11 Reptile Diversity and Research Effort

Peter Uetz

1. Introduction

With more than 12,000 species, reptiles are among the most remarkable components of global biodiversity. Crocodiles, turtles, lizards, and snakes have body plans that almost everybody recognizes immediately, even though there is a tremendous variety (**Chapters 12-14**).

Some 300 million years ago, after the acquisition of water-independent reproduction (**chapter 5**), reptiles have successfully invaded most areas of the world, including the oceans (except the poles) (Raz et al. 2024). As a result of their long evolutionary history, reptiles have accumulated a vast diversity of morphological, behavioural, ecological, life history, and defensive strategies (Vitt et al. 2013, Pough 2015). In this chapter I describe the diversity of reptiles with a focus on squamates and the research effort that has gone into these animals. I also address the geographic distribution of all species and their threat status.

2. The incredible diversity of reptiles in selected examples

Reptiles feature a striking diversity in morphology but also physiology and behavior. First, the size of reptiles reaches both extremes, up to 6-7 m in some crocodiles (*Crocodylus intermedius, C. porosus*) and possibly up to 9 m in some anacondas and pythons (**Chapter 18b**). On the other extreme, the smallest snake (*Tetracheilostoma carlae*, a blind snake) reaches only 10 cm of total length (Hedges 2008). Similarly, the largest lizards are the Komodo dragon (> 3 m total length, Jessop et al. 2006) while the smallest lizards are chameleons of the genus *Brookesia* that reach only about 3 cm total length (Glaw et al. 2021).

In fact, it is not even easy to distinguish between lizards and snakes as **limb loss** has evolved dozens of times in lizards and there are at more than 150 species without limbs (e.g. in the families Dibamidae, Pygopodidae, or the skink genera *Acontias* and *Brachymeles*). Many more species have reduced limbs with one of the most striking examples being the members of the skink genus *Lerista* (**Fig. 1**): some species have fully developed limbs, while others have reduced limbs with 4, 3, 2, 1, or no digits at all (Wiens 2009).

Fig. 1 *Lerista bipes*, West Australia, a species without frontlimbs and reduced hindlimbs that have only 2 toes. Photo: Brian Bush.

Other adaptations include the **venom system** in snakes (**Chapter 15**), so that about 700 species are venomous, although some of them are harmless to humans as their mouths or fangs are either too small or their venoms are only mildly irritating. On the other side of the spectrum, the most dangerous snakes, such as Russell's Viper (*Daboia russelii*) in India may kill thousands of people every year.

Many other adaptations involve the **reproduction** or physiology of reptiles (**Chapter 21**). For instance, viviparity has evolved numerous times independently within otherwise egg-laying (oviparous) families (Pyron & Burbrink 2013). Related to reproduction, some species have evolved to survive high altitudes such as the recently described *Liolaemus misti* which reaches elevations of up

to 5400 m in the Andes (Santa-Cruz et al. 2025, **Chapter 19**). Many such high-altitude species are viviparous because it is simply too cold to bury eggs in the ground. A variety of reproductive features should eventually lead to a deeper mechanistic understanding of their genetics and molecular biology, such as temperature-dependent sex determination, as in many turtles (Krueger & Franzen 2023), parthenogenesis (e.g. in the lizard genus *Darevskia*, Freitas et al. 2022, **Chapter 21a**), triploidy or even tetraploidy (in both lizards and snakes, e.g. Litvinchuk et al. 2024, Zhu et al. 2024).
Given the diversity of reptiles, they have become important model systems for the study of such environmental, physiological, or dietary adaptations (Schwarzkopf 2022). Examples for the latter are dietary specialists that are common among reptiles, such as snakes that only eat snails or eggs, lizards that eat almost exclusively ants or termites, as well as lizards that are largely herbivorous.

3. Genus- and species-level diversity

A few years ago, the number of reptiles overtook that of birds, of which about 11,000 species have been described. While turtles, crocodilians and tuataras (non-squamate reptiles, **Chapters 7, 10-12**) have less than 400 species combined (366 turtles, 27 crocodiles, and 1 tuatara), the clade Squamata (lizards, snakes and amphisbaenians) has diversified into more than 12,000 species (Uetz et al. 2025, **Chapters 13-14**). This richness is mirrored by their geographic range: while turtles and crocodilians have failed to radiate into cold climates despite being widespread around the world, squamates have successfully proliferated even into extreme habitats such as northern Scandinavia or the highest mountains of the Andes (Vitt & Caldwell 2013, Pough et al. 2015). As a result, squamates have consolidated as the most successful lineage among living reptiles in terms of species richness, morphological and ecological diversity, and as one of the most successful orders among terrestrial vertebrates in general. Indeed, some of the most remarkable examples of vertebrate evolutionary radiations have occurred within squamates. Particularly notorious cases are the hyperdiverse clades of skinks, geckos, and colubrid snakes, each of which contain 2000 or more species. Within these superfamilies, some genera have radiated to hundreds of species (**Table 1**). For instance, the iguanid

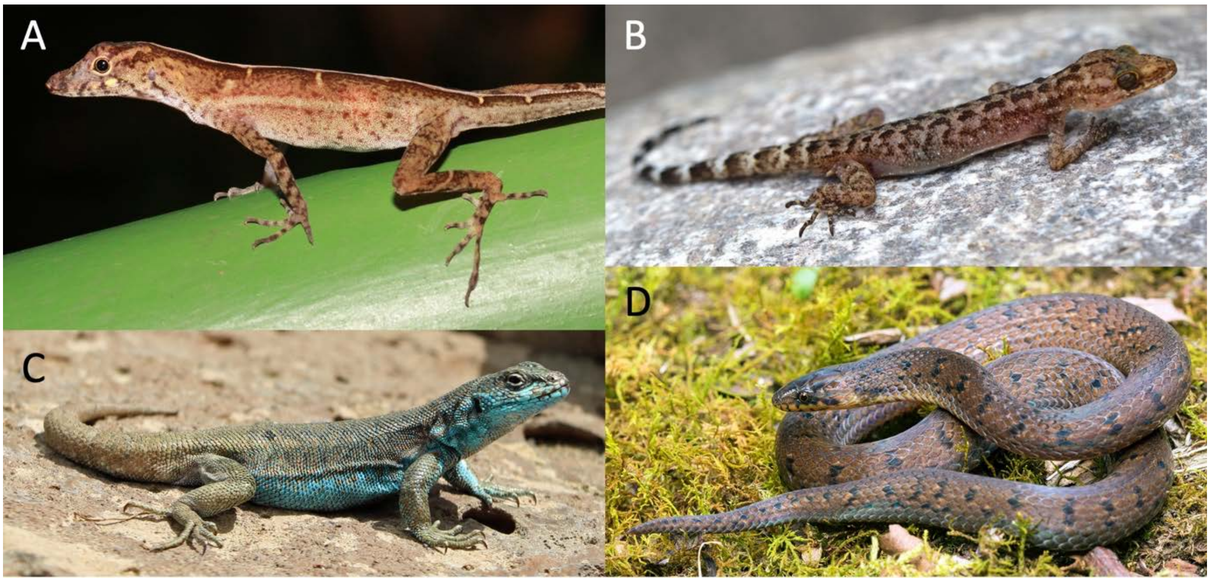

Fig. 2. Representatives of the largest reptile genera: A, *Anolis polylepis* (Costa Rica); B, *Cyrtodactylus martinstolli* (Nepal); C, *Liolaemus coeruleus* (Argentina), D, *Atractus dunni* (Ecuador) is a representative of the largest snake genus. Photos: Peter Uetz, Luciano Avila, Henrik Bringsøe

genus *Anolis* is known from more than 400 species in tropical America (Losos 2009, Burress & Muñoz 2022, Uetz et al. 2025, **Fig. 2**). *Liolaemus* consists of almost 300 species occurring across one of the widest climatic and ecological ranges known among living reptiles, including high-altitude species reaching elevations of more than 5000 m. While *Liolaemus* species are fairly conservative in terms of morphology, they have evolved distinct adaptations such as herbivory or viviparity (Domínguez-

Guerrero et al. 2024, Pincheira-Donoso et al. 2008, Esquerré et al. 2022, Ocampo et al. 2022, **Fig. 2**). Finally, the Asian gecko genus *Cyrtodactylus*, first described by John Edward Gray in 1827, reached 76 species in the year 2000. However, within the past 25 years since then, more than 300 additional species have been described, without an end being in sight (Grismer et al. 2021, Reilly et al. 2023, **Fig. 2**). These three lizard genera are the most species-rich among amniote vertebrates on earth.

Given the overwhelming diversity in these genera, some authors suggested to tame the proliferation of species diversity by splitting large genera into multiple smaller ones. *Anolis* in particular has a long-standing debate about breaking it up into about 8 genera (Nicholson et al. 2012). Among snakes, similar problems arose with sea snakes, a rapidly diversifying group of elapids that were once divided into at least 8 genera, which are so similar that they were recently merged into a single genus, *Hydrophis* (Sanders et al. 2012, **Chapter 16**). Splitting or lumping genera may help taxonomists to manage the sprawling list of species but also to add more phylogenetic, geographic and ecological information, even though some of the resulting genera may be difficult if not impossible to distinguish without technical help (such as DNA sequencing or CT scanning).

Asymmetries in taxonomic richness, that is, some clades being species-rich while others are species-poor, reflect major differences in the evolutionary dynamics that underlie the way lineages radiate and go extinct (Wollenberg et al. 2019). However, the genetic mechanisms that allow some clades to radiate into hundreds of species ("lineage diversification") are poorly understood (Barraclough & Vogler 2000). Extinction, by contrast, is easier to understand as it is an obvious failure to adapt to a changing environment (Alroy 2015). For these reasons, an understanding of the phylogenetic distribution of species richness within major groups of organisms can have profound implications for understanding the way biodiversity evolves (Ricklefs et al. 2007).

Squamate reptiles are a wonderful example of this asymmetry, as they have a few species-rich clades and many more relatively small clades (**Fig. 3**).

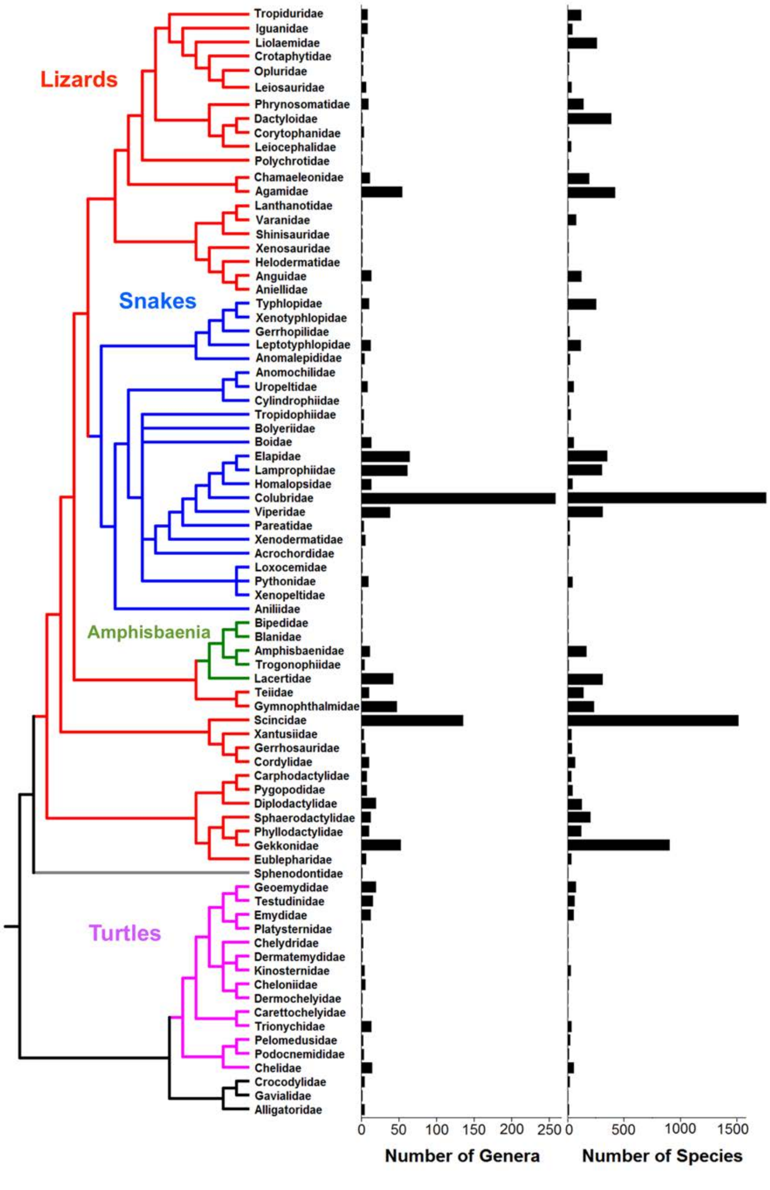

Fig. 3. Phylogenetic distribution of genera and species diversity among currently known families of living reptiles. The six major reptile groups are differentiated in colours. This is a slightly simplified tree modified from Pincheira-Donoso et al. 2013.

The adaptive radiation of anoles and geckos can be explained by inventions such as adhesive toe pads in both groups which allowed them to enter new ecological niches (Poe et al. 2018, Yuan et al. 2019). By contrast, skinks have few obvious traits that “built them for success”, even though they have managed to adapt to a multitude of habitats from deserts to tropical forests to high mountains (Chapple et al. 2023). Similarly, colubrids are highly successful with more than 2000 species and an almost global distribution. Many of them are small and thus escape the pressures of apex predators such as pythons, and many of them are indeed dietary specalists (Grundler & Rabosky 2021).

4. Taxonomic Imbalance

Most families and genera consist of few genera and species, respectively, while very rich lineages are rare (**Fig**. 4). For instance, there are only 11 genera (out of 1260) that have more than 100 species, 39 genera that have more than 50 species, and 289 genera that have 10 or more species. In other words, most genera (971) have between 1 and 9 species.

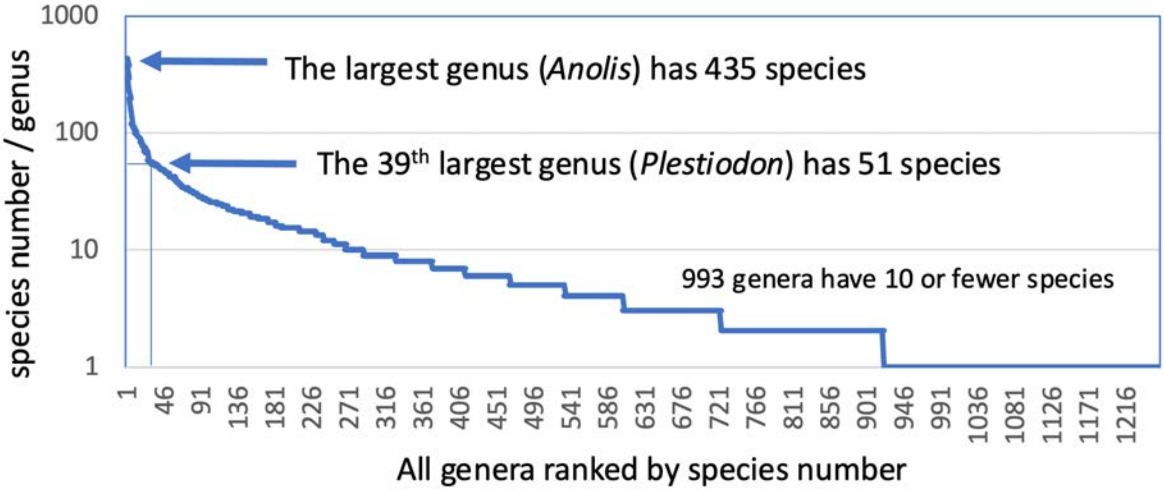

Fig. 4. Number of species per genus in reptiles. Out of the currently recognized 1260 genera of reptiles, 30 (2%) have more than 50 species each.

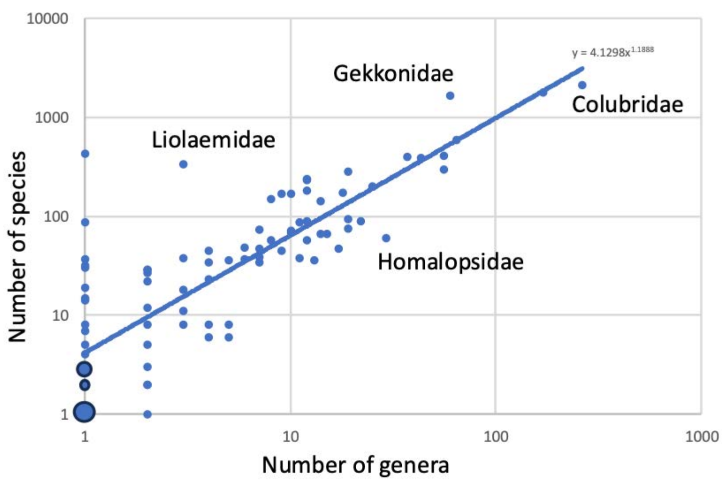

Fig. 5. Larger families have more genera and more species. Each dot represents one family. Note logarithmic scale on both axes.

Not surprisingly, the number of species in a family correlates with the number of genera per family. In other words, the more genera a family has, the more species it also has. However, there are notable exceptions (**Fig**. 4). For example, the family Liolaemidae has only 3 genera but 342 species. The mud snakes (Homalopsidae), by contrast, have 29 genera but only 60 species, with 19 monotypic genera (i.e. they have only one species per genus).
This also means that 50% of the world’s reptile species diversity is accounted for by only 95 genera (7.5% of all reptile genera, all of them squamates), whereas the remaining 50% of species are spread across the other 1,165 genera (**Fig**. 5). Indeed, the ten richest reptile genera (0.8% of the total 1,260 genera) contain 2,135 species in total, which represents 17.2% of global reptile biodiversity.

5. Patterns of Species Descriptions

The world's known diversity of living reptiles has reached more than 12,400 species at the time of this analysis (August 2025), of which 27 (0.3%) are crocodiles, 366 (3.4%) are turtles, and one (0.01%) is the tuatara. The remaining 12,000+ (96.3%) species are squamates (lizards, snakes and amphisbaenians) (**Fig**. 3).

Within squamates, most diversity is concentrated in the paraphyletic suborder Sauria (lizards, ~7,900 species, see **Fig**. 3) and in the monophyletic suborder Serpentes (snakes, ~4,200 species), whereas only ~200 species are amphisbaenians (suborder Amphisbaenia). Compared to 25 years ago (Uetz 2000), the number of species has increased by about 58% or more than 4,500 species.

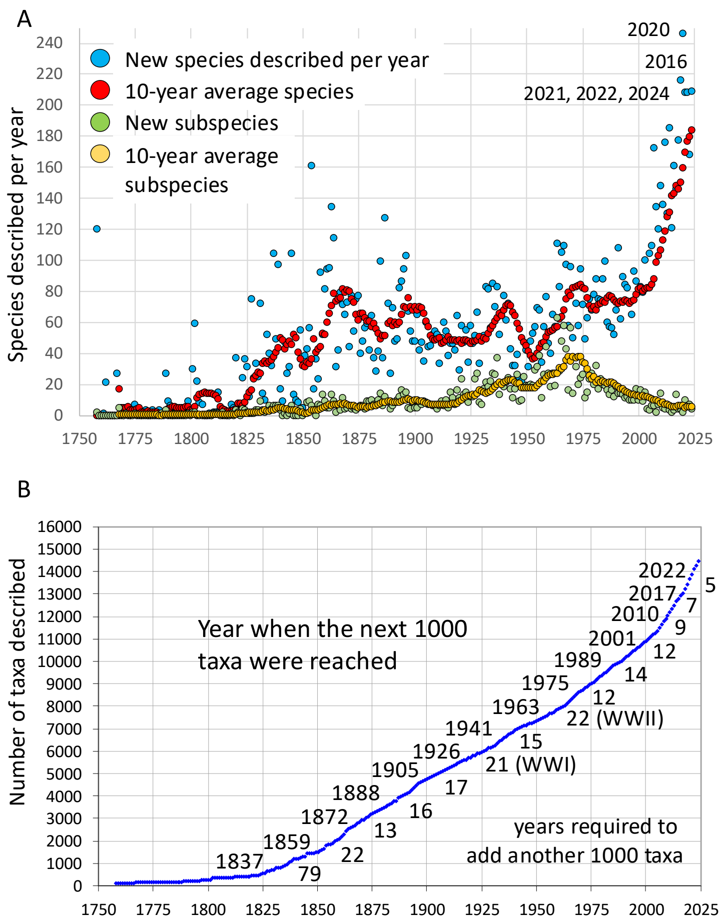

Fig. 6 **Reptile species descriptions over time**. A, species and subspecies descriptions per year (blue, green dots) and 10-year averages (red, purple), B, cumulated numbers of all taxa (species + subspecies). (modified and updated after Uetz & Stylianou 2018)

Historically, the **rates of new species descriptions** have been irregular (**Fig. 6A**), but the increase in species numbers has been relatively steady (**Fig**. 6B). Given that most reptiles are squamates, the historical trends found in squamates and reptiles in general are almost identical. The description rates of new species has an extended peak around the mid-19th century, and increased again starting towards the end of the 20st century. For snakes, the highest proportion of species was described during the 1850s and 1860s, although the numbers of descriptions have increased in the last two decades as well. The historical tendency for descriptions of amphisbaenians is clearly more similar to the historical rates of lizards (Pincheira-Donoso et al. 2013). A decline in reptile species descriptions occurred between approximately the 1940s and the 1970s (**Fig**. 6), apparently a result of World War II and its consequences. Overall, the last 5 years (2020-2025) have seen the highest description rates of reptiles ever with about 200 new species per year (Uetz et al. 2025).

This increase was primarily driven by DNA analysis which can produce phylogenetic data at unprecedented detail. In other words: DNA sequences reveal apparently independently evolving clades which have been described as new species, even if morphological differences are often minimal (e.g. in *Ctenotus*, Rabosky et al. 2014, Prates et al. 2021, Singhal et al. 2025). At the same time, the use of **subspecies** has declined continuously, with a high in the 1960s and 1970s, followed often by fierce debates over the utility of subspecies (Hillis 2021, Burbrink et al. 2022). It is interesting that subspecies remain much more popular in ornithology where the 11,000 bird species have almost twice as many subspecies as species! (Rheindt et al. 2025). An argument can be made that subspecies are simply geographic populations that can still exchange genetic material among each other and hence they are not reproductively separated. However, the same argument can be made for many currently recognized species which are often found to hybridize over more or less narrow hybridization zones. In fact, there are at least 200 reptile species for which inter-species **hybridization** has been found, and some species even hybridize across genera (e.g. between *Caretta caretta* and *Eretmochelys imbricata* or between *Chelonia mydas* and *Eretmochelys imbricata* (Fritz 1995). Banks & Schwaner (1984) describe a hybrid between *Morelia spilota* and *Liasis mackloti*. *Amblyrhynchus cristatus, Conolophus subcristatus* and *Conolophus marthae* can hybridize and produce viable offspring (Tzika et al. 2008). In some cases, hybrids have also been described as new species, e.g. *Mauremys iversoni*, without realizing that they are hybrids (in this case between *Cuora trifasciata* and *M. mutica,* Wink et al. 2001).

The **description of genera** follows a similar pattern as the description of species (**Fig**. 7). After a burst of new genera during the 19th century, a relatively quiet period followed with relatively few new genera, with no more than 10 new genera per year from around 1894 bis 1984. The spike in 1984 was a short spike of what some people may call a period of taxonomic vandalism (Wüster et al. 2021), when Wells & Wellington (1984) described dozens of new genera, most of which were synonymized later on – although about 20 survived. Around the mid-1990s a new wave of genus descriptions started to emerge when molecular tools became available to separate many genera which turned out to be paraphyletic – hence they had to be broken up in order to avoid inconsistent classifications.
The trend to create more and more genera lasts until today. With increasing amounts of DNA sequence data, it has become somewhat arbitrary to split up genera (and species). Despite the urge to split up genera, the average number of species per genus has rather increased, namely from around 5 in 1900 to about 9 today.

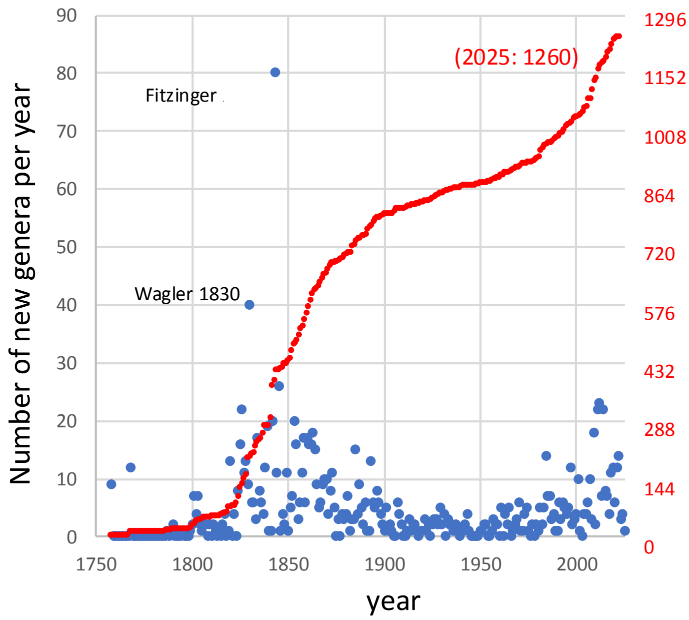

Fig. 7. Number of genera described. The blue dots indicate the number of genera described each year (only genera that are still valid are counted). The red line shows the cumulated number of genera.

6. Factors in reptile discovery

It took more than 260 years to describe the 12,000 or so reptile species (**Fig**. 6). Why took it so long and what are the factors that determine reptile species discovery? When a new species is discovered, it is not immediately clear that it is a new species, and it was not necessarily clear 100 or 200 years ago. First, every potentially new species needs to be compared to all other (related) species and if there is a lot of variation within a species, this can be quite tricky. How can variation be assessed if a taxonomist has only 1 or two specimens at hand? In fact, reptile species descriptions

had a median of 7 type-specimens for lizards (range: 1–412) and 3 for snakes (range: 1-181) (Guedes et al. 2024). If these type specimens are from the same locality, which is usually the case, there is likely very little variation compared to the rest of the range in which that species occurs.
Another factor is the time it takes from collecting a specimen to its description as a new taxon. In a sample of 2,356 squamates the median time lag between collecting a reptile and its formal description was 5 years, but up to 155 years in some cases (Guedes et al. 2020). The most important predictor for relatively rapid descriptions after collection was that the author was also the collector, decreasing the average time lag from 12 to 3 years.

7. The role of collections

The description of a new species typically requires that the describer deposits at least one specimen in a collection, ideally a public museum. That specimen is called the holotype. If there are other specimens, they may become paratypes, although specimens do not have to be designated as types – they can simply be additional specimens without type status. GBIF currently records about 3.7 million reptile specimens in collections around the world of which around 400 000 (12%) remain unidentified at the species level (Guedes et al. 2020). In 2019, we identified 364 collections that hold type specimens of one or more of the 13,000+ species and subspecies of reptiles (Uetz et al. 2019, **Fig. 8**). A few collections dominate the maintenance of reptile type specimens: the 10 largest collections possess more than 50% of all (primary) reptile types, the 36 largest collections possess more than 10,000 types and the largest 73 collections possess over 90% of all types. Of the 364 collections, 107 hold type specimens of only 1 species or subspecies. In addition to these type collections, there are many more collections, such as small collections at universities and colleges which do not have type specimens. Type specimens of about 650 taxa (5%) are either lost or not located, were never designated, or we did not find any information about them. In such a case, a neotype can be designated, but that is only necessary if taxonomic uncertainty requires a type specimen. The Reptile Database currently lists 318 neotypes, so it is a fairly routine process to designate a neotype or replace the lost holotype by another specimen from the type series (then called a lectotype (there are more than 1000 lectotypes listed in the Reptile Database).

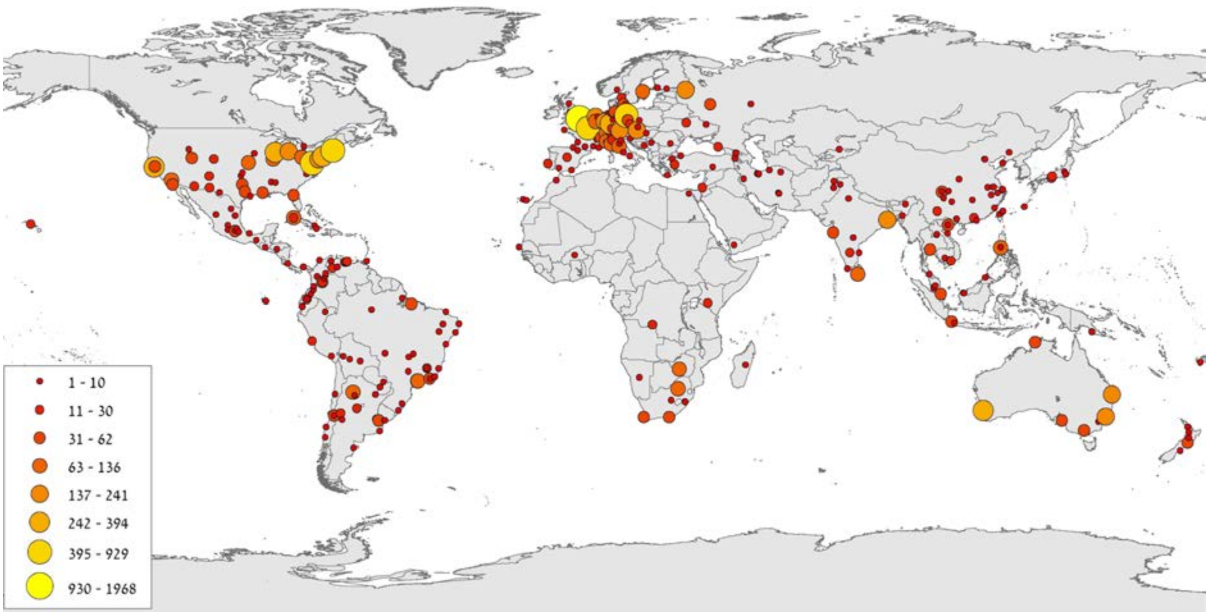

Fig. 8. A map of the 364 collections in the world that hold reptile type specimens.

8. Taxonomic flux: the ever-changing names of reptiles

Once a species is described with a new name, that name serves as an “anchor” for the taxon. However, names may change, and the definition of taxa can change as well. Strikingly, about 41% of all reptile species have changed their genus assignment since their original description. For example, among the 141 reptiles that Linnaeus described in his landmark book, *Systema naturae*, published in 1758, and which are still valid, only 15 retained the genus name assigned by Linnaeus. At the time, taxonomists did not have an evolutionary understanding of biodiversity, hence Linnaeus simply placed almost all snakes in the genus "*Coluber*"; of his 71 species in that genus, only one (*Coluber constrictor*) remains in that genus. The other 70 are now spread out over 55 (!) genera in 10 different families! Even among the ~3,585 species described since the year 2000, about 235 have changed their genus in this short period of time.

The definition of a taxon can change too: if a species is split up into multiple species, the population with the original type locality retains that name. For instance, the viper *Bothrops schlegelii,* a wide-spread species ranging from Mexico to Ecuador, was broken into 10 different species, so that the original species was reduced to a population in a small region of Colombia (Arteaga et al. 2024). This has been challenged and at the time of this writing, the arguments are going back and forth whether or to what extent this re-classification is justified.

Taxonomy has always been contentious and initially, there were few rules. As a consequence of the sometimes chaotic naming conventions in the early 1800s, the International Code of Zoological Nomenclature was developed over several decades starting around 1842 and which was finally published as the "Code" in 1905. A discussion of the Code is beyond the scope of this chapter, but it is important to note that it established rules for naming species that are largely accepted today, including grammatical rules, rules for the priority of names, and for other conventions such as the necessity of type specimens (ICZN 1999, Langeneck & Strazzulla 2025).

9. Species vs. subspecies: a matter of culture

In 2005, 15% of the 8,265 reptile species recognized at the time had subspecies. Today (2025), only 7% have subspecies (**Fig. 6, Fig. 9**). What happened to the more than 1000 subspecies that had disappeared? Most of them were either elevated to full species status or synonymized. Specifically, about 1,500 reptile species were originally described as subspecies and later elevated to full species. It is much less common for a species to be downgraded to subspecies level but it still happens: among the 2000 or so subspecies currently known maybe a tenth of them were originally described as species. In other taxonomic groups, subspecies are much more common. For instance, 43% of the 11,000 or so bird species have about 19,000 subspecies (Rheindt et al. 2025, Guedes et al. 2025)!

Fig. 9 ***Podarcis siculus*** is the reptile species with the most subspecies described. The 60 or so subspecies have been described around Italy and nearby islands and the Balkan. Some of them have also been elevated to full species status. However, most are suspected to be synonymous or simply color variants. Photo: Peter Uetz.

Whether a population is considered a species or subspecies is often a difficult decision and somewhat arbitrary. According to the traditional (biological) **species concept** species are not just morphologically different but also reproductively isolated. However, this is difficult to demonstrate, hence this argument is not very useful in practice. Given that all taxa arose through continuous evolution, there is often no hard line between subspecies and species, so many taxonomists use a more pragmatic evolutionary species concept which defines species as independently evolving and morphologically diagnosable lineages (de Queiroz 2025). However, even that is tricky because many populations are clearly monophyletic but still have only minor morphological differences and possibly very limited genetic differences. In fact, DNA sequences have been reported for only 70% of all reptile species and most of them have rather limited amounts of DNA sequenced available (usually one or a few mitochondrial genes which can evolve independently of their nuclear genome, a phenomenon call cyto- or mito-nuclear discordance). The situation will change with rapidly developing genome sequencing: the vast majority of reptile genomes having been produced only after 2023! However, even if a genome sequence is available, that does not mean we have population-level information, but this situation will also rapidly change with sequencing technology getting cheaper and faster.

10. The future of reptile descriptions

Most reptile descriptions are now available online, no matter when they were published. However, they may not be available easily or even findable. Recent projects such as the Biodiversity Heritage Library (https://www.biodiversitylibrary.org) provide online access to descriptions out of copyright and some projects are actively collecting all reptile descriptions (Uetz et al. 2023). With the advent of Artificial Intelligence (AI), these descriptions can be harvested, analyzed, and processed, so that, for instance, character tables can be generated automatically (Uetz et al. 2023). This field is developing rapidly and while nowhere near perfection in 2025, it will probably reach a stage where a chatbot can be asked for a few traits and the species with these characters determined automatically. Similarly, image analysis is already used on a large scale by citizen science projects like iNaturalist and the latter claims a correct species identification rate of 95% (Loarie 2024). Given that most observations are from only a few species (**Fig**. 12,13), this is probably true for common species but almost certainly not for rarer species or those species complexes with many species, a lot of intraspecific variation, or very similar, closely related species.

11. Research effort and the reptile literature: beyond taxonomy

How much effort has been invested in studying the 12,000+ reptile species? A search in the Zoological Record (ZR), a database of zoological literature, finds about 220,000 papers and books in August 2025, but that number is misleading for several reasons. Most importantly, this number may not include papers about other subjects in which reptiles may be mentioned in passing. In fact, the 220,000 papers also include 13,000 on amphibians and 6000 each on birds and mammals. If we search for Squamata only, we find about 116,000 publications.

A similar search on Google Scholar returns 669,000 results in a search for “reptile”, 694,000 for “lizard”, and 1.7 million for “snake”. Obviously, the latter contain things unrelated to snakes, such as “Snake arm robots” and the huge body of literature on snake bite or the cultural roles of snakes (as in Greek or Hindu mythology). On the other hand, some popular species such as sea turtles have raked up tens of thousands of publications (**Fig. 10**).

A recent study searched for the 11,570 reptile species names in the title, abstract and keywords of the Scopus database and found 89,000 publications (Guedes et al. 2023) with an average of 8.5 publications per species. The 10 most-covered species were represented by 15% (n=13,449) of all papers. By contrast, 90% of species (n=9529) had 10 or less papers about them, with more than 4000 species (39.2%) having no publications at all in the Scopus database. However, this study was likely heavily biased, given that many species have changed their names and hence likely escaped the search terms (see below).

Fig. 10. *Chelonia mydas*, one of the most studied species in the literature, with about 47,000 hits in Google Scholar. Photo: Wikimedia Commons.

Not surprisingly, research effort is highest in countries with the highest number of research institutions, although the logic here is a bit circular. It may be rather the wealth of nations that can afford those institutions and wealthy nations have more resources and researchers and thus produce more output. Other parameters affected research on reptiles but often only marginally: high elevation (mountains are more difficult to reach), rarity or small ranges reduce research effort, while human density and early discoveries increased research effort. Research also increases with species' body size, that is, the bigger the species the more research is done – large animals are obviously easier to study (and to find) than a tiny one. Finally, more recently described species have less research on them published, which is unsurprising too. Some factors like range size or human density do not have simple relationships but rather may or may not increase research effort depending on the region in the world.
Overall, it is reasonable to estimate that the body of literature on reptiles includes hundreds of thousands of publications, not including the literature on dinosaurs and other extinct reptiles (which return another 394,000 results in Google Scholar).

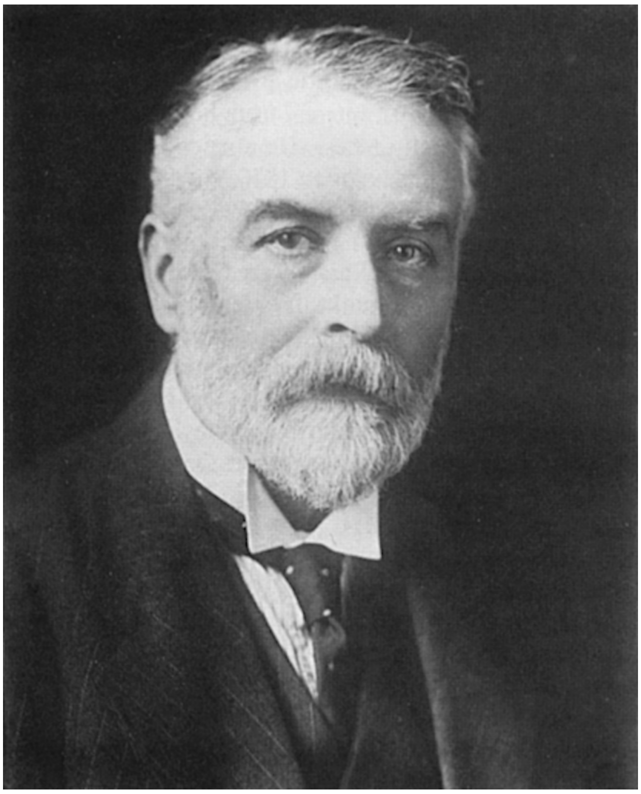

Fig. **11**. George Albert Boulenger (1858-1937), Belgian-British zoologist and the most productive describer of new reptile species. Photo: Wikimedia Commons.

At least in alpha-taxonomy, that is, the description of new species, a few highly productive people have dominated the field and thus the literature. About 40 individuals have described more than half of all species with about a dozen men having described hundreds of taxa each (Uetz 2010, Uetz & Stylianou 2018). The all-time leader of this list is George Boulenger (1858-1937, **Fig**. **11**), a Belgian-British herpetologist who has described about 600 reptile species that are still considered valid today, in addition to more than 1000 fish and 560 amphibian species. However, there may be other people who have published a similar or even higher number of papers, given that many reports on reptiles are short notes on their distribution or ecology. For instance, Hobart Muir Smith (1912-2013), an American herpetologist, published 1637 papers over his long life time (Duellman 2013). This achievement is even more remarkable in the light of Smith's childhood: he was put in an orphanage for two years and only later adopted by the Smith family when he was about 5 years old. When he was a teenager his adoptive parents died too, so he was an orphan again!

12. How abundant are reptiles in nature?

It is obvious that some species are more abundant than others, but how can we quantify this? The the citizen science project iNaturalist reported that almost 75% of all reptile species had been observed in a total of 5.2 million observations (as of June 2025). iNaturalist data available from the Global Biodiversity Information Facility (GBIF) revealed only 2.2 million verified species observations of 7,823 species (62% of all species, June 2025). This means that 25-38% of species had never been observed despite millions of observers. This matches assessments of the IUCN according to which about 21% of reptile species are threatened (Cox et al. 2022). The discrepancy stems from the fact that for many species there is simply not enough data to assess their threat status (hence they are categorized as “data deficient”).

The data shows that the 10 most common species make up about 21% of all observations, the 100 most common species almost 60% and the 1000 most common species 91%. In other words, more than 11,000 species make up less than 10% of all reptile observations, with thousands of species never being seen on iNaturalist (**Fig**. 12).

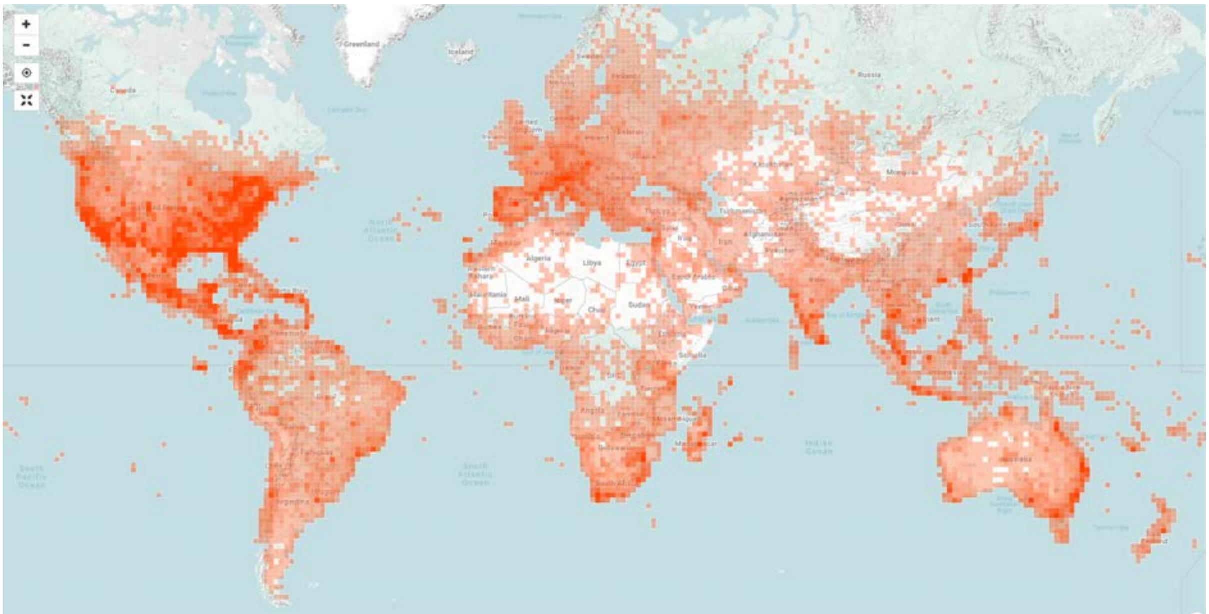

Fig. 12. Geography of reptile observations on iNaturalist. The map shows a summary of 4.8 million verifiable “research grade” reptile observations by 621,000 observers, representing 8894 species (as of 6 June 2025). Note the areas in Africa or Central Asia where reptiles are clearly present but have not been observed on iNaturalist. Source: https://www.inaturalist.org/

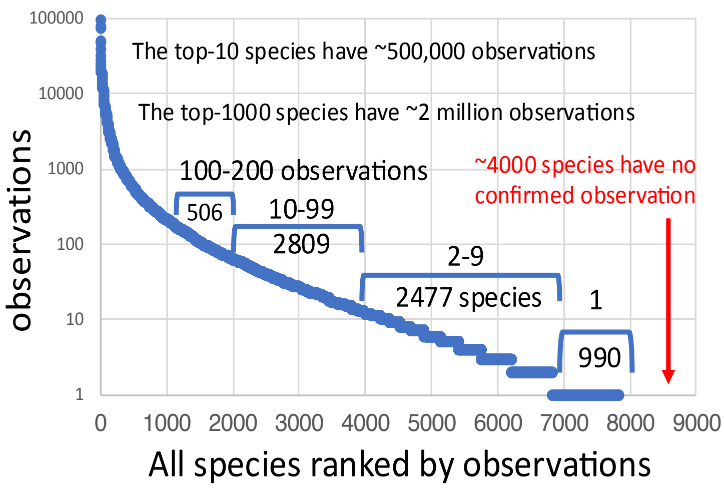

Fig. 13. Abundance of reptile species as reported by the citizen science project iNaturalist. iNaturalist has recorded 4.8 million observations of 8,894 reptile species categorized as “research grade”. Here we show the distribution of 2.2 million of these records as available through GBIF, representing 7824 species. The top-100 species represent about 60% of all observations with about 3500 species having 1-9 observations only.

Geographically, it is not surprising that most reptile species are in the tropics, with a concentration around the equator (**Fig**. 14). The most reptile-rich countries have more than 1000 species each! (**Table** 2). However, there are also stark differences between regions, probably due to inequal research efforts in different countries. For instance, the Congo basin has a relative dearth of species which is likely due to limited research efforts in a region that has suffered from conflicts and political instability (**Fig. 14**).

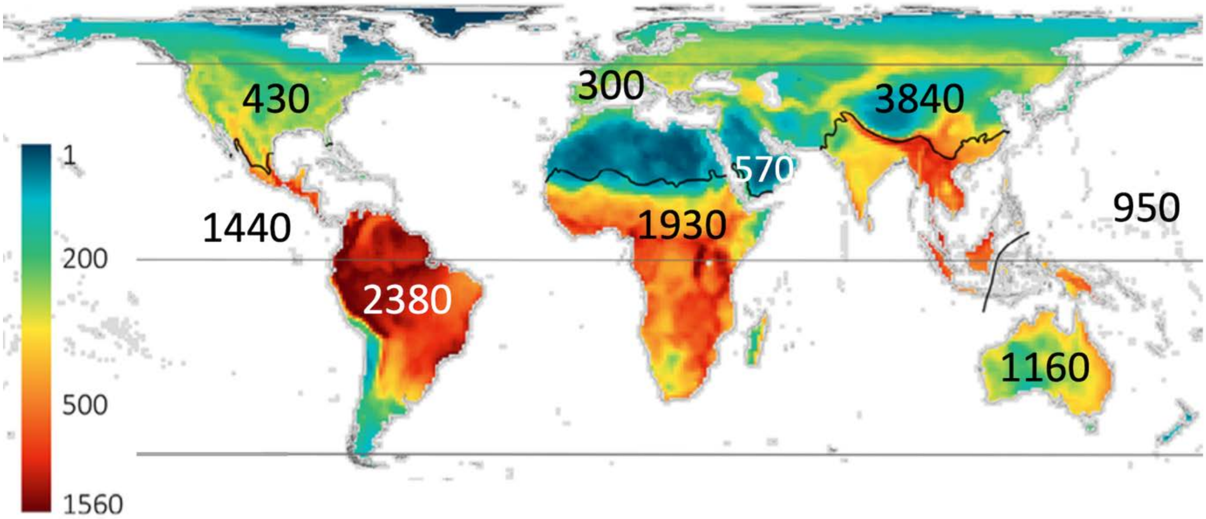

Fig. 14. Reptile species richness. The density of reptile species measured as the number of species in grid cells of ~100 x 100 km. While some grid cells may have up to 200 species, many species may be exceedingly rare. (modified from Raz et al. 2024, courtesy of Shai Meiri). Compare to **Fig**. 12.

The rarity of many reptiles is also shown by the fact that one in seven lizards are only known from their type locality (that is, about 1000 out of the 7000 lizard species). There are literally hundreds of species that are only known from a single specimen (Meiri et al. 2016). Preliminary data shows that the situation in snakes is similar: about 12% of snakes (~450 species) are only known from a very small area (less than 10 x 10 km) (Barki et al., unpublished). Many are small, fossorial species so that they are hard to find, especially in the tropics.

13. How many reptiles are threatened?

A comprehensive extinction-risk assessment of reptiles showed that at least 1,829 out of 10,196 species (21.1%) are threatened with extinction, compared to 40.7% of amphibians, 25.4% of mammals and 13.6% of birds (Cox et al. 2022). However, not all reptile species were assessed and many of the 2000+ recently described species are likely to be threatened too, hence the fraction is likely higher. The proportion of turtles and crocodiles that are threatened (57.9% and 50.0%, respectively) is much higher than those of squamates (19.6%) though. Within squamates, iguanid (73.8%) and xenosaurid (60.0%) lizards and uropeltid (61.1%) and tropidophiid (60.0%) snakes are highly threatened. Since 1500, 31 reptile species (0.3%) have been driven extinct, including 24 squamates and 7 turtles. 40 critically endangered species are 'possibly extinct' (that is, species that are likely to be extinct, but that have a small chance that they may be extant. Limited information resulted in 1,507 species (14.8%) being categorized as data deficient, similar to the number in mammals (15.1%) and lower than for amphibians (20.4%), but much higher than for birds (0.5%). Not surprising, anthropogenic factors that increase extinction risk in reptiles are mainly habitat destruction from agricultural expansion, urban development and logging (Cox et al. 2022, Ihlow et al. 2012).

14. Reptile Data sources and databases

Numerous data sources on reptiles exist and new ones are created all the time. I provide a short list of important sources, with an emphasis on those that have been around for some time and thus hopefully will not go away any time soon (**Table 3**). We have not included printed compendia like Rodda's Lizards of the World (2020) as they do not have an easily accessible online database.

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Table 1: **The 20 most species-rich reptile genera** (>75 species) contain more than 3000 species and thus almost 25% of all species, although they make up only 1.6% of all genera. (cumulative counts are shown for both species numbers and percentages). Data from Uetz et al. (2025).

Genus	Family	Number of Species	cumulative species count	Cumul. % of species	Cumul. % of genera
Anolis	Anolidae	435	435	3.5	0.1
Cyrtodactylus	Gekkonidae	381	816	6.6	0.2
Liolaemus	Liolaemidae	289	1105	8.9	0.2
Cnemaspis	Gekkonidae	230	1335	10.7	0.3
Hemidactylus	Gekkonidae	199	1534	12.3	0.4
Atractus	Colubridae	151	1685	13.5	0.5
Sceloporus	Phrynosomatidae	118	1803	14.5	0.6
Sphenomorphus	Scincidae	115	1918	15.4	0.6
Sphaerodactylus	Sphaerodactylidae	109	2027	16.3	0.7
Ctenotus	Scincidae	108	2135	17.2	0.8
Amphisbaena	Amphisbaenidae	102	2237	18	0.9
Trachylepis	Scincidae	98	2335	18.8	1
Lerista	Scincidae	97	2432	19.6	1
Lygodactylus	Gekkonidae	95	2527	20.3	1.1
Gekko	Gekkonidae	92	2619	21.1	1.2
Oligodon	Colubridae	91	2710	21.8	1.3
Varanus	Varanidae	88	2798	22.5	1.3
Micrurus	Elapidae	83	2881	23.2	1.4
Stenocercus	Tropiduridae	80	2961	23.8	1.5
Emoia	Scincidae	78	3039	24.4	1.6

Table 2. Top-15 Countries with most reptiles. Note that some small countries (like Ecuador) have an outsized number of species and thus an extremely high species density. Data from Uetz et al. (2025)

Country	number of species
Australia	1159
Mexico	1024
Brazil	891
India	825
Indonesia	801
China	683
Colombia	659
Vietnam	556
Peru	548
Thailand	522
Malaysia	519
Ecuador	501
Argentina	477
Madagascar	463
Papua New Guinea	423

Table 3. Selected online data sources for reptile taxonomy and biology.

Name	Description (main focus)	URL or reference
Reptile Database	Taxonomy, species lists	http://www.reptile-database.org
IUCN RedList	Threat status, range maps	https://www.iucnredlist.org
iNaturalist	Citizen science observations	https://www.inaturalist.org
GBIF	Specimens, observations	https://www.gbif.org
SquamBase	life history, ecology	Meiri 2024
RepTraits	Life history traits, morphology, physiology	Oskyrko et al. 2024
Lizard Traits	life history, ecology	Meiri 2018
Squamate presence/absence	Distributions	Stephens et al. 2022