New vertebrate species

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Despite the extreme level of human-induced habitat destruction on Earth, which has resulted in more than 16,000 species worldwide being threatened with extinction, the last decade has seen a dramatic boom in the discovery of new vertebrate species. Such unprecedented taxonomic discoveries are the result of increased use of molecular biology in taxonomic studies and, most importantly, of increased numbers of scientific expeditions in regions (such as the Amazon and the Congo) that have been rarely, or never, surveyed previously. Although many of the newly described species are small and cryptic (appearing identical but genetically quite distinct), some very large and unlikely animals, such as petrels, cats, elephants, pandas, and whales, are being newly described. In the present article, the state-of-the-knowledge in species and subspecies discoveries is discussed, and information is compiled from published taxonomic revisions—essentially a reinterpretation of the taxonomy of known animals—and from new field discoveries of animals. In particular, special attention is paid to tetrapod vertebrates, that is, amphibians, reptiles, mammals, and birds.

Taxonomic revision

In many instances, taxonomic revisions are motivated by discoveries of new species in the field. In order to accommodate a newly discovered animal, taxonomists are often induced to modify known taxonomic relationships. Sometimes, in the process, they propose new species status to animals that were deposited, but unnoticed for decades, in museum collections worldwide. For instance, the recent discovery of Ayres black uakari monkey (*Cacajao ayresi*) along the Aracá River in northern Amazonia prompted a taxonomic revision of black uakaris, resulting in the description of a second species, the Neblina uakari (*Cacajao hosomi*), a known animal but thought previously to be the same animal described in the 1800s by Alexander von Humboldt. Thus, one field discovery resulted in the elevation of black uakaris from 1 to 3 species.

The exploration of areas never before sampled accounts for about 40% of the new mammal species described from 1993 to 2007. In many cases, these species are restricted to regions (for example, Brazil and Madagascar) that are seriously threatened by human occupation and with a high degree of endemism. (Endemic species are those with restricted ranges; thus, if these species were lost from a single region, they would be globally extinct.) In addition, a significant contribution to global biodiversity has emerged with the application of molecular genetic techniques, as has been employed, for example, in the analysis of newly described species of *Microcebus* (mouse lemurs) in Madagascar. Another example is the separation of the 2 previously known orangutan subspecies into 2 different species, *Pongo abelii* in Sumatra and *Pongo pygmaeus* in Borneo, with the latter being subdivided further into 3 new subspecies. The same happened with Central African elephants, where distinct known populations have gained full species status.

For the period from 2000 to 2010, a vast number of new species have been described: 3878 species of fish, 1193 species of amphibians, 990 species of reptiles (including turtles, geckos, and monitor lizards), 423 species of mammals, and 86 species of birds (including New World Psittacidae, some owls, a Brazilian falcon, and one petrel from the Pacific island of Vanuatu). Among the mammals, some of the most notable new species are two new whales, an elephant, a leopard, a panda, various monkeys (from Asia, South America, and Africa), 40 species of lemurs, and the giant Laotian rock rat (belonging to the Diatomyidae family thought to be extinct for 11 million years). The rate of discovery among vertebrates from 2000 to 2010 was almost 600 species per year, with more than a third of them (excluding fish) from South America and about 63% from the combination of South America and Asia (**Figs. 1** and **2**).

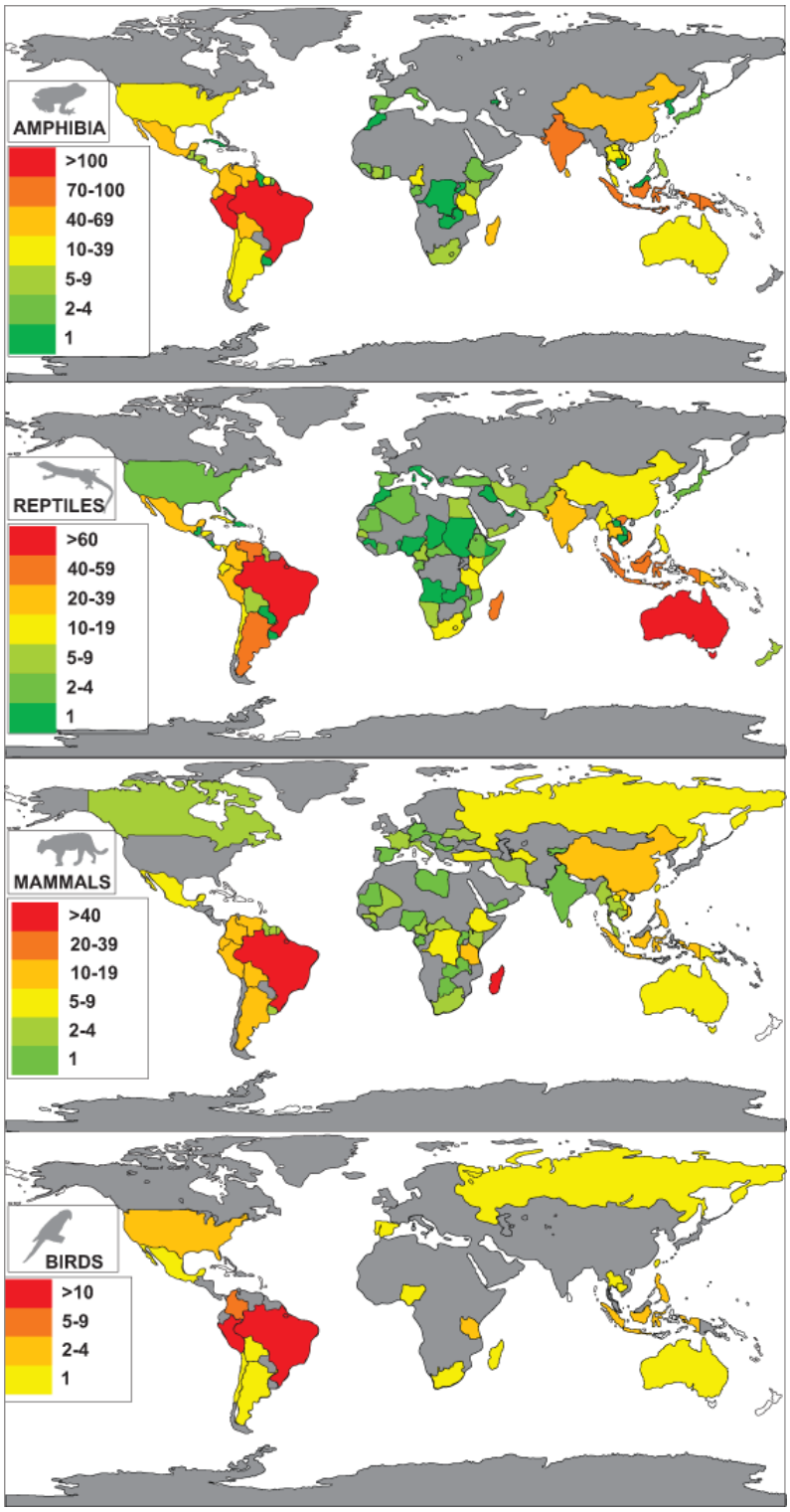

Fig. 1 World distribution of the discoveries of vertebrates (except fishes) for the period 2000–2010.

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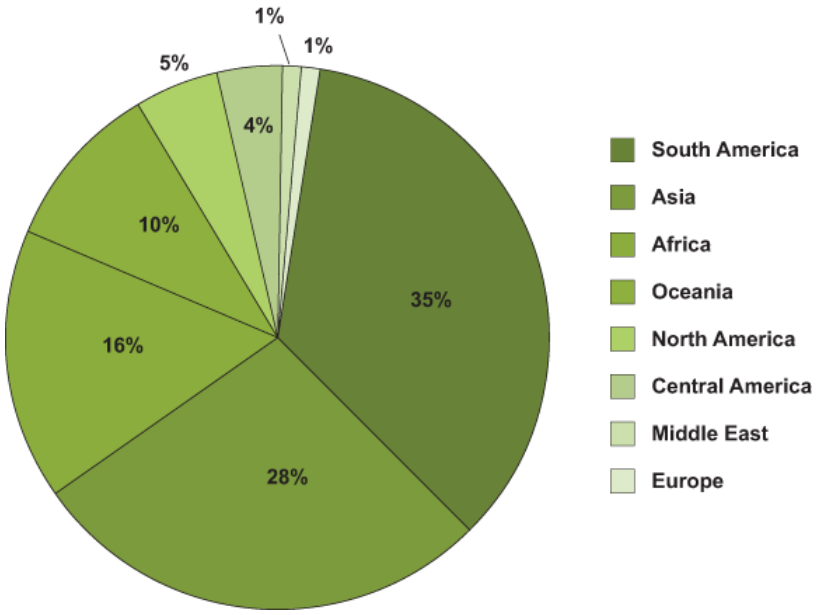

Fig. 2 Percentage of new vertebrate discoveries based on locations around the world for the period 2000–2010.

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The contribution of developing countries to the list of new species is striking. As the frontiers of deforestation advance toward still intact or little-explored remote regions, access becomes easier for scientists. Discoveries are also associated with timber extraction projects and infrastructure work. Prior to the installation of large impact projects, such as construction of roads, dams, and so on, or logging concessions, companies are obliged to finance environmental impact assessments, which in many cases result in numerous new discoveries (for example, many new species in Papua New Guinea, Madagascar, Brazil, and Peru). Unfortunately, the same newly discovered animals sometimes become immediately threatened by the very infrastructure projects that helped finance their discovery. This has been the case for *Saguinus fuscicollis mura* (Mura's saddleback tamarin) in northwestern Brazil, Malagasy lemurs, and orangutans from Borneo and Sumatra.

The distribution of the discoveries around the world has been found to peak in the tropical countries of South America, Asia, Africa, and Oceania (**Figs. 1** and **2**). New vertebrates, however, have been found even in developed countries, including France, Switzerland, Germany, and the United States, where investment in scientific research is greater.

Amphibians and reptiles

Amphibians are the group of tetrapods with the most newly described species over the last decade. A total of 1193 new species have been described, representing approximately 18% of all known amphibians. The annual rate of discoveries for this taxon between 2000 and 2009 was about 115 new species per year. The number of newly described reptiles, 990 species (10.7% of all known reptiles), almost equaled that of amphibians. Moreover, in addition to more refined morphological and behavioral analyses (for example, taxonomic studies based on frog vocalizations), the advent of molecular techniques has resulted in the taxonomic partitioning of several species complexes.

Some findings are special for their uniqueness, such as the description of the purple frog, the last remnant of a new family of amphibians, Nasikabatrachidae, from the Western Ghats of India. This species is considered a living fossil (a living species belonging to an ancient stock otherwise known only as fossils), with its closest relatives being found only in the Seychelles, more than 3000 km (1864 mi) away. The time of separation between the purple frog and its Seychelles relatives is estimated at 130 million years ago. Among reptiles, the family Varanidae (monitor lizards) comprises the largest lizards in the world, including the Komodo dragon. Eleven new species have been described in the genus *Varanus*, including a giant, secretive, and forest-dwelling Philippines monitor lizard (*Varanus bitatawa*), which is more than 2 m (6.6 ft) in body length. Of the 21 species of boas (family Boidae) described to date, 7 (33.3%) were described since 2000, including a new species of anaconda in Bolivia (*Eunectes beniensis*). One of the most diverse families of reptiles, the geckos (family Gekkonidae), had the most newly described species since 2000, with 235 species (24.1% of the reptiles described in this period).

In general, the highest numbers of new species of amphibians and reptiles come from South America, Southeast Asia, and Oceania (see table). Brazil is the leading country, totaling 241 new species of reptiles and amphibians. In Africa, the country that stood out was Madagascar. Contrary to expectations, other African countries showed only modest contributions to both groups. Overall, most discoveries came from tropical countries, which have large expanses of tropical rainforests. As expected, countries containing deserts contributed more new reptile species than

amphibians. Sahara Desert and Middle East countries (including Mauritania, Algeria, Egypt, Iraq, Iran, and Afghanistan) had significant numbers of reptiles described, but no frogs. This is clearly related to the natural history of these organisms, since reptiles are much more adaptable to arid climates than amphibians and tend to diversify in these environments.

Mammals

A review of new mammal species found between 1992 and 2006 showed a strong taxonomic and geographical bias in the new discoveries. New discoveries were above the expected rate for Afrotherian insectivores, primates, rodents, bats, marsupials, and monotremes, whereas discoveries were below the expected rate for eulipotyphlan insectivores, carnivores, ungulates, and cetaceans. A geographical bias is apparent since 71% of the discoveries come from continents and only 28% from islands. On continents, 62% of the findings come from the New World, in particular Brazil and Andean countries. In the Old World, new discoveries are concentrated in the continental regions of sub-Saharan Africa, tropical and temperate Asia, Australia, and Europe. A rate of 24 new descriptions of mammals per year has been estimated. In addition, some 60% of the newly described mammal species are cryptic species, but 40% are large and distinctive.

	Amphibians		Reptiles		Mammals		Birds	
Rank								
1°	Brazil	131	Brazil	76	Madagascar	57	Brazil	18
2°	Peru	110	Australia	63	Brazil	47	Peru	14
3°	Papua New Guinea	86	Argentina	55	Tanzania	18	Colombia	6
4°	India	72	Vietnam	54	Ecuador	17	Ecuador	6
5°	Indonesia	72	Indonesia	53	Peru	16	Cuba	4

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Birds

In stark contrast to the above data, new species discoveries for birds were much less abundant. The South American countries have made the greatest contribution, although birds from Africa, Asia, and Europe have been described. Most of the discoveries were made in tropical forests, revealing distinct and conspicuous species such as parrots and parakeets (Psittacidae), for example, *Pionopsitta aurantiocephala* and *Aratinga pintoi*, as well as some hummingbirds (*Eriocnemis*, *Topaza*, and *Coeligena*). A new species of kiwi (*Apteryx rowi*) from New Zealand and the Vanuatu petrel (*Pterodroma occulta*) are examples of large and distinctive birds that have been discovered. On the other hand, the Cryptic forest-falcon (*Micrastur mintoni*) was first recognized by its distinctive voice. Some nocturnal birds, such as owls and nightjars (*Asio*, *Glaucidium*, *Ninox*, *Otus*, *Athene*, and *Caprimulgus*), that have secretive habits also were discovered in the last decade. As a further example, 4 new species of the genus *Scytalopus* (family Rhinocryptidae) were recently recognized. These passerine birds are very similar morphologically and, in many instances, may be distinguished only by their vocalizations and molecular data. For birds, the largest contribution to the new species pool comes from taxonomic revisions rather than field discoveries in new areas.

Discussion

The findings analyzed here involve both the specific and subspecific level. Despite widespread discussions on the topic of species concepts, subspecies level has not proven effective for conservation planning, since often a single species can harbor dozens of subspecies (mainly in mammals and birds). In order to fulfill the goal of preserving the existing biodiversity, the diversity of organisms must be considered, including the diversity of geographic forms and the genetic diversity of organisms. To this end, it is necessary for conservation planning to consider the most refined taxonomic level as possible.

In spite of its importance for biodiversity conservation, efforts for the discovery of new species are still rather small. In

recent years, the discovery of species has been progressive and continuous, justifying an investment in the training of professionals in taxonomy and molecular biology as well as more funding for expeditions to search for new species in areas not yet explored. Unfortunately, although the rate of new discoveries is high and encouraging, the rate of species loss as a result of habitat destruction is even higher. Recent extinction rates are 100 to 1000 times their prehuman levels in groups taxonomically diverse and well known, from widely different environments.

See also: Biodiversity; Conservation of resources; Ecological communities; Endangered species; Living fossils; Population ecology; Rainforest; Speciation; Species concept; Taxonomy; Zoogeography

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Additional Readings

- Amphibian Species of the World
- Catalog of Fishes
- Integrated Taxonomic Information System
- JCVI/TIGR Reptile Database
- Mammal Species of the World.

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