ZOO VIEW

Herpetological Review, 2015, 46(2), 290–294.

Identifying Amphibians and Reptiles in Zoos and Aquariums

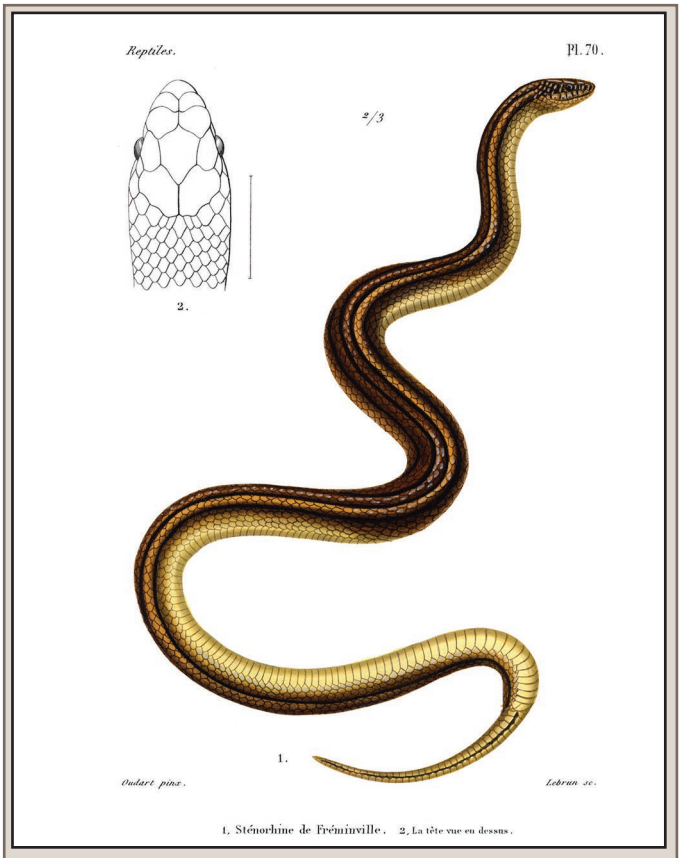
PLUS ÇA CHANGE, PLUS C'EST LA MÊME CHOSE [THE MORE THINGS CHANGE, THE MORE THEY STAY THE SAME]

—*JEAN-BAPTISTE ALPHONSE KARR, 1849*

Reptiles and amphibians are relatively unique in the sense of constantly changing taxonomies. That phenomenon simply is not a big operative problem for bird and mammal zoo personnel. To gain a sense of why this is happening, refer to Frost and Hillis (1990). There is confusion caused by changes in both standard and scientific names in herpetology. The general principle in a zoo is that one wants to be talking about the same species when putting live animals together for breeding or exhibit or analyzing records for genealogy or research. During a visit to the Dallas Zoo when I was there, an academic colleague specializing in snake taxonomy and systematics was chiding me about using a supposed outdated technical name on our graphic panels. I suggested that he consult Hobart M. and Rosella B. Smith's *Synopsis of the Herpetofauna of Mexico, Vol.* III (1976) and look up the number of synonyms for the Slatey Gray Snake (*Stenorrhina freminvillei*). I said that we would have to keep a graphics designer on permanent contract just to deal with the continually fluctuating nomenclatural world. He called a week later, having counted the names, and said point taken. This incident provokes a broader question—what standard and scientific names should we use for amphibians and reptiles in our displays, records, and publications? This is not a trivial issue as virtually all of us can remember some of our colleagues fighting to near death over standard names, taxonomy, and systematics. Who can forget the tension between E. D. Cope and O. C. Marsh in the late 1860s (see Adler 2014)? Or the exchange between Pauly et al. (2009) and Frost et al. (2009)?

I was recently asked by a zoo worker what generic names should be used for some of the various North American ratsnakes: *Elaphe*, *Pantherophis*, *Pituophis*, *Mintonius*, or *Scotophis*, and whether some of these are now recognized as species or subspecies. All New World ratsnakes (and Old World representatives) are listed as *Elaphe* by Schulz (1996); the reason given for this conservative treatment is "…we are of the opinion that the genus *Elaphe* requires an overall revision... Such a revision could reveal aspects, which had been overlooked or not previously recognized, and lead to completely different conclusions." For instance, Collins and Taggart (2008) presented a new alternative generic name for the Eastern (*Mintonius gloydi*) and Western (*M. vulpinus*) Fox Snakes, now synonymized with *Pantherophis* by Crother et al. (2011) and Crother (2012). Corn Snakes and their allies were traditionally placed in the genus *Elaphe* but were recently referred to *Pantherophis* based on their close relationship to other lampropeltine colubrids of the New World (Burbrink and Lawson 2007). Different combinations are used by different authors and my colleagues are struggling with these differences; in other words, which names should they use? Some biologists believe that there is a rule that the most recent taxonomic paper should be the one used but there is no such established convention in the Code (*The International Code of Zoological Nomenclature*). Recently, a convincing description of the dangers of taxonomic vandalism leading to potential destabilization has appeared in the literature (Kaiser et al. 2013) and should be required reading for every zoo biologist. This paper clearly outlines acceptable methods for proper taxonomic and systematic research. Reject any approach that does not adhere to these principles.

JAMES B. MURPHY
Division Amphibians & Reptiles
National Museum of Natural History
10th and Constitution Ave NW
Washington, DC 20013-7012, USA
e-mail: murphyjb@si.edu



COURTESY OF KRAIG ADLER AND TIM HERMAN

FIG. 1. Illustration of Slatey Gray Snake (*Stenorrhina freminvillei*) from *Erpétologie générale by* A. M. C. Duméril, G. Bibron, and A. Duméril, 1854 (plate 70 in Atlas). This species may hold the record for the sheer number of scientific name changes such as spelling errors since the original description as *Stenorhina Freminvillii* on p. 868. A reprint of this classic multi-volume work is available from SSAR.

I was discussing this potentially confusing issue with Roy McDiarmid from Smithsonian National Museum of Natural History and he recommended that the source for any nomenclatural decision used in any paper or any other purpose be stipulated. Roy, being the senior author of *Snake Species of the World* (1999), has had plenty of experience with conflicting names. He pointed out that there are names currently in use that he disagrees with and will not use, but that his readers need to know his reasoning for the decision. This approach makes sense to me so I am recommending here that the source for any name always be included in the beginning for all zoo animal records and placed in the permanent record for graphics panels (archived copies of the designs underlying all displays) and publications.

As a starting point, I use three sources for verification of current usage—*The Reptile Database* (Uetz and Hošek 2015, an online reference that is regularly upated), *Amphibian Species of the World* (Frost 1985 and its online successor, Frost 2015), and *Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding* (Crother 2012). However, decisions also had to be made to produce these sources, and decisions sometimes are poorly justified. The SSAR checklist (Crother 2012) is perhaps better in providing more information about the sources of taxonomic usage and reasons for not following certain proposals. Registrars and others responsible for zoo animal records justifiably complain that different names (sometimes misspelled) are often submitted without explanation by curators and keepers to be used for an accession record, and new names sometimes suddenly appear in the daily animal records. While change is inevitable, in these situations retrieval of important data may be compromised. Zoo curators need to check records carefully for names used at their own zoo or elsewhere and take care to ensure that names are consistent or that synonymies are explained. When changes occur, this fact must be highlighted, with the source material, for the zoo's records and also for central databases such as ISIS and studbooks.

A good example of the challenges faced by curators and registrars who might not be trained in herpetology is the taxonomic history of North American ratsnakes (Fig. 2). In a controversial paper in which he applied the then-new Evolutionary Species Concept, Joseph T. Collins (1991) proposed elevating 55 geographically disjunct amphibian and reptile subspecies to species level, including the Fox Snake from *Elaphe vulpina gloydi* to *Elaphe gloydi,* without supporting evidence but simply because these subspecies were, as he wrote, "mapped as allopatric" in various publications and were "in some way morphologically (and presumably genetically) distinct." In the *Catalogue of American Amphibians and Reptiles*, both subspecies (*E. v. vulpina* and *E. v. gloydi*) were recognized (Powell 1990). In *Standard Common and Current Scientific Names for North American Amphibians, Turtles. Reptiles and Crocodilians (fifth edition)* published by The Center for North American Herpetology in 2002 by Collins and Taggart, both Fox Snake taxa are listed as species and the generic name *Elaphe* is used throughout. Although we were friends for many years, I never agreed with Collins about his instantaneous adoption of proposed name changes.

In the IUCN Red List of Threatened Species: "Although Burbrink concluded that the molecular data show that *E*[*laphe*] *alleghaniensis* and *E. spiloides* represent independently evolving units with separate evolutionary histories and thus should be recognized as different species under the evolutionary species concept, contact zones were not critically examined, so the

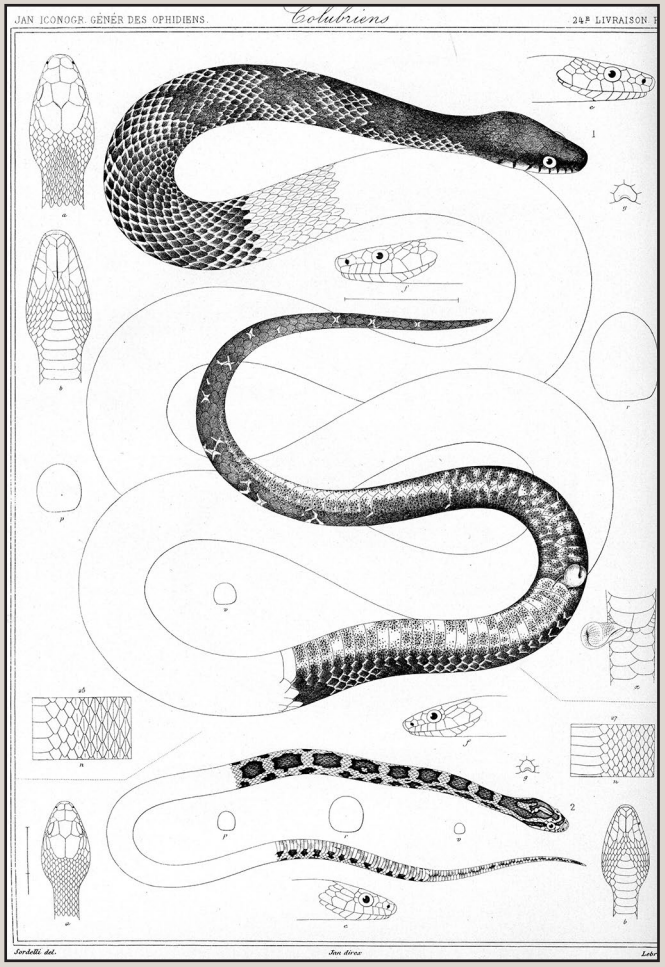


FIG. 2. Fair warning to ophiophobic tourists visiting Washington DC—Eastern Ratsnakes (*Pantherophis alleghaniensis*) are commonly found in the middle of the city at Smithsonian National Zoological Park. Illustration of *Elaphis alleghaniensis* from *Iconographie Générale des Ophidiens* by Georges Jan and Ferdinando Sordelli in 1860–66.

nature and dimensions of clade boundaries, and the precise distributions of *alleghaniensis* and *spiloides* along the length of the Appalachians, remain uncertain. In view of the uncertainties and the need for further study, Burbrink's taxonomic revision has not been adopted in this database" (Hammerson 2007). In *The Reptile Database*, these taxa are listed as Eastern Ratsnake (*Pantherophis alleghaniensis*) and the Midland or Gray Ratsnake (*P. spiloides*). In Crother (2012), this statement justifying the committee's decision is offered: *P. obsoletus* (Say, 1823)—Western Ratsnake. "Based on the congruence of morphological (Burbrink, 2001, Herpetol. Monogr. 15:1–53) and mitochondrial data (Burbrink et al., 2000, Evolution 54: 2107–2118), Burbrink divided *P. obsoletus* into three species (*P. alleghaniensis, P. obsoletus* and *P. spiloides)* with no subspecies." In 2008, Collins and Taggart resurrected the genus *Scotophis* for Burbrink's three taxa, i.e., *S. alleghaniensis*, *S. spiloides*, and *S. obsoletus*, in response to the findings of Burbrink and Lawson (2007) but this has not been followed by subsequent workers (e.g., Pyron and Burbrink 2009). In 2014, Wallach et al. published *Snakes of the World*, a compendium that followed the arrangement of the SSAR checklist (Crother 2012). This classification is also followed by the NCBI (National Center for Biotechnology Information) taxonomy database but there is

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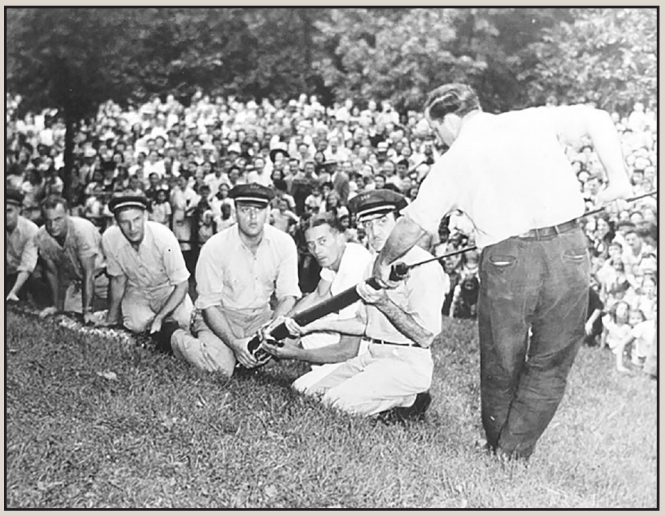

FIG. 3. When the beautiful reptile building opened at the Saint Louis Zoo in 1927, R. Marlin Perkins was installed as curator and Moody J. R. Lentz was his assistant. During those early days, one popular feature was force-feeding large constrictors—such as "Blondie," the Reticulated Python shown here—every other week. Huge crowds attended the event as is evident in this undated photograph. Lentz (third from right) is holding the head. Note that a caulking gun is being used to squirt gruel into the snake's esophagus.

a disclaimer stating that this is not an authoritative source for nomenclature or classification. In ISIS (International Species Information System) /ZIMS (Zoological Information Management System), the administrators admit that they cannot keep up with taxonomic changes. As of this writing, it is current to 13 October 2014. Here are the entries: Ratsnake = *Elaphe obsoleta*; Black Ratsnake = *Elaphe obsoleta obsoleta.*

The term "ratsnakes" is currently used in an historical sense, inclusive of both Old and New World representatives that we now know are not closely related (Utiger et al. 2002). In the New World, the generic name *Bogertophis* has been used for the Baja California Ratsnake (*Bogertophis rosaliae*) and Trans-Pecos Ratsnake (*B. subocularis*) since 1988. The generic name *Senticolis* refers to the Green Ratsnake (*S. triaspis*) from SW USA, Mexico, and Central America. Both genera were recognized by Liner (1994) but not Schultz (1996). The Yellow-red Ratsnake or Yucatan Ratsnake, *Pseudelaphe flavirufa*, is found in Mexico and Central America. For most of its taxonomic life this species resided within *Elaphe*, but was transferred to *Pseudelaphe* by Utiger et al. (2002); the vast majority of published references, including Schultz (1996), list it under its older name.

Pet names are a different problem. My wife Judith Block, retired registrar at the National Zoo, once asked several keepers to help identify some primates in the collection: "When I took the gibbon records over to the Monkey House and asked which animal was named 'Spook,' three of them pointed to three different animals. It was also the primate keepers who taught me that an animal's name is very fluid. One macaque started off as 'Mary,' became 'Margie' then 'Mom' then 'Granny.' And all of the keeper staff contributed to my learning that often the formal name given in consultation with the Embassy or as the result of a contest is not what the animal is actually called—or even close. These experiences, along with many others, taught me not to rely on people's memory when creating and analyzing zoo records." I have argued before (Murphy and Card 1998) that for various reasons pet names should not be used in zoos but many of my colleagues disagree with me.

Knowing precisely which live animals are being assembled for breeding has always been critically important for zoos and aquariums. This has often been difficult because locality data for specimens or their ancestors is seldom known (and even if known rarely kept or at least easily retrieved) and DNA paternity/maternity analyses are virtually never conducted. And now, as these institutions focus on captive breeding colonies and conservation programs that might involve releases, precise identification is even more important (see Soulé and Kohm 1989). My overall impression is the importation of live animals from the field has diminished over the past several decades and the importation of biomaterials for research has increased.

Marking reptiles and amphibians for certain identification of individuals in the collection is an important component as well. Methods are described in several publications (Honegger 1979; Heyer et al. 1994, 2001; Ferner 2007; McDiarmid et al. 2012). Using PIT tags and photographs are helpful methods. At Dallas Zoo, we sometimes placed animals with distinct patterns and colors on a color copier to obtain a permanent record.

It is imperative to keep track of individuals, their origin, and genetic/breeding histories. This tracking may become even more complex when creating certain zoo animal colonies in the future. A recent paper by Cole et al. (2014) described a new species called Neaves' Whiptail Lizard (*Aspidoscelis neavesi*). Their abstract: "The first known tetraploid amniote that reproduces through parthenogenetic cloning by individual females is named and described. The species originated through hybridization between *Aspidoscelis exsanguis* (triploid parthenogen) x *Aspidoscelis inornata* (diploid bisexual or gonochoristic species) in the laboratory." It should be mentioned that not all herpetologists agree that a new species developed only in captivity represents a new taxon.

I may be too old to change but I simply cannot bring myself to use some new names even when a strong case is made to do so (see Reynolds et al. 2014). The Reticulated Python (*Python reticulatus*) was described by Fitzinger in 1826 but is now listed as *Malayopython reticulatus* in The Reptile Database. The Fitzinger name has been used for 170 years. At some point, I may be able to adapt to *Malayopython* but it will be challenging (Fig. 3).

It is easy to reject the generic name *Broghammerus* Hoser 2004 and the six Reticulated Python subspecies for the reasons enumerated by H. Kaiser and colleagues (Kaiser et al. 2013). Unfortunately, a number of zoos, governmental agencies and other institutions, and herpetoculturists have been using this generic name in their online and printed materials including promotional, care, and information sheets—the lack of scientific rigor and indifference to acceptable standards for naming animals will certainly cause confusion when lists of taxa are generated for conservation purposes and studies on herpetofaunal biology are undertaken. Several examples: Rawlings et al. (2008) refer to the Reticulated Python as *Broghammerus reticulatus* and subspecies *jampeanus* and *saputrai* (by implication). The U.S. Fish and Wildlife Service (USFWS) listed the Reticulated Python as *Broghammerus reticulatus* or *Python reticulatus* in several Federal Register documents dealing with possible injurious wildlife species. Reed and Rodda (2009) use *Broghammerus reticulatus* in the frontispiece, captions of their figures, and tables in the joint report by USFWS and U.S. Geological Survey (USGS) and recommended the following: "Rawlings and others (2008) opted for splitting, especially as a suitable name was already in use in

the literature for the Reticulated Python. Adherents of this point of view will wish to use the name *Broghammerus reticulatus*."

I recommend again to curators, registrars, and records keepers that in order to remain as accurate as possible and ensure that the conventions and usage for all names are understood over time by all future reviewers of these records, any changes should be documented. If there is inconsistency, then an explanation of how it was resolved must be placed in the records. Any new names advanced by the curators must have the source included; a copy of at least the title page and preferably the abstract of the relevant source information should be required. Copying the entire paper would be helpful. The curator's name and sources are then kept in the permanent records. (I note here that pdf files can sometimes be obtained on the internet through Google Scholar search engine). Lists of protected species—CITES and other international treaties, and local lists such as USFWS—must be consulted as well to guarantee consistency.

Other recommendations:

—To understand reasons for the sometimes-heated debates in herpetological taxonomy, read Vences et al. (2013) and Wüster and Bérnils (2011). These disagreements are unlikely to be resolved in the forseeable future.

—The IUCN Red List is a set of conservation statuses and recommendations. It is not to be used as a source of taxonomic information. It is updated too slowly and sporadically to be used as such.

—The online system AmphibiaWeb is linked to the IUCN list and provides information on amphibian declines, natural history, conservation, and taxonomy. There are differences between the taxonomies of AmphibiaWeb and *Amphibian Species of the World*. One helpful feature is as a source for photographs called "Photobrowser." The section called "Stories from the Field" is interesting reading highlighting the work of amphibian biologists.

—Follow *Amphibian Species of the World* and *The Reptile Database,* plus the SSAR Standard Names List for English names for US/Canadian taxa. *The Reptile Database* is not perfect, but clearly it is the best thing available. Specifically do NOT use field guides, Wikipedia, or any other taxonomy on the web (other than the above).

—Update taxonomies (across ALL zoo records and signage) once a year. This seems more efficient and likely to occur than rushing to the registrar every time a new taxonomic paper is published. Most curators have to file annual collection plans. Complete taxonomic review of the collection—and appropriately annotated changes to all zoo records—should be a mandatory part of this process.

—ISIS and AZA taxonomic lists are outdated to the point of non-functionality. In AZA guidelines, I believe that Frost (1985) is listed as the official taxonomy for zoos to follow for amphibians. By extension, its online descendent (Frost 2015) then is the official list for AZA.

—Read David L. Hull's book *Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science* (1988).

—Arrange to have an advisor apart from the zoo profession who can suggest proper taxonomies for the records.

—During my zoo career, there has been a reluctance by some zoo biologists to update taxonomies (sometimes for over a decade) for graphics, records, or other purposes, and budget constraints are usually given for one of the reasons. I remember visiting one US zoo with a large herpetological collection where the labels were typed on paper with a barely visible font size and were so old that they were yellowed and turning to dust—the curator said that visitors do not read signs anyway so why should he bother to produce more accurate and aesthetic versions? Another reason offered is that new names are too difficult to learn. When Arnold Kluge changed the generic name of the Green Tree Python from *Chondropython* to *Morelia* in 1993, there was an outcry from some in the herpetological community that was astonishing. Some of my colleagues refuse to use the latter name to this day and will tell anyone who will listen. These are unacceptable excuses for a profession claiming to have a scientific underpinning, especially in this digital world where searching for relevant publications is much easier.

—In summary, evaluate each proposal on its own merits, and also defer to species authorities in cases where you do not have enough knowledge. Clearly there are taxonomic changes that an informed reader can see that warrant immediate adoption given the breadth and depth of evidence (*Natrix* vs. *Nerodia* or *Elaphe* vs. *Pantherophis*), while other proposals, although put forth by experts, probably warrant an extended period of evaluation. Examples of *Lithobates* vs. *Rana*, or *Bufo* vs. *Anaxyrus* come to mind; in these cases there is general agreement on the evidence, but it comes down to whether one wants to carve up a monophyletic group, albeit a large one. In general, I would advocate a conservative approach, make changes when some degree of consensus in the herp community develops, and consult with one or more herpetologists with taxonomic expertise.

As an aside, Kraig Adler told me that as a brash new graduate student at the University of Michigan Museum of Zoology in 1962, he dashed into the office of prominent herpetologist Norman Hartweg waving a newly published paper that made wholesale nomenclatural changes in the Latin names of turtles and insisted that all the labels in the museum collection be changed. Professor Hartweg told this young chap to calm down as no changes were going to be made—the one certainty was that many new changes will prove to be in error and be rejected, and that the older names will return to former prominence. As, in fact, they were.

Acknowledgments.—This contribution is dedicated to René Honegger, Curator of Herpetology at Zürich Zoo in Switzerland between 1960 and 1999, now retired. He was responsible for many innovations in terrarium displays, captive husbandry and management, and national and international conservation issues. René compiled the first IUCN Red Data Book on reptiles (Part 1—Testudines, Crocodylia, Rhynchocephalia) in 1982.

I thank Smithsonian National Zoo registrars Judith Block and Mandy Murphy for reviewing an early draft. Kraig Adler, Kevin de Queiroz, Harry Greene, Robert Hansen, Roy McDiarmid, Joe Mendelson, and George Zug suggested ways to improve the paper. The staff of the herpetological department at National Zoo (Lauren Augustine, Matt Evans) were helpful as well.

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