BULLETIN
of the
Chicago Herpetological Society

Volume 54, Number 2
February 2019

BULLETIN OF THE CHICAGO HERPETOLOGICAL SOCIETY
Volume 54, Number 2
February 2019

Cover: Emperor newt, *Tylototriton shanjing*. Photograph of a captive specimen by Michael Redmer.

The Chicago Herpetological Society is a nonprofit organization incorporated under the laws of the state of Illinois. Its purposes are education, conservation and the advancement of herpetology. Meetings are announced in this publication, and are normally held at 7:30 P.M., the last Wednesday of each month.

Membership in the CHS includes a subscription to the monthly *Bulletin*. Annual dues are: Individual Membership, $25.00; Family Membership, $28.00; Sustaining Membership, $50.00; Contributing Membership, $100.00; Institutional Membership, $38.00. Remittance must be made in U.S. funds. Subscribers outside the U.S. must add $12.00 for postage. Send membership dues or address changes to: Chicago Herpetological Society, Membership Secretary, 2430 N. Cannon Drive, Chicago, IL 60614.

Manuscripts published in the *Bulletin of the Chicago Herpetological Society* are not peer reviewed. Manuscripts and letters concerning editorial business should be e-mailed to the editor, mdloogatch@chicagoherp.org. Alternatively, they may be mailed to: Chicago Herpetological Society, Publications Secretary, 2430 N. Cannon Drive, Chicago, IL 60614. **Back issues** are limited but are available from the Publications Secretary for $2.50 per issue postpaid.

Visit the CHS home page at <http://www.chicagoherp.org>.

The *Bulletin of the Chicago Herpetological Society* (ISSN 0009-3564) is published monthly by the Chicago Herpetological Society, 2430 N. Cannon Drive, Chicago IL 60614. Periodicals postage paid at Chicago IL. **Postmaster:** Send address changes to: Chicago Herpetological Society, Membership Secretary, 2430 N. Cannon Drive, Chicago IL 60614.

Bulletin of the Chicago Herpetological Society 54(2):25-28, 2019

Notes on the Herpetofauna of Western Mexico #21: A Food Item for Tadpoles of *Lithobates neovolcanicus* (Hillis & Frost, 1985)

Daniel Cruz-Sáenz [1]*, Eduardo Castro-Espindola [1], Laura López-Fernández [1], Luis Antonio Hernández-Dávila [2], Javier Banda-Leal [2] and David Lazcano [2]
*** corresponding author: dcruzsaenz@gmail.com**

Abstract

On 30 June 2017 we conducted a nocturnal sampling of amphibians and reptiles in the locality known as Huilotan in San Cristobal de la Barranca, Jalisco, Mexico. This barranca is part of Río Santiago (Río Cañon de Santiago). In an artificially constructed pond we found a group of *Lithobates neovolcanicus* tadpoles feeding on a mango fruit (*Mangifera indica*) that had fallen into the pond.

Resumen

El 30 de junio de 2017 se realizaba un muestreo nocturno de anfibios y reptiles en la localidad conocida como parque ecológico Huilotán, en el municipio de San Cristóbal de la Barranca, Jalisco es una parte de la barranca del río Santiago (Río Cañón de Santiago). Donde encontramos en un estanque un grupo de renacuajos de la especie *Lithobates neovolcanicus* consumiendo el mesocarpio de un mango (*Mangifera indica*) que caía al estanque.

On 30 June 2017 at 12:22 h we conducted a nocturnal sampling of amphibians and reptiles in a private orchard in the area known as Huilotan, Zapopan Municipality, Jalisco, Mexico (20°57'45.94"N, 103°51'34.16"W, elevation 1091 m). This locality is in a portion of Barranca del Río Santiago (Santiago River Canyon). In an artificially constructed open pond (40 × 20 × 2 m) we found a group of *Lithobates neovolcanicus* tadpoles feeding on the mesocarp of a criollo mango fruit (*Mangifera indica*) that had fallen into the pond. We took photos and left the individuals to continue feeding. A small patch of tropical deciduous forest is present in the area. We are conducting a study comparing the activity of the herpetofauna in the orchard with what is left of the tropical deciduous forest. Other than the *Lithobates*, we have found *Sceloporus heterolepis* (odd-scaled spiny lizard / *lagartija de escamas dispares*) and *Smilisca fodiens* (lowland burrowing treefrog / *rana chata*).

Background: tadpoles

Tadpoles are found in a variety of freshwater habitats, and although they are most conspicuous in standing water habitats in temperate zones, tadpole assemblages can also be very abundant and diverse in lotic habitats in the tropics (Inger et al., 1986; Whiles et al., 2006). Where they are found, tadpoles show great morphological diversity, inhabit a wide variety of microhabitats, and most likely play a variety of ecological roles (Altig and Johnston, 1989; Schiesari, 2006). Larval anurans often play an important role in wetland food webs because they can reach high densities and biomass and exhibit high per capita consumption rates. Tadpoles, however, are often overlooked and understudied relative to other consumer groups in freshwater ecosystems, such as fishes and macroinvertebrates. The true trophic status of many tadpole species remains unknown, basic information that is central to understanding their ecological significance

Lithobates neovolcanicus tadpoles feeding on the mesocarp of a criollo mango fruit (*Mangifera indica*).

Artificial pond into which mango fruits fall, and provide food for *Lithobates neovolcanicus* tadpoles.

1. Universidad de Guadalajara, Centro de Estudios en Zoología, Centro Universitario de Ciencias Biológicas y Agropecuarias Km. 15.5 Carretera Guadalajara-Nogales, Predio Las Agujas, A. P. 1-1919, Zapopan, Jalisco, C.P. 44101 México. (ECE: bio.lalo.castro@gmail.com) (LLF: marian_n212@hotmail.com)

2. Universidad Autónoma de Nuevo León, Facultad de Ciencias Biológicas, Laboratorio de Herpetología, Apartado Postal # 513, San Nicolás de los Garza, Nuevo León, C.P. 66450 México. (LAHD: tnt_s_kate@hotmail.com) (DL: imantodes52@hotmail.com)

and thus the consequences of their loss (Altig and Johnston, 1989; Altig and McDiarmid, 1999; Pryor, 2003; Pryor and Bjorndal, 2005a, b; Schiesari et al., 2009; Grant et al., 2016). A more accurate understanding of the nutritional ecology of tadpoles will also benefit captive breeding programs, which appear to represent the last hope for many declining species (Mendelson et al., 2006). While some studies have provided important information on components of tadpole feeding behaviors and diets, information on assimilation and nutritional ecology is mostly lacking. It is well established that dietary variables influence tadpole growth in the field and in the laboratory (Hegner, 1922; Hirschfeld et al., 1970; National Research Council, 1974; Steinwascher and Travis, 1983; Peterson and Boulton, 1999; Skelly and Golon, 2003; Altig et al., 2007; Whiles et al., 2010; Gleason et al., 2016).

Evidence suggests that tadpoles can be an important factor in the trophic pathway of aquatic basal resources such as algae and detritus in food webs, and can also be an important predator in these ecosystems (Pryor, 2003; Schiesari et al., 2009).

Background: mangos

Mango trees (*Mangifera indica*) normally grow in tropical areas and produce an important edible fruit. They are widely grown commercially. The plant, however, contains chemicals such as anacardic acids, which can cause an allergic contact dermatitis. The peel of the fruit and the sap of the tree contain the chemicals. The mango belongs to the cashew family Anacardiaceae, which obviously contains the cashew tree, from which the shell of the nut is extremely toxic. Poison ivy is also a member of this family.

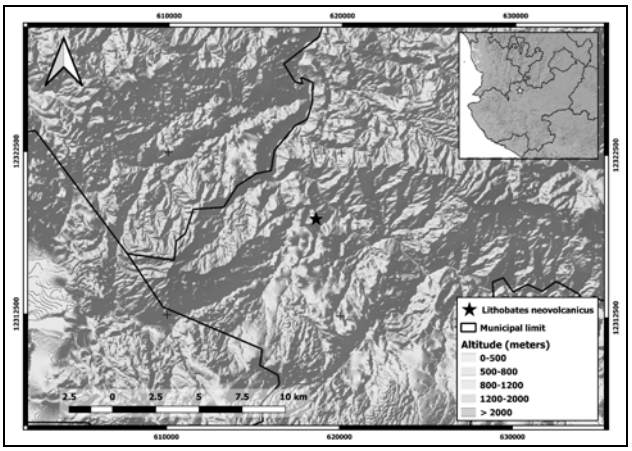
Natural history of *Lithobates neovolcanicus*

Lithobates neovolcanicus adults are semiaquatic, and found in intermittent or permanent bodies of water. They are crepuscular and nocturnal but sometimes can be found active during the day. They live on the shores of lakes, dams, rivers, streams, ponds and artificial water bodies. The breeding season occurs during the spring and summer (Vázquez-Díaz and Quintero-Díaz, 2005). Reproduction is oviparous with indirect development.

Males vocalize during the breeding season on the banks of water bodies, mainly during the night. The eggs are deposited in water forming a spherical mass, which can contain about 4,500 embryos; each egg is 1.7 mm in diameter with a 4-mm-diameter gelatinous covering (Hillis and Frost, 1985). Tadpoles are seen during most of the year, suggesting a long breeding season. Dixon and Lemos-Espinal (2010) mentioned that the larvae can remain in the water for a long period of time (a year or more), depending on the environmental conditions. There is no detailed information on the species' diet.

Study site

San Cristóbal de la Barranca is a municipality within the state of Jalisco and forms part of the Sierra Madre Occidental biogeographic province. This municipality is located at the coordinates 21° 02'42 20"N, 103° 25'43 46'W To the north it



borders the state of Zacatecas, to the south the municipalities of Zapopan and Tequila, to the east Ixtlahuacán del Río, and to the west Tequila. The annual average temperature is 20°C, with a semi-dry climate. The vegetation is composed of huizache, grasslands, disturbed oak-pine forest, and tropical deciduous forest. The collecting site in the municipality is an area where there are still small patches of a tropical deciduous forest, but the particular site is a 200-ha orchard, with fruit tress such as figs, lemons, limes, mangos and plums. It has a man-made pond where we observed many tadpoles of *L. neovolcanicus*.

Discussion and conclusion

Tadpoles comprise a number of types of feeders such as suspension feeders, macrocarnivores, and raspers (Hourdry et al., 1996; Venesky et al., 2011, 2014), the last of which are thought to consume plants, detritus, and material attached to submerged substrata (variously called periphyton, epilithon, aufwuchs, and biofilm: Altig et al., 2007). While many common lentic species (e.g., members of the genus *Lithobates*) are often lumped as primary consumers that graze and suspension-feed, there is mounting evidence that this is an overly simplistic assessment and that many species feed opportunistically on a variety of food sources, with some even functioning as predators (Alford, 1999; Petranka and Kennedy, 1999; Schiesari et al., 2009).

There is evidence that the larvae of the invasive species *Lithobates catesbeianus* could cause significant problems for native communities of tadpoles (Ruibal and Laufer, 2012). Although *L. catesbeianus* has been reported for the state of Jalisco, fortunately in this study site the species has not been observed or found.

A literature review of the diet of *L. neovolcanicus* tadpoles indicated that food was cited simply as "vegetal matter" (Mendoza-Estrada et al., 2008; Lelvas et al., 2012). Our report, therefore, is the first report of these tadpoles feeding on ripe mangos.

There are many questions that need to be answered. For example, we don't know if the tadpoles have other food resources at the site. Would feeding on mangos have an impact in the theory of ecological stoichiometry which provides ecologists with a quantitative framework to predict consumer nutrient limitation, based on similarity of stoichiometric ratios in their body tissues relative to their food resource? (Stephens et al.,

2017) What nutrients are mangos providing?

There is a great need to understand the role of exotrophic anuran larvae in water communities by conductng detailed studies, and to learn if the presence of various species affects the trophic balance, something that has been documented poorly.

Acknowledgments

We wish to thank the authorities of Parque Ecológico Huilotan for their hospitality and friendship, and for financing the project. We wish to thank Larry David Wilson for reviewing our manuscript.

Literature Cited

Alford, R. A. 1999. Ecology: Resource use, competition, and predation. Pp. 240-278. *In*: R. W. McDiarmid and R. A. Altig, editors, Tadpoles: The biology of anuran larvae. Chicago: University of Chicago Press.

Altig, R., and G. F. Johnston. 1989. Guilds of anuran larvae: Relationships among developmental modes, morphologies and habitats. Herpetological Monographs 3:81-109.

Altig, R., and R. W. McDiarmid. 1999. Diversity: Familial and generic characterizations. Pp. 295-337. *In*: R. W. McDiarmid and R. A. Altig, editors, Tadpoles: The biology of anuran larvae. Chicago: University of Chicago Press.

Altig, R., M. R. Whiles and C. L. Taylor. 2007. What do tadpoles really eat? Assessing the trophic status of an understudied and imperiled group of consumers in freshwater habitats. Freshwater Biology 52(2):386-395.

Dixon, J. R., and J. A. Lemos-Espinal. 2010. Anfibios y reptiles del estado de Querétaro / Amphibians and reptiles of the state of Querétaro. México, D.F.: Texas A & M University, UNAM (Universidad Nacional Autónoma de México), and CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad).

Gleason, S. M., J. M. Yahn, and W. H. Karasov. 2016. Digestive efficiency of Northern Leopard Frog (*Lithobates pipiens*) tadpoles during development, reared on a laboratory diet. Herpetologica 72(2):107-113.

Grant, E. A. C., D. A. W. Miller, B. R. Schmidt, M. J. Adams, S. M. Amburgey, T. Chambert, S. S. Cruickshank, R. N. Fisher, D. M. Green, B. R. Hossack, P. T. J. Johnson, M. B. Joseph, T. A. G. Rittenhouse, M. E. Ryan, J. H. Waddle, S. C. Walls, L. L. Bailey, G. M. Fellers, T. A. Gorman, A. M. Ray, D. S. Pilliod, S. J. Price, D. Saenz, W. Sadinski and E. Muths. 2016. Quantitative evidence for the effects of multiple drivers on continental-scale amphibian declines. Scientific Reports 6 (article number: 25625).

Hegner, R. W. 1922. The effects of changes in diet on the incidence, distribution and numbers of certain intestinal protozoa of frog and toad tadpoles. The Journal of Parasitology 9(2):51-67.

Hillis, D. M., and J. S. Frost. 1985. Three new species of leopard frogs (*Rana pipiens* Complex) from the Mexican Plateau. Occasional Papers of the Museum of Natural History, University of Kansas 117:1-14.

Hirschfeld, W. J., C. M. Richards and G. W. Nace. 1970. Growth of larval and juvenile *Rana pipiens* on four laboratory diets. American Zoologist 10(3):315 (abstract).

Hourdry, J., A. L'Hermite and R. Ferrand. 1996. Changes in the digestive tract and feeding behavior of anuran amphibians during metamorphosis. Physiological Zoology 69(2):219-251.

Inger, R. F., H. K. Voris and K. J. Frogner. 1986. Organization of a community of tadpoles in rain forest streams in Borneo. Journal of Tropical Ecology 2(3):193-205.

Lelvas, P., F. Lelvas and M. O. Moura. 2012. Diet and trophic niche of *Lithobates catesbeianus* (Amphibia: Anura). Zoologia 29(5): 405-412.

Mendelson, J. R., III, K. R. Lips, R. W. Gagliardo, G. B Rabb and others. 2006. Confronting amphibian declines and extinctions. Science 313:48.

Mendoza-Estrada, L. J., R. Lara-López, and R. Castro-Franco. 2008. Dieta de *Lithobates zweifeli*. Hillis, Frost y Webb, 1984 (Anura: Ranidae) en un río estacional del centro de México. Acta Zoológica Mexicana (nueva serie) 24(1):169-197.

National Research Council. 1974. Amphibians: Guidelines for the breeding, care, and management of laboratory animals. Washington, D.C.: The National Academies Press.

Peterson, C. G., and A. J. Boulton. 1999. Stream permanence influences microalgal food availability to grazing tadpoles in arid-zone springs. Oecologia 118(3):340-352.

Petranka J. W., and C. A. Kennedy. 1999. Pond tadpoles with generalized morphology: Is it time to reconsider their functional roles in aquatic communities? Oecologia 120(4):621-631.

Pryor, G. S. 2003. Growth rates and digestive abilities of bullfrog tadpoles (*Rana catesbeiana*) fed algal diets. Journal of Herpetology 37(3): 560-566.

Pryor, G. S., and K. A. Bjorndal. 2005a. Effects of the nematode *Gyrinicola batrachiensis* on development, gut morphology, and fermentation in bullfrog tadpoles (*Rana catesbeiana*): A novel mutualism. Journal of Experimental Zoology Part A Comparative Experimental Biology 303(8):704-712.

Pryor, G. S., and K. A. Bjorndal. 2005b. Symbiotic fermentation, digesta passage, and gastrointestinal morphology in bullfrog tadpoles (*Rana catesbeiana*). Physiological and Biochemical Zoology 78(2):201-215.

Ruibal, M., and G. Laufer. 2012. Bullfrog *Lithobates catesbeianus* (Amphibia: Ranidae) tadpole diet: Description and analysis for three invasive populations in Uruguay. Amphibia–Reptilia 33(2):355-363.

Schiesari, L. 2006. Pond canopy cover: A resource gradient for anuran larvae. Freshwater Biology 51(3):412-423.

Schiesari, L., E. E. Werner and G. W. Kling. 2009. Camivory and resource-based niche differentiation in anuran larvae: Implications for food web and experimental ecology. Freshwater Biology 54(3):572-586.

Skelly, D. K., and J. Golon. 2003. Assimilation of natural benthic substrates by two species of tadpoles. Herpetologica 59(1):37-42.

Steinwascher, K., and J. Travis. 1983. Influence of food quality and quantity on early larval growth of two anurans. Copeia 1983(1): 238-242.

Stephens, J. P., A. B. Stoler, J. P. Sckrabulis, A. J. Fetzer, K. A. Berven, S. D. Tiegs and T. R. Raffe. 2017. Ontogenetic changes in sensitivity to nutrient limitation of tadpole growth. Oecologia 183(1):263-273.

Vázquez-Díaz, J., and G. E. Quintero-Díaz. 2005. Anfibios y reptiles de Aguascalientes. Mexico, D.F.: CONABIO (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad) and CIEMA (Centro de Investigaciones y Estudios Multidisciplinarios de Aguascalientes).

Venesky, M. D., R. J. Wassersug, M. E. Jorgensen, M. Riddle and M. J. Parris. 2011. Comparative feeding kinematics of temperate pond-dwelling tadpoles (Anura, Amphibia). Zoomorphology 130(1):31-38.

Venesky, M. D., V. T. de Sousa, F. Nomura, D. de C. Rossa-Feres, T. L. Pezzuti, G. V. Andrade and R. J. Wassersug. 2014. Flexible feeding kinematics of a tropical carnivorous anuran tadpole. Journal of Zoology 293(3):204-210.

Whiles, M. R., M. I. Gladyshev, N. N. Sushchik, O. N. Makhutova, G. S. Kalachova, S. D. Peterson and K. J . Regester. 2010. Fatty acid analyses reveal high degrees of omnivory and dietary plasticity in pond-dwelling tadpoles. Freshwater Biology 55(7):1533-1547.

Whiles, M. R., K. R. Lips, C. M. Pringle, S. S. Kilham, R. Brenes, S. Connelly, J. C. Colon-Gaud, M. Hunte-Brown, A. D. Huryn, C. Montgomery and S. Peterson. 2006. The consequences of amphibian population declines to the structure and function of Neotropical stream ecosystems. Frontiers in Ecology and the Environment 4(1):27-34.

Bulletin of the Chicago Herpetological Society 54(2):29-38, 2019

Notes on the Distribution of *Glyptemys muhlenbergii* in Maryland

Robert W. Miller
803 Bomont Road
Timonium, MD 21093-1804
opacum@hotmail.com

Abstract

A detailed account of the documented distribution of the bog turtle, *Glyptemys muhlenbergii*, in Maryland is presented. The species is currently ranked S2 (Threatened) by the Maryland Department of Natural Resources. Some earlier authors have shown little interest in the literature and no authors have shown any serious interest in systematic collections. Highly questionable reports are discussed and rejected.

Introduction

Due to its vulnerable status throughout much of its highly disjunct range (Ernst and Bury, 1977; Iverson, 1992; Powell et al., 2016), the bog turtle, *Glyptemys muhlenbergii*, has interested biologists for many years. Its rarity, attractive appearance and terrarium-friendly size have also made it the target of hobbyists and profiteers (e.g., Lee and Norden, 1996; Ernst and Lovich, 2009). This species' ecology and conservation concerns have generated considerable interest in Maryland (Chase et al., 1989; Lee and Norden, 1996; Morrow et al., 2001a,b; Dinkelacker et al., 2004; Howard et al., 2004a,b; Smith, 2004; Wilson et al., 2004; Byer et al., 2017, 2018), but its documented distribution in the state has not previously been addressed. Extremely dubious records have also been advocated. Localities mentioned in the text are known or believed to no longer harbor the species. The following collection abbreviations are used: CM (Carnegie Museum of Natural History), MCZ (Museum of Comparative Zoology, Harvard University), MSB (Museum of Southwestern Biology, University of New Mexico), NCSM (North Carolina Museum of Natural Sciences), NHSM (Natural History Society of Maryland), NHSM/HSH (Natural History Society of Maryland/Herbert S. Harris, Jr.), PSM (James R. Slater Museum, University of Puget Sound), TSU (Towson University), UF (Florida Museum of Natural History, University of Florida), USNM (National Museum of Natural History).

Discussion

The bog turtle is known from four of Maryland's 23 counties and was first discovered in the state near Grave Run Mills, Baltimore County, on 8 August 1941 (McCauley and Mansueti, 1943). This locality is based on NHSM 450, and Miller (2015b) noted the checkered history of this specimen. McCauley and Mansueti reported the species again for a local audience in 1944, but did not mention their earlier publication. McCauley (1945) recounted all details concerning this specimen, but did not cite either of his earlier publications; Mansueti also received no mention. The species was next reported from Conowingo, Cecil County, 6 April 1947 by Cooper (1947) for a very limited audience and then again (Cooper, 1949) for a specialized readership. This time he cited NHSM 858 as documentation, but, like McCauley and Mansueti, did not cite his earlier publication. Cooper (1949) mentioned a second specimen collected on 27 April 1947, but neglected to list the catalogue number, NHSM 1580. He also noted a shell collected by R. Mansueti; no date was provided and there is no record of this specimen entering a collection. The first report from Harford County, Broad Creek Boy Scout Camp (now Broad Creek Memorial Scout Reservation), was made by Prince et al. (1955), although they were unaware of its significance. They noted two individuals "obtained" in 1952 (no precise date) by D. J. Lyons, two "collected" on 12 July and 24 August 1954 by R. Duppstadt and another "specimen" taken on 10 July 1955; collector not stated. Reed (1956a), in apparently uncredited personal communications with Duppstadt (mentioned twice in other species accounts), Lyons or Prince, stated: "Broad Creek, in swampy area near pipe drain at Broad Creek Scout Camp (4 collected in three years). New to Harford County." A similar situation occurred again in 1956 with *Scaphiopus holbrookii*, when Reed (1956b) and Stine et al. (1956) published new distributional records in consecutive articles in the same journal. If Reed collected bog turtles at this site, there are no specimens in his private collection or any mention in his card file, both of which are at the Natural History Society of Maryland. Elsewhere in Reed (1956a), he stated that five *Clemmys guttata* and two *Glyptemys insculpta* were "collected," from this particular locality, but again there is no record of him having done so. Despite the welter of bog turtle reports from this site, only one specimen exists: NCSM 23496, but according to the museum's records it was collected in July 1951 by D. J. Lyons, one of the coauthors of Prince et al. (1955). The last Maryland county to be documented and the one with the fewest populations was Carroll. This received no special attention and three localities were plotted by Harris (1975). However, only one site was vouchered at the time: Manchester, 18 April 1970 (NHSM/HSH 99).

Additional new localities were provided by Barton and Price (1955) and Campbell (1960). The former authors, in their summary of the biology of *Glyptemys muhlenbergii*, recorded the species from Elk Neck, Cecil County (CM 26287, 14 July 1945). Campbell noted that two specimens were collected 1.0 mile SW "Eko" (Eklo) by R. S. Simmons. Apparently no dates were provided by Simmons to Campbell. One surviving specimen is presumably NHSM 2730, 15 July 1954. Campbell, overlooking Prince et al. (1955), also mentioned the "Broad Creek" (Broad Creek Boy Scout Camp) site noted above, relying on J. E. Cooper for this information. The focus of Campbell's note was a population he discovered at "Blue Mount Trap Quarry [now Blue Mount Quarry], one mile SW [S] of Whitehall [White Hall], and two miles E [ENE] of Hereford." Between 28 July 1951 and 23 May 1953, Campbell found 21 individuals, 19 of which were living and two that were dead.

Two specimens were deposited in the Florida State Museum (now the Florida Museum of Natural History), University of Florida: UF 1229, 10 April 1953 and UF 1230, 18 May 1952.

The first Marylander to take a strong interest in this species was K. T. Nemuras, who did survey work in Maryland as well as in New Jersey, North Carolina, Pennsylvania and Virginia. He also published numerous articles concerning this species (e.g., Nemuras, 1965, 1966a,b, 1967, 1969, 1974a,b, 1976; Nemuras and Weaver, 1974a,b), earlier ones focusing on natural history and later ones more devoted to conservation pleas. Much of his output is repetitive, but he did more than anyone else to document localities in Maryland and collected 11 specimens from eight localities. Eight were deposited in the National Museum of Natural History and the others in the Natural History Society of Maryland.

Harris (1969) mapped nine sites in Baltimore, Cecil and Harford Counties. At the time, six of these (mentioned above) were in the public domain. Committee . . . (1973) was the next to comment on the bog turtle in Maryland: "There are at least 30 small and isolated populations of this attractive little turtle known in Maryland." This appears to be the number mapped by them, as well as by Harris (1975). However, with the exception of a site jeopardized by golf course construction at Bel Air, Harford County (no date provided), the public record was no more documented than at the time of Harris (1969). Lee and Norden (1996) also mentioned a locality "near Bel Air" in relation to a population discovered in 1969 that disappeared due to vegetational succession. Probably due to conservation concerns, Bel Air would be the last uncontroversial site to be mentioned in the literature concerning Maryland. No explanation was given by Committee . . . (1973) for an odd locality mapped in Baltimore County just east of Baltimore City. This is dealt with below.

An intensive survey for *Glyptemys muhlenbergii* was undertaken in Maryland by Taylor et al. (1984) from mid-April 1976 through September 1978. A summary of their work was published by Dawson (1984). They discovered a startling 173 new sites for this species, when only 30 localities had previously been mapped. However, it is clear that their paper received inadequate review and that these authors were little interested in the historic documentation of this species both within and without Maryland, and relied on citing literature that was readily available to them. In Connecticut they cited Carr (1952) and Conant (1975) as authorities, when Robinson (1956) and Warner (1975) would have been better. In Delaware they relied on Nemuras (1967) and Arndt (1972), although these authors overlooked Conant (1945) who first reported the species from the state in an explicit manner. Arndt (1977) would later discover a much earlier reference, Newton (1916). Taylor et al. cited Behler ("1974" 1971) as documentation for Massachusetts when in fact it was Blanchard (1970) who first reported the species from that state. Nemuras (1967) was again cited for New Jersey, New York and Pennsylvania. Leaving aside the hearsay of Le Conte (1836) and Holbrook (1842), Ennis (1861) was the first to provide a specific locality for New Jersey. Stone (1906), Fowler (1907) and Street (1914) published additional localities. De Kay (1842) published the earliest locality for New York (no date provided), although Eights (1853) stated that he had found the species in ca. 1823. Fisher (1887), Reed and Wright (1909) and Wright (1918a,b) published additional sites. Yarrow (1882) was the first to list a specific locality for Pennsylvania, and Surface (1908), Dunn (1915, 1917) and Mattern and Mattern (1917) provided additional sites. For North Carolina, Taylor et al. relied on an abstract with no specifics (Zappalorti, 1976), although the original report from the state was provided by Yarrow (1882) and repeated by Brimley (1915). Dunn (1917) added two more sites. Nemuras (1974b) was cited for Virginia, when Hutchison (1963) would have been apt. Taylor et al. also stated: "More recently (within the past 2 to 4 years), the Muhlenberg turtle has been documented from South Carolina and Georgia . . . ," but cited no one. They apparently meant Hale and Harris (1980) for Georgia and Herman and Putnam (1982) for South Carolina. Taylor et al. (1984) also misstated when *Glyptemys muhlenbergii* was described ("1792"; 1801 is correct) and provided a locality not given by its describer Schoepff ("near Lancaster, Pennsylvania"). In addition, they erred when stating that bog turtles are confined to the piedmont in Maryland, overlooking the Elk Neck, Cecil County, locality published by Barton and Price (1955), a publication they cited.

Following Barton and Price (1955), Taylor et al. rejected a report of this species from near Plummer's Island, Montgomery County by Brady (1937), stating: "he has no specimens to support this range extension, and for the purposes of this paper, we do not accept this record as legimate [*sic*]." Although, for reasons discussed below, I believe these authors were correct in not accepting this locality, their basis for dismissal was hypocritical since Taylor et al. themselves collected no specimens, nor did they demonstrate any interest in systematic resources. Indeed, in a footnote to their Table 2, they stated: "Includes turtles too small to be sexed; and specimens identified by remains (carapace) only." None of this valuable material was apparently collected and certainly none was deposited in a systematic collection. Taylor et al. also overlooked Prince et al. (1955), Reed (1956a) and a "record" for Havre de Grace (Harris, 1969, 1975; Committee . . . , 1973), resulting in no field work being undertaken anywhere near the Susquehanna River in Harford County. The most inexplicable authority cited by Taylor et al. for the distribution of the bog turtle in Maryland was Schwartz (1967). This superficial work, which was produced for the public, has highly inaccurate range maps and no citations for any statement made in the text. Committee . . . (1973), another overlooked publication by Taylor et al., or Harris (1975) would have been more current and accurate references for them to cite. Schwartz's range map for *G. muhlenbergii*, consisting of a "Known Distribution" and "Expected Localities" is especially egregious. Nearly all of Carroll County was considered to be the part of the "Known Distribution" when, as noted above, the species was not discovered there until 1970. Because they were also little interested in the historical record, Taylor et al. seem to think that Schwartz was partly (Harford County) or completely (Carroll County) responsible for documenting these counties. There is no accounting for the wildly speculative range mapped by Schwartz. The same map appeared in Schwartz (1961).

Lee and Norden (1996) were the most recent authors to deal with the bog turtle's distribution in Maryland. Their paper also considered other aspects of this species' biology; however, there

are a number of errors, omissions and instances of questionable judgment. Of special concern to those interested in this species' distribution is the credence given by Lee and Norden to several extremely dubious reports from Maryland.

At the outset, the authors stated: "the majority of known sites of occurrence in the state were not located until the 1980's." Actually, as noted above, nearly all new sites were discovered from 1976 to 1978 (Taylor et al., 1984), a paper cited by Lee and Norden, but which they give short shrift to. Although a number of references were cited, most of them recent, no detailed explanation was given for the construction of their range map (Figure 1), which differs from the maps of the authors they reference (Ernst and Barbour, 1972; Ernst and Bury, 1977; Conant and Collins, 1991; Ernst et al., 1994). Oddly, especially given the title of their paper, Lee and Norden show virtually no interest in systematic collections, citing only the original report (NHSM 450) and a nonsensical record (NHSM 1816), which is dealt with below. Authors who have published detailed state maps (Gourley, 1979; McCoy, 1982; Klemens, 1993; Palmer and Braswell, 1995) were not cited by Lee and Norden. Tobey (1985), who also provided a detailed map, was cited by Lee and Norden, but I cannot find this reference mentioned in the text. Ernst's (1985) map was also cited, but only to note the presence of the species in Franklin County, Pennsylvania, and its possible implications for the range in Maryland extending farther westward than extreme northeastern Carroll County. Lee and Norden's Figure 3, which shows the increase in knowledge of the bog turtle's distribution in Maryland, omitted the map of Taylor et al.

In the section entitled "Historical Overview of Bog Turtle Research in Maryland," there are several oddities. Lee and Norden noted that Cope (1873) was the first to assert that *G. muhlenbergii* occurred in Maryland, stating that he "reported it in the 'northeastern portion of the State' . . . " They apparently took this passage from McCauley (1945) and did not check the original source. Cope actually said: "The *Chelopus Muhlenbergii* is confined to the north-eastern portion of the State and adjacent New Jersey." As noted by Lee and Norden, Cope cited no evidence for the species occurring in Maryland. However, since Maryland does not border New Jersey, his credibility on this point is further diminished.

For no discernible reason, Lee and Norden's chronology is erroneous. They cited Campbell (1960) before Prince et al. (1955; misstated as 1957) and Reed (1956a). They also noted that Campbell reported the species from Broad Creek (a nearly useless locality since the stream is 27 km long), but neglected to mention that this was based on a personal communication from J. E. Cooper, who undoubtedly was referring to Broad Creek Boy Scout Camp based on Prince et al. The discrepancies concerning the Prince et al. and Reed notes, mentioned above, were not dealt with. Lee and Norden stated: "These early state surveys [Harris (1969, 1975); Committee … (1973)] did much to promote herpetological record-keeping in Maryland, and resulted in a great increase in the number of known records for various species." However, since the custodians of this alleged "record-keeping" were not listed, documentation is lacking except for information in the public domain. Miller (2015a,b) has stated and partially shown that Harris's (1969, 1975) distributional surveys were based on hundreds of personal communications and are therefore not subject to verification. Lee and Norden then commented: "Nemuras (1966 [b], 1967) reported additional sites for bog turtles located in northeastern Maryland. These were important finds and provided the first hints that these earlier specimens from Maryland represented more than isolated, peripheral records." Lee and Norden appear not to have read Nemuras's articles because no new sites are reported from Maryland. Nemuras (1966b) merely published observations on a well-known site in Cecil County (Conowingo) that was first reported by Cooper (1947, 1949). The remarkable aspect of Nemuras (1966b) is that there were any turtles left to observe, since Conowingo has been visited and collected repeatedly since the publication of Cooper's notes. At least seven adults were collected from Conowingo and deposited in scientific collections. This, of course, is only a fraction of the number of turtles removed from this site. The last known bog turtle from Conowingo that I am aware of is an unscathed DOR juvenile, TSU 631, collected on an unknown date in 1974. As for Nemuras (1967), this article focused on the distribution and natural history of the species throughout its range. A few new observations were reported for Conowingo. The second sentence quoted from Lee and Norden makes no sense given the number of turtles that were reported by Prince et al. (1955) and Campbell (1960). Lee and Norden also overlooked Nemuras (1965), as did Nemuras (1966b, 1967) himself, probably because much of its contents are repeated in Nemuras (1966b). In Nemuras (1965) Conowingo, although not stated, is once again the only locality considered.

Lee and Norden's concluding section of their Historical Overview was devoted to the promotion of four extremely dubious reports of *Glyptemys muhlenbergii* in Maryland. This is particularly odd given Lee's vehement rejection of a plan by the Maryland Department of Natural Resources to "reintroduce" the pine snake, *Pituophis melanoleucus*, in Maryland (Ashton et al., 2007). (This paper, including its title, was largely written by Lee; he modestly placed himself alphabetically among its 13 signatories.) Ashton et al. also included a rejection of all seven pine snake reports from the Delmarva Peninsula and two others from southern Maryland. Lee's contrary approach to bog turtle distribution in Maryland is difficult to understand, given that the pine snake's distribution is just as enigmatic as the bog turtle's (Powell et al., 2016). Possibly the stance of Lee and Norden stemmed from Lee's futile pursuit of a bog turtle in Baltimore City from 1953 to 1956. Lee (1943–2014) was 10–13 years old at the time, but stated that the identification of the turtle was "certain." Perhaps, but a single individual occupying highly atypical habitat (an artificial pond) in a densely populated area hardly constitutes strong evidence, let alone proof, of a native population. An attempt to buttress this site was furthered by Lee and Norden's statement: "At that time the Loch Raven/Joppa Road area (a few miles to the north) contained extensive areas of spring-fed sedge meadows and small meandering streams, but that habitat was not surveyed for bog turtles prior to its destruction." Lee and Norden next cited a specimen, NHSM 1816, from Hall Spring (usually termed Hall Springs), Herring Run Park, "13" May 1973. The authors noted that Harris (1975) plotted the site in Baltimore County adjacent to Baltimore City; Committee . . . (1973) did so as well. Hall Springs is located in Balti-

more City (the NHSM catalogue erroneously states Baltimore County), and the date of collection is no more specific than May 1973. Again, there is but a single specimen and again unpersuasive support for this site was offered by Lee and Norden: "No habitat suitable for bog turtles is present today, but we have no record of the condition of this site when Fullano and Sieminski collected their turtle." Actually we have excellent evidence of what Hall Springs looked like decades earlier, ca. 1935: http://collections.digitalmaryland.org/cdm/ref/collection/mdaa/id/38. Clearly this is not bog turtle habitat. Even without photographic evidence, I think it is absurd to believe that this species occurred naturally in a public park in a densely populated city in the 1970s.

Lee and Norden's (1996) account of a bog turtle from southern Maryland, the only such report from the state, is almost completely in error. Based on the syllabus prepared by Rae and Darnell (1976) preparatory to a Washington Herpetological Society (WHS) field trip to search for additional specimens, as well as my experience on that and subsequent trips, the following should be noted. Apparently relying on information provided by H. S. Harris, Jr., who misplotted the site (Harris, 1975; Committee . . . , 1973 misplotted it too), the specimen was not taken "along the north side of Maryland Route 198 east of Laurel in Prince George's County." Rather, it was collected between Laurel and Maryland City (closer to the latter), off the south side of MD Route 198 in Anne Arundel County, on the floodplain along the Patuxent River. Hence, Lee and Norden's comments on the radically changed nature of "the site" and W. L. Grogan, Jr.'s recollection of it prior to the widening of the road are irrelevant—they were in the wrong place. For unknown reasons, Lee and Norden stated that the specimen was brought to the Natural History Society of Maryland and deposited there. This did not occur. It was actually given to the National Zoological Park (Rae and Darnell, 1976). Although Rae and Darnell stated three times that the turtle was collected in 1973, the NZP files record that it was donated to the Park by Darnell on 26 July 1972 and then transferred to R. G. Tuck, Jr. (then of the Division of Amphibians and Reptiles, USNM) "for release on 19 September 1972" (M. Murphy, personal communication, 2017). Tuck (personal communication, 2017) stated that he "probably entrusted" the turtle to K. T. Nemuras for release. According to H. S. Harris, Jr. (personal communication, 2017), Nemuras has no knowledge of this specimen.

My experience on the WHS field trip, held on 25 April 1976, revealed only that the locality was good for the spotted turtle, *Clemmys guttata*, a species that Lee and Norden stated does "not regularly occur syntopically with bog turtles, and we have a clear impression that these two small *Clemmys* prefer different micro-habitats." I observed three spotted turtles and a father-and-son team had also found three. I returned to the site on 19 May 1978, and again on 9 May 1980, not for *G. muhlenbergii*, a record I placed no credence in, but in attempts to collect a *C. guttata*. None were found on either trip and on the first one numerous footprints were noticed where the species was found previously. It appears that the only result of the WHS April 1976 trip was to lead to a drastic reduction or possible extirpation of the population of spotted turtles at this locality. Lee and Norden regarded the "Prince George's County" specimen as a remnant of a nearly extinguished population brought about by environmental degradation. Since shallow swampy habitat is extensive in southern Maryland, something that Lee and Norden surely know, it is odd that this remains the sole record.

Lee and Norden concluded their problematic list with the earliest of the dubious records for this species with a specific locality, that provided by Brady (1937) for the vicinity of Plummer's Island, Montgomery County, and an observation made by Brady for the same area as recorded by Manville (1968). Lee and Norden were ambivalent about this site and thus contradicted themselves repeatedly. As noted twice by these authors, Brady (1924) had earlier reported *Glyptemys muhlenbergii* from near Stubblefield Falls, Fairfax County, Virginia and that the specimen, USNM 95195, was eventually shown to be a juvenile *G. insculpta* (Barton, 1960). [Contrary to Barton, McCauley also did not accept Brady's (1937) report.] Mitchell (1989), in an article overlooked by Lee and Norden, provided additional details and confirmed Barton's reidentification. However, contrary to Mitchell's assertion, Brady (1924) did see the specimen and said so twice. Mitchell (1989) also erred in stating that no date is associated with this specimen. Brady (1937) stated: "One specimen [USNM 95195] taken at Stubblefield [Falls, Fairfax County, Virginia], 1924. Species [*G. muhlenbergii*] reported between canal [Chesapeake and Ohio Canal] and river [Potomac River] in vicinity of Island [Plummer's Island]." Mitchell (2017) also erroneously claimed that he (Mitchell, 1989) was the first to reidentify USNM 95195, when, as just noted, it was Barton (1960). Manville (1968), in a reference overlooked by Mitchell (1989), remarked: "Also reported … in the ponds on the mainland property by Brady on 9 March 1955 (unpubl. notes)." I think that Brady's misidentification of the Stubblefield Falls specimen ended his credibility, while the statement just quoted is merely hearsay. Nonetheless, Lee and Norden commented: "While this [Brady's misidentification] certainly casts doubt on the Plummer's Island records, it doesn't prove them wrong." How is one to disprove hearsay from an unspecified source, especially from the 1930s? This is an unfalsifiable claim and the burden of proof is on Lee and Norden to demonstrate otherwise. Furthermore, the suburbs of the District of Columbia, which includes Plummer's Island, are one of the most heavily collected areas in Maryland. If bog turtles existed in this area, it is likely that there would be at least one unambiguous published report or that one or more would have been collected and deposited in a systematic collection. Then the contradictions start: "We do not wish to suggest that the bog turtle actually occurred in the D.C. area in historic time. In fact, a zoogeographic analysis conducted by Lee and Dennis Herman (1995 [not seen or cited herein; this apparently became Lee and Herman, 2004] suggests that its occurrence in that area was unlikely." Then another contradiction: "We should point out that most of the other reptiles and amphibians reported by Brady from the area are within the accepted modern distributional limits, and that he also recorded both of the other native species of *Clemmys*." I do not think that "most" is good enough when dealing with a species whose distribution is as complex as *G. muhlenbergii*'s. Other dubious reports are to be found in Brady (1937), as well as one attributed to Brady by Manville (1968). Brady's listing of "*Pseudemys floridana concinna*" is erroneous; there is no basis for either *P. concinna* or *P. floridana* in Maryland (e.g., Harris, 1969, 1975; Miller, 2015b). A report of

Ambystoma jeffersonianum (Brady, 1937) was not accepted by Netting (1946) or Uzzell (1967) for lack of documentation (T. M. Uzzell, Jr., personal communication, 1978). The distribution of piedmont and montane members of the *Rana pipiens* complex in Maryland, excluding *R. palustris*, is too complex to be dealt with here; thus Brady's report of "*Rana pipiens sphenocephala*" along the Chesapeake and Ohio Canal (Manville, 1968) is open to doubt. Another statement made by Brady, concerning *Plethodon cinereus*, is puzzling: "Only salamander breeding on the Island, in late spring." His claims concerning the abundance of *Bufo americanus* and *B. fowleri* and their calling dates are also highly questionable. All of this underscores the importance of systematic collections, something Lee and Norden show virtually no interest in. Although a preserved specimen bearing locality data does not prove natural occurrence (if indeed it can ever be proved), at least it allows us to get past the question of whether the species in question was correctly identified. In their concluding comment on the Plummer's Island situation, Lee and Norden once again attempted to promote the possible occurrence of *G. muhlenbergii* in this area because "At that time [sometime in the 1800s] this wetland may have been sedge meadow." And once again this is just speculation.

Lee and Norden concluded their Historical Review with an exhortation for "systematic surveys in eastern Cecil County, Kent and northeastern Queen Anne's County in Maryland." These authors overlooked that Taylor et al. (1984) surveyed 142 potential sites in Cecil County and found the species in several localities in the northeastern portion of this county. Although Taylor et al. understandably did not map the 689 sites they surveyed, I think it is safe to assume that extensive field work was done in the eastern portion of Cecil County, if not throughout the county. Lee and Norden also overlooked the report of this species in the vicinity of Cecilton, Cecil County, by Miller (1984), based on CM 87469, 9 June 1975. Like Taylor et al., Lee and Norden are unaware that bog turtles occur on the coastal plain of Maryland. The specimen just mentioned is from the coastal plain, as is the specimen from Elk Neck, Cecil County, mentioned above (CM 26287, 14 July 1945).

As the foregoing demonstrates, Lee and Norden find it difficult to accept that bog turtles can be introduced into non-native habitats and then come to the attention of people who recognized their significance. They stated: "Looking back, the probability that two bog turtles [Hall Springs, Herring Run Park, Baltimore City and the "Prince George's County" report] would be released (remember that this was a time when few local naturalists had even seen this species), then recaptured by someone who know what they were and bought them to the Natural History Society of Maryland, seems very small. We consider it more probable that these specimens came from colonies that were dying as a result of environmental changes generated by development. It seems likely to us that other now extirpated, disjunct populations of bog turtles in the greater Baltimore Metropolitan Area suffered the same fate." First, I have already shown that the "Prince George's County" turtle did not come to the NHSM. Second and much more important, in common with many species, even a small, secretive, habitat-specific turtle such as *G. muhlenbergii* has a history of feral individuals surfacing, and it is a history that is not confined to Maryland. The earliest of these was published for Newport (Newport County), Rhode Island by Babcock (1917, 1919, 1938). Three specimens, MCZ 10442-10444, were received by the museum on 23 September 1902. [They were received from, not collected by A. Agassiz, as stated by others (e.g., Babcock, 1917, 1919, 1938; Barton and Price, 1955). The collector is unknown.] Following the Lee-Norden criteria, the finding of three bog turtles at one site seven decades before the two mentioned by Lee and Norden from localities 34.5 km apart should surely be unassailable. Yet Barton and Price (1955) published additional data directly associated with the specimens that state: "these specimens were taken in an artificial pond on an estate." Although Lee and Norden cited Barton and Price, they overlooked this undermining fact. Lee and Herman (2004) incorrectly attributed this additional information to others whom they did not name. It should also be noted that Newport is located on Aquidneck Island, another fact that further diminishes the validity of this locality. [The species' former occurrence on Staten Island, New York (Ditmars 1907, 1933) was supported by adjacent mainland populations—Klemens, 2001. The species is believed to be extirpated there (M. W. Klemens, personal communication, 2017).] Lee and Herman (2004) remarked: "While Babcock's (1917) record from Newport, Rhode Island, has been questioned by various recent authors (i.e. [*sic*], Ernst and Bury 1977) it is not necessarily erroneous." The questioning of the Newport locality is scarcely "recent." Aside from Barton and Price, who rejected the site, it dates back to at least Conant (1958) and has been followed by many authors, the most recent being Raithel (1997), the leading authority on the Rhode Island herpetofauna. Klemens (1993), the leading authority on the southern New England herpetofauna, did not even mention the Rhode Island record; this was not an oversight (M. W. Klemens, personal communication, 2017). Other bog turtles, viewed as feral or enigmatic, were reported by Pawling (1939, Union County, Pennsylvania), Tobey (1985, Montgomery County, Virginia), Klemens and Mirick (1985) and Klemens (1993) (Berkshire County, Massachusetts) and DesMeules (1997, Vermont). Even well within the bog turtle's undisputed range in Maryland, K. T. Nemuras appended the following note to a specimen he collected: "May have been introduced at this site." This specimen, USNM 279192 from near Maryland Line, Baltimore County, 30 April 1973, is marked on the accompanying map with a question mark. Another feral individual from Maryland has come to my attention. G. H. Grall and M. P. Walch found one 1.75 km SW Long Green, Baltimore County, ca. 1970. The several feral bog turtles mentioned here almost certainly represent only a small percentage of the turtles that have been released into alien environments.

Other inaccurate statements appear in Lee and Norden (1996). Under Zoogeography, they stated that a fossil record for *G. muhlenbergii* from Cumberland Bone Cave, Allegany County (Holman, 1977), was "only slightly outside the species' known current range." Lee and Herman (2004) made the same statement. It is in fact ca. 110 km WSW of the nearest specimens, USNM 288134-288135, Greene Township, Franklin County, Pennsylvania, 12 November 1946, and roughly 160 km west of the nearest documented Maryland records in Carroll County. Lee and Norden further claimed that "Nearly all sites are confined to the river systems between the Susquehanna River on the east and the Patapsco River on the west. This corresponds to

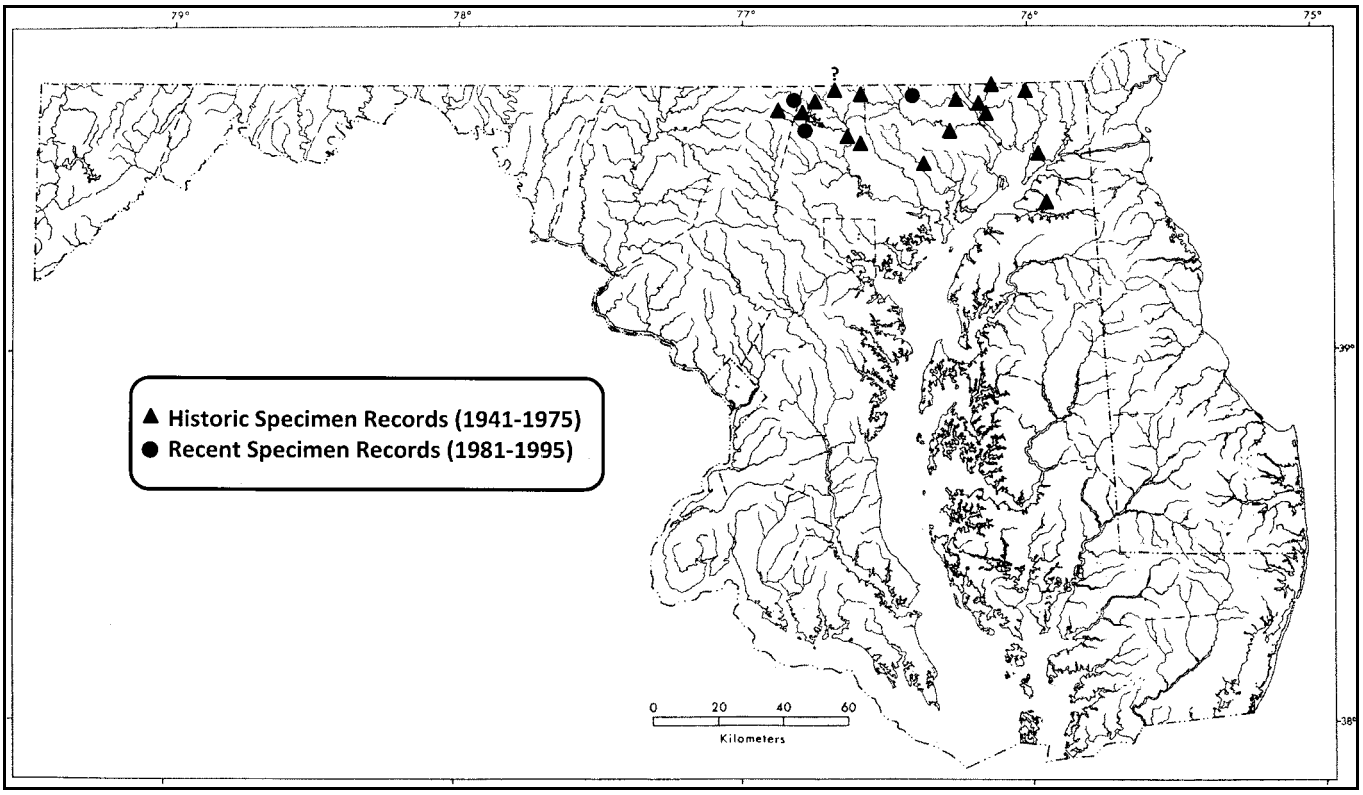


Figure 1. Map of Maryland, Delaware and the District of Columbia showing the documented distribution of the bog turtle, *Glyptemys muhlenbergii*, in Maryland. Questioned locality is discussed in text.

area 'C' as defined by Lee et al. (1981) . . . " Taylor et al. (1984) mapped numerous sites in Cecil County that are not in the Susquehanna River drainage. Several in Harford County also do not drain to the Susquehanna. The citing of the Patapsco River system as a western boundary is inexplicable; only a few bog turtle sites in Carroll County appear to lie in this drainage and all of these are at the head of this system (Taylor et al., 1984). There is not much correspondence here because all of Howard County lies in area C, little of which drains to the Patapsco River; furthermore, bog turtles are unknown from this county. In Lee and Norden's concluding paragraph they noted an area occupied by bog turtles that lies in the Potomac River drainage somewhat outside the expected distribution. They stated that the species is "known from a few sites along Big Pipe Creek," just west of Parr's Ridge, Carroll County and called them documented. Lee and Norden have again paid insufficient attention to Taylor et al. (1984) who mapped a number of sites west of Parr's Ridge. It is also not clear what constitutes documentation to Lee and Norden; there is certainly nothing to be found in the public domain.

A final criticism of Lee and Norden (1996) concerns their statement: "Spotted turtles [*Clemmys guttata*] do not regularly occur syntopically with bog turtles, and we have a clear impression that these two small *Clemmys* prefer different micro-habitats." Lee and Norden again did not consult Taylor et al. (1984). In their Table 4 they listed *C. guttata* as "Common" in the *G. muhlenbergii* sites that they surveyed. Unfortunately they did not quantify this. Other Maryland workers have stated that spotted turtles are "abundant" (Cooper, 1949) and "reasonably common" (Prince et al., 1955) in areas occupied by bog turtles. Campbell (1960) called *C. guttata* a "dominant" species at a site where bog turtles were common. A cursory search of the literature outside Maryland revealed that a close relationship can exist between these two species. In New York, Wright (1918a) stated: "A common associate of this rare form [*G. muhlenbergii*] is the spotted turtle . . . " and Ashley (1948) wrote: "Spotted turtles, *Clemmys guttata* (Schneider), were encountered on every field trip to this area [a locality inhabited by bog turtles]." In Pennsylvania, Robotham (1963) called *C. guttata* "ubiquitous" at one bog turtle site and (Hulse et al., 2001) wrote that the spotted turtle "often occupies a similar habitat" with *G. muhlenbergii*.

Figure 1 shows the documented distribution of *Glyptemys muhlenbergii* in Maryland.

Acknowledgments

I thank the following for providing information or assistance: Margaret G. Arnold (AMNH), Jeffrey C. Beane (NCSM), John F. Cover, Jr. (National Aquarium), Kevin de Queiroz (USNM), David A. Dickey (AMNH), J. Tomasz Giermakowski (MSB), Steve W. Gotte (USNM), George H. Grall (National Aquarium retired), Herbert S. Harris, Jr. (NHSM), Timothy E. Hoen (NHSM), Michael W. Klemens, Bruce C. Miller, Lyndsey E. Miller, James B. Murphy (National Zoological Park retired), Mandy Murphy (National Zoological Park), James A. Poindexter II (USNM), Stephen P. Rogers (CM), Jose P. Rosado (MCZ), Coleman M. Sheehy III (UF), Gary M. Shugart (PSM), Robert G. Tuck, Jr., Thomas M. Uzzell, Jr. (Academy of Natural Sciences of Drexel University), Marc P. Walch (Black & Veatch), Addison H. Wynn (USNM) and George R. Zug (USNM retired).

Literature Cited

Arndt, R. G. 1972. Additional records of *Clemmys muhlenbergi* in Delaware, with notes on reproduction. Bulletin of the Maryland Herpetological Society 8(1):1-5.

————. 1977. Notes on the natural history of the bog turtle, *Clemmys muhlenbergii* (Schoepff), in Delaware. Chesapeake Science 18(1):67-76.

Ashley, H. R. 1948. Muhlenberg's turtle in southern New York. Copeia 1948(3):220.

Ashton, R., R. Chance, R. Franz, J. D. Groves, J. D. Hardy, Jr., H. S. Harris, Jr., W. "Hays" [Hayes], W. Hildebrand, D. S. Lee, W. S. Sipple, R. Stanley, C. J. Stine and R. G. Tuck, Jr. 2007. Delusions of science: Concerns regarding the unwarranted introduction of pine snakes to the Delmarva Peninsula of Maryland. Bulletin of the Maryland Herpetological Society 43(4):147-158.

Babcock, H. L. 1917. An extension of the range of *Clemmys muhlenbergii*. Copeia 1917(42):32.

————. 1919. The turtles of New England. Memoirs of the Boston Society of Natural History 8(3):325-431.

————. 1938. Field guide to New England turtles. New England Museum of Natural History, Natural History Guides (2):1-56.

Barton, A. J. 1960. Deletion of Virginia from the known range of *Clemmys muhlenbergi*. Herpetologica 16(2):120.

Barton, A. J., and J. W. Price, Sr. 1955. Our knowledge of the bogturtle [*sic*], *Clemmys muhlenbergi*, surveyed and augmented. Copeia 1955(3):159-165.

Behler, J. L., Jr. 1971. Bog turtle, *Clemmys muhlenbergi*. Animal Kingdom 74(1):33.

Blanchard, O. J. 1970. New Massachusetts reptile: Bog turtle. Massachusetts Audubon 55(1):34-37. [Klemens and Mirick (1985) and Klemens (1993) stated that this article was erroneously published under the surname Richard.]

Brady, M. K. 1924. Muhlenberg's turtle near Washington. Copeia 1924(135):92.

————. 1937. Natural history of Plummers Island, Maryland. VI. Reptiles and amphibians. Proceedings of the Biological Society of Washington 50(36):137-139.

Brimley, C. S. 1915. List of reptiles and amphibians of North Carolina. Journal of the Elisha Mitchell Scientific Society 30(4):195-206.

Byer, N. W., S. A. Smith and R. A. Seigel. 2017. Effects of site, year, and estimator choice on home ranges of bog turtles (*Glyptemys muhlenbergii*) in Maryland. Journal of Herpetology 51(1):68-72.

Byer, N. W., S. A. Smith and R. A. Seigel. 2018. Microgeographic variation in bog turtle nesting ecology. Journal of Herpetology 52(2):228-233.

Campbell, H. W. 1960. The bog turtle in Maryland. Maryland Naturalist 30(1-4):15-16.

Carr, A. 1952. Handbook of turtles: The turtles of the United States, Canada, and Baja California. Ithaca, New York: Cornell University Press.

Chase, J. D., K. R. Dixon, J. E. Gates, D. Jacobs and G. J. Taylor. 1989. Habitat characteristics, population size, and home range of the bog turtle, *Clemmys muhlenbergii*, in Maryland. Journal of Herpetology 23(4):356-362.

Committee on Rare and Endangered Amphibians and Reptiles of Maryland. 1973. Endangered amphibians and reptiles of Maryland. Bulletin of the Maryland Herpetological Society 9(3):42-100.

Conant, R. 1945. An annotated check list of the amphibians and reptiles of the Del-Mar-Va Peninsula. Wilmington, Delaware: Society of Natural History of Delaware.

————. 1958. A field guide to reptiles and amphibians of the United States and Canada east of the 100th meridian. Boston: Houghton Mifflin Co.

————. 1975. A field guide to reptiles and amphibians of eastern and central North America. Second edition. Boston: Houghton Mifflin Co.

Conant, R., and J. T. Collins. 1991. A field guide to reptiles and amphibians [of] eastern and central North America. Third edition. Boston: Houghton Mifflin Co.

Cooper, J. E. 1947. Some observations on winter herpetology with reference to early spring collecting. Junior Society News 3(14):4.

————. 1949. Additional records for *Clemmys muhlenbergii* from Maryland. Herpetologica 5(3):75-76.

Cope, E. D. 1873. Zoology. Pp. 16-18. *In*: S. J. Martenet, H. F. Walling and O. W. Gray. New topographical atlas of the state of Maryland and the District of Columbia. With descriptions historical, scientific, and statistical, together with maps of the United States and territories. Baltimore, Maryland: Stedman, Brown and Lyon.

Dawson, S. A. 1984. The status of the bog turtle (*Clemmys muhlenbergi*) in Maryland. Pp. 360-362. *In*: A. W. Norden, D. C. Forester and G. H. Fenwick, editors, Threatened and endangered plants and animals of Maryland. Annapolis, Maryland: Maryland Department of Natural Resources.

De Kay, J. E. 1842. Zoology of New-York, or the New-York fauna … Part III. Reptiles and Amphibia. Albany, New York: W. and A. White and J. Visscher.

DesMeules, M. P. 1997. Historic and current status of turtles in Vermont. Pp. 1-2. *In*: T. F. Tyning, editor, Status and conservation of turtles of the northeastern United States: A symposium. Lanesboro, Minnesota: Serpent's Tale.

Dinkelacker, S. A., T. P. Wilson and J. H. Howard. 2004. Natural history and population characteristics of *Clemmys muhlenbergii* at the SHI wetland in Maryland. Abstract. P. 105. *In*: C. W. Swarth, W. M. Roosenburg and E. Kiviat, editors, Conservation and ecology of turtles of the mid-Atlantic region: A symposium. Salt Lake City, Utah: Bibliomania.

Ditmars, R. L. 1907. The reptile book. New York: Doubleday, Page & Co.

————. 1933. Reptiles of the world: The crocodilians, lizards, snakes, turtles and tortoises of the eastern and western hemispheres. Revised edition. New York: Macmillan Co.

Dunn, E. R. 1915. Some amphibians and reptiles of Delaware County, Pennsylvania. Copeia 1915(16):2-4 (unnumbered).

————. 1917. Reptile and amphibian collections from the North Carolina mountains, with especial reference to salamanders. Bulletin of the American Museum of Natural History 37(23):593-634.

Eights, J. 1853. Scraps from a naturalist's note book. The Country Gentleman 2(9):140-141.

Ennis, J. 1861. Untitled. Proceedings of the Academy of Natural Sciences of Philadelphia 13:124-125.

Ernst, C. H. 1985. Bog turtle. Pp. 270-273. *In*: H. H. Genoways and F. J. Brenner, editors, Species of special concern in Pennsylvania. Special Publication of Carnegie Museum of Natural History (11):1-430.

Ernst, C. H., and R. W. Barbour. 1972. Turtles of the United States. Lexington, Kentucky: University Press of Kentucky.

Ernst, C. H., and R. B. Bury. 1977. *Clemmys muhlenbergii*. Catalogue of American Amphibians and Reptiles (204):1-2.

Ernst, C. H., and J. E. Lovich. 2009. Turtles of the United States and Canada. Second edition. Baltimore, Maryland: Johns Hopkins University Press.

Ernst, C. H., R. W. Barbour and J. E. Lovich. 1994. Turtles of the United States and Canada. Washington, D.C.: Smithsonian Institution Press.

Fisher, A. K. 1887. Muhlenberg's tortoise (*Chelopus muhlenbergii* Schweigger), at Lake George, N. Y. American Naturalist 21(7):672-673.

Fowler, H. W. 1907. The amphibians and reptiles of New Jersey. Pp. 23-250. *In*: Annual report of the New Jersey State Museum 1906. Trenton, New Jersey: MacCrellish & Quigley.

Gourley, E. V. 1979. Bog turtle: *Clemmys muhlenbergii*. Pp. 405-406. *In*: D. W. Linzey, editor, Proceedings of the symposium on endangered and threatened plants and animals of Virginia. Blacksburg, Virginia: Virginia Polytechnic Institute and State University.

Hale, P. E., and M. J. Harris. 1980. Geographic distribution: *Clemmys muhlenbergi* (bog turtle). Herpetological Review 11(1):14.

Harris, H. S., Jr. 1969. Distributional survey: Maryland and the District of Columbia. Bulletin of the Maryland Herpetological Society 5(4):97-161.

————. 1975. Distributional survey (Amphibia/Reptilia): Maryland and the District of Columbia. Bulletin of the Maryland Herpetological Society 11(3):73-167.

Herman, D. W., and C. E. Putnam, Jr. 1982. Geographic distribution: *Clemmys muhlenbergii* (bog turtle). Herpetological Review 13(2):52.

Holbrook, J. E. 1842. North American herpetology; or, a description of the reptiles inhabiting the United States. Volume I. Philadelphia: J. Dobson.

Holman, J. A. 1977. The Pleistocene (Kansan) herpetofauna of Cumberland Cave, Maryland. Annals of the Carnegie Museum 46(11): 157-172.

Howard, J. H., T. L. King and S. A. Smith. 2004. Microsatellite marker development and applications for bog turtle (*Clemmys muhlenbergii*) conservation. Abstract. P. 106. *In*: C. W. Swarth, W. M. Roosenburg, and E. Kiviat, editors, Conservation and ecology of turtles of the mid-Atlantic region: A symposium. Salt Lake City, Utah: Bibliomania.

Howard, J. H., S. A. Smith, T. P. Wilson and W. L. Branch. 2004. A metapopulation approach to conservation of bog turtles (*Clemmys muhlenbergii*) in Maryland. Abstract. P. 106. *In*: C. W. Swarth, W. M. Roosenburg and E. Kiviat, editors, Conservation and ecology of turtles of the mid-Atlantic region: A symposium. Salt Lake City, Utah: Bibliomania.

Hulse, A. C., C. J. McCoy and E. Censky. 2001. Amphibians and reptiles of Pennsylvania and the Northeast. Ithaca, New York: Cornell University Press.

Hutchison, V. H. 1963. Record of the bog turtle, *Clemmys muhlenbergi*, in southwestern Virginia. Copeia 1963(1):156-157.

Iverson, J. B. 1992. A revised checklist with distribution maps of the turtles of the world. Richmond, Indiana: Privately published.

Klemens, M. W. 1993. Amphibians and reptiles of Connecticut and adjacent regions. State Geological and Natural History Survey of Connecticut Bulletin (112):1-318.

————. 2001. Bog turtle (*Clemmys muhlenbergii*), northern population recovery plan. Hadley, Massachusetts: U.S. Fish and Wildlife Service. <https://www.fws.gov/northeast/nyfo/es/bogturtle.pdf> Accessed 30 September 2018.

Klemens, M. W., and P. G. Mirick. 1985. Geographic distribution: *Clemmys muhlenbergii* (bog turtle). Herpetological Review 16(1):32.

Le Conte, J. 1836. Description of the species of North American tortoises. Read December 7, 1829. Annals of the Lyceum of Natural History of New-York 3:91-131.

Lee, D. S., and D. W. Herman. 2004. Proposed zoogeographic history of the bog turtle, *Clemmys muhlenbergii*. Pp. 31-42. *In*: C. W. Swarth, W. M. Roosenburg and E. Kiviat, editors, Conservation and ecology of turtles of the mid-Atlantic region: A symposium. Salt Lake City, Utah: Bibliomania.

Lee, D. S., and A. W. Norden. 1996. The distribution, ecology and conservation needs of bog turtles, with special emphasis on Maryland. Maryland Naturalist 40(1-4):7-46.

Lee, D. S., S. P. Platania, C. R. Gilbert, R. Franz and A. Norden. 1981. A revised list of the freshwater fishes of Maryland and Delaware. Southeastern Fishes Council Proceedings 3(3):1-10.

Manville, R. H. 1968. Natural history of Plummers Island, Maryland. XX. Annotated list of the vertebrates. Washington, D.C.: Special Publication of the Washington Biologists' Field Club.

Mattern, E. S., and W. I. Mattern. 1917. Amphibians and reptiles of Lehigh County, Pennsylvania. Copeia 1917(46):64-66.

McCauley, R. H., Jr. 1945. The reptiles of Maryland and the District of Columbia. Hagerstown, Maryland: Privately published.

McCauley, R. H., Jr., and R. Mansueti. 1943. *Clemmys muhlenbergii* in Maryland. Copeia 1943(3):197.

McCauley, R. H., Jr., and R. Mansueti. 1944. Notes on a Muhlenberg turtle. Maryland: A Journal of Natural History 14(3):68-69.

McCoy, C. J. 1982. Amphibians and reptiles in Pennsylvania: Checklist, bibliography, and atlas of distribution. Special Publication of Carnegie Museum of Natural History (6):1-91.

Miller, R. W. 1984. Distributional records for Maryland herpetofauna, III. Bulletin of the Maryland Herpetological Society 20(2):38-45.

————. 2015a. Comments on the herpetological publications of Romeo J. Mansueti, with special reference to Baltimore, Maryland. Part 1. Introduction and amphibians. Bulletin of the Chicago Herpetological Society 50(9):142-153.

————. 2015b. Comments on the herpetological publications of Romeo J. Mansueti, with special reference to Baltimore, Maryland. Part 2. Reptiles. Bulletin of the Chicago Herpetological Society 50(11):189-208.

Mitchell, J. C. 1989. An historical review of the Fairfax County, Virginia, bog turtle record. Catesbeiana 9(1):3-7.

————. 2017. The New Kent County, Virginia timber rattlesnake (*Crotalus horridus*) locality is invalid. Catesbeiana 37(1):40-41.

Morrow, J. L., J. H. Howard, S. A. Smith and D. K. Poppel. 2001a. Home range and movements of the bog turtle (*Clemmys muhlenbergii*) in Maryland. Journal of Herpetology 35(1):68-73.

Morrow, J. L., J. H. Howard, S. A. Smith and D. K. Poppel. 2001b. Habitat selection and habitat use by the bog turtle (*Clemmys muhlenbergii*) in Maryland. Journal of Herpetology 35(4):545-552.

Nemuras, K. T. 1965. The bog turtle in Maryland. Bulletin of the Philadelphia Herpetological Society 13(1-4):14–17.

————. 1966a. Bog trotting in Maryland: A young naturalist in search of rare turtles. Maryland Conservationist 43(3):7-10.

————. 1966b. Some records for *Clemmys muhlenbergi* in Cecil County, Maryland. Bulletin of the Maryland Herpetological Society 2(2):1-2.

————. 1967. Notes on the natural history of *Clemmys muhlenbergi*. Bulletin of the Maryland Herpetological Society 3(4):80-96.

————. 1969. Survival of the Muhlenberg. International Turtle and Tortoise Society Journal 3(5):18-21.

————. 1974a. The bog turtle. Wildlife in North Carolina 38(2):13-15.

————. 1974b. The bog turtle: Profile of an endangered species. Virginia Wildlife 35(6):7-9.

————. 1976. Vanishing bog turtle. Defenders 51(1):38-39.

Nemuras, K. T., and J. A. Weaver. 1974a. The bog turtle: Synonym for extinction? National Parks and Conservation Magazine 48(6):17-20.

Nemuras, K. T., and J. A. Weaver. 1974b. The bog turtle: A little reptile with big problems! Pennsylvania Angler 43(7):15-18.

Netting, M. G. 1946. Jefferson's salamander in Maryland. Maryland: A Journal of Natural History 16(3):60-61.

Newton, W. C. 1916. The vertebrate fauna of Delaware, with notes on certain species. Newark, Delaware: B.Sci. Thesis, University of Delaware. [Not seen; fide Arndt (1977).]

Palmer, W. M., and A. L. Braswell. 1995. Reptiles of North Carolina. Chapel Hill, North Carolina: University of North Carolina Press.

Pawling, R. O. 1939. The amphibians and reptiles of Union County, Pennsylvania. Herpetologica 1(6):165-169.

Powell, R., R. Conant and J. T. Collins. 2016. Peterson field guide to reptiles and amphibians of eastern and central North America. Fourth edition. Boston and New York: Houghton Mifflin Harcourt.

Prince, E. C., R. Duppstadt and D. J. Lyons. 1955. An annotated list of amphibians and reptiles from the Broad Creek-Deep Run area, Harford County, Maryland. Maryland Naturalist 25(1-4):9-12.

Rae, S., and K. Darnell. 1976. Washington Herpetological Society field trip, April 25, 1976. Syllabus.

Raithel, C. J. 1997. The status of turtles in Rhode Island. P. 3. *In*: T. F. Tyning, editor, Status and conservation of turtles of the northeastern United States: A symposium. Lanesboro, Minnesota: Serpent's Tale.

Reed, C. F. 1956a. The herpetofauna of Harford County, Maryland. Journal of the Washington Academy of Sciences 46(2):58-60.

————. 1956b. The spadefoot toad in Maryland. Herpetologica 12(4):294-295.

Reed, H. D., and A. H. Wright. 1909. The vertebrates of the Cayuga Lake basin, N. Y. Proceedings of the American Philosophical Society 48(193):370-459.

Robinson, D. C. 1956. *Clemmys muhlenbergi* in western Connecticut. Copeia 1956(4):257.

Robotham, G. R. 1963. The bog turtle, a gift of responsibility. Bulletin of the Philadelphia Herpetological Society 11(3-4):68-70. [Not seen; fide Nemuras (1967).]

Schwartz, F. J. 1961. Maryland turtles. Solomons, Maryland: Maryland Department of Research and Education.

————. 1967. Maryland turtles. Solomons, Maryland: Natural Resources Institute, University of Maryland.

Smith, S. A. 2004. Status and conservation of the bog turtle (*Clemmys muhlenbergii*) in Maryland. Abstract. P. 111. *In*: C. W. Swarth, W. M. Roosenburg and E. Kiviat, editors, Conservation and ecology of turtles of the mid-Atlantic region: A symposium. Salt Lake City, Utah: Bibliomania.

Stine, C. J., R. S. Simmons and J. A. Fowler. 1956. New records for the eastern spadefoot toad in Maryland. Herpetologica 12(4):295-296.

Stone, W. 1906. Notes on reptiles and batrachians of Pennsylvania, New Jersey and Delaware. American Naturalist 40(471):159-170.

Street, J. F. 1914. Amphibians and reptiles observed at Beverly, N. J. Copeia 1914(4):2 (unnumbered).

Surface, H. A. 1908. First report on the economic features of the turtles of Pennsylvania. Zoological Bulletin of the Division of Zoology of the Pennsylvania Department of Agriculture 6(4-5):107-195.

Taylor, G. J., S. A. Dawson, S. A. Beall and J. E. Schaeffer. 1984. Distribution and habitat description of the Muhlenberg (bog) turtle (*Clemmys muhlenbergii*) in Maryland. Pp. 46-58. *In*: M. Sayre, editor, Transactions of the 1984 Northeast Fish and Wildlife Conference: Coastal Zone: Man and Wildlife.

Tobey, F. J. 1985. Virginia's amphibians and reptiles: A distributional survey. Purcellville, Virginia: Virginia Herpetological Society.

Uzzell, T. 1967. *Ambystoma jeffersonianum*. Catalogue of American Amphibians and Reptiles (47):1-2.

Warner, J. L. 1975. The bog or Muhlenberg turtle, *Clemmys muhlenbergi*, in Connecticut with notes on habits and color variations throughout the northern range. Connecticut Herpetological Society Bulletin 6:2-5.

Wilson, T. P., S. A. Dinkelacker and J. H. Howard. 2004. Nesting and nest site selection in a Maryland *Clemmys muhlenbergii* metapopulation. Abstract. P. 112. *In*: C. W. Swarth, W. M. Roosenburg and E. Kiviat, editors, Conservation and ecology of turtles of the mid-Atlantic region: A symposium. Salt Lake City, Utah: Bibliomania.

Wright, A. H. 1918a. Notes on the Muhlenberg's turtle. Copeia 1918(52):5-7.

————. 1918b. Notes on *Clemmys*. Proceedings of the Biological Society of Washington 31(16):51-57.

Yarrow, H. C. 1882. Check list of North American Reptilia and Batrachia, with catalogue of specimens in U. S. National Museum. Bulletin of the United States National Museum (24):1-249.

Zappalorti, R. T. 1976. The status of the bog turtle, *Clemmys muhlenbergi*, in North Carolina. Abstract. Bulletin of the Maryland Herpetological Society 12(2):69.

Specimens Examined

MARYLAND: Baltimore City: NHSM 1816 (not plotted). **Baltimore County:** NHSM 450, 2065, 2727-2729, 2730, 2731, 2732; TSU 6655; UF 1229, 1230; USNM 279191, 279192, 279194. **Carroll County:** NCSM 52484; NHSM/HSH 99. **Cecil County:** CM 26287, 87469; MSB 30210; NHSM 858, 1580, 1581; NHSM/HSH 63-64, 67; PSM 8033; TSU 631; USNM 279186, 279187, 279189. **Harford County:** NCSM 15927, 21229, 23496; USNM 279188, 279193. **MASSACHUSETTS: Newport County:** MCZ 10442-10444. **PENNSYLVANIA: Franklin County:** USNM 288134-288135.

Eastern Box Turtle, *Terrapene carolina carolina*, Research

Jessica M. West
jessiwest1@outlook.com

In 2014, I received a $1,000.00 grant from the Chicago Herpetological Society in support of my Master's research project at Middle Tennessee State University. We used the funds to study various aspects of health in a population of Eastern Box Turtles, *Terrapene carolina carolina*, in Murfreesboro, Tennessee, USA, including demographic estimates, disease status, physiology, immunology, and body condition. The demographic measures (i.e., age class, sex ratio, body size, population size/density) were all within the range of what is normally reported for the species (West and Klukowski, 2016). We also found that there were seasonal and yearly differences in baseline corticosterone levels, that corticosterone levels increased with one hour of confinement, and that stress levels were correlated with our measure of innate immunity (hemolysis assays; West and Klukowski, 2018). In addition, we documented hibernation site fidelity at our field site (Vannatta and Klukowski, 2015), and unfortunately, we detected the presence of ranavirus in one individual in the population (Vannatta et al., 2016). The results from these studies can be used to better understand box turtle ecology and physiology and can be used for conservation and management practices for the subspecies. Four publications have resulted from this research with a fifth on home range and temporal aspects of hibernation and a sixth on tracking methods currently in review.

Literature Cited

Vannatta, J. M., and M. Klukowski. 2015. *Terrapene carolina carolina* (Eastern Box Turtle). Hibernation site fidelity. Herpetological Review 46(4):622.

Vannatta, J. M., M. Klukowski and S. Wright. 2016. Prevalence of ranavirus infection in the Eastern Box Turtle, *Terrapene carolina carolina*, in an isolated, suburban wetland habitat of middle Tennessee. Herpetological Review 47(1):55-56.

West, J. M., and M. Klukowski. 2016. Demographic characteristics of the Eastern Box Turtle, *Terrapene carolina carolina*, in a relictual, suburban wetland habitat of middle Tennessee. Herpetological Conservation and Biology 11:459-466.

West, J. M., and M. Klukowski. 2018. Seasonal changes in plasma corticosterone and association with innate immunity in free-ranging Eastern Box Turtles, *Terrapene carolina carolina*. General and Comparative Endocrinology 262:71-80.

Minutes of the CHS Board Meeting, January 18, 2019

Rich Crowley called the meeting to order at 7:35 P.M. Board members Dan Bavirsha, Cindy Steinle and Jessica Wadleigh were absent. Minutes of the December 14 board meeting were read and accepted with changes.

Officers' Reports

Treasurer: John Archer presented the financial reports for December. He urged that people handling cash turn in the money monthly. We need to check inventories of T-shirts, magnets etc.

Vice-president: Jessica Wadleigh reported by email that she is still working to confirm speakers for February and March.

Membership secretary: Mike Dloogatch read the list of expiring memberships.

Media secretary: Kim Klisiak has the new ReptileFest and Junior Herpers site up and running. Kim asked for help reading through the site to check grammar. She will contact Barb to take down the two old sites. Kim still needs to work on improving 'Fest Registration for the mobile app. She has started a Facebook Event page.

Sergeant-at-arms: Mike Scott reported 28 at the December 26 general meeting / holiday party. Attendees appreciated the games organized by Jenny Hanson.

Committee Reports

Shows: Gail Oomens mentioned a need for help the weekend of March 16-17, when we have three events scheduled, NARBC, the Chicagoland Family Pet Expo and the Chicagoland Kids Expo.

ReptileFest: General volunteers will be able to sign up online this year.

Junior Herpers: There were 25 people at the January meeting. The junior herpers did a great job acting as docents at the museum. At the February meeting Frank Sladek will talk on "Reptiles in Love." March will feature a behind-the-scenes tour at Lincoln Park Zoo.

Grants: We received 42 grant applications this year. John Archer moved to allocate funds not to exceed $12,000 for grants in 2019. Mike Scott seconded the motion, which was unanimously approved.

New Business

Tom Mikosz suggested Pheasant Run as a possible back-up venue for 'Fest. He gave contact info to Rich Crowley.

The meeting adjourned at 9:40 P.M.

Respectfully submitted by recording secretary Gail Oomens

Bulletin of the Chicago Herpetological Society 54(2):40-45, 2019

The Triumph and Tragedy of *Crotalus atrox* Number 40 (Ca40)

Roger A. Repp
National Optical Astronomy Observatory
repp@noao.edu

"He was not a sportsman, but a biologist. He could kill a thousand animals for science, but not an insect for pleasure."
—John Steinbeck, *The Snake* (1936)

The first time that this author strapped on a receiver and held an antenna was in June of 1993. It was one of the few times that he has been offered a paycheck to do field work. The person he was working for handed him the list of signals for the tortoises that he was supposed to track. Any further teaching could best be described as minimal. (The words "piss poor" come to mind.) The author was completely thrown to the dogs that day. Into the blazing heat of June o'clock went the two of us. My teacher had his list, and I had the remainder. We separated, and off I went, clueless, to witlessly wander about to the sound of blips and static-laden confusion. In the end, my teacher wound up having to track every one of the tortoises himself. He deserved the double-duty. But I refused the paycheck as my conscience would not allow me to accept the money, my efforts having been worthless that day. In retrospect, I should have taken the money. That "teacher" completely dropped the ball. *Nobody* can just step into radio-telemetry without *something* to go on.

The lessons of what was *not* learned here were burned in my brain forever. Perhaps the total despair I felt on this day helped me to become a better teacher. In 2001, Gordon Schuett taught me how to radio-track. He was a good teacher, but still, like my tortoise nerd friend, relied more on me gaining experience by doing it rather than accurately leading me from the start. To his credit, he refused to take the antenna from me, no matter how hard I begged. I eventually learned, but it was done the hard way.

The very first time I taught others how to radio-track, I had a carefully prepared speech. It paid off right away, as each person I taught was nailing things down by the end of the first tracking session. It has been my pleasure and privilege to teach over 300 students from six different universities in the art of radio-tracking. Most of these students came my way through the various herpetology courses that they were enrolled in at the time. And those who didn't want to become herpetologists when they graduated were gunning for a wildlife or zoology degree of one sort or another. Most were seeking their bachelor's degree, but there were always some master's or Ph.D. students in the mix. And their professor was always with them. That was one of my requirements. A few of these tried to bow out and have me babysit their students for a day. These professors were told "If you ain't there, we ain't doing this." The absentee rate for the professors was nonexistent as a result of my bluntness. And as most of the professors who came out with their students had experience, they often led a crew of their own students throughout the course of a day. (We had three receivers and antennas that allowed us to break into smaller groups). The tracking sessions that the students were involved in were *far* more than just following a signal to its source. Once the animal being tracked was found, the student who did the tracking also filled out the datasheet for that animal. The information that they collected was used as if it came from our own fingertips. Their data were good because their teachers were thorough. And the students *loved* the idea that they were taking part in a *real* study, not just a training exercise. Their words are forever enshrined on our datasheets.

RAGE! It is a constant state of being for this author. It is also an all-inclusive acronym for the steps required in order for a successful tracking session to transpire. The purpose for the **"R"** is twofold. It stands for "**Route."** In simple terms, route stands for direction. What direction is the signal coming from? Route also stands for the sage use of footwork. If a prickly pear cactus or palo verde tree is in the direct line of the signal, the tracker goes around it. *Not* through it—around it! (You have to tell these people *everything*.) And even then, on multiple occasions, I have seen students plunge crotch-deep through prickly pear because the signal they were following led them straight through it. By far the most hilarious episode of staying on course with that kite string of a signal occurred with a Ph.D. Harvard graduate. Before I could holler "stop," she went straight through a 20-foot-tall palo verde tree! The trunk of this tree forked roughly one meter from the ground. The gap in said fork was just large enough for her skinny frame to get through, but smaller branches intertwined inside the fork, allowing for that gap to be nearly impenetrable. She nevertheless eventually managed to get through it all alive, but left little strips of her flesh dangling like fresh bacon off some of the sharper branch ends. And it took her at least five minutes to disassociate the cable and antenna from the myriad of sharp, spike-like twigs that emanated in all directions from each branch of the pernicious tree.

The **"A"** in **RAGE** stands for "**Advance**." The signal does not suck the animal to your feet—you must move your feet to get to the animal. This is by far the most daunting step in the learning process. I have seen students stand in one place for over 15 minutes whilst waving the antenna up and down and all around. When I would see somebody doing this sort of thing, I would at first gently remind them once again that the signal does *not* suck the animal to their feet. If the inactivity continued, I would begin to gently say "advance." If advance didn't happen soon after that, I would shout "**ADVANCE, dammit**!" When that didn't work, I would point, and give them a shove in the right direction while hollering "It's *that* way! Do we need to paint a line around you to see if you're moving?"

The **"G"** in **RAGE** is for "**Gain**," which is another word for volume. Oftentimes if the volume is set too loud, the signal seems to be coming from all directions to the tracker. As often suggested to the novice tracker, the signal is like an imaginary kite string. If the student would not adjust the volume of the

signal properly, I would holler, "Look out! It has you surrounded!" Once sure of the direction of the kite string, advancing along it in a brisk fashion is required. As one gets closer to the source, the signal gets louder. Hence, the control of the gain is a constant adjustment downward in volume. If one does not dial down the volume as one advances, the tracker is soon once again "surrounded" by the animal being tracked.

The **"E"** in **RAGE** means "**Encircle**." Eventually, the tracker finds the patch of ground that the animal is on, over or under. That animal is often in a thick patch of prickly pear or some other form of plant-infested island of sorts. Our study plot consists of plant pockets rising out of bare ground. Calling these plant pockets "islands" is an appropriate term. So now, the tracker feels that he or she has found the clump of vegetation that the animal is either on, in or under. The plant island is then encircled. The antenna is aimed toward the plant pocket, and then rotated 180 degrees away from it. Take a few more steps around the island and do the same thing. I call this act doing the "Hokey Pokey" with the antenna. When training a tracker, I'd sing it to them. "You put your antenna in, put your antenna out, put your antenna in and you move it all about. You do the Hokey Pokey and keep going round and round—that's what it's all about!" If the signal remains constantly inward after you've completely encircled the island, you're hot on it! The next step is to dial that gain down to a whisper, and find the loudest square foot of ground. Now you'll either see your quarry or you won't. If you don't see it, you seek any likely looking hole and try to look into it from every angle possible. We often nearly *killed* ourselves trying to get a visual. We wanted to know if that animal was alive or dead, and if alive, we wanted to know *exactly* what that animal was doing. The most important thing to remember is to be constantly on the **Advance** while constantly adjusting the **Gain**.

Route! Advance! Gain! Encircle! **RAGE.**

The day that Ca40 died was on one of those training days for the students. But we get ahead of ourselves by saying so.

The Triumph

While all of our transmittered subjects received proper names, those that received only microchips in the processing stage did not. In order to minimize further mention of the awkward designation "Ca40," I have just now (2 February 2019) decided to name this snake "Bob." This is done to honor my older brother Bob, who is also no longer with us. From this moment forth, any mention of Bob is about Bob the snake. Gordon Schuett and I first found Bob on 27 March 2003. Size, rattle length, rattle shape, and years of experience indicated that Bob was an aging, late prime of life male Western Diamond-backed Rattlesnake (*Crotalus atrox*). As is customary with these columns, we will call these magnificent beasts *atrox* from this point onward. Contrary to what many experts will say about rattles *not* being an indicator of age, when combined with other factors, they are an *excellent* factor in determining age. Bob was probably in the range of ten years old. Take that assertion, or leave it. His snout–vent length was 98.5 cm, his tail length was 9 cm, and his mass was a fairly light 612 grams. He was a skinny guy. In short, he was in need of a few plot biscuits. His

Figure 1. Ca121, Tracy. This image was taken 29 July 2010, roughly two months previous to the combat between Bob and an unknown male *atrox*. We suspect that she was the cause of the "boys will be boys" episode shown in Figure 2. As she was not visible on the day of the fight, we show this image simply because we can. Unless otherwise stated, images are by the author.

rattle was a basal plus 9 segments, crowned by a broken tenth segment. The rattle was without taper, and the segments were wide. He was found across the wash from our favorite hill, on the south ridge of the Suizo Mountains proper. He was near an aggregate den of *atrox* that we had named "Jeff's Den," after the person who had found it, Jeff Moorbeck. At the time, we had zero interest in radio-tracking anything on that side of the wash. Hence, Bob received only a microchip, was processed, and released two days later. Bob's datasheet laments the fact that we never got a photo of him. Upon being dumped out of the bag, he hit the ground and immediately jetted into a deep soil hole. Another opportunity lost due to a slow photographer—or a fast snake.

We fast forward to 19 September 2010. Once again, I was in the company of Gordon Schuett, along with our constant and consistent plot buddy Ryan Sawby. We had just tracked one of our favorite female *atrox*, Ca121, "Tracy," to the source of her signal (Figure 1). Quoting the exact notations as written on the datasheet from that tracking episode at 0746 hours: "Not visible. Wash jetsum (*sic*) above her has gathered on ragweed roots. Hackberry nearby. North berm of closest wash channel to hill." Beautiful! As was customary, my two comrades wandered off while I was doing all the work. I was performing the tedious process of recording Tracy's body temperature, when Schuett suddenly began loudly bellowing my name.

"**ROGER! ROG----ERRR! COMBAT! Get over here. ROGER! COMBAT! ROG-ERRRR! What's taking you so long? Can you *not* hear me? ROGER! COMBAT! Get over here! C'mon! Get over here!"**

The straight-line distance that separated us was less than five meters, but it was five meters of impenetrable hackberry thicket. As suggested in the write-up, Tracy was on the north berm of the closest channel of Suizo Wash to Iron Mine Hill. This point in Suizo Wash is the widest part of the wash itself. It is roughly 200 meters wide, and several meandering channels had been cut through dense stands of hackberry, 10-meter-tall ironwood and palo verde trees, and three-meter-tall ragweed clumps. I may have only been five meters away from Gordon and Ryan, but the

Figure 2. Ca40, "Bob" and unknown male *atrox* in combat, 19 September 2010. Bob is the snake standing taller. He appeared to have the upper hand (and head) throughout the contest.

island of vegetation that I had to sprint around was easily over 100 meters long, which of course meant that once I got to the end of the island, I had to sprint another 100 meters on the other side in order to get back to them. And the whole while I'm moving at warp speed, I keep hearing this idiot yelling:

"**ROGER! ROG-ERRR! Combat! ROG-ERRR! C'mon**!"

And as soon as I arrived at the scene, Ryan, who normally wouldn't say "shit" if he had a mouthful, began to roundly cuss me for taking so long to get there. In all, it could *not* have taken me more than two minutes to arrive on the scene. Neither of them was carrying a camera, and all hell was indeed breaking loose. So, we missed two minutes of action because I was *working*, while they were lollygagging about accomplishing nothing but getting in the way of a working man. While I deeply regret missing that two minutes of action, the very first image I got captured the best of it (Figure 2). It was your classic battle of an older, larger and more experienced snake consistently topping and toppling a slightly smaller and younger snake. Within seconds of my arrival, the older, winning combatant suddenly whirled away from the fight—and came straight at me! That was more than Schuett could stand, and he pounced on it with his snake tongs. While he was bagging it, I got one last shot of the younger snake still in the ascent position (Figure 3). Just after the shutter snapped, he shot into the hackberry thicket behind him and made good his escape. We walked the captured male back around to the side of the island where Tracy was located, as it was shadier there. And all of my equipment—including the microchip reader—was on that side. One wave of the reader popped up a nine-digit number. I always carried a hard copy of an Excel spreadsheet on my clipboard of datasheets. This sheet contained the microchip codes of all of our snakes. And we knew within minutes that our boy was none other than good old Ca40—Bob! I was able to finish off the datasheet on Tracy. Her body temperature under that clump of wash jetsam was 28°C, shaded ambient was 30°C, and the hot spot was 36°C. Hence, we have three temperatures to describe some of the microclimate details of the combat site. As 19 September is right in the thick of mating season for *atrox*, we were seeing normal behavior for this time of year. They fight, and they fu, er uh, fornicate then as

Figure 3. While Gordon Schuett captured Bob, the author snapped this quick photo of the other combatant. This one one got away!

well. We did not have our measuring devices with us that day—they were a long walk back to my truck to fetch. We were content to take a mass, which was 783 g—171 g heavier than his previous mass taken almost exactly 7.5 years earlier. The paint on his rattles indicated that he had shed but three times during that 7.5-year period. Once again, this is indicative of a snake that is growing very slowly—an older snake. We freshened up the paint on the rattles, and released him with Tracy. The two boys were likely fighting over her, and since it appeared that Bob would have won this fight, he got dibs! He shot under the same wash jetsam that Tracy was under, and was left to enjoy the fruits of his (assisted) victory. Tracy gave birth the following year. While we can't say that Bob was the father, we can certainly say that it was possible.

The Tragedy

It must first be stated that no matter what comes off my fingertips next, the buck stops here. Any time something goes badly, we as humans tend to rationalize: "If only this had happened, *that* would not have." I'm no different. I still feel the frustration over what happened on 6 March 2011 to this very day. And truth be told, ***if*** the proper procedures laid out at the beginning of the field trip had been followed, Bob might still be alive and well today. But even if I'm just a little wrong with anything I do, I'm all wrong. In the end, it's all on me.

We start by saying something that will raise some eyebrows. There are many ways to bag a rattlesnake. No matter how the process is done, the main focus is to avoid getting bit. We *do* need to think about safety when doing this. But what method of capture is safest for the snake? A five gallon bucket with a lid is a good way to go. This author knows people who actually carry five-gallon buckets around in the field just for that purpose. I have at times been forced to carry a bucket when working with these people. The bitching that occurs as a result is legendary. Until I grow a third arm and hand, the bucket method is never going to fly with me. But even with a bucket, the potential of a snake biting itself during the capture process is high. And putting more than one snake in a bucket magnifies the chances of one snake biting the other.

No! I don't walk for miles carrying a bucket. That's what snake bags are for. They are obviously much easier to carry. Two experienced people working together on the actual bagging

Figure 4. RAGE! The author teaching radio-tracking techniques to the students of the University of Arizona's herpetology course. Image by Kevin E. Bonine, 6 March 2011.

exercise is the best way to go. Communication between the two is essential. One person holds the bag wide open. Ideally, the bag holder would be wearing thick gloves that extend up to both elbows. But honestly, that has never happened. The second person grabs the snake approximately 4 inches behind the head with the snake tongs, while quickly bare-handing the tail. The person holding the snake gently lowers the tail into the bag, while maintaining the grip with the tongs around the neck area. Within a split second of the posterior portion of the body being lowered into the sack, the tongs are used to shove the head all the way to the bottom. The sack is lowered to the ground, while the person holding the snake maintains the tong grip. It is at this point that communication between the two people involved is *huge*. The person who is holding the snake makes eye contact with the person holding the bag, and on a pre-arranged signal, lets the head of the snake go, and quickly withdraws the tongs. The person holding the bag briskly lays it flat, and the person with the tongs slaps those tongs down lengthwise across the neck of the bag to seal the escape route. The open end of the bag is then knotted on the safe side of the tongs. All this is happening within the time span of seconds. I have done this often, and it has always been quick and clean. I have *never* had a snake bite itself using this process, nor has anybody come remotely close to getting bit.

The date of 6 March 2011 was a training day for the University of Arizona herpetology class. The size of the group was comparatively small. In all, there were 14 students, two teaching assistants (TAs), the professor, and the good Dr. Schuett. Poor Gordo was hampered by a bad knee, and was holding the fort down while I went through the whole **RAGE** rant (Figure 4). He also remained in camp for the tracking sessions. We split into three groups. Only the TAs, the professor, and I were allowed to handle any venomous animals. It was made very clear that the TAs were to stay with their respective groups. One TA was good; mine was not. My idiot TA stuck with us for the tracking of the first Gila Monster. While we were working together on the write-up, he proceeded to publicly discuss the grades everybody was getting from their last assignment. There were some A's, there were some F's, and he made sure everybody knew who got which. If there isn't a law against that sort of thing, there ought to be. The idiot then immediately deserted our group, leaving me to hang with the four students under my watch. All was going well until we approached *atrox* den #7 (AD7). We had two *atrox* with transmitters there, and neither was out. However, there were two males basking outside the long horizontal crevice. I instantly recognized Bob as being one of them. His rattle was out, and his freshly painted green rattles revealed his identity. The second *atrox* was a much smaller male. I began hollering the name of that idiot TA. When I did not get a response, I knew that I was on my own. I stuffed an empty snake bag into the crotch of a hackberry bush in such fashion as it was mostly open at the top. I snatched the smaller male with my tongs, and dropped him into the sack. The makeshift arrangement worked perfectly, and the snake never even got the chance to rattle until the knot was tied. And then, I was eyeing Bob. I had a very strong urge to just leave him be. (How I *wish* that I had left him on the ground). But I also knew that we had not thoroughly processed him when we caught him in the midst of his combat episode the previous September. There was some good growth data on the ground to be had here. I once again, in much more forceful fashion, began calling the name of that *idiot* TA. Bob was a big snake now, and I did not relish handling him alone. When the *worthless* bag of pus TA did not respond, I knew I was on my own. I repeated the steps used to capture the first *atrox*. A fresh bag was suspended in the hackberry. I deftly snatched Bob off the ground, but he knew what was coming! Hell hath no fury like an *atrox* who suddenly decides he doesn't like being snagged by snake tongs. Bob began to thrash violently, snake musk was scattered everywhere, and the students got a good introduction to the famed irascible nature of an aroused Western Diamond-backed Rattlesnake. Bob was thrashing so hard that I feared he would break his own backbone. I released him, and went for a better grab. As soon as he hit the ground, he jetted straight for the crevice of AD7. He was actually 30% inside of it when I snagged him by the rear third of his body and roughly dragged him out. Now he was completely out of control. He began flailing about, striking wildly in all directions. And then, for a split second, he calmed down. His head was cocked at the neck, his black forked tongue wavered in menacing fashion, his rattling filled the air. He malevolently eyed the orange business end of my Whitney tongs, and launched a carefully calculated strike that hit the wide upper fork fulcrum of said tongs broadside. Instead of a quick release following the strike, he began to chew on the hard aluminum surface. Double-barreled rivulets of venom began to flow down the tongs toward the forked tip. I feared he might be damaging his fangs or the sensitive soft tissues in his mouth, so I released the grip of the tongs and shook him off. I next repositioned the tongs a little further up his body. He struck again, but the strike actually landed right in the center of his spine. His fangs entered his spinal column about an inch or so closer to his head than the restraining tongs were located. Once again, rather than a quick release, he began chewing—on himself! I could actually see his venom sacs contracting inside his upper jowls as he shifted his bite force from the left side to the right. (Later developments indicated that one of his fangs had broken off before Bob bit himself—likely during the tong biting). It was a sobering and sickening sight. "No, don't do ***that***!" I shouted at him. (Like any form of reason was going to work here?) "Let go of yourself, *stupid*!" He *did* eventually let go of himself, and

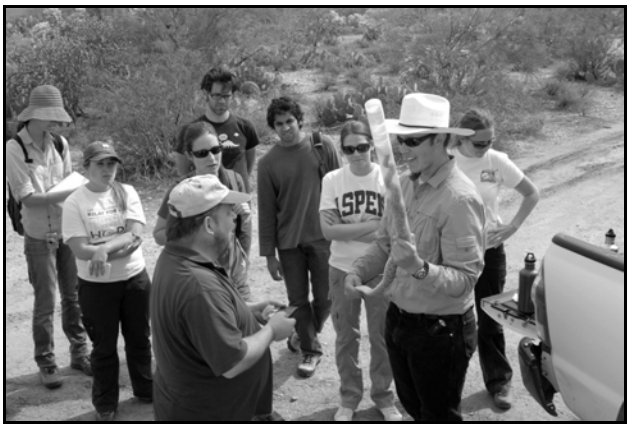


Figure 5. Dr. Gordon Schuett (left foreground) discussing the finer points of rattlesnakes with some of the students. The *atrox* in the tube later became Ca127. Image by Kevin E. Bonine, 6 March 2011.

there was more thrashing and musk slinging. This was *not* going well! In the end, I did what I seldom do. I pinned his head with my snake hook, grasped his head in the classic thumb, forefinger and middle finger fashion, and dropped him into the bag that way. Man! What a pistol! I looked at the students, they looked at me, and we all said "**WOW**" in unison. The stench of sweat and atrox musk filled the air, and the ground on the apron of the den was littered with equipment scattered about.

Both snakes were loaded into my backpack, the mess gathered up, and we started to track the next animal on our list. Just around the lower corner of the massive boulder that tops the crevice of AD7, we found our idiot TA. There was a bee cave on that side of the boulder, and there he was, sitting on a boulder near it, munching peacefully on some of the honeycombs that he had stupidly removed from the hive. When I asked him if he heard us shouting, he said he was afraid to respond lest he disturb the bees. What a jackass! On top of this act of ineptness, his meddling with that hive was a gift that kept giving. I got stung four times with subsequent visits to AD7. Thanks a lot—*idiot*! I didn't say anything further to him the rest of the day, and never saw him again. One can only hope that one fine day, he chooses the wrong hive to cure his sweet tooth . . .

Once all the snakes and Gila Monsters were tracked, we joined Gordon at our parking spot. Besides the recapture of Bob and two new atrox, we had tracked every animal on our list for that plot. I looked over all the datasheets, offering praise, gratitude, and (hopefully) helpful criticisms to the students involved. We then broke out the larger male *atrox* and processed him in front of the group. For many of the students, this was their first chance ever to see a rattlesnake up close. Dr. Schuett held nothing back with the manipulation of this snake. We cracked open its mouth to show the group its fangs. We tubed it, and they all got the chance to handle the tubed snake, fondle the tail and rattle, and take many images (Figure 5). All in all, it was a splendid geek show, and a *real* learning opportunity for all involved. At the end of it all, we sent a very enthused and inspired group of students home.

Gordon, the good TA Brian Park (who often assisted us with our project), and I took the three *atrox* home with us to process them in a more thorough and accurate fashion. To illustrate how the study had grown over the past eight years, Bob was number 40, and the new snakes we processed were number 126 and 127. Both snakes were processed under anesthesia to allow for maximum accuracy. Then, it was Bob's turn. The first step was always to turn the bag upside down into a five gallon bucket. When Bob slid out of the bag and into bucket, he began to slowly twist about, turn upside down, and generally showed that things were not well in his world. We did not wish to make matters worse, so we did not gas him. I showed Gordon and Brian the puncture wound, and insisted that we check the location of Bob's heart. We tubed him, and did a quick check of his heart. It was weak, but we found it! When we pulled him from the tube, we spread him out as best we could in a sweater box, and took the images seen in Figure 6. The reader is advised to look at these images, and read the caption. Bob was pronounced dead at 1625 hours. The self-inflicted bite occurred at 1150 hours. In all, it took him 4 hours and 35 minutes to die post-bite.

The following morning, I emailed a description of what had happened to six well known DVMs and perhaps a dozen other folk knowledgeable in all aspects of herpetology. I included the images shown in Figure 6 with this email. I also erroneously

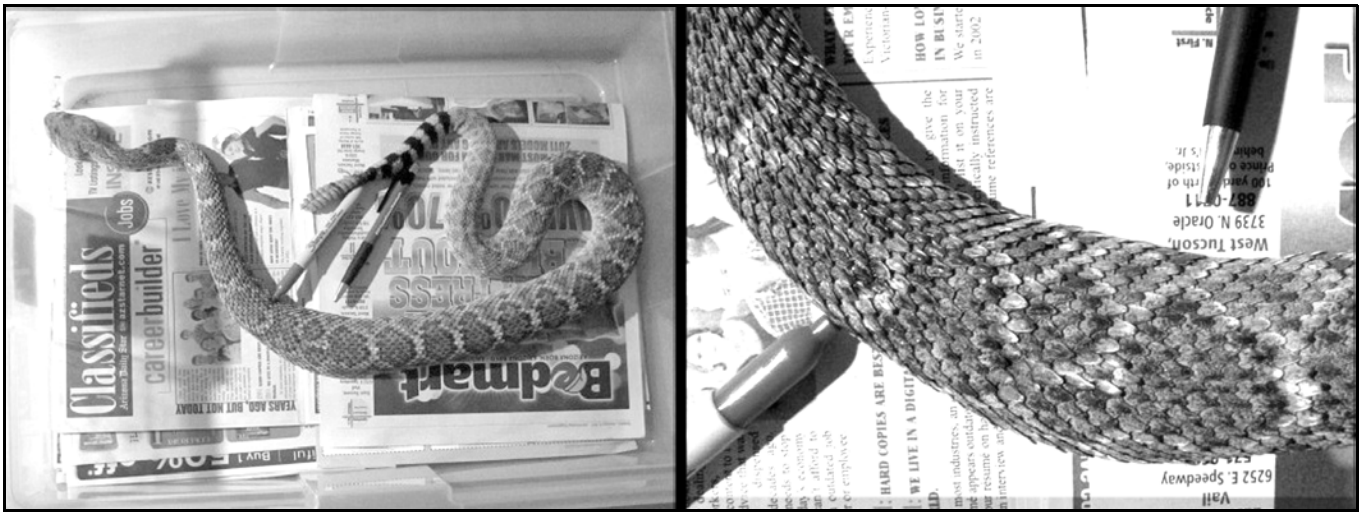


Figure 6. (Left) Full body image of Bob in the final throes of death from a self-inflicted bite. The Sharpie points to the area of fang penetration; the mechanical pencil points to the heart. (Right) A closer look at bite and heart location. Note the swelling evident around the heart. See text for details.

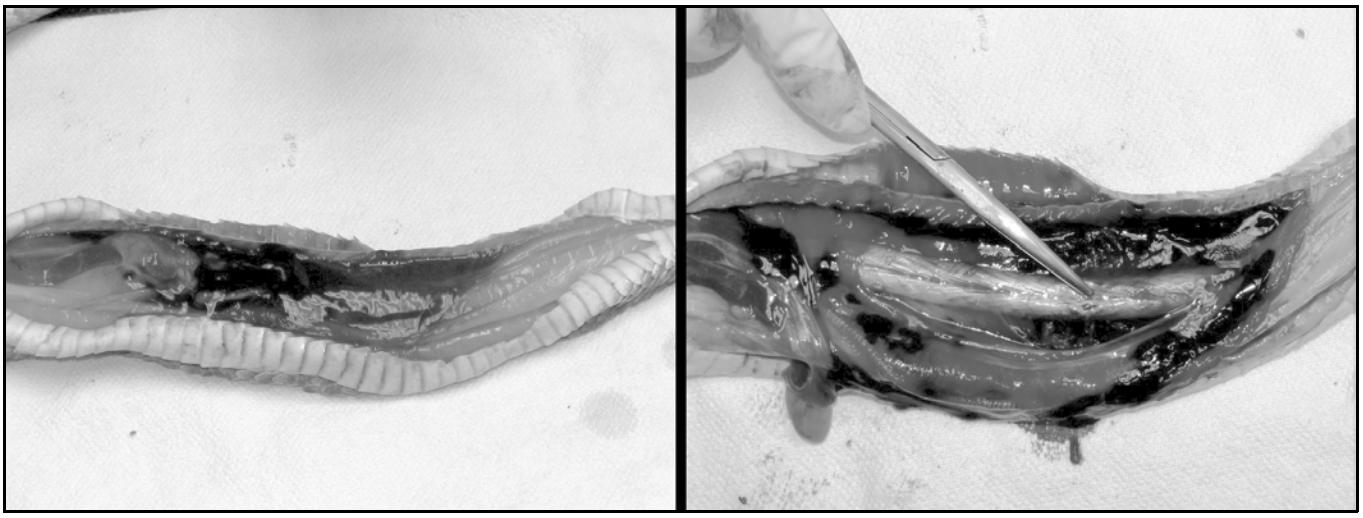


Figure 7. (Left) Upon slicing Bob open, the pooling of blood around the heart was obvious. (Right) While it won't be obvious in the smaller image of this publication, once the blood was cleaned up, it was noted that a single fang had penetrated Bob's spinal column. That fang in turn punched a hole in the aorta. The tweezers in this image point to the fang, which is still embedded in the spinal column. Cause of death: Internal hemorrhage.

stated that I thought Bob had died from a dose of his own venom. The fact that venomous snakes are immune to their own venom is well-published, but for a short while, I was not buying that fact. I encouraged the recipients of this email to forward it around, which they did. I received an avalanche of emails in response. Some of these emails were from venom experts around the world who correctly informed me that I was wrong about self-envenomation being the cause of death. A renowned local herp vet named Jim Jarchow responded with a phone call. Would I like him to perform a necropsy? Hell yeah! An hour later, I was in his office with Bob's corpse.

The result of Dr. Jarchow's postmortem was that Bob's fang pierced the middle of his spinal column, and punctured the aorta. He bled to death internally (see Figure 7 and captions). We remain grateful to Dr. Jarchow for his assistance not only in this case, but in others too numerous to even remember.

There was another slew of emails that came in regarding Bob's unfortunate death. There was an onslaught of other images of venomous snakes that had bitten themselves and died as a result. The one that saddened me the most was an image of a beautiful Black-tailed Rattlesnake (*Crotalus molossus*) that had bitten itself through the lower jaw while in the tube. Its head was roughly the size of a softball. It had to be a miserable experience for the handler, and far worse for the snake. I was touched by the outpouring of honesty from people like this. The negative aspects of the yin and yang of our scientific efforts are seldom openly discussed.

The fact that so many other people shared these sorts of experiences is why I chose to share this one with the CHS. As ashamed as I am to admit all this about Bob, I hope to impart a lesson for all of us. You all can do whatever you want, but please be aware of what can happen not only to yourself, but any venomous snake that you handle when you make contact. If you *must* handle it, then you *must* do so with regard to the safety of the animal. If the only reason to handle it is for a thrill or a good photo opportunity, please consider leaving it alone. Moving forward in life, that is my plan.

This here is Roger Repp, signing off from soggy Southern Arizona, where the turtles are strong, the snakes are handsome, and the lizards are all above average.

Bob's metrics

In order to make this tale of woe count to the max, I happily share the data gathered on Bob. It is hoped that this knowledge is of some use to the reader.

On 27 March 2003, Bob's snout–vent length was 98.5 cm long, his tail was 9 cm, and his mass was 612 grams. His rattle was a basal plus 9 segments, crowned by a broken tenth segment. On 6 March 2011, nearly eight years later, his snout–vent length was 103 cm (growth of 4.5 cm), his tail remained 9 cm (zero growth), and his mass was 747 g (135 g heavier). The paint on his rattles indicated that he had shed four times during that eight-year period.

Herpetology 2019

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

GENETIC DIVERSITY IN A MASSASAUGA POPULATION

S. J. Baker et al. [2018, Copeia 106(3):414-420] note that the eastern massasauga (*Sistrurus catenatus*) is a small, grassland-dependent rattlesnake species declining throughout its native range, and is thus a species of high conservation priority. In Illinois, only a single population remains of a once widespread distribution. The authors documented genetic diversity in this population over a ten-year period and assessed levels of heterozygosity, allelic diversity, inbreeding (F_{IS}), and effective population size (N_e). Neither heterozygosity nor levels of inbreeding differed significantly among periods. They identified 21 alleles that occurred in a single time period, some of which may have been lost from the population given an estimated detection probability of 93%. Effective population size (N_e) was numerically small and showed a decreasing trend through time. Despite small population size and a lack of connectivity, there was no significant decline in genetic diversity over the ten-year study. Aspects of life history, coupled with a preference for a historically patchy habitat, may mitigate the loss of genetic diversity in the species and promote their persistence in the fragmented habitats of the Anthropocene. However, continued genetic monitoring is recommended, and population recovery measures should be implemented as soon as possible to mitigate the deleterious effects of small population size.

ALLIGATOR NEST ATTENDANCE PATTERNS

M. Merchant et al. [2018, Copeia 106(3):421-426] note that the behavioral variation in American alligator (*Alligator mississippiensis*) nest attendance has characterized the species as iconic in common lore and perplexed biologists for decades. The authors quantify patterns in nest attendance among mothers as well as variation in such patterns throughout two nesting seasons. They employed camera traps controlled by circuit boards to capture time-lapse photographs of alligator nest areas for the duration of each nesting season. Data revealed a bimodal pattern of nest attendance over time that significantly varied across incubation days in both 2011 and 2012, and also differed between years. Nest attendance also differed among hours in the diel cycle, and this pattern was the same for both years. Nest visits were frequent immediately after the eggs were laid, and attendance behavior attenuated rapidly after the first week of incubation. Nest visitation then increased near the end of the incubation period with the largest portion of visits recorded during hatching and the maternal movement of hatchlings away from nest sites. While the extent of this pattern varied between years, the pattern itself did not. The majority of attendance behavior occurred during night hours, with little visitation recorded between 1000 and 1600 hours. This study is the first to document temporal variation in alligator nest attendances at daily, seasonal, and annual temporal scales, and the findings suggest nighttime visits during oviposition and hatching periods are consistent among years.

DIETS OF KEMP'S RIDLEY SEA TURTLES

J. R. Schmid and A. D. Tucker [2018, Journal of Herpetology 52(3):252-258] quantified diets of Kemp's ridley sea turtles (*Lepidochelys kempii*) in Charlotte Harbor National Estuary, Florida, to identify possible ontogenetic variation in prey consumption, to examine the use of local prey, and to contrast the diets of conspecifics at other foraging areas. Dietary analysis was conducted by identifying prey remains recovered in 58 fecal samples from 53 turtles (24.2–63.7 cm midline straight carapace length). Turtles consumed seven prey categories: crustaceans, chelicerates, fish, sessile invertebrates, molluscs, plants/algae, and unidentified items. Spider crabs (*Libinia* sp.) are the dominant prey consumed in the mangrove estuary, occurring in 94.8% of fecal samples, accounting for 71.4% of dry mass, and as 76.3% in the Index of Relative Importance. No significant ontogenetic differences were found in prey composition between small (< 40 cm) and large (= 40 cm) turtles, although crustaceans were more prevalent in diets of the larger turtles. The prey consumed in Charlotte Harbor differed significantly from a similar study of a nearby mangrove estuary in the Ten Thousand Islands. Sandy-skinned tunicates (*Molgula occidentalis*) were the predominant food item in the latter locale, and there were no significant ontogenetic differences in prey composition. A comparison of prey availability and use suggests that Kemp's ridley sea turtles ingested the most abundant prey in the Charlotte Harbor estuary. Geographic differences in diet may reflect localized differences in use of foraging habitat and available prey, but more studies are needed on the availability, use, and selection of both habitat and prey.

HABITAT USE BY OREGON SPOTTED FROGS

C. A. Pearl et al. [2018, Copeia 106(3):539-549] note that many amphibians use multiple habitats across seasons. Information on seasonal habitat use, movement between seasonal habitat types, and habitats that may be particularly valuable is important to conservation and management. The authors used radio-telemetry to study late-season movement and habitat use by Oregon Spotted Frog (*Rana pretiosa*) at nine sites from four populations along the Cascade Mountains in Oregon. Movement rates declined with date and were the lowest at the end of tracking in December and January. Frogs across the nine sites used vegetated shallows in late summer and early fall. In fall, frogs used a range of habitat types, and at several sites moved to distinctive habitats such as springs, interstices in lava rock, and semi-terrestrial beaver channels. Distance between first and last tracking location was <250 m for 84.5% (49/58) of frogs, ranged up to 1145 m, and was greater for frogs in ditch habitats than those not in ditches. Distinctive features like springs or semi-terrestrial retreats can host multiple frogs and may represent particularly valuable wintering habitat for *R. pretiosa* in some sites in their Oregon range.

Advertisements

For sale: **highest quality frozen rodents**. I have been raising rodents for over 30 years and can supply you with the highest quality mice available in the U.S. These are always exceptionally clean and healthy with no urine odor or mixed in bedding. I feed these to my own reptile collection exclusively and so make sure they are the best available. All rodents are produced from my personal breeding colony and are fed exceptional high protein, low fat rodent diets; no dog food is ever used. Additionally, all mice are flash frozen and are separate in the bag, not frozen together. I also have ultra low shipping prices to most areas of the U.S. and can beat others shipping prices considerably. I specialize in the smaller mice sizes and currently have the following four sizes available: Small pink mice (1 day old—1 gm) , $25 /100; Large pink mice (4 to 5 days old—2 to 3 gm), $27.50 /100; Small fuzzy mice (7 to 8 days old—5 to 6 gm), $30/100; Large fuzzy mice / hoppers (10 to 12 days old—8 to 10 gm), $35/100 Contact Kelly Haller at 785-234-3358 or by e-mail at kelhal56@hotmail.com

Herp tours: **Costa Rica herping adventures**. Join a small group of fellow herpers for 7 herp-filled days. We find all types of herps, mammals, birds and insects, but our target is snakes. We average 52 per trip, and this is our 10th year doing it. If you would like to enjoy finding herps in the wild and sleep in a bed at night with air-conditioning, hot water and only unpack your suitcase once, instead of daily, then this is the place to do it. Go to our web-site <http://hiss-n-things.com> and read the highlights of our trips. Read the statistics of each trip and visit the link showing photos of the 40 different species we have found along the way. E-mail at jim.kavney@gmail.com or call Jim Kavney, 305-664-2881.

NEW CHS MEMBERS THIS MONTH

Brian Cunningham
Owen Dalmage
Jessica Fennen
Susan Horton
Mary Lynn Pross
Leo Rossi
Deborah Smith

2019 CHS GRANT RECIPIENTS

The CHS Grants Committee has chosen the CHS grant recipients for 2019. The committee consisted of John Archer, Michael Dloogatch, Gery Herrmann, Robert Jadin, Linda Malawy and Jessica Wadleigh. This year we received 42 applications. After a difficult decision process, 13 grants were awarded, as follows:

- Elijah Bieri, Undergraduate, Northern Michigan University. "Assessing *Ambystoma laterale* Road Mortality and Mitigation Strategies at Presque Isle Park, Marquette, Michigan," $500.
- Adam Clause, Ph.D. "Rediscovering Dragons: Conservation of Flagship *Abronia* in a Biodiversity Hotspot," $1,000.
- Elizabeth Hucker, Undergraduate, University of Wisconsin–Madison. "Using a Systematic Coverboard Monitoring Network to Reveal Effects of Climate and Habitat Modification for Small Colubrids," $500.
- Michael W. Itgen, Department of Biology, Colorado State University. "Cell Size Evolution Mediates Simplification in Organ Morphology," $1,000.
- Joseph Kennedy, Department of Biology, The University of Mississippi. "The Role of Reproductive Interference and Endocrine Stress in the Decline of Green Treefrogs following Cuban Treefrog Invasions" $1,000.
- Javier Méndez-Narváez, Department of Biology, Boston University. "Developmental Plasticity, Enzymatic Regulation of N-excretion, and the Reproductive Colonization of Land by Frogs," $1,000.
- Alder Nichols, Undergraduate, Beloit College. "What's under the Surface: Do Ecosystem Characteristics Predict Diet, Growth, and Shell Morphology in Painted Turtles (*Chrysemys picta*)?" $1,000.
- John G. Palis, Palis Environmental Consulting. "Bird-voiced Treefrog Survey of Southernmost Illinois," $500.
- Gerard Tasse, Ph.D. "Outreach and Education to Foster the Conservation of the Goliath Frog (*Conraua goliath*), the Largest Frog on Earth in Cameroon," $1,000.
- Whitney Walkowski, Louisiana State University Health Sciences Center. "Endocrine Control of Retinal Sensitivity in the Green Treefrog, *Hyla cinerea*," $1,000.
- Kathleen Webster, Lugwig-Maximilians-Universität Munich, Graduate School for Evolution, Ecology, and Systematics. "Island Di*skink*tion: Variability of Two Skink Species in the Comoros Archipelago," $1,000.
- Matthew Welc, Department of Biological Sciences, Auburn University. "Clinal Variation in Shell Morphology in a Musk Turtle Species (*Sternotherus peltifer*) throughout the Cahaba River Drainage of North-central Alabama," $1,000.
- Katherine Wiesehan, Department of Biological Sciences, Southern Illinois University Edwardsville. "Conservation Status of the State-Threatened Illinois Chorus Frog, *Pseudacris illinoensis*, in Southwestern Illinois," $1,000.

UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, February 27, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. Because of severe weather the January meeting was canceled. So the January program has been rescheduled for this month. Our speaker will be **Daniel E. Keyler**, a professor of experimental and clinical pharmacology at the University of Minnesota. Dan will speak about "Snakebite Envenoming in Sri Lanka: Polyspecific Antivenom Development." Antivenoms currently distributed in Sri Lanka are prepared using venoms from non-indigenous species that are likely to differ from those of Sri Lankan snakes. In recent years Dan has used his immunotoxicology background in research toward the development of antivenom for treating snakebite victims in Sri Lanka where snakebite is a major public health problem. This has involved travel to Sri Lanka and collaboration with Costa Rica's Instituto Clodomiro Picado.

The speaker at the March 27 meeting will be **Stephen Barten, DVM**. Steve's program will be "Snake Road: Herping Hotspot."

The regular monthly meetings of the Chicago Herpetological Society take place at Chicago's newest museum—the **Peggy Notebaert Nature Museum**. This beautiful building is at Fullerton Parkway and Cannon Drive, directly across Fullerton from the Lincoln Park Zoo. Meetings are held the last Wednesday of each month, from 7:30 P.M. through 9:30 P.M. Parking is free on Cannon Drive. A plethora of CTA buses stop nearby.

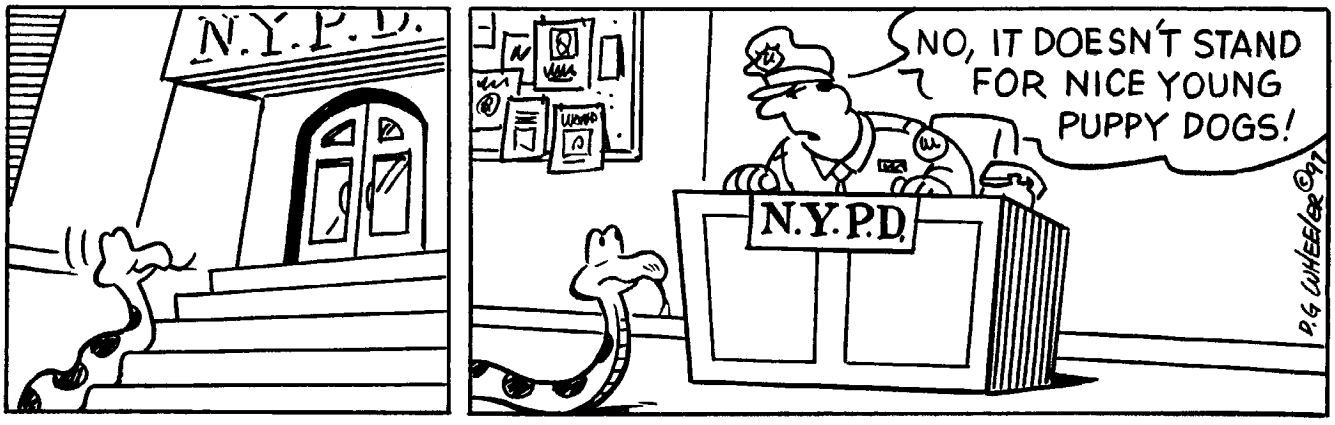
Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? If so, mark your calendar for the next board meeting, to take place on March 15, 2019. The venue is as yet uncertain, so if you wish to attend please email mdloogatch@chicagoherp.org.

The Chicago Turtle Club

The monthly meetings of the Chicago Turtle Club are informal; questions, children and animals are welcome. Meetings normally take place at the North Park Village Nature Center, 5801 N. Pulaski, in Chicago. Parking is free. For more info visit the group's Facebook page.

THE ADVENTURES OF SPOT



**Periodicals Postage
Paid at Chicago IL**

CHICAGO HERPETOLOGICAL SOCIETY

Affiliated with the Chicago Academy of Sciences

2430 North Cannon Drive • Chicago, Illinois 60614