Correspondence

21 years of shelf life between discovery and description of new species

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A large part of biodiversity is still unknown, and it is estimated that, at the current pace, it will take several centuries to describe all species living on Earth. In the context of the ongoing 'sixth extinction', accelerating the completion of the inventory of living biota is an issue that reaches far beyond the taxonomic community. However, the factors that influence the accretion of known species remain poorly understood. Here, we study how long it takes from the first collection of a specimen of a new species to its formal description and naming in the scientific literature [1,2] — a period we refer to as a species' 'shelf life'. Based on a random set of species described in 2007 across all kingdoms of life, we determine that the average shelf life between discovery and description is 21 years. The length of the shelf life is impacted by biological, social and geopolitical biases.

Our dataset consisted of 600 species randomly taken from among the 16,994 species described in 2007. From consulting the original descriptions, a date of first collection was retrieved for 570 species (Supplemental information). The average shelf life was 20.7 years (standard error: 1.05 year), with a median of 12 years, ranging between 206 and zero years. However, the duration of shelf life was not randomly distributed across our sample, and six factors significantly impacted it (Figure 1): shelf life is shorter for aquatic species than for terrestrial ones; longer for plants and vertebrates than for other species; shorter for species described on the base of one or a few specimens only; shorter when the species belongs to a recently revised group; longer when the author works in a rich country, and shorter when (s)he is an amateur. Conversely, the number of co-authors of the description, publication type, economic importance and country of origin of the new species were not found to be significantly correlated with the duration of shelf life (Figure 1).

A frequent misconception of the discovery process is that new species are recognized as new in the field. This is not the case, most newly collected specimens are archived in museums and herbaria: collections thus act as a reservoir of potential new species [2]. Vast collections of plants, vertebrates and insects have already been accumulated in museum vaults, representing a huge amount of unstudied material — this probably explains why these taxa have longer shelf lives than, for instance, fungi and invertebrates excluding insects, which are comparatively underrepresented in museum collections. Throughout

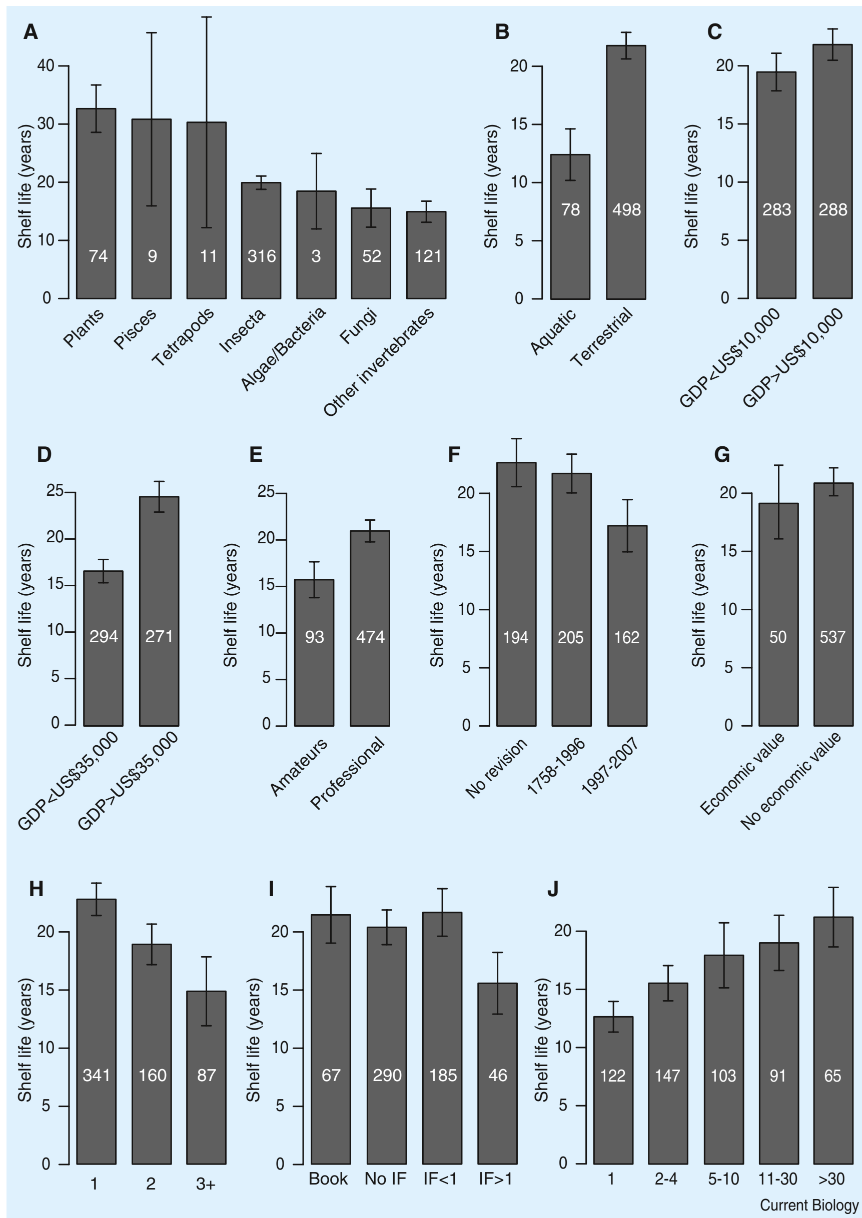

Figure 1. Average shelf life in years against various covariables.
(A) Taxon; (B) Biome (aquatic/terrestrial); (C) GDP of type locality country; (D) GDP of first author country; (E) author status; (F) most recent cited revision of the group; (G) economic value of the new species; (H) number of authors; (I) publication type (IF: Impact Factor); (J) number of specimens used for description. Error bars represent standard error. Figures in histograms represent the number of new species for each category in the random dataset. Total number of species for each graph differs, as information on the various covariables was not available in each description (Supplemental information).

taxa, species belonging to groups that have been recently revised have a shorter shelf life, because it is easier to identify and describe a new species when the systematics of the larger taxon have been updated with modern tools and concepts. The shorter shelf life of aquatic species, by contrast to terrestrial, was an unexpected result, and one for which we do not have a straightforward explanation or interpretation.

There is a significant difference between species described by taxonomists working in developed as opposed to emergent countries, which may also be a consequence of the volume of the collections at their disposal. Because the larger museum collections are found in developed countries, the majority of new species described by taxonomists in emergent countries is derived directly from field work rather than from archived specimens. As expected, the GDP of the country of origin of a new species had no effect on shelf life: countries with low GDP but high biodiversity, i.e. in the tropics, are the source of many new species, but these are mostly described by taxonomists based in developed countries [3].

The other sociological divide in the community of taxonomists is the professional *versus* non-professional distinction. It may come as a surprise that the shelf life of new species described by professionals is longer than the shelf life of new species described by non-professionals. Many amateurs work on personal, small-scale projects and limited amounts of self-collected specimens. However, because amateurs get peer recognition through species descriptions, they devote a lot of time to such descriptions, published mostly in peer-reviewed journals without impact factor. By contrast, for professional taxonomists, recognition and career progression implies publishing in high impact-factor journals and securing grants, both achievements rather at odds with baseline species descriptions. Moreover, professionals are confronted with large institutional collections containing numerous putative new species, and each large-scale collecting operation brings tens or hundreds of thousands of specimens, representing thousands of known and unknown species [4].

Our generation is the first that is aware that both ca. 80% of extant species remain to be described, and that a large proportion of all species may become extinct over the next decades. Different strategies have been suggested to respond to this challenge. Technological and methodological restrictions on data analysis and publication norms are usually highlighted as ‘the’ handicap to rapid species delineation and description, and solutions suggested by several authors do contribute to reduce shelf life [5,6]. However, a decades-long shelf life is essentially due to the lack of specialists at a given time: actual work on specimens (sorting, curating and studying) does not take more than a few years, and most of the shelf life of a new species is spent resting in museum drawers, waiting for an available specialist. This long shelf life is a symptom of one of the aspects of the so-called ‘taxonomic impediment’, i.e. shortage of taxonomists. Obviously, increasing the number of active taxonomists through training and tenure-track jobs would reduce shelf life [7,8], although it remains to be seen what proportion of that newly deployed workforce would actually be describing new species of non-charismatic invertebrate taxa.

However, another issue is that, because most species are intrinsically rare [9], most new species are represented by singletons when first collected. Taxonomists will usually wait for more specimens to turn up before they formally describe and name it, contributing to the long shelf lives observed. Species described on the basis of numerous specimens have a longer shelf life than those described based on singletons. Intensifying and upscaling field work to obtain more specimens would reduce shelf life.

A significant part of the unknown segment of biodiversity awaiting description is already in museum collections [2,10]. With a biodiversity crisis that predicts massive extinctions and a shelf life that will continue to reach several decades, taxonomists will increasingly be describing from museum collections species that are already extinct in the wild, just as astronomers observe stars that vanished thousands of years ago.

Supplemental Information

Supplemental Information including experimental procedures can be found with this article online at http://dx.doi.org/10.1016/j.cub.2012.10.029.

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