

## ARTICLES

### Amphibian Species Diversity Exceeds that of Mammals

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Since the official beginning of zoological nomenclature by Linné in 1758, the number of known mammals has always been higher than that of amphibians. Wilson and Reeder (1993) recognized 4629 mammal species, while their number was estimated to be about 4675 in the middle of 1995 (Hutterer 1995). These estimates prompted us to check the current number of valid amphibian species and their description rates to compare them with those of mammals.

To estimate the current number of living valid amphibian species we compiled a synthesis of the data provided in *Amphibian Species of the World* (Frost 1985) and the additions and corrections to this work by Duellman (1993). The *Zoological Record* (1990–1995) was used as the main data source to complete this synthesis. Additionally, we searched recent herpetological and zoological journals for taxonomic changes (descriptions of new species, resurrections from synonymy, and new synonyms). All these data (available at [www.mabnetamericas.org](http://www.mabnetamericas.org)) were processed on IBM compatible computers using Microsoft Access and Excel software. Calculations about expected future discovery rates of amphibian species were based on a linear regression of the description rates between 1964 and 1994. Our taxonomic classification follows Duellman (1993). The data on mammal species richness were taken from Wilson and Reeder (1993) as updated by Hutterer (1995).

Annual rates of amphibian species descriptions have been extremely variable (Fig. 1). Most of the outstanding peaks are due to important contributions of single scientists (1758: Linné; 1768:

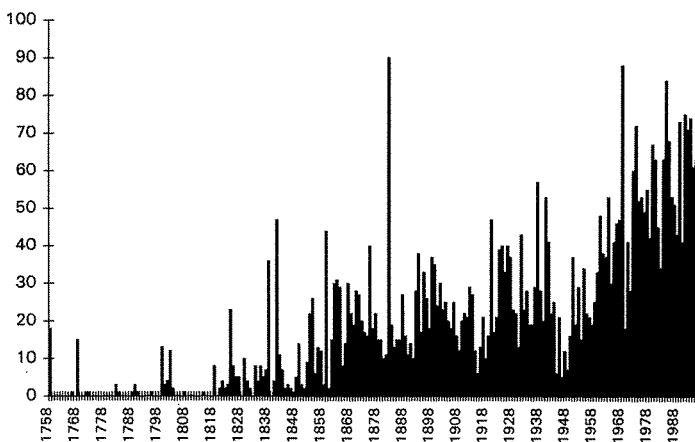


FIG. 1. Annual amphibian species descriptions since 1758 (synonyms not included).

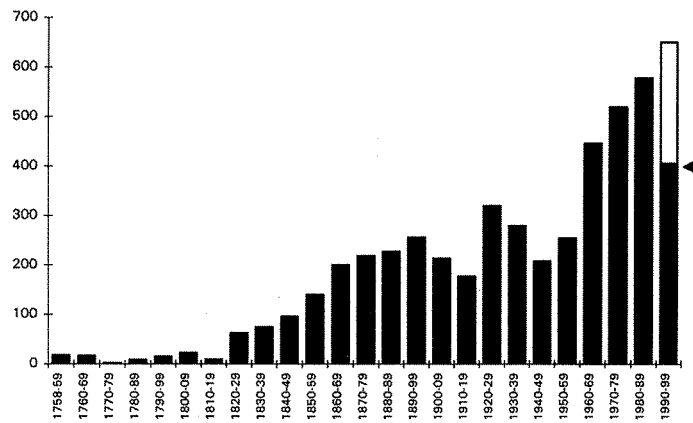


FIG. 2. Amphibian species descriptions since 1758 clustered in decades (synonyms not included). Arrow indicates end of 1995. Species descriptions until the end of this century are extrapolated.

Laurenti; 1799: Schneider; 1803: Daudin; 1824: Spix; 1841: Duméril and Bibron; 1859: Günther; 1882: Boulenger; 1968: Taylor). Despite this variability, increasing rates of description are evident. This trend becomes obvious when the rates are clustered in decades (Fig. 2). Comparison of Fig. 2 with the graph provided by Wilson and Reeder (1993) demonstrates that the largest burst of species discoveries in mammals is over (see also Morell 1996), whereas description rates in amphibians are still increasing. Decrease of description rates between 1910 and 1919 as well as between 1940 and 1949 possibly are due to the first and second world wars, respectively.

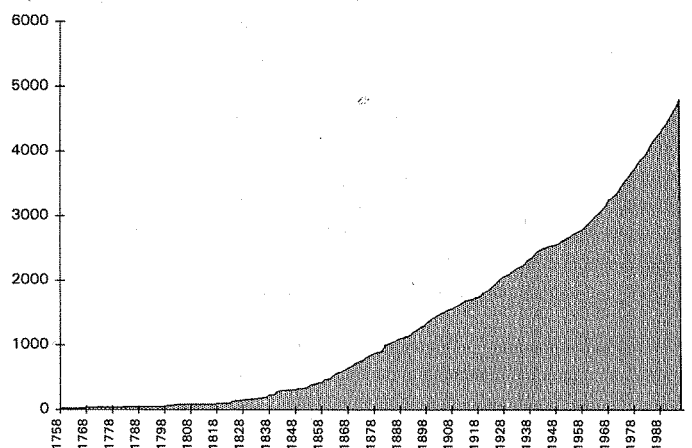


FIG. 3. Increase of valid recognized amphibian species from 1758 to 1995.

The cumulative analysis (Fig. 3) revealed that the number of recognized species strongly increases. The total number of valid amphibian species at the end of 1995 was at least 4780 (Anura: 4204, Urodela: 411, Gymnophiona: 165). Species richness of the ten largest anuran families at the end of 1995 was as follows: Leptodactylidae (906; among them 544 species in the genus *Eleutherodactylus*), Hylidae (754), Ranidae (711), Bufonidae (400), Microhylidae (316), Hyperoliidae (230), Rhacophoridae (228), Dendrobatidae (180), Centrolenidae (116), and Myobatrachidae (116). The largest family of the order Urodela is the Plethodontidae (263 species). The biogeographical portions

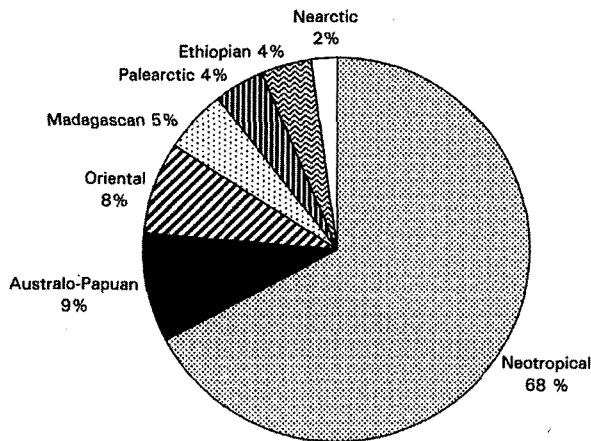


FIG. 4. Percentages of amphibian species described from the beginning of 1986 through the end of 1995 in different biogeographical regions.

of species descriptions during the last ten years are shown in Fig. 4. A comparison with the total number of mammal species showed that since 1994 amphibian species diversity exceeded that of mammals when both vertebrate classes had around 4650 species.

For comparison of species numbers several factors must be taken into account, e.g., subjective opinions and different species concepts of taxonomists, completeness of taxonomic inventories, percentage of synonyms, access of characters and methods. However, we consider these factors to be of similar significance in amphibians and mammals. Our comparison of species discovery rates suggests that the actual number of amphibian species is much higher than that of mammals. If we assume a continuous linear increase of species numbers in amphibians we will have reached 5000 species at the end of this century. The increasing use of modern techniques, especially the analysis of advertisement calls in anurans as well as biochemical and genetic studies, undoubtedly will lead to the discovery of many new species in the future. Recent field surveys in tropical rainforest areas (e.g., Madagascar and Bolivia) indicate that this trend seems realistic for at least the next two or three decades. These estimates demonstrate the urgent need for well-managed national and international biodiversity research programs for amphibians.

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