



INTRODUCTION



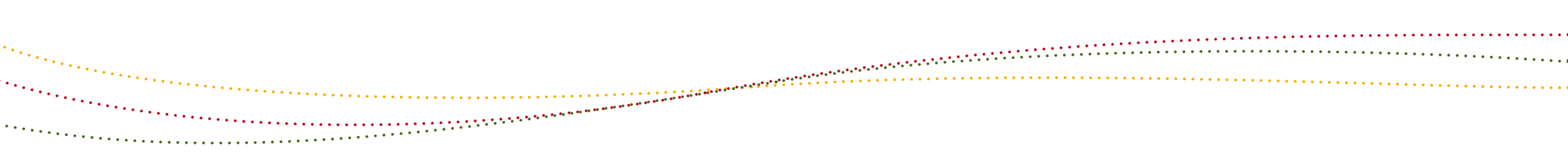


Estimates of the total number of species in the world vary from 5 million to over 50 million (May 1998). In this report figures of close to 11 million species worldwide and about 570,000 for Australia are accepted. Numbers for accepted published species in the world are given here as close to 1,900,000 and 147,579 for Australia.

The number of known species has been estimated by collating information from systematists, taxonomic literature, online resources and previous compilations. Species numbers referred to as 'described' in this report, relate to names of native taxa that have been validly published and are accepted, unless otherwise stated. Although many scientific names are synonyms (thus there being more than one name applied to a species) the numbers of valid species for well-reviewed and familiar groups can be calculated with reasonable accuracy (Groombridge and Jenkins 2002). Most recent calculations for the total number of known (i.e. described) species in the world suggest a figure of around 1.75 million (Hawksworth and Kalin-Arroyo 1995), varying from about 1.5 million to 1.8 million (Tangley 1997). About 18,000 new species are being described each year (16,969 in 2006 and 18,516 in 2007—the last two years for which figures are available). About 75% of the new species described in 2007 were invertebrates, 11% vascular plants and nearly 7% were vertebrates (Connor 2009).

In taxonomic groups where individuals are generally large, charismatic, easily visible, of economic importance, of public interest, or subject to extensive taxonomic interest, such as mammals, birds, and some higher plant groups, the total number of species is likely to be fairly close to the number of known or described species. On average, around 25 mammal species and five bird species have been described each year over recent times (Hammond 1992), with many of these new species resulting from changes in taxonomic opinion and splitting, rather than being due to the discovery of new species (Groombridge and Jenkins 2002). Recently, molecular systematics has led to an increase in newly discovered species as genetic differences become more apparent. Estimates for the total number of species on earth vary from 3–5 million (Tangley 1997) to 50 million (May 1998) and even to as many as 100 million (Tangley 1997). This report settles on a figure of about 11 million.

In contrast, for groups of organisms that contain individuals that are small, difficult to collect, obscure, or of little direct public or economic interest, the total number of species is difficult to estimate and is likely to be much higher than the number of known described individuals (Hammond 1992, Groombridge and Jenkins 2002). Many of these groups have very few or no systematists working on them, although often there are undescribed species awaiting description in many collections.



Reliable estimates of the total number of species in many of the less well known taxonomic groups are unlikely to be made for many decades, although several new initiatives are attempting to fill the gaps in knowledge. In 1998, the Convention on Biological Diversity established the Global Taxonomy Initiative (GTI) (ABRS 1998, CBD 2009a) with the mandate to improve taxonomic knowledge through increasing the number of taxonomists and trained curators. The Global Biodiversity Information Facility (GBIF)¹ is attempting to collate, through collaboration, existing attempts to document the names of species of biodiversity through its *ECAT program* (GBIF 2009a) and through the identification and funding of nomenclatural and taxonomic gaps (GBIF 2009a). Other major projects that are looking at documenting names and taxa on a global basis are the *Species 2000*² project and the *Integrated Taxonomic Information System* (ITIS)³ which together produce the annual *Catalogue of Life* listing (Bisby *et al.* 2009). The *International Plant Names Index* (IPNI)⁴ documents the names of all vascular plant species, along with information on their place of publication. Recently, the Convention on Biological Diversity has been working on the *Global Strategy for Plant Conservation* (CBD 2009b) and this has led to an attempt to determine the size of the task and hence the number of species.

1 Global Biodiversity Information Facility <http://www.gbif.org>

2 *Species 2000* <http://www.species2000.org>

3 *Integrated Taxonomic Information System* <http://www.itis.usda.gov/>

4 *International Plant Names Index* <http://www.ipni.org>

For the Prokaryota, Protoctista, Chromista and Viruses, estimating the number of species (both known and total) is made difficult by uncertainties in definition of a 'species'. Generally, for these groups species are determined on the basis of features shown in culture (Woese 1998, Ward 2002), and estimation of the total number of species in the world is almost impossible. Indeed, according to Curtis *et al.* (2002) 'The absolute diversity of prokaryotes is widely held to be unknown and unknowable at any scale in any environment'.

The listing of threatened species is also difficult. All lists lag well behind discovery and taxonomic revision, and thus are likely to provide under-estimates. On a world basis, very few countries list undescribed species, and this again leads to under-estimation. The only lists available that are regularly updated on a world basis are the IUCN Red Lists of Threatened Species (IUCN 2004, 2009b) and even though these include considerable error (Kirschner and Kaplan 2002), I have relied on them for numbers of threatened species for the world.

Similarly, listing of threatened species in Australia is not simple. As well as the lists of nationally threatened species maintained by the Australian Government (DEWHA 2009a, 2009b) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), each State also maintains its own list. Species listed as threatened in one State may be common in another State. The list maintained by the Australian Government (<http://www.environment.gov.au/biodiversity/threatened/index.html>) is the only comprehensive list of 'nationally' threatened species. Some States (e.g. Western Australia) also list species under categories additional to those recognised by the International Union for Conservation of Nature (IUCN). Although these species may be of no less importance for regional conservation, they are not listed here as it is difficult to provide comparisons between the State lists and between the State lists and the National list.

The 2006 report generated considerable discussion and many individual scientists have sent me new information in personal communications. All these have allowed for much more accurate figures and adjustments for many of the estimates.





In some cases numbers have increased, in others (for example the numbers of published species of insects in Australia) decreased. With the insects, for example, entomologists across Australia have collaborated on an extensive exercise to look at the numbers of insects in each Order (Yeates *et al.* 2003, Raven and Yeates 2007) and other entomologists have worked extensively on some individual Orders (for example, Oberprieler *et al.* (2007), ABRS (2009b)) and this has led to a much more accurate determination of both published numbers and estimates. In the previous report, figures for insects were based on reports at just the Class level as this was all that was consistently available at the time. In addition, international and national online databases and internet lists, including *Trichoptera World Checklist*, *World Spider Catalog*, *FishBase*, *AlgaeBase*, *AmphibiaWeb*, the *Interactive Catalogue of Australian Fungi*, and the *Australian Plant Census*, have provided valuable species statistics. These online species information systems are constantly being updated and improved, and are rapidly becoming definitive resources on species names and thus on the number of accepted species. They have assisted greatly in providing much more accurate and definitive numbers for this report. Still, many gaps and unknowns exist, and it will be years, if not decades, before we truly know how many species exist and how many are described and accepted as good species.

Many of the figures supplied in this report are estimates only. For each group details are given of how the estimates were determined. 'Unknown' is inserted into the tables of species numbers where no information could be obtained. Estimates of total species in Australia were often not easy to find, as were estimates of percentage endemism for many of the invertebrate groups and non plant and animal phyla. For some groups, estimates were made by suggesting that only a small percentage has been described, thus making the figures for total species just approximate.

The estimate of total species for the world was calculated by adding individual estimates, where cited. For a number of groups ranges are given and for these the upper figure is used for the calculation of totals in the Executive Summary. Throughout this report all textual references to the previous version of this report (first edition) are cited as the 'previous report' (<http://www.environment.gov.au/biodiversity/abrs/publications/other/species-numbers/2006/index.html>).

Arthur D. Chapman, 2009