BULLETIN
of the
Chicago Herpetological Society

Volume 53, Number 1
January 2018

BULLETIN OF THE CHICAGO HERPETOLOGICAL SOCIETY
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Cover: 'Brady & Belichick,' a wild-caught *Lampropeltis t. triangulum* from Maine. Photographed in life by Joe Warfel.

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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 53(1):1-20, 2018

Axial Bifurcation and Duplication in Snakes. Part VI
A 10-year Update on Authentic Cases

Van Wallach
4 Potter Park
Cambridge, MA 02138
serpentes1@comcast.net

Abstract

This paper updates and supplements an earlier review that summarized 950 cases of axial bifurcation in snakes. A total of 1,850 cases are now known, the majority of which were bred in captivity. The addition of 900 cases over the past decade can be attributed mainly to inbreeding depression among captive-bred snakes. A statistical breakdown of the cases is presented by family, geographical region, type of dichotomy, and U.S. states. Additionally, data are tabulated for known longevity records, for those snakes known to have reached 1 m in length, and for all sale prices of living dicephalics. X-rays are presented that illustrate five different types of axial bifurcation in snakes.

Introduction

Ten years ago I reviewed both authentic and anecdotal reports of primarily two-headed snakes but also other cases of axial bifurcation and summarized data on 950 cases (Wallach, 2007). Since that time only a few publications have appeared on the subject (Beane, 2009; Jandzik, 2009; Albuquerque et al., 2010; Jovanoviæ, 2011; Kim et al., 2013; Pezdirc et al., 2013; Sant'Anna et al., 2013; Dieckmann et al., 2014; Gvozdenoviæ and Èavor, 2015; Twombley, 2015; Caviglioli et al., 2016; Wallach, 2012; Wallach and Salmon, 2013). An additional 900 cases have been discovered in the interim so it seems worthwhile to provide an updated synopsis on the 1,850 original reports.

Smith and Pérez-Higareda (1987) proposed the following seven terms to categorize axial bifurcation in snakes: craniodichotomy, prodichotomy, proarchodichotomy, urodichotomy, opisthodichotomy, amphidichotomy, and holodichotomy. A craniodichotomous specimen has two incompletely divided heads, a single atlas* and axis*, and a single body and tail. A prodichotomous snake has two complete heads, each with an atlas and axis, either a single or two short necks, and a single body and tail. A proarchodichotomous specimen has two heads, two long necks, and a single body and tail. A urodichotomous snake has one head and body but two tails. An opisthodichotomous specimen has one head, two bodies and two tails. An amphidichotomous snake has two heads, a single body, and two tails. Holodichotomy refers to a pair of twins from a single egg, usually healthy and normal but reduced in size in comparison with their siblings.

Table 1 lists all identified species with some form of axial bifurcation, comprising 111 genera, 213 species, and 254 species and subspecies. Table 2 illustrates the taxonomic composition of cases, Table 3 illustrates the distribution of cases by type of dichotomy, Table 4 breaks down cases by geographical region, and Table 5 shows the distribution of cases by continental state. Besides Alaska and Hawaii, which lack native serpents, the only states lacking a reported case are Rhode Island and North Dakota. Note that 419 records worldwide are unidentified as to species, dichotomy type is unknown in 833 snakes, 20 cases are from an unknown geographic region, and 187 records from the USA lack a state of origin. The type of record quality or reliability is noted for four categories in Tables 2–5 with category I including specimens that are preserved in a private or public natural history collection, category II consisting of all records with some physical evidence, usually photographic, category III containing all reliable reports such as newspapers and scientific observations, and category IV including anecdotal reports from lay people. Table 6 provides longevity records for snakes that lived at least two years in captivity and Table 7 lists sale prices of living dicephalic snakes.Table 8 lists those snakes known to have achieved at least 1 m in length. Table 9 compares survival times for 450 cases of axial bifurcation. Sadly, much of the data (such as longevity, size, origin, etc.) is incomplete as often there have been no responses to my queries concerning these individuals, and the majority of owners do not publicize their unusual specimens. Table 10 summarizes yearly growth data for a *Lampropeltis triangulum* ('Brady & Belichick') while Table 11 summarizes growth data by molting cycle.

It is not unexpected that living snakes with axial bifurcation have some neurological problems. Nearly all neonates crawl with an erratic and jerky motion as both heads vie for command of the same body. Over time, if the snake survives, one head normally takes charge and controls locomotion and the serpent can crawl more naturally. When one head controls most functions, such as movement, feeding and drinking, it is referred to as the dominant head and the snake as either left- or right-headed. A dominant head can swallow a prey item quicker than the opposite head. A dominant head does not always develop; occasionally the heads will continue to fight over the life of the snake.

A most peculiar attribute was seen in 'Brady & Belichick' during its first year, as it was able to reverse direction instantly and crawl backwards (unfortunately this was never recorded on video; Wallach, 2012a). The ability to crawl backwards was also

* In anatomy, the *atlas* is the first vertebra of the spine, so named because in a human being it supports the globe of the head. The *axis* is the second vertebra. The atlas and axis are specialized to allow a greater range of motion than normal vertebrae.

Table 1. List of documented species and subspecies exhibiting axial bifurcation, arranged in phylogenetic order by family and subfamily.

Leptotyphlopidae (1): *Tricheilostoma bicolor*

Pythonidae (19): *Antaresia childreni, A. maculosa, A. stimpsoni, Aspidites melanocephalus, A. ramsayi, Liasis olivaceus, Malayopython reticulatus, Morelia amethistina, M. bredli, M. s. spilota, M. s. cheynei, M. s. mcdowelli, M. s. metcalfei, M. s. variegata, M. viridis, Python bivittatus, P. molurus, P. regius, P. sebae*

Boidae (16): *Acrantophis dumerili, Boa constrictor constrictor, B. c. amarali, B. c. occidentalis, B. imperator, Corallus hortulanus, Epicrates angulifer, E. assisi, E. cenchria, E. maurus, E. striatus, Eunectes murinus, E. notaeus, Gongylophis conicus, Lichanura t. trivirgata, L. t. roseofusca*

Tropidophiidae (1): *Tropidophis melanurus*

Viperidae: Viperinae (9): *Bitis arietans, B. atropos, B. gabonica, Daboia russelii, Montivipera xanthina, Pelias berus, Vipera ammodytes, V. aspis, V. a. francisciredi, V. ursinii rakosiensis*

Viperidae: Crotalinae (35): *Agkistrodon c. contortrix, A. c. mokasen, A. piscivorus, Bothriechis schlegelii, Bothriopsis bilineata, Bothropoides jararaca, Bothrops asper, B. atrox, B. jararacussu, B. lanceolatus, B. moojeni, B. neuwiedii diporus, Crotalus adamanteus, C. atrox, C. basiliscus, C. cerastes, C. durissus collilineatus, C. d. terrificus, C. horridus, C. l. lepidus, C. lutosus, C. mitchelli, C. molossus oaxacus, C. oreganus, C. scutulatus, C. tigris, C. viridis, Gloydius blomhoffii, G. halys, G. shedaoensis, Rhinocerophis alternatus, Sistrurus catenatus, S. miliarius barbouri, S. m. streckeri, Trimeresurus* cf. *albolabris, Tropidolaemus wagleri*

Homalopsidae (7): *Cerberus rynchops, C. schneiderii, Enhydris enhydris, Enhydris* sp., *Erpeton tentaculatum, Homalopsis buccata, Subsessor bocourti*

Lamprophiidae (7): *Boaedon capensis, B. fuliginosus, B. fuliginosus × B. lineatus, Duberria lutrix, Lamprophis inornatus, Lycodon aulicus, Lycophidion capense capense*

Elapidae (6): *Bungarus caeruleus, Hemachatus haemachatus, Naja atra, N. kaouthia, N. naja, Sinomicrurus japonicus*

Hydrophiidae: Oxyuraninae (11): *Acanthophis wellsi, Austrelaps praelongus, A. superbus, Drysdalia coronoides, Notechis scutatus, Ogmodon vitianus, Oxyuranus scutellatus, Pseudechis colletti, P. porphyriacus, Pseudonaja affinis, P. textilis*

Hydrophiidae: Hydrophiinae (4): *Aipysurus laevis, Hydrophis cyanocinctus, H. spiralis, Pelamis platura*.

Colubridae: Psammophiinae (1): *Psammophis* sp.

Colubridae: Boiginae (4): *Boiga dendrophila, B. drapiezii, Crotaphopeltis hotamboeia, Macroprotodon cucullatus*

Colubridae: Colubrinae (36): *Coelognathus helena, Coluber c. constrictor, C. c. priapus, Coronella austriaca, Dinodon rufozonatum, D. septentrionale, Dolichophis jugularis, D. schmidti, Drymarchon couperi, D. melanurus, Elaphe bimaculata, E. climacophora, E. dione, E. quadrivirgata, E. quatuorlineata, E. sauromates, E. schrenckii, Euprepiophis conspicillatus, E. mandarina, Hemorrhois hippocrepis, H. ravergieri, Hierophis viridiflavus, Masticophis flagellum, M. lateralis, Mastigodryas melanolomus, Oligodon barroni, Oocatochus rufodorsatus, Opheodrys aestivus, Oreocryptophis porphyraceus coxi, Orthriophis taeniurus, Philothamnus semivariegatus, Platyceps florulentus, Ptyas korros, P. mucosus, Ptyas* sp., *Zamenis longissimus, Z. scalaris*

Colubridae: Dasypeltinae (1): *Dasypeltis scabra*

Colubridae: Lampropeltinae (34): *Lampropeltis alterna × L. mexicana, L. californiae, L. calligaster, L. elapsoides, L. g. getula, L. g. floridana, L. g. nigrita, L. holbrooki, L. leonis, L. m. mexicana, L. m. thayeri, L. mexicana × L. ruthveni, L. nigra, L. pyromelana, L. splendida, L. t. triangulum, L. t. campbelli, L. t. gaigeae, L. t. hondurensis, L. t. nelsoni, L. t. sinaloae, L. webbi, L. zonata, Pantherophis alleghaniensis, P. emoryi, P. gloydi, P. guttatus, Pantherophis guttatus × P. emoryi, P. obsoletus, P. spiloides, P. vulpinus, Pituophis c. catenifer, P. c. affinis, P. c. annectens, P. c. deserticola, P. c. pumilis, P. c. sayi, P. m. melanoleucus, P. m. mugitus, Pseudelaphe flavirufa*

Natricidae: Natricinae (9): *Amphiesma vibakari, Natrix maura, N. n. natrix, N. n. helvetica, N. n. lanzai, N. tessellata, Rhabdophis tigrinus, Sinonatrix annularis, Xenochrophis piscator*

Natricidae: Thamnophiinae (31): *Nerodia c. clarkii, N. c. compressicauda, N. e. erythrogaster, N. e. transversa, N. fasciata, N. rhombifer, N. s. sipedon, N. s. pleuralis, N. taxispilota, Regina septemvittata, Storeria dekayi, S. occipitomaculata, Thamnophis atratus, T. couchii, T. cyrtopsis, T. elegans biscutatus, T. e. infernalis, T. e. terrestris, T. e. vagrans, T. eques, T. gigas, T. hammondii, T. marcianus, T. ordinoides, T. r. radix, T. r. haydeni, T. sauritus sauritus, T. sirtalis sirtalis, T. s. concinnus, T. s. fitchi, T. s. infernalis, T. s. parietalis, T. s. pickeringii, T. s. tetrataenia, Tropidoclonion lineatum.*

Dipsadidae (8): *Carphophis amoenus, Diadophis punctatus, Heterodon nasicus, H. platirhinos, H. simus, Leptodeira annulata ashmeadii, Sibon* sp., *Sibynomorphus mikanii*

Xenodontidae (14): *Echinanthera cyanopleura, Erythrolamprus aesculapii, Helicops carinicauda infrataeniata, Hydrodynastes gigas, Liophis almadensis, L. miliaris semiaureus, L. perfuscus, L. poecilogyrus, Lystrophis pulcher × L. mattogrossensis, Philodryas olfersii, P. patagoniensis, Thamnodynastes chilensis, Xenodon merremii, X. severus* reported in a neonate *Thamnophis sirtalis* from New Hope Landing, California, in 1957 (Anon., 1957) and in an unidentified species from Spokane, Washington, in 1919 (Anon., 1919).

'Brady & Belichick' had an extreme aversion to water and would never soak in its water dish, thus necessitating its soaking in a wet pillowcase before shedding (which eventually resulted in its accidental death). When placed in a bucket or large bowl of water, the snake would consistently dive towards the bottom of the container, desperately trying to get out! It is as if its sense of balance was upside-down (Wallach, 2012a). A similar condition may have been responsible for the drowning deaths in a water dish of a *Nerodia rhombifer* from MacAlester, Oklahoma in 1973 (Anon., 1973) and a *Thamnophis sirtalis* from Vancouver Island, B.C., Canada in 2010 (Carli Goebel, pers. comm.). There is no logical reason why a water or garter snake could possibly drown in a bowl of water since all snakes can swim (even burrowing blindsnakes and wormsnakes).

The majority of dicephalic snake records are from neonates. Since they are unable initially to coordinate their movements they cannot perform two basic life functions: finding and capturing food and escaping from predators. Therefore, most wild-born dicephalics, if not stillborn, die in the wild from starvation or predation. Only if they are discovered shortly after birth do they have a chance for survival. In captivity, if they are healthy enough to live beyond the first few days or weeks, they usually can survive the natural lifespan of the species. A summary of neonate length for 300 dicephalic snakes ranges from 46 to 480 mm with a mean value of 225 mm (Wallach, unpubl. data). The rare exceptions are those few individuals that live from 10 to 20 years (Table 6) and grow to more than a meter in length (Table 8). To the best of my knowledge, the all-time record for maximum length is 1.83 m by two different *Pituophis melanoleucus* ('Gertrude' and 'Them II') and the longevity record of 22.3 years belongs to *Pituophis catenifer* ('Medusa I').

As proof that axial bifurcation is the result of an accidental mutation (and not genetically transferred), at least three female dicephalics have given birth to all natural offspring (n = 35). 'Thelma & Louise' (*Pantherophis guttatus*) at the San Diego Zoo produced 15 normal neonates from her eggs in 1995. 'Zany & Brainy' (*Lampropeltis californiae*), at Prehistoric Pets in Valencia, CA, has laid four clutches of five eggs each between 1999 and 2006, all of which were normal. 'Xiuhcoatl' (*Pantherophis guttatus*), at Texas Reptile Classifieds, laid a clutch in 2011 of normal offspring (with a previous clutch of two). A most intriguing anecdote from Wisconsin concerns a female dicephalic *Pantherophis gloydi* that laid one clutch of eggs before she died in 2008. The clutch, whose size is unknown, contained healthy babies including two dicephalics. It is possible that the father was also a dicephalic *P. gloydi*. The recipient of some of the healthy offspring, whose online name is Topaz, has been unavailable for more details.

Species

Species with sample sizes greater than or equal to 10 include the following 30 taxa: *Pantherophis guttatus*—117, *Thamnophis sirtalis*—81, *Lampropeltis californiae*—57, *Natrix natrix*—54, *Pituophis catenifer*—51, *Nerodia sipedon*—40, *Pantherophis obsoletus*—40, *Lampropeltis triangulum*—37, *Crotalus horridus*—31, *Pelias berus*—31, *Agkistrodon contortrix*—27, *Boa constrictor*—25, *Morelia spilota*—25, *Coluber constrictor*—20, *Lampropeltis getula*—20, *Python regius*—19, *Thamnophis radix*—19, *Heterodon platirhinos*—15, *Vipera aspis*—15, *Daboia russelii*—14, *Pituophis melanoleucus*—14, *Diadophis punctatus*—13, *Pantherophis spiloides*—11, *Coronella austriaca*—11, *Elaphe climacophora*—11, *Thamnophis elegans*—11, *Thamnophis ordinoides*—11, *Bothrops asper*—10, *Elaphe bimaculata*—10, and *Pseudechis porphyriacus*—10. It is not surprising that the species with the greatest number of cases are either those that are popular captive breeding taxa or species that are abundant and widespread in nature. And there does not appear to be a significant bias for the occurrence of axial bifurcation in either oviparous or ovoviviparous species: three of the top six species and 10 of the top 20 species are live-bearing, which is exactly a 50/50 ratio.

Geography

The species distribution by known country (n = 1,679) reveals 14 countries that have at least 10 cases and 24 countries that have just a single record. The following list gives the number of cases in descending and alphabetical order: USA—1,080, Australia—90, United Kingdom—66, India—41, Canada—35, Brazil—33, Japan—32, Italy—29, Germany—25, South Africa—25, France—23, China—19, Mexico—17, Thailand—12, Colombia—7, Spain—7, Argentina—6, Serbia—6, Sweden—6, Indonesia—5, Sri Lanka—5, Croatia—4, Egypt—4, Russia—4, Taiwan—4, Venezuela—4, Austria—3, Costa Rica—3, Cuba—3, Israel—3, Panama—3, South Korea—3, Switzerland—3, Zimbabwe—3, Azerbaijan—2, Cambodia—2, Chile—2, Finland—2, Hungary—2, Kenya—2, Poland—2, Slovenia—2, Tunisia—2, Turkey—2, Turkmenistan—2, Ukraine—2, Uruguay—2, Uzbekistan—2, Vietnam—2, Algeria—1, Bangladesh—1, Barbados—1, Bolivia—1, Bosnia and Herzegovina—1, Cameroon—1, Czech Republic—1, Denmark—1, Fiji—1, Ghana—1, Iran—1, Madagascar—1, Martinique—1, Mongolia—1, Montenegro—1, Nepal—1, Nicaragua—1, Nigeria—1, North Korea—1, Papua New Guinea—1, Portugal—1, Slovakia—1, Somalia—1, Tajikistan—1, and political division unknown—171.

Mutation rate

When comparing the mutation rate for serpentine axial bifurcation in wild populations vs. captive-bred populations, data collected thus far indicate that the frequency is much greater in captivity than in the wild. A summary of wild population births averages 1/41,330 births (n = 22, range = 1/1,500 to 1/116,667) based on eight authorities (Klauber, 1956; Belluomini, 1959; Sachsse, 1983; Zimmerer, 2003; Nader de León, 2011; Jovanoviæ 2011; Sant'Anna et al., 2013). Captive population births average 1/3,530 births (n = 43, range = 1/60 to 1/25,000) based on data from 24 breeders (McEachern, 1991, and the following personal communications: S. J. Arnold; I. Berlad; B. Boone; J. Brewer; K. Bryant; Chantel; B. Cole; F. De Filippo; A. Denham; N. Gushulak; G. Jacobs; G. Leverton; B. Love; D. Mgee; N. Mutton; V. Paris; R. Roth; M. Schweiger; F. Sleijpen; A. Stotton; C. Wright; J. Zegel; and R. Zuchowski). These data demonstrate that dicephalic mutations are occurring nearly 12

Figure 1. A *Pituophis melanoleucus* with a parasitic or vestigial right head.

times more frequently in captive-bred specimens than in wild populations and clearly implicate inbreeding depression (due to the cross-breeding and back-breeding of siblings and parents to offspring) as a major cause of these mutations.

Parasitic heads

An interesting aspect of some cases of axial duplication is a situation in which one head is normal but the other appears degenerate or incompletely developed, a condition known as parasitic. Parasitic heads run the gamut from a mere blob of tissue on the neck to a head that appears perfectly normal externally but lacks some internal components, such as an esophagus or trachea connecting to the stomach or lungs. Figure 1 depicts a live *Pituophis melanoleucus* with a vestigial right head in the collection of Todd Ray (Venice Beach Freakshow). Figures 2 and 3 illustrate the presence of a parasitic left head in a stillborn *Pantherophis guttatus* named 'Pint & Half-Pint' which was bred by Kayvon Ashrafzadeh of Missouri and cut out of its egg on 15 August 2006. The clutch of 15 eggs was laid 10 June and the 14 normal siblings hatched out 13–14 August. The mother was an Okeetee × Amelanistic Motley while the father and grandfather were both Amelanistic Motleys. In this case the cranium and mandibles developed but the snout and maxillae did not, and skin was lacking over the entire structure.

Vertebrae

Vertebral numbers in the left/right necks (plus the fusion zones when known) are presented below for 85 species. It warrants noting that even with the shortest possible necks in a prodichotomous specimen, the formula will be 2/2 as the atlas and axis are always attached to the cranium. Also, there is no correlation with bifurcation of neck and number of vertebrae, as seen in a *Python regius* that has very short necks but 84–86 vertebrae in the necks. Neck lengths and fusion zones are listed from shortest to longest: 2/2 + 0 (*Lichanura roseofusca, Thamnophis sirtalis*), 2/2 + 3 (*Lampropeltis californiae*), 2/2 + 5 (*Lampropeltis californiae × splendida, Philodryas olfersii*), 2/2 + 8 (*Sibynomorphus mikanii*), 4/4 + 6 (*Coronella austriaca*), 4/5 (*Pelias berus*), 5/5 + 6 (*Vipera ammodytes*), 5/6 (*Natrix natrix),* 6/5 + 13 (*Vipera aspis*), 6/5 + 16 (*Natrix maura*), 6/6 (*Coluber constrictor, Thamnophis elegans*), 6/6 + 3 (*Thamnophis elegans*), 6/6 + 12 (*Pituophis catenifer)*, 7/7 (*Nerodia fasciata, Pantherophis spiloides*), 7/7 + 8 (*Pelias berus)*, 8/8 + 2 (*Natrix maura*), 8/9 (*Vipera aspis*), 8/9 + 7 (*Lampropeltis triangulum*), 8/10 (*Natrix maura),* 9/8 + 8 (*Pelias berus*), 10/10 (*Acanthophis antarcticus*), 10/11 (*Thamnophis elegans),* 11/11 (*Thamnophis gigas*), 12/12 (*Gloydius blomhoffii, Liophis poecilogyrus),* 12/13 (*Thamnophis sirtalis)*, 12/13 + 7 (*Elaphe schrenckii*), 13/12 + 8 (*Lampropeltis californiae*), 13/13 (*Nerodia sipedon)*, 13/17 + 6 (*Elaphe climacophora)*, 14/11 (*Nerodia rhombifer),* 14/12 + 6 (*Nerodia sipedon*), 14/13 + 5 (*Pantherophis guttatus),* 14/14 (*Agkistrodon piscivorus)*, 15/14 + 48 (*Morelia spilota*), 15/15 + 9 (*Elaphe quadrivirgata*), 15/15 + 10 (*Montivipera xanthina*), 15/16 (*Thamnophis sirtalis),* 15/16 + 5 (*Natrix natrix),* 16/16 + 6 (*Thamnophis sauritus),* 16/16 + 8 (*Euprepiophis conspicillatus),* 16/17 + 8 (*Bitis gabonica*), 16/18 + 11 (*Thamnophis elegans vagrans*), 16/19 (*Tricheilostoma bicolor),* 18/15 (*Pituophis catenifer catenifer)*, 18/16 (*Eryx conicus*), 18/20 + 16 (*Notechis ater*), 19/19 + 2 (*Bothrops atrox*)*,* 20/19 + 16 (*Lampropeltis triangulum*), 20/20 (*Lampropeltis getula)*, 21/23 + 6 (*Elaphe climacophora)*, 21/27 + 7 (*Oreocryptophis porphyraceus*), 22/19 + 10 (*Pantherophis obsoletus*), 23/23 + 2 (*Crotalus durissus*)*,* 24/25 + 4 (*Platyceps florulentus*), 25/25 (*Zamenis longissimus),* 25/25 + 8 (*Elaphe climacophora*)*,* 25/26 + 30 (*Bitis arietans*), 26/25 + 8 (*Pantherophis obsoletus*), 26/26 + 2 (*Bothrops jararacussu*)*,* 26/27 (*Thamnophis elegans)*, 28/26 + 14 (*Coelognathus helena*), 29/27 (*Lampropeltis getula)*, 29/30 (*Coluber constrictor)*, 30/24 (*Thamnophis sirtalis*), 31/29 + 5 (*Gloydius blomhoffii*)*,* 32/32 (*Hydrophis spiralis),* 32/33 + 9 (*Pituophis catenifer*), 33/31 (*Elaphe dione*), 33/31 + 7 (*Boaedon fuliginosus × lineatus*),

Figure 2. A preserved *Pantherophis guttatus* with a parasitic left head.

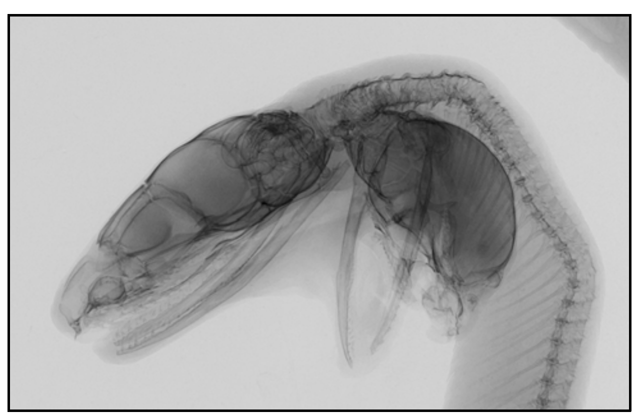

Figure 3. Radiograph of the *Pantherophis guttatus* shown in Figure 2.

34/32 + 9 (*Elaphe dione*), 36/37 + 9 (*Vipera aspis*), 42/42 (*Gloydius blomhoffii*), 48/44 + 15 (*Boa constrictor*), 50/50 + 9 (*Lampropeltis getula*), 54/58 (*Boa constrictor*), 56/54 + 25 (*Gloydius halys*), 56/56 (*Eunectes notaeus*), 57/66 (*Pituophis catenifer sayi*), 76/77 + 8 (*Epicrates assisi*), and 84/86 + 12 (*Python regius*) (Borgert, 1897; Johnson, 1902; Lönnberg, 1907; Hyde, 1925; Strohl, 1925; Fritz, 1927; Fisher, 1928; Inukai, 1929; Heasman, 1933; Nakamura, 1938; Nybelin, 1942; Niimi, 1965, 1971; Belluomini, 1966; Cunha, 1968; Vizotto, 1975; Blanc, 1979; Branch, 1979; Vanni, 1979; Frye, 1981; Laporta et al., 1983; Desai, 1984; Payen, 1991; Ball, 1995; Wallach, 2007, unpubl. data; Beane, 2009; Jandzik, 2009; Albuquerque et al., 2010; Kim et al., 2013; Sayyed, 2015). The images in Figures 4–15 illustrate various conditions and degrees of axial bifurcation, such as craniodichotomous (Figures 4–5 with two snouts, and Figures 6–7 with two heads), prodichotomous (Figures 8–9 with short necks, Figures 10–11 with long necks), proarchodichotomous (Figure 12), opisthodichotomous (Figures 13–14), and amphidichotomous (Figure 15). Two incredible proarchodichotomous Cambodian snakes pictured on Facebook are unavailable for study but photographic evidence indicates the following: a 1 m *Python molurus* has extreme bifurcation of the anterior body with the left and right necks ca. 75% and 65% SVL, respectively, and a neonate colubroid of an undetermined family has necks ca. 55% SVL. In comparison, the specimen with the longest necks above (*Epicrates assisi* with 76/77 vertebrae in necks) has a bifurcation of only 31–34% SVL.

Viscera

Examination of the viscera in 49 specimens, based upon complete and incomplete data (Redi, 1684; Vsevolojsky, 1812; Dutrochet, 1830; Rayer, 1850; Halford, 1872; Dorner, 1873; Borgert, 1897; Yoshinaga, 1901; Cantoni, 1921; Strohl, 1925; Wiley, 1930; FitzSimons, 1932; Heasman, 1933; Ladeiro, 1935; Nakamura, 1938; Themido, 1944; Brongersma, 1952; Sato, 1953; List, 1954; Niimi, 1965, 1971; Cunha, 1968; Nelson and Slavens, 1975; Murphy and Shadduck, 1978; Astort, 1981; Griner, 1983a, b; Laporta et al., 1983; Naulleau, 1983; Payen, 1991; Lema, 1994; Orós et al., 1997; Alahakoon, 2004; Reid, 2005; McAllister and Wallach, 2007, unpubl. data; Albuquerque et al., 2010; Kim et al., 2013), reveals the following details about organ duplication. The trachea is single in 4/46 cases (present only in one head, the other head with a vestigial or absent windpipe), duplicated in 42/46 cases; heart single in 19/41 cases, partially duplicated in 2/41 cases, and duplicated in 20/41 cases; liver single in 24/32 cases, duplicated in 8/32 cases; gall bladder single in 16/21 cases, duplicated in 5/21 cases; pancreas single in 12/17 cases, duplicated in 4/17 cases, and triplicate in 1/17 cases; spleen single in 3/12 cases, duplicated in 9/12 cases; esophagus single in 3/47 cases, duplicated completely in 44/47 cases; stomach single in 13/45 cases, partially duplicated anteriorly in 5/45 cases, and duplicated in 27/45 cases; small intestine single in 27/40 cases, partially duplicated anteriorly in 12/40 cases, and duplicated in 1/40 cases. The lung situation is complex as snakes may have from one to three lungs, depending upon species (v = vestigial lung). Left and right lung condition is as follows: 0/1 in 2/42 cases, 0/2 in 9/42 cases, v/1 in 1/42 cases, 1/1 in 2/42 cases, 2/1 in 4/42 cases, v/2 in 1/42 cases, 2/2 in 1/42 cases, 1 normal right lung in 4/42 cases, and 2 normal (left and right) lungs in 18/42 cases. Presently, there are no known specimens with duplication of any of the viscera in the posterior third of the body as the small intestine is the most caudal organ to exhibit duplication. However, the two deeply bifurcated snakes from Cambodia mentioned previously would most likely have the gonads and possibly the large intestine and/or kidneys duplicated.

Survival and longevity

Whereas it is true that a few dicephalic snakes have lived lives as long in captivity as their normal relatives, the majority do not survive for very long (Table 9). Survival data are available for 450 specimens but this represents only 25% of the total number of cases and, as such, most surely biases the data in the direction of increased longevity. Common knowledge suggests that nearly all specimens are either stillborn, not making it out of their shell or being dead at birth, or die within a few minutes, hours or days. This is most likely the case for most of the other 1,350 cases as they probably represent either specimens with life-preventing deformities or those found dead or which died shortly after birth. In such cases the lifespan is usually not reported by the collector or breeder. Nevertheless, some interesting data come from Table 9, which shows that of the 450 cases, 40% are stillborn, 6.7% survive between 0.5 and 5 hours, 11.3% survive from 0.5 to 6 days, 7.1% survive from 1 to 3 weeks, 18.9% survive from 1 to 9 months, and 16.0% survive from 1 to 22.3 years. The average lifespan of the 270 living individuals is 1.5 years (equivalent to 18.4 months, 73.6 weeks, 515.5 days, or 12,372.3 hours). Clearly these specimens were born healthy, symmetrically formed, and well maintained. One of the major problems in determining lifespan in captivity is that although most cases reported in the literature, on the news, or on the internet when born or collected rarely receive notification when they die.

Growth

The only comprehensive records on growth in a dicephalic snake are those for 'Brady & Belichick,' the *Lampropeltis triangulum* cared for by the author for 6.5 years (Wallach, 2012a). Table 10 summarizes growth data. When collected as a wild-caught neonate in Maine in September 2004 'Brady & Belichick' was 20 cm in length and weighed 4.0 g. Over the next 6 years and 6 months the snake grew to 81.5 cm in length with a weight of 160 g, averaging 95 mm and 23.7 g of growth/year. It shed its skin 51 times, averaging one molt every 43.1 days or 8 molts/year. It fed on 663 pinky and fuzzy mice, weighing between 1.0–8.0 g, with a total weight of 1,579.5 g and an average meal size of 2.4 g. The right head ('Belichick') was dominant and fed on 490 mice (78.5% of total meals) weighing 1109.5 g; the left head ('Brady') fed on 173 mice (21.5% of total meals) weighing 300.5 g. Table 11 presents complete growth data over each molting cycle. Slashes in columns 4 and 5 of Table 11 denote the number of mice eaten and their corresponding weights. 'Brady & Belichick' escaped on 14 Nov. 2006 and hid for 10 days being being recaptured. After that incident, the snake refused to eat for 7 weeks and lost 19.0

Figure 4. The head of a craniodichotomous *Thamnophis s. sirtalis* with two snouts (ANSP 21553).

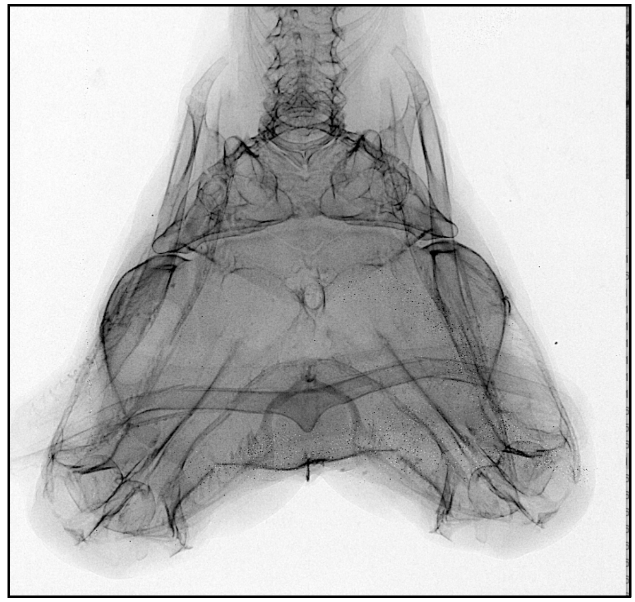

Figure 5. Radiograph of the craniodichotomous *Thamnophis s. sirtalis* shown in Figure 4 (ANSP 21553).

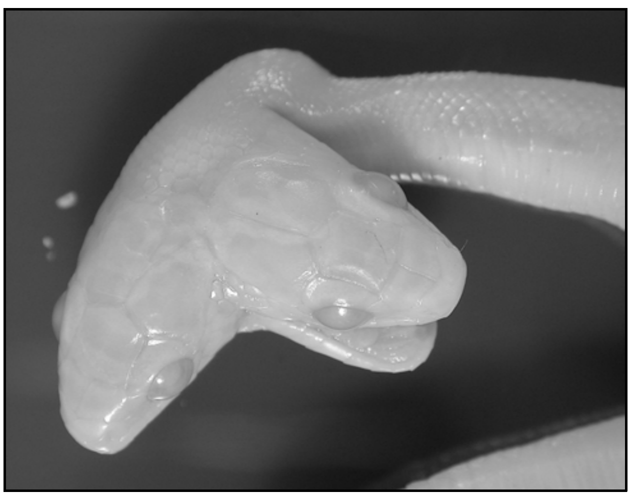

Figure 6. A craniodichotomous *Pantherophis guttatus* with two heads (VWABC 5).

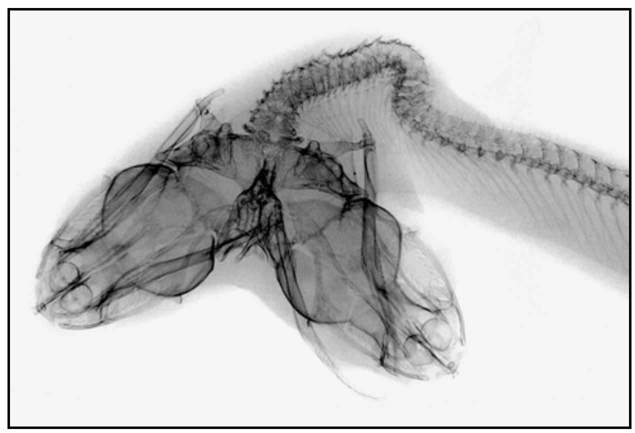

Figure 7. Radiograph of the craniodichotomous *Pantherophis guttatus* shown in Figure 6. (VWABC 5).

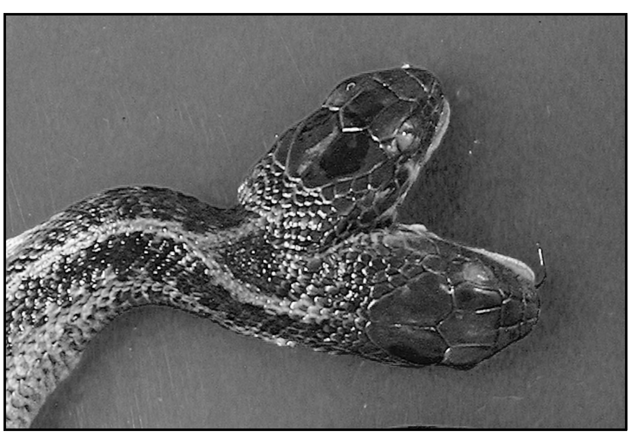

Figure 8. A prodichotomous *Thamnophis elegans vagrans* with short necks (VWABC 1).

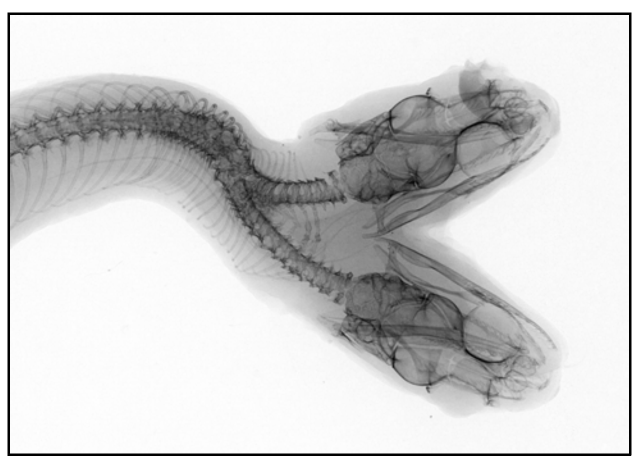

Figure 9. Radiograph of the prodichotomous *Thamnophis elegans vagrans* shown in Figure 8 (VWABC 1).

Figure 10. The heads of a prodichotomous *Lampropeltis triangulum gaigeae* with long necks (VWABC 14).

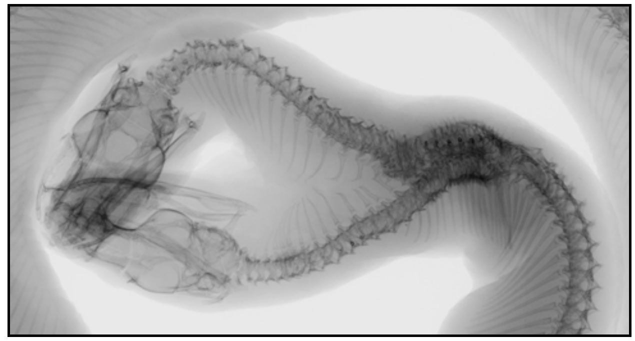

Figure 11. Radiograph of the prodichotomous *Lampropeltis triangulum gaigeae* shown in Figure 10 (VWABC 14).

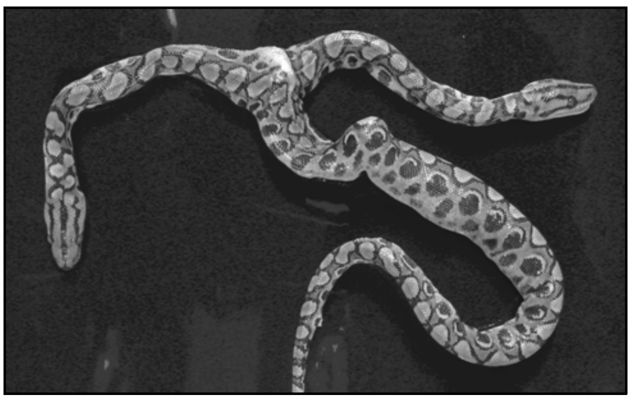

Figure 12. A proarchodichotomous Epicrates assisi (VWABC 4).

Figure 13. Radiograph of the proarchodichotomous *Epicrates assisi* shown in Figure 12 (VWABC 4).

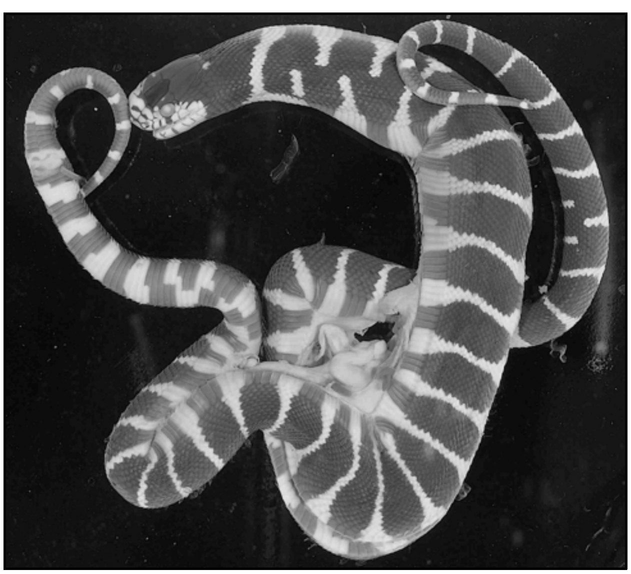

Figure 14. An opisthodichotomous *Lampropeltis californiae* (VWABC 9).

Figure 15. Radiograph of the head and necks of the opisthodichotomous *Lampropeltis californiae* shown in Figure 14 (VWABC 9).

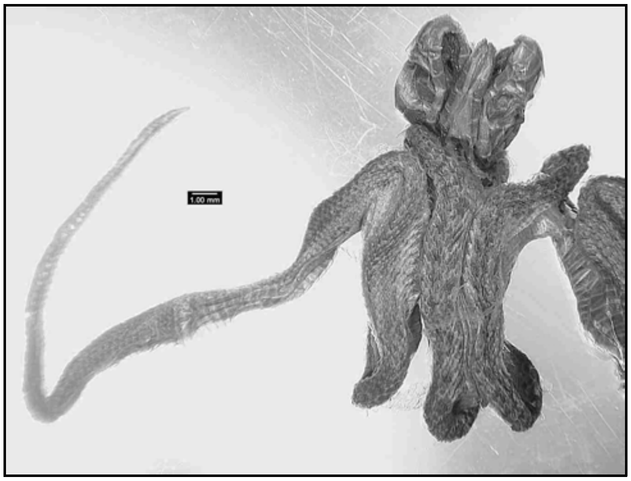

Figure 16. An amphidichotomous *Thamnophis sirtalis* (FMNH 267768).

grams of body weight. It appears from the growth data that the snake reached sexual maturity or adulthood after 4 years.

Other growth records are sparse for dicephalic snakes and initial and final length data are available for only another 19 snakes. An *Agkistrodon contortrix* lived at the Dan Nichols Park Nature Center, in Salisbury, North Carolina, in 2005 and grew from 15 cm to 20 cm in 2.5 months (B. Pendergrass, pers. comm.). A *Lampropeltis nigra* ('Dumb & Dumber') survived at Tennessee Tech University for 3.5 months and grew from 20 cm to 26.6 cm (Wallach, unpubl. data). 'Iggy & Ziggy,' a *Nerodia* sipedon from New York increased its length from 18.5 cm to 21.7 cm in 3.5 months (Wallach and Salmon, 2013). Two *Thamnophis ordinoides* from the state of Washington each survived for 4 months: one, which resided at Seattle's Woodland Park Zoo from 1974–1975, grew from 20 cm to 25 cm (Nelson and Slavens, 1975) and the other, which in 2014 lived in Jordini's Bistro, Port Townsend, grew from 30 cm to 35 cm (D. White, pers. comm.) A *Lampropeltis calligaster* from the St. Louis Zoo increased its size from 28 cm to 40 cm in 4 months (Cunningham, 1937). 'Four Fangs" (*Crotalus viridis*) grew from 26 cm to 28.5 cm in 4.5 months (Reid, 2005). A neonate *Thamnophis elegans* from Oregon increased its length from 30.5 cm to 38.1 cm in 6 months (Cunningham, 1937). A *Pantherophis vulpinus* from Illinois named 'Bully-Bully' grew from 30 cm to 80 cm in 2.5 years (J. Grafton, pers. comm.) and a *Pituophis catenifer* from Missouri named 'Coil & Recoil' also lived 2.5 years (from 1983 to 1986) and doubled its size from 35 cm to 70 cm (Johnson, 1987). A *Thamnophis sauritus* that resided at the North Carolina State Museum of Natural History for nearly 3 years grew from ca. 20 cm to 35.4 cm (Beane, 2009). A *Nerodia sipedon* named 'Hatfield & McCoy' lived in the Miami Serpentarium for almost 4 years (1980–1984) and grew from a 15-cm neonate to a 95-cm adult (G. Salmon, pers. comm.). 'Double Trouble II,' a *Crotalus horridus* owned by Fred Lally from 1995–2000 grew from a 30 cm neonate to 107 cm adult in 4.5 years (Wallach, 2003a). 'Reginald & Llewellyn,' the *Pituophis catenifer* that lived in the Los Angeles Zoo from 1973 to 1982 grew from a 23-cm hatchling to 1 m in 9 years (Wallach, 2003b). 'Two-Heads,' a *Pantherophis spiloides* in the Mississippi Museum of natural Science has grown from 25 cm to 137 cm in the 13 years since 2003 (K. Dierolf, pers. comm.). In the 15 years since 2002 'Laverne & Shirley' (*Pantherophis spiloides*) has increased in size from 45 cm to 1 m (J. Brewer, pers. comm.). The only dicephalic snake to appear in the movies ("Sssssss" in 1973 and "Resurrection" in 1980) is 'Gertrude,' who grew from 61 cm to 183 cm in the 16 years from 1967 to 1983 (Wallach, 2003b). 'Thelma & Louise I' (*Pantherophis guttatus*) grew from a 30-cm hatchling in 1984 to a 1.52-m adult in 2000 during her 16 years at the San Diego Zoo (Wallach, 2003b).

'Dudley Duplex I,' a *Lampropeltis californiae* who became famous and appeared on a TV show ("You Asked for It"), set a longevity record in the 1950s of 6.5 years as the previous record stood at one year (Chapman, 1960). 'Dudley Duplex I' lived in the San Diego Zoo from 1953 to 1960 and grew from 30 cm to 80 cm (Shaw and Campbell, 1974). Of the 174 meals consumed by this snake, the right head ('Dudley') ate 139 (79.9%), the left head ('Duplex') ate 7 (4.0%), and both heads ate 28 meals simultaneously (16.1%) (Shaw, 1959).

Twins

Twins may be identical, monozygotic or maternal (from a single yolk mass and single umbilicus) or non-identical, dizygotic or fraternal (each with a separate yolk mass and umbilical cord). Conjoined twins are identical twins fused together, as exemplified by a case of amphidichotomy in *Hemachatus haemachatus* that had two males fused along the midbody section but with craniodichotic heads and separate tails (Haagner, 1994). Identical twins include *Opheodrys aestivus* (Curtis, 1950), *Pituophis melanoleucus* (Rothman, 1960), *Elaphe bimaculata* (Petch, 1990), *Python molurus* (Manimozhi et al., 2006), and *Pantherophis guttatus, Python regius* (Wallach, unpubl. data). Fraternal twins include *Elaphe climacophora* (Fukada, 1978), *Philodryas patagoniensis* (Gudynas and Gambarotta, 1981), *Morelia spilota* (Ross and Marzec, 1990), *Morelia viridis* (Crowe, 2000; Weier, 2000), and *Pantherophis guttatus,* and *Thamnophis sirtalis* (Wallach, unpubl. data). Undetermined twins include *Natrix natrix* (Klaussner, 1890), *Coronella austriaca* (Cligny, 1897), *Diadophis punctatus* (Groves, 1978), *Pantherophis spiloides* (Shuette, 1978), *Boiga dendrophila* (Howard, 1984), *Orthriophis taeniurus* (Schulz, 1987), *Pantherophis guttatus* (McEachern, 1991), *Ptyas korros* (Dieckmann et al., 2014), and *Aspidites melanocephalus, Lampropeltis californiae, Morelia spilota, Pantherophis guttatus, Pantherophis obsoletus,* and *Python sebae* (Wallach, unpubl. data).

One of a pair of twins in *Python regius* was normal but the other was an albino (Wallach, unpubl. data). A pair of fraternal twins in *Pantherophis guttatus* had separate genders and color patterns but each umbilicus fused near a single yolk sac (Marion and Nowak, 1980). A pair of twins in *Erpeton tentaculatum* had separate umbilical cords going to a single yolk sac (Aucone and Branham, 2005). Breeding of an axanthic mother to a hypo 66% albino male in *Aspidites melanocephalus* resulted in two sets of twins from a three-egg clutch. In *Pantherophis guttatus*, a cross between a Hypo Blood Amel Het Anery female and a Hypo Blood Het Amel male resulted in a set of twins, and a mating of an Ultramel Het Caramel male produced two sets of twins from different females, one being Ultramel Het Charcoal poss Het

Diffused and the other Ultramel Het Caramel Charcoal (Wallach, unpubl. data).

A frequent occurrence is the presence of a pair of twins in a clutch or brood containing a dicephalic individual, as in *Coluber constrictor* (Wallach, 1995), *Morelia spilota* (Mutton and Julander, 2011), *Boaedon fuliginosus* × *lineatus, Hydrodynastes gigas, Lampropeltis triangulum* (twice for one female), *Morelia spilota, Pantherophis guttatus,* and *Python regius* (Wallach, unpubl. data). 'Medusa IV,' a beautiful tangerine albino *Lampropeltis triangulum* has an unusual history. It was bred in 2011 by Daniel Parker in Florida, resided with Ben Siegal from 2012 to 2015, and then was sold to Todd Ray of Venice, California. Its mother was an albino and hatched a dicephalic and pair of twins in 2010, and in 2011 she produced 'Medusa IV,' a second set of twins, and a normal albino. Two sets of twins in one clutch have been recorded in *Elaphe climacophora, Lampropeltis californiae,* and *Pantherophis guttatus* (Wallach, unpubl. data), and three sets of twins have occurred in a wild-caught *Pelias berus* (Leighton, 1901). Two sets of twins plus a dicephalic are known from a *Thamnophis sirtalis* (Anon., 1891) and *Python regius* (Gund, 2001).

Two sets of twins in a single clutch are known in *Pseudechis colletti* (Kinkaid, 1996) and *Pantherophis guttatus* (Wallach, unpubl. data). Twins were present in two different clutches (n = 22 and n = 31) of *Xenochrophis piscator* laid in the same year (Singh and Thapilyal, 1973). Triplets are extremely rare but are known in *Malayopython reticulatus, Morelia spilota,* and *Python bivittatus*. A most unusual occurrence is that of a pair of twin snakes with one being normal (although smaller in size than other siblings) and the other dicephalic. This is reported in *Coluber constrictor* (Brimley, 1903) and *Heterodon platirhinos* (Meyer, 1958). Also unusual is the presence of an amphidichotomous pair of twins in which one specimen is small (SVL = 48 mm) and the other is three times its length (SVL = 145 mm) as in a *Nerodia rhombifer* from Arkansas (Burkett and Huggins, 1985).

Repeated twinning sometimes occurs, as in *Pituophis catenifer pumilis* wherein a twin mother produced three sets of twins in eight years (B. Fengya, pers. comm.). A twin Ultramel Het Caramel male *Pantherophis guttatus* bred to an Ultramel Het Caramel Charcoal female produced two sets of twins in different clutches whereas the two sets of twins from another *Pantherophis guttatus* were in the same clutch and one set was normal but the other set Amber (Wallach, unpubl. data). A *Morelia spilota* had a clutch with both a dicephalic and a pair of twins (Mutton and Julander, 2011).

Nathan Roberts had a pair of dicephalic *Morelia spilota* appear in one clutch in 2010, Steven J. Arnold had a pair of dicephalic *Thamnophis couchii* born in a single brood from California, and Mario Schweiger produced three dicephalic *Thamnophis sirtalis* from a single mother collected in Florida in 1979. An unconfirmed online report lists one female that has produced 10 sets of twins and one set of triplets.

Pet names

Owners of dicephalic pet snakes often give them witty and humorous names, occasionally more than once. In the following list of known epithets for two-headed snakes, Roman numerals following a name indicate how many different snakes were given the same name. The most popular names are 'Medusa,' attributed to five snakes, 'Double Trouble,' given to four snakes, and 'Hydra,' which has been used three times. Another dozen snakes were given an identical name twice. The species with the most epithets is *Lampropeltis californiae* with 19, followed by *Pantherophis guttatus* with 14 and *Lampropeltis triangulum* with 12. Following is a list or recorded pet names for two-headed snakes: *Agkistrodon contortrix* (Louele), *Boa constrictor* (Deuce; Hydra I), *Boa constrictor constrictor* (Him; Indy), *Boa constrictor occidentalis* (Curve & Recurve), *Boaedon capensis* (Four Noses), *Bothrops asper* (Atrox & Asper), *Coluber constrictor constrictor* (Split Sam), *Coluber constrictor priapus* (Double Trouble IV), *Crotalus atrox* (Chang & Eng; Stuck & Unstuck; Hammerhead; The Hammer; Turdblossom), *Crotalus basiliscus* (Triangle Head), *Crotalus horridus* (Double Trouble III; DT; Slither & Slather), *Crotalus lepidus* (Kickstand), *Crotalus viridis* (Double Trouble II; Four Fangs; Twins), *Crotaphopeltis hotamboeia* (Byron), *Daboia russelii* (Russel & Russell), *Elaphe dione* (Sids), *Epicrates assisi* (Neck & Neck I), *Epicrates cenchria* (Jesus & Angel), *Heterodon nasicus* (Duane & Belial; Gemineye; Triclops), *Heterodon platirhinos* (Lenny & Squiggy I), *Lampropeltis californiae* (Blinky & Mortimer; Brett & Brandon; DD I; DD II; Double Trouble I; Dudley; Dudley Duplex I; Dudley Duplex II; Dually; Medusa V; Mince; Nip & Tuck; No Name I; No Name II; Split End; Three Eyes; Tom & Jerry I; Tom & Jerry II; Two Tales; Zany & Brainy), *Lampropeltis californiae* × *L. splendida* (Opposite Directions), *Lampropeltis getula* (Frick & Frack; Sally & Susie), *Lampropeltis holbrooki* (Hydra III), *Lampropeltis mexicana thayeri* (Hola & Adios), *Lampropeltis mexicana* × *L. ruthveni* (Ditto), *Lampropeltis nigra* (Dumb & Dumber; Mary-Kate & Ashley), *Lampropeltis pyromelana* (Bingo-Bongo; Laverne & Shirley II), *Lampropeltis splendida* (Loren & Leroy), *Lampropeltis triangulum gaigeae* (Oscar II), *Lampropeltis triangulum hondurensis* (Cleo & Patra; Dave & Dave; Eddie; Eddy; Medusa IV; Trick & Treat), *Lampropeltis triangulum triangulum* (Brady & Belichick; Dubby; Frank & Nikki; Oscar I; Tick & Tock), *Lamprophis capensis* (Simunye), *Lamprophis fuliginosus* × *L. lineatus* (Kenya & Orono), *Lichanura trivirgata roseofusca* (Nosy & Nosier; Rosy & Rosier), *Morelia spilota* (Pete & Repeat I; Pete & Repeat II), *Morelia spilota cheynei* (Dave & Tracy), *Morelia spilota mcdowelli* (Cain & Able; Katana & Wakizashi), *Morelia spilota metcalfei* (Pete & Re-Pete; Us), *Morelia viridis* (Helter-Skelter), *Natrix natrix* (Slither), *Natrix natrix helvetica* (Four Eyes I), *Nerodia sipedon sipedon* (Hatfield & McCoy; Iggy & Ziggy), *Oligodon barroni* (Mai & Thai), *Oocatochus rufodorsatus* (Slinky & Kinky), *Oreocryptophis porphyraceus coxi* (Schulz & Helfenberger), *Orthriophis taeniurus* (Yin & Yang I), *Pantherophis alleganiensis* (Janus II), *Pantherophis guttatus* (Abbott & Costello; Bo & Luke; Boo; Bush & Rowe; Danny & Arnie; Four Eyes II; Hope; Hydra II; Lucky Destiny; Pint & Half-Pint; Splitting Headache; Thelma & Louise I; Twosome; Xiuhcoatl; Zack & Wheezie), *Pantherophis guttatus* × *P. emoryi* (Emory & Maiz), *Pantherophis obsoletus* (Barney; Golden Girls; Janus I; Jeffrey & Jeffrey the Great; Medusa III; Them I; We; 2-Face), *Pantherophis spiloides* (I-M;

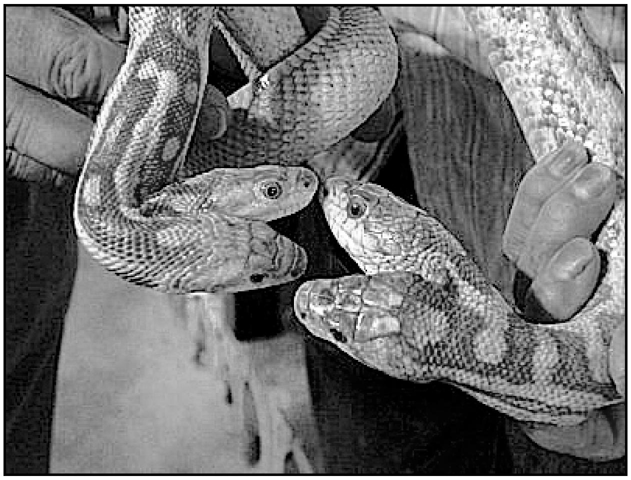

Figure 17. A pair of adult *Pantherophis obsoletus* (‘We’ on left and ‘Golden Girls’ on right).

Instinct-Mind; Laverne & Shirley I; Lefty & Righty; Thelma & Louise II; Two-Head), *Pantherophis vulpinus* (Bully-Bully), *Pituophis catenifer annectens* (Deucey; Double Header; Fred; Reginald & Llewellyn; Reginald & Luiwelan), *Pituophis catenifer catenifer* (Medusa I; Slick & Freddy), *Pituophis catenifer sayi* (Buddy & Bobby; Coil & Recoil), *Pituophis melanoleucus melanoleucus* (Them II), *Pituophis melanoleucus mugitus* (Gertrude; Hocus & Pocus), *Python regius* (Giano; Lenny & Squiggy II; Medusa II), *Regina septemvittata* (Ying-Yang), *Rhinechis scalaris* (Hiss & Hiss), *Sistrurus miliarius* (Neck & Neck II), *Thamnophis elegans terrestris* (Frank & Stein), *Thamnophis radix* (Gartie), *Thamnophis sirtalis* (Three-Point-Two; Two Face; Yin & Yang II), *Thamnophis sirtalis fitchi* (George & Bob), *Thamnophis sirtalis pickeringii* (Snakey), *Thamnophis sirtalis sirtalis* (Dual Snout; The Odd Couple), *Thamnophis sirtalis tetrataenia* (Beauty & The Beast; Two-Faced), *Thamnophis* sp. (BillyBob), and *Tropidolaemus wagleri* (Split Personality).

Probably the most famous dicephalic snake was ‘We,’ an amelanistic (or High Red Albino) *Pantherophis obsoletus*, that lived for eight years (1999–2007) in the World Aquarium in St. Louis, Missouri. Purchased for $15,000 in July 1999 as a 300-mm juvenile, it was right-head dominant although both heads would eat, and it grew to 1.5 m by its death on 20 June 2007. Its owner, Leonard Sonnenschein, claimed that ‘We’ was a hermaphrodite (with one head being male and the other female!) but this condition could only be determined through examination of the reproductive viscera via dissection after death. The only documented hermaphrodite was a *Coluber constrictor* from Massachusetts, collected in 1849 and examined by F. W. Putnam in 1862, that had a male hemipenis only on the right side of the body but was female on the left side (Johnson, 1902: case IX; Cunningham, 1937: plate 5, figures 51–52; Dexter, 1976: figure 1). Sonnenschein once tried unsuccessfully to mate ‘We’ with another two-headed snake (‘Golden Girls’) in Wisconsin (Figure 17). Two former teenage zoo employees broke into the zoo and stole ‘We’ on 24 August 2004 but the police recovered the snake within a few hours from Brandon Smith’s garage. It is estimated that more than one million visitors saw ‘We’ at the zoo and it even appeared once on the Regis and Kelly TV show. Before “We’ died in 2007 Sonnenschein tried to sell it for $150,000. On 3 January 2006 ‘We’ was advertised on eBay for one day before it was known that live animals cannot be sold on eBay. The highest bid of $50,000 was declined by the zoo; however, Nutra Pharma, a biopharmaceutical company, did sign a $15,000 deal in November 2006 to use ‘We’ as its icon. ‘We’ was freeze-dried after its death and recently (November 2016) was placed up for auction at Link Auction Galleries (auction 1019, lot #44) with an opening bid of $25,000 but there were no bids.

Institutions or owners that have had more than one living specimen include the following: San Diego Zoo (6: Dudley Duplex I, Dudley Duplex II, Nip & Tuck, No Name I, Thelma & Louise I, Tom & Jerry I); Todd Ray, Venice (5: Laverne & Shirley II, Lenny & Squiggy I, Medusa IV, *Boa constrictor, Pituophis melanoleucus*); Fred Lally (4: *Crotalus atrox, C. horridus, Pantherophis guttatus, P. obsoletus*); Jay Brewer (3: *Lampropeltis californiae, Malayopython reticulatus, Pantherophis spiloides*), Bob Clark (2: *Python bivittatus, Pantherophis obsoletus*); World Aquarium, St. Louis (2: We and Us); Brian Barczyk (2: *Lampropeltis getula, L. triangulum*), Van Wallach (2: Brady & Belichick and Iggy & Ziggy). Collections of snakes with three or more extant specimens of axial bifurcation include the following: the author’s private collection (VWABC), Cambridge (n = 20), USNM, Washington (n = 13), MCZ, Cambridge (n = 12), IB, São Paulo (n = 10), CAS, San Francisco (n = 8), MNHN, Paris (n = 7), MRCS, London (n = 7), ZSI, Kolkata (n = 7), FAKU, Kyoto (n = 6), PEM, Port Elizabeth (n = 6), FMNH, Chicago (n = 5), NCSM, Raleigh (n = 5), MSNM, Milan (n = 5), AMS, Sydney (n = 5), NMW, Vienna (n = 5), UMMZ, Ann Arbor (n = 4), ANSP, Philadelphia (n = 4), CM, Pittsburg (n = 4), BMNH, London (n = 4), TM, Pretoria (n = 4), John S. Applegarth private collection, Eugene (n = 4), MVZ, Berkeley (n = 3), AMNH, New York (n = 3), ZMB, Berlin (n = 3), ZFMK, Bonn (n = 3), and NHMB, Belgrade (n = 3).

Acknowledgments

For the donation of material for examination I thank Kayvon Ashrafzadeh (*Pantherophis guttatus*). Laboratory space for examination of material and imaging facilities were provided by the MCZ (José Rosado). Joe Martinez took the images of *Bitis gabonica.* The following people provided data on dicephalic reproduction: Steven J. Arnold, Idan Berlad, Berkeley Boone, Jay Brewer, Kevin Bryant, Chantel, Ben Cole, Francesco De Filippo, Ashley Denham, Neil Gushulak, Geoff Jacobs, Gary Leverton, Bill Love, Dingus Mgee, Nick Mutton, Vanja Paris, Rhil Roth, Mario Schweiger; Fons Sleijpen, Al Stotton, Charles Wright, John Zegel, and Rich Zuchowski.

Table 2. Distribution of cases by family (% total = percent of 1850, % with ID = percent of 1431).

Family	Category (see text for explanation)				All categories	% total	% with ID
	I	II	III	IV			
Colubridae	84	335	121	2	542	29.3	37.9
Natricidae	100	111	121	3	335	18.1	23.4
Viperidae	71	83	107	5	266	14.4	18.6
Pythonidae	2	65	17	1	85	4.6	5.9
Boidae	14	32	10	—	56	3.0	3.9
Dipsadidae	6	22	19	—	47	2.5	3.3
Hydrophiidae	11	3	18	—	32	1.7	2.2
Xenodontidae	15	7	—	—	22	1.2	1.5
Lamprophiidae	8	7	2	—	17	0.9	1.2
Homalopsidae	5	7	2	—	14	0.8	1.0
Elapidae	3	8	2	—	13	0.7	0.9
Leptotyphlopidae	1	—	—	—	1	0.05	0.07
Tropidophiidae	1	—	—	—	1	0.05	0.07
Unknown	15	60	299	45	419	22.6	—
Total	336	740	718	56	1850	—	—

Table 3. Distribution by type of dichotomy (% total = percent of 1850, % known = percent of 1017).

Dichotomy type	Category (see text for explanation)				All categories	% total	% known
	I	II	III	IV			
Prodichotomous	120	348	130	3	601	32.5	59.1
Craniodichotomous	102	176	25	1	304	16.4	29.9
Proarchodichotomous	4	32	7	—	43	2.3	4.2
Amphidichotomous	11	14	14	1	40	2.2	3.9
Urodichotomous	3	7	5	1	16	0.9	1.6
Opisthodichotomous	7	5	1	—	13	0.7	1.3
Unknown	89	158	536	50	833	45.0	—
Total	336	740	718	56	1850	—	—

Table 4. Distribution of cases by geographical region (% total = percent of 1850, % known = percent of 1830).

Region	Category (see text for explanation)				All categories	% total	% known
	I	II	III	IV			
North America	145	424	565	41	1175	63.5	64.2
Europe	68	63	41	9	181	9.8	9.9
Asia	44	99	28	1	172	9.3	9.4
Australia–Indonesia	10	46	52	2	110	5.9	6.0
South America	37	32	11	—	80	4.3	4.4
Africa–Madagascar	19	37	9	3	68	3.7	3.7
Mesoamerica–Caribbean	13	28	3	—	44	2.4	2.4
Unknown	—	11	9	—	20	1.1	—
Total	336	740	718	56	1850	—	—

Table 5. Distribution of records by state in the continental USA (% total = percent of 1080, % known = percent of 893).

State	Category (see text for explanation)				All categories	% total	% known
	I	II	III	IV			
California	18	48	44	1	111	10.3	12.4
Pennsylvania	7	9	50	1	67	6.2	7.5
Texas	7	19	32	1	59	5.5	6.6
New York	5	16	26	3	50	4.6	5.6
Oregon	8	9	26	2	45	4.2	5.0
Georgia	2	6	32	1	41	3.8	4.6
Florida	4	23	11	2	40	3.7	4.5
North Carolina	7	13	14	—	34	3.1	3.8
Ohio	4	5	24	1	34	3.1	3.8
Indiana	2	6	20	—	28	2.6	3.1
Illinois	6	8	11	1	26	2.4	2.9
Massachusetts	10	6	7	3	26	2.4	2.9
Missouri	2	8	13	—	23	2.1	2.6
Virginia	5	6	10	2	23	2.1	2.6
Iowa	—	9	12	1	22	2.0	2.5
Kentucky	1	1	20	—	22	2.0	2.5
South Carolina	—	4	16	—	20	1.9	2.2
Kansas	—	8	8	3	19	1.8	2.1
Tennessee	2	6	10	1	19	1.8	2.1
Michigan	2	2	10	1	15	1.4	1.7
Wisconsin	—	2	12	—	14	1.3	1.6
Washington	—	5	8	—	13	1.2	1.5
West Virginia	—	2	10	1	13	1.2	1.5
Maryland	3	3	6	—	12	1.1	1.3
Alabama	2	5	3	—	10	0.9	1.1
Nebraska	—	5	5	—	10	0.9	1.1
Arkansas	1	4	4	—	9	0.8	1.0
Oklahoma	—	3	6	—	9	0.8	1.0
New Jersey	—	4	4	—	8	0.7	0.9
Utah	3	1	3	1	8	0.7	0.9
Arizona	1	2	4	—	7	0.6	0.8
Louisiana	1	1	3	1	6	0.6	0.7
Maine	1	1	4	—	6	0.6	0.7
Mississippi	2	1	2	1	6	0.6	0.7
New Hampshire	1	1	4	—	6	0.6	0.7
Idaho	—	2	2	1	5	0.5	0.6
Minnesota	—	4	1	—	5	0.5	0.6
Connecticut	1	—	3	—	4	0.4	0.4
Colorado	—	1	2	—	3	0.3	0.3
Montana	1	1	1	—	3	0.3	0.3
Nevada	—	1	2	—	3	0.3	0.3
New Mexico	—	—	3	—	3	0.3	0.3
South Dakota	—	1	1	—	2	0.2	0.2
Vermont	—	1	—	1	2	0.2	0.2
Delaware	—	—	1	—	1	0.1	0.1
Wyoming	—	—	1	—	1	0.1	0.1
North Dakota	—	—	—	—	0	0	0
Rhode Island	—	—	—	—	0	0	0
Unknown	32	101	43	11	187	17.3	—
Total	141	364	534	41	1080	—	—

Table 6. Longevity of dicephalic snakes surviving at least two years. An * indicates the snake is still alive at present (according to my latest information)

Species	Age	Name	Owner
Pituophis catenifer	22 years, 2–4 months	Medusa I	Steinhart Aquarium, San Francisco, CA
Pituophis catenifer	21 years, 1 month	Reginald & Llewellan	Los Angeles Zoo, CA
Lampropeltis splendida	16 years, 3 months	Loren & Leroy	Arizona State University, Tempe, AZ
Pantherophis spiloides	16 years	Instinct-Mind	University of Tennessee, Knoxville, TN
Pantherophis guttatus	16 years	Thelma & Louise I	San Diego Zoo, CA
Pantherophis obsoletus	16–18 years	Janus I	San Antonio Zoo, TX
Pituophis melanoleucus	16 years +	Gertrude	Russo's Pet Store, Newport Beach, CA
*Pantherophis spiloides**	15 years +	Laverne & Shirley	Prehistoric Pets, Valencia, CA
*Lampropeltis californiae**	15–17 years +	Tom & Jerry I	San Diego Zoo, CA
*Pantherophis spiloides**	13 years +	Two-Heads	Mississippi Mus. Nat. Sci., MS
Pituophis catenifer	11 years, 1 month	Double Header	La Sierra University, Los Angeles, CA
Pantherophis obsoletus	11 years	Golden Girls	Fred Lally, West Fork, AR
*Pantherophis obsoletus**	11 years +	Jeffrey & Jeffrey the Great	Cape Girardeau Nature Center, MO
*Lampropeltis holbrooki**	10 years +	?	Alligator Alley, Wisconsin Dells, WS
*Lampropeltis californiae**	9 years +	Tom & Jerry II	Reptiles du Monde, Switzerland
Agkistrodon contortrix	9 years	?	Brazos Bend Nature Center, Damon, TX
Pantherophis obsoletus	8 years	We	World Aquarium, St. Louis, MO
Lampropeltis triangulum	7 years, 3 months	Eddy	Reptilandia, Grand Canary Islands
Lampropeltis californiae	7 years	Zany & Brainy	Prehistoric Pets, Valencia, CA
Lampropeltis triangulum	6 years, 6 months	Brady & Belichick	Van Wallach, Cambridge, MA
Lampropeltis californiae	6 years, 5 months	Dudley Duplex II	San Diego Zoo, CA
*Pituophis catenifer**	6 years +	Deucey	Audubon Zoo, New Orleans, LA
*Python regius**	6 years +	Giano	M&S Reptilien, Germany
Pituophis catenifer	6 years +	?	Santa Barbara Mus. Nat. Hist., CA
*Pantherophis guttatus × emoryi**	5 years, 6 months +	Xiuhcoatl	Luis Torres, Ixtapaluca, Mexico
Lampropeltis californiae	5 years, 5 months	Nip & Tuck	San Diego Zoo, CA
*Lampropeltis californiae**	5 years +	?	South Florida Reptile Exchange
Crotalus horridus	4 years, 6 months	Double Trouble	Fred Lally, West Fork, AR
Pituophis catenifer	4 years +	?	John Robinson, Sideshow World
Nerodia sipedon	4 years +	Hatfield & McCoy	Miami Serpentarium, FL
Boa constrictor	4 years +	Hydra II	Poland
Lampropeltis californiae	3 years, 7 months	Dudley Duplex I	San Diego Zoo, CA
*Heterodon nasicus**	3 years +	Duane & Belial	Ashlery Denham, U.K.
*Thamnophis marcianus**	3 years +	Mince	Dmytro Tkachov, Yalta Zoo
Thamnophis sauritus	2 years, 10 months	?	North Carolina State Mus. Nat. Hist., NC
Pituophis catenifer	2 years, 6 months	Coil & Recoil	Hoessel Herpetarium, St. Louis, MO
*Thamnophis sirtalis**	2 years, 4 months	Yin & Yang II	Clinton Horner, Denver, CO
*Pantherophis guttatus**	2 years +	?	Serpentarium Magic, Mills River, NC
Gloydius blomhoffii	2 years	?	Shinto Temple, Nigata, Japan

Table 7. Sale prices of live dicephalic snakes.

Year	Species	Price	Name	Sold
1935	*Nerodia* sp.	$ 3	—	Yes
1873	*Thamnophis* sp.	$ 5	—	Yes
1980	*Nerodia sipedon*	$ 50	Hatfield &	Yes
2013	*Pantherophis spiloides*	$ 50	—	Yes
1900	*Thamnophis hammondii*	$ 100	—	Yes
1915	*Sistrurus catenatus*	one horse	—	Yes
2006	*Pantherophis vulpinus*	$ 200	Bully-Bully	Yes
2011	*Pantherophis guttatus*	$ 200	Zak & Wheezie	No
1970	*Crotalus viridis*	$ 500	Double Trouble I	Yes
2016	*Pituophis melanoleucus*	$ 550	—	Yes
2010	*Lampropeltis triangulum*	$ 650	—	Yes
2015	*Pantherophis obsoletus*	$ 650	—	Yes
1994	*Thamnophis elegans*	$ 750	—	Yes
2005	*Lampropeltis californiae*	$ 750	—	Yes
2012	*Nerodia sipedon*	$ 795	—	Yes
1995	*Crotalus horridus*	$ 850	Double Trouble	Yes
1967	*Regina septemvittata*	$ 3,000	—	No
2002	*Diadophis punctatus*	$ 3,000	—	No
1984	*Pantherophis guttatus*	$ 3,500	Thelma & Louise	Yes
1999	*Nerodia sipedon*	$ 4,500	—	?
2004	*Python bivittatus*	$ 4,500	—	Yes
1972	*Pituophis melanoleucus*	$ 5,000	Gertrude	Yes
2007	*Lampropeltis pyromelana*	$ 5,000	Bingo-Bongo	Yes
2010	*Thamnophis* sp.	$ 5,000	—	No
2014	*Pituophis melanoleucus*	$ 5,000	—	Yes
2000	*Lampropeltis californiae*	$ 6,000	Tom & Jerry II	Yes
2011	*Lampropeltis californiae*	$ 6,500	—	Yes
2013	*Pantherophis guttatus*	$ 7,000	Hydra I	No
2006	*Pantherophis guttatus*	$ 7,500	—	Yes
2009	*Boa constrictor*	$ 7,500	—	Yes
2016	*Pantherophis guttatus*	$ 8,000	—	Yes
2007	*Morelia spilota*	$ 10,000	Us	Yes
2011	*Pantherophis guttatus*	$ 12,500	Lucky Destiny	Yes
2006	*Lampropeltis triangulum*	$ 14,750	—	No
2006	*Pantherophis obsoletus*	$ 15,000	We	Yes
2014	*Pantherophis guttatus*	$ 15,000	Xiuhcoatl	No
2001	*Pantherophis obsoletus*	$ 20,000	—	Yes
2005	*Lampropeltis mexicana* x *ruthveni*	$ 20,000	Ditto	Yes
2009	*Heterodon platirhinos*	$ 20,000	Lenny & Squiggy	Yes
2011	*Thamnophis marcianus*	$ 21,000	Mince	Yes
2000	*Pantherophis obsoletus*	$ 25,000	Golden Girls	Yes
2003	*Boa constrictor*	$ 40,000–100,000	Indy	Yes
2006	*Boa constrictor*	$ 40,000	—	No
2010	*Python regius*	$ 40,000	Giano	Yes
1993	*Heterodon* sp.	$ 50,000	—	No
1995	*Lampropeltis californiae*	$ 50,000	—	Yes
2011	*Lampropeltis triangulum*	$ 50,000	Medusa IV	Yes
2009	*Pituophis catenifer*	$ 120,000	Deucey	Yes
2006	*Pituophis obsoletus*	$ 150,000	We	No
2007	*Elaphe bimaculata*	$ 500,000	—	No

Table 8. Recorded lengths of greater than 1 m in dicephalic snakes. Status: Alive = known alive; ? = uncertain if alive or dead; Dead = date of death unknown; Year = date known to have died.

Species	Pet Name	Total length (cm)	Status
Pituophis melanoleucus	Gertrude	183	1983
Pituophis melanoleucus	Them II	183	Dead
Pantherophis obsoletus	—	167.5	1819
Pantherophis obsoletus	Golden Girls	152.5	Alive
Pantherophis guttatus	Thelma & Louise I	152	2000
Nerodia sipedon	—	150	1890
Pantherophis spiloides	I-M	149	1992
Pantherophis spiloides	Two-Heads	137	Alive
Coluber constrictor	—	129.5	1908
Pantherophis obsoletus	We	122	2007
Pantherophis obsoletus	—	120	1873
Thamnophis sirtalis	—	120	1949
Pituophis catenifer	—	106.5	1913
Pituophis catenifer	Reginald & Llewellyn	100	1982
Epicrates angulifer	—	100	?
Pantherophis obsoletus	Janus I	100	1993
Lampropeltis triangulum	Medusa IV	100	Alive
Pantherophis spiloides	Laverne & Shirley	100	Alive
Lampropeltis californiae	Tom & Jerry I	100	Alive

Table 9. Survival time for 450 specimens with axial bifurcation.

	Stillborn	Hours	Days	Weeks	Months	Years
n	180	30	51	32	85	72
% total	40.0	6.7	11.3	7.1	18.9	16.0
Range	—	0.1–5	0.5–6	1–3	1–9	1–22.3
Mean	—	1.72	2.24	1.94	3.22	5.42

Table 10. Shedding, feeding, length and weight summary for 'Brady & Belichick' (*Lampropeltis triangulum*) over a 6.5-year period.

	Shedding		Feeding			Length		Weight	
Year	**Number of sheds**	**Mean interval (days)**	**Number of meals**	**Total weight of meals (g)**	**Mean weight of meals (g)**	**Total (mm)**	**Gain (mm)**	**Total (g)**	**Gain (g)**
Birth	—	—	—	—	—	200	—	4.0	—
1	7	46	40	63	1.6	290	90	9.2	5.2
2	10	39	62	111.5	1.8	400	110	20.3	11.1
3	14	26	154	334.5	2.2	665	265	67.6	47.3
4	7	47	127	322	2.5	765	100	107.7	40.1
5	4	71	71	236	3.3	770	5	118	10.3
6	6	63.5	136	375.5	3.8	790	20	148	30.0
7	2	63.5	73	137	1.9	815	25	160	12
Total	51	43.1	663	1,579.5	2.4	815	615	160	156

Table 11. Length, weight, and feeding data for all shedding cycles in 'Brady & Belichick' (*Lampropeltis triangulum*) over a 6.5-year period. A = shed number, B = date of shed, C = shedding interval in number of days (weeks), D = number of mice eaten (by weight category), E = weight of mice eaten (by category in g), F = total meal weight (g), G = maximum length of snake (mm) H = length gain of snake (mm), I = body weight of snake (g), J = weight gain of snake (g).

A	B	C	D	E	F	G	H	I	J
1	7 Oct. 2004	—	—	—	—	200	—	4.0	—
2	17 Nov. 2004	41 (6)	4	1.0	4	210	10	4.7	0.7
3	29 Dec. 2004	42 (6)	5	1.0	5	220	10	5.5	0.8
4	20 Feb. 2005	46 (7.5)	8	1.5	12	230	10	6.4	0.9
5	4 May 2005	73 (10.5)	8	1.5	12	240	10	7.7	1.3
6	11 June 2005	38 (4.5)	6	2.0	12	260	10	8.1	0.4
7	22 July 2005	41 (6)	5	2.0	10	280	10	9.0	0.9
8	30 Aug. 2005	39 (5)	4	2.0	8	290	10	9.2	0.2
9	23 Oct. 2005	54 (7.5)	5	2.0	10	300	10	9.5	0.3
10	8 Jan. 2006	77 (10)	6	2.0	12	310	10	9.7	0.2
11	2 Feb. 2006	25 (3.5)	4	2.0	8	325	15	11.1	1.4
12	3 Mar. 2006	29 (4)	4	2.0	8	340	15	13.1	2
13	1 Apr. 2006	29 (4)	6/1	2.0/1.0	13	355	15	15.3	2.2
14	18 May 2006	47 (6.5)	4/2	2.0/1.5	11	365	10	16.4	1.1
15	17 June 2006	30 (4)	5	1.5	7.5	370	5	17.1	0.7
16	16 July 2006	29 (4)	9/1	1.5/2.0	15.5	380	10	18.2	1.1
17	15 Aug. 2006	30 (4)	5/2	2.0/1.5	13	390	10	19.2	0.7
18	22 Sept. 2006	38 (5)	3/5	2.0/1.5	13.5	400	10	20.3	1.1
19	24 Nov. 2006	63 (9)	2/6	2.0/1.5	13	410	10	20.1	1.1
20	15 Dec. 2006	21 (3)	4/3/1	2.0/1.5/1.0	13.5	420	10	21.3	1.2
21	15 Jan. 2007	31 (4)	9/2/1	2.0/1.5/1.0	22	430	10	25.5	4.2
22	30 Jan. 2007	15 (2)	11/5/1	2.0/1.5/0.5	30	450	20	33.2	7.7
23	14 Feb. 2007	15 (2)	1/5/13/1	2.5/2.0/1.5/1.0	33	480	30	39.7	6.5
24	1 Mar. 2007	15 (2)	4/3/3/9	3.0/2.5/2.0/1.5	40	525	45	46.5	6.8
25	18 Mar. 2007	17 (2)	12/4/10	3.0/2.5/1.5	61	575	50	63.6	17.1
26	2 Apr. 2007	16 (2)	12/1/2/4	3.0/2.5/1.5/1.0	45.5	640	65	73.4	9.8
27	10 May 2007	38 (5)	5	3.0	15	645	5	67.3	– 6.1
28	8 June 2007	29 (4)	1	3.0	3	650	5	65.8	– 1.5
29	19 July 2007	41 (6)	2	3.0	6	650	0	61.4	– 4.4
30	9 Aug. 2007	21 (3)	3	3.5	10.5	655	5	61.7	0.3
31	2 Sept. 2007	24 (3)	4/3/2	3.5/3.0/2.0	27	665	10	65.4	3.7
32	25 Sept. 2007	23 (3)	5	3.0	15	665	0	67.6	2.2
33	17 Oct. 2007	22 (3)	1/1/6/10/1	5.0/4.0/3.5/3.0/2.5	62.5	690	25	88.9	21.3
35	31 Dec. 2007	48 (7)	5/2/2	4.0/3.5/3.0	33	735	25	98.0	– 4.5
36	16 May 2008	137 (19.5)	1/1/2/5	3.5/3.0/2.0/1.5	18	740	5	95.7	– 2.3
37	17 June 2008	32 (4)	3/1/1/1/41/7	5.0/4.0/3.0/2.0/1.5/1.0	92.5	750	10	118.3	22.6
38	2 Aug. 2008	46 (6.5)	1/1/5/2/1/5	8.0/6.5/6.0/5.0/3.0/1.5	65	760	10	132.5	14.2
39	28 Aug. 2008	26 (4)	2	1.0	2	765	5	107.7	– 24.8
40	9 Oct. 2008	42 (6)	14	1.5	21	765	0	105.0	– 2.7
41	28 Apr. 2009	124 (18)	1/1/6/15/8	7.0/6.0/2.0/1.5/1.0	58	765	0	103.5	– 1.5
42	3 July 2009	66 (9.5)	2/6/10/4/2	8.0/7.0/6.0/5.0/4.0	146	770	5	166.5	63
43	23 Aug. 2009	51 (7)	1/1	7.0/4.0	11	770	0	118.0	– 48.5
44	10 Dec. 2009	109 (15.5)	1/1/19/6	7.0/4.0/3.0/2.0	80	775	5	136	18.0
45	6 Feb. 2010	58 (8)	2/4/13/8/3	6.0/3.5/3.0/2.5/2.0	91	780	5	130	– 6.0
46	6 Apr. 2010	59 (8.5)	1/5/6/6/28/9	7.0/6.0/3.0/2.0/1.5/1.0	123	790	10	152	22
47	27 May 2010	51 (7)	1/8/1/2	4.0/3.0/2.5/2.0	34.5	790	0	144	– 8.0
48	6 July 2010	40 (5.5)	2/7	4.0/3.0	29	790	0	140	– 4.0
49	8 Sept. 2010	64 (8)	3	6.0	18	790	0	148	8
50	30 Jan. 2011	145 (20)	17/4/22	2.0/1.5/1.0	62	800	10	122	– 26.0
51	19 Apr. 2011	80 (11)	3/1/3/6/17	6.0/5.0/4.0/3.0/2.0	75	815	15	160	34

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Flipping Pages: Appreciations of Herpetological Literature
Raymond L. Ditmars: His Exciting Career with Reptiles, Animals and Insects (1944) by L. N. Wood

John J. Cebula
College of DuPage
425 Fawell Blvd., Glen Ellyn, IL 60137
cebulaj@cod.edu

I once taught a high school senior who told his guidance counselor that he wanted to have a career in herpetology and to make a lot of money. I didn't have the heart to tell the young man that the two goals were probably mutually exclusive. Still, I completely understood his desire, having once desired to become a professional herpetologist myself. Who of us hasn't?

Certainly I didn't know any herpetologists when I was growing up. In fact, I don't think I knew an -ologist of any kind until I went to college. There were, however, people who were able to make a living—and who even had a spouse and children—who were herpetologists. I knew that because one day I discovered *Raymond L. Ditmars* by L(aura) N(ewbold) Wood on the shelves of the Minneapolis Public Library. My discovery then, however, confirms for me the validity of a (paraphrased) Japanese *koan*: When the reader is ready, the book appears.

For CHS members unfamiliar with him, Raymond L. Ditmars was one of the founding curators of the New York Zoological Park (Bronx Zoo), starting when he was 23 and spending the rest of his career there. During his life, he published over a score of books that helped popularize the study of reptiles, and he is credited with producing and directing over 80 silent documentary films about wildlife and nature. In a very real sense, Ditmars laid the foundations which those of us who appreciate reptiles and amphibians, whether in nature or as pets, have built on.

Wood's biography, first published two years after Ditmars died in 1942, is hardly an "authorized" biography. There is no citing of sources; there isn't even a bibliography for further reading. Rather, it is one of those books (are they even published these days?) aimed at "young readers." Wood certainly had plenty of source material to work with: in a whole series of popular books, Ditmars described his adventures and (let's be honest) escapades. In *Strange Animals I Have Known* (1931), Ditmars describes his trek, at age 16, into the Connecticut woods—alone—to visit a rattlesnake den where he pinned and handled a Timber Rattlesnake (both Wood's biography and Ditmars's own books are filled with such examples of "kids, don't try this at home" incidents). Wood describes this capture beginning on page 40, but provides flourishes missing from Ditmars's own account: Ditmars's stick becomes a forked stick, for example, and the mechanism of a snake's fang is described. In fact, even a cursory reading of *Strange Animals* reveals the events Wood elaborates on in the biography. Put another way, Wood engages in creative depictions of events.

None of this brings discredit to the book; quite the contrary, reading the biography is a good way to begin to appreciate Ditmars's enormous contributions to the study of reptiles (and wildlife in general). Besides her elaborations of topics such as the properties of venom, the distribution of snakes, and other subjects unfamiliar to many readers but necessary for an appreciation of Ditmars, Wood explains how matters of husbandry we take for granted (housing, diet, health care) were mysteries until Ditmars began keeping a variety of native and exotic species; Wood relates how he met the challenges his charges presented him with. For example, when faced with a shortage of food snakes for a prized King Cobra, Ditmars stuffed a Black Racer with mice to feed the cobra. Ditmars's silent black-and-white movies introduced thousands of people to animal behaviors they may have only read about, and Wood chronicles Ditmars's creative solutions to filming his wildlife subjects.

Rereading Wood's biography, I appreciated another of Ditmars's enormous contributions, one that probably did not impress me as a youngster: his efforts to establish an antivenin program in the United States. Well into the twentieth century, much of the antivenin used in our country came from Brazil. As Wood narrates, many organizations and companies seemed to have felt deaths from snakebites were simply too rare to justify the cost of producing antivenin. Even now, the Centers for Disease Control and Prevention estimates that between 7,000 and 8,000 people a year in the United States are bitten by venomous snakes, of whom only about five die (although the CDC notes the number of deaths would be higher if those bitten did not seek medical care). Through Ditmars's works, doctors gained a better understanding of venoms, including the therapeutic use of modified venoms. And finally, in 1926, the Antivenin Institute of America was established through the cooperative efforts of the United Fruit Company, Mulford Laboratories, and Harvard's Institute of Tropical Biology and Medicine. Ditmars was named as the director of the institute's Nearctic division.

Another aspect of Ditmars's life that I did not appreciate when reading Wood's book as a youngster was the degree to which Ditmars was self-taught. Certainly he relied on his own experiences to learn about reptiles and other animals, but the degree to which he was autodidactic (look it up, kids) is illustrated by a variety of other endeavors that Wood chronicles. For example, besides movie making, he was an avid (and apparently accurate) meteorologist. When a python died from a bacterial infection, Ditmars bought standard texts on bacteriology to learn more about bacteria. He taught himself auto mechanics (this was during the "brass" period of American autos) and was an amateur authority on Civil War battles (his father had served in Robert E. Lee's Army of Northern Virginia). And while Ditmars's first job was working as an assistant entomologist at the American Museum of Natural History, and later as a newspaper reporter, Ditmars left school at age 16 with no formal training in any of the areas he was to excel in. (This is another example of the kids-don't-try-this-at-home caveat I mentioned earlier.)

Copies of *Raymond L. Ditmars: His Exciting Career with Reptiles, Animals and Insects* are available on Amazon.com, but like so many of the books that inspired and influenced me, don't seem to be available through many (any?) public libraries. Nor does it seem to be available as an e-book (for that matter, nothing I care to read seems to be available as an e-book, but that is a different discussion). For any aspiring young herpetologist, though, reading his biography can be transformative.

Bulletin of the Chicago Herpetological Society 53(1):22-27, 2017

Badgers? We Don't Need No *Stinking* Badgers!

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

Many euphemisms come to mind when it comes to pontificating about personal great deeds in front of a group of herpers. Casting pearls before swine is a good one. Passing gas in a hurricane is another. Whether speaking about individuals or a group, herpers are perhaps the most difficult people in the world to impress. In fact, the greater the deed, the more scorn any herper who happens to open their pie hole to mention it is apt to receive. This trifling matter is not going to stop this author from laying out a few of his accomplishments. Truth be told, I'm a whale amongst minnows, a trout amongst carp, and a python amongst worms. My accomplishments are so many that one book alone is not enough to contain them. That is why I am the star of not one, but *two* books. Now, mind you, we're not talking about the sort of books that herpers normally write about themselves. *Anybody* can do that! These are books that other authors chose to write about me—simply out of admiration for the subject matter. How many of you hotshots out there have had *that* sort of thing happen to you? We're saying that unsolicited, out of the blue "I-want-to-write-a-book-about-Roger Repp" type stuff has happened to me. You know, sort of like Napoleon, or Kennedy, or Patton—for some lesser examples of the human beings I'm talking about.

In one book, I have assumed the role of "Rattlesnake Roger." Heroic deeds abound in this book, and I am the epicenter of it all. No brag, just fact. In the second book, I am actually a cartoon character. There are several full-page images of me fully decked out in camouflage, dealing with rattlesnakes left and right. It is just a matter of time before the Roger Repp action figures will hit the market. I'll be right up there, hanging on the toy store racks, alongside Luke Skywalker, Darth Vader, Hans Solo, G.I. Joe and Spooge Bob Square Ass (or whatever his name is). I just feel sorry for those guys, because you *know* all the kids will choose *me* over them.

I am not going to discuss the Rattlesnake Roger book any further—yet. For now, I want to focus on the cartoon Roger Repp book instead. Why this book did not carry the title of "Cartoon Roger Repp—Superhero Extraordinaire" will forever remain a mystery. It is instead entitled *Katie of the Sonoran Desert*. About three pages into the opening flaps, on the top of the page are the words "For Roger of the Sonoran Desert, as well as "*Para Roger del Desierto Sonorense*." Yup! That Roger would be *me*, and apparently one language alone can't contain enough praise for the Herp King of Southern Arizona.

The author of this book is a fellow herpetologist named Kate Jackson. And no, this is not the "Charlie's Angels" Kate Jackson. This would be Kate Jackson, the herpetologist. (Figure 1). Kate's whereabouts are currently unknown; I'm just hopeful that she was not devoured by cannibals during one of her many trips to the most remote corners of the world. She was often traveling to dangerous places in order to find and describe new species of herps. I first met Kate during the summer of 2004. I was the program chair of the Tucson Herpetological Society (THS) at the time, and my good friend Dale Turner emailed me a copy of an article written by Kate that had just appeared in *Science* magazine. She had conducted recent experiments with natal cornsnakes and kingsnakes, and demonstrated with x-rays how kingsnakes can swallow prey items longer than themselves. In a nutshell—the kingsnakes stretch their stomachs—eh? At Dale's urging, I went on the hunt for this here Kate Jackson, and found her in about two seconds flat. A couple emails later, and bap! She agreed to come to speak to the THS about her work. She jetted down from Ontario, Canada, in August of 2004, and put on a hell of a good show for us.

As the Suizo Mountain Project was in full swing at the time, one of the perks of her visit was that she would come out radio-tracking with me. This she was willing to try, and she took quite a shine to it all. (Who wouldn't?) While this was transpiring, we had a number of Western Diamond-backed Rattlesnakes (*Crotalus atrox*) that had been recently implanted with transmitters. There were so many new ones that we had yet to name some of them. As described in a previous column, we used the names as a way of keeping track of who was who in our study. I selected a hefty dandy of a female, #61, and had Kate track her down. When she got to the prize, I told her I would name #61 "Kate," after her. Kate liked that notion, and she sort of adopted

Figure 1. From the Congo! Definitely better than one of Charlie's Angels, this would be Kate Jackson the herpetologist. She holds a Forest Cobra (*Naja melanoleuca*) in her right hand, and a Water Cobra (*Naja annulata*) in her left. Photograph courtesy of Kate Jackson.

this snake for all future correspondences between us. We stayed in touch after she left. She was always hungry for news of Kate the snake, and I was always happy to talk to her about any subject.

The winter of 2004–2005 was a wonderfully wet one, and by March, the Suizo Mountain Plot exploded into a verdant barrage of greenery. This delightfully wet system was also perfectly timed to produce the best flower show to ever hit our plot. Unfortunately, any time certain unprotected areas of the Sonoran Desert start to prosper, they are penalized. Hordes of cattle are released in droves wherever and whenever there is good forage. From the stockyards to the desert they are hauled and dumped. Kate the snake had chosen a series of Kangaroo Rat holes to overwinter in. As the rains were plentiful, the soft soil where K-rat mounds exist was quite prone to collapsing. And every possible entrance and exit to Kate the snake's K-rat mound was trampled by the hooves of cattle. She was trapped—with no way out.

My approach to any situation that arose with our study subjects usually followed a pattern of staunch non-interference. For example, if I were to have seen a kingsnake choking down one of our subjects, it would have been the death of that subject. I would take pictures, I would take data, but I would not lift a finger to interfere. Such is the creed of any case-hardened wildlife biologist. And so, at first, the entombment of one of our rattlesnake subjects was going to be treated with the same policy of non-interference. But the more I pondered the situation, the more I realized that the introduction of cattle to our plot was a human-caused affair. It had nothing to do with natural events. I would try to save Kate the snake. But I wanted to see if she could save herself first.

The date that I noticed that Kate the snake was trapped was 19 March 2005. Page 46 of our 2005 data binder has this to say: "I'm beginning to suspect that she has been trapped by cattle hoof prints." Around 19 March is close to the universal time that all herps under our watch egress from their overwintering sites. I would play a waiting game, to see if she could somehow worm her way out of her situation on her own. The final decision was that I would wait until the last of our 16 other transmittered *atrox* had cleared out before giving Kate an assist. When Kate Jackson heard of the trouble with her namesake, she absolutely *insisted* that she be there to help free that snake. We booked her a flight for mid-April, and I promised that I would wait for her to arrive before doing any digging. As it turned out, the timing of her visit was perfect. The last two *atrox* to leave their overwintering sites cleared out a few days before Kate Jackson arrived. These two late bloomers were also females who had chosen K-Rat holes in the bajada as their refugia—very similar to Kate the snake's situation.

Death and taxes are no more unfailing than the arrival of Kate Jackson. A physical description of Kate is in order here. Visualize a five foot nothin' petite Kathryn Hepburn. No words wasted there! Though her frame seems frail and fragile, that is not the case at all. She seems to possess an almost inhuman strength, and anybody who shakes hands with her can attest to the powerful grip that she displays. When she speaks, it is with a very proper Harvard style of English, as the British might speak it, with a delightful tinge of a Canadian accent. Classy! Indeed, her mannerisms are much like those of Kathryn Hepburn as well—until there is an escaping snake to deal with. A snake on the run brings a fiercely predatory look upon her visage, and her gray eyes narrow into slits. She then morphs into an out-of-control lioness, and one best not try to get between her and that snake! Her passion with herpetology is the real deal, and Kate Jackson the herper is more like Carl Kauffeld than Kathryn Hepburn.

It came to pass that on 21 April 2005 at precisely 1755 hours, Kate Jackson and I stood before Kate the snake's stomped-in kangaroo-rat-mound tomb. By this point in time, Kate the snake's name had morphed into "Katie." This was due to the confusion of dealing with two Kates at once in both the written and spoken word. We will do the same here: "Kate the snake" is now "Katie." We did not arrive empty handed at Katie's tomb. In addition to the full regalia of radio-tracking gear, we also carried with us a shovel. I used the antenna to pin-point the location of Katie's signal, and used my snake hook to inscribe an X in the dirt. I next peeled all the restrictive gear off my body, started a data sheet, and prepared to dig. I had my back to Kate as I was doing this. When I turned, Kate had the shovel firmly gripped in both hands. It was held horizontal to the ground, cocked in my direction, as if it might be used as a weapon. I was about to remonstrate and tell her it was *my* job to do the digging. But she seemed to anticipate those errant thoughts. Her eyes were clamped into those two menacing and determined slits suggested earlier, and two words were succinctly uttered from her gullet.

"***Shut up*!**" Thus sayeth the mighty Kate Jackson. Her meaning was clear. She wanted to do the digging honors.

I genuflected, hoping that my bow was appropriately low enough to suit the Canadian Herp Royalty that I now faced. "By all means . . . be my guest!"

Shutting up is not my strong suit, especially when blazing and befuddling flandickery is transpiring before my very eyes. I do not consider myself to be an expert with a shovel by any means, and have successfully spent most of my life avoiding using one. But I have never in my life seen a shovel used like this! Kate completely eschewed using the convenient handle grip on that shovel. She chose instead to firmly grasp the shaft of the shovel with both hands, at a point roughly four inches below the handle. She then proceeded to almost straddle it, and plunge that shovel straight downward, as if performing a coup de grace on a downed foe. Perhaps in the land of permafrost where Kate Jackson hails from, that is how to use a shovel? Bang your way through? Nah! *Nobody* uses a shovel like this! That shovel went up and down so fast that the sound it made was exactly like that of a jackhammer. She pounded that X on the ground for an impressive duration of time, with no letup in the tempo. If that strength and energy could have been channeled into conventional shovel usage, she would have hit the uppermost chambers of Hades before she finally gave out. Meanwhile, I was thoroughly engaged in the process of shutting up. Any instruction on my part would have likely resulted in a shovel upside the head. I could do nothing but watch the intensity of her digging method with wide-eyed wonder. When she

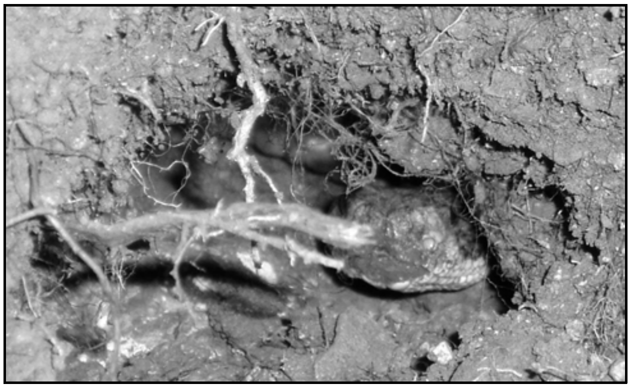


Figure 2. Freedom! Our first look at Katie in 2005. Image by Kate Jackson.

finally gave it a rest, there was barely a two-inch-deep divot in the exact center of the X. At least her aim was good!

It is difficult to imagine what Katie must have been thinking while this was happening. While there is a massive debate going down about whether or not snakes can actually hear airborne sounds, there does not seem to be any question that they can at least sense vibrations through the ground. Being directly below the shovel action, as Katie was, the vibrations must have been downright seismic! Of course, at this point, we did not even know if she was still alive. Moments later, we knew. As soon as Kate ran out of gas, I once again grabbed the tracking gear, in order to see if the signal indicated that Katie was still in that spot. She wasn't! The strongest signal now demonstrated that Katie was roughly 1.2 meters to the west. I turned to Kate.

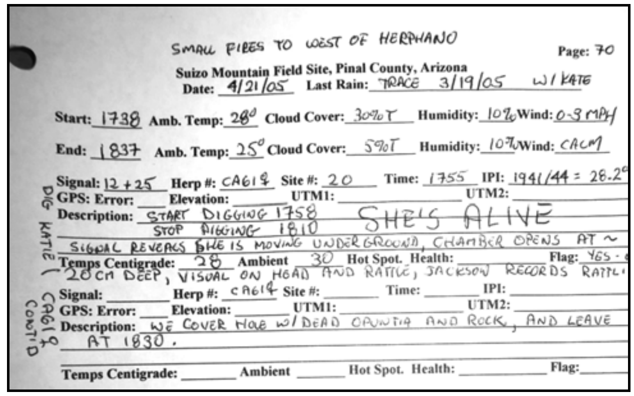
"She's moved over here now," I proclaimed. "By golly Kate, I think she's alive!"

The datasheet was evolving as the digging process progressed. I noted that Katie had shifted underground. I then quickly grabbed the shovel, and before Kate could gather herself to protest, gave it two quick thrusts and turns into the soil. With the second thrust, I was roughly one foot deep, and an elliptical shaped hole suddenly appeared. In all fairness to Kate's digging efforts, the ground was much softer here, as it was closer to the root system of a prickly pear cactus. As soon as the hole opened up, I laid the shovel to one side, and reached into my backpack to fish out my welding gloves. In just the few seconds that I turned away, Kate went after the exposed hole. When I turned to head back to that hole, Kate was already on her knees in front of it, scooping the loose dirt out of it in order to get a better look.

There are moments in time where one can vividly remember the exact details of what happens with amazing clarity. I remember precisely what I said to Kate at that moment in time. What was said was loud, abrupt, and meant to put a hasty stop to what was developing.

"Kate Jackson! Get your effing hands out of that hole!"

Kate's lack of reaction to these words was downright amazing. A sudden look of rapture swept across her visage, and as she reached for her camera, a serene and angelic smile seemed to just light up every fiber of her being. While she is normally nice to look at anyhow, the enthusiastic elation that was overpowering her made her glow with radiance—like an ecstatic bride on



SMALL FIRES TO WEST OF HERPHANO

Page: 70

Suizo Mountain Field Site, Pinal County, Arizona

Date: 4/21/05 Last Rain: TRACE 3/19/05 W/ KATE

Start: 1738 Amb. Temp: 28° Cloud Cover: 30% T Humidity: 10% Wind: 0-3 MPH

End: 1837 Amb. Temp: 25° Cloud Cover: 5% T Humidity: 10% Wind: CALM

DIG KATIE

Signal: 12 + 25 Herp #: CA61♀ Site #: 20 Time: 1755 IPI: 1941/44 = 28.2°

GPS: Error: Elevation: UTM1: UTM2:

Description: START DIGGING 1758 SHE'S ALIVE

STOP DIGGING 1810

SIGNAL REVEALS SHE IS MOVING UNDERGROUND, CHAMBER OPENS AT ~

Temps Centigrade: 28 Ambient 30 Hot Spot. Health: Flag: YES

20CM DEEP, VISUAL ON HEAD AND RATTLE, JACKSON RECORDS RATTLE

CA61♀ CONT'D

Signal: Herp #: CA61♀ Site #: Time: IPI:

GPS: Error: Elevation: UTM1: UTM2:

Description: WE COVER HOLE W/ DEAD OPUNTIA AND ROCK, AND LEAVE AT 1830.

Temps Centigrade: Ambient Hot Spot. Health: Flag:

Figure 3. She's alive! This is an image taken of Page 70 of our 2005 Suizo Mountain Project binder, the data sheet from "dig day" for Katie. Note the enthusiasm displayed by the scribe. Image by the author.

her wedding day. The verbal discourse that followed was one of unabashed joy from one side, and an outright ass chewing from the other.

"Oh! I can see her head . . . "

"How stupid can you get, digging into that hole with your bare hands like that . . . "

"Oh, I can see her tongue flicking . . . "

" . . . when you know *damn* good and well there is a venomous snake in there . . . "

"Oh, now I can hear her rattling . . . "

" . . . who will not hesitate to put you into the hospital or worse."

"Roger, she's *beautiful* . . . "

"If you *must* have a death wish, will you kindly take it someplace else?"

"Roger, come see . . . um, what are you raving about?"

"Jeez! Nothing! Never mind!"

By this time, the danger had passed. Kate was busily photographing Katie, as well as recording the sound of her rattle. This was a process that thankfully required both hands—which is a good thing, as Katie's head was now less than inch deep in the hole, and facing out (Figure 2). No harm, no foul, and in an instant, I was sharing Kate's elation. The danger was past, and there was no sense in being a poop sock about it all. It was indeed a happy moment, and the words that appear on page 70 of my 2005 project binder clearly reflect the excitement of the moment (Figure 3). As the data sheet in Figure 3 indicates, we finished the job by covering the entrance to the hole with a dead prickly pear branch and a flat rock (Figure 4). We then quietly gathered our equipment and left.

The reader can bet their bottom dollar that we returned the following morning to see what Katie would do next. She had cleared out of her tomb, and even before we arrived at that spot, there was no need for the tracking gear. She could be heard vigorously rattling from a distance of about 20 meters away. This is highly unusual behavior coming from a subject who we had been tracking for over a year, and reveals how stressful the whole situation must have been for her. She moved straight out

Figure 4. "As the data sheet in Figure 3 indicates, we finished the job by covering the entrance to the hole with a dead prickly pear branch and a flat rock." This was done in the event that Katie was not ready to come out, as well as a feeble attempt to hide the hole from predators. Image by Kate Jackson.

Figure 5. Erika Nowak demonstrating the art of tubing a rattlesnake. The author has many images of people holding rattlesnakes in tubes, but this is the author's favorite for several reasons. The snake is big, and the enthusiasm of the moment is evident on the visage of the handler. But note that handler's eyes are kept on the head of the snake during the photographic process. One's eyes must never leave that head—even to smile at the camera! Photo courtesy Erika Nowak.

of the hole, traveling roughly 10 meters in a westerly direction. She was found coiled under some bursage and a white thorn acacia tree. As I began digging through my backpack, I was greatly surprised to find a large, freshly-dead kangaroo rat sealed in a plastic bag. How the poor thing managed to get into my backpack and seal itself in a plastic bag will forever remain a mystery. I showed it to Kate, who also wondered how it got there. Being the sharing sort of person that I am, it seemed appropriate to show it to Katie as well. I didn't want to deny her any of the excitement that a dead rat can generate. ("Why look Katie—it's a dead K-rat!") I grasped the rat in my plastic tongs, and displayed it for Katie to have a closer look. Unfortunately, I got a bit too close to her head in the process, and she launched a strike that knocked it clean out of the tongs. The K-rat landed right in front of Katie's head. This was extremely clumsy of me, as it created a safety hazard. We could easily be bitten if we tried to remove the rat, so we chose the safe route and left it right where it fell. The plan was to return later to remove it. Roughly two hours later, both Katie *and* the rat were gone. We next tracked Katie to a place that was 30 meters to the north, and discovered that she had a food bolus. It was a morning full of mysteries. First, we have a dead rat that disappears, and then two hours later, we have a snake that has somehow managed to snag a meal in broad daylight. It's just one of those things that can't be explained, and as this is a scientific publication, we will not speculate. As one of my most ardent critics has suggested, if we can't prove beyond a shadow of doubt that something has happened, we shouldn't guess at it.

Throughout the remainder of Kate's visit, she talked incessantly about how she was going to write a book about Katie. She was going to have Katie go through all kinds of adventures. It was all she could talk about! While the story would be told from Katie's perspective, mention of Kate and I as the wildlife biologists who studied her would also be made. She had some artist friends who would be delighted to help, and it would be the best children's book on rattlesnakes ever published. I have heard this sort of thing from so many different people that I thought it was all a pipe dream. Kate was just enthused by the events that had just unfolded, and by the time she got home, her daily routine would erase all desire to produce the book. Wrong again, Roger!

Through various discussions, Kate had learned that the American Badger (*Taxidea taxus*) was the number one predator of rattlesnakes and Gila Monsters on our plot. It would take all the fingers on both of my hands minimally to count the number of our subjects who had fallen to the merciless mustelids. (An actual count has never been assembled, but ten is certainly a good estimate). Kate began asking me to come up with some way that Katie could fight and win against one. My first answers were honest. Any fight between rattlesnake and badger would be badger bites snake, snake bites dust, end of story. An attack from a badger on Katie would result in ye old dirt nap, and I told Kate that. Kate was not satisfied with this answer, and absolutely *insisted* that I come up with a realistic scenario that would have Katie be the victor of such a battle. It was so important to her that I took a deep breath, and began to think deep thoughts about it. The fact that rattlesnakes in general, and *atrox* specifically, have a secret weapon would play its part in this story.

Any herper who resides within the range of gartersnakes is aware of their ability to fling musk out of their cloacas. Rattlesnakes also do this, and are extremely accurate at the art. When processing rattlesnakes, the first step is always to get them into a clear plastic tube. This of course controls the smart end of the snake (Figure 5). The researcher is usually interested in drawing a blood sample out of the caudal vein, which resides in the tail. This usually has the researcher getting their face close to the tail, in order to properly view the best angle for sinking the needle. We all learn after the very first time we draw blood from a rattlesnake to clamp the rattle with one hand to keep that tail from suddenly flinging that musk of theirs. If one does not hold that tail, musk is flung directly into the eyes—and this in turn burns the piss out of them! Rattlesnakes are extremely accurate with their musk slinging, and there can be little doubt that they go for the eyes when the opportunity presents itself (Figure 6).

But this was not merely to be a battle between rattlesnake and badger simply because the badger wanted to eat the snake. No, in this case, it was to be a mother rattlesnake battling a badger in order to protect her young from it. My first scenario

Figure 6. Like many species of harmless snakes, *Crotalus atrox* has the ability to eject musk from the cloaca. See text for the details as to why this image fits in with the accompanying article. Image by the author.

had Katie nailing that badger as soon as it started to dig into the nest site. Experience has taught me that a mother *atrox* is more than willing to fight any intruder trying to enter the nest, and by far the best time to strike would be just as the badger is entering the hole. But the result would have been a battle inside a dark hole—and Kate insisted this was not good for a picture book. So I laid out the following scenario: Katie was coiled just outside the nest hole, as mother *atrox* often are. A badger comes ambling up, nose to the ground, and gets a good whiff of Katie, the neonate *atrox*, *and* their afterbirth—all likely to happen. The badger comes straight for Katie, who by this time is thoroughly aroused. Katie rises into a defensive posture and begins to rattle as the badger bull-rushes straight toward her. When confronted by this action, the badger hesitates, and that is the best thing that Katie can hope for. Katie then gives a deft flick of her tail, and sends a jetstream of musk toward the face of her assailant. The flying musk scores a direct hit, the musk splatters into both eyes, temporarily blinding the hapless assailant. A well-aimed strike from Katie quickly follows, and she sinks one of her fangs directly into the left eye of the now-blinded creature. The badger then begins to flop about on the ground like a fish out of water, getting all tangled up with downed cholla pods during the process. Katie's venom is actually injected straight into the brain through the eye, causing massive swelling and hemorrhaging, and blood and vomit come jetting out of every bodily orifice. All of the pressure from the swelling inside that badger's cranium causes both eyeballs to explode out of their sockets just before the miserable mustelid expires with its gurgling and wheezing last breath. And there lies the dead badger, all sorts of messed up and defiled by cholla pods, lying in a pool of its own puke and blood. Yeah baby, **eye like it!** Take ***that***, you *stinking* badger! Meanwhile, all of Katie's youngsters are watching from inside their parturition hole. They wildly applaud their momma's brave feat by wiggling their little prebutton nubs, and "high one-ing" each other by raising their little bodies up and slapping chins together.

As I relayed this story to Kate, I was so into it that I was unable to gauge her reaction during the telling of it. When I was finished, I looked directly at her, and was surprised to see a look of all-out horror and disgust upon her visage.

"*For God's sake Roger*!" She exclaimed, "this is a *children's* book! There will be no shit-slinging rattlesnakes allowed in *my* book!"

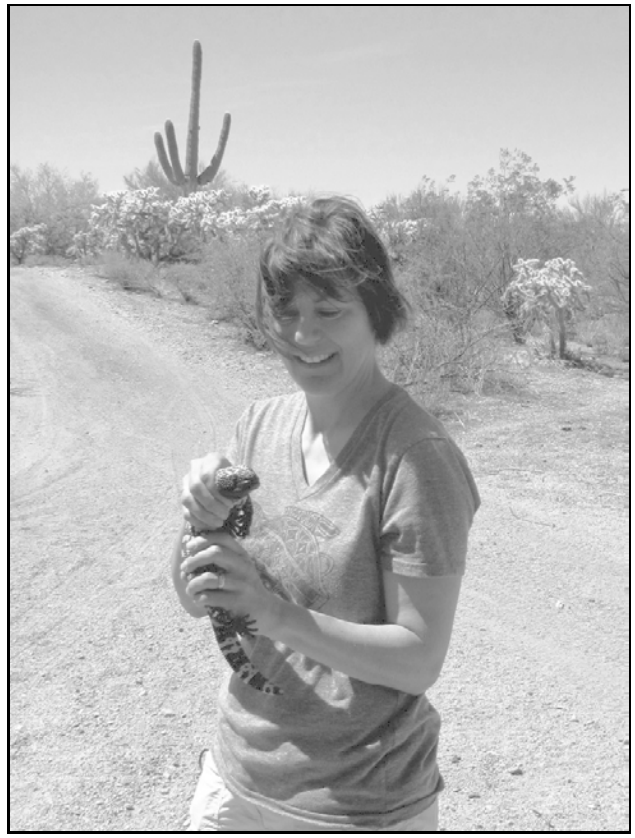


Figure 7. Natalie Rowe, the artist for the book *Katie of the Sonoran Desert*, holding a wild Gila Monster encountered during her first ever visit to Arizona in April of 2011. As the book was published in 2009, Natalie based her skillful illustrations on images from magazines and friends. Image by the author.

Well . . . excuse me! Fine! It was *her* book—and she could snub who she wanted. A short while after Kate headed home, she emailed me the text to the book. I can't remember if I tried to edit it, as by now, I knew not to meddle with it. For a very long period of time, I heard nothing more of it. But eventually I was contacted by Natalie Rowe, the artist who was going to illustrate the text. Kate Jackson was off to the Congo, and for all that Natalie knew, she might never return. Natalie had some questions, and as Kate was whereabouts unknown, would I mind answering these questions? Corresponding with Natalie was a delightful experience, and for no short duration of time, we conversed nearly every day. She was an extremely conscientious individual, who was absolutely driven to make this book the artistic masterpiece that it eventually became. A couple years after the book was published, Natalie and her wonderfully supportive husband Gordon paid a visit to Arizona. I was able to photograph Natalie holding "Tarzan," one of our favorite Gila Monsters (Figure 7).

As for the badger part of the story, yeah, it's in there. Truth be told, other experts with children's books tell me that the accompanying picture is so scary that it is apt to give children nightmares. Perhaps it is my own bias in thinking that having one of those chubby weasels get smacked upside the head with snake shit while having its eyeballs pop out wouldn't be so bad after all. It might teach the younger minds something about the harshness of nature, and would probably have looked awesome in full color if drawn by Natalie's loving hands.

Every time this author starts to think he has about run out of words to say to his big city friends, something new pops into his head that opens the floodgates to future columns. Certainly where badgers are concerned, there are several future columns waiting to be pecked out. As for Kate Jackson and Natalie Rowe? Well, maybe one fine day, I'll write a column about my experiences with them as well. Meanwhile:

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

Epilogue

Additional notes on the book *Katie of the Sonoran Desert* are in order. My personal lack of knowledge on copyright issues, as well as a lackadaisical attitude about seeking permission from the publisher, prohibit me from displaying any of the text or fantastic artwork contained within this work. It would be a disservice to the author and artist to do so anyhow. If you want to see it as it is meant to be seen—buy it! The book is still for sale, and probably will be for a long time to come. Simply type the title in your favorite search engine, and the book pops right up. It is the opinion of this author that this effort goes well beyond being simply a picture book that portrays rattlesnakes in a positive light. There is something for everybody in this book—for experts and neophytes alike. This is a book that should be on the shelf of every elementary school library in the country, not to mention Mexico. And Canada. It certainly belongs on the shelf of anybody who loves snakes, nature in general, or the Sonoran Desert. I'm honestly proud of the part I played in making this book happen, and hold both Kate and Natalie in high esteem for their efforts to make it as good as it is.

Minutes of the CHS Board Meeting, December 16, 2017

The meeting was held at the home of Linda and Andy Malawy. Rich Crowley called the meeting to order at 7:25 P.M. Board members Dan Bavirsha and Jessica Wadleigh were absent. The minutes of the November 17 board meeting were read and accepted.

Officers' Reports

Treasurer: Andy Malawy read through the financial report.

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

Sergeant-at-arms: Attendance at the November 29 general meeting was 44.

Committee Reports

Shows: Gail Oomens will be distributing show guidelines to all volunteers.

Junior Herpers: Frank Sladek reported attendance of about 20 people at the December meeting. Nathan Kutok spoke about his field herping experiences.

Library: Joan Moore has been ordering some new books.

Nominating: The board thanked Kim Klisiak and Mike Scott for their efforts this year.

ReptileFest: Cards and flyers have been printed and are now available. We will have some form of online ticket sales this year. Several companies have been contacted as potential sponsors. We have been reaching out to parks, museums, nature centers and other herp societies. Several will be new exhibitors this year. Nearby Von Steuben High is interested in providing teenage volunteers. A planning meeting will be scheduled for the end of January. Frank Sladek will contact recent CHS grant recipients to have tables to discuss their research. Exhibitor registration will begin on January 1.

Old Business

We have ordered and received two new pop-up signs to identify the CHS at our live animal shows.

We are still looking for a venue for board meetings in 2018.

The meeting adjourned at 8:14 P.M.

Respectfully submitted by recording secretary Gail Oomens

Herpetology 2018

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.

KINGSNAKES OF THE *MEXICANA* GROUP

R. W. Hansen and G. T. Salmon [2017, Mesoamerican Herpetology 4:700-758] provide updated distributional information for species of the *Lampropeltis mexicana* group, an assemblage of colorful snakes occurring throughout northern Mexico and the southwestern United States. They generated point locality maps based on 685 records supported by vouchered specimens. The ranges of constituent species are characterized by allopatry, although some species pairs are nearly parapatric. In light of improved knowledge of the distribution of these taxa, the authors review the historical taxonomy of the *mexicana* group, provide partial synonymies, and present morphology-based diagnoses for each species. They recognize six species as accurately reflecting biodiversity. The conservation status of each of these species is reviewed in the context of new distributional data and in consideration of our revised taxonomy. Range gaps are identified as important targets for future surveys.

RODEO™ HERBICIDE AND CRICKET FROGS

K. L. Krynak et al. [2017, Journal of Herpetology 51(3):402-410] note that disease-associated mortality is a leading cause of amphibian declines and extinctions worldwide. Understanding the influence of land-management practices, like herbicide use, on amphibian immune defense traits could guide changes to improve conservation outcomes. Amphibians are partially protected from pathogens by two skin-associated immune defense traits: bacterial communities inhabiting their skin, and antimicrobial peptides secreted by the skin. Utilizing the Blanchard's cricket frog (*Acris blanchardi*), a declining North American amphibian species, as a model, the authors manipulated Rodeo™ aquatic herbicide concentration and the life stage at which Rodeo exposure occurred. Juvenile survival, time to metamorphosis, juvenile mass, and skin-associated immune defense traits were assessed. Results showed a 37% decrease in survival of larvae exposed to 2.5 mg a.e. L^{-1} (acid equivalent) compared to controls despite that this commercial herbicide formulation does not contain an added surfactant. Surviving larvae exposed to 2.5 mg a.e. L^{-1} Rodeo had structurally different larval skin bacterial communities compared to controls. Larval Rodeo exposure did not carry over to postmetamorphic traits (juvenile mass, juvenile skin bacterial community, juvenile natural peptide secretions). Rodeo treatments did not affect time to metamorphosis or juvenile survival. Rodeo concentration had marginally significant effects on juvenile mass and the juvenile skin bacterial community. This study suggests glyphosate-based herbicide use may indirectly contribute to disease-related amphibian declines by altering the skin bacterial community that can provide pathogen resistance. Improving our knowledge of the influence of herbicide use on amphibians across life stages provides an opportunity for changes to application strategies to protect amphibian health or at minimum, lessen negative effects of the practice.

WINTER MICROHABITAT OF JACKY DRAGONS

J. M. Hall and D. A. Warner [2017, Copeia 105(4):618-625] note that most temperate-climate lizards become inactive during the winter months of each year. As temperatures drop, they must find appropriate overwintering microhabitats to avoid lethal surface temperatures and/or thermoregulate. The environmental variables that characterize such microhabitats and the cues that lizards utilize to assess them are a critical but understudied component of their natural history. While many studies of overwintering site selection focus on temperature, other factors constituting microhabitats (e.g., surface structures, substrate) may play a role in site selection. The authors used the jacky dragon (*Amphibolurus muricatus*), an Australian agamid lizard, to test for preference of using various cover types (leaf litter, open sand, sticks, rocks) for overwintering as well as the consequences of cover type selection. Jacky dragons preferred overwintering beneath leaves compared to other structures, and this choice was associated with growth during winter, but not with survival. The study highlights the potential importance of cover structures in overwintering site selection, suggests that midwinter activity may be common in jacky dragons, and calls for further study of the winter ecology of temperate-climate lizard species.

BOG TURTLE HATCHING SUCCESS

R. T. Zappalorti et al. [2017, Chelonian Conservation and Biology 16(2):194-202] note that in most turtles nest-site selection affects the survival of females and their offspring. Although bog turtles (*Glyptemys muhlenbergii*) do not typically leave their wetlands for nesting, nest-site selection can impact hatching success and hatchling survival. Between 1974 and 2012, the authors monitored the fates of 258 bog turtle eggs incubated in the field and 91 eggs incubated under laboratory conditions from 11 different bogs, fens, or wetland complexes in New Jersey and Pennsylvania. Laboratory-incubated eggs exhibited the greatest hatching success (81%), but no significant difference in hatching success was found between nests protected with predator excluder cages (43%) and unprotected nests (33%). However, significantly lower predation rates were found in protected nests, suggesting that while predator excluder cages successfully reduced predation, other environmental factors persisted to reduce egg survival in the field. Natural hatching success was potentially reduced by poor weather conditions, which may have resulted in embryo developmental problems, dehydration, or embryos drowning in the egg. These results suggest that egg depredation, coupled with embryo developmental problems and infertility, are limiting factors to hatching success in the study populations. Using predator excluder cages to protect bog turtle eggs in the field, or incubating eggs in the laboratory and releasing hatchlings at original nesting areas, may be an effective conservation tool for recovering populations of this federally threatened species.

NEST GUARDING BY FEMALE HORNED LIZARDS

W. C. Sherbrooke [2017, Herpetologica 73(4):331-337] presents the first report of antipredator nest defense by iguanian lizards. Female Texas horned lizards (*Phrynosoma cornutum*) and round-tailed horned lizards (*P. modestum*) consistently exhibited vigorous nest-site defensive behaviors (butting, open-mouth attacks, and biting attacks) when experimentally approached in the field by a potential predator of reptilian eggs, western patch-nosed snakes (*Salvadora hexalepis*). During both prenesting and postnesting snake trials, such defensive attack behaviors by the female lizards were absent. Females of a viviparous congener, greater short-horned lizards (*Phrynosoma hernandesi*), failed to exhibit postpartum defensive behaviors to *S. hexalepis*, and newborns did not associate in proximity to their mothers. Nest-site defense is suggested to be the ancestral behavior in the genus *Phrynosoma*, and it might have been lost during the evolution of viviparity in certain species. Previous failures to detect nest defense behavior in *Phrynosoma*, and in related clades of iguanian lizards, might be attributable to the absence of observations at nest sites after egg laying by such lizards, especially because these behaviors occur only during brief time windows of potential nest detection by egg-hunting snakes. Similar trials with other iguanian lizards and potential nest predators could reveal further examples of parental care in this diverse lineage of lizards.

RESPONSES OF LIZARDS TO WILDFIRES

A. Duarte et al. [2017, Copeia 105(4):609-617] report that high-severity forest fires are increasing in large areas of the southern and western United States as the climate becomes warmer and drier. Natural resource managers need a better understanding of the short- and long-term effects of wildfires on lizard populations, but there is a paucity of studies focused on lizard-wildfire relationships. The authors used a before-after, control-impact sample design to assess the response of three lizard species—six-lined racerunner (*Aspidoscelis sexlineata*), prairie lizard (*Sceloporus consobrinus*), and little brown skink (*Scincella lateralis*)—to high-severity wildfires that occurred in the Lost Pines Ecoregion, Texas, USA. They analyzed monitoring data collected across 17 trapping sessions from spring 2008 to spring 2013 to estimate trends in lizard abundances, while accounting for environmental parameters that might influence lizard detectability. They found no evidence of a fire-induced change in abundance for any of the three lizard species studied, but there was an increase in detectability of *A. sexlineata* following the wildfires. Detectability of *A. sexlineata* and *S. lateralis* increased with air temperature, detectability of *S. consobrinus* decreased with precipitation, and detectability was related to Julian day for all three species. Mean detection probabilities were low (<0.1), suggesting capture-mark-recapture methods at a subset of sample units should be implemented to derive more accurate estimates in future monitoring efforts. The results provide quantitative evidence of the short-term effects of high-severity wildfires on three widely distributed lizard species. Given the wildfires did not result in decreased lizard abundances, managers should minimize their vehicle footprints off of roads during post-wildfire habitat restoration to avoid soil compaction and the potential for direct mortality.

NEW DWARF SALAMANDERS

K. P. Wray et al. [2017, Herpetological Monographs 31(1):18-46] report that the *Eurycea quadridigitata* complex is currently composed of the nominate species and *E. chamberlaini*, with no other species recognized. However, recent molecular studies have revealed at least five genetic lineages within this species complex, with one lineage more closely related to the neotenic *Eurycea* species of central Texas and *E. chamberlaini* nested within *E. quadridigitata* sensu lato. The authors use large-scale geographic sampling in combination with a multilocus species delineation method and morphology to test whether these genetic lineages represent distinct species under the general lineage concept of species. They describe two new species of salamander from this complex (Hillis's dwarf salamander, *E. hillisi*, and the bog dwarf salamander, *E. sphagnicola*), resurrect and elevate a former subspecies to full species status (the western dwarf salamander, *E. paludicola*), add to the diagnosis of *E. chamberlaini*, and redefine *E. quadridigitata* in the context of this revision. All five species are diagnosable from one another through a number of meristic, morphometric, molecular, and ecological criteria.

EFFECTS OF LEAF LITTER FROM AN EXOTIC TREE

D. Saenz and C. K. Adams [2017, The Herpetological Journal 27(4):326-332] note that the establishment of exotic invasive species, including plants, has been linked to the decline of some amphibian populations. Of particular concern with invasive plants, from an amphibian conservation perspective, is that they are disproportionately wetland or riparian species. Recent evidence suggests that Chinese tallow (*Triadica sebifera*), an exotic deciduous tree species, is expanding its range and becoming more abundant where it occurs in the United States. This is particularly relevant to amphibian conservation considering that Chinese tallow tends to invade wetlands, and recent studies have demonstrated that the leaf litter causes mortality of anuran eggs and larvae by reducing the dissolved oxygen and pH of water. The lethal effect of Chinese tallow leaf litter is short lived and concentrated soon after leaf fall, typically December through to February in the south-eastern United States. This study was to determinine the sub-lethal effects of Chinese tallow leaf litter on the surfacing frequency and air-gulping behavior of overwintering anuran larvae. *Lithobates catesbeianus* and *L. clamitans clamitans* are two frog species that commonly overwinter as aquatic larvae and extensively overlap in range with invasive Chinese tallow, which may expose their tadpoles to the deleterious effects of the leaf litter. Experiments exposed tadpoles to four different concentrations of tallow leaf litter and recorded water chemistry and tadpole surfacing frequency. It was found that as Chinese tallow concentration increased, oxygen levels decreased. Both anuran species responded similarly to our treatments and dissolved oxygen levels, where tadpoles swam to the water's surface to air gulp at a significantly higher rate in the treatments with greater tallow concentration. Such changes in behavior induced by Chinese tallow could have negative consequences on tadpole foraging efficiency and predator avoidance, ultimately reducing fitness. As biological invasions will continue to be an important part of global change, more attention should be given to sub-lethal impacts, as they pertain to fitness.

VISUAL DETECTABILITY DIFFERENCES

P. Casula et al. [2017, The Herpetological Journal 27(3):258-265] note that visual counts gathered within citizen science programs are increasingly used to determine distribution and abundance of species of conservation concern. However, to obtain reliable patterns from counts, imperfect detection should always be considered, with particular reference to rare and elusive species. By analyzing data from a citizen science monitoring program based on multiple simultaneous observers, the authors studied detection probability of the Sardinian mountain newt, *Euproctus platycephalus*. Detectability of individual newts widely varied among observers, and was positively affected by the number of newts exposed to during sampling. Training, although appearing to improve detectability, did not accommodate for differences among trained observers. No effect of sampling hour, tree shade, cloud cover, water flow, turbidity, and temperature was found, possibly due to standardisation of sampling conditions. Depending on observer's skills and the population exposed to during sampling, detection probability of newt populations can widely vary. Most of the sampling units (pools) had few newts exposed to during sampling, with a high probability of recording false absences. Herpetological surveys could be more extensively based on multiple simultaneous observers to reduce observer heterogeneity bias in the detection process, and obtain more reliable patterns of species abundance and distribution for conservation purposes.

POST-STRIKE FORAGING BEHAVIOR

M. R. Parker and K. V. Kardong [2017, Copeia 105(4):649-656] note that predators demonstrate context-dependent foraging behaviors to dynamically and successfully track prey and can use multiple cues in this process. In squamate reptiles (snakes and lizards), chemical signals from prey significantly influence predatory behavior, especially substrate and airborne cues. This study examined behavioral variation in rattlesnakes (*Crotalus oreganus*) during strike-induced chemosensory searching (SICS), a sterotyped complex of behaviors seen in squamates. Rattlesnakes can use both substrate and airborne chemical cues during SICS, but the authors sought to determine the changes during SICS when either substrate, airborne, or air-deposited chemical cues were the only types available to snakes in a Y-maze. They hypothesized that these cues represent the spectrum of chemical information available in the natural environment. They also modified scoring of choice in the Y-maze by deriving a choice penalty score, a reflection of how extensively the snake explored the unscented arm of the maze. In the presence of substrate trails, rattlesnakes relocated prey fastest, had highest rates of tongue-flicking, and received the lowest choice penalty scores during SICS. Airborne chemical cues enabled successful relocation, but rattlesnakes took longer to relocate prey, increased the frequency of many searching behaviors, and more extensively explored the Y-maze (more negative choice penalties). When air-deposited cues were the only type available, rattlesnakes took the longest to choose an arm, had the lowest rates of tongue-flicking, and backtracked most often. The authors suggest that as prey odor becomes more dilute, rattlesnakes demonstrate behavioral plasticity in SICS to preserve their ability to relocate prey.

INTRODUCED SEAL SALAMANDERS

C. L. Bush et al. [2017, Copeia 105(4):678-688] note that many reptiles and amphibians are gaining recognition as harmful invaders, highlighted by well-known examples such as the brown tree snake (*Boiga irregularis*), cane toad (*Rhinella marina*), American bullfrog (*Lithobates catesbeianus*), and Burmese python (*Python molurus bivittatus*). In 2003, an introduced population of seal salamanders (*Desmognathus monticola*) was found in Spavinaw Creek, within the Ozark Plateau of northwest Arkansas. Genetic evidence confirmed an introduction from northern Georgia. Very little is known about the status of this non-native population; thus, the objective of this study was to assess the current distribution and abundance of non-native *D. monticola* along Spavinaw Creek. The authors conducted repeated, low-intensity visual surveys along the 30-km extent of Spavinaw Creek in Arkansas and used a hierarchical Bayesian analysis to model the occupancy response of *D. monticola* and five native salamander species relative to river mile and habitat covariates. They also conducted a short-term closed capture-mark-recapture study to estimate abundance of *D. monticola* at the original collection site on Spavinaw Creek. They found a clear geographic pattern of distribution of *D. monticola*, with individuals found throughout the upper 10 km of Spavinaw Creek headwaters, but no clear habitat associations. Estimated abundance of *D. monticola* was extremely high—14.5 individuals and 50 g wet biomass per m^2. The results reveal that introduced *D. monticola* are much more widely distributed than previously recognized and occur at high densities, suggesting that this recent invader could negatively affect ecosystems of Spavinaw Creek and surrounding watersheds in the Ozark highlands.

RINGED SAWBACK DEMOGRAPHICS

R. L. Jones [2017, Chelonian Conservation and Biology 16(2): 215-228] note that effective management of long-lived species requires demographic and life-history data that are best acquired from long-term studies. The ringed sawback (*Graptemys oculifera*), endemic to the Pearl River watershed of Mississippi and Louisiana, is a species of management concern at both the state and federal levels. Population sizes, trapping success, basking counts, sex ratios, survivorship, and growth of this species were investigated at 5 sites on the Pearl River in Mississippi over a 25-yr period. Estimates of age at maturity were 4.6 yrs for males and 9.1 yrs for females. Mean annual survivorship estimates for males, females, and juveniles were 0.88, 0.93, and 0.69, respectively. Maximum longevity estimates were 48.8 yrs for males and 76.4 yrs for females. Average longevity estimates were 8.5 yrs for males and 13.9 yrs for females. The sex ratio of captured turtles was male-biased before 2000 but unbiased after 2000. Realized population growth estimates indicated that four populations were stable over the 25-yr period and one population had declined. Population estimates and basking counts trended downward through time at most sites. Trapping success after 2000 for all sites combined declined by 77%, 45%, and 25% for juveniles, males, and females, respectively. Taken together, these data indicate that one population of *G. oculifera* has declined, three appear to be in the initial stages of decline, and one is relatively stable. Additional monitoring of these populations will be necessary to determine if these trends continue into the future.

Chicago Herpetological Society
Income Statement: January 1 – December 31, 2017

Income		Expense	
Donations	$ 11,174.50	Donations (conservation)	$ 2,000.00
Membership dues	10,210.60	Bulletin printing / mailing	12,733.51
ReptileFest	42,787.00	ReptileFest	36,627.67
Junior herpers	395.00	Grants	10,010.00
Merchandise sales	240.00	Rent (storage)	1,833.22
AmazonSmile	11.10	Bank / PayPal / Square fees	685.41
Interest	44.58	Other CHS shows	3,265.00
Raffle	572.00	Liability Insurance	3,146.00
Bulletin back issues	40.00	Equipment and supplies	796.15
		Licenses and Permits	398.88
		Postage	1,672.79
		Speaker reimbursement	2,301.54
		Awards	282.10
		Interest—credit card	3.09
		Miscellaneous	126.09
Total Income	**$65,474.78**	**Total Expense**	**$75,881.45**

Net Income ($10,406.67)

Chicago Herpetological Society
Balance Sheet: December 31, 2017

Assets	
Checking	$ 2,162.03
Money market	49,030.94
Petty cash--show fund	162.00
PayPal	1,087.08
Postage on deposit	192.64
Total Assets	**$52,634.69**
Liabilities	
Credit card	179.68
Total liabilities	**179.68**
Equity	
Retained earnings	62,861.68
Net income	(10,406.67)
Total equity	**$52,455.01**
Total liabilities & equity	**$52,634.69**

Advertisements

Line ads in this publication are run free for CHS members—$2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to mdloogatch@chicagoherp.org.

NEW CHS MEMBERS THIS MONTH

Jacob Curtis LaFond
Tanner Senti
Timothy Guy
Jaimie Kittle
Ann-Elizabeth Nash
Miranda Strasburg
Michaela Lambert
Catherine Chen
Amber Tagtmeier
Sarah Baker
Daniel Bergin
Thomas Hastings
Craig Bechtel
Tyler Kovacs
Michelle Thran

UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, January 31, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. The speaker will be **Ray Pawley**, retired curator of reptiles at Brookfield Zoo, who now makes his home near Hondo, New Mexico. He is also a many-times past president of the CHS and a frequent contributor to the *Bulletin*. Ray's talk will deal with what he has learned over the years about hibernation in rattlesnakes.

Dr. Robin Warne, assistant professor of zoology at Southern Illinois University in Carbondale will be the speaker at the February 28 meeting. Dr. Warne specializes in the physiological ecology of vertebrates, and will be speaking to us about amphibian diseases.

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.

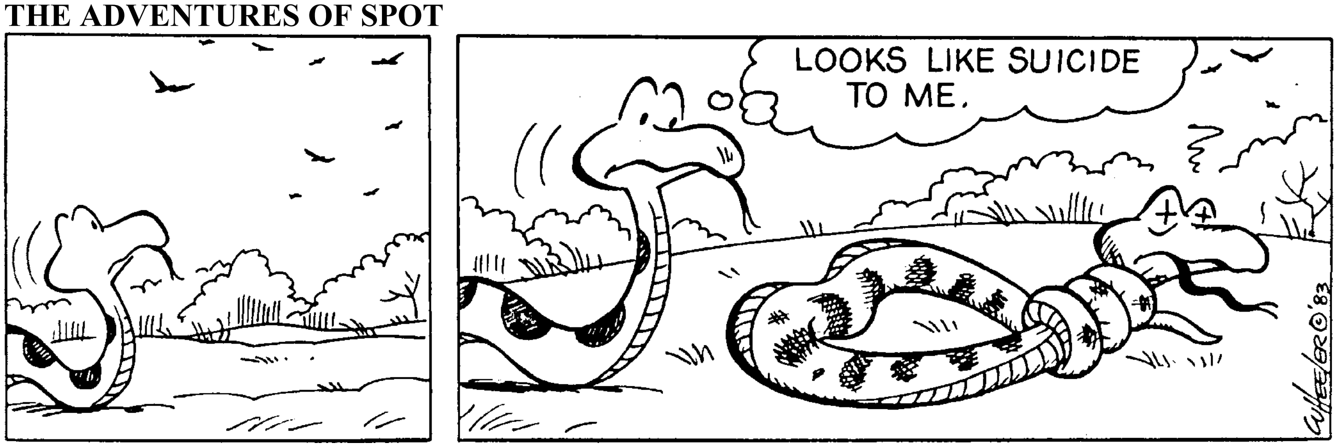
Board of Directors Meeting

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 February 16, 2018. 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



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