhere, such as *Hyla warreni* (MacCulloch and Lathrop 2005), *Stefania roraimae* (MacCulloch and Lathrop 2002) and *Otophryne steyermarki* (Barrio 1999; Campbell and Clarke 1998; Myers 1997), but many reptile species have been reported from a broad range of elevations.

Some genera which have been collected in several other highland locations in the Guiana Shield (e.g., *Hyalinobatrachium*, *Tepuihyla*, *Thamnodynastes*) have not been collected on Roraima.

McDiarmid and Donnelly (2005, p. 512) listed elevation ranges for many Guiana Shield species. Table 1 increases the elevation ranges for *Oreophrynella quelchii*, *Otophryne steyermarki,* and *Tropidurus hispidus*.

Comparisons: Elevational ranges (ER) and distribution patterns (DP) of tepui species were examined by McDiarmid and Donnelly (2005). Elevational ranges and distribution patterns for the Roraima community are in Table 4; SUMER = 648 and SUMDP = 739. These values are similar to those presented by McDiarmid and Donnelly (2005) for other large tepuis. SUMER and SUMDP for Roraima, and for other tepuis, will undoubtedly change as knowledge of the fauna increases.

Myers and Donnelly (2001, p. 79) established five general statements concerning tepui herpetofaunas. The assembled data from

TABLE 4. Elevational ranges and distribution patterns for the 17 species which occur above 1500 m on Mount Roraima. Distribution patterns (from McDiarmid and Donnelly 2005): HR = highly restricted (occurs on only one tepui); MR = moderately restricted (two or more tepuis); GE = Guiana endemic; WS = widespread.

Species	Elevational Range (ER) (m)	ER Weighting Factor	Distribution Pattern (DP)	DP Weighting Factor
Anomaloglossus praderoi	1800–1950	1	HR	1
Anomaloglossus roraimae	1860–2700	2	HR	1
Eleutherodactylus marmoratus	100–2600	100	GE	10
Eleutherodactylus sp. (summit)	2600	0	HR	1
Oreophrynella macconnelli	1067–1800	2	HR	1
Oreophrynella quelchii	1700–2800	10	MR	2
Leptodactylus fuscus	100–1570	10	WS	100
Pseudopaludicola sp.	1550	0	HR	1
Otophryne steyermarki	1550–2150	2	GE	10
Arthrosaura versteegei	100–1920	100	GE	10
Riolama leucosticta	2500–2700	1	MR	2
Norops chrysolepis	100–1920	100	WS	100
Mabuya nigropunctata	100–1550	10	WS	100
Tropidurus hispidus	20–1550	10	WS	100
Liophis breviceps	100–1950	100	WS	100
Bothriopsis taeniata	0–2000	100	WS	100
Crotalus durissus	30–1920	100	WS	100
		SUMER = 648		SUMDP = 739

TABLE 5. Herpetofaunal community composition on summits of Roraima and neighboring tepuis.

Species	Roraima	Kukenán	Ilú	Yuruaní	Wei-Assipu	Citation or Institution
Anomaloglossus sp.					X	Villarreal et al. 2002
Eleutherodactylus marmoratus	X					UMMZ
Eleutherodactylus sp.	X					USNM
Eleutherodactylus sp.				X		Mägdefrau and Mägdefrau 1994
Oreophrynella nigra		X		X		Señaris et al. 1995 Gorzula and Señaris 1999
Oreophrynella quelchii	X				X	Señaris et al. 2005
Oreophrynella vasquezi			X			Señaris et al. 1995 Gorzula and Señaris 1999
Oreophrynella weiassipuensis					X	Señaris et al. 2005
Stefania riveroi				X		Señaris et al. 1997 Gorzula and Señaris 1999
Stefania sp.					X	Villarreal et al. 2002
Hyla warreni					X	Villarreal et al. 2002
Tepuihyla sp.					X	Villarreal et al. 2002
Riolama leucosticta	X	X		X		Gorzula and Señaris 1999

Roraima are examined below to determine the extent to which they support these five points.

Point 1: tepuis have relatively depauperate herpetofaunas. This is true for summit faunas. The Roraima summit fauna consists of four species; the fauna on other tepui summits ranges from zero to 15 species (McDiarmid and Donnelly 2005; Myers and Donnelly 2001, see also Table 5). Herpetofaunas on the slopes of tepuis are usually more diverse.

Point 2: neighboring tepuis are likely to have significantly different faunas. Although Myers and Donnelly (2001) did not quantify the definition of neighboring tepuis, they used Auyán and Chimantá, which are 50 km apart, as examples. Therefore we use this distance as a criterion, and consider tepuis within 50 km of Roraima to be neighboring tepuis.

Four tepuis within a 50-km radius have been visited: Kukenán (05º13'N, 060º51'W, 2650 m elev.), Yuruaní (05º19'N, 060º51'W, 2300 m elev.), Ilú (05º25', 060º59'W, 2700 m elev.), and Wei-Assipu (05º13'N, 060º42'W, 2400 m elev.). Although some specimens have been collected on the slopes of Kukenán (Gorzula and Señaris 1999; Rivero 1961), collections from Ilú, Yuruaní, and Wei-Assipu were made only on the summits, accessed by helicopter (Gorzula and Señaris 1999; Villarreal et al. 2002). Therefore only the summit faunas will be used for comparison among these five tepuis (Table 5). Collections from Kukenán contained one amphibian species (*Oreophrynella nigra*) which has not been collected on Roraima. Specimens from Wei-Assipu include four species which have apparently not been collected on Roraima, although three of these are identified only to genus. The Wei-Assipu community also includes one genus (*Tepuihyla*) which has not been reported from Roraima.

The herpetofauna of Wei-Assipu is more diverse than those of the neighboring tepuis Roraima, Kukenán, Ilú, and Yuruaní. This may be because of summit habitat; on the latter four tepuis the summit is rocky and vegetation is sparse (Señaris et al. 1995, 1997), while the summit of Wei-Assipu supports more vegetation (Villarreal et al. 2002).

Only three species, *Oreophrynella nigra*, *O. quelchii,* and *Riolama leucosticta*, occur on more than one tepui. The ten remaining species are found on only one of the five, although two also occur at more distant locations (*Eleutherodactylus marmoratus* and *Hyla warreni*).

Although *Oreophrynella* are found on all five tepuis, and *Riolama* on three, other genera and even families exhibit little overlap. The summit faunas of these neighboring mountains are quite different. This situation is similar to that observed on Auyán and Chimantá (Myers 1997).

Point 3: tepui endemics outnumber widespread highland species. Expanding on the criterion established in Point 2, we consider any species from Roraima which also occurs in one or more locations more than 50 km distant from Roraima to have a widespread distribution. Using this criterion, seven of the highland species occurring on Roraima have been reported from locations at distances of 50–200 km from Roraima, and are therefore considered widespread species. These are *Stefania roraimae* (MacCulloch and Lathrop 2002), *Hyla warreni* (MacCulloch and Lathrop 2005), *Hypsiboas roraima* (MacCulloch and Lathrop 2005), *H. sibleszi* (Duellman 1997; Hoogmoed 1979b; MacCulloch and Lathrop 2005), *Myersiohyla kanaima* (Duellman and Hoogmoed 1992; Goin and Woodley 1969; MacCulloch and Lathrop 2005), *Eleutherodactylus marmoratus* (Frost 2004), and *Otophryne steyermarki* (Barrio 1999; Gorzula and Señaris 1999).

Of the four Roraima summit species, only *Eleutherodactylus* sp. (USNM) is endemic. Of the highland slope species only four (*Oreophrynella macconnelli*, *Anomaloglossus praderoi*, *Anomaloglossus roraimae*, *Pseudopaludicola* sp. [MHNLS]) have never been reported from elsewhere and can be considered endemic. On Roraima, widespread highland species outnumber endemics.

Point 4: some endemic species have counterparts on other tepuis. This point is supported by the Roraima data. The genera *Oreophrynella*, *Eleutherodactylus* and *Anomaloglossus* are good examples of this phenomenon.

Point 5: lowland species find their way onto tepuis in an irregular, unpredictable manner. This point is well supported by the Roraima data. Several lowland species, *Leptodactylus fuscus*, *Mabuya nigropunctata*, *Tropidurus hispidus*, *Liophis breviceps*, *Bothriopsis taeniata* and *Crotalus durissus*, occur above 1500 m on Roraima. Some of these species (*Leptodactylus fuscus*, *Tropidurus hispidus*, *Bothriopsis taeniata*, *Crotalus durissus*) have also been reported from high elevations elsewhere (Donnelly and Myers 1991; Gorzula and Señaris 1999; McDiarmid and Donnelly 2005; Means 2004).

The Roraima data support Points 2, 4, and 5 well, but provide little support for Points 1 and 3. Some points appear to apply more to summit faunas than to slope faunas.

The Roraima herpetofauna is a mixture of high- and low-elevation taxa, similar to the faunas on numerous other tepuis in the Guiana Shield region. Although knowledge of the region's amphibians and reptiles is far from complete, the situation will improve as more of the region is explored, and as previously collected locations are revisited.

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First Detailed Report of Predation on Anuran Metamorphs by Terrestrial Beetle Larvae

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Invertebrates are known predators of both aquatic and terrestrial stages of amphibians (reviewed in McCormick and Polis 1982; Toledo 2005). Seventy-three percent of reported predation events in and out of the water on anurans involved spiders (ca. 48%) and water bugs. The remainder included crabs, leeches, and various insect groups (Toledo 2005). A review of the published information on predation of juvenile and adult amphibians by beetles revealed reports on predation by adult carabids (Huheey and Stupka 1967; Littlejohn and Wainer 1978; Ovaska and Smith 1988; Robertson 1989; Smith 1946), dytiscids (Hinshaw and Sullivan 1990), cicindelids (McCormick and Polis 1982) and staphylinids (Jung et al. 2000).

There are three reported cases of terrestrial beetle larvae preying on amphibians, all belonging to the carabid tribe Chlaeniini (= Callistini). Shiina and Tachikawa (1988) reported how *Epomis nigricans* larvae ambush *Hyla* sp. and *Rhacophorus schlegelii* on vegetation and prey upon them (shown in photographs by Tachikawa 1994). There is a preliminary report from South Africa on carabid beetle larvae associated with *Bufo* sp. (Moore 1971). That author received two preserved first instar larvae identified as Chlaeniini, which had been found attached by means of the mandibles to the hind leg of a toad. No further information was given as to whether the described larvae were able to kill or physically harm the toad.

While studying the population dynamics of the Green Toad (*Bufo viridis*), a species that was recently declared endangered in Israel (Gafny 2004), we encountered on several occasions a carabid larva attached to Green Toad and Yellow Lemon Tree Frog (*Hyla savignyi*) metamorphs. We describe here the predation behavior and its frequency of occurrence in the central coastal plain of Israel, together with a description of the beetle's larval development and pupation.

Methods.—We monitored *Bufo viridis* breeding populations in the central coastal plain of Israel (0–50 m elevation) at seven rain pools over a period of four years (2002–2005), at two pools for two years (2002–2003), and at one pool for one year (2006). We searched seasonally for metamorphs under cover items including logs, stones and debris, along the edge and in the vicinity of the rain pools. Each site was sampled regularly every two weeks, starting in the third week of March, until no additional metamorphs were located at the site for at least two consecutive visits. All metamorphs were transferred to the laboratory for inspection of malformations or other signs of abnormality and were then returned to the collection site. Among them we found beetle larvae attached to metamorphs. In spring 2005 and 2006, we conducted laboratory observations to study larva-metamorph interaction.

In spring 2005, we conducted laboratory observations of three pairs of beetle larvae and toad metamorphs. Two beetle larvae (one first-instar and one second-instar) were detached from *B. viridis* metamorphs and one single larva (second-instar) was found in the collection container. Beetle larvae were placed individually in 500 ml circular semitransparent plastic containers, and kept indoors at 20–24°C, under a natural photoperiod (L/D, 14:10). Each container held about a 3-cm-deep mixture of peat and coconut fiber bedding that was kept moist. A piece of crumpled tissue paper was added to provide the larvae with substrate for successful molting and for cover. A single toad metamorph was placed into each of the three containers. When a metamorph was consumed, the larva was presented with an additional *B. viridis* metamorph. If the beetle larva did not respond within several hours, the metamorph was removed and offered again on the next day. The metamorphs in the experimental containers were left unfed. In a second set of feeding trials, to examine the diet specificity of the carabid larvae, we offered larvae a selection of macroinvertebrates that they might encounter in their natural habitat. These included house crickets (*Acheta domestica*), snails (*Xeropicta vestalis*) and earthworms (*Lumbricus* sp.). We also tested larval response to mealworms (*Tenebrio molitor*). Larval development was monitored continuously through all molting stages, pupation and adult emergence, to identify the beetle species.

In the following winter (February 2006) we collected four adult beetles (2 females, 2 males) at a rain pool site (Dora; 32°18'N, 34°11'E). We placed the beetles in a 5 L rectangular semitransparent plastic container, indoors at 24–26°C, under a natural photoperiod (L/D, 14:10). The container had bedding similar to that described for the observations in 2005. At least 45 eggs were laid, three were preserved and the rest were left to hatch (all hatched). We repeated the predation experiment following the procedure performed in 2005 with 12 beetle larvae and *B. viridis* metamorphs (reared in the laboratory from tadpoles collected from a drying pool). In addition, three first-instar beetle larvae hatched in captivity were retained in containers but not fed. The remaining hatched larvae were retained and fed metamorphs to document their development.

Results.—Predatory interactions of carabid beetle larvae on anuran metamorphs were found for both *B. viridis* and *H. savignyi* collected in the vicinity of rain pools. We examined a total of 4907 metamorphs, and 909 juveniles and adults of *B. viridis*, as well as occasionally encountered adults (N = 64) and metamorphs (N = 1894) of *Hyla savignyi*. Predation interactions were recorded for less than 0.5% of each of the above anuran species, between April 25 to May 22, at 3 of 10 sites studied. At one site (Hadera-West; 32°96'N, 34°17'E), we encountered 8 carabid larvae attached to metamorphs of *B. viridis* and one to a metamorph of *H. savignyi*. At another site (Dora), we recorded one carabid beetle larva attached to a metamorph of each of the above anurans. Upon checking cover objects in a dried pool (Qadima, 32°27'N, 34°89'E), we observed a first instar carabid larva moving around among a group of *B. viridis* and *H. savignyi* metamorphs. When introduced into a container that held a *B. viridis* metamorph, the beetle larva immediately attached to the metamorph's forelimb. Under a different cover object at the same site we observed a second instar larva attached to a *B. viridis* metamorph.

The attacked *B. viridis* metamorphs were 12–33 mm SVL, and weighed 0.24–3.8 g; *H. savignyi* were 15.5–23.5 mm SVL and weighed 0.3–1.06 g. A single beetle larva was found per anuran individual. In the case of *B. viridis*, 7 were attached to the abdominal area, one to the hind limb, one to the lower jaw and one to the back of the head. For *H. savignyi*, one larva was found attached to the back, and the other to the forelimb. The larvae were strongly attached to the metamorphs' skin by the mandibles and force was needed to dislodge them from the prey, which was left with deep skin lesions (photographs available at: http://www.tau.ac.il/lifesci/departments/zoology/Amphibia/index.html).

Analysis of predation behavior of the beetle larvae on metamorphs is based on laboratory observations of 3 larvae in 2005 and 12 in 2006. Free beetle larvae were relatively inactive during the day, but moved around on the soil surface at night. Upon presentation of a toad metamorph, each larva responded vigorously, grasping the prey's skin with its mandibles. Some toads tried unsuccessfully to rid their body of the larva, but eventually continued apparently normal behavior. Feeding of the beetle larvae on small metamorphs (< 16 mm) appeared to first entail sucking of their body fluids, which lasted less than an hour, and was then followed by chewing of soft tissue. Sucking of larger metamorphs lasted up to 32 h, during which the larvae also changed their attachment position on the prey's body. The larva's body progressively inflated and increased in size while that of the prey shrunk. The larva, which sucked the prey's fluids completely, concomitantly released liquid droplets from its anus. Only 2 of 45 metamorphs survived being preyed upon by the beetle larvae in the laboratory studies (2005–2006), and both were > 29 mm SVL. The larva either moved away from the dead metamorph, or started chewing it, leaving behind only skin and bones (photographs available at: http://www.tau.ac.il/lifesci/departments/zoology/Amphibia/index.html). In 2006, three first-instar larvae were kept without metamorphs and survived for six days.

To examine diet specificity we also presented the carabid larvae with invertebrates that they might encounter in their habitat. In only one of six trials did a larva respond to an earthworm and grab it; and this occurred only after repeated presentations directly in front of its mandibles. It sucked the worm and killed it, as observed for the toads. House crickets, snails and mealworms were ignored.

Beetles emerged in captivity in 2005 were identified as *Epomis dejeani*, Chlaeniini (Dejean 1831, cited in Makarova 2005), a species widely distributed throughout the eastern Mediterranean, the Crimea, southern Russia and central Asia (Winkler 1932). In 2006, we observed adult *E. dejeani* in moist soil in the vicinity of rain pools (Hadera West, Dora) under the same type of cover used by anuran metamorphs. The 4 adult beetles collected in February 2006 laid eggs 32 days later. Six days after spotting of the eggs the first larvae hatched. Hatching continued for another 10 days. The duration of the instar stage progressively decreased from a maximum of 7 days of the first instar to 4 of the third instar (Table 1). In 2005, larval period above-ground lasted 18–24 days (N = 3), while in 2006 it was 8–9 days shorter (Table 1). Construction of the pupation chamber was completed within a period of five days (N = 2, 2005). The pupation period lasted 8 days. The adults remained in the pupating chamber for another 3 days and then

TABLE 1. Developmental stage, duration, and size of *Epomis dejeani* larvae observed under laboratory conditions in 2006, and number of toad metamorphs consumed per larval instar stage. Number in parentheses indicates sample size. NA: not applicable.

Developmental stage	Duration (days)	Length (mm)	Consumed prey
1st instar	4–7 (12)	5–11 (7)	1 (9)
2nd instar	3–5 (10)	7–18 (10)	1 (9)
3rd instar	2–4 (7)	11–27 (8)	4 (5)
Underground period	19; 21 (2)	NA	NA
Total	31; 37 (2)	NA	6

emerged (males, 16 and 18 mm). In 2006, the underground period until emergence lasted 19 and 21 days (N = 2, females, each 19 mm).

First and second instars each consumed one *B. viridis* metamorph. Third-instar larvae presented with metamorphs larger than 16 mm SVL consumed two toadlets per larva (2005 experiment), whereas those presented with smaller prey consumed four (2006 experiment, Table 1). In one case we observed a first-instar larva attached to a second-year juvenile *B. viridis* (50 mm SVL). It completed first, second and third instar stages on the same individual, ultimately killing it.

Discussion.—This is the first detailed description of predation on juvenile anurans (*Bufo viridis* and *Hyla savignyi*) by a terrestrial beetle larva (*Epomis dejeani*). *Epomis dejeani* belongs to the carabid tribe Chlaeniini in which most species are well-known hemi-cryptobionts (i.e., organisms colonizing hidden surfaces; Makarova 2005) of humid, clay-type soils (Thiele 1977). The genus *Epomis* comprises of about 20 species, found mainly in tropical Africa and south and southeastern Asia; five species are known from the Palaearctic region, among them *E. dejeani* (Kryzhanovskij 1983). The larva of this species was first described in 2005 (Makarova 2005). Representatives of the tribe in Israel are often found around the edges of water bodies (Schweiger 1989; A. Gasith, unpubl. data). In our study, *E. dejeani* was found in clay-type and sandy soils around rain pools. These habitats are major breeding sites of *B. viridis* and *H. savignyi* in Israel. Along the coastal plain, metamorphs of both anuran species emerge from the pools in late March and early April. They seek cover in moist soil in the vicinity of the pools until leaving the breeding sites in late May through June (E. Elron, unpubl. data). Larvae of *E. dejeani* are also active during this period. Most carabid larvae and adults are polyphagous, feeding on a wide range of soil invertebrates (Ekschmitt et al. 1997; Lövei and Sunderland 1996). Larval feeding behavior resembles parasitism in the initial phase (sucking body fluids) and can develop into typical predation (tissue ingestion) at the end. They encounter and attack anuran metamorphs on the ground near breeding sites during a relatively short window of opportunity, from late April to late May. Encounters between the beetle larvae and anurans are inevitable because both use the same moist habitats at the same time. Whereas *E. dejeani* larvae attack the prey on the ground, larvae of *E. nigricans* were reported to ambush amphibians on vegetation (Shiina and Tachikawa 1988). Our findings on *E. dejeani* together with the reports on predation of anurans by *E. nigricans* in Japan (Shiina and Tachikawa 1988; Tachikawa 1994) and South Africa (Moore 1971), indicate that this phenomenon is not a peculiar predation behavior of a single Chlaeniini species. Such predators can be categorized as "temporary specialized predators," a term used by Toledo et al. (2007) for vertebrate predators "who look specifically for anurans in a determined phase of their life cycle or for a determined purpose."

Epomis dejeani appear to complete larval development in 40 days or less, consuming four or more anuran metamorphs. This is similar to the life history reported for *E. nigricans*, which completes its life cycle in a month, consuming three anurans (Shiina and Tachikawa 1988). In only one-third of the cases studied (N = 333) were arthropod predators smaller than their vertebrate prey (Toledo et al. 2007). This is also the case of *E. dejeani* larvae, which consumes prey many times larger than their size (5–20 fold in weight). This allows the predator to efficiently supply its energetic needs while impacting a relatively small number of prey. In the present study all affected metamorphs were found with a single larva attached to their body. We have evidence for one case in which a *B. viridis* metamorph was attacked by two carabid larvae simultaneously (M. Vonshak, pers. comm.; Sde Boqer, 30°52'N, 34°46'E, Israel, July 1997).

The carabid larva is a newly reported predator of amphibians. The apparently low frequency of occurrence (< 0.5%) of this interaction and the relatively small number of prey affected per beetle suggest a limited effect on amphibian populations.

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Bacterial Microflora of the Anterior Digestive Tract of Two *Agkistrodon* Species: Additional Evidence for Food Partitioning?

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Copperheads (*Agkistrodon contortrix*) and Cottonmouths (*A. piscivorus*) are closely related species that are sympatric throughout much of their range (Conant and Collins 1998). Although these species overlap in geographic range, reported habitat use by these species differ (Gloyd and Conant 1990; Roth 2005). The differences in habitat use most likely reflect differences in prey preference between the two species (Fitch 1999). Copperheads are primarily upland species and feed on small mammals, cicadas, and upland frogs while cottonmouths are lowland species and feed primarily on fish, thus its given specific eptithet *piscivorus* meaning piscivor or fish eater (Conant and Collins 1998). Although both *Agkistrodon* species are opportunistic feeders (e.g., Lutterschmidt et al. 1996; Roth et al. 2003) and may demonstrate considerable overlap in diet, each species demonstrates unique food habits characteristic to the prey availability within their preferred microhabitat.

Because differences in diet may introduce different bacterial microflora to the oral cavity and esophageal track, we conducted an investigation to inventory the common bacterial microflora of the anterior digestive tract and to address the following questions: 1) Does the bacterial microflora in the oral cavity and esophageal tract differ between *A. contortrix* and *A. piscivorus*?; 2) Do differences in bacterial microflora support the differences in diet and food partitioning between the two *Agkistrodon* species?; and 3) Do wild caught snakes have a greater richness of bacterial microflora in the esophageal tract than captive snakes fed only a diet of laboratory mice (*Mus musculus*)?

Both freshly captured and captive snakes were obtained from populations located in Walker Co., Texas, USA. The four freshly captured snakes (two *A. contortrix* and two *A. piscivorus*) were collected from sampling sites that included FM 2821, the Center for Biological Field Studies (CBFS) and Harmon Creek. These snakes were brought back to the laboratory and immediately sampled for bacteria in their anterior digestive tracts. The four captive snakes used in this study were from the captive snake colony housed in the Lutterschmidt Physiological Ecology Research Laboratory at Sam Houston State University. Theses snakes were housed and fed only laboratory mice (*M. musculus*) for at least one year.

Bacterial microflora were sampled only once from each snake by allowing each snake to crawl into a plastic tube for safe handing and straight positioning of the snake's body for oral and esophageal swabbing. A sterile cotton swab (ca. 30 cm in length) was inserted into the mouth and slowly pushed into the esophageal tract. The swab was inserted to approximately a fourth of the snake's body length and slowly retracted. Once removed, the cotton end of the pharyngeal swab (i.e., sample of both the oral cavity and esophageal tract) was broken off into 15 ml Falcon polystyrene conical tubes (Becton Dickinson and Co., Franklin Lakes, New Jersey) containing 5 ml of Butterfield's buffer. Serial dilutions were prepared for each sample and cultured aerobically at 35°C for 24 h on MacConkey agar for the isolation of Enterobacteriaceae. Isolated colonies were subcultured onto tryptic soy agar and cultured aerobically at 35°C for 24 h. Colonies that were oxidase negative were emulsified into 5 ml of sterile 0.85% NaCl (Leboffe and Pierce 2002). API 20E strips (bioMerieux, Inc., Hazelwood, Missouri) of 20 microcupules containing dehydrated substrates were inoculated according to directions supplied by the manufacturer. All reactions were read after 24 h. Each isolate was identified by using the API 20E profile index.

Only enteric species richness was tabulated for comparison of bacterial microflora among wild and captive *A. contortrix* and *A. piscivorus*. Blaylock (2001) found that most oral bacteria (81.5%)

TABLE 1. Alphabetical listing of the bacterial microflora sampled form eight snakes showing similarities and differences in bacterial species composition between copperheads (*A. contortrix*) and cottonmouths (*A. piscivorus*).

Bacterial Species	**Wild**		**Captive**	
	A. contortrix	*A. piscivorus*	*A. contortrix*	*A. piscivorus*
Acinetobacter baumannii	X	X		
Aeromonas caviae			X	
Aeromonas schubertii			X	
Aeromonas spp.			X	
Citrobacter freundii	X	X	X	
Citrobacter spp.	X		X	X
Enterobacter agglomeras	X			
Enterobacter cloacae		X		X
Enterobacter spp.		X		
Escherichia coli	X		X	
Klebsiella oxytoca			X	
Klebsiella pneumonia		X	X	X
Kluyvera spp.		X		
Leclercia adecarboxylata	X			
Proteus spp.			X	
Providencia alcalifaciens		X		
Providencia rettgeri			X	X
Pseudomonas aeruginosa			X	
Pseudomonas putida		X		
Salmonella spp.		X	X	
Xanthomonas maltophilia	X			
Species Richness (A.c. vs. A.p.)	7	9	12	4
Species Richness (Wild vs. Captive)	14		13	

were Enterobacteriaceae. Jaccard binary similarity coefficients for presence/absence data were used to investigate community similarity of bacterial microflora (Krebs 1999).

We identified 21 (15 to species level and 6 to genus level) bacterial species from the esophageal tracts of the eight *Agkistrodon* snakes. The comparison of bacterial microflora from the esophageal tract of wild-caught *A. contortrix* and *A. piscivorus* indicated that only two bacterial species (*Acinetobacter baumannii* and *Citrobacter freundii*) were shared between the snake species. Five bacterial species found in *A. contortrix* were not observed in *A. piscivorus* and seven bacterial species found in *A. piscivorus* were not observed in *A. contortrix* (Table 1). Of the 14 bacterial species found in the esophageal tract of wild-caught snakes, there was little similarity ($S_J = 0.143$) between wild *A. contortrix* and *A. piscivorus*. If differences in esophageal bacteria are influenced by difference in prey ingestion between *A. contortrix* and *A. piscivorus*, this finding may provide additional evidence for food partitioning between these sympatric snake species.

Although captive and wild snakes had similar species richness in bacterial microflora (13 and 14, respectively), there were considerable differences between the bacterial communities. Wild-caught snakes had eight bacterial species that were not observed in captive snakes (Table 1). These bacterial species may be common in the environment allowing these wild *Agkistrodon* snakes to inoculate their esophageal tracks. The presence of only four bacterial species in captive *A. piscivorus* supported our hypoth-

TABLE 2. Jaccard binary community similarity indices for comparisons of bacterial microflora among snake species for both captive and wild individuals.

		Wild		**Captive**	
		A. contortrix	*A. piscivorus*	*A. contortrix*	*A. piscivorus*
Wild	*A. contortrix*	_	0.143	0.200	0.100
	A. piscivorus	0.143	_	0.167	0.182
Captive	*A. contortrix*	0.200	0.167	_	0.231
	A. piscivorus	0.100	0.182	0.231	_

esis that individuals feeding only on one prey type such as laboratory mice (*Mus musculus*) would demonstrate a lower diversity of esophageal bacterial species. These results also agree with findings of Theakston et al. (1990) where captive snakes had fewer positive bacterial cultures. Although captive *A. contortrix* had the greatest number of bacterial species, captive *A. contortrix* and *A. piscivorus* demonstrated the greatest similarity ($S_J = 0.231$) in bacterial microflora (Table 2).

No study has investigated the bacterial microflora of the esophageal track in *Agkistrodon*. Some clinical work has been done on the antibacterial activity of venom against the bacteria of the oral cavity in crotalid snakes (e.g., Talan 1991). Unlike such clinical investigations, we provide the first inventory and assessment of species richness for common bacteria found in the oral cavity and esophageal tract of any species of *Agkistrodon*. Placing this information in the context of differences in prey use between *A. contortrix* and *A. piscivorus* might prove interesting. If differences in bacterial microflora are correlated with differences in prey ingestion by *A. contortrix* and *A. piscivorus*, then our findings might provide indirect but additional evidence for food partitioning between these sympatric snake species.

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Distribution of the Amphibians of Honduras by Departments

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McCranie and Castañeda (2007) recently published a review of the amphibian fauna of Honduras. That review included 124 species verified to occur in the country, an increase of seven species over that published in McCranie and Wilson (2002). Despite these two reviews, a summary of distribution by departments has never been published for the amphibian fauna of Honduras. The purpose of this paper is to present such a summary, an analysis of which should point out which areas of Honduras are understudied.

Materials and Methods.—The generic taxonomy used herein follows the recent changes proposed by Faivovich et al. (2005), Frost et al. (2006a, 2006b), and Nascimento et al. (2005). Also, the taxonomy for the *Ollotis coccifer* complex suggested by Mendelson et al. (2005) is not followed for the reasons discussed by McCranie and Castañeda (2007).

Of the 499 departmental records listed in Table 1, only seven are based on literature records of specimens not examined by me in the work leading up to McCranie and Wilson (2002) and McCranie and Castañeda (2007). These seven records are: *Bolitoglossa conanti* (Santa Bárbara), *Oedipina elongata* (Cortés), *Hyalinobatrachium cardiacalyptum* (Colón), *Plectrohyla dasypus* (Santa Bárbara), *Craugastor rostralis* (Santa Bárbara), *C. stadelmani* (Atlántida), and *Rhinophrynus dorsalis* (Francisco Morazán). A list of these literature records and of all specimens examined was provided by McCranie (2006).

Results.—Examination of Table 1 indicates that two departments (Lempira and Santa Bárbara) are clearly understudied. Lempira has only 13 species verified from within its limits, whereas Ocotepeque and Intibucá, which border Lempira on either side, have 20 and 25 species, respectively. However, a better indication of Lempira's poorly-studied status is demonstrated by the absence of records for *Scinax staufferi* and *Smilisca baudinii*, both of which are otherwise known from each of the 17 remaining Honduran departments. Also, no records of *Lithobates brownorum*, or *L. forreri*, or their putative "hybrids" have been recorded from Lempira, again the only department not represented by vouchers. Santa Bárbara has only 25 species verified from within its boundaries, but its neighbor to the west, Copán, has 37 species and Cortés, its neighbor to the north, has 49 species. Thus, Santa Bárbara should be expected to have a number somewhat intermediate between those for those two neighbors. Obvious missing species for Santa Bárbara are *Bolitoglossa rufescens*, *Agalychnis callidryas*, *Craugastor charadra*, *Hyalinobatrachium fleischmanni* (although males thought to be this species were heard calling on the night of 9 October 2006 at Cerro Negro, Santa Bárbara), *Leptodactylus melanonotus, Tlalocohyla loquax*, and *T. picta*. Also, McCranie and Castañeda (2007) predicted two species (*Nototriton brodiei* and *Craugastor nefrens*), both of which are known from the moun-

Table 1. Distribution by departments of the 125 species of amphibians known from Honduras. Department abbreviations are: ATL = Atlántida; CHO = Choluteca; COL = Colón; COM = Comayagua; COP = Copán; COR = Cortés; EP = El Paraíso; FM = Francisco Morazán; GAD = Gracias a Dios; INT = Intibucá; IBD = Islas de la Bahía; LAP = La Paz; LEM = Lempira; OCO = Ocotepeque; OLA = Olancho; SB = Santa Bárbara; VAL = Valle; and YOR = Yoro. Symbols in the species lists are: X = presence recorded; I = introduced; and H = "hybrid" populations between *Lithobates brownorum* and *L. forreri*.

SPECIES	ATL	CHO	COL	COM	COP	COR	EP	FM	GAD	INT	IDB	LAP	LEM	OCO	OLA	SB	VAL	YOR	Total
Caecilians (2)																			
Dermophis mexicanus	X	X	—	—	—	X	—	—	—	X	—	—	—	—	—	X	X	—	6
Gymnopis multiplicata	X	—	—	—	—	X	X	—	X	—	—	—	—	—	X	—	—	X	6
Subtotal	2	1	0	0	0	2	1	0	1	1	0	0	0	0	1	1	1	1	12
Salamanders (28)																			
Bolitoglossa carri	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	1
Bolitoglossa celaque	—	—	—	X	—	—	—	—	—	X	—	X	X	—	—	—	—	—	4
Bolitoglossa conanti	—	—	—	—	X	X	—	—	—	—	—	—	—	X	—	X[1]	—	—	4
Bolitoglossa decora	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	1
Bolitoglossa diaphora	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Bolitoglossa dofleini	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	X[2]	—	X	4
Bolitoglossa dunni	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	—	—	—	2
Bolitoglossa heiroreias	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	1
Bolitoglossa longissima	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	1
Bolitoglossa mexicana	X	—	X	X	X	X	X	X	X	—	—	—	—	—	X	X[2]	—	X	11
Bolitoglossa occidentalis	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Bolitoglossa oresbia	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Bolitoglossa porrasorum	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	2
Bolitoglossa rufescens	X	—	—	—	X	X	—	—	—	—	—	—	—	—	—	—	—	X	4
Bolitoglossa striatula	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Bolitoglossa synoria	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	1
Cryptotriton nasalis	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Dendrotriton sanctibarbarus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	1
Nototriton barbouri	X	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	X	3
Nototriton lignicola	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	1
Nototriton limnospectator	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	1
Oedipina cyclocauda	X	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	X	5
Oedipina elongata	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	X[2]	—	—	3
Oedipina gephyra	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	2
Oedipina ignea	—	—	—	—	—	—	—	—	—	X	—	X	—	X	—	—	—	—	3
Oedipina stuarti	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	X	—	2
Oedipina taylori	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	1
Oedipina tomasi	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Subtotals	6	0	2	4	6	10	1	4	3	2	0	2	1	4	6	6	1	7	65

TABLE 1. Continued.

SPECIES	ATL	CHO	COL	COM	COP	COR	EP	FM	GAD	INT	IDB	LAP	LEM	OCO	OLA	SB	VAL	YOR	Total
Anurans (95)																			
Agalychnis callidryas	X	—	X	—	X	X	X	—	X	—	—	—	—	—	X	—	—	—	7
Agalychnis moreletii	X	—	—	—	X	X	—	—	—	X	—	—	—	—	—	—	—	—	4
Agalychnis saltator	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Anotheca spinosa	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Atelophryniscus chrysophorus	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	2
Bromeliohyla bromeliacia	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	—	—	—	2
Centrolene prosoblepon	—	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	3
Chaunus marinus	X	X	X	X	X	X	X	X	X	X	I	X	X	X	X	X	X	X	18
Cochranella albomaculata	—	—	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	2
Cochranella granulosa	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Cochranella spinosa	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Craugastor anciano	—	—	—	—	—	—	—	—	—	—	—	—	X	X	—	—	—	—	2
Craugastor aurilegulus	X	—	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	X	4
Craugastor chac	X	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	2
Craugastor charadra	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	—	—	—	2
Craugastor coffeus	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Craugastor chrysozetetes	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Craugastor cruzi	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Craugastor cyanochthebius	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Craugastor emleni	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	2
Craugastor epochthidius	—	—	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	2
Craugastor fecundus	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Craugastor fitzingeri	—	—	X	—	—	—	X	—	X	—	—	—	—	—	X	—	—	—	4
Craugastor laevissimus	—	—	—	X	—	X	X	X	—	X	—	X	—	—	X	X	—	—	8
Craugastor laticeps	X	—	—	—	X	X	—	—	—	—	—	—	—	—	—	X	—	—	4
Craugastor lauraster	—	—	—	—	—	—	X	—	X	—	—	—	—	—	X	—	—	—	3
Craugastor megacephalus	—	—	—	—	—	—	X	—	X	—	—	—	—	—	X	—	—	—	3
Craugastor merendonensis	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Craugastor milesi	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	—	—	—	2
Craugastor mimus	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Craugastor noblei	X	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	4
Craugastor olanchano	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	1
Craugastor omoaensis	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Craugastor pechorum	—	—	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	2
Craugastor rhodopis	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Craugastor rostralis	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	X[1]	—	X	4
Craugastor saltuarius	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	2
Craugastor stadelmani	X	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	X	3
Craugastor sp.[3]	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	1
Cruziohyla calcarifer	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Dendropsophus ebraccatus	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Dendropsophus microcephalus	X	—	X	X	X	X	X	X	X	X	X	—	—	—	X	X	—	X	13
Duellmanohyla salvavida	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	2
Duellmanohyla soralia	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	X[1]	—	—	3

Table 1. Continued.

SPECIES	ATL	CHO	COL	COM	COP	COR	EP	FM	GAD	INT	IDB	LAP	LEM	OCO	OLA	SB	VAL	YOR	Total
Ecnomiohyla miliaria	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	1
Ecnomiohyla salvaje	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Eleutherodactylus cerasinus	—	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	3
Eleutherodactylus ridens	X	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	4
Eleutherodactylus diastema	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	1
Engystomops pustulosus	—	X	—	X	X	X	X	X	—	X	—	X	X	X	X	X	X	—	13
Exerodonta catracha	—	—	—	X	—	—	—	—	—	X	—	X	—	—	—	—	—	—	3
Gastrophryne elegans	X	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	2
Hyalinobatrachium cardiacalyptum	—	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	3
Hyalinobatrachium crybetes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	1
Hyalinobatrachium fleischmanni	X	—	—	X	X	X	X	—	X	—	—	X	—	—	X	—	—	X	9
Hyalinobatrachium pulveratum	—	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	3
Hypopachus barberi	—	—	—	—	—	—	—	—	—	X	—	X	—	X	—	—	—	—	3
Hypopachus variolosus	—	X	—	X	X	X	X	X	—	X	—	X	—	X	X	X	—	X	12
Isthmohyla insolita	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	1
Isthmohyla melacaena	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Leptodactylus fragilis	—	X	—	X	X	X	X	X	X	X	—	X	X	—	X	X	X	X	14
Leptodactylus melanonotus	X	X	X	X	X	X	X	X	X	X	X	—	—	—	X	—	X	—	13
Leptodactylus savagei	—	—	X	—	—	—	X	—	X	—	—	—	—	—	X	—	—	—	4
Leptodactylus silvanimbus	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	1
Lithobates brownorum	X	—	X	X	X	X	X	X	X	X	X	—	—	—	X	X	—	X	13
Lithobates forreri	—	X	—	—	—	—	X	X	—	H	—	H	—	H	—	—	X	—	4
Lithobates maculatus	X	X	X	X	X	X	X	X	—	X	—	X	X	X	X	X[2]	—	X	15
Lithobates vaillanti	X	—	X	X	X	X	—	X	X	—	X	—	—	—	X	X	—	X	11
Lithobates warszewitschii	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	2
Ollotis campbelli	—	—	—	—	X	X	—	—	—	—	—	—	—	—	—	—	—	—	2
Ollotis coccifer	—	X	—	X	—	—	X	X	X	X	—	X	X	X	X	—	X	—	11
Ollotis leucomyos	X	—	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	X	4
Ollotis luetkenii	—	X	—	X	—	—	X	X	—	X	—	X	—	—	X	—	X	—	8
Ollotis valliceps	X	—	X	X	X	X	X	X	X	X	—	—	—	—	X	X	—	X	12
Plectrohyla chrysopleura	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Plectrohyla dasypus	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	X[1]	—	—	2
Plectrohyla exquisita	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Plectrohyla guatemalensis	X	—	—	X	X	—	—	X	—	X	—	X	X	X	X	—	—	X	10
Plectrohyla hartwegi	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	1
Plectrohyla matudai	—	—	—	—	X	—	—	—	—	—	—	—	X	X	—	—	—	—	3
Plectrohyla psiloderma	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	1
Ptychohyla hypomykter	—	—	—	X	X	X	X	X	—	X	—	X	X	X	X	X	—	X	12
Ptychohyla salvadorensis	—	—	—	—	—	—	—	X	—	X	—	X	X	X	—	—	—	—	5
Ptychohyla spinipollex	X	—	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	3
Rhaebo haematiticus	—	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	3
Rhinophrynus dorsalis	—	—	—	—	—	X	—	X	—	—	—	—	—	—	—	—	—	—	2
Scinax boulengeri	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	1
Scinax staufferi	X	X	X	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	17
Smilisca baudinii	X	X	X	X	X	X	X	X	X	X	X	X	—	X	X	X	X	X	17

tains of Guatemala near the border with Santa Bárbara, should also occur in Santa Bárbara.

Colón, with its 31 species, also appears to be understudied. Atlántida, its neighbor to the west has 40 species and Gracias a Dios, its neighbor to the east, has 43 species. Several species otherwise only recorded from the Mosquitia in northeastern Honduras, should also occur in eastern Colón (e.g., *Cochranella granulosa*, *Craugastor mimus*).

The Pacific lowlands of Choluteca and Valle also appear to be understudied. Although badly denuded, there are several species that are recorded from these continuous lowlands both to the west and south, but have not yet been recorded from one or both of these departments (e.g., *Rhinophrynus dorsalis, Trachycephalus venulosus*).

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Table 1. Continued.

SPECIES	ATL	CHO	COL	COM	COP	COR	EP	FM	GAD	INT	IDB	LAP	LEM	OCO	OLA	SB	VAL	YOR	Total
Smilisca phaeota[4]	—	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	3
Smilisca sordida	—	—	X	—	—	—	—	—	X	—	—	—	—	—	X	—	—	—	3
Tlalocohyla loquax	X	—	—	X	X	X	—	X	X	X	—	—	—	—	X	—	—	X	9
Tlalocohyla picta	X	—	X	—	X	X	—	—	X	—	—	—	—	—	—	—	—	—	5
Trachycephalus venulosus	X	X	X	X	X	X	X	X	X	—	—	—	—	X	X	X	—	X	13
Triprion petasatus	—	—	—	—	—	X	—	—	—	—	—	—	—	—	—	—	—	—	1
Subtotal	32	12	30	21	31	37	23	23	39	22	7	16	12	16	49	18	9	24	422
Totals	40	13	31	25	37	49	25	27	43	25	7	18	13	20	56	25	11	32	499

[1] The La Fortuna, Santa Bárbara, record for this species based on Townsend (2006) was mapped by McCranie and Castañeda (2007), but not listed as from Santa Bárbara in McCranie (2006)

[2] This represents a new departmental record based on collections made at Cerro Negro, Santa Bárbara, on 9–10 October 2006

[3] This apparently represents an undescribed species of the *rugulosus* group recently collected on Montaña de Mixcure, Intibucá

[4] Erroneously mapped in El Paraíso by McCranie and Castañeda (2007)

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Comparison of Clutch Size from Natural Nests and Oxytocin Induced Clutches in the Red-Eared Slider, *Trachemys scripta elegans*

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The discovery (reviewed by Ewert and Legler 1978) that oxytocin could be used to induce oviposition in captive turtles represented a major innovation for studies of reproduction in turtles. The general presumption in studies using oxytocin to induce oviposition is that the number of eggs released in the laboratory by a particular turtle is the same as the number of eggs that turtle would have deposited in a natural nest. Because of the importance that oxytocin use has assumed in modern studies of turtle reproduction (e.g., Iverson and Smith 1993; Rowe 1994, Tucker et al. 1998a, b), it is appropriate to compare clutch sizes from natural nests to clutches from female Red-Eared Sliders (*Trachemys scripta elegans*) induced to oviposit with oxytocin.

The turtles were collected at nesting areas near Stump Lake (N = 131) in Jersey County, Illinois (USA), and from Swan Lake (N = 94) and Pohlman Slough (N = 21) in Calhoun County, Illinois. These localities are on or border the lower Illinois River. Additional turtles (N = 29) were collected from Gilead Slough, a backwater of the Mississippi River in Calhoun County, Illinois. Collecting methods and study sites are detailed in Tucker et al. (1998a, b).

A total of 25 turtles were found in the process of completing natural nests. In each case, the turtle was caught and palpated to determine if any oviductal eggs were retained following nesting. Nests were excavated, and the eggs were removed and counted.

Oxytocin (0.2 ml/kg) was used to induce oviposition in all turtles not found with completed nests. Because some females retain some or all of the complement of oviductal eggs after oxytocin is administered (Congdon and Gibbons 1985), each turtle was palpated to ensure that all eggs had been laid (Iverson and Smith 1993). Palpation is an effective method to detect eggs in this species (e.g., Thornhill 1982). However, when more than one egg per oviduct remains it becomes impossible to accurately count the eggs remaining in the turtle. Thus twelve of the induced turtles that retained more than two oviductal eggs upon palpation were excluded (Tucker et al. 1998a). No turtles making natural nests retained eggs and none were excluded.

The SAS system was used for statistical tests (SAS Institute 1998). Since most egg and clutch parameters are related to measures of female size, analysis of covariance (ANCOVA; female plastron length as the covariate) was used to compare clutch sizes. The resulting least squares means (LSM) are presented in the text along with unadjusted means.

Mean clutch size for 24 natural nests was 14.6 eggs (SD = 2.81, range 9–19 eggs) whereas mean clutch size for 251 turtles induced to oviposit in the laboratory was 14.3 eggs (SD = 3.72, range = 6–30). Once adjusted for plastron length, LSM (14.9 eggs) for natural nests did not differ ($p = 0.3067$) from LSM (14.2 eggs) for induced clutches. Because nesting behavior or response to oxytocin might vary between locations, we also compared clutches from natural nests and clutches induced by oxytocin from Swan and Stump Lakes where the bulk (21 of 25) of the natural nests were encountered. LSM (14.9 eggs, N = 14 clutches) for Swan Lake and LSM for Stump Lake (15.6 eggs, N = 7 clutches) for clutches from natural nests did not differ from induced clutches at Swan Lake (LSM = 14.1 eggs, N = 80 clutches, $p = 0.2248$) nor at Stump Lake (LSM = 14.9 eggs, N = 124 clutches, $p = 0.6224$).

The results confirm that clutch size from clutches induced with oxytocin are statistically equivalent to clutch size for clutches laid in natural nests by *Trachemys scripta elegans*. These results may be widely applicable to other North American temperate turtles but should be confirmed. The present study supports use of clutch size values determined with oxytocin induction along with counts from natural nests, because the values are comparable.

The accuracy of palpation as a method to count eggs in turtles is questionable. However, use of palpation to determine that only one or two eggs are remaining apparently is possible. Had it yielded systematic undercounts of eggs then the means for eggs induced by oxytocin and those for eggs laid in natural nests should have reflected this. Instead means differed by only 0.3 eggs per clutch. Use of palpation may not be applicable to other species. Some species (e.g., Common Snapping Turtle, *Chelydra serpentina*; Spiny Softshell, *Apalone spinifera*) may be too big for palpation to be useful. Others that lay small clutches (e.g., Painted Turtle, *Chrysemys picta*; Stinkpots, *Sternotherus odoratus*) may be more vulnerable to error than those that lay larger clutches. Use of x-rays to determine clutch size may be more accurate in these cases but that hypothesis remains untested.

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TECHNIQUES

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Clutch Bags for Aquatic-Breeding Amphibians

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Life history theory assumes that organisms endeavor to maximize fitness by making the greatest genetic contribution to their population (Begon et al. 2006; Stearns 1992). Fecundity, in turn, is often considered one of the most useful short-term measurements of lifetime fitness (Begon et al. 2006). By understanding how individual life history characteristics interact to regulate fecundity, and therefore fitness, we can draw conclusions about how those influences have shaped adaptation (Lauck 2005; Stearns 1992).

Amphibians are known for their complex and flexible life histories. Many species of amphibians lay eggs in a single mass (e.g. *Ambystoma jeffersonianum* and *A. maculatum*, Brodman 1995; *Eurycea cirrigera*, Guy et al. 2004; *Rana temporaria*, Loman 2001; *Rana sylvatica*, Starnes et al. 2000), allowing easy estimation of clutch size by inspection of natural nest-cover objects and introduced nest-cover objects (e.g., slate tiles, Guy et al. 2004). Other species, however, spread their eggs throughout the environment (e.g., *Tylototriton verrucosus*, Roy and Mushahidunnabi 2001; *Pseudacris triseriata feriarum* and *Hyla chrysoscelis*, Starnes et al. 2000), making estimation of clutch size more problematic. Furthermore, in order to determine how fecundity in amphibians is related to environmental conditions and other female life history traits such as body size, body condition, age, or size and age at metamorphosis, parentage of a clutch must be determined. In past studies, this has primarily been done by sacrificing individuals and determining clutch size via dissection (Chazal and Niewiarowski 1998; Lauck 2005; Redmer 2000, 2002). Other studies have followed individuals until they oviposit, although this typically results in a smaller sample size due to the time restrictions incurred (Giaretta and Menin 2004; Prado and Haddad 2005; Roy and Mushahidunnabi 2001).

An answer to the problem of determining parentage, as well as clutch size for amphibians that do not lay their eggs in a mass, is to capture gravid females during the breeding season and then confine them within their natural environment until they have oviposited. At this point adults can be measured, clutch characteristics determined, and both adults and eggs released without negative effects. In situ cages have been used in the past to rear tadpoles, for hatching eggs, or for containing adult amphibians, however these methodologies utilized bulky, non-collapsible frames or containers (e.g., De Solla et al. 2002; Harris et al. 2001; Hels 2002; Vorndran et al. 2002). Each of these methodologies, however, may prove too cumbersome or difficult to transport in other experimental situations. In response to our need to quantify clutch size of the Arizona Tiger Salamander *Ambystoma tigrinum nebulosum*, a subspecies that lays eggs singly (Collins 1980), we designed a lightweight and collapsible, submersible cage that allows a female to lay eggs within her native pond while permitting efficient collection of eggs. We evaluated our cage in six temporary and permanent ponds at the Mexican Cut Nature Preserve near Gothic, Colorado, USA.

Our "clutch bag" consisted of a cylindrical mesh bag and an internal PVC pipe frame (Fig. 1), which was modified from a design used by Pfennig et al. (1999). The mesh bag was 30.5 cm tall by 100 cm wide, and was made from flexible, galvanized fiberglass screening (New York Wire, Mt. Wolf, Pennsylvania). Each bag was sewn together at a local upholstery using an industrial sewing machine and had a 30.5 cm opening at the top. The supporting frame consisted of a central pipe (90 cm long) and four legs (30 cm long), all constructed from 1/2 in PVC pipe. Two legs were attached to each end of the central pipe using a three way elbow joint. The frames and bags were light to transport and easily assembled and disassembled due to the three way joints, which fit snugly with the PVC pipe without adhesive. These features are especially important when experimental set ups must be transported to remote locations.

Between June 28 and July 11, 2005, metamorphic and paedomorphic female tiger salamanders were collected using dip nets as a part of a long-term life history study of this population (Whiteman and Wissinger 2005). Swollen females were placed in individual cages along with sticks, small rocks and cut sedges from the immediate natural environment for oviposition. The opening to each bag was fastened shut using a plastic "chip clip", typically found in most grocery stores. Bags were placed so that only 2–3 cm of the cages were above water level. The cages were generally placed in the shade, however when shade was not available spruce boughs were placed on top of the cages to prevent overheating. Cages were checked for eggs every one to two days, and no female was left in their cage for more than five days. Any eggs found were counted and immediately released into the pond, except for ~15 eggs per female, which were kept for genetic analysis (Gerlanc unpublished data). In instances when females had not immediately laid eggs, the female was assumed to have not yet mated, and a sexually mature male was added to the bag for 24 h. If females still did not produce a clutch, it was assumed that females had laid prior to being captured and placed in a clutch bag.

Twenty-two of the 29 females placed in bags laid eggs, and none of the females appeared adversely affected by their containment. No salamanders escaped, and the easily manipulated bags allowed efficient counting of eggs. The frames also provided a safer enclosure than previous designs, which were propped open using sticks and often collapsed into themselves during heavy wind and wave action. When working with terrestrial amphibians an air pocket above water is necessary, and can be more consistently and safely provided with the PVC pipe frame than by propping bags open with the aforementioned sticks.

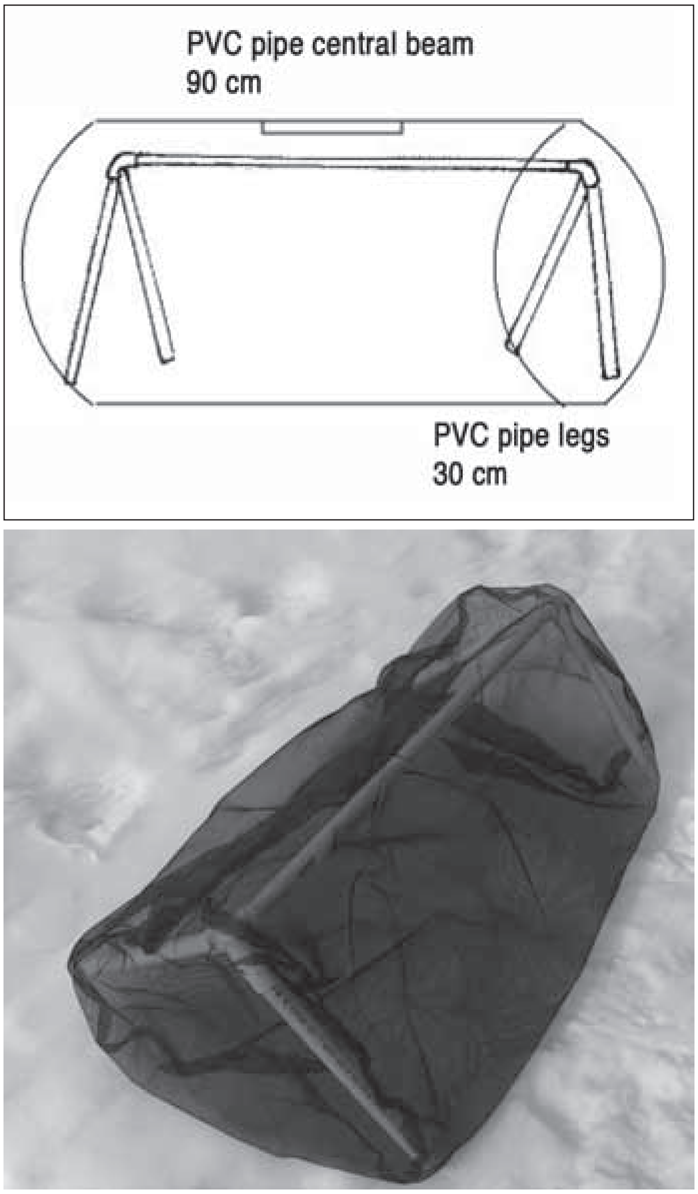

FIG. 1. PVC pipe frame and mesh bag for sampling clutch size. Images are courtesy of Barbara Doyle and Billy Barr.

These cages could be feasibly modified in size for collecting eggs of many different species of salamanders and small anurans, as well as rearing larvae of amphibian species, as has been done with smaller mesh bags and cages (De Solla et al. 2002; Vorndran et al. 2002). Clutch bags can also be used for mating experiments, e.g., to contain a breeding male and female, thereby creating known offspring pedigrees. Additionally, these bags could be used to safely contain predator species when studying the effects of predators on prey behavior in mesocosm experiments.

Materials used to create each bag cost approximately US $6.31. For each frame the budget was as follows: $1.09 for PVC pipe, $2.30 for 3-way elbows and adapters, and $2.92 for screening. Additional funds were spent for the labor to sew bags together; however this could be negligible if the bags were stapled together instead. The low cost, coupled with their versatility, make these bags a suitable and safe alternative to previous methodologies.

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Are Two Methods Better than One? Area Constrained Transects and Leaf Litterbags for Sampling Stream Salamanders

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Concern over large-scale amphibian and reptile declines and general acknowledgement of sparse baseline information for most herpetological species has prompted the initiation of several monitoring programs. These programs, as well as ecological studies focused on metapopulation dynamics and habitat associations, often use presence-absence (or probability of occupancy) as the parameter of interest. For example, the long-term monitoring design of the US Geological Survey's Amphibian Research and Monitoring Initiative (ARMI) uses multi-season models developed by MacKenzie et al. (2003) to estimate the changes in the proportion of sites occupied by a species. As a national program, ARMI has chosen occupancy as the state variable of interest (rather than abundance), because of the ease and relative cost efficiency of collecting survey data (i.e., detection or non-detection of each target species), and the ability to incorporate the probability of detecting a species to obtain unbiased estimates of occupancy (MacKenzie et al. 2002). Sampling methods may differ in their effectiveness in detecting a species at an occupied site (Bailey et al. 2004). Because a higher probability of detection means fewer surveys are needed to obtain good precision for the occupancy estimator (MacKenzie and Royle 2005), efficient survey designs should consider detection probabilities in the cost/benefit analysis of sampling methods. The goal of this study was to determine the most efficient method for estimating stream salamander habitat occupancy at a regional scale, as part of the Northeast region of the ARMI program (NE ARMI).

Several methods exist for sampling stream salamanders including area-constrained transects (Grant et al. 2005; Heyer et al. 1994), cover-controlled active searches (Heyer et al. 1994; Lowe and Bolger 2002), time-constrained searches (Barr and Babbitt 2002) and leaf litter refugia bags ('leaf litterbags'; Pauley and Little 1998). Area-constrained transect surveys may give a reliable index of the relative abundance of stream salamanders, and multiple passes can be used to estimate population sizes using removal models (Bruce 1995; Jung et al. 2000). Leaf litterbags are a uniform way to sample the leaf litter habitat and are an effective method for determining species presence, but not abundance (Chalmers and Droege 2002; Waldron et al. 2003). Leaf litterbags have been proposed as an appropriate method for determining site occupancy (Pauley and Little 1998; Waldron et al. 2003), and they may increase detection probabilities of some species or life stages.

During a survey, a species can be present but not detected (i.e., a false absence), causing the site to appear unoccupied. To estimate the true occupancy state of a species, multiple 'surveys' are required, which can be in the form of repeat site visits, multiple observers, replicate surveys, or multiple methods conducted simultaneously. Methods that increase detection probabilities of a species can reduce the optimal number of surveys of a site needed to obtain a precise estimate of occupancy (MacKenzie and Royle 2005). To determine the most efficient survey design, we compared the probabilities of detecting *Desmognathus fuscus*, *Eurycea bislineata*, and *Pseudotriton ruber* using area-constrained transects (hereafter 'transects') and leaf litterbags in twenty-five 30 m stream reaches within 12 first- and second-order streams in the Chesapeake & Ohio Canal National Historic Park, Maryland (38°59'N, 77°14'W) and Rock Creek National Park, District of Columbia (38°57'N, 77°02'W). We surveyed each site twice from 16 June to 29 July 2005. During the sample period, all age classes of *E. bislineata* and *P. ruber* were available for capture, while only adult and juvenile *D. fuscus* were available (as the previous year's larvae had metamorphosed by this time). By sampling with both methods within the same stream reach, we were able to estimate detection probabilities for each species-method combination, and determine the possible bias associated with each sampling method.

Methods.—The transects consisted of two 15 × 3 m areas (1 m in the water and 2 m on the bank), located on opposite banks and separated by 15 m. To survey each transect, one observer proceeded upstream, turning all cover objects greater than 6 cm in diameter. An aquarium net was used to facilitate the capture of salamanders. Three leaf litterbags were placed within each 15 m transect at 0, 7.5, and 15 m. The bags were placed one week prior to sampling to allow colonization by salamanders. Our leaf litterbags were constructed of two layers of 50 × 50 cm Deer Block brand plastic netting, with a mesh size of 15 × 15 mm, and filled with 50-60 grams (dry weight) of leaf litter (Chalmers and Droege 2002; Waldron et al. 2003). To maximize the likelihood of capturing larval salamanders, leaf litterbags were partially submerged (Waldron et al. 2003), using a rock to hold each bag in place. The leaf litterbags were checked after a week and again 3–4 weeks later by placing a net under the bag, and immediately placing the bag into a wash basin with water. We shook the bag in water for 15–20 seconds to loosen salamanders, then drained the contents of the basin into a net, and searched for salamanders.

We defined a site as a 30 m stream reach and used the program PRESENCE (MacKenzie et al. 2002) to estimate the proportion of sites that were occupied. For each of the following analyses we used the detection/non-detection data for each species separately, and estimated the species-specific detection probability (p; defined as the probability of detecting the species at an occupied site) and the proportion of sites occupied (ψ), while accounting for a species not always being detected when present (i.e., $p < 1$).

We conducted three separate analyses. First, we combined detection information from transect and leaf litterbag searches into a single survey event ('combined' dataset). In this dataset, the probability of detection represents the likelihood that the species was detected by either survey method during a survey event, and the resulting estimate of occupancy should provide an unbiased esti-

Table 1. Detection probability (*p*) and estimates of site occupancy (ψ) for the salamanders *Desmognathus fuscus*, *Eurycea bislineata*, and *Pseudotriton ruber*. The data was analyzed in three ways: using method as a covariate ('Method-covariate'), separately for each method ('Method-specific'), and combined detections from both methods for each survey event ('Combined'). Naïve occupancy estimates for *E. bislineata* ($\psi = 0.68$), *D. fuscus* ($\psi = 0.44$) and *P. ruber* ($\psi = 0.28$) do not account for missed detections. Occupancy could not be estimated for *D. fuscus* under the method-specific leaf litterbag model because there were too few detections for parameter estimation.

		Eurycea bislineata		*Desmognathus fuscus*		*Pseudotriton ruber*	
Survey Method	Dataset	*p* (SE)	ψ (SE)	*p* (SE)	ψ (SE)	*p* (SE)	ψ (SE)
Transect	Method-covariate	0.6206 (0.0879)	0.7153 (0.0992)	0.7869 (0.1052)	0.4602 (0.1052)	0.1127 (0.2979)	0.5412 (0.2979)
	Method-specific	0.6278 (0.1206)	0.7104 (0.1382)	0.8857 (0.0800)	0.4079 (0.1003)	0.6619 (0.3165)	0.0913 (0.0660)
Leaf litterbag	Method-covariate	0.5078 (0.0879)	0.7153 (0.0992)	0.1311 (0.0711)	0.4602 (0.1052)	0.2255 (0.2979)	0.5412 (0.2979)
	Method-specific	0.5476 (0.1410)	0.6669 (0.1678)	0.0612 (0.0342)	—	0.3282 (0.2465)	0.3713 (0.2699)
Both methods	Combined	0.8204 (0.0781)	0.7131 (0.1001)	0.8377 (0.0919)	0.4560 (0.1040)	0.4383 (0.2059)	0.4164 (0.1949)

mate of the true occupancy state of the site. Second, we analyzed a single dataset in which each detection/non-detection observation was separate for the two methods employed during a survey event ('method-covariate'). By modeling "method" as a covariate in the PRESENCE models, we were able to obtain detection estimates for each survey method, using knowledge of sites where the species was detected by the other method. Finally, we analyzed separate datasets ('method-specific') for each method, in which the probability of detection represents the likelihood that the species was detected by only one method. This dataset represents the data that would be collected if only one method was implemented, and thus may reveal a potentially biased estimate of the site occupancy, suggesting that the sampling method itself may be flawed.

These analyses allowed us to investigate possible heterogeneity in detection probabilities caused by sampling bias associated with each survey method. The two methods may differ in their detection probabilities, but if the methods are able to detect a species, then the detection-adjusted estimates of occupancy should be the same among all the analyses. Drastic differences in the occupancy estimates would suggest a bias in the actual sampling method (i.e., if one method was unable to detect, or had very low probability of detecting the target species at occupied sites). Comparing the method-specific estimates of occupancy with the 'method-covariate' and 'combined' datasets gives an assessment of sampling bias for each survey method (Bailey et al. 2004).

Results and Discussion.—For *D. fuscus* and *E. bislineata*, the detection probabilities were higher for transects than leaf litterbags (Table 1). For *D. fuscus* this was expected, because submerged leaf litterbags target the larval life stage (Waldron et al. 2003), which was not present during the survey period. We were therefore unable to estimate a method-specific estimate for leaf litterbags for *D. fuscus* (Table 1). For *E. bislineata* the probability of detection increased slightly when both methods were used. Both methods appear suitable for detecting this species, as the point estimates of site occupancy were similar across all datasets, though transects alone had a slightly higher probability of detection (Table 1). For both *D. fuscus* and *E. bislineata*, incorporating detection probability resulted in an estimate of occupancy that was higher than the naïve estimate (the fraction of sites where the species was detected without accounting for missed detections; naïve $\psi_{E.\ bislineata} = 0.68$; naïve $\psi_{D.\ fuscus} = 0.44$, Table 1).

For *P. ruber*, leaf litterbags were more effective at detecting salamanders than area constrained transects (Table 1). Using transects, *P. ruber* was detected at 2 of the 25 sites, and at one site it was found during both survey events. This resulted in a high estimate of *p*, (though with a large SE) for the method-specific transect dataset. However, when method is modeled as a covariate (Table 1; method-covariate dataset), additional information is provided from leaf litterbag detections, which were more efficient at detecting larval salamanders. Including detections from leaf litterbags reduced the estimate of *p* for the transect method (as *P. ruber* was never detected by both methods at a site). The estimate of occupancy for the method-specific dataset using transects was much lower than the known, naïve estimate of site occupancy (method-specific $\psi = 0.09$, naïve $\psi = 0.28$). These data indicate the bias in occupancy estimates which would have resulted from using only the transect sampling method, due to the very low probabilities of detecting *P. ruber* (i.e., $p = 0.1127$ for the transect survey method in the 'method-covariate' dataset). For this species, sampling with leaf litterbags in combination with transects increases the detection probability, eliminates or reduces bias in occupancy estimates that may result from using just one detection method, and also decreases the number of times a site should be visited to obtain an optimal occupancy estimate (i.e., low SE) from 19 to 4 visits (MacKenzie and Royle 2005; Table 2).

As expected, using two methods to detect the presence of a species provides a more precise estimate of occupancy than a single method alone (Table 1). For example, *P. ruber* was never detected by both methods at the same site, and the estimate of occupancy is more precise for the combined dataset (Table 1).

If one method is superior for detecting a species, then the addition of a second method provides redundant information that does not improve the occupancy estimate. The inferior sampling method can still be used, but the optimal number of visits to a site increases substantially (e.g., Table 1, 2; leaf litterbags are less suitable for detection of *D. fuscus*, and therefore inflate the optimal number of surveys from k = 2 to 17, MacKenzie and Royle 2005). Further, when the detection probability is high, the increase in detection provided by a second method does not change the esti-

TABLE 2. Optimal number of surveys (k) given occupancy (ψ) and detection (*p*) estimates from the method-covariate dataset and the combined dataset models (from Table 1).

Survey Method	*Eurycea bislineata*	*Desmognathus fuscus*	*Pseudotriton ruber*
Transect	3	2	19
Leaf litterbag	4	17	9
Combined	2	2	4

mate of occupancy or the optimal number of visits to a site (e.g., Table 1, 2; *E. bislineata*).

Sampling methodologies may vary in their effectiveness of sampling different life stages. Leaf litterbags are designed to preferentially capture larval salamanders (Waldron et al. 2003), and our transect surveys are designed to sample all life stages. In our study, leaf litterbags detected adult salamanders of all three species with low probabilities, and thus leaf litterbags are not likely to provide the data necessary to estimate patterns in stream occupancy by adult salamanders with sufficient power. If occupancy of a habitat by a particular life stage is of primary interest, then the sampling program should be designed primarily using methods that target that life stage. Regardless, interpretation of results should consider that a sampling method may detect all life stages, while having different detection probabilities for each life stage.

Conclusions.—In studies designed to assess the status and trends in occupancy of a suite of species across a large area, the allocation of survey effort is a chief concern. For species that are difficult to detect on a given sampling occasion, such as *P. ruber,* the use of an additional method may increase the precision and decrease bias in estimates of occupancy. However, since we found leaf litterbags were expensive to construct (materials cost per bag was US $2.50), difficult to maintain in the field, and had lethal effects on non-target organisms (i.e., two dead snakes were found tangled in the litterbags), we suggest sampling the leaf litter at a set distance interval (i.e., 1 m) using an aquarium net, rather than deploy leaf litterbags. Incorporating leaf litter sampling into the transect surveys may be more effective than using leaf litterbags because of increased detections of species that are more likely to be captured within the leaf litter (Bruce 2003; E. Grant, unpubl. data).

Regardless, when designing a research or monitoring program, assessment of the potential bias in survey methods should be incorporated into the study design (e.g., this study; Bailey et al. 2004; O'Connell et al. 2006). In addition, pilot data can guide optimization of data collection to meet a variety of study objectives (Bailey et al. *in press*; MacKenzie and Royle 2005), and will ultimately yield estimates that facilitate comparisons among studies, provided the state variable estimates account for missed detections.

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A New Method for Estimating Clutch Sizes of Ambystomatid Salamanders and Ranid Frogs: Introducing the Ovagram

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Clutch size is an important demographic trait of amphibians that is frequently used in descriptive ecological studies (Woodward 1982), biogeographic comparisons (Karraker et al. 2006), studies of population dynamics (Berven 1990) and population modeling (Vonesh and De la Cruz 2002). However, egg masses are large in many species, and clutch size cannot be easily determined visually in the field because embryos in the interior of the mass are obscured. In these instances, determination of clutch size often requires breaking clutches apart which can subject interior embryos to changes in temperature, predation, and microbial attack. Thus, it is important to develop techniques that permit collection of reliable clutch size data while minimizing impacts on study organisms.

Several methods have been used to estimate clutch sizes in Spotted Salamanders (*Ambystoma maculatum*) and Wood Frogs (*Rana sylvatica*), including direct counts of embryos (Berven 1982, Brodman 1995), visual estimation (Stenhouse 1987), photographic analysis (Harris 1980), regression estimation from dry weight (Howard and Kluge 1985), and dissection (Woodward 1982). Clutch sizes of *A. maculatum* were also determined by flattening egg masses beneath a glass plate and counting the embryos (Harris 1980). To my knowledge, none of these estimation techniques were assessed for accuracy.

Here I describe the construction and use of the "ovagram," a non-destructive device to quickly estimate clutch sizes of ambystomatid salamanders and ranid frogs. This improves on Harris's (1980) method of flattening egg masses of *A. maculatum* with a glass plate in being a lightweight, inexpensive device that is easily transported to remote locations, and the addition of grid lines increases ease of counting and probably accuracy. The ovagram is the first reported method, to my knowledge, of clutch size estimation for a ranid frog by flattening egg masses beneath a clear object. I provide results of an assessment of the ovagram's accuracy in estimating clutch sizes in *A. maculatum* and *Rana sylvatica,* and its impacts on hatching success in *A. maculatum*.

Materials and Methods.—The ovagram was constructed using two circular, 1400 ml plastic, reusable food storage containers. These containers were made of thin, clear plastic and are commonly available in supermarkets. The dimensions of the containers were as follows: top diameter 17 cm; bottom diameter 14.5 cm; circumference 53.4 cm; depth 8.5 cm. I drew a series of parallel lines, 1 cm apart, using a fine-point permanent marker, across the entire underside of one container (Fig. 1). Lines must be narrower than embryos so that embryos falling directly beneath the lines can be detected. To use the ovagram, an egg mass of *A. maculatum* was gently removed from the water and placed in the container without lines. The container with lines was placed on top of the egg mass inside the other container and pressure was gently applied to flatten the egg mass (Fig. 1). The amount of pressure applied was not great enough to physically damage the ova or the outer jelly matrix. Counts were made in a systematic pattern, for example left to right and top to bottom, counting the number of embryos intersecting the first line, then in the space between the first and second lines, and so on (Fig. 1). A similar method was used for clutches of *R. sylvatica*, except that clutches were cut into six, approximately equal-sized pieces with a sharp knife and counts were made for each piece separately. The ovagram can be used at any stage prior to hatching, but counts are more easily obtained from recently oviposited egg masses that are less turgid and smaller in size. For clutches of *R. sylvatica*, fewer embryos were damaged when cutting recently laid clutches. Estimates were made in approximately 10–20 s for *A. maculatum* and 2–3 minutes for *R. sylvatica*. Following estimation, clutches were returned to the water, and an attempt was made to return the egg mass to its original attachment point at the water depth from which it was taken.

The ovagram was used to estimate clutch sizes of 277 egg masses of *A. maculatum* from 30 ponds, and 116 clutches of *R. sylvatica* from 24 ponds in the Adirondack region of New York. It is important to note that female *A. maculatum* generally deposit 2–4 egg masses at breeding (Bishop 1941; Shoop 1974), so clutch size here refers to the number of eggs per egg mass and not the full egg complement. *Rana sylvatica* deposit one egg mass or clutch in a given breeding season (Wright and Wright 1949).

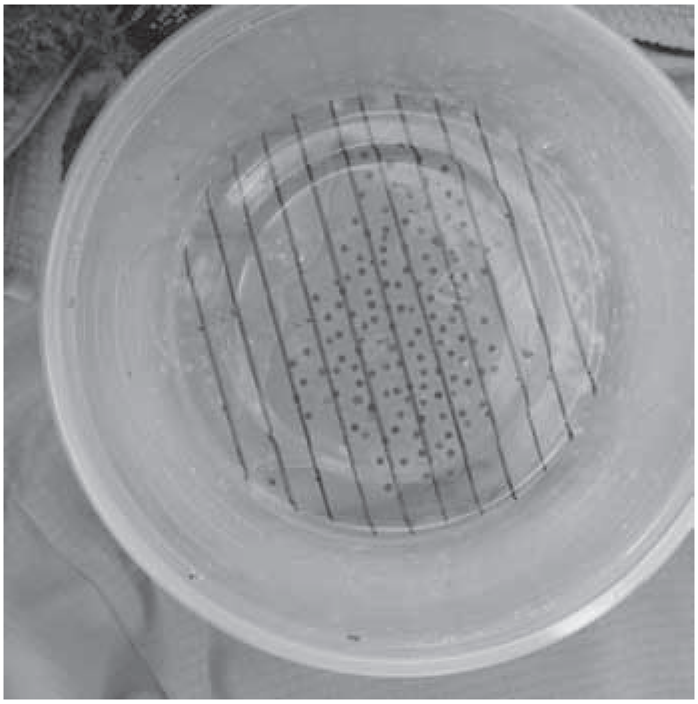

FIG. 1. Photograph (top view) of ovagram containing an egg mass of *Ambystoma maculatum* and showing parallel lines used to count embryos. Note that width of each line is narrower than that of each embryo.

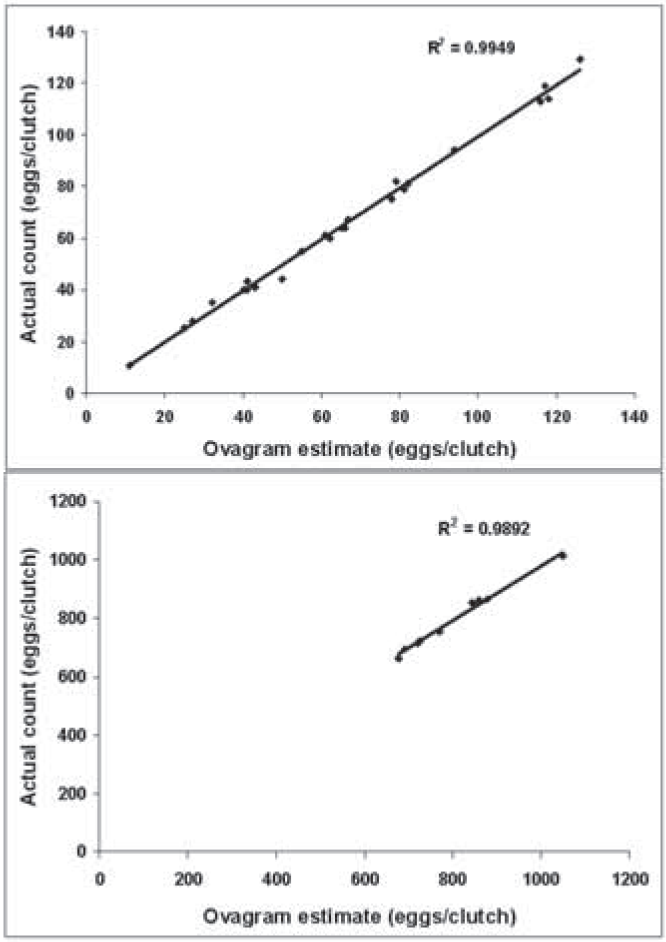

FIG 2. Relationship between estimates of clutch size using the ovagram and actual counts of 24 clutches from *A. maculatum* and 10 clutches from *R. sylvatica*.

To determine the accuracy of clutch size estimates using the ovagram, I collected 24 egg masses of *A. maculatum* from two vernal pools and 10 egg masses of *R. sylvatica* from two vernal pools in the same region. I estimated clutch size using the ovagram and then gently dissected each egg mass into easily counted sections containing 1–4 embryos each. I counted the number of embryos in the dissected portions twice for each egg mass, to ensure accurate counts. To determine the impacts of use of the ovagram on egg masses of *A. maculatum*, I compared the hatching success of embryos from egg masses manipulated by the ovagram and those not manipulated.

Results.—Average clutch size of *A. maculatum* in the central Adirondack region of New York estimated with the ovagram was 67.2 (SD = 30.5, N = 277) and clutch sizes ranged from 7–155. Mean clutch size of *R. sylvatica* was 682.4 (SD = 118.2, N = 116) and ranged from 429–1049 eggs per clutch.

In the accuracy assessment, the mean absolute difference between ovagram estimate and actual count for *A. maculatum* was 1.7 embryos (SD = 1.6, N = 24) and for *R. sylvatica* was 11.3 embryos (SD = 10.6, N = 10). In *A. maculatum*, seven of 24 ovagram estimates matched the actual counts (including four clutches that had more than 50 embryos each), 11 were overestimates (largest = 6 embryos), and 6 were underestimates (largest underestimate = 3 embryos). In *R. sylvatica*, 8 of 10 counts were overestimates (largest = 11) and 2 were underestimates (largest = 37). Clutch sizes of *A. maculatum* estimated using the ovagram averaged 65.7 embryos (SD = 31.8, range 11–126) and were comparable to actual counts which averaged 65.2 embryos (SD = 31.7, range 11–129) for the 24 egg masses evaluated in the accuracy assessment (Fig. 2). Similarly, in *R. sylvatica*, ovagram estimates averaging 798.9 embryos (SD = 107.7, range 662–1012) were comparable to actual counts which averaged 807.8 embryos (SD = 113.6, range 678–1049) (Fig. 2).

The ovagram was used to estimate clutch size in *A. maculatum* in a laboratory experiment, where survival to hatching averaged 83% (SD = 10; N = 5) in control (exposed only to filtered water) egg masses. Survival averaged 82% (SD = 17; N = 17) in egg masses not exposed to the ovagram and used as controls in another experiment (Karraker and Gibbs, in prep.), suggesting that survival of embryos to hatching was not compromised by the technique. I did not determine survival to hatching in clutches of *R. sylvatica* following use of the ovagram.

Discussion.—Variation in clutch size in this study was pronounced, ranging from at least 7–155 in *A. maculatum* and 429–1049 in *R. sylvatica*, emphasizing the need for accurate clutch size estimation for biological studies of these species. A number of other methods have been used previously to estimate clutch size in these amphibians. Egg masses have been marked in the field and frequent visits made to each clutch to monitor development. In one study (Brodman 1995), as the first larvae began hatching, all live and dead embryos were counted. Estimates using this method, as well as visual estimation at any time in the developmental period (Stenhouse 1987), may under- or overestimate clutch size because of the difficulties associated with counting interior embryos. Predation by caddisfly larvae (Stout et al. 1992) during development may also make accurate counts difficult. In addition, multiple visits must be made to egg masses, particularly as embryos near hatching, making it more difficult to obtain larger sample sizes. Female *A. maculatum* have been collected, euthanized, and dissected to determine clutch size (Woodward 1982), but this method, depending upon the numbers collected, may be detrimental to local populations. Egg masses have been photographed and embryos counted using gridded oculars on a dissecting scope (Harris 1980). This technique is minimally invasive, but if a photograph is taken from one perspective, an embryo directly in line with another may not be counted and the method can be cumbersome and protracted relative to the ovagram method described herein. Harris (1980) also flattened egg masses beneath a glass plate in a plastic tub and counted embryos, a method similar to the ovagram. However, the lines on the ovagram may improve accuracy, and the ovagram is small, lightweight, and inexpensive.

The ovagram can be used to accurately estimate clutch sizes of *A. maculatum* and *R. sylvatica*, and probably other ambystomatid salamanders and some ranid frogs, causing minimal physical damage to egg masses and without reducing survival of embryos in *A maculatum*. As all egg masses of *A. maculatum* examined in this study were clear, future research should test the efficacy of the ovagram on opaque eggs of *A. maculatum* and on the eggs of other species. To expedite counts, this method could be coupled with digital photography and an image processing and analysis program that counts discrete objects in an image, such as has been used to measure compactness of substrates in nests of fish (Candolin and Salesto 2006). This would reduce time in the field and bias, if multiple observers are involved.

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An Alternative Method for Restraining Frogs

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Herpetologists use several different methods for marking adult anurans to study their natural history and ecology. Some techniques include toe-clipping, passive integrated transponder (PIT) tags, visible implant elastomer (VIE), and radio transmitters (Donnelly et al. 1994). Employing these techniques requires maintaining control of study animals, which often requires additional personnel or the use of anesthetics (e.g., MS-222). These methods of restraint are often expensive and anesthetics require recovery time and may have lasting effects on an animal. Several devices have been designed for restraining herpetofauna (Hoefer et al. 2003; Jones and Hayes-Odum 1994; Poulin and Ivanyi 2003; Quinn and Jones 1974; Walston and Mullin 2005), however, only two methods have previously been described for restraining anurans (Christy 1998; Heyer et al. 1994). While effective, these methods are either useful with a specific marking method (e.g., PIT tags) or are overly complicated and have limited durability. Consequently, there is a need for an inexpensive and more efficient means of restraining anurans to be marked. Here I present a new device for restraining anurans being fitted with radio transmitters or marked using other techniques (e.g., PIT tags and VIE) that is inexpensive, durable, waterproof, easy to use and decontaminate, lightweight, and restrains frogs safely and quickly.

The device has five basic components: the base plate, the compression plate, two anchor bolts, two compression locks, and two compression pads (Fig. 1). The base plate is a 240 × 90 × 6 mm piece of clear Plexiglas® with a pair of countersunk and threaded 4 mm holes. Each hole is positioned 8 cm from one short edge and 1 cm in from each long edge. The compression plate, also constructed of clear Plexiglas® (90 × 25 × 6 mm), has two 6 mm holes centered along its width that align with the holes in the base plate. The two anchor bolts are 4 mm fine-thread stainless steel bolts screwed into the base plate. The compression pads are two pieces of weather stripping (PVC closed cell foam, 6 × 9 × 9.5 mm), which can be purchased at most hardware stores. This material is soft and forms to the contours of the frog's hind legs without damaging the skin. The two compression locks are plastic cord locks commonly used on backpacks and stuff sacks and are available for purchase at most camping stores. All components (~ US $7.00) are durable and easy to decontaminate when moving between study sites.

Restraining frogs is simple, quick, and effective. With hind legs extended, the frog is positioned ventral side down on the base plate with the knees centered on the base plate compression pad (Fig. 2). The positioning of the frog on the device is important because controlling the knees inhibits movement of the hind legs and prevents injury to the frog. The compression plate is then slid over the anchor bolts and appropriate pressure is applied to prevent the frog's legs from moving. The cord locks are then slid

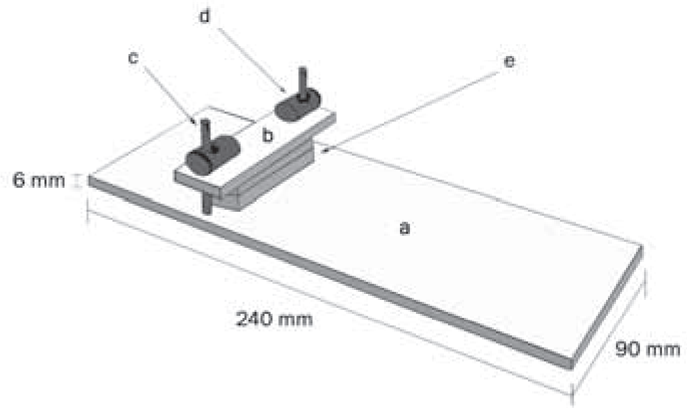

FIG. 1. The five basic components of the anuran restraining device: a) base plate; b) compression plate; c) two anchor bolts; d) two compression locks; and e) two compression pads.

over the anchor bolts and locked against the compression plate. Spinning the cord locks clockwise or counter clockwise allows fine-tuning of the pressure exerted on the frog. Care must be taken to avoid exerting excessive force, which could restrict blood flow. The amount of time required to restrain a frog using this device is approximately 15–30 seconds.

I have found this device to be invaluable when working alone and marking small to medium-sized ranid frogs (30–90 mm snout–urostyle length, SUL). To date it has been used to effectively restrain Foothill Yellow-legged Frogs (*Rana boylii*, N = 150 [R. Bourque, unpubl. data and C. Wheeler, pers. comm.]), Cascades Frogs (*Rana cascadae*, N = 711 [J. Garwood, pers. comm.]), and Mountain Yellow-legged Frogs (*Rana muscosa*, N = 15 [J. Bettaso, pers. comm.]) during PIT tag implantation, radio transmitter attachment, and/or toe clipping. I have also found this device to be effective for restraining Bullfrogs (*Rana catesbeiana,* N = 5), Pacific Treefrogs (*Hyla regilla,* N = 5)*,* Northern Red-legged Frogs (*Rana aurora,* N = 5), and Coastal Tailed Frogs (*Ascaphus truei,* N = 5). Restraint of larger frogs (> 90 mm SUL) would require constructing a larger version of the device described here. Of approximately 148 individual frogs of three species (*R. boylii, R. cascadae, and R. muscosa*) that were restrained using this device and studied using radio telemetry for relatively long time periods (28–112 days), no visible ill effects were observed resulting from restraint. Lastly, this device has reduced handling time, and thus minimized the amount of stress experienced by the frog during marking procedures.

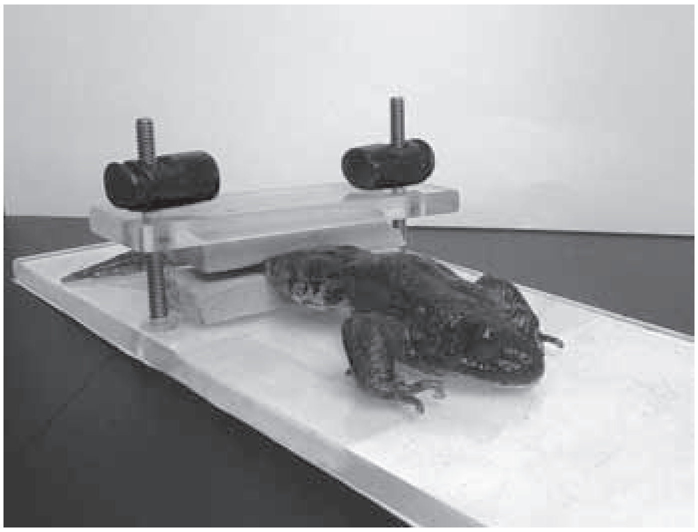

FIG. 2. Proper restraint of a frog (*Rana boylii*) with knees centered on the compression pads and immobilized using appropriate pressure, which is maintained by cord locks.

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Use of Ground Penetrating Radar to Image Burrows of the Gopher Tortoise (*Gopherus polyphemus*)

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The Gopher Tortoise (*Gopherus polyphemus*) is a large fossorial chelonian, averaging 23–28 cm in carapace length, that constructs extensive underground burrows in pyrogenic ecosystems of the southeastern US, especially favoring the sandhill and scrub vegetative communities (Auffenberg and Franz 1982; Diemer 1992). Because an entire community of at least 362 species of vertebrates and invertebrates use these burrows at some stage in their life or seasonal cycle (Jackson and Milstrey 1989), the Gopher Tortoise has been referred to as a keystone species (Eisenberg 1983). Gopher Tortoise burrows vary in diameter, depth, and complexity and play a critical role in the ecological processes of sandhill and scrub communities of Florida. They impact geomorphology (Butler 1995), soil dynamics (Gardner and Landers 1981), vegetation patterns (Kaczor and Hartnett 1990; Tuberville, 1998), animal community diversity (Milstrey 1987 for invertebrates, Franz 1986 for vertebrates), and possibly hydrology, at scales ranging from microsites to landscapes. Some species, such as Florida Mice (*Podomys floridanus;* Jones and Franz 1990), Eastern Cottontail Rabbits (*Sylvilagus floridanus;* Kinlaw 1999), and Armadillo (*Dasypus novemcinctus*; Guyer and Hermann 1997), will modify tortoise burrows for their own needs, adding complexity over time. Gopher Tortoise populations currently are in decline throughout the species' range (Auffenberg and Franz 1982; Diemer 1986; Estes and Mann 1996). The Florida Fish and Wildlife Commission (FWC) is currently reclassifying the tortoise from its present status as a 'Species of Special Concern' (FWC 2004) to a Threatened status (FWC 2006a), along with strengthening protection of its burrows (FWC 2006b).

Data on the internal geometry of a burrow can be obtained using simple measurement tools such as calipers, calibrated flexible rods, or by measuring dimensions of casts of burrows made from hardening agents. In the southeastern US, Gopher Tortoises are collected on sites slated for development by excavating their burrows using heavy equipment (Blankenship and Thomas 2005). Although general information about the depth and extent of burrows can be learned by this method, it destroys burrows, along with any opportunity for repeat measurements of burrow geometry. With excavation, any beneficial ecological effects of the destroyed burrow are lost. Invasive probing methods can cause burrow abandonment or behavioral disruption of the burrow inhabitants (A. Kinlaw, pers. obs.). Some success in understanding underground burrow structure for other animals has been achieved in the UK using geophysical methods. Butler et al. (1994) were successful in determining size for six badger (*Meles meles*) setts using soil resistivity but were unsuccessful using magnetmometry. Any approach to modeling changes of burrow structure over time, such as Meadow's (1991) model, which is based on tortuosity and complexity, requires a method to image burrows that is non-invasive, repeatable, and relatively quick.

Ground penetrating radar methodology.—Ground penetrating radar (GPR) is a non-invasive subsurface imaging technology which uses a surface antenna to transmit electromagnetic energy pulses in the form of radar waves, downward into the ground (Conyers 2004). Waves of varying amplitudes are then reflected back from buried interfaces to a receiving antenna, which is assembled together with the transmitting antennae on a movable sled or cart. The time elapsed between transmission and reception, the amplitude and phase of the received waves, and the frequency of those waves are recorded on the hard drive of a computer which interfaces with the antennas. Of the waves reflected back from buried interfaces, the largest amounts of energy are reflected back from highly contrasting media. In the case of air-filled burrows, a good deal of radar energy is reflected from the interface between the sandy sediment and the void of the burrow itself; other reflections can occur from tree roots, shallower burrows of other animals and sedimentary or soil beds. As the sled is slowly moved along pre-determined surface transects, a series of reflections can be collected at a programmed distance, determined by the revolutions of a survey wheel attached to the sled (Fig. 1A). All reflections are collected in radar travel times measured as two way-travel time in units of nanoseconds. These times can be converted to approximate depth in the ground when the velocity of the radar energy travel is calculated. When many hundreds of these reflections from varying depths are stacked and viewed in a two-dimensional vertical profile, a "cross-section" of the ground is produced.

Radar energy propagation occurs best in dry sandy soils, however good penetration also can occur in a number of other ground conditions (Conyers 2004). The applicability of GPR to locate cavities such as pipes or tunnels was recognized in the 1970s (Fullagar and Livleybrooks 1994). Since air-filled voids provide an excellent dielectric constant contrast (Daniels et al. 1992), GPR is used to identify animal burrows in earthen dams in the United States which might cause collapse of dams (ASDSO 1999).

Field Site Description and Burrow Selection.—Three study sites were located in the Ocala National Forest, Marion County, Florida, USA. The sandhill site (Kerr site) is located along the north shore of Lake Kerr, in the Lake George District of the Forest. The two oak scrub sites were located adjacent to the US Naval Reservation in the Seminole District of the Forest. In Florida, sandhill vegetative communities are rolling park-like woodlands of Longleaf Pines (*Pinus palustris*) rising above a continuous cover of Wiregrass (*Aristida stricta*) with other grasses and forbs, and occasional clumps of deciduous oaks, mostly Turkey Oak (*Quercus laevis*; Myers 1990). Visually, sandhills are open and one can often see for a hundred meters or so. Uncut Sand Pine scrub is a vegetative community of tall, twisted, leaning Sand Pine trees (*Pinus clausa*) rising above a thick understory of evergreen scrub oaks (*Q. geminata*, *Q. myrtifolia*, *Q. inopina*, *Q. chapmanii*), Florida Rosemary (*Ceratiola ericoides*), interspersed with Rusty Lyonia (*Lyonia ferruginea*), Scrub Holly (*Ilex opaca* var. *arenicola*), Silk Bay (*Persea humilis*), and Scrub Hickory (*Carya floridana*; Myers 1990). However, scrub vegetation often has open areas. Our GPR scrub sites had been logged within 10 years previous to our study, thus the Sand Pine trees were between one and five meters high. The soil type in both sandhill and Sand Pine scrub vegetation is classified as entisols, dominated by gently sloping, well-drained thick sands (Brown et al. 1990). These excessively drained soils are derived from quartz sand (Brown, et al. 1990) and are mostly devoid of silt and clay.

Our plots and burrows were chosen as part of a related research project. Many sandhill plots were available, thus a map of this vegetative community was gridded into one hectare squares and each square assigned a number. The plots were then selected using a random numbers table (Steele and Torie 1980). Gopher tortoises seem to prefer sand pine scrub areas that have undergone succession three to five years after a clear-cut, so the scrub plots were chosen from the few appropriately aged plots available. We tried to select only burrows that appeared to have been recently dug or were actively being used by the tortoises, since the literature indicated that these provided the most biological insight.

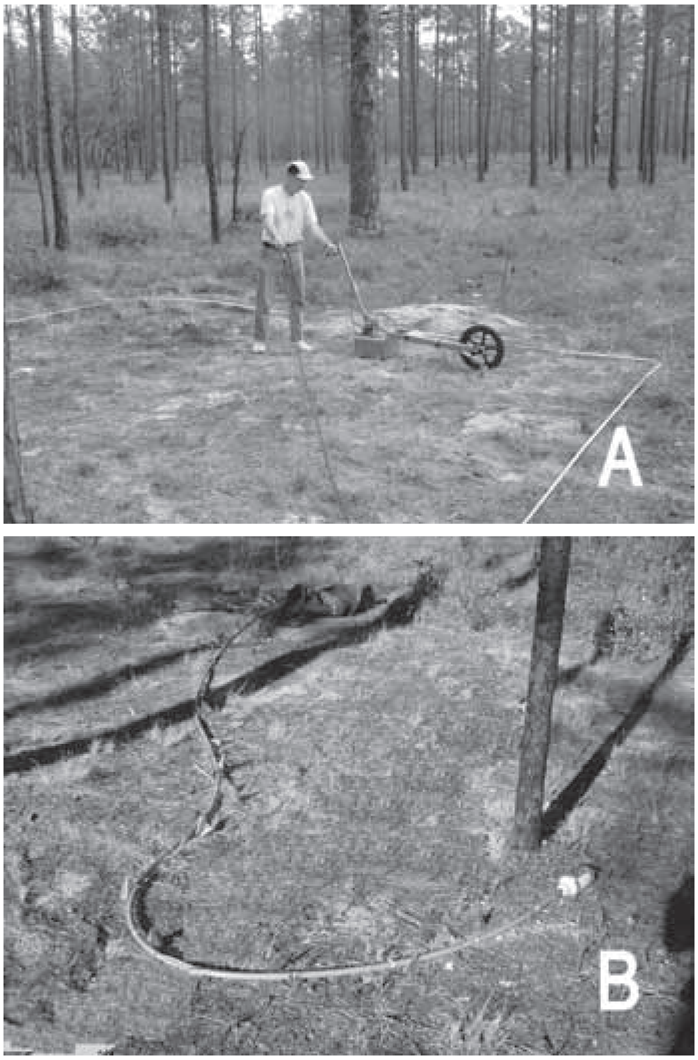

FIG. 1. A) Pulling GPR antenna in perpendicular direction across the long axis of gopher tortoise burrow in sandhills plant community, Ocala National Forest, Florida, USA. Note mound of sand behind antenna, indicating where tortoise piled up sand from digging activities. B) Two-dimensional profile of burrow Kerr6 on ground surface. The path of the burrow is outlined by the line marked by flags and spray paint, with the tube of the video camera also aligned along the path. View is opposite to the digging direction of the tortoise, with the burrow opening at the upper center of photo.

Prior to testing with GPR all burrows were examined with an infrared video probe camera attached to a 7.7 m section of polybutylene tubing (assembled by Edward E. Wester, Southern Ecosystems Research, 6485 Lee Road 54, Auburn, Alabama 36830, USA). This examination found that six of the burrows each contained a tortoise. The length of four others exceeded the length of the camera tether and occupancy could not be confirmed, but recent tracks, skid marks, and other surface signs indicated obvious use within a day or two prior to our testing. Finally, four burrows had sign that was somewhat deteriorated and did not have a resident tortoise (Table 1). Under the current scheme in use in the southeastern US to classify the status of Gopher Tortoise burrows (Auffenburg and Franz 1982), ten would be classified as "active" and four as "inactive."

GPR Collection Procedure.—The GPR antennae at our test sites were first calibrated for ground conditions that were often unique to each area. This included setting automatic range gain settings to enhance the reflection amplitudes with depth due to normal energy attenuation in the ground (Conyers 2004). A time window was selected, measured in nanoseconds, which preliminary velocity tests showed to be consistent with the maximum depth of the burrows. This time window varied between 50 and 70 nanoseconds, which corresponded to a maximum energy penetration depth of about 4–5 m. Optimal energy penetration occurs when the antennae are in direct contact with the ground surface at all times (Conyers 2004). To facilitate this, ca. 20–80 m^2 of vegetation immediately above each burrow was mowed. We then followed a two step procedure to map the burrows in the field. First, each burrow was probed with a piece of flexible electrical conduit to determine its beginning direction and maximum extent. Then, using a 900 MHz frequency antenna (Geophysical Survey Systems, Inc., 13 Klein Drive, PO Box 97, North Salem, New Hampshire 03073-0097, USA), we collected a series of "trial and error" transects at orientations estimated (from the initial probings) to be perpendicular to the burrow. In this way radar reflections when viewed in profile would produce a hyperbolic shaped reflection, with the apex of each hyperbola (Fig. 2A) denoting the top of the burrow tunnel. The location of each hyperbola apex was marked with a pin flag at the ground surface immediately over the section of tunnel that had just been crossed by the GPR antenna. This preliminary process of profile collection and immediate interpretation was continued until an approximate burrow path was delineated by flags, and then its total extent was marked with spray paint. During this preliminary step it was quickly determined that most burrows were not straight, but angled quickly from the surface as they continued down to greater depths. When many reflection profiles were collected in this way and viewed on the computer screen in "real time," the depth and orientation of the burrow void spaces could be determined. Often this process was confusing, as shallower burrow reflections, tree roots and the complex nature of reflections from curving tortoise burrows that often reached three and a half meters in depth produced an array of reflections with many different orientations.

Following Stott (1996), we wanted to verify that the hyperbole reflected by the GPR antenna was in fact the subsurface tortoise burrow we believed we were imaging, not a different burrow, unknown air void, or a sampling artifact. During this pilot step, we confirmed that the GPR antenna was actually imaging the burrow path by examining the section of tunnel directly underneath with the video probe camera slid down the tunnel. By treating the vertical distance between the antenna and the burrow immediately below the antenna as side A of a right triangle, and the horizontal distance between the antenna and the burrow entrance on the ground surface as side B of the triangle, we used the Pythagorean Theorem to calculate the correct distance (hypotenuse) to slide the camera down the burrow to be immediately underneath the antenna. This confirmation step was only conducted near the entrance of the first few burrows we imaged before the burrow curved.

To accurately map the depth of the burrows, we conducted a velocity analysis to calibrate the relationship between radar travel time and depth. At several locations along the first three burrows we processed, a calibrated steel rod was inserted from the ground surface to the top of the burrow; the point of insertion into the burrow could be determined by a relaxation of insertion pressure as it entered the void space. Correct placement of the rod in the burrow chamber was confirmed by observation with the video-probe camera. These depths were then measured and the elapsed radar time measured in the GPR reflection profile at that location was then obtained. In these tests an average radar travel velocity was calculated to be 8 cm/nanosecond. Using this average velocity a two-way radar travel time of 45 nanoseconds was equivalent to ca. 3.6 m in the ground. This velocity was used to convert all measured times of burrow reflections to depth at all test sites. For all the sites tested this average velocity appeared to be consistent, which is understandable as all the burrows tested were found in the same type of dry aeolian sand. Ground moisture conditions, which can sometimes dramatically change radar velocities, were similar during GPR data acquisition. By following this process, an accurate depth profile of each burrow was made.

In the second step, a rectangular grid was then arranged over the total extent of each burrow with tape measures and their surface extent was mapped as x and y coordinates, measured from the southwest datum of each grid. The GPR antennae were moved in four meter transects perpendicularly across the burrow to collect reflection profiles normal to the orientation of the burrow (Fig. 1a). The middle of the profile (at ca. 2 m) therefore denoted the approximate center of each burrow, no matter what its depth. Reflection transects were placed every 50 cm along each surface-outlined burrow in this second step, which was a more formal process than our preliminary trial and error step. Paint and surveyor flags were used to mark the orientation and extent of each burrow (Fig. 1b), and photographs were taken. In this fashion the x and y coordinates of the burrow were determined from the surface measurements with z values (depth) obtained for each profile by measuring from the surface down to the apex of each reflection hyperbola (Fig. 2a). On each burrow, we made a final longitudinal transect along the ground surface that followed the path of the burrow; the resulting profile illustrated the gradual vertical drop of the burrow as the antenna moved (Fig. 2B).

Image Analysis.—Data points were transferred to two programs which translate three-dimensional spatial data into visual displays. Slicer-Dicer (Pixotec, LLC, 15917 S.E. Fairwood Blvd, Renton, Washington 98058, USA) is a program that allows the user to visualize three-dimensional data as a projected volume. This program creates isosurfaces from the data, meaning that the inter-

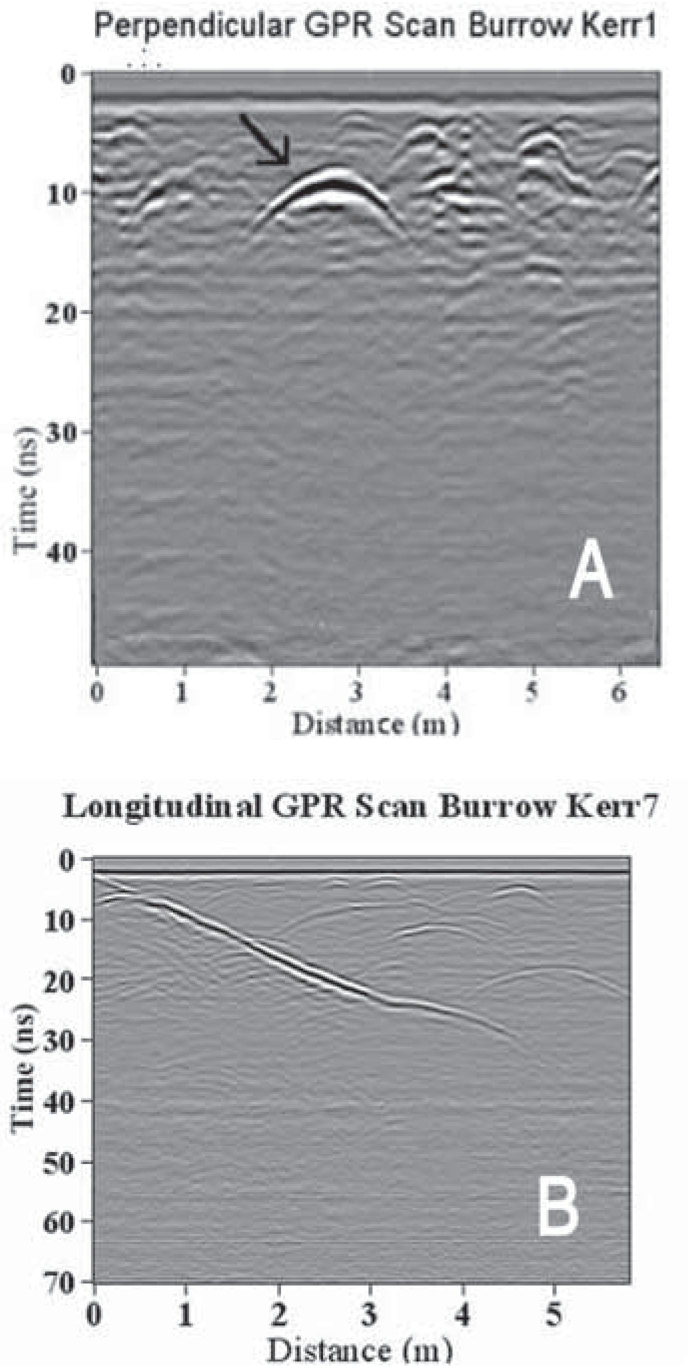

FIG. 2. A) Hyperbole (indicated by arrow) shown in GPR reflection profile, collected by moving the GPR antenna on the ground surface over the burrow at a 90° angle to the orientation of the burrow. B) GPR Longitudinal profile of burrow, collected by moving the GPR antenna on the ground surface following the path of the burrow.

faces producing the GPR reflections are placed in three dimensions, and a pattern or color is assigned to specific amplitudes in order for them to be visible (Heinz and Aigner 2003). The second program, FormZ (Auto·des·sys Inc., 2011 Riverside Drive, Columbus, Ohio 43221, USA), is a general-purpose solid and surface modeler with which the user can generate highly articulated renderings of most three-dimensional forms from x, y, and z data. To determine how accurately these renderings describe real burrow geometry, we compared them with physical casts of burrows prepared at a Clermont, Florida site where the burrows were being excavated for relocation purposes, with photos taken during these burrow excavations, and with one literature account.

Results.—The two dimensional outlines on the ground surface showed that nine burrows turned to the left within two to three meters of their opening, three turned right, and one was fairly straight (Table 1). Data were incomplete for one burrow which had collapsed about three m from the entrance. A 3-dimensional profile was developed for one burrow using the Slicer-Dicer visualization program, showing a downward corkscrew turn to the left (Fig. 3A). Three-dimensional profiles were developed for four burrows using the FormZ modeling program, which showed the burrow tunnels had smooth sides, some up and down loops or twists, and an overall "jagged" corkscrew shape (Fig. 3B). Examinations of hardened foam burrow casts and photos from the Clermont relocation site confirmed that those burrows had the same properties.

Discussion.—This research provided the first intact visual views of gopher tortoise burrows. The two-dimensional outlines on the ground surface show that most burrows investigated in this study turn in some fashion. The three-dimensional profile showing a corkscrew shape coincides with observations by Smith et al. (2005) for burrows that were excavated during a drought in east-central Florida. They reported burrows which angled down in a corkscrew fashion and attributed this to tortoises digging until they reached a cool hardpan layer under sand during the drought. Moreover, our comparison with the appearance and orientation of the FormZ three-dimensional renderings with actual hardened foam casts of burrows indicates that the models developed with this program accurately compares with the orientation and shape, including turns, of real burrows. Since the resolution of the GPR system we used was not detailed enough to image smaller side tunnels or rough surfaces along the side of the main tunnel, these features would not be represented in the visualization programs. Although the FormZ program smoothes the surface of a tunnel, this did not affect our results, as our burrow casts show fairly smooth surface features. These foam casts were taken in an area without shrubs or trees; we caution that the sides of burrows occurring in areas with more roots may not be as smooth. The longitudinal GPR profiles produced at each site clearly show burrows descending into the ground, sometimes leveling out, and again descending to their end. The FormZ models illustrate well both the up and down undulations of the burrows, as well as the turns, and the foam casts confirmed that these features occur in real burrows. All bio-mathematical models are approximations, and there is no reason why our three-dimensional renderings of burrows should be different. Thus, comparisons with features of real burrows show that these visualization programs using GPR data do provide reasonable models of burrows.

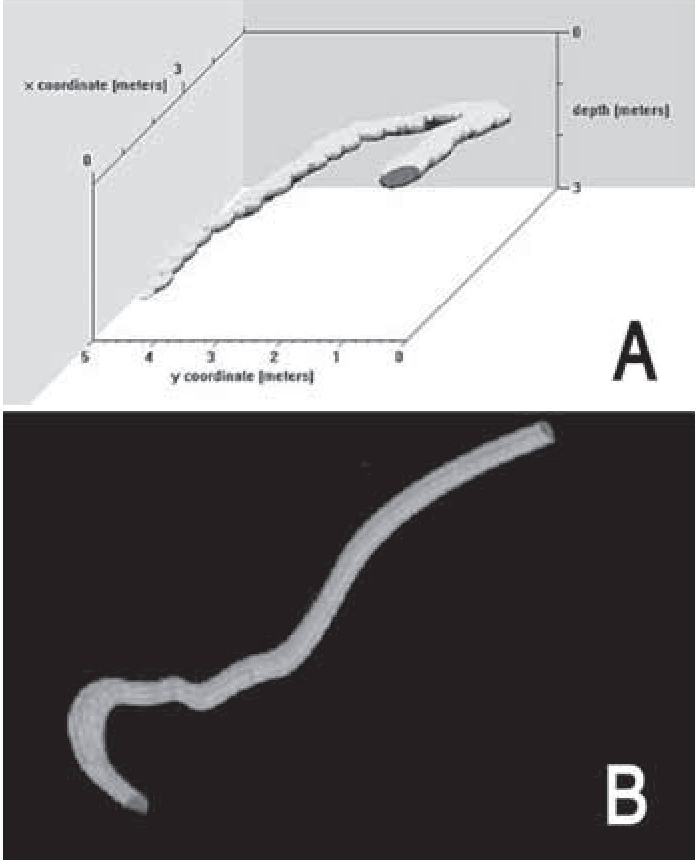

FIG. 3. A) Three-dimensional image of burrow Kerr3 developed using the Slicer-Dicer isosurface modeling program. B) Black on white three-dimensional rendering of burrow Kerr6 developed with the FormZ program.

Ground penetrating radar can assist with practical conservation efforts of the Gopher Tortoise. Gopher tortoises occur in a number of national forests and military reservations throughout the southeast. GPR could be used to assess or estimate the damage caused by heavy equipment, such as forestry skidders or military tanks, which can cause the collapse of burrow entrances. Gopher tortoises will also dig burrows in suitable soil occurring on cattle ranches. Trampling by cattle can collapse the opening or shallower sections of burrows, especially in overgrazed areas (A. Kinlaw, pers. obs.). The single collapsed burrow (NE2) found in this study was encountered very early in our study and we did not attempt to thoroughly map it. However, our subsequent mappings demonstrated that intact tortoise burrows could be imaged even if the entrance was completely sealed, because our GPR ground profiles showed other burrows underground (near our imaged burrows) that could be traced to old soil mounds.

By imaging the internal architecture of burrows, GPR technology could clarify issues relating to energy expenditure in building the burrows, flooding of burrows, respiratory environment, and amount of living space for invertebrates and commensal vertebrates. By collecting a time series of profiles at the same burrow, changes in the architecture of a burrow can be better understood, as well as changes in architecture brought about by other animals that modify a burrow.

There are many advantages of using GPR for mapping and vi-

TABLE 1. Data for Gopher Tortoise burrow study collected without and with ground penetrating radar.

Data gathered before use of GPR				Additional data gathered with GPR			
Burrow Number	Habitat	Length Probed (m)	Tortoise Present?	Beginning Direction	Ending Direction	Configuration	Maximum Depth (m)
NE1	Scrub	4.9	N	160 °	?	turned left	2.48
NE2	Scrub	2.1 (a)	N?	260 °	?	straight (?)	1.28
Nor1	Scrub	4.1 (b)	Y	330 °	225 °	turned left	1.76
Nor2	Scrub	5.9 (b)	Y	170 °	55 °	turned left	1.52
Nor3	Scrub	3.4	Y	215 °	105 °	turned left	1.84
Nor4	Scrub	5.9	Y	315 °	30 °	turned right	2.88
KerrA	Sandhill	>7.6 (c)	?	60 °	75 °	straight	1.92
Kerr1	Sandhill	>7.9 (c)	?	310 °	210 °	turned left	1.04
Kerr2	Sandhill	>7.9 (c)	?	295 °	190 °	turned left	3.68
Kerr3	Sandhill	3.6 (b)	Y	200 °	?	turned left	2.0
Kerr4	Sandhill	6.7 (b)	Y	320 °	125 °	turned right	3.2
Kerr5	Sandhill	5.8	N	40 °	230 °	turned left	1.92
Kerr6	Sandhill	>6.4(c)	N	240 ^{0}	120 ^{0}	turned left	1.52
Kerr7	Sandhill	6.1	N	10 ^{0}	230 ^{0}	turned right	2.24

(a) Unable to manipulate camera past this point in burrow

(b) Gopher tortoise at length indicated, unable to manipulate camera past tortoise, burrow continues unknown length

(c) Burrow extends beyond length of camera; gopher tortoise probably residing in burrow based on recent tracks and sign

sualization of burrows. Like any good scientific method, GPR mapping is repeatable. A major advantage is its non-destructive abilities. Although the environmental impact of mowing a small amount of vegetation at the surface immediately above a burrow is not known, none of the burrows or entrances was physically impacted in any way using this technique. The method is non-invasive to the interior of the burrow; all the work is done at the surface. Finally, the digital format allows the data to be analyzed using a variety of approaches.

Presently the only other method available to obtain an image of a burrow is to fill a burrow with some type of material that hardens into a three-dimensional mold of the burrow shape, then excavate the mold. Although excavations are normally conducted to relocate gopher tortoises, it can be part of a process to map burrows, as in our Clermont foam study mentioned above. Although the time spent in the field with each activity was roughly comparable, mapping by excavation is an inefficient and crude technique compared to GPR. With GPR, we tested 14 sites in 8 field days, spending three to four hours at each site, including set-up time. Practically any burrow could be selected; with the excavation method only burrows listed on a State-issued permit could be imaged.

There are some limitations to the GPR method as well. Stott (1996) found that his GPR system exaggerated vertical tunnel height by a factor of 1.43. In our studies tunnel height could not be determined as the reflection derived from the top of the burrow in most cases was so high in amplitude that it effectively interfered with any reflections that might have occurred from the burrow base. In addition, the suitability of GPR to survey animal burrows in media other than dry sand can not be predicted. Although sand is well known as excellent for radar transmission, silty and clay-rich soils would likely attenuate energy prior to reaching the depth of burrows. For most intermediate-sized burrowing vertebrates that inhabit dry upland sandy regions of Florida, however, this would not be a problem. There have also been no tests of this technique with smaller (e.g., rodent) sized burrows. Burrows we surveyed were ca. 25–35 cm in width and 11–18 cm high. Our burrow camera showed the existence of smaller Florida Mice (*Podomys floridanus*) burrows intersecting the main tortoise tunnels, but our GPR profiles did not discern these smaller tunnels. It is possible that antennae with very high frequencies (greater than 900 MHz) could potentially be used to image smaller burrows, following techniques discussed in this paper. Higher frequency antennae have a greater resolution, but a shallower depth of total energy penetration. Finally, we were unable to confirm the presence of tortoises in two burrows where our camera showed that they were in fact there.

In our study, a catalog of the shape, depth, and orientation of burrows was produced for 14 Gopher Tortoise burrows in central Florida. Data were collected in dense grids of reflection profiles over 8 field days, which were then interpreted to show their orientation in three-dimensions. We demonstrated that the GPR method can be accurately and cost-effectively used in these types of studies for not only burrowing reptiles such as gopher tortoises, but potentially many other burrowing organisms. This imaging technique potentially has worldwide conservation implications for the study of these structures and the medium to large-sized vertebrates that dig and use them.

Ground-penetrating radar is one of the more complex near-surface geophysical methods and there is usually a learning curve involved for all who would like to use the technique. As with most tools, manuals are only partially helpful in standard set-up and data collection methods, which must usually be adjusted for each area studied. This is because ground conditions (soil type and moisture) as well as the nature of the targets usually vary at different geographic sites. Some systems record directly to a laptop, but most record data internally within the radar control system for later downloading. Software to process received reflected data into profiles and three-dimensional images is available for each system, written by the manufacturer. A number of competing software packages are available, some for free on the internet, and some that necessitate yearly subscription expenses of about US $1500 or so. A complete GPR system costs about US $30,000 to purchase, but can be rented from a number of companies in the U.S. and around the world for about US $250 per day. If one wished to write a grant to use this technology in a study, perhaps US $2500 should be allocated for initial training, along with US $3000 for system rental for a few weeks. One should then plan on spending at least four weeks to learn the intricacies of this system in the field. The SlicerDicer program costs about US $600 (academic version US $450) and the FormZ program costs US $400. About one or two weeks is a reasonable time period required for one to effectively learn each program.

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Use of Satellite Imagery to Find the Salamander *Salamandrella keyserlingii* at Darhadyn Wetland, Mongolia

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Aquatic-breeding habitats are essential to many amphibian species that spend most of their life in terrestrial habitats. However, outside of the breeding season, it is difficult to find salamanders such as ambystomatids, hynobiids, and salamandrids. Post-breeding adults disperse upland, find refuge in subterranean burrows or under cover objects such as decaying logs, woody debris, leaves, and stones, and therefore cannot be readily found (Duellman and Trueb 1986). Because of their "unobservability" (sensu Verrell and Davis 2003) it is a common practice to survey for egg masses deposited in aquatic habitats as a means of detecting unknown sites of hynobiids (Hasumi and Kanda 1998). However, lack of roads or poor road conditions may hinder access to potential breeding sites, forestalling surveys. Darhadyn Wetland, Khovsgol Province, Mongolia (Fig. 1: 130 × 30 km area; 50°40'–51°40'N, 99°15'–99°45'E; 1540–1580 m elev.) seemed to correspond to such an inaccessible wetland.

The Siberian salamander *Salamandrella keyserlingii* (Hynobiidae) has the widest range of amphibians worldwide (Borkin 1999; Kuzmin 1999). This species is spread from eastern Europe to Kamchatka, and occurs sporadically in China, Japan, and Mongolia (Borkin and Kuzmin 1988). The Mongolian Red Data book has shown an anecdotal point of distribution for *S. keyserlingii* in Darhadyn Wetland (Shiirevdamba 1997). However, there was no mention of where this species existed within the large wetland. There also is a description of the occurrence of *S. keyserlingii* along the Shishkhid River, which flows through this wetland (Fig. 1, Site 5), but an accurate site location was not provided (Borkin and Kuzmin 1988). During and shortly after the breeding season (estimated to be early June), potential breeding sites of this species seemed to be inaccessible, except by horseback, due to poor road conditions caused by melting of the frozen soil.

If aquatic-breeding habitats cannot be accessed during spring at a target wetland, it may be helpful to conduct a summer survey of likely sites determined by inspection of a satellite picture (remote-sensing techniques: Carey et al. 2001). While larval surveys can be conducted during summer for many species and sites, at Darhadyn Wetland, larvae were rarely captured from crescent lakes and pools during summer because of their earlier metamorphosis (mostly during July: M. Hasumi, unpubl. data). Thus, trying to capture larvae during summer when roads become fully accessible (mid-July to August) is not a useful method to search for new sites of this species in Darhadyn Wetland. After metamor-

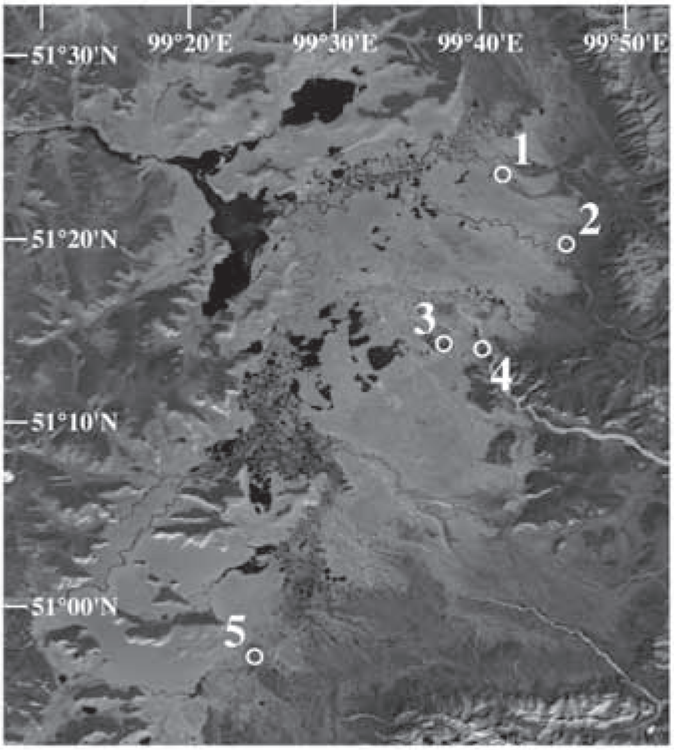

FIG. 1. A satellite picture of Darhadyn Wetland, Mongolia (excluding the northern and southern tips), photographed on 9 August 2001 from the Landsat (published by the ESDI), with five sites we examined for *Salamandrella keyserlingii* (open circles). A site was documented along the Khodon River (Site 2: 51°19'52"N, 99°45'52"E) and along the Shishkhid River (Site 5: 50°57'40"N, 99°24'30"E). No salamanders were found at three other sites proposed for salamander hunting (Site 1: 51°23'40"N, 99°41'30"E; Site 3: 51°14'20"N, 99°37'40"E; Site 4: 51°14'03"N, 99°40'10"E).

phosis, *S. keyserlingii* are nocturnal in summer (Grigoriev and Erdakov 1981); salamanders forage above ground at night and hide in cool, moist refugia during the daytime. Common refugia are decaying logs, and therefore searching forest zones adjacent to aquatic habitats may improve detectability of these salamanders. In this context, the aim of our study was to record occurrences of *S. keyserlingii* at potential sites with adjacent water bodies and forest zones, assessed by a satellite picture of the whole Darhadyn Wetland during the nonbreeding summer season, and to determine the efficiency of this method.

We utilized available Landsat pictures, which were published by the Earth Science Data Interface (ESDI) at the Global Land Cover Facility (University of Maryland, USA), and analyzed the most recent satellite picture of the whole Darhadyn Wetland, photographed on 9 August 2001. We chose Landsat pictures because of their availability and spatial scale including the entire wetland. Pictures from higher spatial resolution satellites such as IKONOS and SPOT were expensive, and while ASTER pictures were less expensive, they covered only one-third (western area) of this wetland by 2005. In band 4 of the Landsat data, having 760–900 nm wavelengths (infrared; 30 m resolution), water indicated a low value below 5% due to lack of its reflectance, but vegetation showed a high value around 40%. Thus, we could determine a site composed of both water bodies and forest zones with image processing. Where a river winds through the wetland, its track forms off-channel "oxbow" crescent lakes and pools (see Fig. 2A). In Darhadyn Wetland, the central region contained many areas like this, but these areas did not have much adjacent forest vegetation. Such areas with more forest vegetation were concentrated to the northeastern and eastern portions of the wetland. In this context, we proposed four potential habitats for salamander surveys (Fig. 1, sites 1–4).

We searched for *S. keyserlingii* at these four sites from 18–23 August 2005. At each site we conducted field reconnaissance and located bodies of water such as stream backwaters, crescent lakes, and pools by walking. We then went to the nearby forest zone and surveyed decaying logs for salamanders. We verified site locations and elevations using a Global Positioning System (GPS; eight satellites, to within 8 m), including the locations of logs. Distance between sites was calculated based on the satellite picture. We determined distance of a log that harbored any individual or the nearest water that was estimated to be suitable for oviposition, using a measuring tape and a GPS. We measured length and diameter of each log when it harbored individuals. We recorded "age class" (i.e., juvenile or adult), sex, and maturity of each individual, according to Hasumi (2001). We weighed each individual (body mass: BM, to within 0.05 g), and measured the broadest head width (HW), maximum tail height (TH), snout–anterior vent length (SAVL: distance from the tip of the snout to the anterior angle of the vent), snout–posterior vent length (SPVL: from the tip of the snout to the posterior angle of the vent), and tail length (TL: from the posterior angle of the vent to the tip of the tail) to within 0.01 mm by a modification of Wise and Buchanan's (1992) method without using anesthesia.

Additionally, at a suspected site along the Shishkhid River mentioned above (Fig. 1, Site 5; Fig. 2A), surveys were conducted from 18–23 July 2004 and from 6–17 August 2005. Previously, several individuals had been reported from this area (independent of analyzing a satellite picture) under decaying logs on land on 23 August 2002 (T. Hongorzul, unpubl. data) but related data were

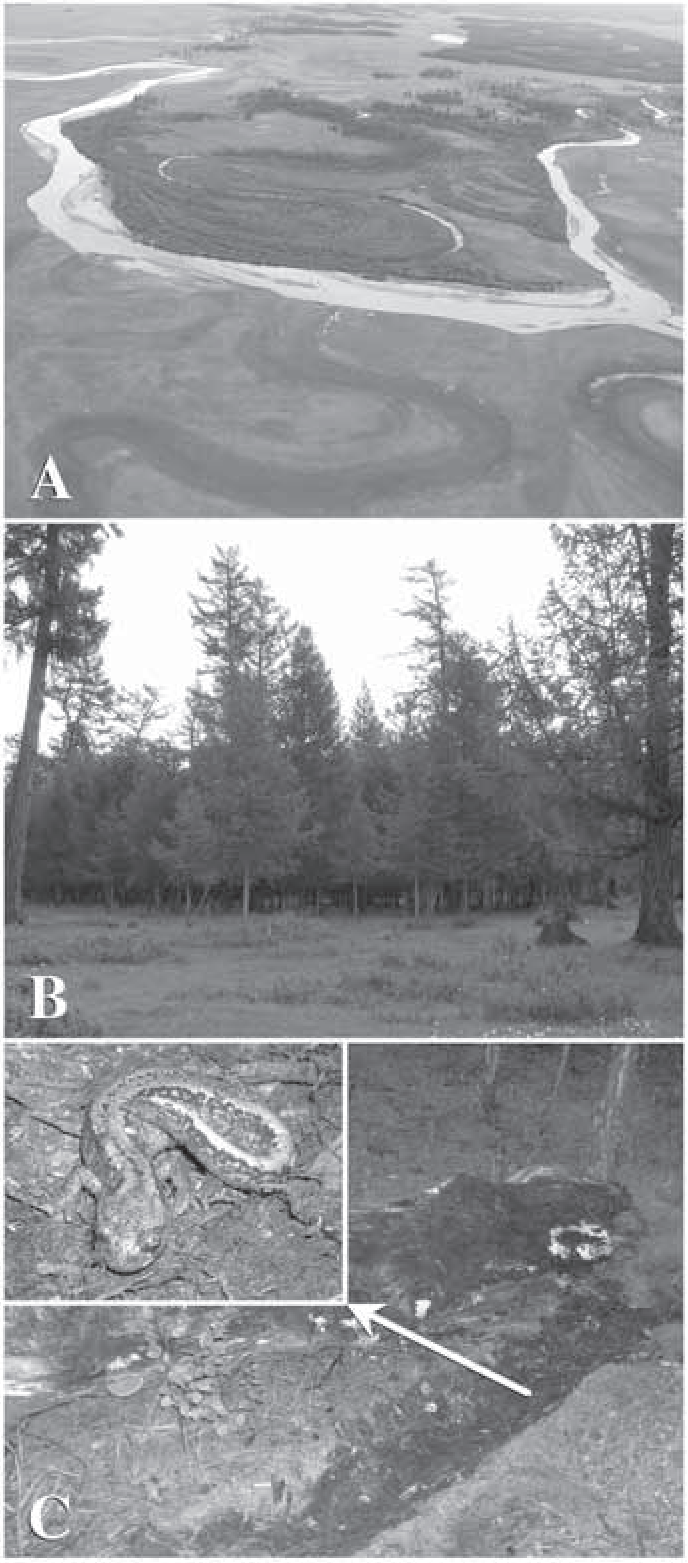

FIG. 2. Two sites of *S. keyserlingii* within Darhadyn Wetland, Mongolia: A) a bird's eye-view picture of site 5 (Fig. 1) with several off-channel crescent lakes and pools (photographed by T. Morita from a paraglider); B) a forest (*Larix* sp.) zone of site 2 (Fig. 1); and C) a decaying log under which a male was found.

not obtained at that time. This site is part of a separate mark–recapture study, and we report only occurrences here to better understand the distribution of the salamander at Darhadyn Wetland.

We detected salamanders at one of four sites selected from satellite imagery. This site occurred in a forest (*Larix* sp.) zone along the Khodon River at 1566 m elev. (Fig. 1, Site 2; Fig. 2B). In the forest, a male was discovered under a decaying log at 2010 h on 20 August 2005 (Fig. 2C). Due to near darkness at that time, this male was released after photographing, without measuring body size characteristics, and detailed site data were obtained from 1100–1320 h on the next day. The log was 3.0 × 0.4 m (length × diameter) and was 237 m from the nearest backwater (BW1). We found a stream approximately 400 m long with 20 or more backwater pools at the uppermost extent of BW1. Most of these backwaters appeared favorable for oviposition, but no larva was found. In this area, a second male (BM = 3.20 g, HW = 8.75 mm, TH = 4.85 mm, SAVL = 46.16 mm, SPVL = 49.53 mm, TL = 25.30 mm) was found under a decaying log (12.0 × 0.25 m) 5 m from the nearest backwater (BW2), located at a slope of the left bank (while looking downstream) near the water sources. There was 375 m distance between BW1 and BW2, and 439 m distance between the logs that harbored the first and second males.

We also found *S. keyserlingii* within a wetland complex in a floodplain along the Shishkhid River (40–60 m wide, 1560 m elev.; Fig. 1, Site 5; Fig. 2A). In summer surveys from 2004–2005, 299 individuals were collected by hand in and under decaying logs on land within the forest zone at this site. It is unknown whether or not this site corresponded to the site recorded previously (Borkin and Kuzmin 1988). In a follow-up survey in mid-May 2006, Site 5 (Fig. 1) could be accessed, but the water surface was frozen and no egg masses were found (M. Nakagawa, pers. comm.).

The distance between the first and second sites was 49.8 km. No salamander was found at three other sites proposed for salamander surveys (Fig. 1).

When aquatic-breeding habitats could not be accessed during spring, our summer surveys of water bodies and adjacent forest zones in the four sites proposed by a Landsat satellite picture were a relatively useful method, with a 25% detection rate of new *S. keyserlingii* sites. Although our approach was limited and we include only preliminary data, a satellite imagery method for predicting distribution of *S. keyserlingii* across huge and often inaccessible landscapes as found in Mongolia may have merits and broad applicability to other regions with similar landscapes. Our approach cannot definitely determine species absence. It is unknown whether or not a 50 km interval between the first and second sites (between the Khodon and Shishkhid Rivers) accurately reflects the distribution of *S. keyserlingii* in Darhadyn Wetland (Borkin and Kuzmin 1988). However, if this is the case, desertification or fragmentation of this wetland that now appears to be progressing due to climate changes melting the permafrost region (N. Fuji, unpubl. data), is a potential explanation for the species occurring at potentially isolated sites. Analyses of satellite images through time are needed to assess changes in wetland–forest habitat conditions, which also could be modeled into the future. While this is a broad-ranging species, its loss at specific sites across its range may be a concern for local population stability.

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Digital Recorders Increase Detection of *Eleutherodactylus* Frogs

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Improved methods for large-scale and long-term amphibian monitoring projects would aid species status assessments and identification of potentially declining species (e.g., Stuart et al. 2004). Acoustical surveys allow researchers to quickly determine species presence and calling activity level (Lips et al. 2001; Zimmerman 1994). The North American Amphibian Monitoring Program, a large-scale monitoring effort, uses acoustical surveys to monitor species in ponds and wetlands (United States Geological Survey 2004). A challenge of this approach is accurate species identification, which is particularly problematic in a tropical area with high anuran species diversity (e.g., anuran species richness in the Neotropics [2135] was greater than in the Neartic [90], Duellman 1999). Furthermore, abundant or loud species may lower the detection probability of other species.

An assumption that needs to be tested in acoustical surveys is that detection is highly correlated with the species presence or activity. Without an appropiate correction for detection probability, data will not accurately reflect the status of the species (MacKenzie et al. 2002). This may result in inappropriate management decisions that could waste time and money.

Digital recorders can be used as a standard method for species detection and determination of calling activity level in amphibian choruses in long-term monitoring projects. Digital recordings can be stored and transferred easily and can allow experts to analyze the recordings at their convenience. In addition, loud or abundant species can be filtered using computer software to increase the detection of other species. I tested the hypothesis that detection of species presence and calling activity level in anuran choruses will be higher when recordings are analyzed with the help of computer software compared to only hearing the recordings. The resulting increase in detection should result in improved population status data and reduced false negatives during species inventories (i.e., when a species is not detected due to interference).

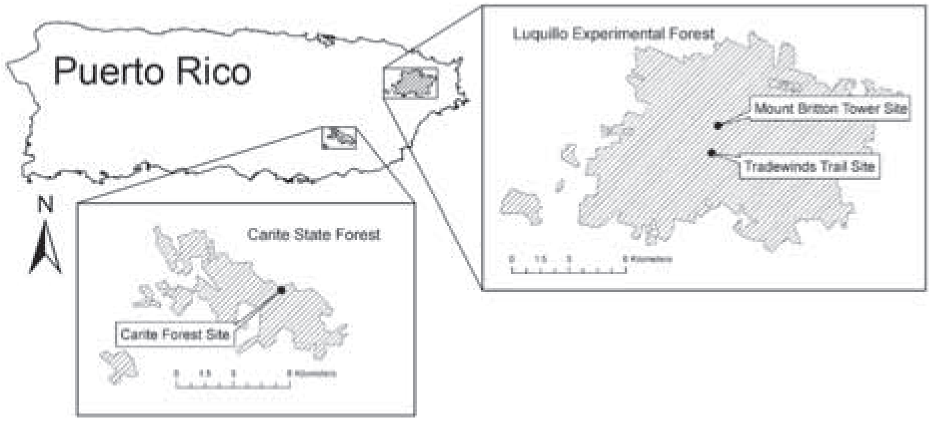

FIG. 1. Location of the three study sites in Puerto Rico.

Materials and Methods.—I recorded amphibian choruses at two sites in the Luquillo Experimental Forest (Tradewinds Trail site, 18.290°N, 65.798°W; Mount Britton Tower site, 18.303°N, 65.795° W), and at one site in the Carite State Forest (18.103° N, 66.035° W), Puerto Rico (Fig. 1). The Tradewinds and Mount Britton sites were located in the Lower Montane Wet Forest lifezone and the Carite State Forest site was located in the Subtropical Wet Forest lifezone (Ewell and Whitmore 1973). Recordings were made using an Automated Digital Recording System (ADRS; Acevedo and Villanueva-Rivera 2006). The recorder was a Nomad Jukebox 3 digital player and recorder (Model DAP-HD0003, Creative Labs, Inc, California), and was set to record in 16-bit wav files with a sampling rate of 48 kHz. Because the recorder had no microphone input, only a line level input, the microphone was connected to a portable preamplifier (Model SP-PREAMP, The Sound Professionals, Inc., New Jersey).

To test if digital recordings can be used to increase detection in tropical frog choruses, I compared one minute recordings, made at 2000, 2200, and 0000 h on five consecutive days, for a total of fifteen recordings per site. I analyzed these recordings using two methods: 1) listening to the recordings; and 2) listening and analyzing the recordings using computer software. For the first method I listened to the recordings with headphones, and each species heard was given an Amphibian Calling Index value (ACI; United States Geological Survey 2004). The ACI has four possible values: 0—no animals calling; 1—a few animals calling without overlap; 2—some overlap of animals calling; and 3—a full chorus of the species. For the second method, I listened to the recordings with headphones and analyzed them using computer software to detect the signal of each species' call by their sound and visual pattern in the auditory spectrum. There is little overlap in the call spectrum of the *Eleutherodactylus* frogs in Puerto Rico, and thus it was possible to distinguish each species (Drewry and Rand 1983). In addition, recordings of the calls of all the species have been published (Rivero 1998). Each recording was then filtered to remove the range of frequencies of the dominant species, *Eleutherodactylus coqui* (1–2.4 kHz), and re-analyzed. I gave each species a new ACI value for this second method. All recordings were coded and analyzed in random order to reduce bias. Each pair of results, for each recording, by species, were compared using Wilcoxon signed ranks tests.

To evaluate the differences in the level of the recorded sound of the species, which may explain why some species were not heard, I obtained the average signal level by frequency using the values of decibels full scale (dBFS), which corresponds, on a logarithmic scale, to the signal in the digital file. On this scale the maximum is 0 dB and the minimum is -96 dB, which corresponds to the maximum and minimum levels, respectively, of sound that the digital file can store (Fries and Fries 2005). The recordings were analyzed using the program AUDITION (ver. 1.0, Adobe Systems, Inc., California, USA).

Results.—A total of eight species of *Eleutherodactylus* frogs were detected. Seven species were detected at the Tradewinds Trail site (Fig. 2a), where there was no difference between the methods

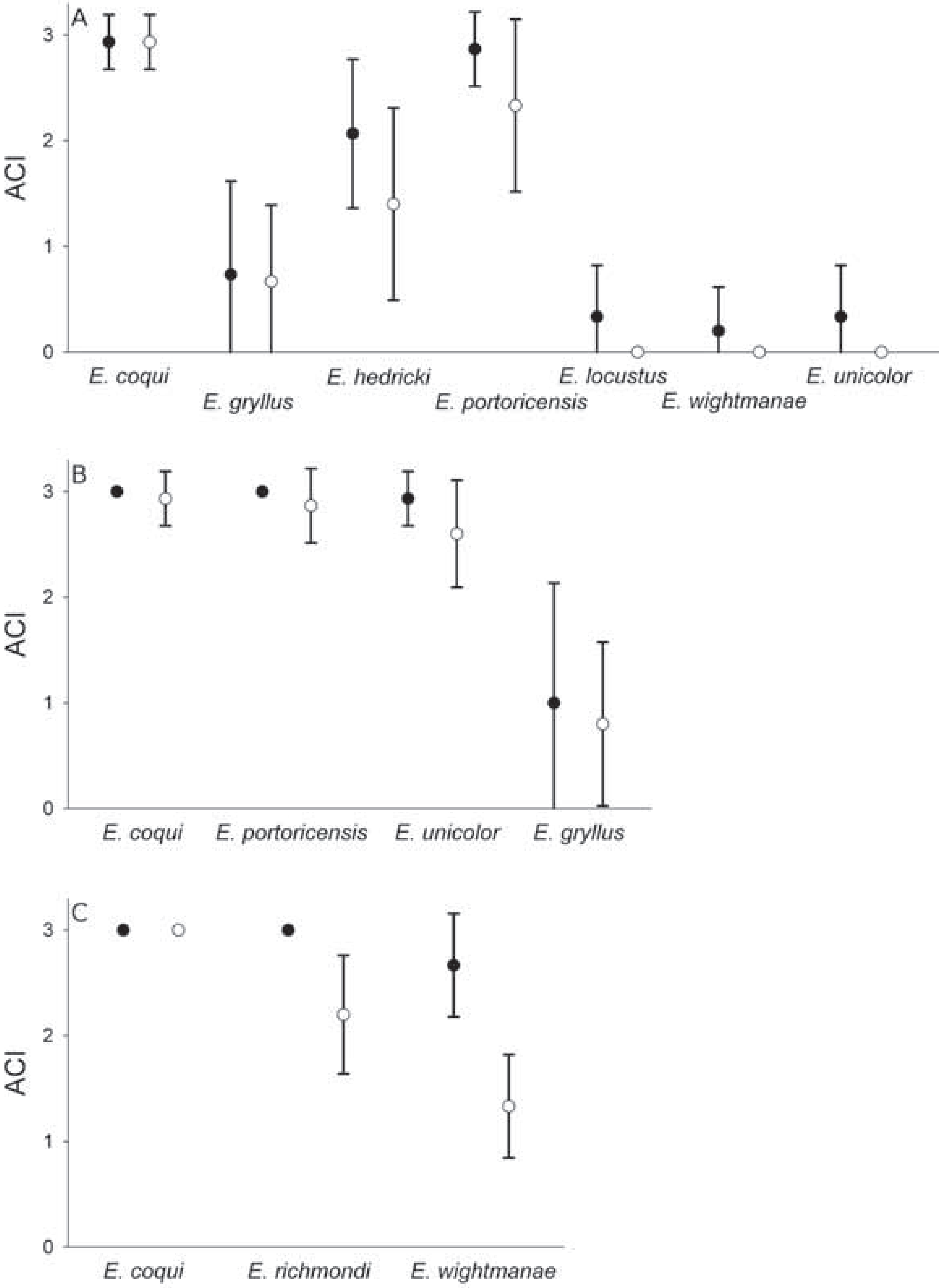

FIG. 2. ACI values (mean ± SD) per species using two methods at: A) Tradewinds Trail site; B) Mount Britton Tower site; and C) Carite Forest site. Filled circles = values for computer analysis method. Open circles = values for the listening method.

for *E. coqui* and *E. gryllus*. The ACI values of two species were higher on the computer-analyzed recordings: *E. hedricki* (P = 0.016) and *E. portoricensis* (P = 0.022). Three species were detected only when the signals of their calls were seen in the spectrogram and the recordings were filtered: *E. locustus, E. unicolor,* and *E. wightmanae*. I detected *E. locustus* and *E. unicolor* in five of the

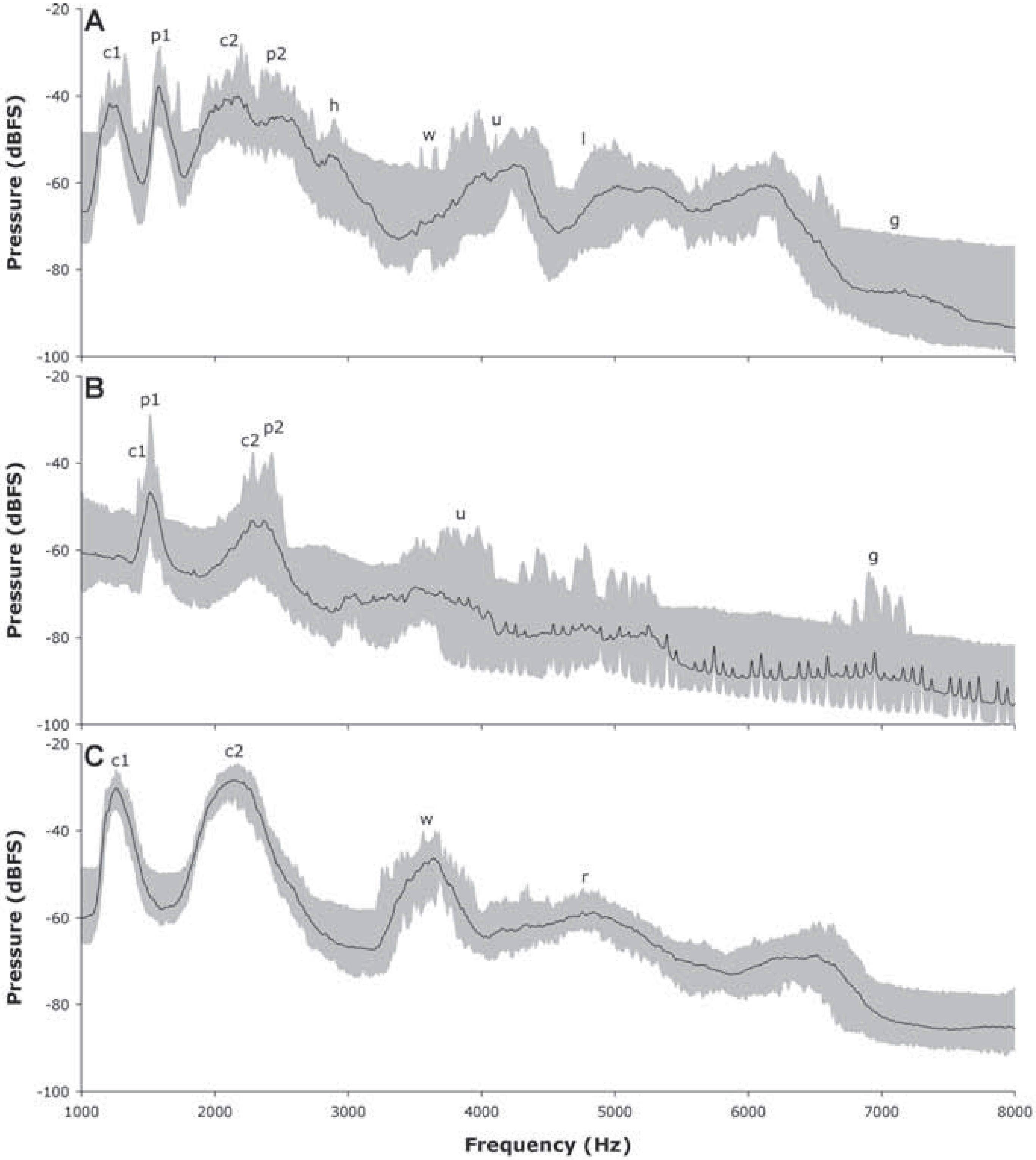

Fig. 3. Sound pressure by frequency of species of *Eleutherodactylus* frogs at the (A) Tradewinds Trail site, (B) Mount Britton Tower site, and (C) Carite Forest site. Sound pressure is measured in decibels full scale (dBFS). The black line represents the average for the fifteen recordings at each site and the shaded area encloses the range of values for each frequency. Letters above the graphs represent the dominant frequency for the species. c1 = first note of *E. coqui*; c2 = second note of *E. coqui*; p1 = first note of *E. portoricensis*; p2 = second note of *E. portoricensis*; h = *E. hedricki*; w = *E. wightmanae*; u = *E. unicolor*; l = *E. locustus*; r = *E. richmondi*; g = *E. gryllus*. Other peaks represent sounds made by insects.

fifteen recordings and *E. wightmanae* in only three of fifteen recordings. Two species had the highest sound pressures, *E. coqui* and *E. portoricensis* (Fig. 3a). The average level of the signal was -41.7 dB and -40.0 dB for the first and second notes of *E. coqui*, respectively, and -37.7 dB and -44.7 dB for the first and second notes, respectively, of *E. portoricensis*. The average maximum signal level for *E. locustus* was -50.7 dB, 13.0 dB less than the average of the loudest species, *E. portoricensis*. The average maximum signal level of *E. unicolor* was -44.5 dB and for *E. wightmanae* was -43.3 dB; these values were 6.8 dB and 5.6 dB lower than the loudest species, respectively.

There were four species at the Mount Britton Tower site: *E. coqui*, *E. gryllus, E. portoricensis*, and *E. unicolor*. There was no significant difference between methods for the four species (Fig. 2b).

I detected three species at the Carite State Forest site (Fig. 2c). There was no difference between methods for *E. coqui*, but the other two species had higher ACI values when analyzed by computer: *E. richmondi* ($P = 0.004$) and *E. wightmanae* ($P = 0.002$). The highest signal level was made by *E. coqui*, with -30.1 dB and -28.4 dB for the first and second notes, respectively (Fig. 3c). The average signal level for *E. richmondi* was -58.8 dB, 30.4 dB less than *E. coqui*, and for *E. wightmanae* it was -46.3 dB, 17.9 dB less than the loudest species.

Discussion.—The loudest species at the study sites, *E. coqui* and *E. portoricensis*, had a continuous chorus. In addition, the sound pressure of these species was higher than the species that were not as easily detected, up to 30 dB louder (Fig. 3). The continuous loud chorus of *E. coqui* and *E. portoricensis* caused interference in the detection of the other species.

The detection and level of activity measured using the ACI increased at two of three sites when recordings were filtered and the spectrogram was evaluated in the computer compared to only listening to the recordings. Of particular importance was the detection of three species, *E. locustus*, *E. unicolor*, and *E. wightmanae* at one of the sites only after filtering. These three species appear to be threatened or endangered since their range is restricted and few populations are known (Burrowes et al. 2004; pers. obs.).

Digital recordings, and their analysis using software, can be used as a tool to search for populations with apparently limited distributions, in areas where limited herpetological work has been conducted, and where loud species interfere with the detection of others. The ACI of four species was higher when the recordings were filtered to remove the common and loud *E. coqui*. Two of these four species, *E. hedricki* and *E. portoricensis*, have limited distribution in the highlands of Puerto Rico, and the two other species, *E. richmondi* and *E. wightmanae*, are thought to have only a few small populations (Burrowes et al. 2004; Villanueva-Rivera 2006).

Furthermore, recordings and computer analysis of choruses may advance our knowledge of anuran breeding phenology. For example, Bridges and Dorcas (2000) found that *Rana sphenocephala*, a species that was thought to be breeding only during the spring and fall, was also calling during the summer between 0200 and 0500 h. This finding, made with a cassette-based automated recording system, indicated a calling period that was missed by most herpetological work done in the area (Bridges and Dorcas 2000).

The use of digital recordings has important implications for the current discussion of amphibian declines and the need for long-term monitoring projects. In a study that tested the use of recorders to detect species of birds, several experts agreed on the identifications of the species present in the recordings, so the method was recommended as an effective avian monitoring method (Rempel et al. 2005). In another study, the number of species identified with recordings made with an ADRS was higher when compared to point counts for birds and transects for amphibians (Acevedo and Villanueva-Rivera 2006). For amphibian monitoring projects, technicians can deploy ADRS and record choruses to be analyzed by experts in the laboratory at another time. This can reduce personnel costs, especially for areas with a small temporal window of amphibian reproductive activity, areas that have high frog diversity, species that do not congregate, and species with low detection probabilities. Another important advantage is that a recording is a permanent record of the presence of a species. Lastly, as demonstrated here, digital recorders and use of computer software may help detect rare species or calls that are difficult to detect due to interference.

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Herpetological Review, 2007, 38(1), 63–66.

A Comparison of the Effectiveness of Recommended Doses of MS-222 (tricaine methanesulfonate) and Orajel® (benzocaine) for Amphibian Anesthesia

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Traditionally, tricaine methanesulfonate (Ethyl 3-aminobenzoic methanesulfonate salt), commonly known as MS-222, has been used to anesthetize amphibians for a variety of procedures including surgery, marking, and photography (Anholt et al. 1998; Kaplan 1969; Kaiser and Green 2001). Recently, Orajel®, a widely used analgesic for oral pain in humans, has been suggested as an effective alternative (Brown et al. 2004; Chen and Combs 1999). Previous studies also have suggested that Orajel® may be a more convenient choice (Altig 1980; Chen and Combs 1999) because it may be purchased from pharmacies and convenience stores, is relatively inexpensive (Crook and Whiteman 2006) and may be easier to transport (Kaiser and Green 2001; Wright 2001).

Few studies have examined the responses of amphibians to either MS-222 (Anholt et al. 1998; Kaplan 1969; Lowe 2004) or Orajel® (Brown et al. 2004). Crook and Whitman (2006) found that benzocaine, the active ingredient in Orajel®, was more effective than MS-222 for anesthetizing *Ambystoma tigrinum,* and Cakir and Strauch (2005) found that benzocaine had more associated health risks than MS-222 in *Rana pipiens*. No other studies have compared the effectiveness of MS-222 and Orajel® among amphibian groups with dissimilar physiology that may affect their responses to anesthesia (Fellers et al. 1994). For example, factors such as rate of gas exchange across the skin vary among groups (e.g., plethodontid and ambystomatid salamanders), and may alter rates of anesthesia uptake.

We examined the effectiveness of recommended doses of MS-222 and Orajel® on four North American amphibian species (Northern Cricket Frogs [*Acris crepitans*], Mole Salamanders [*Ambystoma talpoideum*]*,* Fowler's Toads [*Bufo fowleri*], and Northern Dusky Salamanders [*Desmognathus fuscus*]) by measuring the length of time required until induction, initial recovery, complete recovery, and the entire anesthesia process.

Methods.—We collected 54 adult *A. crepitans*, 41 adult *B. fowleri* and 46 adult *D. fuscus* from various localities within the western Piedmont of North Carolina, USA, and 16 adult *A. talpoideum* were collected on the Savannah River Site in the upper Coastal Plain of Aiken and Barnwell counties, South Carolina, USA. The snout-vent lengths ranged: 18–27 mm for *A. crepitans*; 29–64 mm for *B. fowleri*; 28–78 mm for *D. fuscus*; and 47–61 mm for *A. talpoideum*. After capture, we minimized stress by housing animals in dark containers with paper towels wetted with aged tap water. We housed *A. crepitans* and *D. fuscus* in same-species pairs in 18 × 18 × 7 cm plastic containers and housed *A. talpoideum* and *B. fowleri* in species-specific 75 × 32 × 30 cm aquariums with no more than 20 individuals per aquarium. *Acris crepitans, B. fowleri,* and *A. talpoideum* were kept at room temperature (ca. 21°C), and *D. fuscus* individuals were kept at 4°C but allowed to equilibrate to room temperature 3 h prior to testing. Individuals were kept no longer than a week prior to testing and monitored for at least 24 h before release. We prepared anesthesia solution by adding the recommended doses, 0.50 g/L for MS-222 (0.05%, Fellers et al. 1994) and 1.0 g/L of maximum strength Orajel® (Active ingredient: 20% benzocaine, Brown et al. 2004), to 1 L of 20–22°C, de-chlorinated tap water prepared by allowing chlorine evaporation overnight. We chose not to use a pH buffer with MS-222 as recommended by Lowe (2004) because we did not detect substantial pH change during use, as measured initially by a pH meter (YSI pH100; MS-222 pH = 6.53 ± 0.14, N = 6, Orajel® pH = 7.13 ± 0.08, N = 6) and by hydrion test strips (Micro Essential Laboratory, Inc.) following the last use of a solution (MS-222 pH = 7, N = 6, Orajel® pH = 7, N = 6). Baths were prepared in containers that allowed *D. fuscus* and *A. talpoideum* to completely submerge within the anesthesia solution. *Acris crepitans* and *B. fowleri* were placed in containers that allowed them to maintain their head above the solution until anesthetized.

After we prepared the solutions, individuals were arbitrarily assigned to two groups, either MS-222 or Orajel®, and no more than three individuals at a time were placed in their respective anesthesia solutions (Peterman and Semlitsch 2006). Animals were removed from the anesthetic solution when they failed to respond to our stimulus. We used a toe pinch as our stimulus and administered the pinch every minute in the anesthesia bath and every 2 minutes after induction until complete recovery. All amphibian species groups were tested separately, replacing anesthesia solutions after 15 animals were tested or after 1.5 h of testing. We defined "time until induction" as the period of time necessary for an individual to fail to respond to the toe pinch after being placed in the anesthesia bath. When the animal no longer responded to our stimulus, we removed animals from the anesthesia bath and rinsed them for 30 seconds in a de-chlorinated water bath. We then placed test animals on moist paper towels, observed, and recorded time until the first response to a toe pinch, which defined our "time until initial recovery." At this point, we visually monitored individuals until they exhibited behavior with no signs of sluggishness or disorientation associated with anesthesia. We defined this time period to be the "time until complete recovery." We chose to use a toe pinch as our stimulus as opposed to a typical righting response (Crook and Whiteman 2006) because our use of anesthesia occurs mainly during injections of visual implant elastomer (Northwest Marine Technology; e.g., Nauwelaerts et al. 2000), and animals frequently responded to elastomer injections (i.e., were not completely anesthetized) even when they failed to right themselves.

We analyzed our data using a MANCOVA (Minitab ver. 12.1) for each species. We used anesthesia type as the independent variable, mass of individual as a covariate, and time until induction, time until initial recovery, time until complete recovery, and the total time for all three stages of anesthesia as dependent variables. We evaluated significance at an $\alpha = 0.05$ level in all statistical tests. Because of the unexpected mortality of *B. fowleri*, we used logistic regression (Hosmer and Lemeshow 1989) to examine the effects of mass, snout–vent length, and treatment on mortality. We used a stepwise procedure with an inclusion/removal cutoff of $p = 0.10$. This analysis was conducted using the SAS statistical package (SAS v. 9.1, SAS Institute, Cary, North Carolina, USA).

Results.—We found that Orajel® required less time until induction in all species tested (MANCOVA: *A. crepitans*, $F = 46.38$, df = 1, 51, $p < 0.001$; *A. talpoideum*, $F = 24.21$, df = 1, 13, $p < 0.001$; *B. fowleri*, $F = 36.96$, df = 1, 36, $p < 0.001$; *D. fuscus*, $F = 20.99$, df = 1, 42, $p < 0.001$; Fig.1), produced longer times until initial recovery in *A. crepitans, B. fowleri,* and *D. fuscus* (MANCOVA: *A. crepitans*, $F = 148.73$, df = 1, 51, $p < 0.001$; *B. fowleri*, $F = 21.39$, df = 1, 36, $p < 0.001$; *D. fuscus*, $F = 70.77$, df = 1, 42, $p < 0.001$; Fig. 1a–c), but a shorter initial recovery period in *A. talpoideum* (MANCOVA: $F = 10.65$, df = 1, 13, $p = 0.006$; Fig. 1d). Anesthesia type had no effect on complete recovery times in *A. crepitans, A. talpoideum,* or *D. fuscus* (MANCOVA: *A. crepitans*, $F = 0.16$, df = 1, 51, $p = 0.69$; *A. talpoideum*, $F = 2.27$, df = 1, 13, $p = 0.156$; *D. fuscus*, $F = 0.24$, df = 1, 42, $p = 0.626$; Fig. 1 a, b, d), but anesthetization using Orajel® resulted in a longer period until complete recovery in *B. fowleri* (MANCOVA: $F = 14.55$, df = 1, 36, $p < 0.001$; Fig. 1c). Anesthesia using Orajel® took less time for the entire anesthesia process in *A. crepitans* and *A. talpoideum* (MANCOVA: *A. crepitans*, $F = 23.71$, df = 1, 51, $p < 0.001$; *A. talpoideum*, $F = 28.46$, df = 1, 13, $p < 0.001$; Fig. 2), but more time in *B. fowleri* and *D. fuscus* (MANCOVA: *B. fowleri*, $F = 24.74$, df = 1, 36, $p < 0.001$; *D. fuscus*, $F = 17.71$, dF = 1, 42, $p < 0.001$; Fig. 2). Mass significantly affected time until induction in

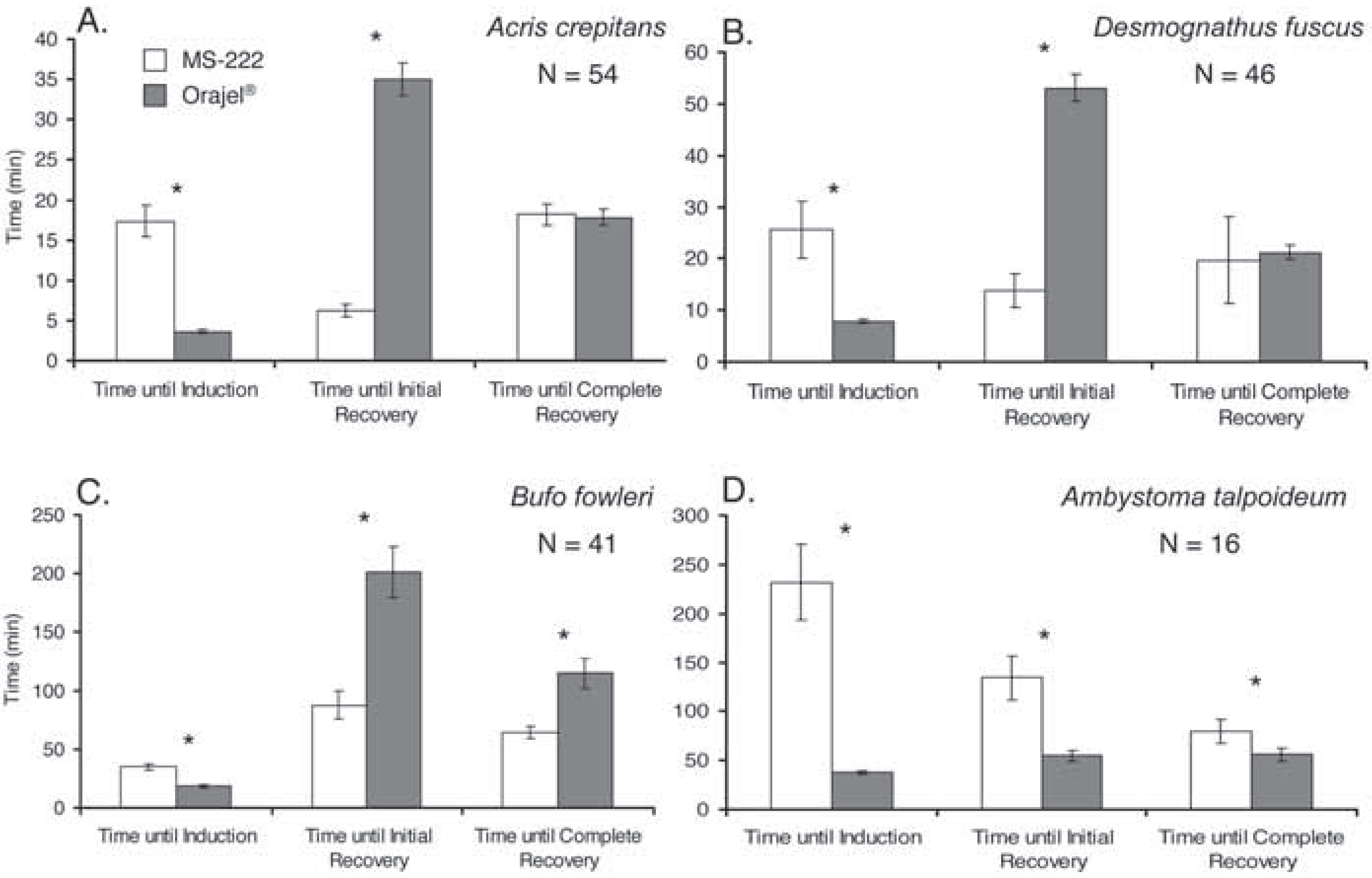

FIG. 1. Time (mean ± SE) required for the three stages of anesthesia using MS-222 and Orajel® in each test species. "*" indicates $p < 0.001$ (MANCOVA).

B. fowleri and *D. fuscus* (MANCOVA: *B. fowleri*, F = 16.91, df = 1, 36, $p < 0.001$; *D. fuscus*, F = 8.53, df = 1, 42, p = 0.006). We recorded relatively high mortality rates for *B. fowleri* in Orajel® (35%) and MS-222 (12%), but no mortality occurred in the other species tested. Results of our stepwise logistic regression identified mass as the best predictor of mortality, with heavier individuals having a higher probability of death (model likelihood ratio statistic = 4.9528, p = 0.026; parameter estimate for mass = -0.1193, p = 0.032).

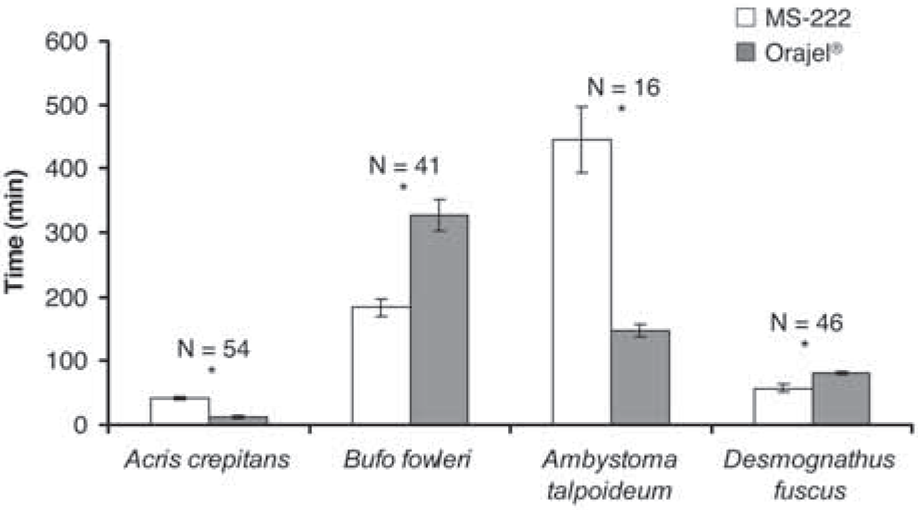

FIG. 2. Time (mean ± SE) required for the entire anesthesia process using MS-222 and Orajel® on our 4 test species. "*" indicates $p < 0.001$ (MANCOVA).

Discussion.—We observed that for most of the amphibian species we tested, anesthetization using Orajel® required less time for induction and produced a longer anesthetization period with variable recovery periods than recommended doses of MS-222 (Fig.1). The effect of anesthesia type on the time required for the entire anesthesia process varied among species (Fig. 2). We attribute inconsistent effects of anesthesia to variation in the physiologies of the species we tested. Factors such as methods of gas exchange, differing metabolic rates, or variation in water absorption rates likely impacted the reactions of species to each anesthesia (Feder and Burggren 1992).

Differences in time required for the three periods of the anesthetization process for each species also may have been a function of mass. We detected a positive effect of mass on induction time in *B. fowleri* and *D. fuscus*. Our sample contained individuals with masses ranging from 2.1 to 27.3 g in *B. fowleri* and 0.5 to 6.5 g in *D. fuscus*. Conversely, we were unable to detect any effect of mass in *A. crepitans* and *A. talpoideum*, which might be a result of testing similarly sized individuals (masses ranged from 0.4 to 1.6 g in *A. crepitans* and 3.9 to 7.6 g in *A. talpoideum*). Contrary to Lowe (2004) but similar to Peterman and Semlitsch (2006), we found that heavier individuals of some species required more time for induction than individuals that weighed less.

An unexpected result of our study was mortality experienced by *B. fowleri*. Orajel® and MS-222 have been used for euthanasia, but typically concentrations are higher or applied differently (Altig 1980). The mortality we observed might be attributed to behavioral and physiological responses of toads to physical handling. During handling, toads frequently released water from their cloacas. Toads might have rapidly absorbed water through their "pelvic patch" (Brekke et al. 1991) in response to water loss. Thus, they might have absorbed more anesthesia than necessary for anesthetization, effectively acquiring a lethal dose before showing signs of reduced motor coordination. Results from our logistic regression suggest that these effects may be most pronounced in heavier individuals. Despite the mortality we witnessed in toads, we suspect that Orajel® and MS-222 are safe for many non-bufonid species. For example, although not included in this study, we also have anesthetized several other species of larval and adult amphibians, including *Ambystoma maculatum, Eurycea cirrigera,* and *Pseudotriton ruber*, safely in Orajel® and have experienced no mortality. Yet, our study and others suggest the importance of experimenting with anesthesia type prior to anesthetizing many individuals because effects may vary between different species and life stages (Crook and Whiteman 2006).

Researchers should consider several factors when choosing an anesthesia. For example, researchers needing to work quickly in a field setting may want to consider the anesthesia that requires the least amount of time for the entire anesthesia process. Conversely, if total time or recovery time is less of a concern, researchers may choose to use the anesthesia that produces the shortest induction period, which was Orajel® in all tested species. Investigators choosing anesthesia may also consider the procedures they are conducting such as visual implant elastomer injections or implantation of radio transmitters, because a long anesthetization period may be required. For these longer procedures, Orajel® appears to be a better option for many species (Fig. 1).

Various other factors also may affect a researcher's choice of anesthesia. Although MS-222 must be purchased from a chemical supply company (Brown et al. 2004), Orajel® is a common oral analgesic, can be found at most convenience stores, and is slightly less expensive per dose than MS-222 (Orajel®: CVS Pharmacy in Davidson, NC, US $0.65/dose; MS-222: Sigma Aldrich US $0.87/dose). We also observed that, similar to Crook and Whiteman (2006), Orajel® anesthesia baths anesthetized more individuals than MS-222 baths. Furthermore, although there are no known negative side effects of low doses of Orajel® on amphibians, MS-222 may decrease natural cutaneous gram-negative bacterial growth (Fedewa and Lindell 2005).

Based on our study, researchers should prioritize their needs while choosing anesthesia for amphibians. Orajel® appears to be a relatively safe, quick, and convenient anesthesia, but MS-222 may be a better choice when the study organism requires less time for the entire anesthesia process, or the study organism's mortality risk due to anesthesia is high and/or the study species is of special conservation concern.

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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). Authors without the ability to send manuscripts electronically may supply hard copy instead. 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: **Marc P. Hayes** (amphisbaenids, crocodilians, lizards, and *Sphenodon*; mhayesrana@aol.com); **Charles W. Painter** (amphibians; charles.painter@state.nm.us); **Andrew T. Holycross** (snakes; holycross@asu.edu); and **James Harding** (turtles; hardingj@pilot.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 [2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. Herpetol. Circ. 29:1–82; available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>]; for Mexico as it appears in Liner [1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish*, Herpetol. Circ. 23:1–113]), 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).

Recommended citation for notes appearing in this section is: Lemos-Espinal, J., and R. E. Ballinger. 1994. *Rhyacosiredon leorae*. Size. Herpetol. Rev. 25:22.

CAUDATA

AMBYSTOMA TALPOIDEUM (Mole Salamander). **PREDATION**. On 15 May 2005, I observed a Nine-banded Armadillo (*Dasypus novemcinctus*) foraging along a drift fence at Ellenton Bay, a Carolina bay on the Savannah River Site in Aiken County, South Carolina, USA. It was a wet night with light rain falling, and many metamorphic Mole Salamanders were moving from the wetland toward surrounding terrestrial habitat. They were slowed and concentrated spatially by the drift fence of buried aluminum flashing, increasing their vulnerability to predators. The armadillo moved slowly along the fence, devouring salamanders repeatedly. On several occasions, it did not take the tail and I verified that the prey were Mole Salamanders by collecting these tails. Although I observed many salamanders captured in bucket traps along the fence during the night, they had all disappeared by morning; only parts of carcasses remained strewed around the traps. Because escape from these buckets was highly unlikely, armadillos probably ate most of these salamanders. Later in the migration season, I observed several individual armadillos foraging simultaneously at the same site. These observations indicate that nine-banded armadillos can be formidable predators of ambystomatid salamanders, perhaps severely affecting their populations when indirectly offered easy foraging opportunities by standard sampling techniques for amphibians.

To my knowledge, this is the first report of Nine-banded Armadillos preying on Mole Salamanders. Several studies have reported that armadillos feed on various salamander species (Breece and Dusi 1985. *In* Montgomery [ed.], The Evolution and Ecology of Armadillos, Sloths, and Vermilinguas, pp. 419–427. Smithsonian Inst. Press, Washington, D.C.; Fitch et al. 1952. J. Mammal. 33:21–37; Kalmbach 1943. The Armadillo: Its Relation to Agriculture and Game. Texas Game, Fish and Oyster Comm. Bull.) but none reported Mole Salamanders specifically. Each of these reports concluded that amphibians are a very small portion of the total diet of armadillos (less than 2% by volume) and that a majority are taken during the cooler parts of the year when most salamander species migrate. However, the evidence reported here suggests that as nine-banded armadillos continue to expand their geographic range they may increasingly affect ambystomatid populations in new regions of the southeastern United States, especially when inadvertently aided by drift fences at research sites. Although researchers probably trap and remove most bothersome predators during sampling periods, potential for abnormally high predation remains if drift fences are left partially erect when inactive.

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PLETHODON ALBAGULA (Western Slimy Salamander). **BROODING DEFENSE BEHAVIOR AND OOPHAGY.** Salamanders of the genus *Plethodon* are known to brood egg clutches (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington D.C. 587 pp.; Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. Arkansas Press, Fayetteville. 421 pp.). Aggressive defense behavior while brooding has been documented in *P. cinereus* (Redback Salamander) numerous times (Bachmann 1984. Herpetologica 40:436–443; Highton and Savage 1961. Copeia 1961:95–98). Although defensive brooding behavior has been documented in other plethodontids (see Bachmann 1984, *op. cit.*, for citations), it has not been reported in *P. albagula*. Herein, we report four instances of brooding defense behavior by *P. albagula* and document oophagy in this species.

Spillway Mine (Garland Co. Arkansas, USA) is a sanctuary for brooding female *Plethodon albagula*. This 149-m linear abandoned mineshaft, located in the Ouachita National Forest in south-central Arkansas, is utilized by a number of *P. albagula* females each late summer and fall (August–December). Trauth et al. (*in press*, Herpetol. Nat. Hist.) reported on brooding postures and nest site fidelity of the females using this mineshaft. Several lone females, not attending an egg clutch, have been observed to freely roam the mine during the brooding season and could potentially be marauding egg clutches.

On 4 Oct 1984, a female *P. albagula* brooding a clutch of 19 eggs (76 m from mine entrance) was attacked by a lone adult female. Upon attack, the attacker approached the clutch from an unguarded side and violently pulled a single egg from the clutch. The attacking female retreated while the brooding female repeatedly bit the side and tail of the attacker after chasing it into a crevice. The bites were made as the intruder made one bite and released quickly. Afterwards, the brooding female returned and wrapped herself around her clutch. The second instance occurred on 13 Sept 2002, as a lone female attempted to inspect an egg clutch (99 m from mine entrance) attended by a brooding female. As the lone female traveled in front of the brooding female, she was inflicted with a series of bites to the tail until the lone female quickly retreated and settled 0.2 m from the attack site. The final instances occurred 23 Oct and 18 Nov 2004. On 23 Oct, a brooding female (55 m from mine entrance) attacked a pair of calipers and, subsequently, the researcher's finger as egg diameter measurements were being taken. The female proceeded to inflict three separate bites on the calipers until the researcher retreated. The second instance from the same female occurred on 18 Nov where the female inflicted one bite to the researcher's hand. These occurrences suggest brooding defense behavior is common in the wild for *P. albagula*.

On 5 Nov 1999, a female *P. albagula* was collected from Spillway Mine. Upon necropsy, the female contained three eggs in her digestive tract. During Fall 1999, 31 females were brooding clutches in the abandoned mine shaft and, through photo identification, this female was not determined to be a female with a clutch. Thus, to our knowledge this is the first documented instance of oophagy in *P. albagula*.

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PLETHODON GLUTINOSUS (Slimy Salamander). **BURROWING BEHAVIOR.** Slimy Salamanders get their name from the sticky substance excreted from their skin when grabbed or roughly handled (Petranka 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 587 pp.). It is also known that these salamanders frequently inhabit abandoned burrows made by other organisms and shelter underneath rocks and logs. On 17 Sept 2005 in West Davenport, New York (USA) I attempted to capture and measure an adult *P. glutinosus* as it went into a burrow. Upon excavation of the burrow, it was observed that the burrow was L-shaped, shallow (ca. 10 cm deep), non-continuous, and had just enough room to fit the salamander. A thick, cloudy, white, glue-like substance was found completely coating the walls of the burrow. This substance was strong enough to adhere clumps of dirt to my hand making further pursuit of the salamander difficult. Due to the thickness of the substance it was improbable that it was put there during the short period of attempted capture. During the excavation process, the adult *P. glutinosus* remained in the burrow.

This is the first report of *P. glutinosus* layering the walls of a burrow with slime. The slimed walls could be a means of prey capture or be used as an insulating mechanism during times of hibernation.

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TRITURUS MARMORATUS (Marbled Newt). **LIMB ABNORMALITIES.** Herein we report a high occurrence of limb abnormalities in a population of *Triturus marmoratus*. Data were gathered during 2000–2003 and 2005, while we were investigating the orientation behavior of this species (Diego-Rasilla and Luengo 2002. J. Ethol. 20:137–141; Diego-Rasilla and Luengo 2004. Behav. Ecol. Sociobiol. 55:556–560).

A temporal pond 270 m^2 situated in Valdeajos (Burgos, northern Spain; 42º44' 32 N, 3º54'41"W; 1040 m elev.) was monitored for Marbled Newts during the spring. This eutrophic pond, constructed for cattle use and surrounded by an agricultural landscape, is characterized by high levels of nutrient runoff from agricultural lands and heavy livestock use.

Of the 33 adult newts collected in 2000, one adult male and one adult female had visible abnormalities (6.1 % abnormal). The female newt had seven digits (polydactilia), which were poorly separated and short, indicating missing phalanges (brachydactyly) in its right hind limb. The male had the normal number of metatarsal bones in its right hind limb, but the number of phalanges was reduced (brachydactyly) (see Diego-Rasilla 2000. Bol. Asoc. Herpetol. Esp. 11[2]:88–89).

Fifteen newts were examined in 2001, and one adult male and one adult female appeared abnormal (13.3% abnormal). On the left hind limb of the male, digit IV had a duplicated phalanx (polyphalangy). In the adult female the left hind limb adopted a palette shape, only three digits were present (ectrodactyly), and they were all short (brachydactyly).

Of 27 adults collected 23 March 2002, one adult female had visible abnormalities (3.7% abnormal). Digit II of its right fore limb had a duplicated last phalanx (polyphalangy), and it was albino (Diego-Rasilla et al., submitted).

Twenty-three adult newts were captured on 11 April 2003. In this survey we collected the albino female again which was the only individual having visible abnormalities (4.3% abnormal).

We searched the pond again on 1 May 2005 and collected 18 adult newts. Three were identified as having abnormalities (16.7% abnormal), one of them being the albino female described above. The other two specimens, male and female, had abnormalities in three of their limbs. The adult female had four digits (i.e., four metatarsal bones) in its left fore limb, but the number of phalanges was reduced (brachydactyly); the right fore limb was very short, showing an absence of the proximal portion of the limb, with the foot attached very close to the body and proximal bones that could not be identified (phocomelia). This is phocomelia and not ectromelia because a foot is present, although the foot is abnormal with only three metatarsal bones (ectrodactyly) associated with a reduced number of phalanges (brachydactyly). The female also showed reduced right hind limb elements (brachydactyly), and digit III was rotated about 90º to the left. The male newt showed reduced right and left fore limb elements (brachydactyly); also digit III in its right fore limb was rotated about 90º to the left and showed reduced right hind limb elements (brachydactyly).

These rates of visual abnormalities exceeded the baseline abnormality percentage of 0–2% predicted in amphibian populations (Ouellet 2000. *In* Sparling et al. [eds.], Ecotoxicology of Amphibians and Reptiles, pp. 617–646. Soc. Environ. Toxicol. Chem.). It has been suggested that the composition of landscapes surrounding wetlands affects rates of limb malformation. Particularly, proximity to human associated land uses including agriculture, as is the case in our Marbled Newt population, is associated with an increased risk (Ouellet et al. 1997. J. Wildl. Dis. 33:95–104).

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TRITURUS MARMORATUS (Marbled Newt). **ALBINISM**. On 23 March 2002 we collected an albino adult female *Triturus marmoratus* (129 mm TL; 57 mm tail length; 12.2 g) from a temporary pond situated in Valdeajos (Burgos, northern Spain; 42º44'32"N, 3º54'41"W) at an elevation of 1040 m. The albino adult female also exhibited polyphalangy in its right forelimb. After being examined, the belly and dorsal patterns were photographed for identification and the individual was returned to its breeding pond.

The albino female was golden in appearance, whereas all other *T. marmoratus* captured at the pond showed the characteristic color pattern of this species (Barbadillo et al. 1999. Anfibios y Reptiles de la Península Ibérica, Baleares y Canarias. 419 pp.). This albino female had black eyes and a speckled body pattern, however due to the deficiency of melanophores, there were no greenish or black colors. The dorsal surface had a golden base color with dark spots showing poorly defined edges. Dorsally, the individual showed a golden, poorly defined, dorsal stripe. Golden shades were clearest on the limbs and on the ventral surface of the abdomen, thorax, and head because dark spots scarcely appeared on these surfaces. The ventral surface of the abdomen showed a thinner epidermis, and it was possible to see the intestines through the skin.

In a subsequent survey at the same pond on 11 April 2003, we collected the albino female for a second time (132 mm TL; 60 mm tail; 10.9 g). We searched the same pond again on 1 May 2005 and collected the albino female again (137 mm TL; 64 mm tail; 8.1 g). It seems that selective pressures against albinism in wild *T. marmoratus* may not be strong since this individual survived as an adult animal. Also, it successfully returned in successive years to the same pond, showing strong site fidelity for its breeding pond.

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ANURA

ASCAPHUS TRUEI (Tailed Frog). **NEST SITE**. Few nest sites of *A. truei* have been reported and the timing of oviposition is relatively unknown. Here I report the first *A. truei* nest site from Mendocino County, California (USA) and also the first site detected within a seep. Karraker and Beyersdorf (1997. Northwest. Nat. 78:110–111) reported the only previously documented site in California on 16 August 1994.

On 3 August 2005, I found an *A. truei* nest site ca. 9 km S of Elk, Mendocino Co., California in the Elk Creek drainage. Twenty-five eggs were attached to the underside of a large cobble (126 × 118 mm) in a seep (0.3 m wide), ca. 6 km inland from the Pacific Ocean. The eggs were in a continuous string and each egg was ca. 6 mm in diameter. The site occurred on private forest land in a west-facing seep with 75% gradient. Overstory vegetation was primarily 40-year old Coast Redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*), with 89% canopy closure (measured with a densiometer). The nest site was located 1 m above the seep's confluence with a 3rd order fish-bearing stream.

On 18 August, five tadpoles were observed in the seep and there were no unhatched eggs remaining. The five tadpoles measured 15–17 mm TL and had moved as far as 15 cm downstream from the nest site towards the fish-bearing stream. The tadpoles had functioning oral discs and characteristic white tail flags. No predators were observed within the seep, and it appeared as if many tadpoles had moved into the fish-bearing stream prior to the second visit.

Although I do not know if predation of eggs occurred prior to my discovery, the clutch size (N = 25) is consistent with other clutches reported for coastal *A. truei* (Adams 1993. Northwest. Nat. 74:15–18; Karraker and Beyersdorf, *op. cit*.; Noble and Putnam 1931. Copeia 1931:97–101) and further supports the hypothesis that coastal populations have smaller clutch sizes than inland populations.

I thank David W. Ulrich and Christopher A. Morris for their assistance in concluding this work.

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GASTROPHRYNE ELEGANS (Elegant Narrow-mouthed Toad). **ABUNDANCE.** *Gastrophryne elegans* is found in Belize, Guatemala, Mexico, and Honduras and is characterized as a species of least concern by the IUCN Global Amphibian Assessment (http://www.globalamphibians.org; accessed 21 July 2005). Nonetheless, *G. elegans* is known from only a few localities in Belize (Meyer and Foster 1996. A Guide to the Frogs and Toads of Belize. Krieger Publ. Co., Malabar, Florida. 80 pp.). McCranie and Wilson (2002. The Amphibians of Honduras. SSAR Contrib. Herpetol. 19, 625 pp.) reported only two localities in Honduras, and Lee (1996. The Amphibians and Reptiles of the Yucatán Peninsula. Cornell Univ. Press, Ithaca, New York. 500 pp.) described it as uncommon. During a 20-month study in the Bladen Nature Reserve (16°33.124'N, 88°42.974'W), southern Belize, I observed *G. elegans* on several occasions. Here I present observations of unusually high abundance during April 2000, the driest month of the study.

From 24–28 April 2000, I observed many individuals of *G. elegans* during diurnal and nocturnal visual encounter surveys along an unpaved road in tropical evergreen forest. The road was recently graded and large clumps of soil were exposed on the surface. On 28 April 2000, during a 10-min. visual encounter survey that began at 1918 h, I observed 10 adults active on the road surface. The substrate was damp, but there was no standing water. On the same night at another location on the road, I observed 17 *G. elegans* over a period of 10 min. starting at 2005 h. The soil at this site was dry, and there was no standing water. Such abundance was not observed in forested sites distant from the road during April 2000 or during any other survey during the study period. These observations of aboveground activity are unusual because April 2000 was the driest month of my 20-month study, with only 9.6 mm of precipitation. This small quantity of rain fell during the first half of the month and therefore could not be a factor influencing these observations. Because *G. elegans* is fossorial, I suspect that the frogs were unearthed by the recent roadwork and were unable to obtain cover in the extremely dry and hard soil. These observations suggest that although infrequently encountered, *G. elegans* may exist at locally high densities.

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PHYLLOMEDUSA ROHDEI (Mertens' Leaf Frog). **DIET**. *Phyllomedusa rohdei* is endemic to the Atlantic Rainforest of southeastern Brazil. No information exists on food habits of this species. Herein we provide data on the stomach contents of 20 individuals (17 males and 3 females) of *P. rohdei* collected by one of us (RLT) on 20 January 2003, between 2000 and 2300 h, in the municipality of Nova Venécia (18°42'S, 40°30'W), Espírito Santo State, southeastern Brazil. Males ranged from 33.1 to 41.9 mm SVL (mean 37.2 ± 2.5 mm), and females from 42.1 to 45.0 mm SVL (mean 43.7 ± 1.5 mm). The diet was comprised of various arthropods, without a marked dominance of a single prey type, though stoneflies (Plecoptera) were the most important items overall. This is somewhat unexpected, as stoneflies have not been reported in the diets of other *Phyllomedusa* (Duellman 1978. Univ. Kansas Mus. Nat. Hist., Misc. Publ. 65:1–352; Duré 1999. Herpetol. Rev. 30:92; Santos et al. 2004. Iheringia, Sér. Zool. 94:433–438; Vaz-Silva et al. 2004. Herpetol. Rev. 35:160). Data

TABLE 1. Prey in the stomach contents of *Phyllomedusa rohdei* (N = 20) from Nova Venécia, Espírito Santo, southeastern Brazil. F = frequency of occurrence; N = number of individual prey items; M = prey wet mass (in mg).

Prey	F	N	%N	M	%M
INSECTA					
Coleoptera	2	2	6.9	12.3	5
Diptera	4	7	24.1	4.5	1.8
Homoptera	1	1	3.5	1.7	0.7
Lepidoptera (larvae)	4	4	13.8	36.8	15
Odonata	3	3	10.3	45.8	18.7
Orthoptera	1	1	3.5	7.3	3
Plecoptera	7	9	31	102.4	41.7
ARACHNIDA					
Araneae	2	2	6.9	13.4	5.5
MISCELLANEOUS					
Shed skin	2	—	—	21.3	8.7
TOTAL	-	29	100	245.5	100

from these studies, as well as that presented here, suggests an opportunistic diet consisting of a wide variety of arthropods, with frequent consumption of relatively large, soft-bodied prey such as orthopterans, spiders, cockroaches, and larvae. This report reinforces the notion that *Phyllomedusa* tend to be opportunistic predators. The presence of stoneflies and dragonflies (Odonata) in the diet suggests that *P. rohdei* in this population may frequently forage at the margins of water bodies.

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***PHRYNOHYAS* SPP.** (Golden-eyed Treefrogs). **PREDATION**. The genus *Phrynohyas* includes seven species distributed across the lowlands of Mexico, Central and South America east of the Andes, south to northern Argentina (Frost 2004. Amphibian Species of the World: an Online Reference. http://research.amnh.org/herpetology/amphibia/index.html; August 2005). These species are known to produce a secretion that can be irritating to skin and mucous membranes (Rodríguez and Duellman 1994. Univ. Kansas Nat. Hist. Mus. Special Publ. 22:1–80). Herein we report predation on two species of *Phrynohyas* (*P. mesophaea* and *P. venulosa*) by the snakes *Liophis* and *Leptophis*.

A *Liophis miliaris* (female; 65 cm TL) was collected during 1994 in Matinhos Municipality, Paraná State, Brazil (25°45'S, 48°30'W, Atlantic Forest, Restinga habitat). Stomach analysis revealed a partially digested *P. mesophaea,* swallowed headfirst. Stomach analysis of a *Liophis poecilogyrus* (female; 57.7 cm TL) collected during 1998 in Jussara Municipality (23°37'7"S, 52°28'10"W, Araucaria Forest) revealed a partially digested *P. venulosa*. On 17 March 2004 in Céu Azul Municipality (25°20'S, 53°46'W, Semi-deciduous Seasonal Forest) a VHS video recorded 1.5 m TL *Leptophis ahaetulla* resting on the roots of a tree at a river edge. As the collector approached, the snake exhibited the typical open-mouth threat display (Achaval and Olmos 2003. Graphis Press, Montevideo. 136 pp.) and then regurgitated a *P. venulosa* female covered in a thick mucous. *Liophis miliaris, L. poecilogyrus*, and *Leptophis ahaetulla* are known to include anurans in their diet (Michaud and Dixon 1989. Herpetol. Rev. 20:39–41; Pardo 2003. Herpetol. Rev. 34:231–232; Teixeira and Porto 1991. Herpetol. Rev. 22:132).

Voucher specimens, with prey items, were deposited in the Herpetological Collection of the Museu de História Natural Capão da Imbuia, Curitiba, Paraná, Brazil (MHNCI 8266, *Liophis poecilogyrus*; MHNCI 9732, *Liophis miliaris*). Video images of the *Leptophis ahaetulla* are also available in the herpetological laboratory at the same institution. We thank Reginaldo A. Machado for specimen identification, Paulo S. Bernarde for the revision of the text, and Beto Sporkens for the VHS image. We also thank Fernando C. Straube for the contribution of his field notes.

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RANA BOYLII (Foothill Yellow-legged Frog). **REPRODUCTION**. Recent work on explosive-breeding anurans has provided increasing evidence of male competition (e.g., *Agalychnis callidryas*, D'Orgeix and Turner 1995. Mol. Ecol. 4:505–508; *Rana dalmatina*, Lodé and Lesbarrères 2004. Naturwissenschaften 91:44–47; *Rana temporaria*, Vieites et al. 2004. Nature 431:305–308). However, evidence for male competition is sparse among North American ranid frogs, even for western species that exhibit explosive breeding, including *Rana boylii*. Hence, we provide observations from western Oregon (USA) indicating male competition in *R. boylii*.

These observations were made on 22 June 2004, during the oviposition period of the northernmost extant population of *R. boylii*. Elsewhere (Rombough and Hayes 2005. Herpetol. Rev. 36:163–164), we detail the location (on the South Santiam River) and provide a site description. Oviposition takes place exclusively in a few off-channel pools and troughs with reduced flow velocities that reduce the likelihood of egg scour (Rombough 2002. Status of the Foothill Yellow-legged Frog [*Rana boylii*] in the South Santiam River, Linn County, Oregon. Report to the Oregon Department of Fish and Wildlife. 42 pp.; but also see Kupferberg 1996. Ecol. Appl. 6:1332–1344; Lind et al. 1996. Herpetol. Rev. 27:62–67). Frogs discussed herein were captured for measurement after oviposition and after interactions between frogs were completed.

Between 1010 and 1045 h, CJR observed an amplectic pair (male: 51.5 mm SVL, 11.5 g; female: 59.0 mm SVL, 15.7 g) during their entire oviposition sequence, also described elsewhere (Rombough and Hayes 2005. Northwest. Nat. 87:157–160). During the oviposition process (including substrate preparation and egg deposition), at least seven other male frogs took up positions within 150 cm. Typically, males sat emergent in shallow water (< 2 cm) or on the bottom, near some sort of substrate irregularity (e.g., a cobble or bedrock ledge) in deeper water (> 10 cm). One of these males (No. 1; 56.5 mm SVL, 13.2 g) remained within 5–11 cm of the pair the entire time. This male never touched the pair nor got closer than 5 cm, even during egg deposition. He often hid under cobbles or sat underwater nearby, always facing the amplectic pair. As soon as the female had finished laying, No. 1 shot forward and rammed the left side of the pair, hitting mostly the male. Immediately after he contacted the pair, No. 1 gave a frog kick that caused the pair to swivel away from the mass. Then, holding the pair with his front limbs, he lowered his vent to the egg mass and held it there for ca. 60 sec. The pair then moved and started to swim, and No. 1 grappled at the male in the pair, but was shaken off, and the pair swam away. When the pair were just over 20 cm from the egg mass, they broke apart and each swam off in different directions. After the pair separated, the formerly paired male grabbed No. 1 and began amplexing him, even though he struggled to escape. At this point, all three frogs were captured and measured. Over the period of observation, the paired frogs initially traveled ca. 2 m.

A second amplectic pair (male 53 mm SVL, 12.8 g; female 74.4 mm SVL, 35.5 g), observed entering the oviposition area at 1055 h, just after capture and release of the frogs described above, was also followed closely by two additional male frogs (No. 2: 54.0 mm SVL, 11.0 g; No. 3: 67.5 mm SVL, 20.0 g). These males behaved in a manner similar to No. 1, but approached much more closely and frequently made contact with the pair. On at least 10 occasions, they grappled at the paired male or the hind leg of the female. Usually, the female would forcefully kick the intruder(s) away, but occasionally both amplectic partners or rarely, only the male, would do the kicking. The unpaired males also continuously rushed, grabbed, and amplexed one another. Rushes would be made from a near touching position to distances > 45 cm away, with smaller males grabbing larger males and vice versa. Often, release following an amplectic grab would be immediate, without a sound. However, for at least one third of (> 30) such grabs, one male amplexed a second male for between 30 sec and 2 min, even while the other forcefully tried to escape, swimming a meter or more and flipping upside down (often with the frogs' bright yellow-and-white undersurfaces visible for at least 30 sec). These entire sequences occurred without any apparent vocalization. On at least three occasions, one male even grabbed another male facing backwards (i.e., the frogs were facing opposite directions). Although individual males would swim to the surface regularly (more frequently than the male/female pair) to gulp air (and then swim quickly back to the bottom to hide), pairs of males were also observed to surface together to gulp air on multiple occasions. This behavior continued for 3 hours, until the frogs were captured and measured.

Non-vocal competition for females is known for a number of anuran species, and is most common among explosive breeders (Wells 1977a. *In* Taylor and Guttman [eds.], The Reproductive Biology of Amphibians, pp. 233–262. New York, Plenum Press; Wells 1977b. Anim. Behav. 25:666–693). Over five years of study, the *R. boylii* at this location have completed most of their breeding activity within a week. At breeding sites, males outnumber females by an average of 7 to 1, and observations of breeding frogs indicate that females are amplexed by the first male they approach (CJR, unpubl. data). Because frogs in male-only aggregations often grab one another, tactile identification (rather than auditory or visual identification) of a suitable partner appears to be an important cue for stimulating amplexus (Noble and Aronson 1942. Bull. Am. Mus. Nat. Hist. 80:127–142; Wells 1977b, *op. cit.*).

While physical displacement of a competing male is obvious, male competition may not involve much, if any direct contact. In particular, the behavior performed by male No. 1 (holding his vent over freshly laid eggs) strongly resembles the "clutch piracy" behavior of *R. temporaria*, in which pirate males fertilize the eggs of another frog pair, either during or after laying (Vieites et al., *op. cit.*). Confirmation of this hypothesis requires genetic data, but our observations imply that such competitive behavior may be more widespread among ranid frogs than previously thought.

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RANA CATESBEIANA (American Bullfrog). **MORTALITY**. On 25 Aug 2005, I found a recently deceased adult male Bullfrog (snout–urostyle length ca. 16.5 cm) with the posterior half of an 11.5 cm TL Brown Bullhead (*Ameirus nebulosus*) protruding from its mouth. I made this observation along the edge of a drying pool in a blackwater creek swamp on Fort Stewart Military Installation, Long Co., Georgia, USA. The 4 × 6 m turbid and fetid pool was littered with the carcasses of dozens of Brown Bullheads and centrarchids that had recently died, likely due to anoxic conditions. A few live fish occasionally surfaced to gulp air. As seen in Fig. 1, the frog evidently choked on the fish while attempting to swallow it. Whether the dorsal or pectoral spines of the fish prevented the frog from swallowing the fish or whether the frog choked solely because of the large size of the prey is unknown. To my knowledge this is the first observation of a Bullfrog choking while attempting to prey on a bullhead.

I thank John G. Palis for reviewing this note.

FIG. 1. Adult American Bullfrog (*Rana catesbeiana*) that died while attempting to eat a Brown Bullhead (*Ameirus nebulosus*).

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TESTUDINES

PHRYNOPS HILARII (Hilaire's Side-necked Turtle). **FEEDING BEHAVIOR**. *Phrynops hilarii* posseses a prominent pair of barbels in the gular region that function as mechanoreceptors and are used during mating behavior (Bager 1997. M.S. Thesis. Universidade Federal do Rio Grande do Sul. Rio Grande do Sul.

Brazil. 110 pp.; Winokur 2005. J. Morphol. 172:59–74; Legler 1993. *In* Glasby et al. [eds.], Fauna of Australia, vol. 2, pp. 108–119. Canberra). The barbels are beige in color, matching the turtle's gular coloration, but have a conspicuous black ring at the base. Here we present a description of the species' use of the barbels in feeding, specifically in attracting and capturing fishes.

Captive-hatched *Phrynops hilarii* hatchlings (mean carapace length = 42.4 ± 3.25 mm; N = 111) were kept in a 500-L aquarium (30–40 turtles per tank) with a water depth of 50 cm, a small dry area, and a quantity of floating aquatic macrophytes. Hatchlings were fed live fish and pieces of beef. Thirty juvenile lambari (*Astyanax* sp.), a characid fish, with a mean length of 3.1 ± 0.5 cm, were placed in the tank weekly.

The *P. hilarii* hatchlings were observed using a unique feeding strategy whereby they aligned themselves with submerged *Pistia stratiotes* roots or stalks or on the terrarium substrate itself by extending their anterior limbs forward and hind limbs backward. Their necks remained fully extended, which is contrary to the strategy used by "fishing" *Chelus fimbriatus*, which keep the neck partially contracted (Pritchard 1984. Symp. Zool. Soc. London 52:87–110; Lemell et al. 2002. J. Exp. Biol. 205:1495–1506). The head is jerked in short and quick movements, which causes the barbels to move. It was observed that the black circle at the barbel's base gives an impression of discontinuity between the turtle's gular region and the barbel, hence it may resemble a small invertebrate to a passing fish. Juvenile fish that approach a *Phrynops hilarii* hatchling's head and try to bite at the barbels are often captured, though the efficiency of this strategy was not quantified.

The fish were not quickly swallowed, probably due to their comparatively large size. A hatchling *P. hilarii* that captured a fish was soon approached by other hatchlings, starting a competition for the resource involving agonistic behavior. Such behavior included bites to the anterior and posterior limbs.

The monitored hatchlings did not have any contact with juvenile or adult exemplars, making it unlikely that the observed feeding behaviors were learned. Systematic observations in a natural environment have not been made, but on several occasions we observed the same postures in juvenile and adult specimens submerged in rivers and wetlands, though a complete behavioral sequence with prey ingestion has not yet been noted.

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RHINOCLEMMYS FUNEREA (Black Wood Turtle). **REPRODUCTION**. The reproductive biology of *R. funerea* is inadequately known. Courtship and mating behavior, and egg-laying have been described by Iverson (1975. J. Herpetol. 9:249–250) and Merchán and Mora (2000. Reptilia 26:31–38). Nevertheless, the reproductive season, clutch size, and egg and hatchling size are poorly known. This note provides additional data on reproduction in Costa Rica.

Between November 1999 and December 2001 we found nine egg clutches of *R. funerea* in the Reserva Zoo Ave (Alajuela Province, Costa Rica). Mean clutch size was 4.3 eggs (range 1–7, SD = 1.94). Egg laying occurred between May and October, with a peak in May (44.4% of the sample). The incubation period ranged from 81 to 106 days (mean 92.3) at a temperature of 28ºC. Twenty-five of 40 eggs produced hatchlings. Data for 40 eggs are as follows. Mean mass = 49.6 g (range 37.3–60.0 g, SD = 6.0); mean length = 64.2 mm (range 55.3–76.1 mm, SD = 5.5); mean width = 34.9 mm (32.0–38.1 mm, SD = 1.3). Hatchling measurements are shown in Table 1.

Table 1. Data on 25 hatchlings of *Rhinoclemmys funerea*. Weight in grams, rest of measures in millimeters. St. Dev: Standard Deviation. SCL: Straight Carapace Length. SCW: Straight Carapace Width. SPL: Straight Plastron Length. SPW: Straight Plastron Width.

	N	Mean	Minimum	Maximum	St. Dev.
Weight	25	32.4	24.9	38.5	4.12
SCL	15	56.5	50.8	65.0	3.75
SCW	15	48.0	43.6	54.7	3.17
SPL	15	50.3	44.7	58.5	4.00
SPW	15	39.7	35.4	44.9	2.65

We thank Zoo Ave Reserve for permission to study the *R. funerea*. The Spanish International Cooperation Agency (AECI-Foreign Office, Spain) provided financial support to Manuel Merchán in Costa Rica.

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CROCODYLIA

CROCODYLUS ACUTUS (American Crocodile). **MIGRATION**. American Crocodiles require an elevated, well-drained substrate for nesting (Mazzotti 1989. Bull. Mar. Sci. 44:220–228). In Florida, human-made nesting areas along canal banks (berms) at Crocodile Lake National Wildlife Refuge, East Cape Canal in Everglades National Park (ENP), and the cooling canal system at Turkey Point Power Plant provide near ideal nesting conditions, with year-round habitat adjacent or in close proximity to nesting sites. In contrast, nesting areas and nursery habitat in Florida Bay within ENP are often separated by kilometers, necessitating migrations by females to nest sites (Kushlan and Mazzotti 1989. J. Herpetol. 23:1–7). Mazzotti (1983. The Ecology of *Crocodylus acutus* in Florida. PhD dissertation, The Pennsylvania State University, University Park, Pennsylvania. 161 pp.) reported seasonal movements of 5–15 km from year-round habitat to nesting beaches. *Crocodylus acutus* at other locations across its range have been suspected to exhibit this behavior as well; however, to date no such reports have been published. Here we report the longest distance recorded yet for migration of one female *C. acutus* to a nest site.

During the 2003 nesting season, a crocodile nest was reported on Lower Matecumbe Key (24°52'30.4"N, 80°41'54.8"W, datum: WGS84; elev. 0.5 m) in the yard of a private estate. On 22 September 2003, the nesting female crocodile (272 cm total length, 70 kg) was captured along with nine hatchlings in a pond adjacent the nest. All individuals were measured, weighed and given a unique scute mark as described by Mazzotti (1983, *op. cit.*). On 18 November 2004, during a spotlight survey in the Flamingo district of ENP, the female was recaptured (283 total length, 72 kg) in a creek between Henry Lake and Monroe Lake (25°11'23.2"N, 80°45'11.5"W, datum: WGS84; elev. 0.5 m), a straight-line distance from the nest site of over 35.5 km. The female likely traveled though several creeks and along a chain of islands in ENP, possibly passing areas with suitable nesting habitat before reaching her chosen nest site at Lower Matecumbe Key. We were able to identify this female at active nest sites on Lower Matecumbe Key in 2004 (nest failed) and 2005 (nest produced 20 hatchlings). Reuse of nest sites by individual females has been surmised (Thorbjarnarson 1988. Bull. Florida State Mus., Biol. Sci. 33:1–86) but is difficult to document. Mazzotti (1983, *op. cit.*) reports the only data concerning reuse of an individual nest over consecutive years for *C. acutus*.

We thank John Craig Eaton, Sally Horsfall Eaton, and Billy Bishop for bringing this nest to our attention, for providing us with access to their property, and for their willingness and appreciation of what it means to live with American Crocodiles in their backyard.

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LACERTILIA

AGAMA AGAMA AFRICANA (African Rainbow Lizard). **REPRODUCTION**. Wilson and Porras (1983. Univ. Kansas Mus. Nat. Hist. Spec. Publ. No. 9:1–89) first reported *Agama agama africana* in Florida. Subsequently, Enge et al. (2004. Florida Sci. 67:303–310) documented five allopatric populations in Broward, Charlotte, Martin, Miami-Dade, and Seminole counties (Florida), and reported gravid females in late May. Herein, we augment reproductive data in Florida for this non-native species.

On 7 April 2006, we collected eight *Agama a. africana* from two nearby sites under SR 17 in Punta Gorda, Charlotte County, Florida: at Lavilla Road (26°56'22.2"N, 82°01'38.2"W, datum: NAD83; elev. < 1 m) and at Florida Street (26°56'20.4"N, 82°01'28.9"W, datum: NAD83; elev. < 1 m). Specimens were collected using live crickets as bait after Krysko (2000. Carib. J. Sci. 36:162) and deposited in the Florida Museum of Natural History (FLMNH), University of Florida collection (UF). All females (N = 5, UF 147111–14, 147116) collected were gravid (i.e., contained shelled oviductal eggs) and ranged in size from 108.0–122.5 mm SVL. Mean clutch size of oviductal eggs was 7.6 ± 0.4 mm SE (range = 7–9), mean length of oviductal eggs was 19.6 ± 0.2 mm (range = 15.1–23.8, N = 38), and mean length of vitellogenic (i.e., yolk-producing) follicles was 5.7 ± 0.2 mm (range = 3.7–7.7, N = 49). Enge et al. (*op. cit.*) mistakenly reported clutch sizes to include both oviductal eggs and vitellogenic follicles. We recalculated their data to include mean clutch size of oviductal eggs as 8.7 ± 0.4 mm SE (range = 5–12, N = 17), mean length of oviductal eggs as 14.1 ± 0.3 mm (range = 8.6–21.2, N = 146), and mean length of vitellogenic follicles as 5.8 ± 0.2 mm (range = 3.8–8.8, N = 39). In Africa, *A. a. africana* oviposits multiple clutches consisting of 3–9 eggs each, with five or six eggs being most common (Daniel 1960. Copeia 1960:94–97; Harris 1964. The Life of the Rainbow Lizard. Hutchinson Tropical Monographs, London, 174 pp.). Our data for female *A. a. africana* from Florida are similar to those in their native range. Enge et al. (*op. cit.*) further suggested that their oviductal eggs found at the end of May were from a second clutch that year. Our larger oviductal eggs found in April support their findings and illustrate that reproduction in *Agama a. africana* occurs in as early as April in Florida, but breeding takes place even earlier. Besides oviductal eggs, we identified at least two size classes of vitellogenic follicles, suggesting the potential for females to oviposit three clutches annually. Although the ecological impacts of *Agama a. africana* on native Florida wildlife is unknown, the fecundity exhibited by this species secures its ecological status as an established non-native species.

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ANOLIS CUVIERI (Puerto Rican Giant Anole). **REPRODUCTIVE ECOLOGY**. Mating systems that include pair-bonding in lizards are rare and only well documented in few long-lived species, mostly scincids (*Eumeces laticeps*, *Niveoscincus microlepidotus*, *Tiliqua rugosa*; Pough et al. 2001. Herpetology, 2nd ed., Prentice Hall, Upper Saddle River, New Jersey. 612 pp.). For example, in the long-lived Australian skink *Tiliqua rugosa* (ca. 30 cm SVL), pair-bonding can reduce energetic costs associated with finding a mate during the breeding season and increase mating success (Bull 1994. *In* Vitt and Pianka [eds.], Lizard Ecology, pp. 159–174. Princeton Univ. Press, Princeton, New Jersey). In this species, energetic costs are reduced by mates by following each other into the same retreat and sleeping sites, thus reducing the time and effort to find mates during the breeding season (Bull, *op. cit.*).

In Puerto Rico, pair-bonding has been suggested for the Puerto Rican Dwarf Anole, *Anolis occultus* (ca. 3.4 cm SVL), based on observations of sleeping pairs in nature (Gorman 1980. Carib. J. Sci. 15:29–31). Unfortunately, the reproductive phenology of *A. occultus* is largely unknown, limiting interpretation of the adaptive significance of this behavior. Here, we document sleeping pair behavior in the Puerto Rican Giant Anole, *Anolis cuvieri*, a large-sized anole (ca. 12.5 cm SVL) that frequently occurs in the forest canopy and sub-canopy (Reagan 1996. *In* Reagan and Waide [eds.], The Food Web of a Tropical Rain Forest, pp. 321–345. The University of Chicago Press, Chicago, Illinois; Rivero 1998. The Amphibians and Reptiles of Puerto Rico, 2nd ed., revised. Editorial de la Universidad de Puerto Rico, San Juan, Puerto Rico. 510 pp.). *Anolis cuvieri* is widely distributed in forests throughout Puerto Rico, especially in the karst (limestone) habitats, but very little is known about its reproductive ecology. We interpret the possible adaptive significance of sleeping pair behavior to the species' reproductive phenology and population dynamics based on monthly samples obtained over a year.

Between 2130 and 2200 h on 20 October 2001, NRL found a sleeping pair of adult *A. cuvieri* (FIG. 1a) at a height of 2.2 m on a small (ca. 1-cm diam. twig) of *Quararibea turbinata*, an evergreen tree that can reach 6 m or more in height (Little and Wadsworth 1989. Common Trees of Puerto Rico and the Virgin Islands. U.S. Forest Service, Department of Agriculture, Washington. Agricultural Handbook No. 249. 556 pp.). This observation was made on a karst hillside in Sabana Seca (18°25'21"N, 66°11'37"W, datum: WGS84; elev. 25 m), Toa Baja, northern coastal Puerto Rico. This site is classified as Subtropical Moist Forest with an average annual rainfall and temperature of 1700 mm and 27°C, respectively (Ewel and Whitmore 1973. The Ecological Life Zones of Puerto Rico and the US Virgin Islands. Institute of Tropical Forestry, Río Piedras, Puerto Rico. Forest Service, US Department of Agriculture. Research Paper ITF 18:1–72). Microclimatic conditions at the height of the lizards were 0 km/h wind speed, 24.8°C air temperature, and 96% relative humidity. On a nearby karst valley (ca. 500 m away from the karst hill), NRL found another adult pair sleeping between 2200 and 2300 h on 27 June 2003 on an unidentified liana (ca. 2 cm diam.) at 3.3 m height (Fig. 1b). About a month later (25 July 2003), NRL observed a sleeping pair at 2100 h in the same orientation on this same liana, presumably the same pair. Between the years 2000 and 2003, ARPR also recorded 15 adult male-female pairs of *Anolis cuvieri* sleeping within centimeters of one another at heights between 2.2 m and 15 m in lianas (e.g., *Cissus trifoliata*) and trees (e.g., *Bursera simaruba*, *Quararibea turbinata*, and *Zanthoxylum martinicense*) while conducting nocturnal visual encounter surveys for the Puerto Rican boa, *Epicrates inornatus,* in several karst forests through the island. This suggests that sleeping pair behavior may be more common in *A. cuvieri* than previously recognized.

FIG. 1. Sleeping pairs of adult *Anolis cuvieri* on a tree branch (A) and on a liana (B). Note sexual dimorphism in the tail crest.

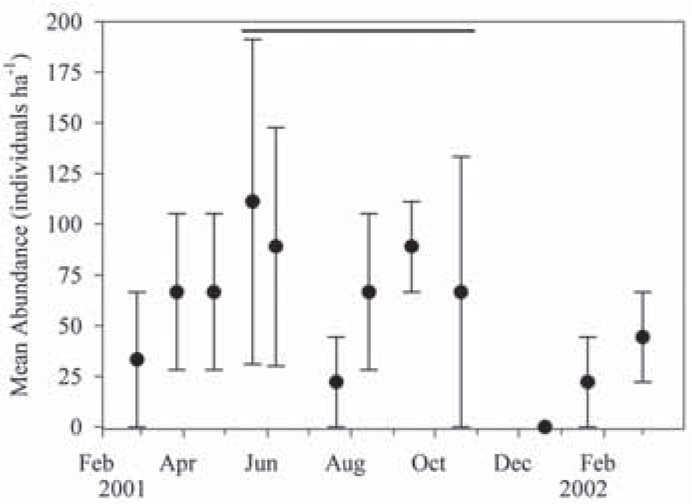

FIG. 2. Mean relative abundance (and standard deviation) of *Anolis cuvieri* from three karst microhabitats in Sabana Seca, Puerto Rico, between February 2001 and March 2002. Horizontal bar on top of graph spans dates when sleeping pairs were observed and the period when recently hatched juveniles were found among microhabitats.

Between February 2001 and March 2002, NRL performed detailed diurnal and nocturnal monthly visual surveys of adult and juvenile *A. cuvieri* along strip plots (50 m long × 3 m wide) in a karst hilltop, hillside, and closed-canopy valley in Sabana Seca, Puerto Rico. Here, both rainfall and temperature are mildly seasonal with most rain occurring May to November, which also represent the warmer months. The mean relative abundance of *Anolis cuvieri* increased to ca. 74 individuals ha^{-1} (range: 0–200 individuals ha^{-1}) during the warmer, wetter months and decreased to ca. 39 individuals ha^{-1} (range: 0–133 individuals ha^{-1}) during the cooler, drier months (December–April; Fig. 2). Recently hatched juveniles were only found during July and October (mean SVL = 4.1 cm, N = 7). Given that eggs of large species like *A. cuvieri* in the tropics may hatch after a ca. 55-day incubation period (R. Andrews, pers. comm.), the period between May and October may represent a distinct breeding season for *A. cuvieri* in Sabana Seca the way it occurs with other sympatric anoles, including native prey species (Reagan, *op. cit.*; Rivero, *op. cit.*).

In Sabana Seca, all *A. cuvieri* sleeping pairs were found only during months in which we found recently hatched juveniles (FIG. 2). Population dynamics and the natural history of the species implies that male and female *Anolis cuvieri* may sleep as pairs as part of a pair-bonding strategy, at least during the warmer, wetter months. The relative large home ranges (275–326 m^2 in males, and 68 m^2 in females: Losos 1990. Carib. J. Sci. 26:65–66; Dial and Roughgarden 1994. Carib. J. Sci. 30:278–279) and the low densities of *A. cuvieri* are consistent with pair-bonding as a strategy to reduce the energetic costs associated with finding mates, and maximize mating success as known in other large-bodied, long-lived lizards with similar demographies (Bull, *op. cit.*).

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ANOLIS NEBULOSUS (Clouded Anole). **DIET.** *Anolis nebulosus* has been shown to vary its foraging sites and feeding rate with seasonal variations in prey abundance (Lister and García Aguayo 1992. J. Anim. Ecol. 61:717–733). However, no reports exist detailing its diet other than the assumption that it eats arthropods. Here we report observations on the stomach contents of 8 *A. nebulosus* collected during 2003 and 2004 from Chínipas, Chihuahua (N = 4; 27°23'39.9"N, 108°32'36.0"W, datum: WGS84; elev. 469 m), Rancho Jovinos, Chihuahua (N = 1; 27°21'3.5"N, 109°30'10.8"W, datum: WGS84; elev. 428 m); and Arroyo Las Borregas, Chihuahua (N = 3; 27°23'4.3"N, 108°32'21.1"W, datum: WGS84; elev. 470 m) (see Lemos-Espinal et al. 2004. Bull Chicago Herpetol. Soc. 39:164–168; Smith et al. 2005. Bull Chicago Herpetol. Soc. 40:45–51). Of the 8 individuals, 7 contained identifiable stomach contents; one individual had an empty stomach. Table 1 lists the diet items. Numerically, termites were the most important prey, but volumetrically grasshoppers were most important. Interestingly, we found plant material in one stomach. Whether the plant material was intentionally consumed is unclear as it was the only item found in that stomach.

TABLE 1. Stomach contents of 7 *Anolis nebulosus* from Chihuahua, México.

Prey Type	Prey Items N =	(%)	Volume cm^3	(%)	Number of Stomachs
Coleoptera					
Adults	2	(11.8)	0.05	(15.6)	2
Larvae	1	(5.9)	0.03	(9.4)	1
Hymenoptera (ants)	2	(11.8)	0.03	(9.4)	2
Isoptera	7	(41.2)	0.01	(3.1)	1
Lepidoptera	1	(5.9)	0.05	(15.6)	1
Orthoptera	3	(17.7)	0.12	(37.5)	2
Plant Material	1	(5.9)	0.03	(9.4)	1

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CALLISAURUS DRACONOIDES (Zebra-tailed Lizard). **DIET; CLUTCH SIZE.** *Callisaurus draconoides* is reported to eat a variety of insects and invertebrates (Hotton 1955. Am. Midl. Nat. 53:88–114; Asplund 1967. Am. Midl. Nat. 77:462–475; Pianka and Parker 1972. Copeia 1972:493–508; Smith et al. 1987. Great Basin Nat. 47:175–185) and rarely vegetation (Pianka and Parker, *op. cit.*). Two previous reports on its diet exist for México; Asplund (*op. cit.*) reported on lizards from Baja California, and Pianka and Parker (*op. cit.*) studied *C. draconoides* diet in Sonora. However, the latter authors pooled results with data from Arizona and California, disallowing distinguishing potential regional differences. Thus, we provide data on *C. draconoides* diet exclusively from Sonora, México.

Our observations are based on the stomach contents of 7 *C. draconoides* collected from 22–24 April and 25–27 July 2004 from three localities in Sonora: Valle de Guaymas (N = 3; 28°17'23.0"N, 119°43'0.8"W, datum: WGS84; elev. 103 m), Punta Chueca at Sierra Seri (N = 3; 28°53'20.6"N, 111°59'37.1"W; elev. 75 m), and near Bahía Kino (N = 1; 28°59'43.2"N, 112°7'43.3"W; elev. 48 m; see Smith et al. 2005. Bull Chicago Herpetol. Soc. 40:45–51). All 7 animals contained identifiable stomach contents comprising several invertebrate taxa and some plant material (Table 1). Beetles, found in 5 stomachs, were numerically most important, but volumetrically wasps were most important. One stomach had a small amount of plant material (leaves); as this individual also contained several (5) other prey, leaf ingestion was likely unintentional. Our observations are similar to previous reports on diet in that insects are dominant. However, both Asplund (*op. cit.*) and Hotton (*op. cit.*) found caterpillars important in *C. draconoides* diet, but we observed none. Otherwise, diet composition is very similar to the pooled Mojave and Sonoran Desert sample of Pianka and Parker

TABLE 1. Stomach contents of 7 *Callisaurus draconoides* from Sonora, México.

Prey Type	Prey Items N =	(%)	Volume mm^3	(%)	Number of Stomachs
Araneae	2	(5.6)	55.5	(3.4)	2
Coleoptera					
Adults	14	(38.9)	276.1	(16.8)	5
Larvae	2	(5.6)	42.4	(2.6)	1
Hymenoptera (wasps)	5	(13.9)	1151.2	(70.1)	3
Hymenoptera (ants)	3	(8.3)	1.6	(0.1)	1
Isoptera	4	(11.1)	13.0	(0.8)	1
Orthoptera	1	(2.8)	3.5	(0.2)	1
Unidentified insect	2	(5.6)	23.8	(1.5)	1
Unidentified larva	1	(2.8)	11.0	(0.7)	1
Plant Material	1	(2.8)	7.9	(0.5)	1
Unknown	1	(2.8)	56.1	(3.4)	1

(*op. cit.*), to the level of including some vegetation.

Two animals were females (67.1 mm and 65.7 mm SVL), each containing five enlarged ovarian follicles. These clutch sizes are similar to the mean clutch size reported for several populations of *C. draconoides* (Pianka and Parker, *op. cit.*; Smith et al., *op. cit.*).

Specimens were deposited in the Herpetological Collections of the Unidad de Biología, Tecnología y Prototípos (UBIPRO) (JLE11956–11957, 12153, 12334, 13130, 13201, 13377). Collection was conducted under a permit issued to JAL by the Dirección General de Vida Silvestre (DGVS) de la Secretaria del Medio Ambiente y Recursos Naturales.

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CNEMIDOPHORUS LONGICAUDUS (NCN). **BODY TEMPERATURE**. *Cnemidophorus longicaudus* is an oviparous lizard inhabiting the hot arid landscape of the Monte Phytogeographic Province in Argentina (Cei 1986. Museo Regionale di Scienze Naturali. Monografie IV. Torino, Italy. 527 pp.). Data on its biology are sparse. Limited study has addressed diet (Belver and Avila 2001. Bol. Soc. Biol. Concepción 72:37–42), time budgets and space use (Videla and Puig 1994. Multequina 3:99–112; Belver and Avila 2001. Bol. Soc. Biol. Concepción 72:31–36; Ontivero 2005. Uso especial y temporal de la estructura de parches de vegetación por *Liolaemus darwinii* [Squamata: Lilaemidae] y *Cnemidophorus longicaudus* [Squamata: Teiidae] en los Medanos grandes, San Juan, Argentina. Tesis de Licenciatura. Universidad Nacional de San Juan. 50 pp.), but information on its thermal ecology is lacking. Hence, we present preliminary data on *Cnemidophorus longicaudus* thermal ecology.

From February 2005 to February 2006, we conducted field work in Médanos Grandes, Departamento Caucete, Provincia de San Juan (38°41'S, 67°48'W, datum: WGS84; elev. 600 m). Located in the Monte Phytogeographic Province, *Bulnesia retama*, *Larrea* sp., and *Prosopis* sp. dominate the flora (Cabrera and Willink 1980. Biogeografía de América Latina. Washington, D.C. 109 pp.). We present data based on 30 individuals observed and 10 captures. To collect these data, we revisited a randomized selection of bushes across the study site. Captures were made by hand, and each individual was measured SVL (to nearest 0.1 mm). Sex was not determined in the field because obvious sexual dimorphism was lacking. For each capture, cloacal (T_c), substrate (T_s) and air (T_a) temperatures were measured (to nearest 0.1ºC) with a rapid-reading Miller-Weber thermometer. We took T_s at the exact point of observation, and T_a 1 cm above the substrate, both immediately following capture. We also recorded microhabitat type for each capture and activity time.

Mean SVL of the 10 captures was 43.6 mm (SD = 9.7, range: 32–58, N = 10). Mean body temperature of the 10 *C. longicaudus* was 36.7°C (SD = 2.2°C, range = 33–41°C). Mean air temperature was 37.7°C (SD = 6.5°C, range = 31.2–48°C). Mean substrate temperature was 39.3°C (SD = 7.3°C, range: 31.4–50°C). Body size appeared unrelated to T_c (Spearman Rank Correlation: r_s = 0.44, *P* = 0.19, N = 10). Cloacal temperature was not correlated with each of T_s and T_a (Spearman Rank correlation: r_s = 0.04, *P* = 0.13; r_s = 0.08, *P* = 0.81, respectively).

Most lizards were observed under vegetation (N = 27) and the remainder in open habitat (N = 3). The activity of *C. longicaudus* was unimodal, the first active lizards were sighted at 0900 h. Thereafter, number of active lizards increased until reaching a maximum of 11 individuals between 1300 and 1400 h; animals disappeared before 1500 h.

The mean body temperature of *C. longicaudus* is similar to *C. ocellifer* (36.5°C), *C. abaetensis* (36.7°C) in Restinga of Dunas do Abaeté (Dias and Rocha 2004. J. Herpetol. 38:586–588), *C. lemniscatus* (37.6°C) in Lavrado and Curuá-Una (Vitt et al. 1997. Copeia 1997:745–757) and *C. littoralis* (38.6°C) in Restinga de Jurubatiba, Macaé (Hatano et al. 2001. Rev. Brasil. Biol. 61:287–294). These similar body temperatures might reflect a conservative thermal physiology in the genus.

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CROTAPHYTUS COLLARIS (Eastern Collared Lizard). **COMMUNAL HIBERNATION; DISPERSAL.** Lizards living in temperate climates often hibernate in subterranean burrows where they sometimes aggregate (Ruby 1977**.** Herpetologica 33:322–333). As part of ongoing mark-recapture studies at Arcadia Lake (AL), Oklahoma, USA, on 27 March 2005 we discovered a hibernaculum on a south-facing rocky slope when a newly emergent mud-covered male retreated into a tunnel-like opening (6 cm wide) leading into a burrow beneath a rock. Removal of the rock caused this unidentified male to flee, revealing a bowl-shaped chamber (9.1 cm deep and 20 cm wide) unlike the J-shaped hibernaculum previously described for collared lizards at AL (Baird 1999. Herpetol. Rev. 30:227). Within this same burrow, we also found a two-year old male with his head and torso buried, but his hind limbs and tail exposed. The same burrow also contained two females (a two-year old and a one-year old) that were both tightly buried tail-first within the soil. The one-year old female was buried 13 cm below ground inside a 6 cm long horizontal cavity. Although all in the same burrow, these lizards were separated from one another by a mixture of sandy soil and pebbles. We also found one empty lizard eggshell within the burrow.

Mapped sightings revealed that these three identified lizards moved outside of their 2004 home ranges to hibernate even though burrowing sites similar to the occupied one are abundant throughout the homogeneous rock habitat at AL (Baird and Sloan 2003. Ethology 109:879–894). Only the first (25 April) and last (2 August) captures of the two-year old male in 2004 were within 10 m of the hibernaculum, whereas the nearest border of his 2004 home range (based on 25 census sightings) was 62 m away. The proximity of the first and last sightings to the burrow suggests that this male may have used this location as a hibernaculum during the winter of 2003–2004, established a home range distant from it during the following spring, and then returned to hibernate in the same burrow over the 2004–2005 winter. Such interseasonal fidelity to hibernacula is documented for other lizards (Elfstrom and Zucker 1999. J. Herpetol. 33:240–248). The territory defended by this male as a two-year old in 2005 was six times larger than, and overlapped only 5% of his 2004 home range, but included the hibernaculum. Although the overlap of the home ranges occupied by the two-year old female during 2004 and 2005 was high (73%), neither included the hibernaculum, which was 26 m from her 2004 and 2005 home ranges, respectively. We first captured the one-year old female as a recent hatchling in August 2004, 126 m from the hibernaculum. Although we sighted this female only three times in May 2005, she dispersed as far as 68 m from the burrow.

Ours represents the second report in *C. collaris* of communal hibernation involving lizards of two generations as well as remnants of eggs (Legler and Fitch 1957. Copeia 1957:305–307). Because adults generally enter hibernacula before young hatch, the newly emerged juvenile must have located this burrow following hibernation of the three adults, which may suggest that conspecific cues are used to orient to communal burrows. Ours, along with one previous observation of collared lizard eggshells within hibernacula (Legler and Fitch 1957, *op. cit.*) suggests that this species uses the same burrows for over-wintering and nesting. Communal hibernation may have thermal advantages, or may be a consequence of limited suitable burrow sites (Gregory 1982. *In* C. Gans and H. Pough [eds.], Biology of the Reptilia Vol. 13, pp. 53–154. Academic Press, New York). Because we found each lizard surrounded by soil rather than in direct physical contact with conspecifics, thermal advantages seem unlikely in our observation. Even though similar burrowing sites are abundant in the human-constructed habitat at AL, they are much less abundant in the rocky substrate that is naturally inhabited by collared lizards (Baird and Sloan 2003, *op. cit.*). Therefore, limitation of suitable sites remains a viable hypothesis that may explain communal hibernation in this species.

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CTENOPHORUS NUCHALIS (Central Netted Ground-dragon). **ENDOPARASITES.** *Ctenophorus nuchalis* occurs in the central and northern coasts of Western Australia, the drier parts of central and northern Australia to central Queensland and western New South Wales; adults measure about 100 mm SVL (Cogger 1996. Reptiles & Amphibians of Australia, 6th ed., Ralph Curtis Publ., Sanibel Island, Florida. 808 pp.). One previous report of helminths exists for *C. nuchalis*; Jones (1995. Aust. J. Zool. 43:141–164) reported larvae assigned to *Abbreviata* (Physalopteridae). The purpose of this note is to report two additional species of Nematoda in *C. nuchalis*.

Coelomic cavities and small and large intestines of 18 *C. nuchalis* (mean SVL = 92 mm ± 12.0 SD, range: 70–110 mm from Western Australia, 28°27'S, 119°05'E [datum: AGD66] elev. ca. 530 m), collected 1966–1967 in the herpetology collection of the Natural History Museum of Los Angeles County (LACM 54225, 54227–28, 54231, 54234, 54236, 54243–44, 54246, 54251, 54254, 54256, 54259, 54268, 54270, 54272, 54274, 54278) were examined for helminths. Stomachs were unavailable for examination; they had been removed during an ecological study that included stomach content analysis (Pianka and Pianka 1976. Copeia 1976:125–142). Nematodes were cleared in a drop of glycerol on a glass slide, cover-slipped and identified as *Maxvachonia brygooi* (infection site: small intestine, large intestine; prevalence: infected lizards/lizards examined × 100 = 39%; mean intensity: mean number of helminths per infected lizard ± SD = 2.0 ± 1.5) and *Parapharyngodon kartana* (infection site: large intestine; prevalence: 6%, mean intensity: 1). Helminths were deposited in the United States National Parasite Collection, Beltsville, Maryland: *Maxvachonia brygooi* USNPC (98266); *Parapharyngodon kartana* USNPC (98267).

Maxvachonia brygooi is known from Australian scincids, agamids and a varanid (Goldberg and Bursey 2000. Trans. Roy. Soc. S. Aust. 124:127–133). *Parapharyngodon kartana* has been found in Australian scincids, agamids and gekkonids (Goldberg and Bursey, *op. cit.*). Infection by *Maxvachonia brygooi* (Cosmocercidae) and *P. kartana* (Oxyuridae) occurs from ingesting eggs (no intermediate host is utilized) (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission. CABI Publishing, Wallingford, U.K. 650 pp.). *Ctenophorus nuchalis* represents a new host record for *Maxvachonia brygooi* and *Parapharyngodon kartana*.

We thank Christine Thacker (LACM) for permission to examine *C. nuchalis* and Dustin Goto (Whittier College) for assistance with dissections.

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CTENOSAURA MACROLOPHA (Mainland Spinytail Iguana). **DIET; CLUTCH SIZE.** Adults of members of the genus *Ctenosaura* are typically herbivorous (Durtsche 2000. Oecologia 124:185–195; Durtsche 2004. Physiol. Biochem. Zool. 77:459–470; Köhler 1996. Salamandra 32:153–162), but juveniles may be primarily insectivorous (Durtsche 2000, *op. cit.*; Durtsche 2004, *op. cit.*) and adults are known to take a variety of animal prey (e.g., Arndt 1999. Florida Sci. 62:111–114). Here we report observations on the stomach contents of *C. macrolopha* from Chihuahua, México.

Three *C. macrolopha* (78–89 mm SVL) were collected 5–12 July 2002 from Arroyo El Camuchil, Batopila and road to Satevo (27°1'34.1"N, 107°45'44.5"W, datum: WGS84; elev. 435 m; see Lemos-Espinal et al. 2004. Bull. Chicago Herpetol. Soc. 39:1–7).

TABLE 1. Stomach contents of 3 *Ctenosaura macrolopha* from Chihuahua, México.

Prey Type	Prey Items N =	(%)	Volume cm^3	(%)	Number of Stomachs
Hymenoptera (ants)	28	(58.3)	0.31	(27.2)	3
Isoptera	19	(39.6)	0.76	(66.7)	3
Seed	1	(2.1)	0.07	(6.1)	1

All three animals contained identifiable stomach contents (Table 1). Numerically, ants were the most important prey, but volumetrically termites were most important, although both groups were found in all three stomachs. Presence of a seed in the smallest of the three individuals suggests that *C. macrolopha* may consume fruit. Based on the maximum size of *C. macrolopha* observed near the collection locality (female = 106 mm SVL, male = 120 mm SVL), these individuals likely represent small adults; hence, insectivory might be expected if these animals, like smaller *Ctenosaura* that eat more insects (e.g., Durtsche 2000, *op. cit.*), are still in their interval of rapid growth.

Two of the *C. macrolopha* were females that contained enlarged ovarian follicles. An 87.4 mm SVL animal had 10 enlarged follicles; the other (88.9 mm SVL) had nine enlarged follicles. We are unaware of other reports of clutch size in *C. macrolopha*. However, the clutch sizes we observed for *C. macrolopha* are larger than those reported for *C. defensor* (2–3 eggs; Köhler, *op. cit.*) but similar to the maximum clutch sizes reported for *C. hemilopha* (Goldberg and Beaman 2005. Herpetol. Rev. 36: 317–318).

Specimens are deposited in the Herpetological Collections of the Unidad de Biología, Tecnología y Prototípos (UBIPRO) (JLE9386, 9389, 9392). Collection was conducted under a permit issued to JAL by the Dirección General de Vida Silvestre (DGVS) de la Secretaria del Medio Ambiente y Recursos Naturales.

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DIPLOLAEMUS BIBRONI (NCN). **MOUTH INJURY.** Lizard mouth injuries resulting from foraging activities in the wild are unreported in herpetological literature from South America. In fact, we were unable to find any citation in our survey of the literature related to any wild lizard population. Most external injuries reported for lizards are associated with predation attempts by other animals or result from encounters with conspecifics. Here, we provide the first report of injury resulting from foraging activities in a leiosaurine lizard from central Patagonia, Argentina.

On 25 February 2006, we encountered an adult male *Diplolaemus bibroni* (90.5 mm SVL) basking on an accumulation of small volcanic rocks along Provincial Road 26, 52.3 km W of its intersection with Provincial Road 25, southwest of Pampa de Los Guanacos, Departmento de Sarmiento, Chubut (45°16'43.9"S, 68°43'03.3"W, datum: WGS84; elev. 486 m). After observing its behavior for 10 min, we caught the lizard and held in captivity for 4 weeks. The lizard had an insect thorax jammed in his left lower jaw. Although the insect thorax was fairly large (5 mm long), occupying a significant area of the lizard's mouth (25.7 mm head length), the lizard did not seem to have any obvious limitations in prey capture, mobility or signs of distress, and we did not observe it trying to remove the thorax. The appearance of the wounded area suggested that it was an older injury. Insect part was identified as thorax of a tenebrionid beetle (Family Tenebrionidae, Subfamily Pimeliinae, Tribe Nycteliini, *Nyctella* sp.).

The lizard (LJAMM 3999) was deposited in collection Luciano Javier Avila Mariana Morando (LJAMM) now housed in Centro Nacional Patagónico (CENPAT-CONICET), Puerto Madryn, Argentina.

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KENTROPYX LAGARTIJA (NCN). **DIET.** Diet of few species of *Kentropyx* has been studied. *Kentropyx striatus* (Vitt and de Carvalho 1992. Can. J. Zool. 70:1995–2006), *K. pelviceps* and *K. altamazonica* (Vitt et al. 2000. Oecologia. 122:410–420) have all been reported to be insectivorous, but the diet of *K. lagartija* is unstudied. Hence, here we report an observation of predation by a young *K. lagartija* on a *Mabuya* (skink).

On 17 December 2002, we collected a young male *K. lagartija* (4.5 cm SVL) in the Parque Nacional Copo, 3.7 km SE of Puesto Maján (25°51'43.0"S, 62°11'10.1"W, datum: WGS84; elev. 160 m), Santiago del Estero, Argentina. It was found in an open grassy area inside the Chaco Forest. Dissection of this animal revealed a *Mabuya frenata* neonate (2.6 cm SVL) in the stomach.

The *K. lagartija* (MCN 1201) and the *M. frenata* neonate (MCN 1202) were deposited in the herpetological collection of the Museo de Ciencias Naturales of the Universidad Nacional de Salta (MCN).

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LEIOSAURUS BELLI (NCN). **PREDATION**. The natural history of *Leiosaurus belli*, a lizard inhabiting the austral Monte and northern Patagonian steppes, is poorly known. In particular, its predators are unreported (Cei 1986. Reptiles del Centro, Centro Oeste y Sur de la Argentina. Monographia IV, Torino, Italy. 527 pp.). Here, we provide the first observation of predation on *L. belli*. On 1 January 1986, A. Gosztonyi obtained a sample of fresh pellets and prey remains from a Burrowing Owl (*Athene cunicularia*) burrow near Oasis Ranch, 120 km NW Puerto Madryn, Departamento Biedma, Chubut Province, Argentina (42°32'S, 65°40'W, datum: WGS 84; elev. 150 m). Lizards comprised the bulk of vertebrate remains, representing 62% of the individual prey items. Using diagnostic prefrontal bones, we identified 53 individuals of *Leiosaurus belli* from this sample. Variation in prefrontal bone sizes indicated that 28 lizards were juveniles (< 60 mm SVL), 21 were adults 90 mm SVL and 4 were adults > 90 mm SVL. Additionally, eight heads of *L. belli* were found around the burrow entrance, three of which were from adult lizards > 90 mm SVL.

Two aspects of our observation merit comment. First, a high percentage of lizard prey remains represents a pattern unusual for burrowing owl diet in Patagonia, where percentages of lizards taken have been <1.3% (Nabte 2003. Dieta de *Athene cunicularia* [Aves: Strigiformes] en el nordeste de la provincia del Chubut, Argentina. Tesis de licenciatura, Universidad Nacional de la Patagonia San Juan Bosco, Sede Puerto Madryn, Chubut, Argentina. 47 pp.). Second, *L. belli* is a species usually considered to occur at low densities, and that is more active near sunset (Cei, *op. cit.*), when *A. cunicularia* actively hunt (Nabte, *op. cit.*). The high frequency of *L. belli* as lizard prey indicates that either *Athene cunicularia* is a highly efficient hunter or that the density of this lizard, perhaps because of its behavior, has been underestimated.

The pellet sample remains were deposited in the Colección de Material de Egagrópilas y afines "Elio Massoia", Centro Nacional Patagónico CNP-E 86, Puerto Madryn, Chubut, Argentina.

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LIOLAEMUS PSEUDOANOMALUS (NCN). **REPRODUCTION.** *Liolaemus pseudoanomalus* is an oviparous lizard inhabiting the hot arid landscape of the Monte Phytogeographic Province in northern Argentina (Cabrera and Willink 1980. Biogeografía de América Latina. Washington, D.C. 109 pp.). *Liolaemus pseudoanomalus* has an ambiguous conservation status, defined as a species for which "insufficient knowledge" exists (Lavilla et al. 2000. Categorización de los Anfibios y Reptiles de la República Argentina. Asoc. Herpetol. Arg., Tucumán City. 97 pp.). Data on its biology are sparse. Limited study has been devoted to thermoregulation, sexual dimorphism, time budgets, and space use (Villavicencio et al., *in press*. Amphibia-Reptilia; Villavicencio et al. 2003. Rev. Esp. Herpetol. 17:87–92; Villavicencio et al. 2002. Multequina Latin Amer. J. Nat. Res. 11:51–60; Villavicencio et al. 2003. Nótulas Faunísticas, Segunda Serie 15:1–6; Villavicencio et al. 2003. Bull. Maryland Herpetol. Soc. 42:1–7). Hence, we add the first data addressing *L. pseudoanomalus* reproductive ecology.

We conducted fieldwork in a temporary creek bed near La Laja (31°19'S, 68°41'W, datum: WGS84; elev. 700 m), Departmento de Albardón, San Juan Province, Argentina. Data were collected every 10 days from August 2000 to August 2001 by a random pattern of revisits across the study site. Each animal was measured (SVL) and dissected for gonadal examination. In females, we recorded the number of developing follicles and oviductal eggs, the length and width of oviductal eggs, and the condition of the oviducts. In males, we recorded the width and length of testes to enable calculation of volume based on Dunham (1983. *In* Huey et al. [eds.], Lizard Ecology, pp. 261–280. Harvard Univ. Press, Cambridge, Massachusetts). Testicular volume was natural log-transformed to accommodate its curvilinear function (King 2000. J. Herpetol. 34:148–150). Clutch size was determined from the combined number of developing follicles and eggs in the oviducts. We used the simultaneous presence of developing follicles and enlarged oviducts to suggest that more than one clutch was produced seasonally. The smallest female with vitellogenic follicles or oviductal eggs was used to estimate SVL at maturity. We identified various reproductive states for females: a) non-vitellogenic follicles, b) vitellogenic follicles, c) oviductal eggs and d) post-reproductive (oviducts enlarged).

Males were considered sexually mature if they contained enlarged epididymides. All measurements were obtained to the nearest 0.02 mm with Vernier calipers. Testes of males and fat bodies of both sexes were removed and weighed (to nearest 0.001 g). We used residuals of each of two regressions (testicular volume vs. SVL and fat body mass vs. SVL) to describe male reproductive and fat bodies cycles. This technique retains variation due to extrinsic factors while minimizing the confounding effect of individual variation in SVL (Ramirez-Bautista et al. 1998. J. Herpetol. 32:18–24).

Of 101 captures, 43.6% were sexually mature (29 males and 15 females). Forty females ranged in size from 28 to 68 mm SVL; minimum reproductive size was 59 mm. Female body size was not correlated with clutch size (Spearman: $r_s = 0.50$; $P = 0.20$; N = 8). Clutch size averaged 6.8 (SD = 2.4, range: 2–10, N = 8). We did not observe females with developing follicles and enlarged oviducts simultaneously. Between October and February, we recorded 6 females with vitellogenic follicles. Between November and February, we recorded 4 females with oviductal eggs. Between December and April we recorded 11 females with enlarged

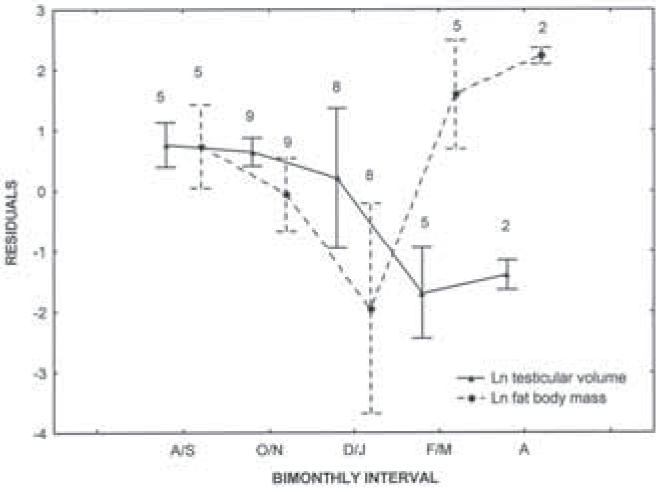

FIG. 1. Bimonthly change in relative testicular volume and fat body mass of the lizards *Liolaemus pseudoanomalus*. Dates are represented as means ± SD. Sample sizes appear above whisker. A/S = August / September; O/N= October / November; D/J = December / January; F/M = February / March and A = April.

oviducts.

Fifty-eight males ranged in size from 22 to 75 mm SVL; minimum reproductive size was 61 mm. Testicular volume was not correlated with body size (Spearman: $r_s = 0.33$; $P = 0.07$; N = 29). Testicular volume varied through the gonadal cycle (ANOVA: $F_{4,24} = 10.75$; $P = 0.0001$; N = 29; Fig. 1).

Seasonal variation in fat body mass (measured as bimonthly samples) was statistically significant (ANOVA: $F_{4.24} = 9.37$; $P = 0.0001$; N = 29; Fig. 1) for males.

Our data suggest that *Liolaemus pseudoanomalus* produces one clutch a year like *L. multimaculatus* (Vega 1999. Ecología de saurios arenícolas de las dunas costeras bonaerenses. Tesis doctoral, inédita, Universidad Nacional de Mar del Plata. 102 pp.) and *L. chacoensis* (Cruz and Ramirez-Pinilla 1996. Rev. Española Herpetol. 10:33–39). Mean clutch size of *L. pseudoanomalus* is larger than *L. darwinii* (mean: 4.9, range: 2–8, N = 40), *L. riojanus* (mean: 4.2, range: 3–6, N = 15) (Blanco et al. 2001, *op. cit*.; Blanco et al. 2003. Reunión de Com. Herpetol. Asoc. Herpetol. Argentina. XVII:31 pp.), *L. koslowskyi* (mean: 4.2, range: 3–9, N = 53) (Aun et al., *op. cit*.); and *L. wiegmanni* (mean: 4.6, range: 4–5, N = 19), *L. multimaculatus* (mean: 4.2, range: 3–7, N = 29), *L. gracilis* (mean: 4.7, range: 4–6, N = 19) (Vega, *op. cit*.) and *L. olongasta* (mean: 3.8, range: 1–8, N = 10) (Cánovas et al., *in press*. Herpetol. Rev.). Our data suggest spring–summer reproductive activity with a late maturing, single annual clutch reproductive strategy (Tinkle 1969. Amer. Nat. 103:501–516).

All specimens (IMCN-UNSJ 4100–4201) were deposited in the Herpetology Collections of Instituto y Museo de Ciencias Naturales of Universidad Nacional de San Juan. I thank M. Hayes for comments and suggestions, and CICITCA- 21E/E633 for financial support.

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PHRYNOSOMA CORNUTUM (Texas Horned Lizard). **WINTER ACTIVITY.** Reports of winter activity among horned lizards are sparse. One that appeared recently (Wone and Beauchamp 2003. J. Herpetol. 37:679–686) described winter activity of *Phrynosoma mcallii* from California. Although the Texas Horned Lizard, *P. cornutum,* is well studied across its geographic range, the only data close to addressing winter activity are those of Fair and Henke (1999. J. Herpetol. 33:525–517), who described activity prior to hibernation and after emergence in south Texas. Hence, here we report mid-winter activity of *P. cornutum* from west Texas.

Our observations were made in the Dog Canyon area of Big Bend National Park, Brewster County, Texas (29°37'N, 103°09'W, datum: NAD83; elev. 789 m). A small group (N = 3) of *P. cornutum* were individually fitted with PD-2T radio transmitters (Holohil Systems Ltd, Carp, Ontario, Canada) and iButton thermachron temperature dataloggers (Dallas Semiconductor, Sunnyvale, California, USA) to monitor overwinter activities and external temperatures. Additional thermachrons were placed on the ground at each of two reference sites (shade and sun). Dataloggers recorded temperatures every two hours from 1 September 2005 to 16 February 2006. We inferred lizard activity from the temperature datalogger record and verified this by regular observations of the lizards. Lizards were observed twice weekly from 7 August 2005 through 24 April 2006. Each lizard was assigned an alphanumeric identifier of a letter indicating its sex followed by a number. Measurements of each lizard (M1: 96 mm SVL, 73 g; F2000: 111 mm SVL, 99 g; F4000: 107 mm SVL, 93 g) were taken just prior to dormancy.

On 15 September 2005, the male (M1) buried himself 2 cm beneath the ground surface under the cover of a honey mesquite (*Prosopis glandulosa*) and did not emerge from this site until 7 March 2006. The two females buried themselves ca. 2 cm below the ground surface on 24 October 2005, both locations under the cover of *P. glandulosa*. Female F2000 remained underground until emerging on 16 April 2006. Interestingly, female F4000 emerged on 17 December 2005 (58 days after beginning dormancy) and moved to a second location 6 m away where she reburied herself for an additional 104 days until emerging on 2 April 2006. Exposed daytime ground temperatures nearby (~200 m) recorded a high of 29.0°C while the thermachron attached to the lizard's dorsum recorded a high of 29.5°C for 17 December 2005. Both pre- and post-movement refuges were located within one meter of the center of a *P. glandulosa* ca. 2 cm below ground level in sandy soils.

The low temperature recorded for F4000 on the morning of 17 December 2005 prior to its movement was 3.5°C while the thermachrons of two other lizards recorded lows of 7.0°C (M1) and 5.5°C (F2000) that morning. Low temperatures recorded on lizard F4000 10 days before and after movement averaged 5.4°C (range: -1.0–12.5°C) while the other two lizards (M1 and F2000) averaged 6.2ºC (range: 1.0–12.0°C) and 4.4°C (range: -1.5°–10.5ºC), for that time period respectively. An F-test indicated no significant difference in temperature variation recorded on lizard thermachrons before and after F4000 moved.

To our knowledge, this is the first report of mid-winter activity in *P. cornutum*. We believe the winter movement observed may have been a result of the low temperature recorded on the morning of 17 December 2005, but we cannot exclude the possibility of other factors. This type of winter activity may be more common than recognized, and only has come to light with the increasing use of temperature dataloggers and radio telemetry equipment during non-breeding seasons.

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PHYLLODACTYLUS TUBERCULOSUS (Yellow-bellied Gecko). **DIET.** Knowledge of *Phyllodactylus tuberculosus* ecology and natural history is sparse. In particular, we have been unable to locate previous reports on its diet. However, reports on the diet of other *Phyllodactylus* from Peru and Iraq suggest that these geckos eat arthropods, especially insects (Weber 1960. Copeia 1960:153–154; Huey 1979. Oecologia 38:249–259). Hence, we provide preliminary data on *P. tuberculosus* diet from Chihuahua, México.

Our observations are based on the stomach contents of 9 *P. tuberculosus* collected from 12–16 July 2000 and from 21–23 July 2003 from two localities: the vicinity of Chínipas (N = 3; 27°22'48.0"N, 108°32'41.1"W, datum: WGS84; elev. 469 m) and the vicinity of Batopilas (N = 6; 27°1'34.1"N, 107°45'44.5"W; elev. 435 m; see Lemos-Espinal et al. 2001. Bull Chicago Herpetol. Soc. 36:201–208; Lemos-Espinal et al. 2004. Bull Chicago Herpetol. Soc. 39:164–168). Of nine individuals, seven contained identifiable stomach contents (Table 1); two had empty stomachs. Numerically, caterpillars were the most important prey, but volumetrically both orthopterans and caterpillars were important. These data agree with other reports of diet in *Phyllodactylus* (Weber, *op. cit.*; Huey, *op. cit.*).

Specimens are deposited in the Herpetological Collections of the Unidad de Biología, Tecnología y Prototípos (UBIPRO) (JLE5917, 5943–5947, 11845–11846, 11869). Collection was conducted under a permit issued to JAL by the Dirección General de Vida Silvestre (DGVS) de la Secretaria del Medio Ambiente y Recursos Naturales.

TABLE 1. Stomach contents of 7 *Phyllodactylus tuberculosus* from Chihuahua, México.

Prey Type	Prey Items N =	Prey Items (%)	Volume mm^3	Volume (%)	Number of Stomachs
Araneae	1	(10)	42.2	(2.4)	1
Coleoptera (larva)	2	(20)	194.6	(11.3)	2
Lepidoptera (larva)	4	(40)	743.5	(43.1)	2
Orthoptera	2	(20)	628.4	(36.4)	2
Unknown insect	1	(10)	117.3	(6.8)	1

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PLESTIODON BREVIROSTRIS (Short-nosed Skink). **REPRODUCTION**. *Plestiodon brevirostris*, variable and broadly distributed in Mexico, occurs in high montane pine and pine-oak-dominated terrains. Few data exist on its natural history. Axtell (1960. Copeia 1960:19–26) reported that four females collected in San Antonio de Las Alazanas on 6–7 July had three embryos each. Goldberg (2002. Herpetol. Rev. 33:134) reported that of four females recollected in June, one had two well-developed embryos and three appeared to have already given birth. Goldberg also collected two neonates in June: a 23 mm SVL animal on 19 June, and a 21 mm SVL individual on 27 June. However, he did not indicate the locality of origin of either the female or the neonates. Hence, we provide reproductive data on *P. brevirostis* from different points across its geographic range.

Each of the three females gave birth in captivity shortly after the date of collection. The first (MZFC 18774; 62 mm SVL, 50.4 mm tail [partly regenerated], 4.74 g) was collected in Pablillo, Nuevo León (24°34'53.0"N, 99°57'56.2"W, datum: WGS84; elev. 2330 m), in a forest dominated by *Pinus teocote* and *Quercus* spp. on 1 July 2005. On 13 July, this female gave birth to three live offspring, and the next day a fourth. After parturition, the female weighted 2.74 g. The SVL, tail length, and mass (mean ± SE) of the four neonates were 26.25 ± 0.12 mm, 25.25 ± 012 mm, 0.303 ± 001 g, respectively. The second female (MZFC 18779; 65 mm SVL, 37 mm tail [partly regenerated], post-parturition mass = 3.24 g) was collected ca. 14 miles E of San Antonio de las Alazanas, Coahuila, near of type locality of *P. b. pineus* (25°13'1.2"N, 100°23'17.9"W, elev. 2919 m) in forest dominated by *Pinus cembroides* on the same date as the previous female. On 14 July, this female gave birth to four neonates (mean ± SE: 26.87 ± 0.34 mm SVL, 24.75 ± 0.13 tail, 0.291 ± 005 g). The third female (MZFC 19135, 59 mm SVL, 132.2 mm tail, post-parturition mass = 3.5 g) was collected in Los Lirios, Coahuila (25°22'32.5"N, 100°30'38.9"W; elev. 2429 m) in a *Pinus cembroides-Cupressus* sp. forest on 2 July 2005. This female birthed two neonates (25.0 ± 0.12 mm SVL; 25.0 ± 0.15 mm tail) on 10 July 2005.

We also collected four neonate-sized lizards. Two (MZFC 18767–18768, both 25.0 mm SVL, 25.0 mm tail) near Marmolejo, Tamaulipas in the Sierra de San Carlos (24°37'19.8"N, 99°01'55.0"W; elev. 596 m) in a *Pinus pseudostrubus-Quercus canbyi* forest on 30 June 2005 at the type locality of *P. b. dicei*. The other two lizards were collected in Pablillo (MZFC 18770, 25.0 mm SVL, 25.0 mm tail), and in Los Lirios (MZFC 18783, 26.5 mm SVL, 27.5 mm tail) on 1 and 2 July of 2005, respectively. Locality data are as indicated previously. Our data suggest that both *P. b. dicei* and *P. b. pineus* give birth from late June to mid-July.

We also collected one presumptively neonate-sized lizard on 15 March 2006. This lizard (MZFC 19134, 27.0 mm SVL; 14 mm tail [broken]) was collected 4.8 km N of Mitla, Oaxaca, near the type locality of *P. b. brevirostris* (16°59'03.1"N, 96°20'05.3"W; elev. 2453 m). Assuming neonates at this latitude are birthed at a similar size, this suggests that the southern populations of *P. brevirostris* (i.e., *P. b. brevirostris*) are born about three months before offspring from populations in northeast Mexico (i.e., *P. b. dicei* and *P. b. pineus*).

The specimens were deposited in the herpetological collection of Museo de Zoología de la Facultad de Ciencias, in the Universidad Nacional Autónoma de México.

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PLESTIODON FASCIATUS (Five-lined Skink). **PREY**. At 1519 h on 11 June 2006, a mature male Five-lined Skink (67.2 mm SVL, 7.15 g) was observed stalking prey in the Clemson University Experimental Forest near the Issaqueena Dam (34°44'08.8"N, 82°51'46.1"W, datum: WGS 84; elev. 191 m) in South Carolina. The skink seized the potential prey item, pinned it to the ground and I captured it by hand within 5 sec of it seizing the item. The prey was identified as a Carolina Scorpion, *Vaejovis carolinianus* (0.37 g, 4.33 mm carapace length). The scorpion was held in the lizard's mouth by the cephalothorax with one pedipalp in the mouth and one extending from the right side. The scorpion was motionless and made no effort to sting or pinch. This method of seizing and holding scorpions, a potentially dangerous prey item, differs from that used by the Spotted Whiptail, *Cnemodophorus gularis* (O'Connell and Formanowicz 1998. J. Herpetol. 32:75–79), which repeatedly bit, shook, and released the bark scorpion, *Centruroides vittatus*, in laboratory studies. Arachnids have been reported to comprise a large percentage of the diet of some populations of *P. fasciatus* (Fitch 1954. Univ. Kansas Publ. Mus. Nat. Hist. 8:1–156). However, to our knowledge, this represents the first published record of predation on a scorpion by *P. fasciatus*.

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PODARCIS SICULA CAMPESTRIS (Italian Wall Lizard). **PREDATION**. Few accounts have mentioned predation on the wall lizards introduced to Long Island, New York. Long Island lacks native lizards and hence may lack predators that typically take them. Gossweiler (1975. Copeia 1975:584–585) suggested that cats, dogs, sea gulls, and "one snake" might prey on the introduced Long Island lizards; Burke and Ner (2005. Northeast Nat. 12:349–360) listed Northern Mockingbirds (*Mimus polyglottos*), Blue Jays (*Cyanocitta cristata*), and American Crows (*Corvus brachyrhynchos*) as potential predators. To date, the only predators documented to prey upon *P. sicula campestris* are non-native house cats (Burke and Ner, *op. cit.*), and spiders (species not identified) and mantids (probably *Tenodera aridifolia*) on hatchling lizards (Burke and Deichsel, *in press*. Herpetol. Conserv.).

I observed a single predation event while studying a population of *P. sicula campestris* at the Carle Place train station in Carle Place, New York (40°44'56"N, 73°36'19"W, datum: WGS84; elev. 30 m). The station, dominated by low growing exotic shrubs (e.g., *Artemisia vulgaris*) and herbaceous annuals and perennials (e.g., *Centaurea* sp.), lacks substantial shade. On 12 June 2006 at 1155 h, a *Corvus brachyrhynchos* was seen with an adult *P. sicula campestris* in its beak sitting on a pile of railroad ties ca. 2 m from the tracks. The capture was not witnessed. The crow was first observed holding the lizard by the torso in its beak, then dropped the lizard at its feet and picked at it several times before flying away with the lizard in its beak as a passenger train approached the station. Until the crow flew off, the lizard's tail had remained intact, implying capture by the head or torso given the lizard's ability to autotomize its tail when grabbed.

I also observed a predation attempt by an Eastern Garter Snake, *Thamnophis sirtalis sirtalis*. *Thamnophis s. sirtalis* are abundant at the Carle Place train station and can often be seen basking during morning hours in close proximity to *P. sicula campestris* in open clearings close to nearby vegetation (pers. obs.). On 17 June 2006 at 1112 h, a *T. s. sirtalis* (ca. 65 cm) was observed moving through low growing vegetation behind the westbound platform. An adult female *P. sicula campestris* was seen basking in a relaxed position (front limbs extended back against the body) in a nearby clearing ca. 1 m from the patch of vegetation partly concealing the snake. The snake slowly entered the clearing and came within 1 m of the lizard before the lizard became alarmed and quickly retreated to a nearby patch of vegetation ca. 2 m away. The snake chased the lizard into the vegetation, where the lizard rapidly ascended an *A. vulgaris* plant. After the failed capture attempt, the snake moved deeper into the vegetation, where it was not seen again. The *P. sicula campestris* descended after 4 mins and resumed basking on the vegetation edge.

No documented reports of Eastern Garter Snakes preying upon introduced wall lizards exist. Moreover, instances of *Thamnophis s. sirtalis* preying on any lizard are rare (Hamilton 1951. Am. Midl. Nat. 46:385–390; Carpenter 1952. Ecol. Monogr. 22:235–258). Hence, despite my observation of attempted predation, *Thamnophis s. sirtalis* might not be expected to be a frequent predator of the introduced lizards on Long Island.

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SCELOPORUS CYANOGENYS (Blue Spiny Lizard). **PREDATION.** There are few reports concerning the natural history of *Sceloporus cyanogenys*. Current knowledge addresses reproduction (Kennedy 1960. Southwest. Nat. 5:44–45), general behavior (Greenberg 1977. J. Herpetol. 11:177–195), taxonomy and distribution (Wiens and Reeder 1997. Herpetol. Monogr. 11:1–101), and mite infestations (García-de la Peña et al. 2005. Bull. Chicago Herpetol. Soc. 40:52–53). Recently, Castañeda et al. (2006. Herpetol. Rev. 37:227) added the Southwestern Rat Snake (*Pantherophis emoryi*) to its predator set. Here, we add *Trimorphodon tau tau* to that predator set.

At 2300 h on 6 May 2006 (air temperature 28°C) during a vertebrate inventory in the municipalities of Dr. Gonzalez, Higueras, and Cerralvo in the Sierra Picachos at a place called Rancho Fraile, Nuevo Leon, México (25°55'20"N, 99°46'12"W, datum: NAD27; elev. 435 m), we observed an adult male *S. cyanogenys* (109.mm SVL, 134 mm tail, 46.4 g) being consumed by a female *T. tau tau* (880 mm TL, 180.8 g including prey). Our observation occurred on a human-built brick structure (2 m × 1.5 m) covered with an unidentified vine. When first observed, the snake had seized the lizard. The feeding sequence took ca. 20 min. Local vegetation consists of a submontane matorral association of *Prosopis glandulosa* and *Hellieta parvifolia*. The snake was released following examination.

Information on the natural history of *Trimorphodon tau tau* is sparse (McDiarmid and Scott 1987. Los Angeles Co. Mus. Nat. Hist. 179:1–44; Scott and McDiarmid 1984. Cat. Amer. Amphib. Rept. 354.1). McDiarmid and Scott (*op. cit.*) provided the only dietary data for the species, indicating that it consumes frogs and lizards and may eat small mammals. They specify the genera *Cnemidophorus* and *Sceloporus* as lizard prey, but specific species are not mentioned. Because related species of *Trimorphodon* are reported to take these genera (Bogert 1939. Publ. Univ. California Los Angeles, Biol. Sci. 1:177–236), their appearance as prey items may be a generic-level pattern. This observation is the first record of *S. cyanogenys* as prey for *T. tau tau*.

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SCELOPORUS OCCIDENTALIS (Western Fence Lizard). **PREY**. The Argentine Ant (*Linepithema humile*) is a common invasive in California that competitively displaces native ants (Holway 1999. Ecology 80:238–251) and negatively affects some reptile species. Coast Horned Lizards (*Phrynosoma coronatum*) typcially do not eat Argentine Ants (Montanucci 1989. Herpetologica 45:208–216; Suarez et al. 2000. Ecol. Appl. 10:711–725) or experience negative growth rates in invaded communities when forced to consume them and other non-ant arthropods (Suarez and Case 2002. Ecol. Appl. 12:291–298). As a consequence, *P. coronatum* appears to avoid areas where Argentine Ants are abundant (Fisher et al. 2002. Conserv. Biol. 16:205–215). Argentine Ants also appear to negatively affect Orange-throated Whiptails (*Aspidoscelis hyperythra beldingi*) by displacing their natural prey items (Jennings and Hayes 1994. Amphibian and Reptile Species of Special Concern in California. California Dept. Fish Game, Inland Fisheries Division. Contract No. 8023. 260 pp.). Information on Argentine Ant consumption by other reptiles is lacking. Here, we report consumption of Argentine Ants by a *Sceloporus occidentalis* using unusual methods of prey capture.

At 1500 h on 12 June 2006, we observed a pair of *S. occidentalis* at the Santa Barbara Zoological Gardens, Santa Barbara Co., California (34°25'15"N, 119°39'58"W, datum: WGS84; elev. 9 m) moving out from underneath a metal tub and basking on gravel adjacent to a blacktop road. The male (ca. 8 cm SVL) moved into a path of Argentine Ants and stopped. Ants began to crawl on him intermittently. When an ant would crawl on his head, he would quickly consume it without displaying rejection behaviors (e.g., regurgitating, spitting out the prey). This unique method of prey capture was observed on five occasions over a period of ca. 15 min. The female (ca. 6 cm SVL) was not observed eating the ants. To our knowledge, this is the first report of Argentine Ant predation by *S. occidentalis* and potentially indicates flexibility in Western Fence Lizard diet. As Argentine Ants appear to be generally rejected by ant-consuming California reptiles, their consumption by *S. occidentalis* deserves further investigation, particularly for its potential effects on fence lizard body size and fitness.

We thank Michael Caterino (Santa Barbara Natural History Museum) for identifying five Argentine Ants, which were deposited in the SBNHM. We also thank Marc Hayes (Washington Department of Fish and Wildlife), Sam Sweet (University of California at Santa Barbara), Andrew Suarez (University of Illinois at Urbana-Champaign), and Estelle Sandhaus (Santa Barbara Zoological Gardens) for providing assistance in preparing this manuscript through valuable discussions of and information about Argentine Ants.

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SPHENOMORPHUS CHERRIEI (Striped Litter Skink, Chirbala Lisa). **ENDOPARASITES.** *Sphenomorphus cherriei,* a small diurnal litter-dwelling skink reaching 178 mm total length, occurs from central Veracruz, México on the Atlantic versant and Costa Rica on the Pacific slope to extreme western Panama (Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents Between Two Seas. Univ. Chicago Press, Chicago, Illinois. 934 pp.). To our knowledge, no endoparasites are known from *S. cherriei*. The purpose of this note is to report one species of Digenea and three species of Nematoda from *S. cherriei*.

Coelomic cavities and stomachs and small and large intestines of 10 *S. cherriei* (mean SVL = 49 mm ± 3.8 SD, range: 43–55 mm) from Costa Rica collected between 10°04'N to 10°46'N and 83°22'W and 84°70'W (datum: WGS84) during 1959, 1960, and 1963 from the herpetology collection of the Natural History Museum of Los Angeles County (LACM 161180–161189) were examined for helminths. Digeneans were regressively stained in hematoxylin, mounted in Canada balsam, studied as whole mounts and identified as *Mesocoelium monas* (infection site: small intestine; prevalence: infected lizards/lizards examined × 100 = 10%; mean intensity: mean number of helminths per infected lizard ± SD [where appropriate] = 11). Nematodes were cleared in a drop of glycerol on a glass slide, cover-slipped, and identified as *Oswaldocruzia nicaraguensis* (infection site: stomach, small intestine; prevalence 30%; mean intensity 1.3 ± 0.60), *Physaloptera* sp. (infection site: stomach; prevalence 10%; mean intensity 7) and acuariid larvae (infection site: stomach wall; prevalence 10%; mean intensity 6). Helminths were deposited in the United States National Parasite Collection, Beltsville, Maryland: *Mesocoelium monas* USNPC (98269), *Oswaldocruzia nicaraguensis* USNPC (98270), *Physaloptera* sp. USNPC (98271), acuariid larvae USNPC (98272).

Mesocoelium monas has a wide distribution among amphibians and reptiles in the Neotropics, Oceania, and the Orient (Goldberg et al. 2005. Comp. Parasitol. 72:88–101). Cercariae emerge from the sporocyst to encyst in the viscera of a molluscan host or occasionally leave the host to encyst on vegetation; infection occurs upon ingestion of an infected snail or vegetation containing cysts (Prudhoe and Bray 1982. Platyhelminth Parasites of the Amphibia. British Museum, Oxford University Press, Oxford, United Kingdom. 217 pp.). *Oswaldocruzia nicaraguensis* was described from *Ameiva festiva* from Nicaragua (Bursey et al. 2006. J. Parasitol.

92:350–352). *Sphenomorphus cherriei* is the second species to harbor this nematode. Infection is direct (no intermediate host) (Anderson 2000. Nematode Parasites of Vertebrates: Their Development and Transmission, 2nd ed. CABI Publishing Oxon, United Kingdom. 650 pp.). Larvae of *Physaloptera* sp. (but not adults) are commonly found in amphibians and reptiles (Goldberg et al. 1993. Bull. South. California Acad. Sci. 92:43–51). *Physaloptera retusa* is the common species found in lizards of the Americas (Bursey et al. 2005. Comp. Parasitol. 72:50–68); but males are necessary to assign species. Physalopteridae utilize insect intermediate hosts (Anderson, *op. cit.*). Species of the Acuariidae are normally parasites of birds and utilize arthropod intermediate hosts (Anderson, *op. cit.*). Adults are not known from reptiles which likely serve as transport (paratenic) hosts. *Norops limifrons* from Costa Rica has also been reported to harbor acuariid larvae (Bursey and Goldberg 2003. J. Parasitol. 89:573–576).

Sphenomorphus cherriei represents a new host record for *Mesocoelium monas, Oswaldocruzia nicaraguensis, Physaloptera* sp., and acuariid larvae. Costa Rica is a new locality record for *O. nicaraguensis*.

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TUPINAMBIS MERIANAE (Tiú, Teiú, Tegu, or Teju). **DIET**. *Tupinambis merianae*, a large, diurnal teiid, is broadly distributed from the Amazon River in Brazil southward to Argentina, Paraguay, and Uruguay (Colli et al. 1998. Herpetologica 54:477–492). Although the species is known to eat terrestrial arthropods, small vertebrates, and quantities of fruit (*op. cit.*), and therefore might also contribute to seed dispersal (Castro and Galetti 2004. Pap. Avul. Zool. 44:91–97), the range of its dietary habits, and hence its trophic ecology, are poorly known. Here, I present the stomach contents analysis of an adult *T. merianae* from southern Brazil that augments data on its diet.

The *T. merianae* examined, a large (27 cm SVL) adult male, was killed on Brazilian Highway PR 160 on 13 February 2000, adjacent to Klabin Ecological Park, in the municipality of Telêmaco Borba, in the state of Paraná (24°20'S, 50°35'W, datum: SAD69; elev. 715 m). Examination of the entire digestive tract contents of this individual revealed 14 different taxa, two plants and 12 animals: 6 gabiroba fruits (*Campomanesia xanthocarpa*); 8 false-coerana fruits (*Vassobia breviflora*); 2 beetles (Coleoptera: Cerambycidae: Prioninae); 2 crickets (Orthoptera: Gryllacrididae); 2 katydids (Orthoptera: Tettigoniidae), and 3 grasshoppers (Orthoptera: Acrididae); 1 (Orthoptera: Proscopiidae); 1 cicada (Hemiptera: Cicadidae); 5 caterpillars: 1 of which was a sphingid (Lepidoptera: Sphingidae: Sphinginae), and 4 saturniids (Lepidoptera: Saturniidae: Hemileucinae); 1 spider (Arachnida: Lycosidae); 1 millipede (Diplopoda); parts of an eggshell of the cowbird (*Molothrus bonariensis*); and the skull of a bat (Chiroptera: Vespertilionidae).

The cowbird egg might have come from a ground-nesting host, such as *Zonotrichia capensis*. Lack of other bones might indicate that the bat skull came from an already dead animal. This wide range of food items might indicate that the *T. merianae* is opportunistic, which might help explain its broad distribution.

Thanks to José Ricardo M. Mermudes, Margareth Sekiama, Marcelo Duarte, Mauro Pichorim, and Vlamir Rocha for their help in identification of various items; to Sergio A. Filipaki for his help in the field; to Klabin Paraná for logistic support; to James Joseph Roper and Marc P. Hayes for assistance with the text.

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UMA EXSUL (Coahuila Fringe-toed Lizard). **SWIMMING.** The six recognized species in the genus *Uma* are sand habitat specialists well known for their ability to literally "swim" in sand (Cornett

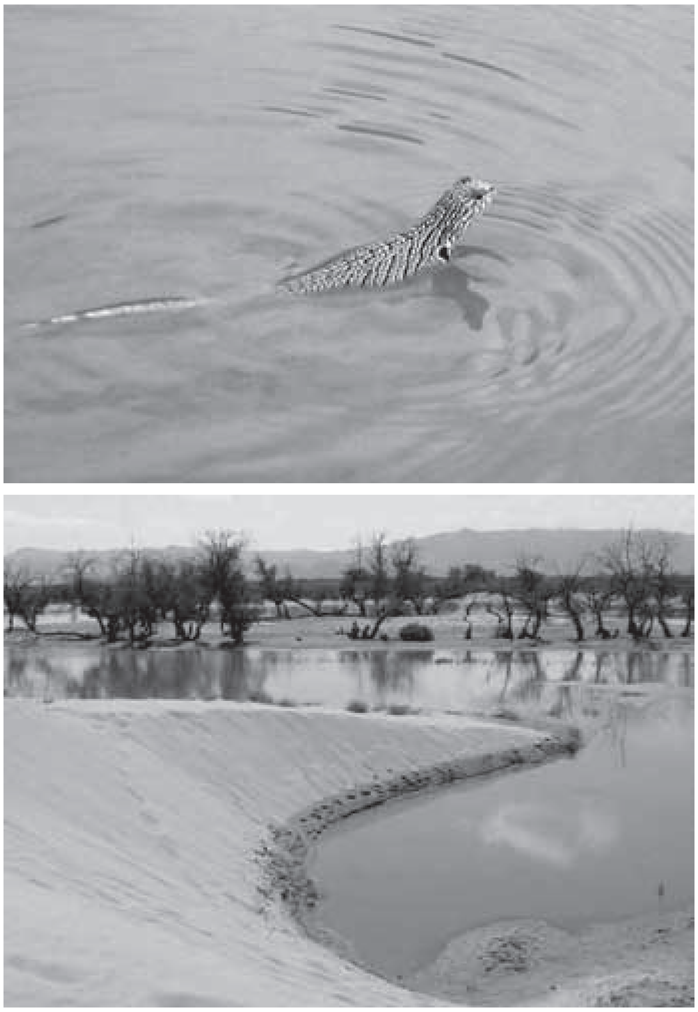

FIG. 1. An adult *Uma exsul* swimming across a temporary pool (top) following heavy precipitation at the Bilbao Dunes, Coahuila, Mexico (bottom).

1983. Pacific Discovery 36:2–10; Pough et al. 1978. Copeia 1978:81–86; Jayne and Daggy 2000. J. Exp. Biol. 203:1241–1242). The fact that these highly xeric-adapted terrestrial lizards can also swim in the water remains unreported. Here, we report observations of the swimming ability of *Uma exsul*, a protected species endemic to the Chihuahua Desert (SEMARNAP 2000. Diario Oficial de la Federación [16 Octubre], México, D.F., México).

During October 2002 and July 2003, we observed two different *U. exsul* swim in the well-known dunes at Bilbao in the Municipality of Viesca, Coahuila, México (25°26'33.64"N, 102°53'33.19"W, datum: NAD27; elev. 1093 m) (Fig. 1). On each occasion, we observed an adult (70 and 72 mm SVL, respectively) swim across pools 8–20 cm deep. The pools were the result of heavy precipitation during those years (Comisión Nacional del Agua, Estación Meteorológica: Emiliano Zapata, Coahuila, 2004).

The lizards swam over a distance of about 10 m and 15 m, respectively. On the first occasion, the lizard was first observed at one end of the pool and swam across; no predator or conspecific was observed that might have precipitated the swim. During the July 2003 observation, the lizard was initially observed swimming in the center of the pool. The swimming movement made a serpentine pattern that was especially evident in the tail; this animal would stop periodically to float and to change direction.

Swimming behavior would allow *Uma exsul* to move between dunes or escape a predator during intervals when water fills interdune depressions.

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URACENTRON FLAVICEPS (Thornytail Iguana). **ENDOPARASITES.** *Uracentron flaviceps* is a medium-sized (100 mm SVL adults) tropidurid lizard found in western Amazonia, Brazil, Colombia, Ecuador, and Peru (Avila-Pires 1995. Lizards of Brazilian Amazonia [Reptilia: Squamata]. Zoologische Verhandelingen Nationaal Natuurhistorisch Museum, Leiden, Netherlands. 706 pp.). To our knowledge, no reports of parasites from *U. flaviceps* exist. The purpose of this note is to report two species of nematodes, *Physaloptera retusa* and *Physalopteroides venancioi* from *U. flaviceps*.

Five *U. flaviceps* females (mean SVL = 86 mm ± 1.5 SD, range: 84–88 mm) from Moropon, on Río Nanay (3°43'S, 73°14'W, datum: WGS84; elev. 100 m), Department Loreto, Peru, collected 13 September 1973 were borrowed from the Texas Cooperative Wildlife Collections (TCWC), Texas A&M University, College Station, Texas (TCWC 44562–63, 44566, 44568–69). The esophagus, stomach, small and large intestines were opened and separately examined for helminths under a dissecting microscope. The body cavity was also examined for helminths. Two species of nematodes, *Physaloptera retusa* (one adult female from the stomach of TCWC 44569) and *Physalopteroides venancioi* (one adult female from the stomach of TCWC 44563) were found. Nematodes were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland as: *Physaloptera retusa* (USNPC 99001) and *Physalopteroides venancioi* (USNPC 99002).

Physaloptera retusa is widely distributed in lizards and two bufonid species in the New World (Bursey et al. 2005. Comp. Parasitol. 72:50–68). Larvae occur in insects (Schell 1952. J. Parasitol. 38:462–472; Lincoln and Anderson 1975. Can J. Zool. 53:385–390). Lizards presumably become infected by eating insects containing larvae. *Physalopteroides venancioi* is known from South American anurans and lizards (Bursey et al., *op. cit.).* Life cycles of species of *Physalopteroides* are unstudied, but like other members of the Physalopteridae, insects are probable intermediate hosts (Anderson 2000. Nematode Parasites of Vertebrates. Their Development and Transmission. CABI Publishing, Oxon, United Kingdom. 650 pp.). Both *P. retusa* and *P. venancioi* have previously been reported in other lizard species from Peru (Bursey et al., *op. cit.*). *Physaloptera retusa* and *P. venancioi* in *U. flaviceps* are new host records.

We thank Toby Hibbitts (Department of Wildlife and Fisheries, Texas A&M University) for permission to examine specimens and Sarah Goldsberry (Whittier College) for assistance with dissections.

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SERPENTES

AGKISTRODON BILINEATUS (Cantil). **REPRODUCTION**. *Agkistrodon bilineatus* ranges along the Pacific Coast and foothills from southern Sonora, Mexico, southward through México into Guatemala, Belize, Honduras, and Nicaragua (Campbell and Lamar 2004. The Venomous Reptiles of the Western Hemisphere. Cornell University Press, Ithaca, New York. pp. 262–265). Currently, three subspecies are recognized within the *A. bilineatus* complex. The northern subspecies, *A. b. bilineatus*, occurs along the Pacific Coast of Mexico, Guatemala, and El Salvador, and in the Rio Grijalva Valley of Chiapas, Mexico (Campbell and Lamar, *op. cit*.). Little published information exists regarding the biology of the northern subspecies, *A. b. bilineatus*. Furthermore, the cantils as a group are under extreme pressure as vast amounts of habitat are being rapidly converted to agricultural lands (Parkinson et al. 2000. Mol. Ecol. 9:411–420). Species-specific surveys with the Tropical Deciduous Forest (TDF) of southern Sonora have yielded few additional specimens of *A. bilineatus*.

At approximately 0900 h on 10 July 2004, an adult female *A. b. bilineatus* (ca. 533 mm TL) was killed by a farmer on the Las Cabras Ranch, Alamos, Sonora. The ranch lies within the foothills of the Sierra Madre Occidental within the TDF zone. The snake was discovered in a pile of decomposing leaves in a mango-avocado orchard. It was collected of by one of us (SM) and immediately frozen. We opened the snake to check for stomach contents, and discovered three neonates in the early stages of development. To our knowledge this represents the first litter for the species in the state of Sonora.

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CONIOPHANES IMPERIALIS (Black-striped Snake). **DIET**. *Coniophanes imperialis* is a small, terrestrial snake that can be active day or night. *Coniophanes* spp. are known to have a broad diet that includes insects, salamanders, frogs, frog eggs, lizards, snakes, reptile eggs, bird eggs, insects, and earthworms (Köhler 2003. Reptiles of Central America. Herpeton Verlag, Offenbach, Germany. 367 pp.; Savage 2002. The Amphibians and Reptiles of Costa Rica: A Herpetofauna Between Two Continents, Between Two Seas. University of Chicago Press, Chicago, Illinois. 934 pp.), although *C. imperialis* has only been reported to consume lizards, frogs, and insects (Campbell 1998. Amphibians and Reptiles of Northern Guatemala, the Yucatan, and Belize, University of Oklahoma Press, Norman. 380 pp.). We report two prey items for *C. imperialis* on the island of Cayo Cochino Pequeño in the Cayos Cochinos Archipelago (Islas de la Bahia, Honduras).

On 27 May 2006 at 1700 h we captured a small female (177 mm SVL, 29 mm tail, 4.0 g) *C. imperialis* with an obvious prey bulge, crawling through the leaf litter. We forced the snake to regurgitate and identified the food item as a single lizard egg suspected to be *Norops lemurinus*, based on size and shape of the egg and that *N. lemurinus* is the most common polychrotid lizard on the island. Although *Coniophanes* spp. are known to feed on reptile eggs (Köhler, *op. cit.*) our observation represents the first report of *C. imperialis* preying on lizard eggs (Campbell, *op. cit.*).

On 21 June 2006 at 1600 h we observed a large male (245 mm SVL, 115 mm tail, 11.0 g) *C. imperialis* in the leaf litter that contained a very large food item. After capturing the snake and forcing it to regurgitate we identified the partially digested prey item as an adult male (65 mm SVL, 9 mm tail, 6.0 g) *N. lemurinus*. The lizard represented 54.5% of the snake's mass and a 43.1% of its length. *Coniophanes imperialis* is known to consume lizards, but our observation represents the first report of *N. lemurinus* in the diet of *C. imperialis*. Our observation is also the largest reported meal by mass or length for *C. imperialis* (Alvarez de Toro 1960. Los Reptiles de Chiapas. Inst. Zool. Estado, Tuxtla Gutierrez, Chiapas, 204 pp.), although *C. fissidens* was reported to consume an *Eleutherodactylus rugulosus* that weighed 76.4% of snake mass (Seib 1985. Biotropica 17:57–64).

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CONOPSIS NASUS (Large-nosed Earth Snake). **PREDATION.** On 3 October 2005, while conducting a road transect along Road No. 68 in the state of Aguascalientes in central Mexico, we found a DOR male Coachwhip (*Masticophis flagellum*) (SVL 920 mm, TL 200 mm). Close examination of the carcass (possibly killed the day before) revealed two partially digested *Conopsis nasus* (SVL 110 mm each, sexes undetermined) protruding from the gut. To our knowledge this is the first record of predation of *M. flagellum* on *C. nasus*.

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CROTALUS HORRIDUS (Timber Rattlesnake). **BEHAVIOR.** On 7 March 1998 we observed an adult *Crotalus horridus* at a communal hibernaculum in Scioto County, Ohio, USA. The snake alerted us to its presence by rattling, and dried mud was present on its tail. Skies were partly cloudy with occasional periods of sunlight and a light breeze. Ambient temperature was 14°C and substrate temperature was 18°C. Earliest emergence date is a key component of the seasonal cycle of this species (Brown 1993. Biology, Status, and Management of the Timber Rattlesnake [*Crotalus horridus*]: A Guide for Conservation. SSAR Herpetol. Circ. No. 22, 78 pp.). Published accounts of the seasonal cycle of *C. horridus* in Ohio note observations from May to September (Conant 1938. Amer. Midl. Nat. 20:1–200). To our knowledge, this is the earliest emergence date for *C. horridus* at this latitude (Martin 1992. *In* J. A. Campbell and E. D. Brodie Jr. [eds.], Biology of the Pitvipers, pp. 259–278. Selva Press, Tyler, Texas).

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CROTALUS LEPIDUS LEPIDUS (Mottled Rock Rattlesnake). **DIET**. The diet of *Crotalus lepidus* recently was reviewed by Holycross et al. (2002. J. Herpetol. 36:589–597), and relatively little information exists on mammals consumed by rock rattlesnakes under natural conditions. Mammals consumed by this species in the wild include shrew, mouse, *Dipodomys* spp., *Chaetodipus* spp., *Perognathus* spp., *Peromyscus* spp., and *Sigmodon* spp. (Holycross et al., *op. cit.*).

On 23 March 2005 I observed and photographed an adult *C. l. lepidus* consuming an adult White-ankled Mouse (*Peromyscus pectoralis*) at 1350 m elev. in Carlsbad Caverns National Park, Guadalupe Mountains, Eddy Co., New Mexico, USA (Arizona State University, ASU HP-00054). This event was observed below the stone amphitheater on the paved switchback trail leading into the large natural entrance of Carlsbad Cavern. At about 2230 h (Mountain Standard Time), I found the *C. l. lepidus* swallowing the *P. pectoralis* head-first with back legs and white ankles of the mouse still visible, which facilitated the specific identification (see

Fig. 63 in Geluso and Geluso 2004. Mammals of Carlsbad Caverns National Park, New Mexico. Bull. Univ. Nebraska State Mus. 17:1–180). My sighting represents the first documentation of a known species of mammal being consumed by *C. lepidus* under natural conditions. Information on the natural history of this subspecies is important because it is listed as endangered by the New Mexico Department of Game and Fish (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque).

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CROTALUS VIRIDIS VIRIDIS (Prairie Rattlesnake). **BEHAVIOR**. Observations of the directional movements of experimentally displaced *Crotalus atrox* (Landreth 1973. Copeia 1973:26–31) and the straight-line paths of migratory *C. viridis viridis* between seasonal habitats (Duvall et al. 1985. Nat. Geogr. Res. 1:80–111) have led to the suggestion that rattlesnakes use celestial cues (e.g., the sun) for orientation. However, the use of other cues for orientation and navigation by rattlesnakes can not be ruled out based on limited experimental evidence. This observation of the homing ability of a naturally displaced prairie rattlesnake suggests that the species possesses not only a compass sense but also a map sense (Type III orientation; Griffin 1952. Biol. Rev. 27:359–400), providing knowledge of their location in relation to a destination. I employed radio telemetry to track the migrations of 18 non-gravid female Prairie Rattlesnakes, *Crotalus v. viridis*, from two dens near Medicine Hat, Alberta, Canada in 2005. One radio tagged rattlesnake was tracked across the South Saskatchewan River to its north side on 16 May (Fig. 1). The radio tagged rattlesnake remained on the north side of the river until 17 September and all recorded locations during this period were within approximately 560 m of the den of origin. On 18 September the rattlesnake crossed the river and was located on its south side ca. 2000 m east of its last known location. The river flows from west to east and it is assumed that the snake drifted downstream when crossing. Prior to this displacement the den was ca. 453 m from the snake's location on a true bearing of 103°. After displacement the den was ca. 1621 m away on a bearing of 246°. On the day following the crossing the snake moved 55 m from her previous location on a bearing of 333°. On the third and fourth day, four positions were recorded as the rattlesnake moved 1610 m back to the den. The route taken by the snake approximated a straight line with a mean bearing of 243.3° + 4.2°.

In this instance type II orientation can be discounted because the rattlesnake did not continue to orient as if it had not been displaced (Lawson 1994. Copeia 1994:263–274). Lohmann et al. (2004. Nature 428:909–910) stated, "Migratory animals capable of navigating to a specific destination, and of compensating for an artificial displacement into unfamiliar territory, are thought to have a compass for maintaining their direction of travel and a map sense that enables them to know their location relative to their destination." If we assume that Prairie Rattlesnakes are capable of using the sun as an effective compass it would allow the displaced rattlesnake to maintain a heading, but this would not account for the rattlesnake's apparent knowledge of its location relative to the den. Map sense in other taxa (e.g., turtles and birds) is thought to be based on the use of visual (Avens and Lohmann 2003. J. Exp. Biol. 206:4317–4325) or solar cues (Akesson et al. 2005. Current Biol. 15:1591–1597) combined with magnetic cues. Among snakes, chemosensory cues could also be used in combination with other cues for navigation during migration (Brown and Parker 1976. Copeia 1976:225–242; Fitch 1960. Univ. Kansas. Mus. Nat. Hist. Misc. Publ. 13:85–288; Lawson 1989. Musk-Ox 37:110–115). This observation of a naturally displaced Prairie Rattlesnake suggests

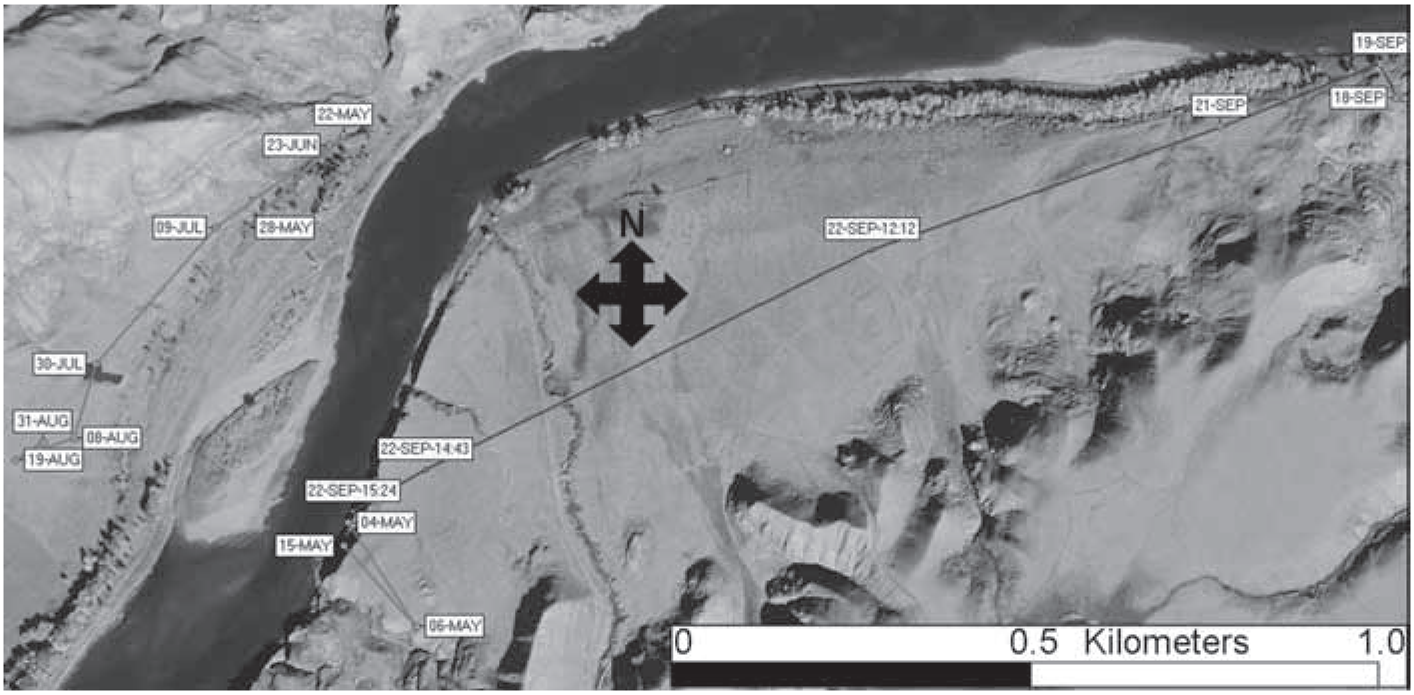

FIG. 1. Seasonal movements of a radio-tagged *Crotalus viridis viridis* displaced while crossing the South Saskatchewan River.

that this animal was capable of type III orientation. The advanced navigational abilities of Prairie Rattlesnakes might be based on the use of multiple sensory cues but further research is required to identify the role and importance of individual cues.

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DENDRELAPHIS PICTUS (Gmelin's Bronzeback). **DISPERSAL.** A juvenile *Dendrelaphis pictus* was found onboard a traditional fishing boat used for the transportation of tourists between Sape on the eastcoast of Sumbawa and Komodo Island, Indonesia. The boat embarked us as well as food (e.g., vegetables obtained in Sape), on 25 August 1998, and we were transported to the harbor off Kampong Komodo where we stayed overnight. The ship was never attached to a bridge at Komodo Island but remained anchored in a bay. The snake was discovered onboard the ship late afternoon the next day (26 August 1998). It seems impossible that it could have entered the ship from Komodo Island because no cargo was loaded there. More likely it was loaded with vegetables obtained in Sape on Sumbawa. The ship was used for this type of tourist transportation and had not visited other areas "for a long time," as the skipper informed me, so the snake probably originate from this area. All crew members, as well as the tourists onboard reacted negatively on the presence of the snake and killed it, suggesting the snake was not brought onboard intentionally. This observation is interesting because it illustrates the ease with which snakes can be accidentally transported by human activities.

The snake is deposited in the collection of the Natural History Museum, Göteborg, Sweden, under the number GNM Re.ex. 6587 and the identification was verified by Göran Nilson at this museum.

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DRYMARCHON CORAIS COUPERI (Eastern Indigo Snake). **FEEDING BEHAVIOR.** *Drymarchon corais couperi* is a dietary generalist that feeds on a wide range of vertebrate prey species including fish, frogs, toads, lizards, snakes (including venomous species), small turtles, birds, and small mammals (Moler 1992. Rare and Endangered Biota of Florida, Vol III: Amphibians and Reptiles. University of Florida Press, Gainesville. 291 pp.). *Drymarchon c. couperi* is a robust species that typically overpowers its prey using its strong jaws while pinning the prey item to the substrate with a body coil, usually swallowing its prey alive (Moler, *op. cit.*). Herein we report, not only a novel incident of carrion feeding in this species, but also a novel feeding behavior for Serpentes.

On 18 March 2001 at approximately 1330 h an adult *D. corais couperi* (ca. 2 m total length) was observed in the field at Pier 4, Playalinda Beach (Canaveral National Seashore, Brevard Co., Florida, USA) feeding on the head of a decapitated shark (species undetermined). Skies were overcast, ambient temperature was ca. 20°C, and a strong wind was blowing from the east. The feeding event occurred on top of a sand dune vegetated with sea oats (*Uniola paniculata*). Upon approaching the site, a Black Vulture (*Coragyps atratus*) flew off prior to observing the presence of the *D. corais couperi*. Feeding behavior consisted of the snake thrusting its head into the exposed neck musculature of the shark head and biting the exposed tissue. The snake would then twist its head and upper body laterally in attempt to tear the meat away. This behavior was observed for approximately three minutes, during which time it was photographed. The snake then ceased the biting behavior but continued to investigate the lateral surfaces of the shark head that had the skin intact, using its rostrum and lower jaw to push on it three more times. This behavior appeared to be associated with the snake's interest in locating additional feeding opportunities along the shark head. At this time the presence of small pieces of tissue derived from the neck musculature of the shark could be seen surrounding the upper and lower labial scales. The snake then abruptly left the carcass and crawled away into the dune grasses, appearing undisturbed. The amount of shark musculature actually ingested (if any) could not be determined as peristaltic contractions of the esophagus and neck region associated with swallowing could not be discerned.

A radio-telemetry study of over 80 *Drymarchon c. couperi* has been conducted from 1998 through 2005 in similar habitat at the Kennedy Space Center, Brevard Co., Florida, during which time carrion feeding was never observed (R. Bolt, pers. comm.). Observation of a snake attempting to tear pieces of flesh from a disarticulated carcass has not been previously reported.

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ELAPHE GUTTATA (Corn Snake). **PREY/PREDATOR WEIGHT RATIO.** To our knowledge, published accounts where prey mass has been equivalent to, or exceeded that of the predator have involved viperids (Greene 1983. Amer. Zool. 23:431–44; Lindey and Sorrell 2004. Herpetol. Rev. 35: 272–273; Mulcahy et al. 2003. Herpetol. Rev. 34:64) and boids (Weaver 2005. Herpetol. Rev. 36:189). Among the largest prey/predator weight ratios for colubrids are those reported by Lind and Welsh (1990. J. Herpetol. 24:104–106), who documented weight ratios for the genus *Thamnophis* as high as 0.88, and Tucker (2000. Herpetol. Rev. 31:106–107), who reported prey/predator weight ratios between 0.20 and 0.58 in four species of neonatal colubrid snakes. Hamilton et al. (1956. Ecology 37:519–526) described one instance of an *E. guttata* with a juvenile *Sigmodon hispidus* in its stomach that exceeded the weight of the snake, but did not provide the mass of predator or prey. Here we describe an observation of an *E. guttata* with an equivalent prey/predator weight ratio.

On 30 March 2006, one of us (TGJ) collected a neonate female *E. guttata* (369 mm SVL, 10 g) with a large bolus in its stomach. The snake was located in the southwestern corner of the Camp Shelby Training Site, Perry County, Mississippi, USA. I palpated a 10 g *Peromyscus* sp. from the snake's stomach, resulting in a prey/predator weight ratio of 1.00. An unsuccessful attempt was made to re-feed the prey item to the snake which was released at the point of capture the following day.

We thank Geoffrey G. Sorrell and Matthew G. Hinderliter for their comments.

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LEPTODEIRA ANNULATA (Banded Cat-eyed Snake). **DIET**. The anuran *Leptodactylus mystaceus* (Leptodactylidae) is distributed in the Amazon Basin from its southern limit in Brazil to Paraguay, Bolivia, Peru, Ecuador, Colombia, Venezuela, and the Guianas (Frost 2002. Amphibian Species of the World: An Online Reference V3.0). During a visual encounter survey on 07 November 2004, at 2125 h, an adult *L. mystaceus* (INPA-H 15713; 47 mm SVL; 8.7 g), was found being ingested by the snake *Leptodeira annulata* (Colubridae; INPA-H 12778; 601 mm SVL; 53 g), in a dry forest stream in the Brazilian Parque Nacional do Pico da Neblina (São Gabriel da Cachoeira municipality, Amazonas state). The snake was swallowing the frog head-first. From the time we first encountered it, the snake took an additional seven minutes to finish swallowing the frog. The new record reinforces assertions that *L. mystaceus* prey extensively on anurans (Vitt 1996. Herpetol. Nat. Hist. 4:69–76).

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LEPTODEIRA ANNULATA (Banded Cat-eyed Snake). **MATING**. *Leptodeira annulata* occurs from Mexico to Argentina (Peters and Donoso-Barros 1986. Catalogue of Neotropical Squamata. Part I, Snakes. Revised ed. Smithsonian Institution, Washington, D.C. 347 pp.). The ecology of *L. annulata* has been studied (Vitt 1996. Herpetol. Nat. Hist. 4:69–76), but little is known regarding its mating behavior.

On 08 Jun 2005, we found one female (577 mm SVL, 177 mm tail length, 36 g) and three male (514, 533, and 473 mm SVL; 188, 187, and 176 mm tail length; 24, 23, and 19 g, respectively) *L. annulata* in a pitfall trap at Floresta Nacional de Carajás, eastern Brazilian Amazônia (06°02'S, 50°15'W). The snakes were forming a breeding ball and were releasing a strong odor. When handled, males discharged fetid cloacal secretions and the female expelled a large amount of sperm from the vent. This observation suggests that, although this species is primarily arboreal, mate searching occurs in the ground, perhaps because tracking pheromone trails in the discontinuous arboreal substratum is difficult.

This observation was supported by Compahia Vale do Rio Doce.

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LEPTODEIRA ANNULATA (Banded Cat-eyed Snake)**. SIZE, REPRODUCTION, AND PREY.** The colubrid snake *Leptodeira annulata* has a wide distribution in the Neotropics, ranging from Mexico to Argentina (Peters and Orejas-Miranda 1986. Catalogue of the Neotropical Squamata, Part I – Snakes. Smithsonian Institution Press, Washington D.C. 347 pp.). Most of the published information on the ecology of *L. annulata* in South America originated from Amazonian populations (Fitch 1970. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 52:1–247; Duellman 1978. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 65:1–352; Henderson et al. 1979. Milwaukee Publ. Mus. Contr. Biol. Geol. 22:1–11; Vitt 1996. Herpetol. Nat. Hist. 4:69–76; Martins and Oliveira 1998. Herpetol. Nat. Hist. 6:78–150). Data are currently lacking for this species in the Atlantic Forest of eastern Brazil. In this note we report data on body size, reproductive traits, and stomach contents of an individual from an Atlantic Forest locality in southeastern Brazil.

On 28 September 2004 at 2105 h during a herpetofaunal survey at the Paraíso Ecological Station (22°29'S, 42°55'W; Guapimirim Municipality, Rio de Janeiro State, Brazil) two of us (DV and CCS) found a female *L. annulata* (718 mm SVL; 920 mm TL; 87 g) at the margin of a stream. The snake had a distinct mid-body bulge, indicating that it had eaten recently. Upon dissection, we found five eggs in the oviducts, with a mean length of 23.4 ± 1.7 mm (range 21.0–25.7 mm) and a mean width of 11.1 ± 1.7 mm (range 9.6–14.0 mm). The snake's stomach contained a partially digested *Bufo crucifer* (70 mm SVL) which had been swallowed head-first. The snake and its stomach contents were deposited at the Museu Nacional, Rio de Janeiro (MNRJ 12232).

Total length of MNRJ 12232 was larger than the maximum total lengths (between 760–870 mm) reported for *L. annulata* (Duellman 1958. Bull. Amer. Mus. Nat. Hist. 114:1–152; Duellman 1978, *op. cit.*; Fitch 1981. Misc. Publ. Mus. Nat. Hist. Univ. Kansas 70:1–72; Martins and Oliveira, *op. cit.*) and its SVL was greater than the maximum SVL (659 mm) of 59 Amazonian specimens examined by Vitt (*op. cit.*; total lengths not given). On the other hand, Savage (2002. The Amphibians and Reptiles of Costa Rica. University of Chicago Press, Chicago, Illinois. 934 pp.) reported a maximum total length of 1038 mm for this species in Costa Rica, which exceeds the size of MNRJ 12232. Nevertheless, the specimen reported here represents, to our knowledge, the largest size on record for *L. annulata* in South America.

Clutch size of this individual (five eggs) is within the ranges reported by Fitch (1970, *op. cit.*) for Amazonian Peru (2–7 eggs; mean = 4.0) and Vitt (*op. cit.*) for Amazonian Brazil and Ecuador (3–6 eggs; mean = 4.7). The eggs, on the other hand, were large compared to those reported for females of Amazonian populations: Vitt (*op. cit.*) reported an average length of 19.0 mm (range 13.5–22.4 mm) and an average width of 7.4 mm (range 5.3–10.2 mm) for 25 eggs taken from five females and Martins and Oliveira (*op. cit.*) recorded lengths of 17–18 mm and widths of 7–8 mm for six eggs taken from one female. It would be interesting to examine more *L. annulata* specimens from the Atlantic Rainforest domain to verify whether they usually lay larger eggs than their Amazonian conspecifics, as suggested by the present data.

Prey reported for *L. annulata* at various localities consist almost exclusively of anuran amphibians, mainly hylids and leptodactylids (Duellman 1958, *op. cit*.; 1978, *op. cit*.; Vitt, *op. cit*.; Martins and Oliveira, *op. cit*.). Vitt (*op. cit*.) recorded one bufonid (*Bufo granulosus*) and Duellman (1958, *op. cit*.) reported three species of *Bufo* (*B. marinus*, *B. typhonius,* and *B. valliceps*) and a few indeterminate *Bufo* specimens from stomachs of *L. annulata*. The present note reports another species of *Bufo* as prey of *L. annulata*, which suggests that predation on such animals by this snake might not be infrequent. Thus, the toxic secretions from the parotoid glands of *Bufo* spp. do not seem to be an efficient deterrent from predation by *L. annulata*, which might not be affected by the toxin to any significant degree. The present data also indicate that *L. annulata* does not stop feeding during pregnancy.

We thank A. Pissinatti for allowing the authors to work at the Paraíso Ecological Station, José P. Pombal Jr. for identifying the toad, and the Center for the Conservation of Biodiversity (CCB) for logistic support.

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LEPTODEIRA ANNULATA (Banded Cat-eyed Snake). **PREY**. *Leptodeira annulata* is an arboreal and nocturnal colubrid that ranges from México through Central America and the Amazon basin into northern Argentina. Often it is found in trees and bushes near water and feeds primarily on anurans (Duellman 1958. Bull. Amer. Mus. Nat. Hist. 114:1–152; Savage 2002. The Amphibians and Reptiles of Costa Rica. The University of Chicago Press, Chicago, Illinois. 954 pp.).

On 12 March 2004 at 2140 h we observed an *Osteocephalus taurinus* (Anura) sitting on a rock ca. 50 cm above a small tributary to the Rio Chumilla (between Shapaja and Chazuta in the Tarapoto region of Peru, ca. 500 m elev.). Over a distance of ca. 5 m, a *L. annulata* (ca. 1 m TL) approached the frog from amidst overhanging branches. The frog leapt from its rock and was seized by the snake in mid-air. The snake ingested the seemingly alive, but paralyzed frog (hindlimbs first), while hanging head-down from its original perch over a period of ca. 30 minutes. To the best of our knowledge, this is the first documentation of *L. annulata* predation on *O. taurinus*.

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LIOPHIS REGINAE (Reticulated Snake). **DIET.** Throughout large parts of the Neotropics, peccaries (Tayassuidae*, Pecari tajacu* and *Tayassu pecari*) create and maintain wallows in the forest understory. These pools provide year-round breeding habitat for amphibians that opportunistically breed in pools. For several years, one of us (HB) has worked at the Cocha Cashu Biological Station within the Manu National Park (11°52'S, 71°21'W), Peru to test whether peccaries function as ecosystem engineers by creating new habitats (wallows) that may be colonized by other species. On 23 March 2005 while monitoring the breeding activities of the leptodactylid frog *Edalorhina perezi* at peccary wallows, we noticed a juvenile (186 mm SVL) *Liophis reginae* inside a terrestrial *E. perezi* foam nest. As the snake left the foam nest it was collected and preserved in 70% ethanol. Upon dissection, we found six *E. perezi* tadpoles in its stomach. This is the first record of *L. reginae* preying upon *E. perezi* tadpoles inside a foam nest. Depredation of frog eggs and larvae by snakes is well documented in the Neotropics, and several snake taxa may be considered anuran specialists. Few predators, however, have been documented feeding within the foam nests of leptodactylid frogs.

The snake (TUMZ 8051), the ingested tadpoles and voucher specimens (TUMZ 8052) from the foam nest are permanently stored at the Museum of Zoology at Towson University, Department of Biological Sciences.

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MASTICOPHIS FLAGELLUM FLAGELLUM (Eastern Coachwhip). **GROWTH AND MOVEMENT.** Little is known regarding growth rates of *Masticophis flagellum* and limited data have been generated regarding their movement (Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Institution Press, Washington, D.C. 668 pp.). Herein we report on a PIT-tagged male *M. flagellum* that was captured three times over a 23-month time period in Baker Co., Georgia, USA. In May 2003, the individual measured 1605 mm SVL, 2078 mm TL, and 940 g. Reliable measurements were not taken during June 2004, when the snake was captured a second time. In April 2005, the same individual was recaptured and measured 1622 mm SVL, 2089 mm TL, and 951 g. The first and second capture locations were 1469 m apart (straight line distance) and separated by Ichawaynochaway Creek (a major tributary of the Flint River) while the second and third locations were 291 m apart (straight line distance) for a minimum cumulative movement of 1760 m. *Masticophis flagellum* are known to travel considerable distances (ca. 1 km; Secor 1995. Herpetol. Monogr. 9:169–186) but to our knowledge, movements on this scale have not been recorded. In addition, movement across aquatic habitats such as creeks or rivers does not appear to have been previously documented in this species.

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NERODIA ERYTHROGASTER FLAVIGASTER (Yellow-bellied Watersnake). **DIET**. *Nerodia erythrogaster* is a prey generalist with a diet consisting of crayfish, a variety of fish, salamander, anurans and their larvae. The majority of prey consumed by this semi-aquatic snake are amphibians including the potentially toxic toads of the genus *Bufo* (Gibbons and Dorcas 2004. North American Watersnakes: A Natural History. Univ. Oklahoma Press, Norman, Oklahoma. 438 pp.). Previously reported bufonid species have included *B. americanus*, *B. houstonensis*, *B. terrestris*, *B. valliceps*, and *B. woodhouseii*. There has been discrepancy in the literature about the validity of *Bufo velatus* as a species. Some researchers regard it as an intergrade between species in the *B. woodhouseii* complex (Conant and Collins 1998. Reptiles and Amphibians: Eastern and Central North America. Houghton Mifflin Co., New York. 616 pp.; Dixon 2000. Amphibians and Reptiles of Texas. Texas A & M University Press, College Station, Texas. 421 pp.). Herein, *B. velatus* is considered a species according to recent literature and systematic analysis (Dixon 2000, *op. cit*.; B. Fontenot, pers. comm.). No previous records are known of *N. erythrogaster* consuming *B. woodhouseii* within the currently understood range of *B. velatus*; thus this report is the first documentation of the East Texas Toad, *B. velatu*s, as a prey item of *N. erythrogaster*.

On 2 May 2004 a *N. erythrogaster* (763 mm SVL, 310 g) was collected from under an artificial cover item at the Old Sabine Bottom Wildlife Management Area (OSBWMA) Smith County, Texas, USA (32°35.853'N, 95°20.369'W). A gravid female *B. velatus* (43.1 g) was palpated from the specimen.

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NERODIA ERYTHROGASTER FLAVIGASTER (Yellow-bellied Watersnake). **ANTI-PREDATORY BEHAVIOR**. Tail breakage is an anti-predatory strategy employed by several species of snake (Mendelson 1992. Herpetologica 48:448–445; Fitch 2003. Herpetol. Rev. 34:212–213). When a snake is captured by the tail it may roll or rapidly undulate to facilitate breakage. The remaining tail fraction creates little movement and the snake is provided an opportunity for escape. This behavior, however, potentially has detrimental effects on locomotion, courtship, and defensive behavior (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. University of Oklahoma Press, Norman. 332 pp.; Chapple et al. 2004. J. Herpetol. 38:137–140). This note is the first documentation of tail breakage by *Nerodia erythrogaster*.

On 9 April 2005, a female *N. erythrogaster* (720 mm SVL, 226.3 g) was found under a piece of tin at the Old Sabine Bottom Wildlife Management Area, Smith County, Texas, USA (32°35.945'N 095°20.638'W). The snake was seized by the tail as it attempted to flee. Very soon after restraint, the snake rotated its body and the tail broke off in my hand. The intact tail length was 179 mm and the disconnected tail fraction was 73 mm. Based upon length, approximately 29% of the tail was lost.

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NERODIA FASCIATA CONFLUENS (Broad-banded Watersnake). **DIET**. *Nerodia fasciata* is primarily a piscivorous snake (Mushinsky and Hebrard 1977. Herpetologica 33:162–166). A wide variety of amphibians, however, have also been documented as food items (Gibbons and Dorcas 2004. North American Watersnakes: A Natural History. University of Oklahoma Press, Norman, Oklahoma. 438 pp.). Five species of salamander, representing four families, have previously been reported as prey. Here I report the first published record of the family Ambystomatidae in the diet of *Nerodia fasciata*.

On 29 March 2005, a *N. fasciata* (163 mm SVL, 6 g) was found under a piece of corrugated tin at the Old Sabine Bottom Wildlife Management Area (OSBWMA) Smith County, Texas, USA (32°35.853'N, 95°20.369'W). The individual readily regurgitated a prey item identified as an *Ambystoma texanum* metamorph (0.7 g) approximately half-digested. The nearby pool was sampled for *A. texanum* larvae. Of three captured larvae, the mean SVL was 34.7 ± 5.8 mm and the mean mass was 1.93 ± 0.8 g. The OSBWMA is a bottomland floodplain that experiences occasional flooding. The floods create ephemeral pools that contain pulsed resources such as fish. However, droughts and dams up-river of the site have decreased the frequency and intensity of natural floods and fish are no longer common in the vernal pools. *Ambystoma texanum*, on the other hand, are quite numerous in this floodplain and are abundant prey items for many semi-aquatic snakes species.

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PHILODRYAS OLFERSII (NCN)**. NATURAL HISTORY.** *Philodryas olfersii* is found in western Brazil and eastern Peru through Bolivia and Paraguay to Uruguay and Argentina. Despite its wide distribution, information regarding the ecology of the species is scarce and focused in small portions of the species' distribution (e.g., northeastern Brazil). In Pantanal, the species was found in rocky areas, deciduous and semideciduous forest and urban environments. Here, we present data from oviposition in captivity and activity in rocky areas near Corumbá, Mato Grosso do Sul, Brazil. On 26 November 1998, five eggs with a mean length of 49.5 ± 4.9 mm (44.1–57.6 mm), mean width of 17.3 ± 1.2 mm (16.3–19.2 mm), and mean volume of 7800 ± 1297 mm^3 were found in Laboratório de Zoologia of Campus de Corumbá. After 73 days, four hatchlings with an average mass of 7.1 ± 1.1 g (5.8–8.5 g) emerged. Unfortunately, we did not measure the hatchlings. One month later (day 19) in the terrarium of the same female nine eggs were found with mean length 33.4 ± 2.7 mm (29.3–37.9 mm), mean width 17.3 ± 2.1 mm (14.8–21.5 mm), and mean volume 5263 ± 1336 mm^3. In this case only three eggs hatched (after 39 days), with a mean mass of 3.8 ± 0.4 g, mean SVL of 214.0 ± 10.8 mm, and mean tail length of 93.7 ± 4.0 mm. One hatchling died within 3 minutes of hatching. The specimens have been deposited in Coleção Zoológica de Referência do Campus de Corumbá (CEUCH 167, 191–195).

We captured five *P. olfersii* in rocky areas from June 2003 to March 2004. We found two individuals basking in bromeliads at 0700 h and 1324 h, one on the ground below bushes at 1525 h, and two were found foraging at 1340 h and 1450 h. Foraging behavior consisted of constant movement in search for prey in bushes ca. 3 m high. One individual (CEUCH 044, SVL 946 mm) had a juvenile *Bufo schneideri* (TL 33.2 mm) in its stomach. Our observations suggest that *P. olfersii* is an active forager, uses foliage for foraging and basking, appears to produce more than one clutch/year, and oviposits in the early rainy season, unlike populations in the Caatinga of northeastern Brazil (Vitt 1980. Pap. Av. Zool. 34:87–98).

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PITUOPHIS CATENIFER SAYI (Bullsnake). **NESTING**. On 20 June 2005, while monitoring turtle activity at a drift fence north of Gimlet Lake on the Crescent Lake National Wildlife Refuge in Garden County, Nebraska, USA (see Iverson 1991. Herpetologica 47:371–393), we encountered an obviously gravid (palpable eggs, freshly ecdysed) female Bullsnake (1110 mm snout–vent length; 118 mm tail length; ca. 475 g body mass). Because of her condition and direction of movement (from low meadow to upland sandhills), we presumed that she was moving to oviposit, and force-fed her a transmitter (model LF1-STL-RS, LL Electronics, Urbana, Illinois) coated in wax (total weight 9 g) and released her. Over the next five days she spent the nights underground in an abandoned pocket gopher (*Geomys bursarius*) burrow complex (diameter of all nocturnal locations ca. 1 m). During the day she ventured up to 29 m (17 m minimum) from that complex, and when not actively moving, was found coiled in the partial shade of one of many yuccas (*Yucca glauca*) in the area. At 0545 h on 25 June she was underground in the gopher burrow, but at 0940 h she was obviously spent (298 g body mass, including transmitter) after having crossed the drift fence on her way toward the meadow. We assumed that she oviposited the previous night. She was captured at 1015 h after moving ca. 104 m directly toward Gimlet Lake (total distance from the burrow complex to the cattails fringing the lake's shoreline, ca. 200 m).

On 26 June at 0900 h we excavated the gopher burrow complex and located the snake's clutch of 9 eggs (mean length 44.4 mm; mean width 27.7 mm) in a single cemented cluster (total mass 176.8 g) at the end of a shallow branch off the main gopher burrow below where it had been located the day before. Depth from the soil surface to the top egg was 263 mm, and to the bottom of the lowest egg, 312 mm. We also found the shed skin of a much larger *P. catenifer* in another branch of the same burrow complex, but no other evidence of any other snakes or eggs. The nest site was on a southwest-facing (237 degrees), 14 degree slope in a sparsely vegetated area of mid-grass prairie dominated by Needle and Thread Grass (*Stipa comata*), bluestems (*Andropogon* sp.), Switchgrass (*Panicum virgatum*), yucca, and introduced cheat grass (*Bromus* sp.). Early on 27 June she defecated the transmitter and was released in the meadow.

Although nest sites of the Pinesnake (*Pituophis melanoleucus*) have been well described (Burger and Zappalorti 1991. J. Herpetol. 25:152–160), only anecdotal reports are available for *P. catenifer*. In western Oregon communal nests of Pacific Gophersnakes (*P. c. catenifer*) were found in "cavities" in a talus slope, with one specifically found at a depth of 30 cm in an inactive rodent burrow (Brodie et al. 1969. Herpetologica 25:223–227). Similarly, in British Columbia at least two female Great Basin Gophersnakes (*P. c. deserticola*) nested communally in a rodent burrow (Shewchuk 1996. M.S. thesis, Univ. of Victoria), and in northern Utah at least four females nested singly or communally (sometimes with *Masticophis taeniatus*) in abandoned rodent burrows at depths of 34–42 cm (Parker and Brown 1980. Milwaukee Publ. Mus. Publ. Biol. Geol. 7:1–104). These data suggest that *P. melanoleucus* excavates its nest burrows, whereas *P. catenifer* uses natural cavities or burrows for oviposition; however, further data are needed for both species to determine the universality of this pattern.

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PITUOPHIS MELANOLEUCUS LODINGI (Black Pinesnake) **CARRION FEEDING.** Members of the genus *Pituophis* are known to take a wide variety of prey items, including small mammals, birds and their eggs, lizards, snakes and their eggs, and insects (Ernst and Barbour 1989. Snakes of Eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.; Rodríguez-Robles 1998. Copeia 1998:463–466; Rodríguez-Robles 2002. Biol. J. Linn. Soc. 77:165–183). However, information pertaining to the diet and the prey items selected by the Black Pinesnake (*Pituophis melanoleucus lodingi*) are limited (e.g., Cliburn 1962. Herpetologica 18:34–37; Rudolph et al. 2002. Herpetol. Nat. Hist. 9:57–62). Herein I report an instance of carrion feeding by *P. melanoleucus lodingi*.

On 24 June 2005 at 1203 h, a female *P. melanoleucus lodingi* (121 cm SVL, 615 g), implanted with a radio transmitter (Holohil, SI-2T), was located as part of an ongoing radio-telemetry investigation into the movement patterns and general life history of *P. melanoleucus lodingi* on the Camp Shelby Training Site, Perry County, Mississippi, USA. The snake was observed basking 5 m from the entrance to an underground refugium (stump hole), and appeared to have recently fed as indicated by a large bolus in its stomach. Upon palpating the snake a young *Sciurus niger* was regurgitated. The squirrel was fairly decomposed and completely covered in maggots (still alive). When the snake was released it quickly retreated to the nearby stump hole, and the squirrel was placed in front of the refugia's entrance. The next day the snake was rediscovered in the exact location it had been observed the previous day and had presumably re-ingested the squirrel since it was nowhere to be found, and the snake was observed with a similarly sized bolus in its stomach. The presence of maggots on the prey item suggests the squirrel had died prior to being consumed, and the fact that the maggots were still alive implies the snake had recently eaten the animal. The frequency and propensity to scavenge and the relative contribution that carrion represents in the diet of the Black Pinesnake is unknown. However, carrion probably plays an important supplementary role, as is the case with a number of other snake species (See DeVault and Krochmal 2002. Herpetologica 58:429–436).

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PITUOPHIS MELANOLEUCUS LODINGI (Black Pinesnake). **SEXUAL BEHAVIOR.** *Pituophis melanoleucus lodingi* is a large, secretive colubrid whose range is limited to the Gulf Coastal Plain of Louisiana, Mississippi, and Alabama. Seasonal timing of sexual behavior (e.g., courtship, coitus) for this subspecies has not been reported, although detailed studies on the reproductive biology and reports of courtship exist for *P. m. melanoleucus* and *P. m. mugitus* (Ashton and Ashton 1981. Handbook of Reptiles and Amphibians of Florida. Part 1. The Snakes. Windward Publ. Inc., Miami, Florida. 176 pp.; Zappalorti et al. 1983. Bull. Chicago Herpetol. Soc. 18:57–72; Burger and Zappalorti 1986. Copeia 1986:116–121; Gerald and Holmes 2004. Herpetol. Rev. 35:180). The literature indicates that courtship takes place during late spring (the month of May, in both Tennessee [Gerald and Holmes, *op. cit.*] and New Jersey [Zappalorti et al., *op. cit.*] populations); although Goldberg and Parker (1975. Herpetologica 31:317–322) suggested that breeding throughout the year is possible. Here I report the first observation of copulatory behavior in a pair of *P. m. lodingi* from Mississippi, and possibly the latest known seasonal instance of such behavior for *P. melanoleucus*.

On 28 September 2005, at 1035 h, I observed a pair of *P. m. lodingi* copulating in the southwestern corner of the Camp Shelby Training Site, in Perry County, Mississippi, USA. Both individuals (male: 149.5 cm SVL, 1001 g; female: 121.2 cm SVL, 615 g) carried intraperitoneally implanted radio-transmitters weighing less than 5% of body mass. The pair was loosely coiled on the ground with the male's entire body positioned on top of the female's with the exception of the tail, which was extended along the side of her body in such a manner as to allow for copulation. Ambient air temperature was 33.2°C during the time of the observation and no precipitation occurred within the previous 24 h. The snakes remained together in the same area for 3 days following the initial observation, but were located below ground, in a rotted-out pine root system, during each visit. On the fourth day both snakes moved to different locations ca. 300 m apart.

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PYTHON MOLURUS BIVITTATUS (Burmese Python). **NESTING**. Although *Python molurus bivittatus* is native to Southeast Asia, both adult and juvenile specimens have been collected in Everglades National Park, Florida, USA, since the mid 1990s (Meshaka et al. 2000. Florida Sci. 63:84–102). Breeding of free-living *P. m. bivittatus* has not been confirmed anywhere in Florida. Here we document the first nest outside of captive breeding efforts in the United States.

On 25 January 2006 a female *P. m. bivittatus* was collected within Everglades National Park. On 8 February 2006 she was released with two VHF radio transmitters implanted subcutaneously as part of a study on movements and habitat use. On 17 May 2006 we located the female to remove her from the field and found her coiled around eggs (Everglades National Park Museum photograph, EVER 41050).

The nest (25.36°N, 80.68°W, elev. 0.5 m) was located in an overgrown debris pile (approximately a 20 m semicircle) comprised mainly of vines, small forbs and shrubs, other vegetation, cut logs, PVC pipe, barbed wire, poster-board, planks, cardboard, pieces of a filing cabinet, and other materials. The nest was located under a piece of metal that was under a nodule of the root system of the tallest tree (a Brazilian Pepper, *Schinus terebinthifolius*) in the debris pile. The eggs were clustered on a circle of decomposed organic matter ca. 80 cm in diameter. The nest had 46 eggs (42 fertile, 2 infertile, and 2 opened at the nest and not measured). Mean egg length (N = 44) was 91.8 mm (SD = 6.5), mean egg width was 62.7 mm (SD = 4.0), mean egg mass was 189.1 g (SD = 37.2). Mean embryo length (N = 24) was 90.0 mm (SD = 6.8).

To date, there are scant data of *P. m. bivittatus* nest structure or material, although pythons are known to nest in mammal burrows, hollow logs, cavities under rocks, and around plant roots (Minton and Minton 1973. Giant Reptiles. C. Scribner's Sons, New York. 345 pp.).

Submitted by **RAY W. SNOW**, South Florida Natural Resources Center, Everglades National Park, 40001 State Road 9336, Homestead, Florida 33034, USA (e-mail: skip_snow@nps.gov); **VALERIE M. JOHNSON** (e-mail: johnsonv@ufl.edu), **MATTHEW L. BRIEN** (e-mail: mbrien@ufl.edu), **MICHAEL S. CHERKISS** (e-mail: mcherkis@ufl.edu), and **FRANK J. MAZZOTTI**, Department of Wildlife Ecology and Conservation, University of Florida, Fort Lauderdale Research and Education Center, 3205 College Avenue, Davie, Florida 33314, USA (e-mail: fjma@ufl.edu).

SONORA SEMIANNULATA (Ground Snake). **PREDATION**. *Sonora semiannulata* (Colubridae) is a small burrowing species that occurs in desert, grassland, and semi-arid forest formations throughout the southwestern U.S. and northern Mexico (Frost 1983. Cat. Amer. Amphib. Rept. 333.1–4). The snake feeds primarily on small arthropods, including venomous centipedes, and was assumed to have some physiological resistance to venom or behavioral attributes allowing for successful prey capture without being envenomated (Kassing 1961. Texas J. Sci. 13:185–203; Werler and Dixon 2000. Snakes of Texas: Identification, Distribution, and Natural History. Univ. Texas Press, Austin, Texas, 437 pp.). Consuming venomous arthropods by *S. semiannulata* is thus well established, but the reverse situation, the predation on that species by venomous arthropods, has not been documented. Here we present the first reported observation of predation on a *S. semiannulata* by the centipede, *Scolopendra heros*, a large (maximum 210 mm TL) and voracious species, with relatively toxic venom, which reportedly consumes about any animal it can overpower, including snakes (Maldonado 1998. The Taxonomy and Biology of Southwestern U.S. Scolopendrid Centipedes [Chilopoda: Scolopendridae]. M.S. Thesis, Dept. of Biol. Sci., The Univ. of Texas at El Paso, 110 pp.). As an example, Easterla (1975. Southwest. Nat. 20:411) described a 118 mm (TL) *S. heros* eating a freshly killed 247 mm (TL) Long-nosed Snake, *Rhinocheilus*

FIG. 1. A *Scolopendra heros* examining a freshly killed *Sonora semiannulata* prior to devouring its soft body parts.

lecontei, near Study Butte, Brewster Co., Texas, and noted that soft portions of the head and neck of the snake were consumed first.

On 12 June 2003 at 0916 h, while lifting a pitfall trap cover board, a large *S. heros* (ca. 203 mm TL) was observed killing and then eating a *Sonora semiannulata* (ca. 218 mm TL; Fig. 1) near the headquarters of Indio Mountains Research Station (IMRS), Hudspeth Co., Texas (30°46'35"N, 105°00'55"W; 1215 m elev.). The local environment at the observation site was a sloping alluvial fan covered by Chihuahuan Desert scrub vegetation. Estimating length, which was determined by using a string to measure each animal, was necessary due to IMRS policy prohibiting unnecessary disruption of animals engaged in natural behavior. Fortunately, the centipede could be realistically measured since the animal ignored us while feeding. The snake was still alive when first discovered, but obviously incapacitated by either the centipede's venom or by other trauma associated with the attack. Even though the centipede was shorter than the snake, it nonetheless had a more massive body and in all probability had little difficulty initially overpowering its weaker prey. Surveillance of ensuing feeding behavior confirmed that the snake was being consumed from the head backward along the body (similar to that reported by Easterla, *op. cit.*). Soft parts were devoured flush to the vertebrae and ribs while the centipede made circular bites around the snake's torso. The feeding process was tracked for about 20 minutes, after which time the centipede carried away the half-eaten snake and disappeared into nearby vegetation. Fig. 1 and another digital photograph depicting the centipede consuming the snake are deposited in the photograph collection, Laboratory for Environmental Biology, Centennial Museum, The University of Texas at El Paso (UTEP G2005.1.1–1.2).

Submitted by **JERRY D. JOHNSON, G. WALKER JOHNSON,** and **HECTOR RIVEROLL, JR.**, Department of Biological Sciences, The University of Texas at El Paso, El Paso, Texas 79968, USA (e-mail: jjohnson@utep.edu).

THAMNOPHIS CYRTOPSIS (Black-necked Gartersnake). **BEHAVIOR**. On 12 August 2004, one of us (EWS) captured a small (179 mm SVL, 2.0 g), male *T. cyrtopsis* with a noticeable food bulge in a creek in the Rincon Mountains, Saguaro National Park, Arizona, USA. As the snake was readied for processing it was held loosely, during which time it coiled itself into a knot. The snake was looped into a circle with a coil around its body directly posterior of its head. The coil was tight and it seemed strength was gained by buttressing the anterior ventral surface against the top of the head. Proceeding posteriorly from the first loop, the tail was brought back under its head and another coil was looped around its body, anterior to the first loop. Here, it appeared strength was gained by buttressing against the side of the head. The end of the tail was placed against the top of the snake's head, giving the appearance that leverage was gained by the tail's placement. The combination of coils circling the body and bracing of body parts made for a very tight structure; the snake could literally be held by the long section of its body with the coiled head and tail remaining stiff and inflexible (Fig. 1). To our knowledge, this behavior has not been reported for any *Thamnophis*. Veer et al. (1997. Herpetol. Rev. 28:91) report similar behavior by *Sonora semiannulata* in response to attempted predation by *Micruroides euryxanthus*. Their report describes a behavior whereby a *Sonora* formed a loop that (temporarily) stymied predation by grasping itself behind its own head, forming a loop that the *Micruroides* "walked over" as it maneuvered to find the ground snake's head. Given that *T. cyrtopsis* is sympatric with *M. euryxanthus* and other ophidiophagous snakes (e.g., *Lampropeltis* spp., *Masticophis* spp., *Diadophis punctatus*), the unique behavior we observed may provide a similar defensive role.

FIG. 1. *Thamnophis cyrtopsis* showing presumed defensive behavior.

Submitted by **ERIC W. STITT**, School of Natural Resources, 125 Biological Sciences East, University of Arizona, Tucson, Arizona 85721, USA (e-mail: estitt@u.arizona.edu); and **DON E. SWANN,** National Park Service, Saguaro National Park, Tucson, Arizona 85730, USA.

THAMNOPHIS MARCIANUS MARCIANUS (Checkered Garter Snake). **DIET**. Although a wide variety of taxa, including invertebrates, fish, lizards, snakes, and mammals, are considered part of its diet, *Thamnophis marcianus* preys most frequently on amphibians (reviewed in Ernst and Ernst 2003. Snakes of the United States and Canada. Smithsonian Inst. Press, Washington, D.C. 668 pp.). Only two species of lizard (*Cophosaurus texanum* and *Holbrookia maculata*) have been previously documented as prey items of *T. marcianus*. This is a report of the first documented occurrence of a teiid lizard, *Aspidoscelis inornatus*, as a prey item of *T. marcianus*.

On 3 August 2006 a *T. marcianus* (ca. 70 cm TL) was found crossing Highway 380, ca. 11 miles E of Roswell, Chaves Co., New Mexico, USA (33°23.843'N, 104°25.296'W). Upon capture, the snake readily regurgitated the remains of an *A. inornatus*.

Submitted by **PAUL M. HAMPTON**, Department of Biology, University of Louisiana at Lafayette, Lafayette, Louisiana 70504, USA; and **BRIAN E. FONTENOT**, Department of Biology, University of Texas at Arlington, Arlington, Texas 76019, USA.

THAMNOPHIS PROXIMUS PROXIMUS (Western Ribbon Snake). **NECROPHAGY**. Reports of necrophagy in snake species, although uncommon, have previously been documented, particularly with roadkill as the food item (Teixeira and Vrcibradic 2003. Herpetol. Rev. 34:248). The diet of *Thamnophis proximus* is broad, consisting of several salamanders, frogs, toads, and fish species (Rossman et al. 1996. The Garter Snakes: Evolution and Ecology. University of Oklahoma Press, Norman, Oklahoma. 332 pp.). This is the first published account necrophagy by *T. proximus*.

On 9 April 2005, a female *T. proximus* (679 mm SVL, 99 g) with an obvious prey bulge was captured at the Old Sabine Bottom Wildlife Management Area, Smith Co., Texas, USA (32°36.156'N, 95°20.329'W). An *Ambystoma texanum* (56 mm SVL, 2 g) was removed. The salamander was ingested mid-body first and appeared to have desiccated prior to ingestion as evidenced by sunken eyes and shrunken leathery skin. The salamander was also rigid, which is inconsistent with the generally soft body of palped amphibian prey. Little digestion was apparent, also inconsistent with other palped prey items. Given the condition of the food item, it is most likely that the item was eaten post-mortem.

Submitted by **PAUL M. HAMPTON**, Department of Biology, University of Texas at Tyler, 3900 University Blvd, Tyler, Texas 75799, USA.

GEOGRAPHIC DISTRIBUTION

Herpetological Review publishes brief notices of new geographic distribution records in order to make them available to the herpetological community in published form. Geographic distribution records are important to biologists in that they allow for a more precise determination of a species' range, and thereby permit a more significant interpretation of its biology.

These geographic distribution records will be accepted in a **standard format** only, and all authors *must* adhere to that format, as follows: SCIENTIFIC NAME, COMMON NAME (for the United States and Canada as it appears in Crother 2000. *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding*. SSAR Herpetol. Circ. 29:1–82, available online at <http://herplit.com/SSAR/circulars/HC29/Crother.html>; for Mexico as it appears in Liner 1994, *Scientific and Common Names for the Amphibians and Reptiles of Mexico in English and Spanish.* Herpetol. Circ. 23:1–113), LOCALITY (use metric for distances and give precise locality data), DATE (day-month-year), COLLECTOR, VERIFIED BY (*cannot* be verified by an author—curator at an institutional collection is preferred), PLACE OF DEPOSITION (where applicable, use standardized collection designations as they appear in Leviton et al. 1985, *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology,* Copeia 1985[3]:802–832) and CATALOG NUMBER (required), COMMENTS (brief), CITATIONS (brief), SUBMITTED BY (give name and address in full—spell out state or province names—no abbreviations).

Some further comments. This geographic distribution section does not publish "observation" records. Records submitted should be based on preserved specimens which have been placed in a university or museum collection (private collection depository records are discouraged; institutional collection records will receive precedence in case of conflict). A good quality color slide or photograph may substitute for a preserved specimen *only* when the live specimen could not be collected for the following reasons: it was a protected species, it was found in a protected area, or the logistics of preservation were prohibitive (such as large turtles or crocodilians). Color slides and photographs *must* be deposited in a university or museum collection along with complete locality data, and the color slide catalog number(s) must be included in the same manner as a preserved record. Before you submit a manuscript to us, check Censky (1988, *Index to Geographic Distribution Records in Herpetological Review: 1967–1986*; available from the SSAR Publications Secretary) and other sources to make sure you are not duplicating a previously published record. The responsibility for checking literature for previously documented range extensions lies with authors. Do not submit range extensions unless a thorough literature review has been completed.

Please submit any geographic distribution records in the **standard format only** to one of the Section Co-editors: **Alan M. Richmond** (USA & Canadian records only); **Jerry D. Johnson** (Mexico and Central America, including the Caribbean Basin); **Indraneil Das** (all Old World records); or **Gustavo J. Scrocchi** (South American records). Short manuscripts are discouraged, and are only acceptable when data cannot be presented adequately in the standard format. **Electronic submission of manuscripts is required** (as Microsoft Word or Rich Text format [rtf] files, as e-mail attachments). Refer to inside front cover for e-mail addresses of section editors.

Recommended citation for new distribution records appearing in this section is: Schmitz, A., and T. Ziegler. 2003. Geographic distribution. *Sphenomorphus rufocaudatus*. Herpetol. Rev. 34:385.

CAUDATA

AMBYSTOMA MACULATUM. (Spotted Salamander). USA: TENNESSEE: Lauderdale Co.: John Tully Wildlife Management Area managed by the Tennessee Wildlife Resources Agency located in the Golddust 7.5 minute Quad (35.66007°N, 89.803250°W, NAD 83). 17 October 2006. Daniel Stanfield of the Tennessee Wildlife Resources Agency. Austin Peay State University Museum of Zoology (APSU 18243). Verified by A. Floyd Scott. One Spotted Salamander found while conducting a visual encounter survey in bottomland hardwoods. Temperature at collection was 22°C. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.; hard copy and Internet versions, the latter of which includes links to information on Tennessee amphibians having appeared since 1996, http://www.apsu.edu/amatlas/, accessed 19 October 2006).

Voucher image collection made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

AMBYSTOMA TALPOIDEUM (Mole Salamander). USA: TENNESSEE: Lauderdale Co.: John Tully Wildlife Management Area managed by the Tennessee Wildlife Resources Agency and located in the Golddust 7.5-minute Quad (35.65639°N, 89.800450°W, NAD 83). 17 October 2006. Daniel Stanfield of the Tennessee Wildlife Resources Agency. Austin Peay State University Museum of Zoology (APSU 18244). Verified by A. Floyd Scott. One individual found while conducting a visual-encounter survey in bottomland hardwoods near Goose Pond. Temperature at collection was 23°C. New county record (Redmond and Scott 1996. Atlas of Amphibians in Tennessee. Misc. Publ. No. 12, The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp.; hard copy and Internet versions, the latter of which includes links to information on Tennessee amphibians having appeared since 1996, http://www.apsu.edu/amatlas/, accessed 19 October 2006).

Voucher image collection made under the authority of the Tennessee Wildlife Resources Agency; field work supported by State Wildlife Grant (SWG) funding under the authority of the U.S. Fish and Wildlife Service.

Submitted by **CHRIS HUNTER**, Tennessee Wildlife Resources Agency, 200 Lowell Thomas Drive, Jackson, Tennessee 38301, USA; e-mail: christopher.hunter@state.tn.us.

AMBYSTOMA TIGRINUM TIGRINUM (Eastern Tiger Salamander). USA: ILLINOIS: Hamilton Co.: Hamilton County State Fish and Wildlife Area, vernal pond ca. 500 m S of the Dolan Lake spillway parking lot (38°03'05"N, 88°24'08"W). 15 April 2006. Cy L. Mott and Michael A. Steffen. Verified by Ronald A. Brandon. SIUC H-08673. Larval specimen. New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **CY L. MOTT**, Cooperative Wildlife Research Laboratory, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA; e -mail: cm8755@siu.edu.

HEMIDACTYLIUM SCUTATUM (Four-toed Salamander). USA: INDIANA: Henry Co: 2.4 km S of Springport (Minton 1998. *In* M. J. Lannoo [ed.], Status and Conservation of Midwestern Amphibians. Univ. Iowa Press, Iowa City). 01 April 2006. Kelly Jones. Verified by Michael J. Lannoo. INHS voucher photo INHS 2006d. Gravid female 39 mm SVL, 54 mm TL with partly regenerated tail seen climbing out of the water onto a moss-covered log at approximately 0030 h EST. Previously thought to be extirpated from site. First sighting of this species at this site and in this county in ~30 years (James List, pers. comm.).

Submitted by **KELLY JONES**, 6207 Welham Road, Indianapolis, Indiana 46220, USA; e-mail: kellyjones78@yahoo.com.

PLETHODON GLUTINOSUS (Northern Slimy Salamander). USA: OHIO: Preble Co.: Israel Township. Hueston Woods State Park (39°34.4627'N, 83°44.6420'W). 11 June 2006. Jeffrey G. Davis. Verified by John W. Ferner. Cincinnati Museum Center (CMNH 8970). New county record (Pfingsten and Matson 2003. Ohio Salamander Atlas. Ohio Biological Survey Misc. Contribution No. 9, Columbus).

Submitted by **JEFFREY G. DAVIS,** Cincinnati Museum Center – Fredrick and Amye Geier Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA; e-mail: anura@fuse.net.

ANURA

AMOLOPS KAULBACKI (Kaulback's Torrent Frog). INDIA: MIZORAM: Lunglei District: Small stream at Theiriat, Lunglei (22º48'–52'N, 92º48'–53'E; 1050 m elev.). Male, SVL 67.5 mm. 14 August 2003 at ca. 2030 h. Department of Zoology Museum, North Eastern Hill University Collection HT 0004. H. T. Lalremsanga, Saipari Sailo, and R. N. K. Hooroo. Verified by Saibal Sengupta. Previously reported from Northern Myanmar (Smith 1940. Rec. Indian Mus. 42:465–486; Pl. VIII). New record for India.

Submitted by **SAIPARI SAILO** (e-mail: spsailo@yahoo.co.in), **H. T. LALREMSANGA** (e-mail: htlrsa@yahoo.co.in), and **RUPA NYLLA K. HOOROO** Department of Zoology, Developmental Biology Laboratory, North Eastern Hill University, Shillong 793 022, Meghalaya, India; e-mail: rnkhnehu@hotmail.com.

BUFO BOREAS (Western Toad). USA: IDAHO: Nez Perce Co.: Gravel access road S of Route 12 near Idaho Department of Transportation gravel pit (46°27.846'N, 116°46.820'W) 253 m elev. 29 October 2006. Alex Dornburg. Verified by Kenneth V. Kardong. Photo voucher deposited in the Washington State University Conner Museum Collection (CRCM-P-29) Juvenile was found under cover object near gravel pathway adjacent to train tracks. Ambient temperature at time of encounter was 12°C. First county record. This record fills a gap in distribution data, as this species has been documented in adjacent Latah, Clearwater, and Idaho counties (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow, Idaho, 332 pp.).

Submitted by **ROBERT E. WEAVER** (e-mail: weaverr@wsu.edu) and **ALEX DORNBURG**, School of Biological Sciences, Washington State University, Pullman, Washington 99164, USA (e-mail: dornburgalex@yahoo.com).

BUFO FOWLERI (Fowler's Toad). USA: OHIO: Miami Co.: Spring Creek Township, Statler Road (40°07'54.9"N, 84°08'20.5"W). 29 August 2004. Jeffrey G. Davis and Paul J. Krusling. Verified by John W. Ferner. Cincinnati Museum Center (CMNH 9778–9779). New county record (Davis and Menze 2000. Ohio Frog and Toad Atlas. Ohio Biological Survey Misc. Contributions No. 6, Columbus).

Submitted by **JEFFREY G. DAVIS** (e-mail: anura@fuse.net) and **PAUL J. KRUSLING**, Cincinnati Museum Center – Fredrick and Amye Geir Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130 USA (e-mail: pkrusling@fuse.net).

BUFO MELANOSTICTUS (Asian Toad). WEST MALAYSIA: PERAK: CAMERON HIGHLANDS: Robinsons Falls Trail (04°28.318'N, 101°22.634'E) (La Sierra University Herpetological Collection 6596). 16 August 2004. Male; SVL 82 mm. Collected at night on a cement trail. Timothy M. Youmans, Perry L. Wood Jr. Verified by L. Lee Grismer. Known from Sri Lanka, Burma, Thailand, China, West Malaysia, Bali, Borneo, India (Manthey and Grossmann 1997. Amphibien und Reptilien Südostasiens. Natur und Tier-Verlag, Münster. 512 pp.). This specimen is a new record for Cameron highlands (Lim et al. 2002. J.

Wildl. Parks, Kuala Lumpur 20:49–57).

Submitted by **TIMOTHY M. YOUMANS** (e-mail: timoyoum@lasierra.edu) and **PERRY L. WOOD, JR.** (e-mail: perrwood@lasierra.edu), Department of Biology, La Sierra University, Riverside, California 92515-8247, USA.

BUFO WOODHOUSII (Woodhouse's Toad). USA: NEW MEXICO: Lea Co.: NM Hwy 508; 19.66 mi N, 10.62 mi E Tatum (jct. US Hwy 380 and NM Hwy 206); T9S, R37E, boundary of S11 (SW 1/4) and S14 (NW 1/4); 13S, 3712898N, 0673517E (WGS 84). MSB 72602. 09 July 2006 by Michael T. Hill, Taylor B. Cotten, and Clayton D. Crowder. Verified by Charles W. Painter. New county record (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque. 431 pp.).

Submitted by **MICHAEL T. HILL, TAYLOR B. COTTEN**, Department of Wildlife and Fisheries Sciences, Texas A&M University, 2258 TAMU, College Station, Texas 77843, USA; and **CLAYTON D. CROWDER**, 14 Mountain Laurel, Los Lunas, New Mexico 87031, USA.

***CHAUNUS PYGMAEUS*.** BRAZIL: ESPÍRITO SANTO: Mimoso do Sul Municipality: 21°03'48"S, 41°23'23"W, 279 m elev. 01–05 November 2001. G. Ramos da Silva. Herpetological Collection, Departamento de Zoologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro (ZUFRJ 8987–8989, males, calling in a temporary muddy pond). Verified by E. Izecksohn. Previously known only from Rio de Janeiro State, in coastal Brazil, where it occurs at very low elevations, from sea level up to only 50 m, in restingas (Carvalho-e-Silva et al. 2000. *In* F. A. Esteves and L. D. Lacerda [eds.], Ecologia de Restingas e Lagoas Costeiras, pp. 89–97. Nupem/Universidade Federal do Rio de Janeiro, Macaé, Rio de Janeiro). First state record and the first outside of restingas, where it was thought to be endemic. Extends range ca. 90 km NW from São Joao da Barra (Myers and Carvalho 1952. Zoologica 37:1–3.).

Submitted by **GUILHERME RAMOS DA SILVA** (e-mail: grscinax@gmail.com), **SERGIO POTSCH DE CARVALHO-E-SILVA** (e-mail: sergio@biologia.ufrj.br), and **ANA MARIA PAULINO TELLES DE CARVALHO-E-SILVA,** Departamento de Zoologia, Universidade Federal do Rio de Janeiro, caixa postal 68.044, CEP 21944-970, Cidade Universitária, Rio de Janeiro, Brazil (e-mail: atelles@unirio.br).

HYLA CINEREA (Green Treefrog). USA: TENNESSEE: Hamilton Co.: 1278 Enclave Road, Chattanooga (35°05'39.7"N, 085°16'32.3"W). 24 September 2006. Ashley Miller and Thomas Wilson. Verified by John Jensen, Georgia DNR. The University of Tennessee at Chattanooga Natural History Museum (UTCA 187–188). Two deceased adult individuals collected from residential driveway. Fourteen individuals counted the previous day following heavy rain. Species previously reported from adjacent Marion County (Davenport et al. 2005. Herpetol. Rev. 36: 209–210). Represents first verified record for Hamilton County (Conant and Collins 1998. Reptiles and Amphibians: Eastern/ Central North America 3rd ed., expanded. Houghton Mifflin Co., Boston, Massachusetts, 616 pp.; Redmond and Scott 1996. Atlas of Amphibians in Tennessee. The Center for Field Biology, Austin Peay State University, Clarksville, Tennessee. 94 pp. http//www.apsu.edu/amatlas/). Collection made under Tennessee Wildlife Resources Agency Permit 1534.

Submitted by **ASHLEY MILLER**, **THOMAS P. WILSON**, **MATTHEW B. SMITH**, **ROBERT MINTON**, and **CHRIS MANIS**, Department of Biological and Environmental Sciences, The University of Tennessee at Chattanooga, 615 McCallie Avenue, Chattanooga, Tennessee 37403, USA.

HYLA CINEREA (Green Treefrog) USA: TEXAS: Brewster Co.: Big Bend National Park: Rio Grande Village beaver pond. 29°10'46"N, 102°57'12"W. 30 September 2006. Collected by D. J. Leavitt and T. C. Mullet. Verified by Steven G. Platt. Sul Ross State University J. F. Scudday Vertebrate Collection (SRSU 1502); one froglet found atop a submersed bunchgrass in thick vegetation. New county record and non-native (Dixon 2000. Reptiles and Amphibians of Texas. Texas A&M Univ. Press, College Station. 500 pp.) The location is near a frequently visited campground, suggesting inadvertent translocation. Dayton (2002. Amphibians and Reptiles Checklist: BBNP. BBNHA, BBNP) lists this species as hypothetical based on vocalizations heard at the Rio Grande Village beaver pond. This coupled with the age of the individual suggests an established breeding population.

Submitted by **DANIEL J. LEAVITT**, **TIMOTHY C. MULLET**, and **CHRISTOPHER M. RITZI**, Biology Department, Sul Ross State University, Alpine, Texas 79832, USA; and **J. RAYMOND SKILES**, National Park Service, Big Bend National Park, Texas 79834, USA.

HYLA VERSICOLOR (Gray Treefrog). USA: OHIO: Tuscarawas Co.: York Township. County Road 21 (40°28'39.2"N, 81°29'17.6"W). 27 July 2005. Danielle K. Thompson. Verified by John W. Ferner. Cincinnati Museum Center (CMNH Herp Photodocumentation Collection HP 250–251). New county record (Davis and Menze 2000. Ohio Frog and Toad Atlas, Ohio Biological Survey Misc. Contrib. No. 6, Columbus).

Submitted by **DANIELLE K. THOMPSON**, Institute of Environmental Sciences, Miami University, 102 Boyd Hall, Oxford, Ohio 40056, USA (e-mail: thompsondk@muohio.edu); and **JEFFREY G. DAVIS**, Cincinnati Museum Center – Fredrick and Amye Geier Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA (e-mail: anura@fuse.net).

KALOPHRYNUS ORANGENSIS (Orang Sticky Frog): INDIA: WEST BENGAL: Jalpaiguri District: Mendabari Range, Chilapata Reserve Forest (26º20'N, 89º25'E). 13 October 2006. Subhadip Paul. ZSIC A.10402. Verified by Sushil Kumar Dutta. Adult male, SVL 34.6 mm found calling from a bush, 60 cm above ground adjacent to Bong Basti Forest Village within primary semi-evergreen forest. Previously known from Orang National Park, 26º32'N, 92º15'E, Darrang District, eastern Assam, India (Dutta et al. 2000. Hamadryad 25:67–74). Westward range extension by ca. 320 km, and a new record for West Bengal State.

Submitted by **SUBHADIP PAUL**, Village Birpara, District Jalpaiguri, P.O. Alipurduar 736 121, West Bengal, India; **MANINDRA CHANDRA BISWAS**, Divisional Forest Officer, Cooch Behar Forest Division, Nilkuthi, Cooch Behar 736 101, West Bengal, India; and **KAUSHIK DEUTI**, Zoological Survey of India, Nizam Palace, Kolkata 700 020, West Bengal, India (e-mail: kaushikdeuti@rediffmail.com).

LEPTOBRACHIUM SMITHI (Smith's Litter Frog). INDIA: MIZORAM: Kolasib District: Kawnpui (22º58'17.6"N, 92º41'34.8"E; 305 m elev.). Female, SVL 65.2 mm, found near small stream. 25 June 2006 at ca. 2000 h. Department of Zoology Museum, North Eastern Hill University Collection MZ 0100. Saipari Sailo, H. T. Lalremsanga, and R. N. K. Hooroo. Verified by Saibal Sengupta. Known from Assam State in northeast India, Myanmar, Thailand, and northern Malay Peninsula (Matsui et al. 1999. Japan. J. Herpetol. 18[1]:19–29; Sengupta et al. 2001. J. Bombay Nat. Hist. Soc. 98[2]:289–291; Das and Chanda 2004. Asiatic Herpetol. Res. 10:245–246). New state record for Mizoram State.

Submitted by **H. T. LALREMSANGA** (e-mail: htlrsa@yahoo.co.in), **SAIPARI SAILO** (e-mail: spsailo@yahoo.co.in), and **RUPA NYLLA K. HOOROO,** Department of Zoology, Developmental Biology Laboratory, North Eastern Hill University, Shillong 793 022, Meghalaya, India (e-mail: rnkhnehu@hotmail.com).

PHYLLOMEDUSA ROHDEI (Rohde's Leaf Frog). BRAZIL: BAHIA: Uruçuca (14º35'12"S; 39º17'23"W; ca. 100 m elev.). 16 August 2004. O. G. S. Araújo, L. F. Toledo, D. Loebmann, and J. Zina. Verified by C. F. B. Haddad. Coleção de anuros Célio F. B. Haddad, Departamento de Zoologia, Instituto de Biociências, Universidade Estadual Paulista, Rio Claro, São Paulo, Brazil (CFBH 13189–93). Previously known from the states of Rio de Janeiro (Rio de Janeiro, Teresópolis, and Saquarema Municipalities), São Paulo; Minas Gerais and Espírito Santo, Brazil (Frost 2006. Amphibian Species of the World: an Online Reference. Version 4. http://research.amnh.org/herpetology/amphibia/index.php; Wogel et al. 2005. J. Nat. Hist. 39:2035–2045; Sazima 1974. J. Herpetol. 8:376–377; Feio et al. 1998. Anfíbios do Parque Estadual do Rio Doce [Minas Gerais]. Universidade Federal de Viçosa, Viçosa, Brazil, 32 pp.; Vrcibradic et al. 2006. Herpetol. Rev. 37:101). First state record, extends the species distribution ca. 470 km N from the municipality of Nova Venécia, state of Espírito Santo (Vrcibradic et al., *op. cit.*) and ca. 780 km N from the municipality of Viçosa, state of Minas Gerais (Feio et al., *op. cit.*).

Submitted by **OLÍVIA GABRIELA DOS SANTOS ARAÚJO**, **DANIEL LOEBMANN**, **JULIANA ZINA**, and **LUÍS FELIPE TOLEDO**, Departamento de Zoologia, Instituto de Biociências, Universidade Estadual Paulista, Caixa Postal 199, CEP 13506-970, Rio Claro, São Paulo, Brazil (e-mail: oliviaaraujo@gmail.com).

PIPA ARRABALI (Arrabal's Surinam Toad). BRAZIL: RONDÔNIA: Pimenta Bueno Municipality, Parque Municipal de Pimenta Bueno (11º40'21"S, 61º11'35"W). 20 February 2006. B. L. Sousa. Herpetological collection of Universidade Federal do Acre – UFAC, Campus Floresta, Cruzeiro do Sul, Acre (UFACF 079). Verified by R. A. Machado. Species was previously known from Guyana, Surinam, eastern Venezuela, and northern Brazil in the Amazonas and Pará states (Trueb and Cannatella 1986. Herpetologica 42[4]:412–449; Zimmerman and Rodrigues 1990. *In* Gentry [ed.], Four Neotropical Rainforests, pp. 426–454; Bario-Amorós 1999 "1998." Acta Biol. Venezuel. 18:59). First state record, extends the range of this species 710 km SW from the Serra do Cachimbo, Novo Progresso municipality, Cristalino River, Pará State (Garda et al. 2006. S. Amer. J. Herpetol. 1[1]:20–24).

Submitted by **BRUNO LOPES DE SOUSA**, Faculdade de Ciências Biomédicas de Cacoal – FACIMED, Av. Cuiabá 3033, Jardim Clodoaldo, CEP: 78.976-005 Cacoal, RO, Brazil (e-mail: brunosousa_biologo@hotmail.com); and **PAULO SÉRGIO BERNARDE**, Centro de Ciências Biológicas e da Natureza, Campus Floresta, Universidade Federal do Acre – UFAC, CEP: 69980-000 Cruzeiro do Sul, AC, Brazil (e-mail: paulobernarde@uol.com.br).

PSEUDACRIS BRACHYPHONA (Mountain Chorus Frog). USA: GEORGIA: Walker Co.: Roadside pool along Georgia Hwy 157, 7.2 km N of jct. with Moon Lake Road, on top of Lookout Mountain. 4 March 2004. John B. Jensen and Carlos D. Camp. GMNH 49903–04. Verified by Elizabeth McGhee. First county record and first Georgia record within the Cumberland Plateau physiographic province. Extends range ca. 45 km E of nearest record (Jackson Co., Alabama; Mount 1975. Reptiles and Amphibians of Alabama. Auburn University Agricultural Experiment Station, Auburn, Alabama). Many males were issuing breeding calls during daylight hours.

Submitted by **JOHN B. JENSEN**, Georgia Department of Natural Resources, Nongame-Endangered Wildlife Program, 116 Rum Creek Drive, Forsyth, Georgia 31029, USA (e-mail: john_jensen@dnr.state.ga.us.); and **CARLOS D. CAMP**, Department of Biology, Piedmont College, P.O. Box 10, Demorest, Georgia 30535, USA.

PSEUDACRIS CRUCIFER (Spring Peeper). USA: ILLINOIS: Gallatin Co.: Shawnee National Forest, vernal pond ca. 1 km from Pounds Hollow Rd. on York Lane Rd. (37°36'14"N, 88°15'46"W). 04 March 2006. Cy L. Mott, Michael A. Steffen, John M. Uzzardo, and Brian K. Willey. Verified by Ronald A. Brandon. Color photo voucher. SIUC H-08676. New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **CY L. MOTT**, Cooperative Wildlife Research Laboratory, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA; e - mail: cm8755@siu.edu.

PSEUDACRIS C. CRUCIFER (Northern Spring Peeper). USA: OHIO: Miami Co.: Newton Township. Brukner Nature Center (40° 00'53.9"N, 84°19'18.56"W). 13 April 2002. Jeffrey G. Davis and Paul J. Krusling. Verified by John W. Ferner. CMNH 9141–9142. New county record (Davis and Menze 2000. Ohio Frog and Toad Atlas, Ohio Biological Survey Misc. Contribution No. 6. Columbus).

Submitted by **JEFFREY G. DAVIS** (e-mail: anura@fuse.net) and **PAUL J. KRUSLING**, Cincinnati Museum Center – Fredrick and Amye Geier Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA (e-mail: pkrusling@fuse.net).

PSEUDACRIS PACIFICA (Pacific Treefrog). USA: IDAHO: Nez Perce Co.: 30 m S of Route 12 near train tracks along the Clearwater River (46°28.234'N , 116°46.481'W) 258 m elev. 27 October 2006. Chad D. Brock. Verified by Kenneth V. Kardong. Photo voucher deposited in the Washington State University Conner Museum Collection (CRCM-P-28). Two adults were found sharing a cover object. Ambient temperature at time of collection was 16°C. First county record. Field guides depict the range of this species as continuous throughout most of northern and western Idaho (Jones et al. 2005. Amphibians of the Pacific Northwest. Seattle Audobon Society, Seattle, Washington), however, its presence in north-central Idaho is poorly documented. This record fills a distributional gap, as localities for this species have been reported for adjacent Latah and Idaho counties (Nussbaum et al. 1983. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow, Idaho).

Submitted by **ALEX DORNBURG** (e-mail: dornburgalex@yahoo.com), **CHAD D. BROCK** (e-mail: cdbrock@wsu.edu), and **ROBERT E. WEAVER,** School of Biological Sciences, Washington State University, Pullman, Washington 99164, USA (e-mail: weaverr@wsu.edu).

PTERORANA KHARE (Winged Frog). INDIA: MEGHALAYA: East Khasi Hills District: vicinity of Lawsohtun (25°35'N, 91°55'E; 1588 m elev.). Two males collected; one from under boulder in stream. 24 August 2006 at ca. 1500 h. SVL 53.81 mm. Another from the same stream at 2300 h on 9 September 2006; SVL 41.1 mm. Department of Zoology Museum, North Eastern Hill University Collection DK 010–011. Duwaki Rangad, Ronald K. Lyngdoh Tron, and Rupa Nylla K. Hooroo. Verified by Indraneil Das. Previously reported from Nagaland (Kiyasetuo and Khare 1986. Asian J. Exp. Sci. 1:12–17), and from Aizawl District (Dey and Ramanujam 2003. Hamadryad 27:255–256). New record for Meghalaya State.

Submitted by **DUWAKI RANGAD** (e-mail: duwaki@yahoo.com), **RONALD K. LYNGDOH TRON**, and **RUPA NYLLA K. HOOROO** (e-mail: rnkh@hotmail.com), Department of Zoology, Developmental Biology Laboratory, North Eastern Hill University, Shillong 793022, Meghalaya, India.

SCAPHIOPUS COUCHI (Couch's Spadefoot). USA: NEW MEXICO: Guadalupe Co.: Santa Rosa Lake (T10S R4E NW1/4 Sec 30) (1 male, 1 female). 30 May 1980. J. A. White and K. M. White. Museum of Southwestern Biology (MSB 37619). Guadalupe Co: 4.5 rd miles S of Santa Rosa Lake (T9N R22E, NE 1/4 Sec 36) (1 female). 31 May 2003. Bruce L. Christman and Michelle R. Cummer. MSB 72246. Verified by J. Tomasz Giermakowski. MSB 37619, first county record, and MSB 72246, second county record indicating continued persistence 23 years later (Degenhardt et al. 1996, Amphibians and Reptiles of New Mexico. Univ. of New Mexico Press, Albuquerque. xii + 431 pp.).

Submitted by **BRUCE L. CHRISTMAN** and **MICHELLE R. CUMMER,** 736 Cardenas SE, Albuquerque, New Mexico 87108, USA.

SCINAX GRANULATUS. ARGENTINA: BUENOS AIRES: Partido de General Madariaga: (37º01'09"S, 57º06'57"W). 20 September 2005. R. Cajade and D. A. Barrasso. Verified by J. Williams. Herpetological collection Museo de La Plata, Buenos Aires, Argentina (MLP.A. 4922–24). Species previously known from southern Brazil, southeastern Paraguay, northeastern Argentina, and Uruguay (Cei 1980. Monitore Zoologico Italiano N.S. 2:1–609; Aquino et al. [eds.] 1996. O.R.: 331– 400; Kwet 2001. Salamandra 37:211–238). Previously, the southernmost locality supported by voucher specimens was Pereyra Iraola, Partido de La Plata, Buenos Aires province, Argentina (Gallardo 1961. Com. Mus. Arg. Cien. Nat. "Bernardino Rivadavia" III [5]:145–158). Gallardo (*op. cit.*) mentioned two specimens from Sierra de la Ventana, located 450 km WSW from General Madariaga, but this record is not supported by voucher specimens. Therefore, the present account establishes a new southern vouchered record for *Scinax granulatus* and extends the range of the species ca. 250 km S from La Plata.

Submitted by **BARRASSO DIEGO A.** and **RODRIGO CAJADE**, Centro de Investigaciones del Medio Ambiente, Departamento de Química, Facultad de Ciencias Exactas, UNLP, 47 y 115 (CP 1900), La Plata, Bs. As., Argentina.

TESTUDINES

CHELYDRA SERPENTINA (Common Snapping Turtle). USA: ILLINOIS: Franklin Co.: Snapping turtle was live caught from an ephemeral pool located on Wayne Fitzgerrell State Park just east of Fitzgerrell Park Road. GPS coordinates are as follows: N 0331325 and W 4219341, zone 16 using NAD27 CONUS map datum in UTM's. 08 March 2006, 2339 h. James T. Lamer and Chad R. Dolan, Illinois Natural History Survey. INHS 2006.59 Verified by Chris Phillips, Illinois Natural History Survey. Specimen is a photographic record and first county record. Photograph is located at the Illinois Natural History Survey in Champaign/ Urbana, Illinois (Phillips 1999. Field Guide to Amphibians and Reptiles of Illinois). Turtle was kicked up while wading in pool and then hand caught during steady rainfall with an air temperature of 18.3°C. The following measurements were recorded: carapace length = 324 mm, carapace width = 287 mm, carapace height = 123 mm, plastron length = 222 mm, and mass = 9000 g.

Submitted by **JAMES T. LAMER, CHAD R. DOLAN,** and **JOHN K. TUCKER,** Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

CHRYSEMYS PICTA DORSALIS (Southern Painted Turtle). USA: ARKANSAS: Monroe Co.: On US Hwy 49, 0.5 mi N of Hwy 79; 34°42.364'N, 91°08.916'W (WGS 84): 22 Apr. 2005. Josh Engelbert and Melissa Patrick. Verified by Stanley E. Trauth. Voucher specimen in Arkansas State University Museum of Zoology (ASUMZ 29270). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **JOSH ENGELBERT** and **MELISSA PATRICK**, Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, Arkansas 72467-0599, USA (e-mail: josh.engelbert@smail.astate.edu).

EMYDOIDEA BLANDINGII (Blanding's Turtle). USA: WISCONSIN: Ozaukee Co.: Mud Lake, Cedarburg Bog State Natural Area (43°22'39"N, 88°01'24"W, NAD27). 2–4 June 2006. Joshua

M. Kapfer and Timothy Muehlfeld. Verified by Christopher A. Phillips. INHS 2007a. New county record, fills gap where species occupies all neighboring counties (Casper 1996. Geographic Distributions of the Amphibians and Reptiles of Wisconsin. Milwaukee Public Museum, 87 pp.) and confirms several prior observational reports.

Submitted by **GARY S. CASPER**, University of Wisconsin-Milwaukee Field Station, 3095 Blue Goose Road, Saukville, Wisconsin 53080, USA; **JOSHUA M. KAPFER**, Department of Biological Sciences, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53211, USA; and **TIMOTHY MUEHLFELD,** 123 North 87th Street, Wauwatosa, Wisconsin 53226, USA.

GRAPTEMYS PSEUDOGEOGRAPHICA KOHNII (Mississippi Map Turtle). USA: TEXAS: SMITH CO.: Texas Parks and Wildlife Department's Old Sabine Bottom Wildlife Management Area. Approximately 12.8 km N of Lindale, Texas on County Rd. 4106. UTM (NAD 83) 15S, 0281466 N, 3609440 W, 175 m elev. 15 May 2005. Jessica L. Coleman. Verified by Ronald L. Gutberlet, Jr. University of Texas at Arlington – Amphibian and Reptile Diversity Research Center (UTA digital images 1005–1007). Adult male photographed basking (1125 h) in a 1.5 km section of the Sabine River with approximately nine additional *G. p. kohnii* and five other species of turtles (Emydidae). In this section of river a total of 116 individual turtles of various species were observed basking that day. New county record (Dixon 2000. Amphibian and Reptiles of Texas. 2nd ed. Univ. of Texas A&M Press, viii+421 pp.).

Submitted by **JESSICA L. COLEMAN,** University Blvd., Tyler, Texas 75799, USA; e-mail: jachooo@hotmail.com.

LACERTILIA

EMOIA ATROCOSTATA (Littoral Skink). USA: GUAM: INARAJAN MUNICIPALITY: 400 m S of Inarajan town center, Inarajan Pool public park (13.271356°N; 144.74748°E, determined in WGS84 map projection), on raised limestone under *Pemphis acidula* shrub in high-energy coastal habitat. 07 September 2006. R. N. Reed. Verified by B. Lardner. USNM 563345. First record for the island of Guam. Three additional individuals observed in same area on this date. *E. atrocostata* is known from Cocos Island, Anae Islet, and Agrigan Islet, all just off the coast of Guam, as well as on several islands in the northern Marianas, but had not previously been documented on Guam proper.

Submitted by **ROBERT N. REED** (e-mail: robert_reed@usgs.gov), **GORDON H. RODDA**, and **THOMAS J. HINKLE**, U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Ave, Bldg C, Fort Collins, Colorado 80526, USA.

HEMIDACTYLUS PLATYURUS (Flat-tailed Gecko). MALAYSIA: PAHANG: CAMERON HIGHLANDS: The Cool Point Hotel in Tanah Rata (04°28.318'N, 101°22.634'E). La Sierra University Herpetological Collection 6636. 17 August 2004. Male (SVL 54 mm, TL 61.5 mm) found ca. 1.5 m above ground on cement wall. Perry L. Wood, Jr. and Timothy Youmans. Verified by L. Lee Grismer. Previously known from India, Sri Lanka, Myanmar, Thailand, Vietnam, China, Taiwan, West Malaysia, Singapore, Borneo, Sumatra, Java, Sulawesi, Lombok, Sumbawa, Flores, New Guinea, and the Philippines (Manthey and Grossmann 1997. Amphibien und Reptilien Südostasiens. Natur und Tier Verlag, Münster. 512 pp.). New record for Cameron Highlands (Lim et al. 2002. J. Wildlife & Parks 20:49–57).

Submitted by **PERRY L. WOOD** (e-mail: pwoo213@my.lasierra.edu) and **TIMOTHY YOUMANS** (e-mail: tyou101@my.lasierra.edu), Department of Biology, La Sierra University, Riverside, California 92515-8247, USA.

LACERTA BILINEATA (Western Green Lizard) and ***PODARCIS MURALIS*** (Common Wall Lizard). UNITED KINGDOM: DORSET: Bournemouth Cliffs: Portman Ravine (01°43'W, 50°43'N). *Lacerta bilineata* were probably released at Portman Ravine circa 1995, but possibly earlier. An expanding colony of *L. bilineata* has now established itself along a 1.5 km stretch of cliff and cliff-top. Animals of all age classes can be seen basking around the margins of gorse (*Ulex major*) stands and in other scrub, herbs, and dune grasses. Observation over the last three years suggest that the animals are becoming more numerous, visible, and widespread. A population of *Podarcis muralis* became established at the same location around the same time, but does not appear to have extended as widely. The origins of both introductions are unknown. Gleed-Owen (2004. Herpetol. Bull. 2004:88,3–7) described the discovery of the population in 2002 and its subsequent monitoring. *L. bilineata* have been seen up to 550 m W and 1050 m E of the 'core area' at Portman Ravine, and a single animal has been seen 3.2 km W of the core area. This latter sighting raises suspicions that releases might be occurring. There are *Podarcis muralis* populations elsewhere on the cliffs of Poole Bay, and in other parts of southern England, but this is the only known *L. bilineata* population in Britain. The absence of *Lacerta agilis* from this part of Poole Bay has raised concerns that *L. bilineata* or *P. muralis* might be competitively displacing them, but historical re-profiling of the cliffs offers an alternative explanation. *Zootoca vivipara* is extant in the area and is being monitored by CGO for a possible decline as a consequence of the introduction of two lizard species alien to the United Kingdom. In continental Europe, there are numerous anecdotal reports and speculations on a negative effect of introduced *P. muralis* on native *Z. vivipara* and *L. agilis*. Only D. Münch (2001. Dortmunder Beiträge zur Landeskunde 35:187–190) provides data. He quantifies the duration of coexistence of introduced *P. muralis* and native *Z. vivipara* as 10 years, after which the latter were no longer observed in the area investigated near the city of Dortmund, Germany.

An autotomized tail of *Podarcis muralis* and two carcasses of *Lacerta* sp. (*viridis* or *bilineata*) was brought to one of us (CGO) between 03 and 11 May, 2005. CGO found another *Podarcis* tail at the frequently dog-walked site in this period. The tail tips were preserved in ethanol as tissue samples. No voucher specimens were retained. Total genomic DNA was extracted from each of the ethanol preserved tail tips, following a standard phenol-chloroform procedure. Amplifications of *cytochrome b* PCR fragments were performed in 25 µl reaction mixtures containing PCR buffer with 1.5 mM $MgCl_2$, 0.2 mM of each dNTP, 0.4 µM of each PCR primer, 0.5 units of *Taq* polymerase (Amersham). Reaction conditions comprised an initial denaturation step of 2 min at 94°C, 35 cycles of 10 s at 95°C, 15 s at 50°C, 50 s at 72°C, and a final extension step of 7 min at 72°C.

For *P. muralis* a 1019 bp long segment was amplified (primers: "sicnt-L" 5'-TTTGGATCCCTGTTAGGCCTCTGTT-3' and "H15906" 5'-GGTTTACAAGACCAGTGCTTT-3') and direct-sequenced (primers: "sicnt-L" and "murnum" 5'-AGGCACCTCCATAGTTCACC-3'). For the Green lizards the complete *cytochrome b* sequence was amplified using the primers NThe-H (5'-GGTTTACAAGACCAGTGCTTT-3') and LGluLK (5'-AACCGCTGTTGTCTTCAACTA-3'). PCR products were cloned using the TA vector (TOPO TA Cloning Kit, Invitrogen). Sequencing was performed by MWG sequencing service (Ebersberg, Germany).

The sequences of both *P. muralis* samples were identical and deposited at GenBank (accession number DQ646343). They were compared with homologous regions of sequences from samples scattered across the most of the range of *P. muralis* and which were analyzed in the course of a thorough genetic analysis of the species (Schweiger et al., unpubl.). The sequences of the Bournemouth samples were nearly identical to samples from the eastern Po plain and Friuli regions in Italy, and southern Slovenia. *P. muralis* from that region used to be assigned to subspecies *maculiventris*. However, since the systematics of *P. muralis* is currently under revision, we refrain from assigning a subspecies name to the Bournemouth population.

The sequence of one of the *Lacerta* sp. samples proved to be incomplete, possibly due to decay of the carcass. Amplified fractions of it were similar but not identical to the complete section of 807 bp gained from the other carcass. This complete section was compared with homologous sequences of *Lacerta viridis* from Austria, *Lacerta bilineata* from the Croatian island of Cres (Mayer, unpubl.) and GenBank sequences of *L. bilineata* samples from Italy. The sequences were most similar to samples from northern Italy and the island of Cres, proving that these specimens from the Bounemouth population belong to the latter species and are consistent with an origin similar to that of the *P. muralis*. The sequence was deposited at GenBank (accession number DQ646344).

Submitted by **GUNTRAM DEICHSEL**, Friedr.-Ebert-Str. 62, Biberach an der Riss, Germany D–88400 (e-mail: guntram.deichsel@gmx.de); **CHRIS GLEED-OWEN,** The Herpetological Conservation Trust, 655a Christchurch Road, Boscombe, Bournemouth, BH1 4AP, United Kingdom (e-mail: chris.go@herpconstrust.org.uk); and **WERNER MAYER**, Natural History Museum, Molecular Systematics, Burgring 7, Vienna, Austria A–1014 (e-mail: werner.mayer@nhm-wien.ac.at).

LIOLAEMUS BURGERI. ARGENTINA: MENDOZA PROVINCE: San Rafael Department: 47 km S from El Nihuil, Ruta Provincial 180, deviation 9 km S road to Cerro Negro, Sierra del Nevado (35º20'07.6"S, 68º36'48.8"W) 18 January 2006. C. S. Abdala, R. Juarez, and C. Robles. Museo Ciencias Naturales, Salta, Argentina (MCN 2188). Verified by F. Lobo. Previously known from Paso Pehuenche and Valle Hermoso, Malargüe Department, Mendoza Province (Cei 1986. Mus. Reg. Sci. nat. Torino Monografie IV: 527 pp.; Pincheira and Nuñez 2005. Mus. Nac. His. Nat. Chile, Publ. Ocac. Nº 59:7–486). The present record extends the eastern range 135 km from Paso Pehuenche and 153 km from Valle Hermoso (Cei, *op. cit.*).

Submitted by **CRISTIAN ABDALA** (e-mail: popper@tucbbs.com.ar) and **CECILIA ROBLES,** Instituto de Herpetología, Fundación Miguel Lillo, Miguel Lillo 251, 4000 Tucumán, Argentina (e-mail: zezi74@hotmail.com).

LIOLAEMUS UMBRIFER. ARGENTINA: CATAMARCA PROVINCE: Tinogasta Department: Between Fiambalá and Cazadero Grande, 57 km NW of Fiambalá, 2800 m elev. (27º43'11.6"S, 68º08'29.52"W). 15 October 2005. C. S. Abdala, S. Quinteros, and C. Robles. Museo Ciencias Naturales, Salta, Argentina (MCN 2185–2187). Verified by S. Quinteros. Previously known from Quebrada de Randolfo, Antofagasta Department, Catamarca Province and from 2 km SE of Peña Fría, Antofagasta Department, Catamarca Province (Espinoza and Lobo 2003. Herpetologica 59:89–105). The present record extends the southwestern range 164 km from Quebrada de Randolfo and 151 km from the Peña Fría record (Espinoza and Lobo, *op. cit.*).

Submitted by **CRISTIAN ABDALA,** Instituto de Herpetología, Fundación Miguel Lillo, Miguel Lillo 251, 4000 Tucumán, Argentina (e-mail: popper@tucbbs.com.ar); and **FERNANDO LOBO**, Cátedra de Anatomía Comparada, Facultad de Ciencias Naturales, Universidad Nacional de Salta, Bolivia 5150, 4400, Salta, Argentina (e-mail: flobo@unsa.edu.ar).

OPHISAURUS VENTRALIS (Eastern Glass Lizard): USA: VIRGINIA: City of Virginia Beach: near Munden (36°34'46"N, 76°02' 47"W, NAD 83), 14 May 1981. D. Jones. Verified by William M. Palmer (North Carolina State Museum of Natural History, NCSM 67451). Listed by the Virginia Department of Game and Inland Fisheries as state threatened based on its rarity in the southeastern corner of the Commonwealth. (Mitchell and Pague 1981. *In* K. Terwilliger [coord.], Virginia's Endangered Species, pp. 464–466. McDonald & Woodward Publ. Co., Blacksburg, Virginia). Previously known only from Back Bay National Wildlife Refuge and False Cape State Park on the eastern side of Back Bay (Mitchell and Pague, *op. cit*., Mitchell 1994. The Reptiles of Virginia. Smithsonian Inst. Press, Washington, DC, 352 pp.; Mitchell and Reay 1999. Atlas of Amphibians and Reptiles in Virginia. Spec. Publ. 1, Virginia Dept. Game and Inland Fish, Richmond, Virginia, 122 pp.). The immature specimen represents the only known record west of Back Bay and is about 14 km WSW of the closest known site at False Cape Landing in False Cape State Park on the Currituck Spit. The record suggests that this state-listed species might have a broader distribution in southeastern Virginia than previously understood.

Submitted by **JOSEPH C. MITCHELL**, Department of Biology, University of Richmond, Richmond, Virginia 23173, USA; e-mail: dr.joe.mitchell@gmail.com.

PHYMATURUS VERDUGO. ARGENTINA: MENDOZA PROVINCE: Malargüe Department: Surroundings of Arroyo El Gancho, 9 km NW of Las Loicas (35°50'48.15"S, 70°00'22.04"W). 25 January 2006. C. S. Abdala, R. Juárez, and C. Robles. Museo Ciencias Naturales, Salta, Argentina (MCN 1958, 1960–61). Verified by F. Lobo. Extends the range 104 km SE from the only previously known (and type) locality: Mendoza Province, Malargüe Department, Río Grande source, Peteroa Vulcan (Cei and Videla 2003. Boll. Mus. Reg. Sci. nat. Torino 20[2]:291–314).

Submitted by **CRISTIAN ABDALA**, Instituto de Herpetología, Fundación Miguel Lillo, Miguel Lillo 251, 4000 Tucumán, Argentina (e-mail: popper@tucbbs.com.ar); and **RICARDO JUAREZ**, Departamento de Zoología, Museo de Historia Natural de San Rafael, Parque Mariano Moreno, 5600, San Rafael, Mendoza, Argentina (e-mail: ricardoj73@hotmail.com).

PTYCHOZOON KUHLI (Kuhl's Parachute Gecko). WEST MALAYSIA: JOHOR: PULAU PEMANGGIL: Kampung Buau (02°35.02'N, 104°18.925'E), 20 m elev. An embryo was collected from an egg stuck to underside of a rock, ca. 1 m above ground. First record of eggs attached to a rock. La Sierra University Herpetological Collection 8024. 21 August 2006. Hatchling, SVL 26 mm. Perry Lee Wood, Jr. Verified by L. Lee Grismer. Previously reported from Nicobar Islands, southern Thailand, West Malaysia, Singapore, Borneo, Sumatra, Pulau Enggano, Java, and questionably from Myanmar (Manthey and Grossmann 1997. Amphibien und Reptilien Südostasiens. Natur und Tier Verlag, Münster. 512 pp.). New record for Pulau Pemanggil (Grismer et al. 2006. Raffles Bull. Zool. 54[1]:173–196).

Submitted by **PERRY L. WOOD**, Department of Biology, La Sierra University, Riverside, California 92515-8247, USA; e-mail: pwoo213@my.lasierra.edu.

SCELOPORUS CYANOGENYS (Blue Spiny Lizard). USA: TEXAS: NUECES CO.: South of Bishop, ca. 20 m S of County Road 4, 1 road km E of business Highway 77 (27°34.130'N, 97°48.358'W). 08 October 2006. Collected by Randy L. Powell. Verified by Travis J. LaDuc. Texas Natural History Collections (TNHC 65743). New county record, extends range east one county (Dixon 2000. Amphibians and Reptiles of Texas, 2nd ed. Texas A&M Univ. Press, College Station. 421 pp.).

Submitted by **RANDY L. POWELL,** Department of Biological and Health Sciences, MSC 158, Texas A&M University, Kingsville, Texas 78363, USA; e-mail: randy.powell@tamuk.edu.

SERPENTES

BOIGA KRAEPELINI (Kraepelin's Cat Snake): VIETNAM: LANG SON PROVINCE: CAO LOC DISTRICT: Mau Son Commune: Mau Son Mountain: THE R1006, nr. 21°52.012'N, 106°57.947'E, ~400 m elev., ca. 150 km NE Vinh Phuc Province (Orlov et al. 2003. Russian J. Herpetol. 10:217–240). 15 October 2006. T. Q. Nguyen, K. V. Doan, and C. T. Ho. On tree, ca. 2 m above stream. Verified by Nikolai L. Orlov. Known from Cao Bang, Vinh Phuc, Nghe An, Ha Tinh, and Thua Thien-Hue provinces of Vietnam; and extralimitally, China (including Hainan), Taiwan, and possibly Laos (Bain et al. 2007. Herpetol. Rev. 38:107–117; Ho et al. 2005. J. Biol., Hanoi 27[4A]:95–102; Orlov and Ryabov 2002. Russian J. Herpetol. 9:33–56; Orlov et al. 2000. Russian J. Herpetol. 7:69–80; Orlov et al. 2003, *op cit*.; Tillack et al. 2004. Sauria, Berlin 26[4]:3–12; Ziegler 2002. Die Amphibien und Reptilien eines Tieflandfeuchtwald-Schutzgebietes in Vietnam. Natur und Tier-Verlag GmbH, Münster. 342 pp.). First provincial record for the species.

Submitted by **NGUYEN QUANG TRUONG, DOAN VAN KIEN, HO THU CUC,** and **NGUYEN VAN SANG**, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam (e-mail: truong@iebr.vast.ac.vn).

CALLOSELASMA RHODOSTOMA (Malayan Pit Viper). LAOS: KAMPHAENG NAKHON VIENTIANE (Vientiane Prefecture): 6 km N of Vientiane, in American housing compound. 15 June 1963. Louis G. Bush. AMNH R-90639. Verified by Bryan L. Stuart. Deuve (1970. Mem. ORSTOM. 39:239) reported this distinct species from the Xieng Khuoang (= Xiang Khoang) Plateau (Xiang Khoang Province), as well as Thakhek (= Khammouan) and Savannakhet Provinces in Laos, but without reference to specific locality or voucher information. Outside of Laos, this species is known from Thailand, the Malay Peninsula, the Greater Sunda Islands, Cambodia (Mondolkiri, Koh Khong, Kompong Som, Kampot Provinces), and the southern Vietnam provinces of Ninh Thuan, Binh Phuoc, Binh Duong, Ba Ria-Vung Tau, Tay Ninh, Dong Nai, and An Giang (Campden-Main 1969. A Field Guide to the Snakes of South Vietnam, p. 96; Smith 1943. The Fauna of British India, Ceylon and Burma, Including the Whole of the Indo–Chinese Region. Vol. III. Serpentes:498; Saint Girons 1972. Mém. Mus. Nat. Hist. Natur. n. s., A, Zool.:155; Stuart and Emmett 2006. Fieldiana: Zool., n.s., 109:23; Stuart et al. 2006. Raffles Bull. Zool. 54:152; Taylor 1965. Univ. Kansas Sci. Bull. 45:1060). Orlov et al. 2002. Faun. Abh. 23:200) also report this species from Kon Tum, Gia Lai, and Dak Lak Provinces of Vietnam, but without reference to specific locality or voucher information.

Submitted by **RAOUL H. BAIN**, Center for Biodiversity and Conservation, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, USA; and **NGUYEN QUANG TRUONG** and **DOAN VAN KIEN**, Department of Vertebrate Zoology, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam.

CHIRONIUS BICARINATUS (Two-keeled Whipsnake). URUGUAY: Dpto. Cerro Largo: Cañada Vichadero (32º07'43"S 53º43'48"W). 22 March 2002. F. Scarabino and E. Gonzalez. Colección de Reptiles, Museo Nacional de Historia Natural y Antropología, Montevideo (MNHN 6758, adult female). The range of this species includes Brazil from Salvador (Bahia) to Pelotas (Rio Grande do Sul) and some islands on the coast; southwest of Misiones and Rio Uruguay, Chaco, Corrientes, Salta, Formosa and Entre Ríos in Argentina; in Uruguay was reported from departments on the Rio Uruguay, Artigas, Salto and Rio Negro (Peters and Orejas Miranda 1970. Bull. U.S. Natl. Mus. 297: i-viii + 1–347; Dixon et al. 1993. Revision of the Neotropical snake genus *Chironius* Fitzinger [Serpentes, Colubridae]. Museo Regionale di Scienze Naturali, Torino, Monografía 13, 279 pp.; Carreira et al. 2005. Reptiles de Uruguay. DI.R.A.C. Facultad de Ciencias, Universidad de la República, Montevideo, 639 pp.). Carreira et al. (2005) cited the presence of this species on the east of Cerro Largo, but the locality was not confirmed because no voucher was collected. This specimen is the first for the east of Uruguay, and provides evidence for the continuous distribution of this species from Argentina to Brazil. The nearest locality is Pelotas, Rio Grande do Sul (31º45'25"N, 51º20'16"W), ca. 140 km distant. First departament record, and extends known distribution in Uruguay ca. 420 km from localities in Dpto. Rio Negro.

Submitted by **SANTIAGO CARREIRA** and **IGNACIO LOMBARDO**, Museo Nacional de Historia Natural y Antropología, 25 de Mayo 582, CP 11000, Montevideo, Uruguay (e-mail: carreira@fcien.edu.uy).

DENDRELAPHIS CAUDOLINEATUS (Stripe-tailed Bronzeback). MALAYSIA: JOHOR: Kampung Buau, W coast of Pulau Pemanggil (02°34.973'N, 104°18.868'E), 10 m elev. Collected at night, ca. 1 m above ground on a small tree. La Sierra University Herpetological Collection 8031. 21 August 2006. Female, SVL 853 mm, TL 339 mm. Perry Lee Wood, Jr. Verified by L. Lee Grismer. Previously known from Indonesia (Babi, Bangka, Batu Islands, Belitung, Kalimantan, Mentawai Archipelago, Nias, Riau Archipelago, Sumatra, and questionably from Java), Brunei Darussalam, Malaysia, Myanmar, and the Philippines (including Palawan and Sulu Tandjong) (David and Vogel 1996. The Snakes of Sumatra. An Annotated Checklist and Key with Natural History Notes. Edition Chimaira, Frankfurt am Main. 260 pp.). New record for Pulau Pemanggil (Grismer et al. 2006. Raffles Bull. Zool. 54[1]:173–196).

Submitted by **PERRY L. WOOD**, Department of Biology, La Sierra University, Riverside, California 92515-8247, USA; e-mail: pwoo213@my.lasierra.edu.

DIADOPHIS PUNCTATUS EDWARDSII (Northern Ringnecked Snake). USA: OHIO: BROWN CO.: Pleasant Township. Straight Creek Road on valley wall of Straight Creek (38°49.839'N 83°50.5003'W). 13 June 2006. Jeffrey G. Davis, John W. Ferner, and Paul J. Krusling. Verified by Greg Lipps Jr. Cincinnati Museum Center (CMNH 10460). New county record (Wynn and Moody 2006. Ohio Turtle, Lizard, and Snake Atlas. Ohio Biological Survey Misc. Contribution No. 10, Columbus).

Submitted by **JEFFREY G. DAVIS (**e-mail: anura@fuse.net) and **PAUL J. KRUSLING**, Cincinnati Museum Center – Fredrick and Amye Geier Research and Collections Center, 1301 Western Ave., Cincinnati, Ohio 45203-1130, USA (e-mail pkrusling@fuse.net); and **JOHN W. FERNER**, Department of Biology, Thomas More College, Crestview Hills, Kentucky 41017 USA (e-mail: JohnFerner@Thomasmore.edu).

DIADOPHIS PUNCTATUS EDWARDSII (Northern Ringnecked Snake). USA: OHIO: CLINTON CO.: Vernon Township. Shoreline of Cowan Creek along Cowan Creek Road (39°24.008'N 83°56.591'W). 30 July 2006. Jeffrey G. Davis and Scott A. Menze. Verified by John W. Ferner. Cincinnati Museum Center (CMNH 10597). New county record (Wynn and Moody 2006. Ohio Turtle, Lizard, and Snake Atlas, Ohio Biological Survey Misc. Contribution No. 10, Columbus).

Submitted by **JEFFREY G. DAVIS**, Cincinnati Museum Center – Fredrick and Amye Geier Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA; and **SCOTT A. MENZE**, William Henry Harrison High School, 9860 West Road, Harrison, Ohio 45030, USA (e-mail: anura@fuse.net).

DRYMOLUBER BRAZILI (Brazilian Woodland Racer). PARAGUAY: CANINDEYU DEPARTMENT: Mbaracayu Forest Natural Reserve: Horqueta mí (24°08'09.2"S, 55°19'21.3"W). 2004. S. Fernández and F. Ramírez. Museo Nacional de Historia Natural del Paraguay, Asunción, Paraguay (MNHNP 11025, female, SVL 291.5 mm, TL 120.5 mm). Verified by N. J. Scott, Jr. Previously known only from Brazil (Amaral 1977. Serpentes do Brasil. Iconografía colorida. Ed. Melhoramentos & Inst. Nac. Livro, Edit. Univ. Sao Paulo, 248 pp.; Nogueira 2001. Herpetol. Rev. 32:286; Argôlo 2004. Herpetol. Rev. 35:191; Lehr et al. 2004. Copeia 2004 [1]:46–52). First country record, extends range ca. 167 km S of Ponta Porã, Mato Grosso do Sul, Brazil, the southernmost locality known for the species (Lehr et al., *op. cit.*).

Submitted by **PIER CACCIALI**, Museo Nacional de Historia Natural, Sucursal 1, Ciudad Universitaria, San Lorenzo, Paraguay (e-mail: pier_cacciali@yahoo.com); **SIXTO FERNÁNDEZ** and **FREDDY RAMÍREZ**, Fundación Moisés Bertoni, Prócer Carlos Argüello 208, CC 714, Asunción, Paraguay (e-mail: mbertoni@mbertoni.org.py).

DRYOCALAMUS DAVISONII (Bridled Snake): VIETNAM: KIEN GIANG PROVINCE: PHU QUOC ISLAND: Bai Thom Commune: Bai Dai: IEBR 3128, nr. 10°21.787'N, 104°04.863'E, ca. 30 m elev., ca. 300 km SW Dong Nai Province (Nguyen an Ho 2002. J. Biol. 24[2A]:2–10). 30 October 2006. K. V. Nguyen. Verified by Nikolai L. Orlov. Previously known from Quang Binh, Quang Tri, Khanh Hoa, Binh Thuan, Dong Nai, Tay Ninh Provinces, and Ho Chi Minh City, and extralimitally, Myanmar, Laos, Thailand, and Cambodia (Campden-Main 1970. A Field Guide to the Snakes of South Vietnam. Smithsonian Institution, Washington, D.C. 114 pp.; Chan-ard et al. 1999. Amphibians and Reptiles of Peninsular Malaysia and Thailand, an Illustrated Checklist. Bushmaster Publications, Würselen. 240 pp.; Cox et al. 1998. A Photographic Guide to Snakes and other Reptiles of Thailand and Southeast Asia. New Holland Publishers [UK] Ltd., London. 144 pp.; Ngo 1998. J. Biol., Hanoi 20[4]:12–19; Nguyen and Ho 2002. J. Biol. 24[2A]:2–10; Pham et al. 2000. J. Biol., Hanoi 22[1B]:24–29; Smith 1943. Fauna of British India. Vol. 3- Serpentes. Taylor & Francis, London. 525 pp.; Ziegler et al. 2006. *In* Vences et al. [eds.], Herpetologia Bonnensis II. Proc. 13th Congress Soc. Europ. Herpetol., pp. 247–262). First provincial record.

Submitted by **NGUYEN QUANG TRUONG**, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam; e-mail: truong@iebr.vast.ac.vn.

GEOPHIS DUGESII AQUILONARIS (Chihuahuan Earth Snake). MÉXICO: SONORA: MUNICIPIO DE YÉCORA, E slope of Sierra El Chuchupate, 10.7 km S of Mex Hwy 16 (28°18.272'N, 108°47.389'W), 1400 m elev. 09 July 2005. E. Enderson and R. Bezy. Verified by George Bradley. Photographic voucher, UAZ 56421-PSV. First state record, extending the range ca. 153 km (airline) NE of Creel, Chihuahua (Downs 1967. Misc. Publ. Mus. Zool. Univ. Michigan 131:1–193).

Submitted by **ERIK F. ENDERSON**, Drylands Institute, PMB 405, 2509 North Campbell Avenue, Tucson, Arizona 85719, USA (e-mail: eenderson@cox.net); and **ROBERT L. BEZY**, Herpetology, Natural History Museum of Los Angeles County, Los Angeles, California 90007, USA.

GEOPHIS DUGESII AQUILONARIS (Chihuahuan Earth Snake). MÉXICO: SONORA: 48.3 km E km marker 280 on Hwy 16 at eastern edge of Yécora (ca. 28°04'N, 108°31'W), 1450 m elev. 20 August 2005. Ian M. Recchio and Christopher M. Rodriguez. Verified by Jonathan A. Campbell. Photographic collection, Laboratorio de Herpetología, Universidad Autónoma de Nuevo León (UANL 6798). Second record for Sonora (see Enderson and Bezy 2007. Herpetol. Rev. 38:103), otherwise extending range ca. 60 km west from the closest known locality in the Sierra Tarahumari at Yoquivo, Chihuahua (BM 1911.12.12.30–31). The snake was found active on ground surface during a light, early evening rainstorm in pine-oak forest on the Sierra Madre Occidental.

Submitted by **IAN M. RECCHIO**, Los Angeles Zoo, 5333 Zoo Drive, Los Angeles, California 90027, USA (e-mail: irecchio@zoo.lacity.org); **CHRISTOPHER M. RODRIGUEZ**, Department of Biology, California State University, Northridge, Northridge, California 91330-8303, USA and Los Angeles Zoo, 5333 Zoo Drive, Los Angeles, California 90027, USA (e-mail: christopher.rodriguez.68@csun.edu); and **DAVID LAZCANO,** Universidad Autonoma de Nuevo Leon, Facultad de Ciencias Biológicas, Laboratorio de Herpetologia, Apartado Postal-513, San Nicolas de los Garza, Nuevo Leon, C.P.66450, México (e-mail: dvlazcano@hotmail.com).

GONIONOTOPHIS BRUSSAUXI (Mocquard's Lesser File Snake). CENTRAL AFRICAN REPUBLIC, Ngotto Forest, Baturi River area (03°54'N, 17°2'E; 445 m elev.), right bank of the Lobaye River. Within a mixed-species semi-deciduous primary rainforest at northern limit of the Guineo-Congolese rainforest. Between 25 November 1998 and 6 December 1999. P. Barrière. MNHN 2003.2959. Verified by Laurent Chirio. Subadult, SVL 222 mm, tail L 73 mm, found dead in a pitfall trap. First country record. Previously known from the forested areas of Cameroon, Equatorial Guinea, Gaboon, Republic of Congo, Democratic Republic of Congo, south through Angola, and east through Uganda. The unique Uganda specimen belongs to the eastern subspecies, *G. b. prigoginei* with higher ventral and subcaudal counts. Central African Republic reptiles have been subject of a recent publication (Chirio and Ineich 2006. Afr. J. Herpetol. 55[1]:23–59) dealing with a collection comprising about 5000 specimens deposited in MNHN; this species is unlisted in that collection.

Submitted by **IVAN INEICH**, Muséum national d'Histoire naturelle, Département de Systématique et Evolution, USM 602 Taxinomie et collections (Reptiles), 25 rue Cuvier, F–75005 Paris, France (e-mail: ineich@mnhn.fr); **THIERRY FRETEY**, Association Racine, 2 rue de la Cité, F–35360 Médréac, France (e-mail: fretey.thierry@wanadoo.fr); **MARC COLYN**, and **PATRICK BARRIÈRE**, Laboratoire Ecobio: Ecosystèmes, Biodiversité et Evolution, UMR 6553–CNRS, Université de Rennes 1, Station Biologique, F–35380 Paimpont, France (e-mail: Patrick.Barriere@laposte.net).

LAMPROPELTIS TRIANGULUM CELAENOPS (New Mexico Milksnake). USA: NEW MEXICO: LUNA CO.: NM Hwy 27, 2.7 road miles N of Nutt (T20S, R6W, SE1/4 Sec 6), one male AOR. 07 September 2005. Bruce L. Christman, Michelle R. Cummer, and June M. Christman. Museum of Southwestern Biology (MSB 72462). Verified by J. Tomasz Giermakowski. First county record, first specimen documented from Nutt grasslands (Degenhardt et al. 1996. Amphibians and Reptiles of New Mexico. Univ. of New Mexico Press, Albuquerque. xii + 431 pp.).

Submitted by **BRUCE L. CHRISTMAN**, **MICHELLE R. CUMMER,** and **JUNE M. CHRISTMAN,** 736 Cardenas SE, Albuquerque, New Mexico 87108, USA.

LAMPROPELTIS T. TRIANGULUM (Eastern Milksnake). USA: OHIO: BROWN CO.: Union Township. South-facing hillside overlooking Ohio River along State Route 52 (38°45.526'N, 83°51.658'W). 13 June 2006. Paul J. Krusling, Jeffrey G. Davis, and John W. Ferner. Verified by Greg Lipps Jr. Cincinnati Museum Center (CMNH 10461). New county record (Wynn and Moody 2006. Ohio Turtle, Lizard, and Snake Atlas. Ohio Biological Survey Misc. Contribution No. 10, Columbus).

Submitted by **PAUL J. KRUSLING** (e-mail: pkrusling@fuse.net) and **JEFFREY G. DAVIS,** Cincinnati Museum Center – Fredrick and Amye Geier Research and Collections Center, 1301 Western Avenue, Cincinnati, Ohio 45203-1130, USA (e-mail: anura@fuse.net); and **JOHN W. FERNER**, Department of Biology, Thomas More College, Crestview Hills, Kentucky 41017, USA (e-mail: JohnFerner@Thomasmore.edu).

LYCODON LAOENSIS (Indo-chinese Wolf Snake). LAOS: KAMPHAENG NAKHON VIENTIANE (Vientiane Prefecture): vicinity of Vientiane. January 1963. Louis G. Bush. Verified by Bryan L. Stuart. AMNH R-94153–94154. This is a new provincial record for Laos. Dueve (1970. Mem. ORSTOM. 39:124) states that this species is also known from all of the provinces in central and southern Laos, but without localities or voucher information. This species is also known from India, the Malay Peninsula, Thailand, China (Yunnan Province), Cambodia (Kompong Som, Siem Reap Provinces), and Vietnam (Quang Nam, Lam Dong, and Dong Nai Provinces, as well as Ho Chi Minh City) (Campden-Main 1969. A Field Guide to the Snakes of South Vietnam, p. 34; Saint Girons 1972. Mém. Mus. Nat. Hist. Natur. new ser. A, Zool.:56; Smith 1943. The Fauna of British India, Ceylon and Burma, including the Whole of the Indo–Chinese Region. Vol. III. Serpentes, p. 260; Taylor 1965. Univ. Kansas Sci. Bull. 45:740–748; Zhao and Adler 1993. Herpetology of China. Society for the Study of Amphibians and Reptiles, Contributions to Herpetology, No. 10, p. 246). In Vietnam, it has also been reported from Bac Giang, Song Be (= Binh Phuoc), and Tay Ninh Provinces, but without reference to specific locality or voucher information (Nguyen et al. 2005. Checklist of Reptiles and Amphibians of Vietnam, p. 88; Pham et al. 2000. J. Biol. 22:24–29).

Submitted by **RAOUL H. BAIN**, Center for Biodiversity and Conservation, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, USA; **NGUYEN QUANG TRUONG** and **DOAN VAN KIEN**, Department of Vertebrate Zoology, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam.

NERODIA SIPEDON (Northern Watersnake). USA: ILLINOIS: HAMILTON CO.: Hamilton County State Fish and Wildlife Area (38°03'56"N, 88°23'52"W). 15 April 2006. Cy L. Mott and Michael A. Steffen. Verified by Ronald A. Brandon. Color photo voucher. SIUC R-03446. Juvenile specimen. New county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **CY L. MOTT**, Cooperative Wildlife Research Laboratory, Department of Zoology, Southern Illinois University, Carbondale, Illinois 62901, USA; e-mail: cm8755@siu.edu.

OPHEODRYS AESTIVUS (Rough Greensnake). USA: ARKANSAS: Van Buren Co.: near Brock Creek Lake: 35.49037°N, 92.80132°W. 15 Oct. 2005. Josh Engelbert, Melissa Patrick, Ashley Patrick, and Mauricio Solis. Verified by Stanley E. Trauth. Voucher specimen in Arkansas State University Museum of Zoology (ASUMZ 29441). County record (Trauth et al., 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **JOSH ENGELBERT, MELISSA PATRICK,** and **MAURICIO SOLIS,** Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, Arkansas 72467-0599, USA (e-mail: josh.engelbert@smail.astate.edu).

OPHEODRYS AESTIVUS (Rough Greensnake). USA: ILLINOIS: Clay Co.: Snake was found DOR at 1.8 km S of Effingham County line on IL Rt. 37 (38.8997°N, –88.6892°W). 16 September 2006. Specimen collected by John K. Tucker and Maelin J. Abbott, Illinois Natural History Survey. INHS 20134. Verified by Chris Phillips. Specimen is a first county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, Champaign, Illinois. xii + 282 pp.).

Submitted by **JAMES T. LAMER, JOHN K. TUCKER, CHAD R. DOLAN,** and **MAELIN J. ABBOTT**, Illinois Natural History Survey, 8450 Montclair Ave, Brighton, Illinois 62012, USA.

OXYRHOPUS MELANOGENYS (Black-headed Calico Snake). GUYANA: Mazaruni-Potaro District, Wokomung Massif (04°55'34"N, 59°55'24"W), ~1077 m elev. 05 December 2006. Collected by D. Bruce Means and Michelle Kalamandeen. Verified from photographs by William W. Lamar. Specimen preserved in 95% ethanol and deposited in Centre for the Study of Biological Diversity, University of Guyana Museum (HR-700), plus four photographs deposited in the Florida Museum of Natural History (UF-150161). Found crawling through wet leaf litter on top of a log and a few moments later, partially under a rock loosely embedded in dry overflow sediments of a rocky mountain stream. First record of species in Guyana and extends range about 640 km ESE of the closest known locality in French Guiana (Hollowell and Reynolds [eds.] 2005. Checklist of the Terrestrial Vertebrates of the Guiana Shield. Bull. Biol. Soc. Washington 13:1–109; Starace 1998. Guide des Serpents et Amphisbenes de Guyane. Ibis Rouge Editions, Guadaloupe, Guyane). The record is notable because it fills a distributional gap between French Guiana (Guyane) on the east and Venezuela on the west.

Submitted by **D. BRUCE MEANS**, Coastal Plains Institute and Land Conservancy, 1313 Milton Street, Tallahassee, Florida 32303, USA; and **MICHELLE KALAMANDEEN**, Centre for the Study of Biological Diversity, Department of Biology, University of Guyana, Turkeyen Campus, East Coast Demerara, Guyana.

PROTOBOTHROPS MUCROSQUAMATUS (Brown-spotted Pitviper). VIETNAM: LANG SON PROVINCE: Cao Loc District: Mau Son Commune: Mau Son Mountain: IEBR 2492, nr. 21°52.012'N, 106°57.947'E, 380 m elev., ca. 200 km SE Ha Giang Province (Ziegler et al. 2006. Sauria, Berlin 28[1]:29–40). 14 October 2006. T. Q. Nguyen, K. V. Doan, and C. T. Ho. Verified by Nikolai L. Orlov. Previously recorded from Lao Cai, Ha Giang, Cao Bang, Bac Kan, Thai Nguyen, Vinh Phuc, Quang Ninh, Hai Phong, Hai Duong, Ha Tay, Ninh Binh, Nghe An, Ha Tinh, Quang Tri, Kon Tum, Gia Lai, and Thua Thien-Hue provinces; extralimitally, India, Bangladesh, China (including Hainan), Taiwan, and Myanmar (Bain et al. 2007. Herpetol. Rev. 38:107–117; Darevsky 1999. *In* H. Ota [ed.], Tropical Island Herpetofauna: Origin, Current Diversity, and Conservation, pp. 27–42, Elsevier Science B.V., Amsterdam; Gumprecht et al. 2004. Asian Pitvipers. Geitje Books, Berlin. 368 pp.; Herrmann et al. 2004. Herpetologica 60[2]:211–221; Ho et al. 2001. J. Biol., Hanoi 23[3b]:137–145; Ho et al. 2005. J. Biol., Hanoi 27[4A]:95–102; Hoang et al. 2005. J. Biol., Hanoi 27[4A]:109–116; Le 1978. Sci. Newsl. Nat. Sci. Part 1[2]:96–101; Le and Hoang 2001. J. Biol., Hanoi 23[3b]:59–65; Leviton et al. 2003. Proc. California Acad. Sci. 54[24]:407–462; Nguyen 2000. J. Biol., Hanoi 22[15]:195–201; Nguyen et al. 2005. A Checklist of Amphibians and Reptilies of Vietnam. Agricultural Publishing House, Hanoi. 180 pp.; Orlov et al. 2000. Russian J. Herpetol. 7:69–80; Smith 1943. Fauna British India. Vol. 3: Serpentes. Taylor & Francis, London. 525 pp.; Szyndlar and Nguyen 1996. The Snake 27[2]:91–98; Tran and Nguyen 1995. Poisonous Snakes of Vietnam. Science and Technology Publishing House, Hanoi. 204 pp.; Tran et al. 1981. *In* Dao et al. Science and Technology Publishing House, Hanoi, pp. 365–427; Vogel 2006. Venomous Snakes of Asia. Edition Chimaira, Frankfurt am/Main. 148 pp.; Zhao and Adler 1993. Herpetology of China. Society for the Study of Amphibians and Reptiles, Oxford, Ohio. 522 pp.; Ziegler 2002. Die Amphibien und Reptilien eines Tieflandfeuchtwald-Schutzgebietes in Vietnam. Natur und Tier-Verlag GmbH, Münster. 342 pp.; Ziegler et al. 2006. Sauria, Berlin 28[1]:29–40). First provincial record.

Submitted by **NGUYEN QUANG TRUONG**, **DOAN VAN KIEN**, **HO THU CUC**, and **NGUYEN VAN SANG**, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam (e-mail: truong@iebr.vast.ac.vn).

PSEUDOFICIMIA FRONTALIS (False Ficimia). MÉXICO: SONORA: Municipio de Yécora: W slope of the Sierra Madre Occidental, 0.3 km (by Mex Hwy 16) E Tepoca (28º26.230'N, 109º15.470'W), 593 m elev. 01 September 2005. E. Enderson and R. Bezy. Verified by George Bradley. Photographic voucher, UAZ 56368-PSV. Northernmost record for the species, extending the range ca. 161 km (airline) N of Alamos, Sonora (Hardy 1972. J. Herpetol. 6:53–69; Schwalbe and Lowe 2000. *In* Robichaux and Yetman [eds.], The Tropical Deciduous Forest of Alamos, pp. 172–199. Univ. Arizona Press, Tucson). The snake was AOR at 2308 h in tropical deciduous forest.

Submitted by **ERIK F. ENDERSON**, Drylands Institute, PMB 405, 2509 North Campbell Avenue, Tucson, Arizona 85719, USA (e-mail: eenderson@cox.net); and **ROBERT L. BEZY**, Herpetology, Natural History Museum of Los Angeles County, Los Angeles, California 90007, USA.

REGINA GRAHAMII (Graham's Crayfish Snake). USA: ILLINOIS: Grundy Co.: found dead in a minnow trap in a shallow cattail marsh pool at Goose Lake Prairie State Natural Area (UTM: Zone 16 390697E and 4580308N; 41.3669°N, 88.3069°W, NAD 83 CONUS map datum). 27 June 2006. M. J. Dreslik and D. Ludwig.Verified by Christopher A. Phillips, INHS 20119. This is the second specimen observed; the first was captured live on 22 June 2006, photographed and released. Over the next few weeks several more individuals were found in other marsh wetlands within the natural area. Specimen is the first county record (Phillips et al. 1999. Field Guide to Amphibians and Reptiles of Illinois. Illinois Nat. Hist. Surv. Manual 8, 300 pp.).

Submitted by **SARAH J. BAKER,** Illinois Natural History Survey, Division of Biodiversity and Ecological Entomology, 1816 South Oak Street, Champaign, Illinois 61820, USA; **DANIEL KIRK,** Illinois Department of Natural Resources, Silver Springs State Park, 13608 Fox Road, Yorkville, Illinois 60560, USA; **CARL E. SCHMIDT** and **MICHAEL J. DRESLIK**, Illinois Natural History Survey, Division of Biodiversity and Ecological Entomology, 1816 South Oak Street, Champaign, Illinois 61820, USA.

SINONATRIX AEQUIFASCIATA (Spotted Water Snake): VIETNAM: LANG SON PROVINCE: CAO LOC DISTRICT: Mau Son Commune: Mau Son Mountain: IEBR 2446, 2480, and 2494, nr. 21°52.012'N, 106°57.947'E, 380 m elev., ca. 450 km N Nghe An Province (Ziegler and Hoang 2005. Herpetol. Rev. 36:84). 13–14 October 2006. T. Q. Nguyen, K. V. Doan, and C. T. Ho. Verified by Nikolai L. Orlov. On tree above stream in secondary forest. Previously recorded from Lao Cai, Ha Giang, Cao Bang, Vinh Phuc, Bac Giang, Nghe An, and Ha Tinh provinces of Vietnam; extralimitally, China (including Hong Kong) (Bain and Nguyen 2004. Amer. Mus. Novit. 3453:1–42; Bain et al. 2007. Herpetol. Rev. 38:107–117; Ho et al. 2005. J. Biol., Hanoi 27[4A]:95–102; Karsen et al. 1998. Hong Kong Amphibians and Reptiles. Provisional Urban Council, Hong Kong. 186 pp.; Nguyen et al. 2002. J. Biol., Hanoi 24[2A]:11–14; Nguyen et al. 2005. A Checklist of Amphibians and Reptilies of Vietnam. Agricultural Publishing House, Hanoi. 180 pp; Orlov et al. 2000. Russian J. Herpetol. 7:69–80; Vogel et al. 2004. Hamadryad 29:110–114; Zhao and Adler 1993. Herpetology of China. Society for the Study of Amphibians & Reptiles, Oxford, Ohio. 522 pp; Ziegler and Hoang 2005. Herpetol. Rev. 36:84). First provincial record.

Submitted by **NGUYEN QUANG TRUONG**, **DOAN VAN KIEN, HO THU CUC**, and **NGUYEN VAN SANG**, Institute of Ecology and Biological Resources, 18 Hoang Quoc Viet, Hanoi, Vietnam (e-mail: truong@iebr.vast.ac.vn).

SISTRURUS CATENATUS TERGEMINUS (Western Massasauga). USA: OKLAHOMA: WASHINGTON CO.: 1.3 km N of East Tuxedo Blvd on Bison Rd. (N 3990): 15S 241225, 4073104 (UTM WGS84). 14 September 2004. Josh Engelbert and Melissa Patrick. Verified by Stanley E. Trauth. Voucher specimen in Arkansas State University Museum of Zoology (ASUMZ 29859). New county record (Webb 1970. Reptiles of Oklahoma. University of Oklahoma Press, Norman, 370 pp.; and Distribution of Oklahoma Amphibians and Reptiles by Recorded Sighting, http://www.biosurvey.ou.edu/dokadesc.html.

Submitted by **JOSH ENGELBERT** and **MELISSA PATRICK**, Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, Arkansas 72467-0599, USA (e-mail: josh.engelbert@smail.astate.edu).

SONORA SEMIANNULATA (Groundsnake). USA: NEVADA: PERSHING CO.: Sonoma Range, above Sonoma Creek (40°48'49.0"N, 117°42'29.8"W, 1505 m elev.) under a small rock in sagebrush habitat. 07 May 2006. Bryan Hamilton. Verified by Jack Sites (BYU 8591). Three individuals of this species were observed at this locality in 1993 but no vouchers were collected (Scott, pers. comm.). This record fills a gap in the northeastern distribution of this species with the nearest documented records 64 km E (Battle Mountain, Humboldt Co., Nevada; CAS-SUR 10032), 160 km NW (Denio, Pershing Co., Nevada; Stebbins 2003. Western Reptiles and Amphibians. 3rd ed., Houghton Mifflin Company, Boston, Massachusetts), and 60 km SW (Humboldt House, Pershing Co., Nevada; UNR 493).

Submitted by **BRYAN HAMILTON,** 100 Great Basin National Park, Baker, Nevada 89311, USA; and **PAULETTE CONRAD,** Nevada Department of Wildlife, 4747 Vegas Drive, Las Vegas, Nevada 89108, USA (e-mail: pconrad@ndow.org).

STORERIA DEKAYI (Dekay's Brownsnake). USA: ARKANSAS: LONOKE CO.: 2.2 km E. Ward (T5N, R9W, S25). 10 April 2005. Donald F. McKenzie. Verified by Stanley E. Trauth. Arkansas State University Museum of Zoology Herpetological Collection (ASUMZ 29316). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville. 421 pp.).

Submitted by **MICHAEL V. PLUMMER**, Department of Biology, Box 12251, Harding University, Searcy, Arkansas 72149, USA (e-mail: plummer@harding.edu); and **DONALD F. McKENZIE,** Wildlife Management Institute, 2396 Cocklebur Road, Ward, Arkansas 72176, USA (e-mail: wmidm@ipa.net).

STORERIA OCCIPITOMACULATA (Northern Red-bellied Snake). USA: SOUTH DAKOTA: MARSHALL CO.: BIA Hwy 15, 4.8 km S Veblin. 26 September 2005. Lars Bryan Williams. Verified by Zannita Fast Horse. Campbell Museum, Clemson University (CUSC 2323–24). Two snakes found crossing road near wetland. County record (Ballinger et al. 2000. Trans. Nebraska Acad. Sci. 26:29–46). Extends distribution ca. 46 km NW from populations in adjacent Roberts Co.

Submitted by **LARS BRYAN WILLIAMS**, Department of Math and Science, Oglala Lakota College, P.O. Box 490, Kyle, South Dakota 57752, USA; **STEVEN G. PLATT**, Department of Biology, P.O. Box C-64, Sul Ross State University, Alpine, Texas 79832, USA (e-mail: splatt@sulross.edu); **THOMAS R. RAINWATER**, The Institute of Environmental and Human Health, Department of Environmental Toxicology, P.O. Box 764, Jefferson, Texas 75657, USA; and **STANLEE M. MILLER**, Department of Biological Sciences, 132 Long Hall, Clemson University, Clemson, South Carolina 29634-1903, USA.

THAMNOPHIS PROXIMUS PROXIMUS (Orange-striped Ribbonsnake). USA: ARKANSAS: LEE CO.: Jct. of US Hwy 79 and US Hwy 78: 34.46.545N, 90.57.874W (WGS 84): 22 April 2005. Josh Engelbert and Melissa Patrick. Verified by Stanley E. Trauth. Voucher specimen in Arkansas State University Museum of Zoology (ASUMZ 29276). New county record (Trauth et al. 2004. The Amphibians and Reptiles of Arkansas. Univ. of Arkansas Press, Fayetteville, 421 pp.).

Submitted by **JOSH ENGELBERT** and **MELISSA PATRICK**, Department of Biological Sciences, Arkansas State University, P.O. Box 599, State University, Arkansas 72467-0599, USA (e-mail: josh.engelbert@smail.astate.edu).

TROPIDODRYAS STRIATICEPS (Jiboinha). BRAZIL: BAHIA. Municipality of Palmeiras: Vale do Capão, 12º31'S, 41º33'W. 14 August 2003. Collector unknown. Verified by G. Puorto. Coleção de Répteis do Museu de Zoologia da Universidade Federal da Bahia, Salvador, Bahia, Brazil (UFBA-SER 1380). Species previously known from Rio Grande do Sul to Bahia states in Brazil (Argôlo 1999. Herpetol. Rev. 30:56; Hofstadler-Deiques and Di-Bernardo 2004. Herpetol. Rev. 25:193; Lema 2002. Os Répteis do Rio Grande do Sul: atuais e fósseis – biogeografia – ofidismo. Edipucrs, Porto Alegre, 264 pp.; Thomas and Dixon 1977. The Pearce-Sellards Series 27:1–20). Northernmost locality for the species, extends range ca. 280 km N from Barra do Choça, the previously known northern locality (Argôlo 1999, *op. cit*.)

Submitted by **BRENO S. HAMDAN** and **REJÂNE MARIA LIRA-DA-SILVA**, Núcleo Regional de Ofiologia e Animais Peçonhentos da Universidade Federal da Bahia, Rua Barão de Geremoabo, 147 - Campus de Ondina, CEP 40170-290, Salvador, Bahia, Brazil (e-mail: brenohamdan@hotmail.com).

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New Herpetofaunal Records from Vietnam

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Between 1997 and 2005, increased survey effort and closer examination of natural history collections have resulted in the description of 53 new species of amphibians and 27 new species of reptiles from Indochina (Laos, Cambodia, and Vietnam). Over that same time period, range extensions into Indochina of 36 amphibian species and 33 reptile species were recorded. Despite this increase in knowledge, the diversity of the region remains imperfectly known, as new discoveries continue to be published at a rapid pace; in 2006 (up until mid-November) six species of amphibians, one species of snake, and one species of lizard were described from the region, along with 37 new country or provincial records (Bain and Stuart 2006 [2005]; Bain et al. 2006; Ohler and Delorme 2006; Orlov, Ananjeva, and Ho 2006; Orlov, Dutta et al. 2006; Orlov, Nguyen, and Nguyen 2006; Stuart 2006; Stuart and Emmett 2006; Stuart et al. 2006; Ziegler and Le 2006; Ziegler, Ohler et al. 2006; Ziegler, Thanh et al. 2006). Herein, we provide one novel country record and 60 novel provincial records for Vietnam. We feel that specific locality and voucher data is crucial to understanding patterns of diversity, so we include species that have been reported in the literature, but without reference to specific locality or voucher material. We comment on those records that have been reported on in only a general way, and we provide novel natural history information for recently described species that are very poorly known. Our taxonomy follows Frost et al. (2006), Malhotra and Thorpe (2004), Schmitz et al. (2004), and Utiger et al. (2002). Referred specimens are housed either at the Institute of Ecology and Biological Resources, Hanoi (IEBR), or the American Museum of Natural History, New York (AMNH). Specimens on long term custodial loan from IEBR to AMNH are assigned dual catalogue numbers (e.g., AMNH XXXX/IEBR YYYY).

Amphibia

Order Anura

Family Bufonidae

Ingerophrynus macrotis. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune: IEBR 2303, 16°14.529'N, 107°27.354'E, elev. ~ 150 m, 17 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran. A Roang Commune: AMNH A-169338, nr. 16°04.636'N, 107°29.290'E, elev. ~ 650 m, 26 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho; from undergrowth on a bank, of a rocky stream in primary forest . *Ingerophrynus macrotis* is a widespread species (Myanmar, Thailand, Laos, and Cambodia), but in Vietnam voucher specimens have only been reported from Dak Lak Province (Buon Geng District [= Buon Giang Lanh]) (Bourret 1942; Inger et al. 1999; Nguyen and Hoang 2000; Ohler et al. 2002; Smith 1930; Stuart 2005b; Taylor 1962).

Family Microhylidae

Microhyla marmorata. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: AMNH A-169291, nr. 16°04.636'N, 107°29.290'E, elevation ~ 650 m, 29 August 2005, R. H. Bain and T. Q. Nguyen; AMNH A-169292, elevation ~ 680 m, 30 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho. Both specimens were collected along leaf litter around forest ponds. Dozens of males were calling in and around the pond: floating on the surface, atop herbaceous undergrowth (< 5 cm from the ground), atop fallen logs, and from the leaf litter. In life the oblique shape on the dorsum and head is green-grey, outlined with white; spots along the dorsum, legs, and flanks are black, outlined in white; white lines run along the dorsum and legs; limbs pinkish with brown bands; the remainder of the dorsum mottled yellow; venter brown, mottled with yellow on chest and belly. This species is known from Ha Tinh (Huong Son, Ky Anh- Ke Go Districts), Quang Binh (Phong Nha District), and Quang Nam (Tra My District) Provinces in Vietnam, as well as Khammouan and Bolikhamxay Provinces in Laos (Bain and Nguyen 2004a).

Family Megophryidae

Brachytarsophrys feae. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, forest above Nam Tha River: AMNH A-168658, nr. 21°55'13" N, 104°22'15" E, elevation 950 m, 7 September 2004, R. H. Bain. AMNH A-168659, 168660, 21°54'56"N, 104°21' 39" E, elevation 1300–1400 m, 11–12 September 2004, R. H. Bain, T. Q. Nguyen, K. V. Doan, A. C. Lu, and V. T. Trieu. AMNH A-168658 was collected from a pitfall trap set in mixed hardwood and bamboo forest between two tributaries of the Nam Tha. AMNH A-168659, 660 were collected under leaves on the forest floor, > 20 m from a small stream. Within Vietnam, this species has been reported from Lang Son (Mao Son [= Mau Son]), and Vinh Phuc (Tam Dao N.P.) (Bourret 1942; Inger et al. 1999). Orlov et al. (2002) include 'northern Vietnam' in the distribution, Nguyen, Ho, and Nguyen (2005) note this species from Lao Cai Province, and Ho et al. (2005) note this from Cao Bang (Nguyen Binh District), but without reference to precise locality or voucher specimens. It is otherwise known from Myanmar, Thailand, and China (Yunnan Province) (Bourret 1942; Fei et al. 2005; Taylor 1962).

Leptobrachium banae. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: AMNH A-169283, 16°04.877'N, 107°28.424'E, elevation ~ 850–900 m, 28 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho; collected from the bank of a cascading, rocky stream, a few meters from the water. IEBR 2304 nr. 16°04.636'N, 107°29.290'E, elevation ~ 650 m, 29 August 2005, R. H. Bain and T. Q. Nguyen; on the stream bank. Color in life as in holotype with the following exceptions: limb bands and flank spots orange; venter grey, spotted with white on throat and thighs, marbled with white on chest and belly. Within Vietnam, this species is only known from its type locality in Gia Lai Province (An Khe District [= K Bang]) (Lathrop et al. 1998). Nguyen, Ho, and Nguyen (2005) note this from Quang Nam Province, but without reference to voucher specimens or specific locality. This species has also been reported from Xe Kong Province, Laos (Stuart 2005b).

Leptolalax pluvialis. HA GIANG PROVINCE, Vi Xuyen District, Cao Bo Commune, Mount Tay Con Linh II: AMNH A-163833–163834, 22°46'18"N, 104°49'12"E, elevation 1710 m, 10 September 2000, C. Johnston; from a small pan trap set in the forest floor. They were erroneously reported as juveniles of *L. bourreti* (Bain and Nguyen 2004b), but subsequent analysis showed that these were adults of *L. pluvialis*. This is the first record of this species east of the Red River. It is otherwise only known from the type locality on Mt. Fan Si Pan, Lao Cai Province (Ohler et al. 2000).

Leptolalax sungi. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, tributary to Khe Pan River: AMNH A-168676–168677, 21°56'39"N, 104°24'12"E, elevation 331 m, 17 September 2004, R. H. Bain, K. V. Doan, and V. T. Trieu. AMNH A-168676 was collected on an embankment ~ 5 m from the stream's edge atop an herbaceous leaf (~ 2 m off the ground), and AMNH A- 168677 was collected on the ground of a flat, rocky stream bank, ~ 1.5 m from the edge of the water. These specimens have distinct day and night coloration. At night, the dorsum is a solid red-brown with creamy yellow tubercles towards the sacrum; flank yellow, with some black speckling; limbs banded with light brown; canthus and supratympanic fold each creamy yellow above, with thick dark brown line below; loreal red-brown, with two dark spots, upper lip with three dark spots. In the day, the color is the same except that the dorsum is creamy with irregular brown splotches; a black loreal spot extends above canthus; dorsal tubercles red-brown; finger tips white. This species is otherwise known only from the type locality of Vinh Phuc Province (Tam Dao N.P.) (Lathrop et al. 1998). This is the first record of it west of the Red River. Nguyen, Ho, and Nguyen (2005) note this species from Van Yen District, Yen Bai Province, but without reference to precise locality or voucher specimens.

Leptolalax tuberosus. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: AMNH A-169283, 16°04.877'N, 107°28.424'E, elevation ~ 850–900 m, 28 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho. Calling from atop a shrub on a steep bank, ~ 1 m above the ground, 5 m from the edge of a cascading, rocky stream in disturbed primary forest. In life, dorsum sandy with green hatching pattern; brown spots on upper lip and posterior portion of tympanum; limbs with olive green bands; iris sandy-gold, upper one-quarter peach, with thick network of deep indigo. This species is only known from two other provinces in Vietnam, Gia Lai (An Khe District [= K Bang]) and Quang Nam (Tra My District) (Bain and Nguyen 2002a; Inger et al. 1999).

Ophryophryne gerti. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune, A Pat Stream, above Ho Chi Minh Highway marker kilometer 398 + 700: AMNH A-169287, nr. 16°04.636'N, 107°29.290'E, elevation ~ 680 m, 30 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho. This was collected sitting on a leaf atop a small shrub (< 1 m), beside a rocky-bottomed stream. QUANG NAM PROVINCE, Tra My District, Tra Don Commune: AMNH A-163668, nr. 15°11.688'N, 108°02.413'E, elevation 980 m, 17 March 1999, T. Q. Nguyen. In life, dorsum brown, butterfly markings and irregular patterns darker brown, outlined in tan; dorsal ridges, including supratympanic fold, outlined in tan; loreal, upper lip, tympanic regions, and anterior portion of upper arm dark brown, continuing as a sash on forearm; front of knee, leg bands dark brown; flank tan, with anterior grey wash; flank tubercles black below, tan above; iris orange-brown. In Vietnam, this species is otherwise only known from Gia Lai (An Khe District [= K Bang]) and Lam Dong (Cam Li, Dran) Provinces (Ohler 2003). It has also been reported from Champasak Province, Laos (Stuart 2005b).

Ophryophryne hansi. THUA THIEN-HUE PROVINCE, Huong Thuy District, Khe Dau, Duong Hoa Commune, tributary to Dau River: AMNH A-169286, nr. 16°17.995'N, 107°33.307'E, elevation ~ 109 m, 8 September 2005, R. H. Bain, T. Q. Nguyen, C. K. Dang, and T. D. Nguyen; in leaf litter, a few meters from edge of a stream. A Luoi District: Huong Nguyen Commune, Vu Vu Stream: AMNH A-169284, 16°14'30"N, 107°29'23"E, elevation ~ 100 m, 20 August 2005, R. H. Bain, T. Q. Nguyen, and M. V. An. In Vietnam, this species is also known from Quang Binh Province (Phong Nha-Ke Bang), Quang Nam Province (Tra My District) and Gia Lai Province (An Khe District [= K Bang]) (Frost et al. 2006; Ohler 2003; Ziegler, Ohler et al. 2006). The specimen reported by Frost et al. (2006), AMNH A-163669 from Quang Nam, has dorsum dark brown, with irregular light brown markings; limbs with light brown markings forming bands; dorsal tubercles either red-brown or tan; iris grey-brown. This species has also been reported from Laos (Bolikhamxay, Khammouan, and Xe Kong Provinces), and Cambodia (Stung Treng Province) (Stuart 2005b; Stuart et al. 2006).

Ophryophryne microstoma. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: AMNH A-169285, nr. 16°04.636'N, 107°29.290'E, elevation ~ 680 m, 23 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, tributary to Khe Pan River: AMNH A-168682, 21°56'39"N, 104°24'12"E, elevation 331 m, 17 September 2004, R. H. Bain, K. V. Doan, and V. T. Trieu. In Vietnam, this species is also known from a wide latitudinal range of provinces: Ha Giang (Yen Minh District), Cao Bang (Nguyen Binh), Lang Son (Mao Son [= Mau Son]), Vinh Phuc (Tam Dao N.P.), and Gia Lai (An Khe District = [K Bang]) (Bain and Nguyen 2004b; Inger et al. 1999; Ohler 2003). This species has also been reported from Thua Thien-Hue (A Luoi), Lao Cai (Van Ban), Hai Duong (Chi Linh), Thanh Hoa (Ben En), Quang Tri (Dong Tam Ve), but without reference to specific locality data or voucher information (Ho et al. 2001; Ho et al. 2005; Nguyen, Ho, and Nguyen 2005; Nguyen, Nguyen, and Ho 2005). It is otherwise known from Thailand and Yunnan Province, China (Fei et al. 2005; Ohler 2003).

Ophryophryne pachyproctus. HA TINH PROVINCE, Huong Son District, Rao An region, tributaries of Rao An River: AMNH A-161358, 18°21'53"N, 105°13'13"E, elevation 200 m, 12 May 1998, D. A. Kizirian, and T. Q. Nguyen. In Vietnam, this species has been reported from two provinces, Vinh Phuc (Tam Dao N.P.) and Nghe An (Inger et al. 1999; Ohler 2003). Nguyen, Ho, and Nguyen (2005) report this from Huong Son District and other provinces, but without reference to specific locality data or voucher information. It is otherwise known from Yunnan Province, China (Fei et al. 2005; Ohler 2003).

Family Dicroglossidae

Limnonectes hascheanus. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: AMNH A-169294, nr. 16°04.285'N, 107°29.499'E, elevation ~ 680–820 m, 27 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho; calling from a mud burrow, about 3 m from low-flowing water. This specimen was one of several males of this species calling alongside the stream. NGHE AN PROVINCE, Con Cuong District, Chau Khe Commune, Hieng Stream: AMNH A-161224, 19°2'17"N 104°42'6"E, elevation 300 m, 29 April 1998, T. Q. Nguyen. LAM DONG PROVINCE, Da Teh District, Quoc Oai Commune: IEBR 1263, nr. 11°41.010'N, 107°32.032'E, elevation 630 m, 6 May 2003, T. Q. Nguyen. This specimen was collected from a small puddle on a logging road. In Vietnam, this species has been reported from Lao Cai (Thai Nien) and Quang Binh (Phong Nha District) Provinces (Bourret1942; Ziegler 2002; Ziegler et al. 2004). This species has also been reported from Ha Tinh (Khe Tho-Ke Do), Quang Tri (Dak Rong, Huong Hoa), and Dong Nai (Cat Tien) Provinces, as well as from 'central and northern regions of Annam mountains,' but without specific locality or voucher information (Le 2005; Nguyen and Ho 2002; Orlov et al. 2002). This is a widespread species across continental southeast Asia and the Greater Sunda islands (Smith 1930).

Limnonectes poilani. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune, Da Stream: AMNH A-169295, 16°15.625'N 107°26.634'E, elevation ~ 160 m, 16 August 2005, R. H. Bain, Q. T. Nguyen, and X. A. Tran; collected in the mud of a slow-moving portion of the stream surrounded by secondary forest. A Lieng Stream: AMNH A-169296, 16°14.185'N 107°27.669'E, elevation ~ 160 m, 17 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran. A Bong stream: AMNH A-169297, 16°14.285'N, 107°27.177'E, elevation, ~ 150 m, 19 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran. LAM DONG PROVINCE, Da Teh District, Quoc Oai Commune: IEBR 1261, nr. 11°41.010'N, 107°32.032'E, elevation 630 m, 5 May 2003, T. Q. Nguyen. This was described from Quang Tri Province (Dong Tam–Ve), and has been reported from Quang Nam Province (Tra My District), Quang Binh Province (Minh Hoa), and (as *L.* cf. *blythii*) Gia Lai Province (An Khe District [= K Bang]) (Bourret 1942; Frost et al. 2006; Inger et al. 1999; Ngo et al., 2006; Ziegler, Ohler et al. 2006). This species has been reported from A Luoi District, and Cat Tien N.P., Dong Nai Province (both as *L. blythii*), but without exact locality or voucher information (Ho 2002b; Nguyen and Ho 2002; Nguyen, Ho, and Nguyen 2005). This species is also known from Mondolkiri Province, Cambodia (Stuart et al. 2006).

Occidozyga martensii. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune: AMNH A-16928, 16°14.529'N, 107°27.354'E, elevation, ~ 150 m, 17 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran; floating in amplexus, in a large buffalo wallow. This species is also reported from Ha Tinh (Huong Son District), Quang Binh (Phong Nha District), Dac Lak (Yok Don), Gia Lai (An Khe District), and Ba Ria-Vung Tau (Con Dao) Provinces (Frost et al. 2006; Inger et al. 1999; Ngo et al. 2006; Smith 1920; Ziegler 2002; Ziegler et al. 2004). It has also been reported from Lao Cai (Van Ban), Son La (Sop Cop, Xuan Nha), Thanh Hoa (Ben En), Nghe An (Pu Mat, Pu Huong) Quang Nam (Phuoc Son), Thua Thien-Hue (A Luoi), Dong Nai (Cat Tien), but without reference to locality or voucher specimens (Le and Hoang 2001; Le and Nguyen 1999; Ho 2002b; Hoang et al. 2005; Nguyen 2005; Nguyen, Nguyen, and Ho 2005; Nguyen and Ho 2002; Nguyen and Hoang 2000). It is also known from Thailand, Laos (Champasak, Vientiane, Bolikhamxay, and Attapeu Provinces), China (Yunnan, Hainan, and Guangxi Provinces), and the Cardamom Mountains of Cambodia (Fei et al 2005; Ohler et al. 2002; Stuart 2005b; Taylor 1962; Teynie et al. 2004).

Family Ranidae

Amolops cremnobatus. QUANG BINH PROVINCE, Minh Hoa District, Cha Lo: AMNH A-161141, 14 April 1998, D. A. Kizirian, and T. Q. Nguyen. This species has previously been reported from neighboring Ha Tinh Province (Huong Son District) and Nghe An Province (Con Cuong District) (Bain and Nguyen 2001; Chen et al. 2005). Outside of Vietnam, this species is known from Vientiane Municipality, and Khammouan and Bolikhamxay Provinces of Laos (Inger and Kottelat 1998; Stuart 2005b).

Huia absita. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune, A Pat Stream, above Ho Chi Minh Highway marker kilometer 398 + 700: AMNH A-169302, 16°4'28"N, 107°29'14"E, elevation ~ 653 m, 23 August 2005, R. H. Bain, T. Q. Nguyen, V. S. Ho, and V. T. Le; alongside a stream in a patch of grass. KON TUM PROVINCE, Kon Plong District, Mang But Commune, nr. Vi Xay Village, Nuoc Re Stream: IEBR 307, 315, 316, 14°45.665'N, 108°15.245'E, elevation 1120–1200 m, 3–4 January 2001, T. Q. Nguyen. Mang Canh Commune, Nuoc Ka

Stream: IEBR 337, 14°41.950'N, 108°12.095'E, elevation 1100–1200 m, 10 January 2001, T. Q. Nguyen. The Kon Tum specimens were all collected in small streams in mixed evergreen-bamboo forest in humid weather. This species is currently only known from Quang Nam Province (Tra My District), Vietnam (Bain and Nguyen 2005), and Xe Kong and Saravane Provinces, Laos (Stuart and Chan-ard 2005). Orlov, Ananjeva, and Ho (2006) described a new species of cascade ranid, *Rana gigatympana,* from Kon Tum Province (Kon Plong District), which looks remarkably like *Huia absita*, although it exhibits a much larger tympanum (male tympanum diameter: eye diameter 1.14–1.31 for *R. gigatympana*, 0.60–0.89 for *H. absita*). The tympanum diameter of our specimens from Kon Plong (all males), however, fell well within the range of *Huia absita* (tympanum diameter: eye diameter 0.69–0.92).

Huia bacboensis. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, tributary to Khe Pan River: AMNH A-168739, 21°56'24"N, 104°24'7"E, elevation 360–400 m, 15 September 2004, R. H. Bain, K. V. Doan, and V. T. Trieu. This species is otherwise known from the following provinces: Tuyen Quang (Na Hang Nature Reserve), Bac Kan (Ba Be National Park), and Nghe An (Con Cuong) (Bain et al. 2003).

Huia banaorum. HA TINH PROVINCE, Huong Son District, Huong Son Reserve, Rao An region: AMNH A-161249–161250, 18°22'N, 105°13'E, elevation 200 m, 20 April 1998, T. Q. Nguyen. This species has otherwise only been reported from An Khe District (= K Bang), Gia Lai Province in Vietnam (Bain et al. 2003), and from Mondolkiri, Stung Treng, and Ratanakiri Provinces of eastern Cambodia (Stuart et al. 2006). Nguyen, Ho, and Nguyen (2005) report this species from Danang (Ba Na N.P.), but without reference to specific locality or voucher information.

Huia khalam. KON TUM PROVINCE, Kon Plong District, Mang But Commune: IEBR 231, 250, 251, 268–270, 286, 288, 312. 14°45.657'N, 108°15.835'E, elevation 1400–1540 m, 28 December 2000–4 January 2001, T. Q. Nguyen. This species has only been reported from Thua Thien-Hue (Bach Ma N. P.) and Da Nang (Ba Na N. P.) Provinces in Vietnam, and Xe Kong (Kaleum District) and Saravane (Samoy District) Provinces in Laos (Stuart et al. 2005).

Huia morafkai. THUE THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune, A Lieng Stream: AMNH A-169309, 16°14'11"N, 107°27'40" E, elevation ~ 160 m, 17 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran; from a branch ~ 4 m off the ground, ~ 3 m from the side of the stream. AMNH A-169311–169312: A Roang Commune, forested stream at Ho Chi Minh Highway marker kilometer 398+700, 16°4'28"N 107°29'14" E, elevation ~ 653 m, 26 August 2005, R. H. Bain, N.Q. Nguyen, and V. S. Ho; from rocky cascades. AMNH A-169313: 16°4'53"N, 107°28'25"E, elevation ~ 850–900 m, 28 August 2005, R. H. Bain, N.Q. Nguyen, and V. S. Ho; from rocky cascades. In Vietnam, this species has previously been reported from the following provinces: Ha Tinh (Huong Son District), Quang Nam (Tra My District), and Gia Lai (An Khe District [= K Bang]), (Bain et al. 2003; Bain and Stuart 2006 [2005]). It is otherwise known from Champasak and Xe Kong Provinces in Laos, and Ratanakiri and Mondolkiri Provinces of Cambodia (Bain and Stuart 2006 [2005]; Stuart et al. 2006; Teynie et al. 2004).

Huia orba. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune, stream at Ho Chi Minh Highway marker kilometer 398 + 700: AMNH A-169314, 16°4'28"N, 107°29'14"E, elevation ~ 653 m, 23 August 2005, R. H. Bain, T. Q. Nguyen, V. S. Ho, and T. V. Le; atop a small fern (< 1 m off the ground), ~ 3 m from the bank of a swift, rocky bottomed stream. This species is otherwise only known from Ha Tinh Province (Huong Son District) in Vietnam, and eastern portions of Khammouan and Bolikhamxay Provinces of Laos (Stuart and Bain 2005).

Sylvirana attigua. THUE THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune: AMNH A-169303, nr. 16°14'26"N, 107°27'11"E, elevation ~152 m, 19 August 2005, R. H. Bain, T. Q. Nguyen, and V. M. Tran; from a small branch above a small, still, streamside pool. Vu Vu Stream: AMNH A-169304, 16°14'30"N, 107°29'23"E, 20 August 2005, R. H. Bain, T. Q. Nguyen, and M. V. Tran. A Roang Commune, stream at Ho Chi Minh Highway marker kilometer 398 + 700: AMNH A-169305, nr. 16°4'28"N, 107°29'14"E, elevation ~ 653 m, 26 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho; on a leaf about 0.5 m above the ground, 2 m from the stream. Nam Dong District, Thuong Lo Commune, tributary to Cha May River: AMNH A-169306, 16°7'40"N, 107°44'44"E, elevation 220–270 m, 2 September 2005, R. H. Bain, T. Q. Nguyen, and V.P. Nguyen; collected atop a small stick over a tiny pool of water in the forest. This species has been reported from Quang Nam (Tra My District), and Gia Lai (An Khe District [= K Bang]) Provinces (Bain and Nguyen 2002b; Inger et al. 1999). This species has been reported from Thua Thien-Hue Province and Kon Tum Province (Ngoc Linh Mountain, and Kon Plong District), but without precise locality data or voucher specimen information (Nguyen 2002; Nguyen, Ho, and Nguyen 2005). It is otherwise known from Champasak and Xe Kong Provinces in Laos and Mondolkiri Province in Cambodia (Stuart 2005b; Stuart et al. 2006).

Sylvirana maosonensis. BAC KAN PROVINCE, Ba Be Lake National Park, ca. 1 km W on trail into forest from shoreline on west end of Lake: AMNH A-161488, 8 August 1997, D. R. Frost, and C. J. Raxworthy. In Vietnam, this species is known from the following provinces Ha Giang (Vi Xuyen District), Lang Son (Mau Son), Vinh Phuc (Tam Dao N.P.), Ha Tinh (Khe Tho- Ke Do), and Quang Binh (Minh Hoa) (Bain and Nguyen 2004b; Bourret 1942; Inger et al. 1999; Ziegler 2002; Ziegler, Ohler et al. 2006). This species has been reported from other northeastern provinces of Vietnam, but without reference to specific localities or voucher specimens (Ho et al. 2001; Ho et al. 2005; Nguyen 2005; Nguyen et al. 2000; Nguyen, Ho, and Nguyen 2005; Orlov et al. 2002). This species has also been reported from Bolikhamxay and Khammouan Provinces of Laos (Stuart 2005b).

FAMILY RHACOPHORIDAE

Chiromantis vittatus. THUA THIEN HUE PROVINCE, A Luoi District, Huong Nguyen Commune: A169316, 169317, 169337, 16°14'32"N, 107°27'21"E, 17 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran; in amplexus on a branch above a buffalo wallow. The green eggs were also collected from the foam nest. Several other pairs were in amplexus in and around the wallow. In Vietnam, this species is known from the following provinces: Quang Binh (Phong Nha District), Ha Tinh (Chin Xai), Gia Lai

(An Khe District [= K Bang]), and Ba Ria-Vung Tau (as Cap St. Jacques) (Bourret 1942; Inger et al. 1999; Ziegler 2002; Ziegler et al. 2004). It has also been reported from Lang Son (Huu Lien), Phu Tho (Thanh Son, Ha Hoa), and Dong Nai (Cat Tien), but without reference to locality or voucher information (Ho 2002a; Nguyen and Ho 2002; Nguyen et al. 2000). This species is also known from India, Myanmar, Thailand, China (Xizang, Hainan, Guangxi, Fujian, and Yunnan Provinces), Laos (Vientiane Municipality, Champasak Province), and Cambodia (Cardamom Mountains) (Chanda 2002; Fei et al. 2005; Ohler et al. 2002; Stuart 2005b; Stuart et al. 2006; Teynie et al. 2004; Taylor 1962).

Philautus banaensis. THUA THIEN-HUE PROVINCE, Huong Thuy District, Binh Thanh Commune, IEBR 2307, 16°17'58"N, 107°33'18"E, elevation 109 m, 8 September 2005, R. H. Bain, T. Q. Nguyen, C. K. Dang, and T. D. Nguyen; collected calling from atop leaves, ~ 3 m high above a stream. This species is otherwise known from Quang Nam Province (Tra My District) and the type locality in Danang Province (Ba Na) in Vietnam (Bourret 1942; Stuart, *in press*). This species has previously been reported from Thua Thien-Hue and Thanh Hoa Provinces, but without reference to a distinct locality or voucher information (Ho 2002b; Nguyen, Ho, and Nguyen 2005; Nguyen and Hoang 2000; Orlov et al. 2002).

Rhacophorus annamensis. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune, Khe Coi Stream: AMNH A-169325, 16°15'32"N, 107°27'15"E, elevation ~ 101 m, 18 August 2005, R. H. Bain, T. Q. Nguyen, and M. V. Tran; from the side of a deep rocky pool. Other specimens were present on small branches overtop of the pool. Huong Thuy District, Binh Thanh Commune: AMNH A-169326, 16°17'49"N, 107°32'48"E, elevation 100–200 m, 9 September 2005, R. H. Bain, T. Q. Nguyen, C. K. Dang, and T. D. Nguyen; on a streamside rock. QUANG NAM PROVINCE, Tra My District, Tra Don Commune: AMNH A-163745, 15°11'41"N, 108°2'25"E, elevation 940 m, 19 March 1999, T. Q. Nguyen; AMNH A-163746, 15°11'41"N, 108°2'32"E, elevation 970 m, 22 March 1999 T. Q. Nguyen; AMNH A-163747, 15°11'30"N, 108°2'23"E, elevation 960–990 m, 13 March 1999, T. Q. Nguyen; AMNH A-163748, 15°11'41"N, 108°2'25"E, elevation 940 m, 26 March 1999, P. R. Sweet. Within Vietnam, this species has been reported from Quang Binh Province (Minh Hoa District, Phong Nha-Ke Bang), Gia Lai Province (An Khe District [= K Bang]), and Lam Dong Province (Daban) (Bourret 1942; Frost et al. 2006; Inger et al. 1999; Ziegler, Ohler et al. 2006). Nguyen, Ho, and Nguyen (2005) report this species from Tra My District and Thua Thien-Hue Province, and Orlov et al. (2002) report this species from Ninh Thuan, Lam Dong, Dak Lak, and Kon Tum Provinces, but neither refer to exact locality or voucher information. It is also known from Mondolkiri Province of Cambodia (Stuart et al. 2006).

Rhacophorus bipunctatus. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune: A169333, 16°14’32"N, 107°27’21"E, 17 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran; from foliage overhanging a large buffalo wallow. LAO CAI PROVINCE, Van Ban District, Liem Phu Commune, Cham Vai: IEBR 1197, 21°57.445'N, 104°20.963'E, elevation 1100 m, 28 June 2002, T.Q. Nguyen and H. V. Nguyen; collected from leaves ~ 1 m over a small, rocky stream in disturbed primary forest. In Vietnam, this species has also been reported from Quang Binh (Phong Nha Khe Bang N.P.), Ha Tinh (Huong Son District), and Gia Lai (Anh Khe), Provinces (Frost et al. 2006; Inger et al. 1999; Ziegler et al. 2004). Orlov et al. (2002) state that this species ranges from Gia Lai northwards to Ha Tinh Province, but without reference to any specific localities or voucher specimens. This species has been reported from Lao Cai (Van Ban), and Dong Nai (Cat Tien) Provinces, but without any reference to specific localities or voucher information (Nguyen and Ho 2002; Nguyen, Nguyen, and Ho 2005). This wide-ranging species is also known from India, Myanmar, Thailand, Xizang Province in China, Phongsalay and Sayaboury Provinces in Laos, and the Cardamom Mountains of Cambodia (Bourret 1942; Fei et al. 2005; Ohler et al. 2002; Stuart 2005b; Taylor 1962).

Rhacophorus calcaneus. HA TINH PROVINCE, Huong Son District, Huong Son Reserve, Rao An region: AMNH A-161404, 18°22'N, 105°13'E, elevation 200 m, 21 April 1998, D. A. Kizirian, and T. Q. Nguyen. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune, Da Stream: AMNH A-169328, 163929, 16°15'38"N, 107°26'38"E, 16 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran; calling from thin branches of streamside trees, ~ 2 m off the ground. Little A Ma Stream: AMNH A-169331,16°15'17"N, 107°26'59"E, elevation ~ 90 m, 21 August 2005, R. H. Bain, T. Q. Nguyen, and M. V. Tran. Nam Dong District, Thuong Lo Commune, tributary to the Cha May River: AMNH A-169332, 16°7'40"N, 107°44'44"E, elevation ~ 220 m, 1 September 2005, R. H. Bain, T. Q. Nguyen, V. P. Nguyen, V. T. Nguyen, and V. M. Ngo; from branch of a streamside tree, ~ 3 m high. In Vietnam, this species has been reported from Gia Lai (An Khe District [= K Bang]), and Quang Nam Provinces (Tra My District), as well as the Lam Vien Plateau (Bourret 1942; Frost 2006; Inger et al. 1999). It has been reported widely from the country (including Thua Thien-Hue and Quang Nam Provinces), but without specific localities or voucher information (Nguyen 2002; Nguyen, Ho, and Nguyen 2005). It is also known from Xe Kong Province, in Laos (Stuart 2005b).

Rhacophorus exechopygus. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: IEBR 2011, nr. 16°04.636'N, 107°29.290'E, elevation ~ 680 m, 23 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho; atop a broadleaf on a shrub, ~ 3 m off the ground, ~ 3 m from the stream up a steep embankment. This species is known only from the Vietnamese provinces of Gia Lai (An Khe District [= K Bang]) and Quang Nam (Tra My District) (Bain and Nguyen 2002c; Inger et al. 1999). Orlov et al. (2002) report this species from Kon Tum Province, but without reference to specific locality or voucher information.

Rhacophorus kio. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune: AMNH A-169327, 16°14'32"N, 107°27'21"E, 17 August 2005, R. H. Bain, T. Q. Nguyen, and A. X. Tran; in amplexus on a branch overhanging a large buffalo wallow. This species has recently been shown to be separate from *Rhacophorus reinwardtii*, which is currently known from the Greater Sundas and the southern portion of the Malay peninsula. In Vietnam, this species has been reported from the following provinces (as *Rh. reinwardtii*): Lao Cai, Ha Tinh (Chin Xai, Khe Tho, Ke Do), and Gia Lai (An Khe District [= K Bang]) (Inger et al. 1999; Ohler and Delorme 2006; Orlov et al. 2001; Ziegler 2002; Ziegler et al. 2004). Several other accounts across Vietnam are listed (Cao Bang [Nguyen Binh], Hai Duong [Chi Linh], Son La [Xuan Nha], Thanh Hoa [Thach Thanh, Ben En], Thua Thien-Hue [A Luoi], Da Nang [Ba Na], and Quang Nam [Nam Giang, Tay Giang] Provinces), but without specific locality or voucher information (Ho 2002b; Ho et al. 2001; Ho et al. 2005; Ho and Orlov 2000; Le 2000; Le and Nguyen 1999; Nguyen 2000; Nguyen 2005; Nguyen and Hoang 2000). This widespread species is also known from Thailand (although not on the Malay Peninsula), China (Guangdong, Yunnan Provinces), and Laos (Bokeo, Khammouan, Phongsaly, Huaphahn, Sayabourym Provinces) (Ohler and Delorme 2006; Stuart 2005b).

Rhacophorus orlovi. NGHE AN PROVINCE, Con Cuong District, Chau Khe Commune, Ngun Stream: AMNH A-161411, 19°2'17"N, 104°42'6"E, elevation 300 m, 27 April 1998, T. Q. Nguyen and D. A. Kizirian. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, tributary to Khe Pan River: AMNH A-168770, 21°56'24"N, 104°24'7"E, elevation 360–400 m, 15 September 2004, R. H. Bain, K. V. Doan, and V. T. Trieu; from the stem of a broadleaf plant, 1.5 m above the ground, ~ 4 m from the stream. THUA THIEN-HUE PROVINCE, A Luoi District, Huong Nguyen Commune, Little A Ma Stream: IEBR 2305, 16°15'17"N, 107°26'59"E, elevation ~ 90 m, 21 August 2005, R. H. Bain, T. Q. Nguyen, and M. V. Tran. Within Vietnam, this species is known from the following provinces: Ninh Binh (Cuc Phuong N.P.), Quang Binh (Phong Nha-Khe Bang N.P.), Ha Tinh (Ky Anh-Ke Go), Gia Lai (An Khe District [= K Bang]) (Stuart 2005a; Ziegler and Köhler 2001; Ziegler et al. 2002). It is also known from Thailand and Khammouan Province, Laos (Chan-ard 2003; Stuart 2005b).

REPTILIA

SUBORDER SAURIA

FAMILY AGAMIDAE

Calotes emma. BAC KAN PROVINCE, Ba Be Lake National Park, cave area, ca 1.5 km E of guest house: AMNH R-147066, 22°24'1"N, 105°37'54"E, 8 August 1997, D. R. Frost, and C. J. Raxworthy. THUA THIEN-HUE PROVINCE, Huong Thuy District, Binh Thanh Commune: AMNH R-154613, stream nr. 16°17'49"N, 107°32'48"E, elevation 100–200 m, 9 September, R. H. Bain, T. Q. Nguyen, C. K. Dang, and T. D. Nguyen. This widespread species has been reported from across continental southeast Asia (e.g., Boulenger 1885; Smith 1935; Stuart et al. 2006; Taylor 1963; Ziegler 2002; Ziegler et al. 2004), however these are new provincial records within Vietnam. Nguyen, Ho, and Nguyen (2005) report this species from Bac Kan, but without reference to specific locality or voucher information.

Pseudocalotes floweri. VIETNAM, KON TUM PROVINCE, Kon Plong District, Mang Canh Commune, forest nr. Nuoc Ka Stream: IEBR 330, 14°41.950'N, 108°12.095'E, elevation 1200 m, 10 January 2001, T. Q. Nguyen; in secondary forest. The specimen is female, snout-vent length 68.2 mm; head length nearly twice its breadth; upper labials 8 left side, 10 right side; lower labials 9 left side, 8 right side; eye diameter 4.8 mm (more than twice the tympanum of 2.1 mm); snout length 9.2 mm (nearly twice the obit diameter); six scales between nasal and supraorbital; nuchal crest with 8 erect spines; length of finger III = IV; 52–56 scales round the middle of the body; tail length 151.2 mm. Body compressed; upper head scales keeled; series of enlarged scales forming a λ-shaped figure on forehead; dorsal scales feebly keeled, all pointing backwards and downwards; median ventrals small and strongly keeled; 19 scales under finger IV; blade-like outer keels under toe III, not bicarinate; tail compressed, covered with keeled scales. In life, this specimen is brown, enlarged dorsal scales bluish, spines are light brown; radiate dark brown lines around eye to supraorbital ridge; limbs yellow with dark brown irregular bands; dark brown gular spot, and 10 dark brown spots on the tail (which fade in preservative). This species is otherwise known from Chanthaburi, Thailand and the Elephant Mountains (Bockor [= Bokor]), Cambodia (Smith 1935; Taylor 1963; Hallerman and Böhme 2000). This is the first country record for Vietnam. Our specimen is shorter than those previously described (snout–vent length for type specimen 98 mm; 95 mm for referred specimen) (Boulenger 1912; Smith 1935; Taylor 1963 described specimens from Thailand without reporting their snout–vent lengths).

Pseudocalotes microlepis. BAC KAN PROVINCE, Ba Be District, Ba Be National Park, cave area, ca 1.5 km E of guest house: AMNH R-147071, 22°24'1"N, 105°37'54"E, 8 August 1997, D. R. Frost, and C. J. Raxworthy. In Vietnam this species is also known from Quang Ninh, Danang (Ba Na), and Lam Dong (Lang Bian, Camley [= Cam Ly]) Provinces (Ziegler, Thanh et al. 2006). Otherwise, it is known from Myanmar, Thailand, China (Hainan Island, Guizhou Province), and Laos (Phong Saly [= Phong Sali Province]) (Bourret 1939b; Smith 1935; Hallerman and Böhme 2000; Zhao and Adler 1993).

FAMILY DIBAMIDAE

Dibamus greeri. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: AMNH R-154630/IEBR 2311, nr. 16°04.636'N, 107°29.290'E, elevation ~ 650 m, 26 August, 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho; under a streamside rotting log. This specimen conforms precisely with the description of the holotype, including the diagnositic characters: incomplete medial-rostral nasal suture; one postocular; two supra labials; very large frontal; posteromedial edge of infralabials bordered by one long, narrow scale; 20 mid-body scale rows (the tail is partially regenerated). In life the body is purplish-brown with a blue-grey mid body transverse band. A second blue-grey transverse band just posterior to the head is evident in preservative. This species is otherwise only known from its type locality in An Khe District [= K Bang], Gia Lai Province (Darevsky 1992).

FAMILY SCINCIDAE

Plestiodon quadrilineatus. HA TINH PROVINCE, Huong Son District, Huong Son Reserve, Rao An Region, nr. top of Po-mu Mountain: AMNH R-147116, elevation 900–1200 m, 22 April 1998, T. Q. Nguyen. AMNH R-147117, nr. 18°22’N, 105°13’E, April 1998, Diana Silva. In Vietnam, this species is known from Lang Son Province (Man Son Mountains [= Mau Son Mountains]) and Quang Binh Province (Phong Nha), (Bourret 1939a; Darevsky and Orlov 2005; Taylor 1935; Ziegler et al. 2004). This species has been reported from Cao Bang (Nguyen Binh), Quang Ninh (Ba Mun), Son La (Moc Chau, Cao Pha), Thanh Hoa (Ben En), Ha Tinh, Nghe An (Pu Mat, Pu Huong), and Da Nang (Ba Na) Provinces, but without reference to a precise locality or voucher information (Ho et al. 2005; Hoang et al. 2005; Le 2000; Le and

Hoang 2001; Le and Nguyen 1999; Nguyen 2000; Nguyen 2005; Nguyen, Ho, and Nguyen 2005; Nguyen and Hoang 2000). In addition, this species is known from Thailand, China (Guangdong, Hong Kong, Guangxi, Sichuan, Hainan Provinces), and Cambodia (Smith 1935; Taylor 1935; Zhao and Adler 1993).

Sphenomorphus cryptotis. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, tributary to Khe Pan River: AMNH R-153698, 153699, 153700, 21°56'24"N, 104°24'7"E, elevation 360–400 m, 15 September 2004, R. H. Bain, K. V. Doan, and V. T. Trieu. AMNH R-153701, 21°56'39"N, 104°24'12"E, elevation 331 m, 17 September 2004, R. H. Bain, K. V. Doan, and T. V. Trieu. All specimens were collected sleeping on leaves or small branches overhanging a stream. This species is only known from Quang Ninh (Uong Bi Town, Yen Tu Mountain), and Nghe An (Quy Chau District) provinces in northern Vietnam (Darevsky et al. 2004).

Sphenomorphus tridigitus. QUANG NAM PROVINCE, Tra My District, Tra Don Commune, Mt. Ngoc Linh: IEBR 73, 15°11.688'N, 108°02.413'E, elevation 940 m, 21 March 1999, C.A. Johnson; IEBR 74. 15°10.762'N, 108°02.731'E, elevation 1470 m, P. R. Sweet. Both specimens were collected in pit fall traps, which were set near the ridges of the mountainous primary forest. Our specimen agrees with a recent redescription (Greer et al. 2006), including discrepancies with the type. As with the specimen of Greer et al. (2006), our specimens include a frontonasal with two widely separated prefrontals, and fusion of nasal and first infralabial scales. The loreal scale is not fused with the preocular, as Greer et al. (2006) believe it may be in the poorly preserved holotype. In Vietnam, this species is only known from Thua Thien-Hue Province (Bach Ma) from the original description (Bourret 1939c). It otherwise only known from Champasak Province, Laos (Teynie et al. 2004).

Tropidophorus cocincinus. THUA THIEN-HUE PROVINCE, Huong Thuy District: Binh Thanh Commune, tributary to Dau River: AMNH R-154623, nr. 16°17.995'N, 107°33.307'E, elevation 109 m, 8 September 2005, R. H. Bain, T. Q. Nguyen, C. K. Dang, and T. D. Nguyen; from a rocky shore of the stream. A Luoi District, Huong Nguyen Commune, A Lieng Stream: AMNH R-154624, 16°14'10"N 107°27'26"E, elevation ~ 160 m, 17 August 2005, R. H. Bain, T. Q. Nguyen, A. X. Tran; from a rocky portion of the stream edge in the water. A Luoi District, Huong Nguyen Commune: AMNH R-154625, 154626, nr. 16°14'26"N 107°27'11"E, elevation ~ 152 m, 19 August 2005, R. H. Bain, T. Q. Nguyen, and M. V, Tran; collected from a rocky portion of the stream edge in the water. In Vietnam this species is known from Kon Tum (Kon Tum) and Quang Binh (Phong Nha-Khe Bang) Provinces (Bourret 1939c; Darevsky and Orlov 2005; Smith 1935; Ziegler et al. 2004). This species has been reported from Thua-Thien-Hue (A Luoi) and Da Nang (Son Tra) Provinces, but without specific locality or voucher information (Dinh and Nguyen 2000; Ho 2002b; Nguyen, Ho, and Nguyen 2005). It is otherwise known from Laos (Xe Kong Province) and Thailand (Greer and Biswas 2004; Taylor 1963).

Tropidophorus hainanus. HA TINH PROVINCE, Huong Son District, Huong Son Reserve, Rao An region: AMNH R-147123, 18°20'47"N, 105°14'10"E, elevation 870 m, 9 May 1998, D.T. Pham. LAO CAI PROVINCE, Van Ban District, Nam Xay Commune: IEBR 1219, 21°58.731'N, 104°01.403'E), elevation 1550 m, 6 July 2002, Nguyen Quang Truong and Nguyen Van Hung; disturbed primary forest. This latter specimen was found on the ground near the steep bank of a small rocky stream within a hardwood forest. In Vietnam, this species has been reported from Tonkin (Tam Dao, Ngan Son) [= Tam Dao Mt., Vinh Phuc Province and Ngan Son District, Bac Kan Province], Nam Dinh (Giao Thuy District), and Cuc Phuong N.P. (Cuc Phuong borders Hoa Binh, Thanh Hoa, and Ninh Binh provinces, but the record from Bobrov [1993] does not stipulate from which part of the park the species was found) (Bourret, unpubl. 1937a, 1939b, 1939c; Bobrov 1993). Ziegler, Thanh et al. (2006) also list Bac Kan, Cao Bang, Dak Lak, Ha Tay, Hai Duong, Kon Tum, Lai Chau, Phu Tho, and Quang Ninh provinces of Vietnam as having records of this species, but they cite Nguyen (2005) and Orlov (2005), neither of which give precise locality or voucher information. Outside of Vietnam, this species is known from China (Hainan, Jiangxi, Guangxi provinces) (Smith 1935; Zhao and Adler 1993).

SUBORDER SERPENTES
FAMILY COLUBRIDAE

Dendrelaphis ngansonensis. QUANG NAM PROVINCE, Tra My District, Tra Don Commune, AMNH R-148550, nr. 15°11.459'N, 108°2.523'E, elevation 1100 m, 1 April 1999, P. R. Sweet. In Vietnam this species is known from the following provinces Cao Bang (Ngan Son), Vinh Phuc (Tam Dao), Quang Binh (Phong Nha Khe-Bang), Ha Tinh ("Chuc A", Ke Anh-Ke Go, Chin Xai), Thua Thien-Hue (Bach Ma), Col des Nuages nr. Tourane = (Quang Nam Danang Province nr. Danang City), and in Cuc Phuong N.P. (this park borders Hoa Binh, Thanh Hoa, and Ninh Binh provinces, but the record from Ziegler and Vogel [1999] does not stipulate from which part of the park the species was found) (Bourret 1936; Orlov et al. 2000; Ziegler 2002; Ziegler et al. 2004). Nguyen, Ho, and Nguyen 2005 state that it is found in Quang Nam Province (Chu Lai), but without specific locality or voucher information. This species is also known from Xieng-Khouang (= Xieng Khoang) Province, Laos (Deuve 1970).

Dinodon septentrionalis. THUA THIEN-HUE PROVINCE, Nam Dong District, Thuong Lo Commune, Cha May River: AMNH R-154176, 16°7'40"N, 107°44'44"E, elevation ~ 220 m, 1 September 2005, R. H. Bain, T. Q. Nguyen, V. P. Nguyen, V. T. Nguyen, and V. M. Ngo; collected from among tree roots next to a cascade. In Vietnam, this species has been reported from the following provinces: Lai Chau, Lao Cai, Bac Kan, Cao Bang, Vinh Phuc, Nghe An, Quang Binh, Ha Tinh (Orlov et al. 2003). This wide-ranging species is also known from India, Myanmar, Thailand, China (Yunnan Province), Laos (Kiang Kuoang [= Xieng Khoang] Province), and Cambodia (Mondolkiri Province) (Bourret 1936; Orlov and Ryabov 2004; Smith 1943; Stuart et al. 2006).

Euprepiophis mandarinus. HA TINH PROVINCE, Huong Son District, Huong Son Reserve, Rao An region, top of Po-mu Mountain: IEBR 2302, 18°20'53"N, 105°14'38"E, elevation 1010–1080 m, 8 May 1998, T.X. Le. In Vietnam this species is known from Lao Cai (Mt. Fan Si Pan, Chapa [= Sa Pa], Ngo Toi), Lang Son (Mau Son), Vinh Phuc (Tam Dao), and Tuyen Quang (Na Hang District) Provinces (Angel and Bourret 1933; Bourret 1936; Le and Ziegler 2004; Orlov et al. 2000; Parker 1925). This species has been reported from Son La (Ta Sua, Xuan Nha), as well as Ha Tinh (Huong Son), but without a specific locality or voucher information (Nguyen 2000; Nguyen 2005; Nguyen, Ho, and Nguyen 2005). Elsewhere it is known from India, Myanmar, and several provinces across China (Smith 1943; Zhao and Adler 1993).

Pareas carinatus. QUANG NAM PROVINCE, Quang Nam, Tra My District, Tra Don Commune, Ngoc Linh Mountain: AMNH R-148551, elevation 980 m, 17 March 1999, T. Q. Nguyen. Smith (1943) stated that in Vietnam, this species was found "below 19°", otherwise it has only been specifically reported from Vinh Phuc (Tam Dao), Gia Lai (Son Lang), Quang Tri (Quang Tri), Quang Bonh (Phong Nha), Tay Ninh (Tay Ninh), and Dong Nai (Trang Bom) Provinces (Campden-Main 1969; Orlov et al. 2000; Szyndlar and Nguyen 1996; Ziegler, Ohler et al. 2006). This species has also been reported from Lam Dong (Lac Duong), Dong Nai (Cat Tien), and Tay Ninh (Ba Den Mt.), but without reference to specific voucher or locality information (Ho and Nguyen 1982; Nguyen and Ho 2002; Pham et al. 2000). It is otherwise known from Myanmar, the Greater Sundas, Thailand, China, Laos, and Cambodia, (Manthey and Grossmann 1997; Pauwels et al. 2003; Saint Girons 1972; Smith 1943; Stuart and Emmett 2006; Zhao and Adler 1993).

Pseudoxenodon macrops. LAI CHAU PROVINCE, Mount Fan Si Pan: AMNH R-147147, elevation 2,020 m 19 August 1997, D. R. Frost and C. J. Raxworthy. HA TINH PROVINCE, Huong Son District, Huong Son Reserve, Rao An Region: AMNH R-147148, nr. 18°22'N, 105°13'E, 9 May 1998, via D. A. Kizirian. This species has previously been reported from Lao Cai (Ngoi Tio, Sa Pa), Vinh Phuc (Tam Dao), Da Nang (Ba Na), and Lam Dong (Fyan, Da Lat, Lang Bian) provinces (Campden-Main 1969; Orlov et al. 2000; Parker 1925). It is otherwise a widespread species throughout southeast Asia, from the eastern Himalayas to the Malay peninsula and east through Myanmar, Thailand, China and the Indochinese peninsula (Farkas and Fritz 1999; Smith 1943; Taylor 1965; Zhao and Adler 1993).

Sibynophis collaris. BAC KAN PROVINCE, Ba Be District, Ba Be National Park: AMNH R-147156, 7 August 1997, D. R. Frost and C. J. Raxworthy; beside a cascade. HA TINH PROVINCE, Ke Go Nature Reserve, Mon Stream: AMNH R-147157, 11 April 1998, T.Q. Nguyen and D. A. Kizirian. In Vietnam, this species is known from Lai Chau (Muong Nha), Nonh Bonh (Xom Bong [= Cuc Phuong]), Quang Binh (Phong Nha), Quang Tri (Xa Huc), Thua Thien-Hue (Hue), Gia Lai (Son Lang), Lam Dong (Bao Loc, Da Lat, Lang Bian), and Dong Nai (Bien Hoa) Provinces. (Campden-Main 1969; Szyndlar and Nguyen 1996; Ziegler et al. 2004). In Vietnam it has also been reported from Nghe An (Pu Mat, Pu Huong, Ky Son), Ha Tinh (Huong Son), Thua Thien-Hue (A Luoi), and Dong Nai (Cat Tien) Provinces, but without any voucher information (Ho 2002b; Le and Hoang 2001; Nguyen 2000; Nguyen and Ho 2002; Nguyen, Ho, and Nguyen 2005). This species is widespread across India, Nepal, Myanmar, Thailand, China, Laos, and Cambodia (Smith 1943).

Sinonatrix aequifasciata. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, tributary to Nam Tha River: AMNH R-153712, 153713, 21°55'23"N, 104°22'43"E, elevation ~ 640 m, 3 September 2004, R. H. Bain, T. Q. Nguyen, K. V. Doan, and A. C. Lu; from tree branches overhanging fast flowing water. Tributary to Khe Pan River: AMNH R-153714, 21°56'24"N, 104°24'7"E, elevation 360–400 m, 16 September 2004, R. H. Bain and K. V. Doan. In Vietnam, this species has been reported from Ha Giang (Vi Xuyen District), Vinh Phuc (Tam Dao) and Nghe An (Ky Son) Provinces (Bain and Nguyen 2004b; Orlov et al. 2000; Vogel et al. 2004; Ziegler and Hoang 2005). This species has also been reported from Lao Cai (Van Ban), Cao Bang (Nguyen Binh), and Bac Giang (Luc Nam) provinces, Vietnam, but without reference to specific locality or voucher information (Ho et al. 2005; Nguyen et al. 2002; Nguyen, Nguyen, and Ho 2005). This species is otherwise known from China (Guangxi, Guangdong, Hong Kong, Hainan, Fujian, Guizhou, Hunan, Jiangxi, Sichuan, Zhejiang) (Zhao and Adler 1993; Zhou and Yu 2002).

Sinonatrix percarinata. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune: IEBR 2312, nr. 16°04.636'N, 107°29.290'E, elevation ~ 680 m, 23 August 2005, R. H. Bain, T. Q. Nguyen, and V. S. Ho; on vegetation overhanging a stream, ~ 2 m above the surface. In Vietnam, this species is otherwise known from Lao Cai (Chapa [= Sa Pa], Thai Nien, Ngoi Toi), Ha Giang (Yen Minh District), Bac Kan (Ngan Son), Vinh Phuc (Tam Dao), Bac Giang (An Lac, Thanh Son), Quang Binh (Phong Nha Khe Bang N.P.), Ha Tinh (Chin Xia, Ke Go-See), and Kon Tum (Kon Tum, Kon Plong) provinces (Bain and Nguyen 2004b; Bourret 1937b, 1939; Campden-Main 1969; Orlov et al. 2000; Parker 1925; Szyndlar and Nguyen 1996; Ziegler 2002; Ziegler et al. 2004). This species has also been reported from Cao Bang (Nguyen Binh), Lang Son (Huu Lung), Son La (Muong Do, Xuan Nha), Hoa Binh (Da Bac), Bac Giang (Luc Nam), Thua Thien-Hue (A Luoi, Hung Thuy), and Dong Nai (Cat Tien) Provinces, but without reference to specific locality or voucher information (Dang et al. 1975; Ho 2002b; Ho et al. 2005; Nguyen 2005; Nguyen and Ho 2002; Nguyen et al. 2000; Nguyen et al. 2002; Nguyen, Ho, and Nguyen 2005). This species is otherwise known from India, Myanmar, Thailand, China (Hainan, Chekiang, Jiangxi, Fujian, Guangdong, Guangxi, Kweichow, Sichuan, and Hupeh Provinces), and Taiwan (Captain et al. 1998; Smith 1943; Zhao and Adler 1993; Zhou and Yu 2002).

FAMILY VIPERIDAE

Protobothrops mucrosquamata. LAO CAI PROVINCE, Van Ban District, Nam Tha Commune, forested stream above Nam Tha River: AMNH R-153720, 21°55'13"N, 104°22'15"E, elevation ~ 950 m, 5 September 2004, R. H. Bain, T. Q. Nguyen, K. V. Doan, V. T. Trieu, and A. L. Chu. In Vietnam, this species has been reported from Ha Giang (Du Gia Commune), Cao Bang, Bac Kan (Ngan Son), Thai Nguyen, Vinh Phuc (Tam Dao), Quang Ninh (Nam Son, Quan Lan), Ha Tay, Hai Duong, Ninh Binh, Nghe An, Ha Tinh (Ky Anh-Ke Go), Thua Thien-Hue (A Luoi), Gia Lai, and Kon Tum Provinces (Bourret 1936; Orlov et al. 2000; Szyndlar and Nguyen 1996; Ziegler 2002; Ziegler, Thanh et al. 2006). This widespread species is otherwise known from Bangladesh, India, Myanmar, and China (Leviton et al. 2003; Smith 1943; Zhao and Adler 1993).

Viridovipera vogeli. THUA THIEN-HUE PROVINCE, A Luoi District, A Roang Commune, stream at Ho Chi Minh Highway marker kilometer 398+700: AMNH R-154632, 16°4'28"N, 107°29'14"E, elevation ~ 653 m, 23 August 2005, R. H. Bain, T. Q. Nguyen, V. S. Ho, and V.T. Le; from flat rocky stream bank. HA TINH PROVINCE, Huong Son District, Rao An Region, nr. top of Po-mu Mountain: AMNH R-147162, elevation 900–1200 m, 22 April 1998, T. Q. Nguyen. In Vietnam, this species is known from Quang Binh, Gia Lai (An Khe =[K Bang], Krong Pa), Quang Nam, and Danang (Ba Na) Provinces (Malhotra and Thorpe 2004; Malhotra et al. 2004; Orlov et al. 2003). Nguyen, Ho, and Nguyen (2005) report this species from A Luoi, but without any specific locality or voucher specimen information. This species is otherwise known from Thailand, Laos (Champasak), and Cambodia (Mondolkiri Province, Cardamom Mountains) (David et al. 2001; Malhotra et al. 2004; Stuart et al. 2005).

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BOOK REVIEWS

Herpetological Review, 2007, 38(1), 118–119.

Pythons of the World, Volume II. Ball Pythons: The History, Natural History, Care, and Breeding, by David G. Barker and Tracy M. Barker. 2006. Vida Preciosa International, P.O. Box 300, Boerne, Texas 78006, USA (www.vpi.com). Clothbound. xv + 320 pp. US $75.00 (Leather bound US $250.00). ISBN 0-9785411-0-3.

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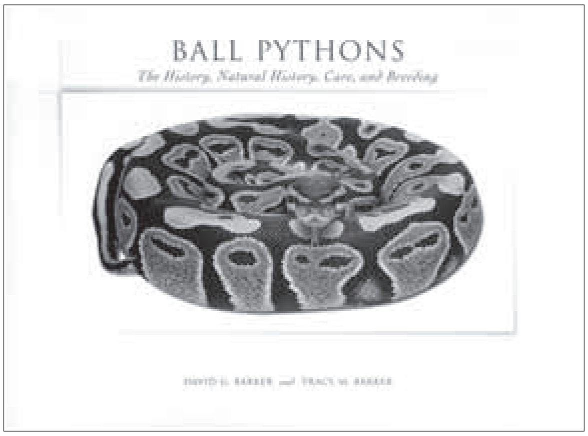

Like a locomotive slowly building up steam, the herpetoculture juggernaut commercially came of age sometime in the late 1980s to early 1990s. After years of simply just trying to keep amphibians and reptiles alive in captivity, this plateau marked the beginning of an era of not only successful maintenance of these fascinating animals, but also standardized propagation that could, at least in some cases, be called "cookbook." Since the early 1990s amphibian and reptile books and magazines have proliferated, products specifically targeting these animals have appeared on the store shelves, expos have become a weekly event, and through the use of a little thing known as the internet, the global community is suddenly within reach and ideas are quickly disseminated.

Several species come to mind as being the most successful in herpetoculture, these being leopard geckos (*Eublepharis macularius*), corn snakes (*Pantherophis guttata*), and ball pythons (*Python regius*). The reasons for the success of these three species are probably many, including among others, their relatively small size, easy adaptability to captivity, and attractiveness. A further common feature is the incredible variety of selectively bred color and pattern phenotypes available and, at least in the case of ball python designer morphs, the tremendous prices they command.

Who else would be better suited or more qualified to write about or simply more in love with the subject of this new book than Dave and Tracy Barker? *Pythons of the World, Volume II. Ball Pythons: The History, Natural History, Care, and Breeding* is a colossal effort from two skilled biologists/herpetoculturists who have spent practically their entire lives working with pythons. As is the case with the first volume in the series, *Pythons of the World, Volume I. Australia*, the current book is an incredible photographic and literary feast.

As a prelude, the book begins with Contents, Acknowledgments, Introduction, About This Book, About the Pictures, and The Golden Age of Herpetoculture. The Barkers describe how their obsession with ball pythons started—getting one, then another, then another, and how things "began to spiral out of control." This indeed is something many reptile enthusiasts (including some professional herpetologists) can identify with.

The first chapter, "Introducing the Ball Python," sets the groundwork for the reader and covers the early history of pythons in Europe, classification, habitat and distribution, life span, natural history, abundance, defensive behavior, and the reasons why they are so popular. Chapter Two, "The Relationships of Humans and Ball Pythons in Africa" includes both python worship and modern day human interaction with the ball python. Beginning with the humorous opening statement "We are not the first people to revere and even worship ball pythons," the authors describe how ophiolatry, or the worship of snakes, affected the lives of the Whydah,an African culture inhabiting the border region between present day Benin and Nigeria. Pythons were regarded as gods incarnate and the penalty for killing one was severe.

Chapter Three, "The Physical Ball Python," describes the ball python, with information on physical characteristics, size, intelligence, sensory abilities, the reproductive system, and determination of sex. This chapter is particularly useful to keepers in that it describes as well as illustrates sex determination techniques such as probing and manually everting the hemipenes of a male (also known as popping). The following chapter, "Skin and Shedding," covers the outer surface of the ball python and ends with practical information on shedding problems.

Chapter Five, "The Basis of Color and Pattern," is devoted to the mechanics of the various chromatophores and how they relate to color and pattern. The chapter includes "A Glossary of Color Terms" with definitions of the terminology used in the discussion. Chapter Six, "The Morphs," takes one to the very core of the success of ball pythons in herpetoculture. Eighteen pages cover everything from why morphs have become popular, naming a morph, to wild morphs (those found in nature), and designer morphs (those produced in captivity from crossing wild morphs). Fifty-three pages of color photographs featuring over 240 individual ball python morphs follow.

The next fourteen chapters focus on husbandry related issues and begin with what to look for when acquiring a ball python (Chapter 7, "Choosing a Ball Python"). The next chapter, "Transporting Ball Pythons," covers everything one should know about packing and shipping — including importing and exporting CITES regulated species such as ball pythons. "The Ultimate Snake Room," "Snake Room Equipment and Supplies," and "Snake Cages" (Chapters 9–11) together constitute a thorough checklist (with explanations) of everything that should be considered when housing these snakes.

The Barkers begin Chapter 12, "Temperatures," with a nice discussion on what exactly is an optimal temperature for a snake. Too often captive snakes are maintained at subpar temperatures with complete disregard for the fact that they behaviorally thermoregulate to control their temperatures. Working at a zoo, I found the next chapter, "Maintenance," particularly poignant in that it discusses my regular working routine: cleaning, disinfecting, and quarantining. However, regular maintenance is an essential area that is neglected by many who maintain snakes. Chapter 14, "Feeding," explains why ball pythons acquired the reputation of being recalcitrant feeders in captivity. Sound, practical information follows, touching all the bases from when, what, and how much to feed, to the presentation of food, to the last ditch efforts of force feeding a reluctant snake. Accidents occasionally happen during feeding and the snake may mistake your hand for the food being presented which opens the door, hence Chapter 15, "Snake Bites."

The word "herpetoculture," defined as maintaining and propagating reptiles, strikes to the heart of Chapter 16, "Breeding Ball Pythons." One of the very reasons why reptiles have gained popularity in recent years is not only because of their innate physical and behavioral features, but also because they can and do reproduce in captivity. Having bred literally thousands of ball pythons (as well as other reptiles), the authors are more than capable of delivering the message behind the mechanics of reproducing this species. Chapter 17, "Eggs, Incubation, and Hatching," flows naturally from the previous chapter and thoroughly covers eggs and their management.

"Medical Matters" (Chapter 18) focuses on health issues including how to find a local veterinarian who specializes in reptiles. One may question why the subject of the next chapter, "Eradicating Snake Mites" was not included in the previous chapter. For those of us who have had to deal with large infestations of snake mites, the answer is very understandable: there are very few circumstances that are as life altering as having a collection affected by mites. Not only do they feed upon blood, but mites have also been implicated as possible vectors for diseases that may debilitate an entire collection. Practical information about recognizing and eliminating mites is treated by the authors as a military-style battle plan.

The closing sections of this book include the chapter "Basic Genetics for Python Breeders" — an introduction into the basic principles of genetics and inheritance. A glossary of anatomical terms (Appendix I) and a quick reference to many (233) of the ball python morphs (Appendix II) follows, with the book finishing off nicely with an extensive bibliography of all published references concerning ball pythons (including images), Literature Cited, and Index.

Very few errors or problems could be found in this book. The most noticeable, however, were the faint captions accompanying the photographs and figures which made reading the smaller captions difficult at best. According to one of the authors, this unfortunate mistake resulted from a misunderstanding between the layout studio and the printer (D. Barker, pers. comm.). A short perusal into the sensory abilities of ball pythons in Chapter Three "The Physical Ball Python," brought my attention to a citation for Young (2003) on page 25. Interested in locating the particular reference, I skipped back to the Literature Cited section on page 314 and found the author's name and the paper's title, yet a publication reference wasn't given. Another problem I found was a lack of Latin nomenclature accompanying the popular names of some of the pythons mentioned in the text. I had the feeling that I knew what a Lesser Sundas Python and a Halmahera Python were (page 44), but common names are not necessarily common to all readers.

Written primarily for the Ball Python enthusiast, but highly useable by all snake keepers, *Pythons of the World, Volume II* is a comprehensive effort that easily distances itself from any other husbandry book on this or any other snake species. It is very easy to read and the depth of coverage in the husbandry chapters alone is simply astounding, leaving few stones unturned. Coupled with superb photography and excellent line drawings, the authors have produced a solid effort that should become a classic for years to come.

I had been patiently awaiting the arrival of this second volume in the *Pythons of the World* series for the last ten years. In that time, my eyesight and lower back have slowly deteriorated to the point of requiring attention. Was it worth the wait? You bet.

Herpetological Review, 2007, 38(1), 119–121.

Guide des Serpents d'Afrique Occidentale (Savane et Desert), by Jean-Francois Trape and Youssouph Mane. 2006. Editions IRD, Paris. Softcover. 226 pages. 29.00 € (approx. US $38.00). ISBN 2-7099-1600-2.

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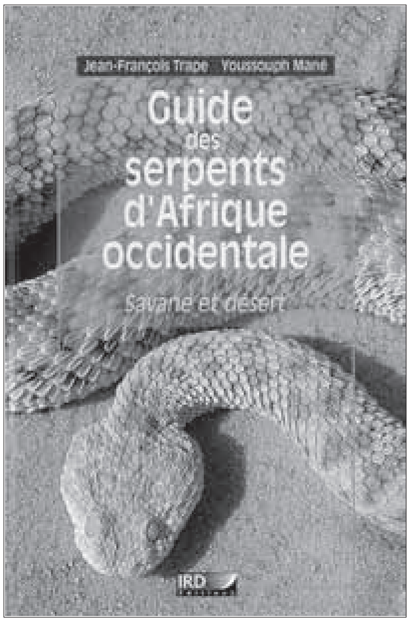

The herpetological literature of West Africa has been of little use to the naturalist, particularly where snakes are concerned. Some good papers have been published, for example Dunger's series of papers in the *Nigerian Field* (1971a, 1971b, 1972, 1974) and Doucet's papers on the Ivory Coast snakes (1963), but these are hard to find. However, the books—for example Leeson (1950), Villiers (1950, with several new editions since, but little improved) and Roman (1980)—have been mostly characterized by a lack of maps, a poor selection of black and white photographs, often of specimens that are long-dead, mutilated or distant from the camera, fairly useless line drawings, no common names, and no attempt to make the data accessible to non-specialists. George Cansdale's handy little book (1961, reprinted in 1973) is a notable exception, with its reasonably accurate color paintings and sensible selection of species, although it is somewhat biased towards snakes known from Ghana. A decent attempt to improve the situation was made by

Chippaux (1999), although his book is marred by lack of common names and an arcane selection of color pictures, some of which are misidentified (see the review by Hughes 2000). So it is a pleasure to come across a book on West African snakes that is thorough, sound, illustrates all its subjects in color photographs and is accessible to the interested naturalist.

Trape and Mane's book covers the 81 species of snake that are deemed by the authors to inhabit the savanna, semi-desert, and desert of western Africa, north of latitude 9°N. Species solely inhabiting forest and woodland are excluded, although some genuine rainforest areas lie within the map boundaries. The baseline data for this book are derived from two large collections. One comprises 13,000 snakes, mostly from Senegal and Mali, but with some from Mauritania, Niger, and Guinea. These are preserved in the IRD research center in Dakar, Senegal, where Mane is the curator. The other is a collection of 4000+ preserved snakes from Burkina Faso, deposited in the National Scientific and Research Centre in Ouagadougou by the late eccentric Spanish priest Pere Benigno Roman.

The aim of this book, stated in the introduction, is to assist with the rapid identification of the snakes of six main countries of western Africa (Senegal, the Gambia, Mauritania, Mali, Niger, and Burkina Faso). The authors emphasize the significance of snakebite in western Africa, which at 10 cases per 100,000 inhabitants per year is, according to the authors, higher than the road accident deaths in Africa and Europe. Next, there are sections on snakebite (including details on treatment), the climate and vegetation of the region, identification, capture and preservation of snakes, and familiar and specific keys to all species, plus some useful tables comparing scale counts, sizes, etc. The environmental section includes 16 color photographs of habitats, ranging from the desert and oases to the well-wooded Guinea Savanna, and a rainfall map. The descriptions of the 81 species are in classic user-friendly, field guide style, with all the information in one place. Each species gets a double-page spread, with two photographs occupying an entire page; the map, description, and drawings of head scales (in plan and profile) are on the facing page. The book concludes with an eight-page bibliography and an index of scientific names. It is very nicely produced, slightly larger than octavo, tough and well bound, on glossy paper. There are some fascinating pictures in addition to the species illustrations, for example, the lady receiving local treatment for an *Echis* bite in the form of a cow dung poultice.

As anyone who has been involved in assisting the public to identify snakes will tell you, what they want are decent, large color illustrations. The big, mostly half-page pictures, nearly all taken by Trape, fit that bill exactly. Most show a whole animal and a close-up, but some show two color forms. There are species here that I don't think have ever been illustrated in color before, for example *Haemorrhois dorri* and the red-banded form of *Lycophidion albomaculatum*. The relatively large maps, showing western Africa from 18°W to 16°E, and 9° to 27°N, are divided into degree squares and national borders are shown. A locality is marked by red shading of the relevant square. In addition to the six countries mentioned above, the map also shows parts of Western Sahara, Algeria, Libya, Chad, western Cameroon, and the northern sectors of the countries of the West African seaboard, from Nigeria west to Guinea, and relevant records for the featured species within those countries are given. The description includes names (French, scientific, English) and a few lines on rapid identification plus notes under the headings Size, Distribution and Habitat, Description (scale data and color/pattern), and Natural History.

The distribution maps give nice insight into West African zoogeography. The high country of East and Southern Africa is full of fragmented habitats, each with their quota of endemic species, often confined to a single mountain range or high forest ("and all waiting to become extinct," as a colleague once cynically remarked to me). Western Africa is very different. With the exception of a few isolated massifs, most of the region is flat country, largely below 500 m altitude. The differing vegetation and climatic zones occupy huge east-west swaths, changing only as one travels north into increasing aridity. In West Africa one can drive hundreds of kilometers in an east-west direction and see very little variation in either altitude or habitat. This lack of habitat diversity is reflected in the distributions shown here; no fewer than 58 of the 81 species extend over 30 degrees of longitude. Consequently only one "single-country" endemic species is featured, *Mehelya gabouensis*, although there are a few snakes that are endemic to the southwestern corner of West Africa (e.g., *Rhinoleptus koniaguiu*, *Lycophidion albomaculatum*, *Elapsoidea trapei*). The featured snakes fit into clear faunal groups: Pan-African savanna species (*Bitis arietans*, *Naja nigricollis*), West African savanna forms (*Psammophis elegans*, *Dromophis praeornatus*), desert species (both species of *Cerastes*, *Malpolon moilensis*). There are also a few examples of what Hughes (1983) calls "East African invaders" (*Hemirhagerrhis nototaenia*, *Eryx colubrinus*) and a couple of large, genuine forest snakes (*Toxicodryas blandingi* and *Dendroaspis viridis*) whose size and consequent mobility have enabled them to colonize the woodland of the Casamance and River Gambia.

Their large collections and familiarity with the snakes of the area have enabled Trape and Mane to have a confident shot at getting rid of what is the curse of African herpetology, dubious records. Such records are usually old, often without supporting specimens, or with imprecise or possibly inaccurate labelling. Unfortunately, they often cannot be simply discarded because they might turn out to be valid, and have value simply because there are so little other data (for example, see Branch and Bauer 1992). In the introduction, as well as listing the new species they have added (seven of which have been described in the last 10 years, six by the authors), Trape and Mane briskly discard 15 species. Justifications for both additions and deletions are provided. The catalogue of deletions is fascinating and includes several species routinely listed for the Gambia, including *Lamprophis virgatus* and *Hapsidophrys smaragdina*, and, startlingly, *Rhamphiophis maradiensis*, described in 1991, which we learn was a misidentified *Malpolon moilensis*. With hindsight, in view of the lack of one-country endemics from this region, this is perhaps not unexpected. Consequently, whatever might be added in the future, the species featured in this book are what one might call the cast-iron, core snake fauna of the region. This book thus represents seminal literature.

I have a few complaints. Many of the illustrations are of dead snakes. This is unavoidable, you can't always find living examples of the species you want. If you want to illustrate every species from your area, you will have to photograph a few dead museum specimens. In most cases here the photographs of obviously dead snakes are adequate for identification, pin-sharp, and of freshly killed or recently preserved specimens, retaining their original color. They are just aesthetically unpleasing, with misaligned or gaping mouths, sunken or dulled eyes, and curious postures. But it is disappointing to see magnificent animals like the cobras and mambas illustrated by lifeless corpses. The fine photographs of the rearing Egyptian cobra on page 195 and the alert *Cerastes* on page 208 show what can be done. Good pictures of living examples of a number of prominent species are in existence. I wish the authors had attempted to obtain these rather than relying so heavily on their own pictures of dead specimens. In addition, although burrowing asps, *Atractaspis*, do have very long fangs, the fang of *Atractaspis aterrima* illustrated on page 19 seems to me to be deceptively long; I suspect it has been dislocated.

The taxonomy here is largely conservative and very sound, but there are some decisions I find odd. Three new species of egg-eating snake are illustrated here, *Dasypeltis confusa*, *D. sahelensis*, and *D. gansi*. This last is what was regarded as a savanna form of *Dasypeltis fasciata*. However, I am not aware that the original paper (Trape and Mane 2006) has actually appeared. The egg-eaters are a complex and confusing genus, showing a huge amount of variation in both scale counts and color. Eminent herpetological taxonomists have struggled with the group, for example see Gans (1959 and 1964) and Hughes (1997). On present evidence I have my doubts as to the validity of *D. sahelensis* and *D. confusa*. The use of the generic name *Haemorrhois* for part of *Coluber* is indicative of the taxonomic morass that at present envelopes this widespread genus; it will be a long time before the debate is settled and it might have been worth sticking with the old name until the situation is resolved. There are also a few errors and typos (e.g., Bob Drewes has become Dewes on page 223, *Hemirhagerrhis nototaenia* is described as non-venomous on page 112, but it is rear-fanged). I am not sure I would agree with the authors' observations that the house snake, *Lamprophis fuliginosus*, is placid and easily captured and handled. It is harmless but in my experience these snakes are quick moving and bite savagely and rapidly when first captured.

I do not want to carp or nit-pick, however. The huge merits of this book far outweigh its minor shortcomings. It is well researched, well illustrated and, in these days of what I sometimes consider almost insanely high prices for herpetological books, relatively inexpensive. It makes the West African savanna and desert snake fauna accessible to the man in the street, and will be genuinely useful in the field. Most important of all, in the hands of medical professionals in West Africa, this book will save lives. In herpetological publishing, you don't get more useful than that.

Acknowledgments.—I thank Barry Hughes for helpful criticisms and information.

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Herpetological Review, 2007, 38(1), 121–123.

Reptiles and Amphibians of East Africa, by Stephen Spawls, Kim M. Howell, and Robert C. Drewes. 2006. Princeton University Press (press.princeton.edu). Softcover. 240 pp. US $24.95. ISBN 0-691-12884-7.

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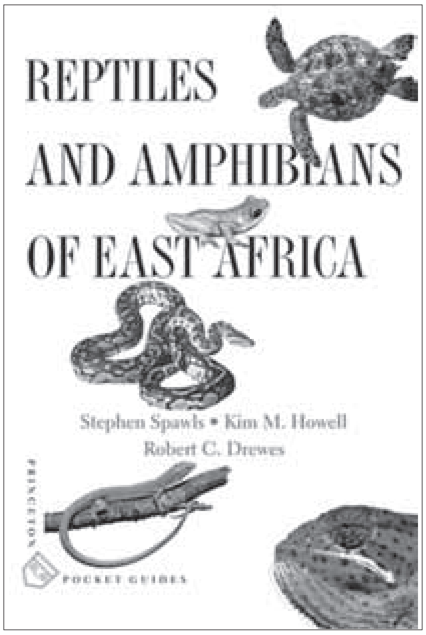

In the Introduction to *Reptiles and Amphibians of East Africa* (RAEA) the authors explain that their book is meant to be a portable field guide to identify the 190 reptiles and 85 amphibians (of their estimated 620 species total) that they feel the public are most likely to encounter in East Africa. The authors have certainly accomplished this modest goal with their photo-rich, lightweight, compact book (12.5 × 19 cm), which can easily fit into a backpack or vehicle glove compartment.

Short (1–3 pages), illustrated subsections of the Introduction entitled "How to use this book," "East African reptiles and amphibians and their zoogeography," "Observing and collecting reptiles and amphibians," "Conservation," "Safety and reptiles," "Identifying reptiles," and "Identifying amphibians" orient the novice through basic information about East African amphibian and reptile morphology, biogeography, behavior and natural history. One-page introductions to the orders of reptiles and amphibians precede their respective species accounts. There are also one-paragraph descriptions of each family (and in some cases, suborders), including taxonomic notes, natural history, identification pointers and content in East Africa. The brief species accounts with photos are about half a page each, and convey basic information about identification (size, coloration, basic morphology), habitat and distribution in East Africa, and natural history comments. Other species are listed without photos and are limited to one or two sentences about identification and distribution. I counted 193 reptile species accounts with photos, nine species with photos mixed in with the 230 additional, abbreviated reptile accounts, 84 amphibian species accounts with photos, and two species with photos in the 85 additional, abbreviated amphibian accounts. Although the main focus of the book is on the East African countries of Kenya, Uganda, Tanzania, Rwanda and Burundi, some accounts include information about the surrounding countries of Somalia, Democratic Republic of Congo, Malawi, Mozambique, and Zambia. At the back of the book, the authors have included brief (1–3 pages) sections including a Glossary, Institutions involved with East African herpetology, Photo credits, Index of scientific names, and Index of English names.

For more extensive information, identification keys, and additional reptile species accounts, RAEA directs readers to *The Dangerous Snakes of Africa* (Spawls and Branch, 1995) and *A Field Guide to the Reptiles of East Africa* (Spawls et al., 2002). Herpetologists familiar with the latter book will recognize the exact same information and photographs in many of RAEA's reptile species accounts. The information has been condensed, and just over 75% of the photos are identical. The photographs range in quality from excellent to poor, consistent with a review of Spawls et al. (2002) by Branch (2002). However, many of the new photographs are of improved quality, and one snake (*Polemon christyi*) was not illustrated in Spawls et al. (2002) or *Snakes of Zambia* by Broadley et al. (2003). Nearly all of the amphibian photographs are original—only one of the amphibian photographs (*Hyperolius orkarkarri*) is present in *Treefrogs of Africa* (Schiøtz, 1999), and none seem to be identical to photographs in *Amphibians of Central and Southern Africa* (Channing, 2001) or *Amphibians of East Africa* (Channing and Howell, 2006). Moreover, RAEA illustrates six species (*Schoutedenella schubotzi*, *Hemisus guineensis*, *Phrynobatrachus irangi*, *Spelaeophryne methneri*, *Xenopus wittei*, and *X. victorianus*) that are not illustrated in the latter amphibian volumes, and 11 different color patterns of the highly variable *Hyperolius viridiflavus/glandicolor* complex.

In addition to the photographic benefits of the book, RAEA is sprinkled with interesting natural history information and creative descriptions of certain groups. Many readers will be delighted to learn about geckos that are known to steal bread and sugar from homes (*Lygodactylus picturatus*, pg. 39), a skink that can swim well in the ocean (*Cryptoblepharus boutonii*, pg. 48), a lacertid that can glide between trees when pursued by predators (*Holaspis guentheri*, pg. 52), chameleons that supercool (*Chamaeleo hoehnelii*, pg. 68; *C. rudis*, pg. 71), toads with internal fertilization (*Mertensophryne micranotis*, pg. 167; two species of *Nectophrynoides*, pg. 169), female frogs that can carry tadpoles on their backs (*Hemisus marmoratus*, pg. 173), and treefrogs with bile pigments in their circulatory system that stain its muscles, bone and blood green (*Leptopelis barbouri,* pg. 178). Some of the unique observations about certain groups include plated lizards that make "excellent, confiding pets" (*Gerrhosaurus major*, pg. 59), vipers that can form C-shaped coils and rub them together, "making a noise like water falling on a hot plate" (pg. 147), and my personal favorite—rain frogs (*Breviceps*) that "resemble badly made meatballs to which the chef has added a face and four legs" (pg. 218).

Because the writing of the book was completed in August, 2005, herpetologists should not look for recent, major taxonomic changes of amphibians (e.g., Frost et al., 2006). RAEA seems to have benefited from criticism of *A Field Guide to the Reptiles of East Africa* (Spawls et al. 2002) by Branch (2002) and Broadley (2002) in some cases. For example, the correction by Broadley (2002) of the genus of large tree agamas from *Acanthocerus* to *Acanthocercus* was incorporated, but the advice regarding the common name of *A. atricollis* was ignored. In a similar fashion, some but not all of the taxonomic changes suggested by Branch (2002) were incorporated, including the correction of a misidentified photo of *Mehelya poensis*. Taxonomic changes and species descriptions that were published recently have, in some cases, been missed or unincorporated (e.g., *Trachylepis* instead of *Mabuya*, Bauer, 2003; *Strongylopus kilimanjaro*, Clarke and Poynton, 2005).

I noticed that RAEA listed *Boulengerula taitanus* instead of *B. taitana*, which was spelled correctly by Channing and Howell (2006). The authors use the term paratoid gland (pg. 216) to refer to the lack of glandular tissue behind the eyes of *Tomopterna*, but this spelling should be used for similar glands in salamanders (Tyler et al. 2001). In frogs the correct spelling is parotoid gland, not parotid gland (salivary glands in mammals), which is used elsewhere in RAEA (amphibian features figure on pg. 16; pgs. 18, 162–71, 232). This book review would not be complete without the requisite listing of typographical errors, of which I noticed a few: "This is particularly useful identification pointers are the colours…" (pg. 6); "Most of their lives is spent buried…" (pg. 15); "A quick-moving gecko, with a round pupils…" (*Cnemaspis* accounts, pgs. 31–32); "recognized throughout sub-Saharan African…" (pg. 195); "with an isolated recorded from…" (pg. 206). Finally, I found it frustrating that none of the species in the abbreviated accounts are listed in the index.

These drawbacks aside, this book will be an informative, inexpensive, and practical field guide to herpetologists, other biologists, and tourists on safari in East Africa. Because this book is bound to be popular, and tourists surely uncover rare species from time to time, I was especially pleased to see the authors encouraging people to bring worm lizards (amphisbaenians) to museums (pg. 79) because they are harmless and poorly known. Professional herpetologists who are interested in East Africa and own a copy of *A Field Guide to the Reptiles of East Africa* (Spawls et al. 2002) will still want to pick up a copy of RAEA for the unique amphibian photos and practical use in the field.

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Artwork and Images Wanted for *HR*

We are always interested in obtaining illustrations of herpetological subjects for publication in *Herpetological Review*. Generally, original drawings should be of a scale that would permit reduction to fit a 90-mm wide column. Original art, or high quality photocopies, should be packaged to ensure safe delivery and sent to the Editor. Alternatively, we would be pleased to receive material in electronic format; consult the Editor for appropriate file formats and sizes.

Also, we are interested in evaluating outstanding color slides or high-resolution digital images of amphibians and reptiles for possible use on future *HR* covers. When reviewing material for submission, photographers should keep in mind the vertical format of our covers. In addition to highlighting outstanding photography, our cover subjects should lend themselves to communication of biologically interesting information through accompanying text. If you would like to have your work considered, please contact the Editor ***prior*** to sending any material. We prefer to review images as JPEG or PDF files before requesting examination of original slides. Postal and e-mail addresses are listed on the inside front cover.

Herpetological Review, 2007, 38(1), 123–124.

A Field Guide to Amphibians and Reptiles in Arizona, by Thomas C. Brennan and Andrew T. Holycross. 2006. Arizona Game and Fish Department, Phoenix, Arizona (www.azgfd.gov). Softcover. vi + 150 pp. US $12.00. ISBN 0-917563-53-0.

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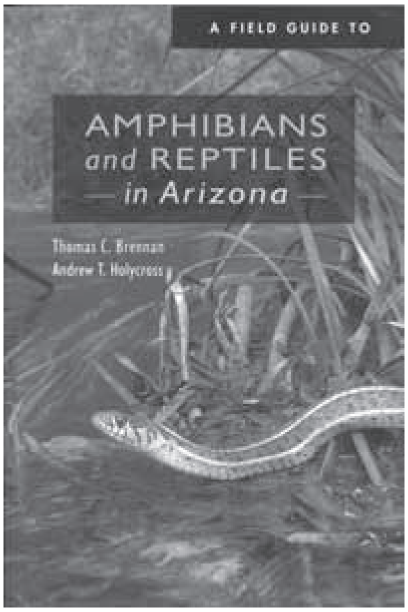

Those of us old enough to remember the indispensable little green book—whether Conant or Stebbins—share a collective longing for its economy and ergonomic form. Into the glove box or backpack it would go, altogether unobtrusive and readily retrievable. True, back then we on the Eastern Seaboard dealt with just one species of slimy salamander while western colleagues enjoyed a monotypic *Rhyacotriton*. As our recognition of herpetological diversity grew, however, so did its documentation. And we watched our once slim, succinct guides become encyclopedic, lamentably unwieldy—more of a desk reference than anything suitable for the field. Enter the new *Field Guide to Amphibians and Reptiles in Arizona* by Thomas Brennan and Andrew Holycross, with one of its many appealing features—portability. At a modest 150 pages, the book is comprehensive without being cumbersome, the authors having struck a near perfect balance between content and utility.

Totaling 132 species, Arizona's rich herpetofaunal diversity is attributable to the region's interplay of geography, geology, and climate. Eight major biomes fall within the state, yielding 14 distinct biotic communities that range from tropical desert scrub to alpine tundra. Brennan and Holycross convey the significance of these communities to Arizona's natural history in a concise treatment of biotic community structure. Each community is profiled and illustrated by an accompanying photograph, and its overall distribution color-coded on a state map. In my view, this illustration may be the single most important figure in the book, as much of Arizona's herpetofauna is community-specific. To this end, the authors appropriately list those species common to each biotic community, and the community map provides a valuable cross-reference for the species distribution maps.

Species accounts are where this book really shines; much thought and effort apparently went into their layout with respect to function and aesthetics. The color plates are superb and beautiful to browse. Field guide plates can often be distractingly cluttered, but not here. Turning page after page, I was struck by the clarity of the plates, each bearing images that seemingly draw you in, right to the key characters, clearly marked. Where necessary, particularly when diagnostic scalation is an issue, species photographs are supplemented with clean line drawings. For the few species with distinctly marked young (e.g., Barking Frog, Madrean Alligator Lizard, Eastern Racer), a photograph of the juvenile accompanies the adult. Ventral shots are included for the lizard genera *Callisaurus*, *Cophosaurus*, *Holbrookia*, and *Uma*, illustrating diagnostic patterns and/or coloration on the throat or belly. I was duly impressed by the photograph of the Zebra-tailed Lizard (*Callisaurus draconoides*) in characteristic field pose: tail upturned and arched over the back, revealing its black and white ventral barring.

Species accounts, set up on facing pages, opposite respective photographs, allow the reader to glance back and forth between the two with ease. Each species profile provides requisite information on size (mm and inches), description, occupied biotic communities, habitat specificity, and activity period. For the vast majority of species, details on diet, breeding season, and clutch or litter size are also given. A brief description of the call is included for the anurans. Where applicable, species are noted as being NON-NATIVE, PROTECTED, and/or VENOMOUS in colored-coded, bold font that prefaces the general text. Distribution maps, though small, are fairly detailed and color-coded to distinguish current (green) versus historic (tan) geographic ranges, as well as introductions (red).

Brennan and Holycross made every effort to incorporate the latest taxonomic updates, with attendant nomenclatural changes involving both common and scientific names. The section on common and scientific names outlines their justification for decisions regarding full specific status in some cases (Arizona Black Rattlesnake, *Crotalus cerberus*) and synonymy in others (*Rana subaquavocalis* is subsumed in *R. chirichauensis*). Many of the citations providing the phylogenetic justification behind these taxonomic decisions are conveniently listed in this section. The book's current taxonomy reminds us seasoned recalcitrants that we're just going to have to let go of *Cnemidophorus* and start thinking *Aspidoscelis* the next time we try to identify a whiptail in Arizona.

Current status is equally important from an ecological perspective, and Brennan and Holycross bring to light those species that are experiencing decline. One particularly disturbing case involves the Narrow-headed Gartersnake (*Thamnophis rufipunctatus*). This strongly aquatic snake, characterized by a distinctively tapered, gracile head, is a foraging specialist on many of the state's native fishes. Populations have undergone precipitous declines recently in both Arizona and adjacent New Mexico. Non-native fish and crayfish have been argued to account, in part, for this unusual species' unfortunate demise.

What better state field guide than Arizona's to include a section on envenomation. Here the authors offer a paragraph invoking common sense as the main operative for avoiding snake and Gila Monster bites, but provide "To Do" and "NOT To Do" first aid lists should such an incident occur. In their account on the Mohave Rattlesnake (*Crotalus scutulatus*), Brennan and Holycross underscore this snake's distinction in producing primarily neurotoxic venom and warn that populations inhabiting southeastern Arizona carry exceptionally potent neurotoxins. They also include a section on the Sonoran Desert Toad (formerly, the Colorado River Toad) as a potential threat to overly curious pets, given this toad's size and toxicity. Oddly, they do not mention Sonoran Desert Toads in the context of "toad licking" or the hallucinatory state its toxins can reputedly produce.

In keeping with the tenor of a field guide, the book includes a short though insightful section on viewing tips, a glossary, and checklist of scientific names, in which each name is followed by a short space for jotting down dates, locality data, etc. In summary, Brennan and Holycross have succeeded admirably in assembling a field guide that is delightfully accessible, one allowing readers —from the weekend naturalist to professional herpetologist—to identify Arizona's amphibians and reptiles quickly, easily, and reliably. No herpetologist should venture field-side in Arizona without one. In fact, take two—they're small!

PUBLICATIONS RECEIVED

Skin Diseases of Exotic Pets, edited by Sue Paterson. 2006. Blackwell Publishing, Ames, Iowa (www.blackwellpublishing.com). x + 333 pp. Softcover. US $74.990. ISBN 0-632-05969-9.

This book is intended for a veterinary audience and provides basic information on the diagnosis and treatment of skin diseases in a variety of vertebrates. Amphibians are not considered, but 65 pages are devoted to reptiles. An introductory chapter includes an overview of the basic structure and function of reptile skin, including normal histology and the process of ecdysis. General aspects of patient examination and diagnosis are presented, along with a basic reptile formulary. Separate chapters deal with skin diseases and treatments of snakes, lizards, and chelonians. Parasitic diseases, trauma, dysecdysis, neoplasias and both nutritionally- and endocrinologically-induced conditions are covered as are their clinical signs and recommended therapy. The book is illustrated by color photos throughout. Other sections of the text deal with fish, birds, and a variety of small mammalian pets, exclusive of dogs and cats.

Synopsis of Helminths Endoparasitic in Snakes of the United States and Canada, by Carl H. Ernst and Evelyn M. Ernst. 2006. Society for the Study of Amphibians and Reptiles (www.ssarherps.org). SSAR Herpetological Circular No. 34. 86 pp. Softbound. US $9.00. ISBN 0-916984-67-2.

Parasitic worms have been reported from 61% of the 131 North American snake species occurring north of Mexico. This small book provides both a synopsis of the helminths recorded from snakes and a list of worms organized by snake host species. The former list includes synonyms, habitats (the organs or regions of the host that harbor the worms), host species recorded, geographic distribution, and references. The later presents an alphabetical listing of worms by major taxonomic group (cestodes, trematodes, acanthocephalans, nematodes) and references. Many widespread snakes support a surprising diversity of parasites (e.g., approximately 50 species in *Nerodia sipedon*). A bibliography of nearly

450 entries comprehensively covers the scattered literature dealing with parasitic worms of North American snakes. Separate indices to the scientific names of worms and snakes conclude the work.

Ecology of the Acanthocephala, by C. R. Kennedy. 2006. Cambridge University Press, Cambridge, UK (www.cambridge.org). ix + 249 pp. Harcover. US $110.00. ISBN 0-521-85008-8.

This book is devoted to a relatively poorly-studied group of parasitic worms that are capable of damaging the intestines of their hosts. All 1000 or so acanthocephalans have intermediate arthropod hosts and definitive vertebrate hosts. They occur in terrestrial, freshwater and marine environments. Only 2% and 1.8% of known species have as their final hosts amphibians and reptiles, respectively. However, snakes, lizards, and frogs are commonly utilized as paratenic hosts (i.e., they eat the intermediate host and are in turn eaten by the definitive bird or mammal host, providing the parasite the opportunity to jump between trophic levels). This book is written from the perspective of the biology of the parasite, but the ecological relationships described are equally relevant to the host organisms, including amphibians and reptiles.

Emerging Threats to Tropical Forests, edited by William F. Laurence and Carlos A. Peres. 2006. University of Chicago Press, Chicago (www.press.uchicago.edu). xii + 563 pp. Softcover. US $40.00. ISBN 0-226-47022-9.

Emerging threats are dangers to biodiversity resulting from direct or indirect human action on the environment. Forty-nine contributors in 23 chapters discuss the impacts of several categories of these threats including climatic and atmospheric change, pathogens and invasive species, habitat loss and fragmentation, and fire. Solutions to these problems and means of mitigating threats are discussed in several chapters. Examples come from throughout the tropics, with an emphasis on the Neotropics and Central Africa. Although the focus of most contributions is on threats to forest biodiversity in a broad sense, some chapters focus on particular forest-dwelling taxa, such as primates. No chapters are devoted to the herpetofauna, but mention of tropical frogs and reptiles are scattered throughout the book and amphibian declines are a focus of the chapter on emerging infectious diseases. The broad regional or global nature of the environmental changes documented in this volume bear directly on the future of all tropical biota. The book is illustrated throughout with maps, graphs and black and white photos. A 79-page cumulative literature cited section provides an entry into the relevant environmental literature. This book will be particularly appreciated by ecologists and tropical biologists.

Amniote Paleobiology: Perspectives on the Evolution of Mammals, Birds, and Reptiles, edited by Matthew T. Carrano, Timothy J. Gaudin, Richard W. Blob, and John R. Wible. 2006. University of Chicago Press, Chicago, Illinois (www.press.uchicago.edu). vi + 547 pp. Softcover. US $40.00. ISBN 0-226-09478-2.

This volume honoring University of Chicago paleontologist James Allen Hopson comprises 15 contributed chapters by leading amniote paleontologists. These are arranged into four main subsections, as well as a biography and bibliography of Hopson. Three of these, "New Fossils and Phylogenies," "Large-scale Evolutionary Patterns," and "Ontogeny and Evolution" include chapters devoted to fossil reptiles. Among the taxa treated are dinosaurs (Theropod Dinosaurs from the Early Jurassic of Huizachal Canyon; The Origins of High Browsing and on Neck Length in Sauropodomorphs; Body-Size Evolution in the Dinosauria), plesiosaurs (Neoteny and the Plesiomorphic Condition of the Plesiosaur Basicranium), the early tetrapod *Whatcheeria deltae*, and a variety of mammals and mammal-like reptiles. Most of the contributions are data-rich and well illustrated by black and white photographs and line drawings. This volume will be of interest to those interested in functional and evolutionary morphology and in amniote phylogenetics, as well as to vertebrate paleontologists in general.

ERRATUM

In the article "The influence of body size and trophic morphology on the size of molluscan prey of female Texas map turtles (*Graptemys versa*)" by Collins and Lindeman (Herpetol. Rev. 37:416–418), the incorrect data were depicted in Fig. 3. The corrected Fig. 3 is shown here. A pdf reprint of the article, with the correct version of Fig. 3, is available from Lindeman (e-mail: plindeman@edinboro.edu).

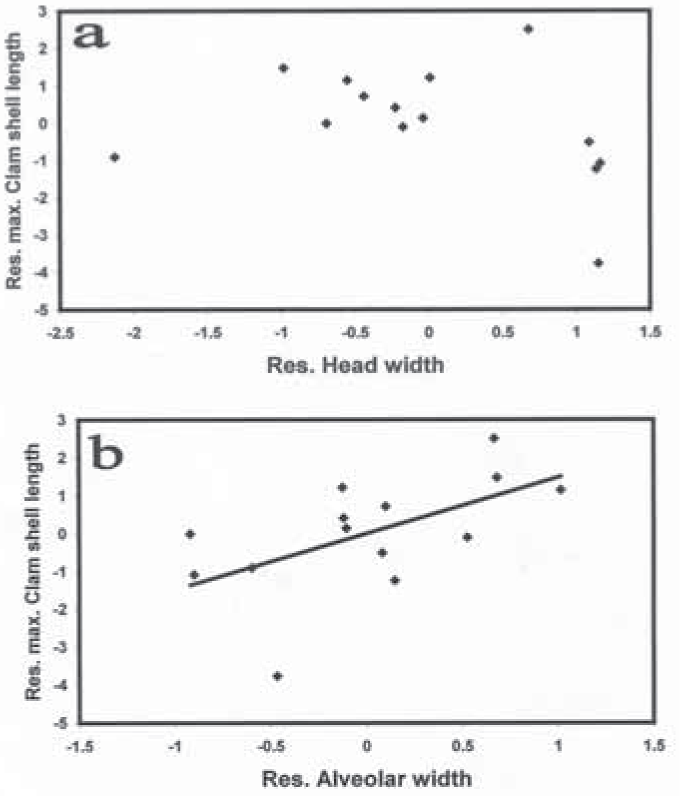

FIG. 3. Results of residual analyses testing (a) whether maximum shell length was related to head width (HW) after correction for both variables' log-log correlation with plastron length ($r = 0.335$, $P = 0.24$) and (b) whether maximum shell length was related to alveolar width (AW) after correction for both variables' log-log correlation with plastron length ($r = 0.575$, $P = 0.032$).

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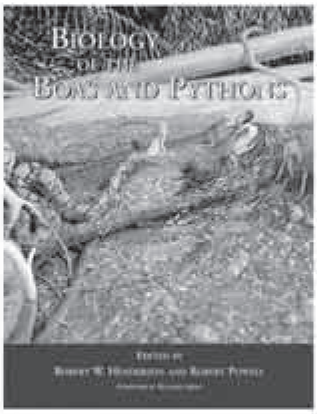

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Foreword by Richard Shine

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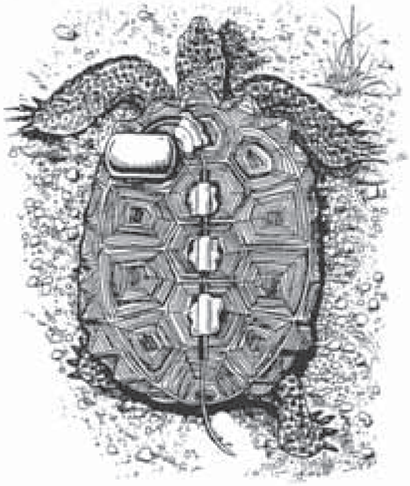

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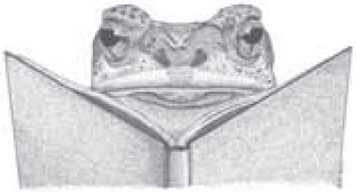

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