ARTICLES

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How Many Reptile Species?

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Vertebrates are certainly the best-studied animals of which most species have been identified. Accordingly there are comprehensive compilations that list all known 4675 mammal species (Hutterer 1995; Wilson and Reeder 1993), all 9702 birds (Sibley and Monroe 1993), 4780 amphibians (Duellman 1993; Frost 1985; Glaw and Köhler 1998) and 23,250 fish (Eschmeyer et al. 1998). Nevertheless, new fish, amphibians, and reptiles continue to be described at a rate of about 200, 80, and 60 species per year, respectively (Bauer 1999; Eschmeyer et al. 1998; Glaw and Köhler 1998; this work). Two comprehensive lists of reptile species have been attempted recently (Ananjeva et al. 1988; Frank and Ramus 1995) which list 7712 and ~6700 reptile species, respectively. However, both have shortcomings: they are mere lists of names that do not distinguish between original and secondary names (Frank and Ramus 1995) or do not give the year of description (Ananjeva et al. 1988); they do not list synonyms, statistics, or distributional data; and they provide no references to individual species. Finally, as with most printed lists, corrected updates are not forthcoming and likely would soon be out of date again. Interestingly, misconceptions about the diversity of reptiles persist. For example, two randomly selected textbooks on biodiversity (Becher 1998:92; Margulis and Schwartz 1998:331) mention the existence of 6300 and 5000 reptile species, respectively. The latter number neglects 37% of all described species!

To overcome such shortcomings we started an online database of reptile species about four years ago (Uetz and Etzold 1996). This list currently contains 7870 extant reptile species and provides not only synonymies and distributional data, but also attempts to give references for every species. The database has been assembled mainly from published monographs and checklists and from submissions by individual contributors. Currently, it contains original references for about 75% of the known reptile species and provides links to photographs of more than 1000 species on the World Wide Web. Eventually the database should serve as a guide to descriptions and keys in the literature or even contain them as online information. Together with the recently established amphibian species checklist (http://www.mabnetamericas.org/; see also http://research.amnh.org/herpetology/amphibia/index.html), this database completes the lists of more than 50,000 vertebrate species names that are available online.

The majority of reptile species are the lizards (4470 species) and snakes (2920), whereas the turtles (295), crocodiles (23), and tuataras (2) represent only 4.1% of all living reptiles. 51% of known reptile species belong to one of only three families: the colubrid snakes (about 1850 species), the skinks (1200), and the geckoes (1000). Fig. 1 summarizes the assignment of extant reptile species to their families. Furthermore, I assembled a preliminary world reptile diversity map that illustrates species richness in different geographic areas of the world (Fig. 2). The database is easily queried for individual countries or subordinate areas, although incomplete data yield more erroneous results for national and subnational regions like states or provinces.

I am aware that such a database will never be complete, simply because new species are constantly being discovered and because new phylogenetic insights lead to taxonomic and nomenclatural rearrangements. Furthermore, species concepts in herpetology changed, especially with the influential paper of Frost and Hillis (1990), who proposed adoption of an evolutionary species concept (ESC) as opposed to the hitherto used biological species concept (BSC). The ESC suggests the recognition of "diagnosable" evolutionary units or populations as species. This suggestion led to the elevation of many subspecies to species status. Unfortunately, the ESC has been applied very unevenly and often without proper study and therefore many taxonomic and nomenclatural changes will follow. In fact, this is also true for other vertebrates such as birds (Haffer 1997). The increasing popularity of molecular studies is another factor that will cause significant rearrangements and nomenclatural changes within many taxa, simply because morphological analysis often does not resolve the phylogenetic relationships between both distantly and closely related taxa or even gives contradictory results (see for instance Hedges and Poling 1999). Retrieval of DNA sequence data from the reptile species database is facilitated by its location on the European Molecular Biology Laboratory server which not only hosts GenBank and related databases but also uses the same query interface.

The EMBL Reptile Database (http://www.embl-heidelberg.de/~uetz/LivingReptiles.html) is a starting point for further developments. Its shortcomings can be overcome by regular review by specialists. Collaborations with several herpetological societies are currently being negotiated. Until decisions are reached, I solicit all systematic herpetologists to communicate taxonomic changes as well as errors or omissions.

Acknowledgments.—The database described here could not have been realized without the help of many individuals, too many to list here but who are listed on the database's website. I thank Gerard Cagney, Bill Duellman, Jakob Hallermann, Ray B. Huey, Mirco Sole Kienle, and George Zug for helpful comments on earlier versions of this manuscript.

LITERATURE CITED

ANANJEVA, N. B., L. J. BORKIN, I. S. DAREVSKY, AND N. L. ORLOV. 1988. Dictionary of Animal Names in Five Languages. Amphibians and Reptiles. Russky Yazyk Publ., Moscow. 554 pp.

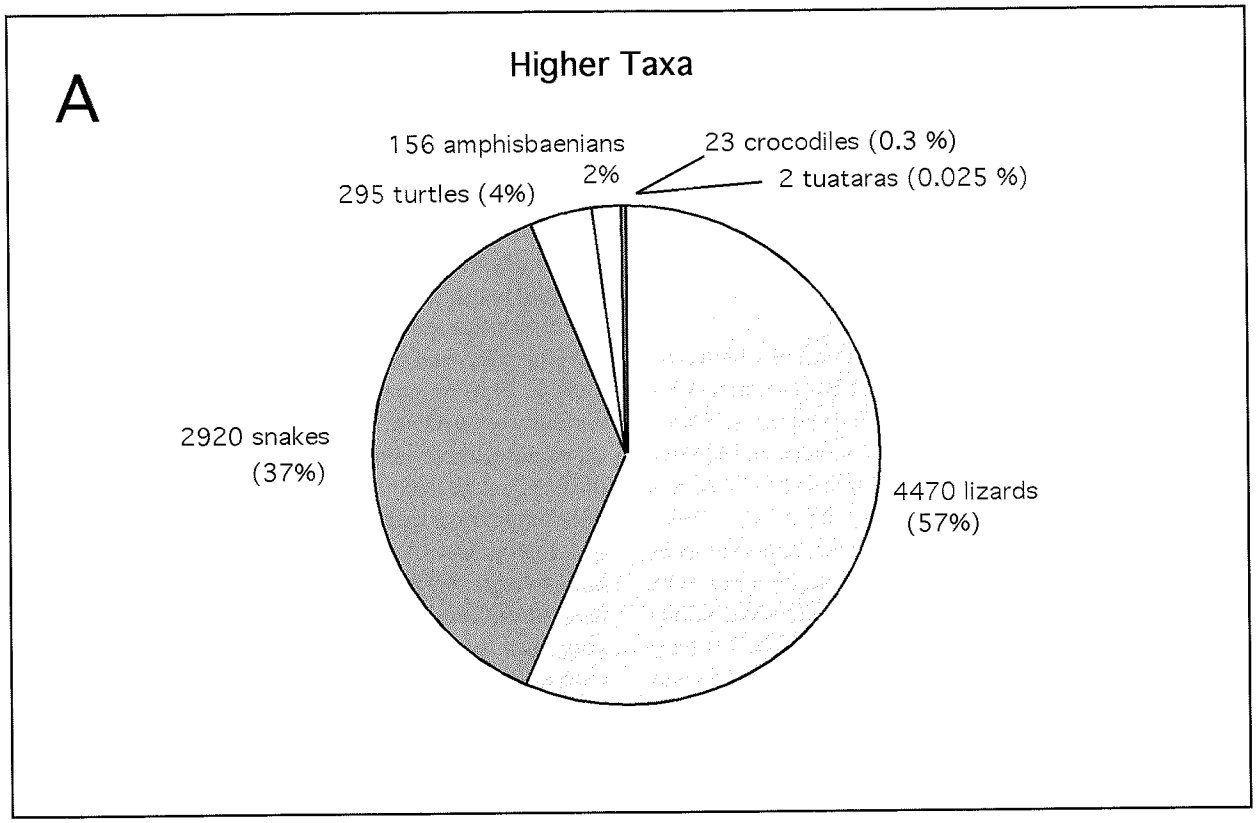
BAUER, A. M. 1999. Twentieth Century amphibian and reptile discoveries. Cryptozoology 13(1997–1998):1–17

BECHER, A. 1998. Biodiversity. ABC-CLIO, Santa Barbara, California. 275 pp.

DUELLMAN,W. E. 1993. Amphibian Species of the World: Additions and Corrections. Univ. Kansas, Mus. Nat. Hist., Spec. Publ. 21:1–372.

ESCHMEYER,W. N., C. J. FERRARIS, AND M. D. HOANG. 1998. Catalogue of Fishes, 3 vols. California Acad. Sci., San Francisco, 2905 pp. http://www.calacademy.org/research/ichthyology/species/ http://ibs.uel.ac.uk/ibs/sp2000/fishbase/.

FRANK, N., AND E. RAMUS. 1995. A Complete Guide to Scientific and Common Names of Reptiles and Amphibians of the World. N G Publishing Inc., Pottsville, Pennsylvania. 377 pp.



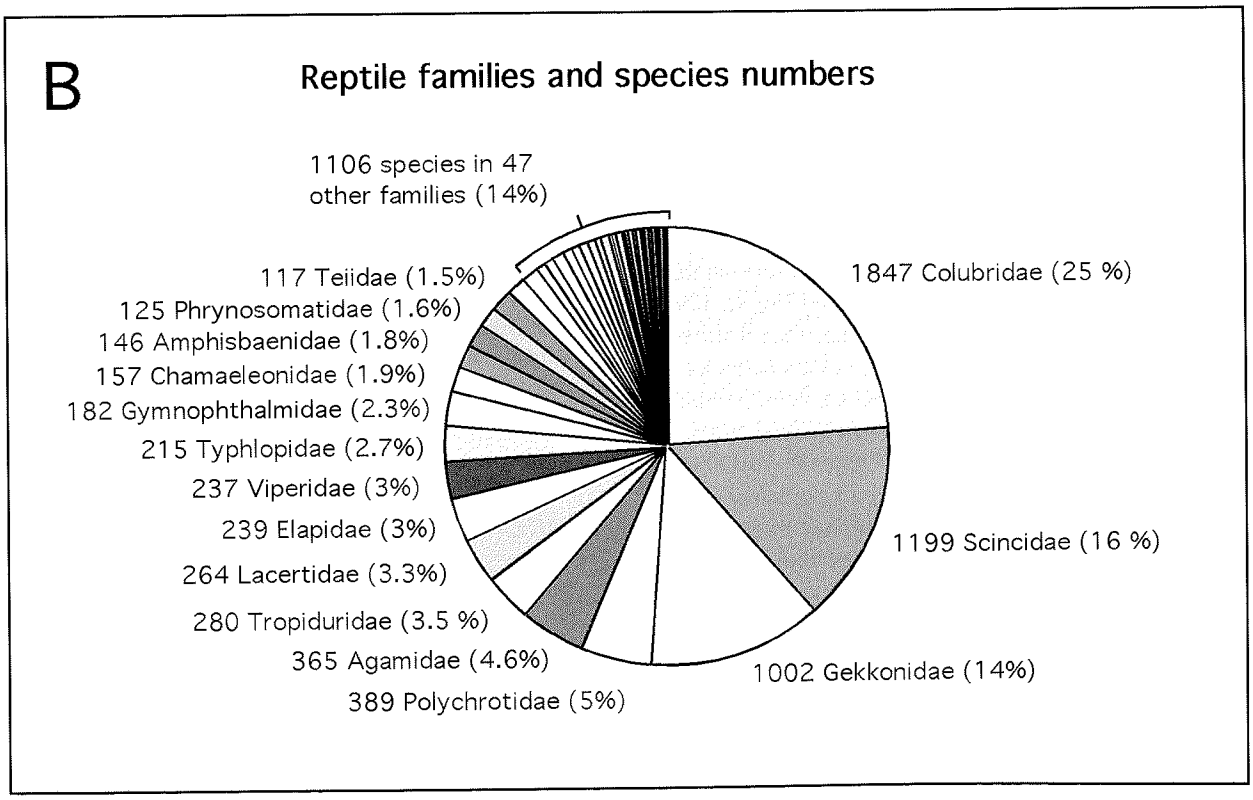


FIG. 1. Absolute species numbers and their percentage of the major extant reptile families. A. Higher taxa. B. Individual families. This chart uses a rather traditional classification with the Gekkonidae containing the Eublepharidae but not the Pygopodidae. The iguanian families have been split according to Frost and Etheridge (1989). Some authors have suggested reverting to the traditional family "Iguanidae" (e.g., Macey et al. 1997), which would form the fourth-largest family with 865 species. Elapidae and Hydrophiidae are treated as separate families. Numbers for the smaller families can be retrieved from our web site. The numbers are available at our web site and will be updated regularly.

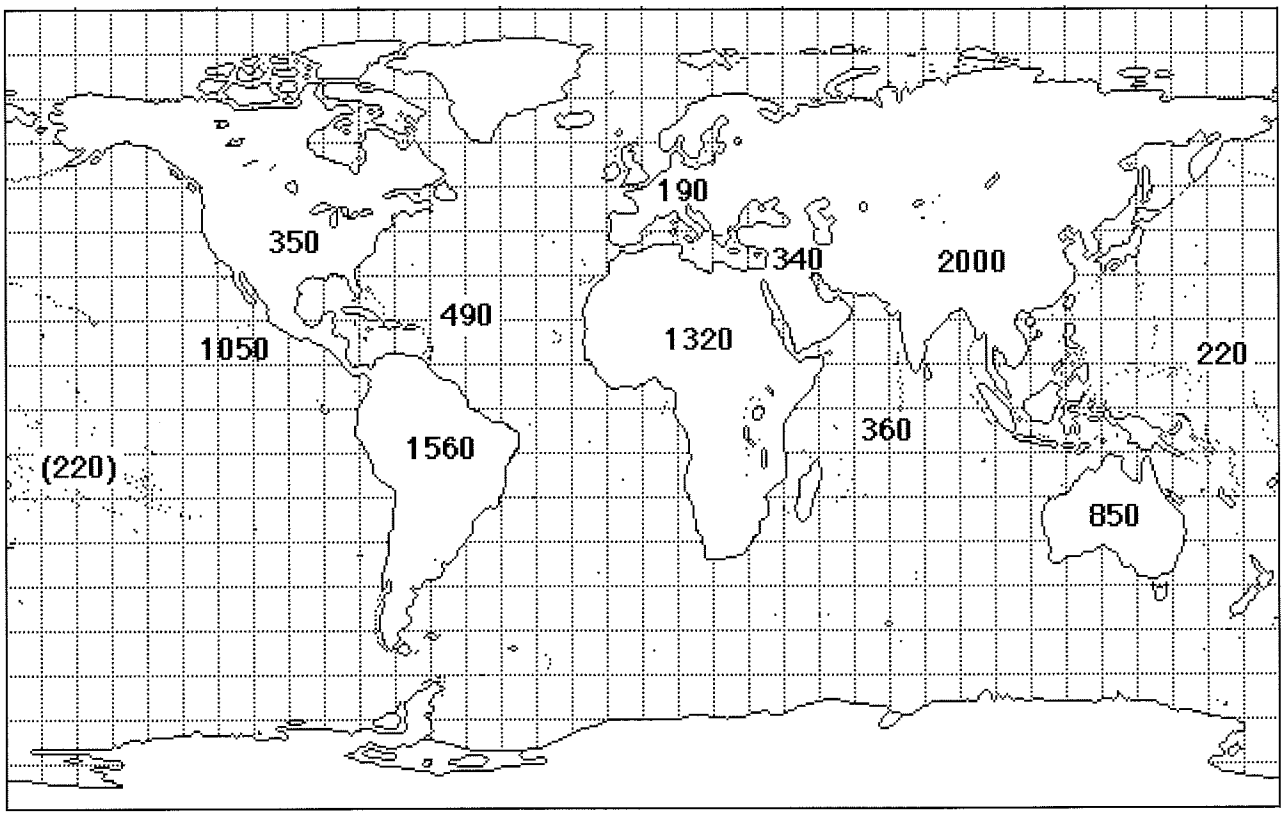


FIG. 2. Species numbers for different continents or geographic areas: Africa (1320), Asia incl. New Guinea (2000), Australia (850), Caribbean (490), Europe incl. Canary Islands (190), Indian Ocean incl. Madagascar, Comoros, etc. (360), Middle America (1050), Near East incl. Iran, Iraq (340), North America (350), Oceania incl. New Zealand (220), South America (1560). The sum of these numbers (8750) exceeds the total number of species (7870) because some species occur in several of these areas (e.g., 125 species occur both in Panama and Colombia, i.e., Middle and South America). Numbers in the figure have been rounded to the nearest 10. Numbers for individual countries can be found online in the EMBL Reptile Database. This map is available at the web site and will be updated with future releases of the database.

FROST, D. R. (ED.). 1985. Amphibian Species of the World: A Taxonomic and Geographical Reference. Allen Press and Assoc. of Syst. Coll., Lawrence, Kansas. 732 pp.

_____, AND R. ETHERIDGE. 1989. A phylogenetic analysis and taxonomy of iguanian lizards (Reptilia: Squamata). Misc. Publ., Univ. Kansas Mus. Nat. Hist. (81):1–65.

_____, AND D. M. HILLIS. 1990. Species in concept and practice: herpetological applications. Herpetologica 46:87–104.

GLAW, F., AND J. KÖHLER. 1998. Amphibian species diversity exceeds that of mammals. Herpetol. Rev. 29:11–12.

HAFFER, J. H. 1997. Species concepts and species limits in ornithology. *In* J. del Hoyo, A. Elliott, and J. Sargatal (eds.), Handbook of the Birds of the World. Vol. 4, pp. 11–24. Lynx Edicions, Barcelona.

HEDGES S. B., AND L. L. POLING. 1999. A molecular phylogeny of reptiles. Science 283(5404):998–1001.

HUTTERER, R. 1995. Unbekannte Säugetierwelt: Übersicht der seit 1985 beschriebenen Arten. Tier und Mus. 4(3/4):77–88.

MACEY, J. R., A. LARSON, N. B. ANANJEVA, AND T. J. PAPENFUSS. 1997. Evolutionary shifts in three major structural features of the mitochondrial genome among iguanian lizards. J. Mol. Evol. 44:660–674.

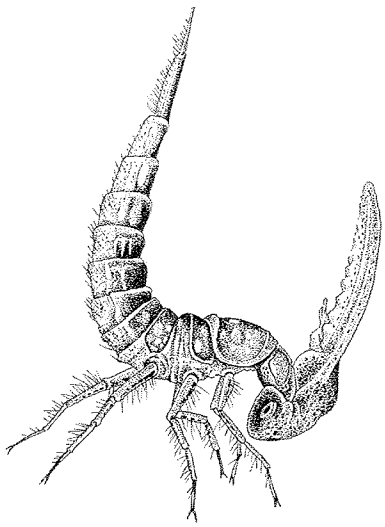
MARGULIS, L., AND K. V. SCHWARTZ. 1998. Five Kingdoms. Freeman, New York. 520 pp.

MONROE, B.L., JR., AND C. G. SIBLEY. 1993. A World Checklist of Birds. Yale Univ. Press, New Haven, 393 pp. http://www.itc.nl/~deby/SM/.

UETZ, P., AND T. ETZOLD. 1996. Die EMBL-Reptiliendatenbank. Elaphe 4/96:49-53.

_____, AND _____. 1996. The EMBL/EBI Reptile Database. Herpetol. Rev. 27:174–175. http://www.embl-heidelberg.de/~uetz/LivingReptiles.html.

WILSON, D. E., AND D. M. REEDER (EDS.). 1993. Mammal Species of the World. Smithsonian Institution Press, Washington D.C. 1206 pp. http://nmnhwww.si.edu/msw/.



Great Diving Beetle larva (*Dytiscus marginalis*) consuming Common Frog (*Rana temporaria*) tadpole. Illustration by P. A. Benson.