

Editorial

Zoological Checklists: From Natural History Museums to Ecosystems

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Backwards and forwards at once, the zoological checklists bring the past into the present and draw a direction towards the future. They cover historical and current information providing open data for environmental issues.

The action of building species checklists has always been a prerequisite for ecological studies, biodiversity assessment, conservation reports, and other analyses related to animal biodiversity [1,2]. Checklists are used in various fields, from monitoring species richness and population trends to sustainable land management.

The present-day research framework aims to produce papers reporting lists of animal species, after a couple of decades of absolute refusal of such inventories, years where the checklists were of interest mainly to amateur naturalist groups [3]. There has been a long period where the prevalence of studies has been focused on ecological or molecular statistics.

Now, the contemporary era is moving towards the gathering of organized data, shared on web platforms, and cross-linked in a sort of global metadata outcome [4–6]. It means that a single record of the occurrence of a species can be associated with its DNA tag (e.g., DNA barcode), the georeferenced localities of its captures, and the correspondent museum specimen preserved in a collection (e.g., holotype).

The amount of information on our planet is going to be stored in many databases validated by editors with specific skills on animal taxa, e.g., in the Catalogue of Life, the LifeWatch European research infrastructure, or the World Register of Marine Species (WoRMS) [7,8].

The checklists are not simply lists of species but they achieve globally the actual revised classifications and nomenclature of taxa and become an easy-to-use tool for anyone who needs to search taxonomic, geographical, and ecological information.

In the light of embracing as many as possible assemblages of species, we are assisting in a re-evaluation of the zoological museum collections, due to their importance as historical data from a country or a specific taxon, that can be a strategic tool in a time-scaled assessment. Museums are the most relevant existing “organic-banks” in the world; museum specimens are the key to understanding the history of species. They provide essential baseline information in the fields of systematics, biogeography, and evolutionary ecology.

Natural history museums play a key role in supporting biodiversity and nature conservation-related research. The museum collections, traditionally associated only with taxonomy, now support the studies of a much wider range of topics that have practical applications for biodiversity conservation. They have a fundamental role in preserving the historical wildlife heritage of a region, mirroring its past and current biodiversity [9–11], and they enable researchers to track the genetic modification of species, in light of the anthropogenic impacts regarding habitat destruction and degradation.

The potential of natural history museums consists in being a large reservoir of historical/ancient DNA. Despite the degradation processes of biological material over time, methodological advances now allow us to obtain precious genetic inferences from degraded samples [12]. In this context, museomics represents an emergent and promising



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field, which takes advantage of the potentiality of genomics applied to natural history museum specimens. Therefore, every single museum sample can potentially preserve a genetic record which can be useful to understand the evolutionary history of the species to which it belongs.

As many of the museum samples date to before the extreme biodiversity loss caused by anthropogenic drivers, we can generate baseline data for most of the endangered species, which can be compared to the current situation to quantify the human impact. Information on the number of species that are listed as being threatened with global extinction in the near future can provide one of the bases for estimating the scale of impending extinctions [4]. However, the natural history collections remain largely unexplored and unused, mainly because updated and standardized taxonomic lists are still lacking. This situation hinders the formation of an open-access database that can be easily consulted online by all scientific institutions interested in wildlife biodiversity. The inventory of species constitutes a starting point to facilitate the use of museum collections of interest for researchers and may contribute to the interconnection of the institutions.

The checklists are a way to quantify biodiversity, map biodiversity, and indeed reveal biodiversity. An interesting case is the one of the neglected environments that represent a relatively small portion of the marine or terrestrial habitats that may hold great scientific and ecological importance, embodying a major reservoir of marine biodiversity and providing multiple ecosystem services. The marine caves richness of the rocky coastline of the Mediterranean region is an example [13].

Many habitats are considered important hotspots for biodiversity worldwide, deserving of study and protection. Most of them have been found to contain unique taxa assemblages, including several exclusive taxa, typical elements of endemism, e.g., [14]. Unfortunately, most of the information is still limited primarily due to major constraints such as the time and experience needed for sampling and taxonomy skills [15]. Furthermore, studies have not been conducted homogeneously across the globe.

Sometimes, checklists reflect rarity, i.e., species only found in one site, whose role in the ecosystem and importance in bioassessment is still debated. This was the case for almost sixty per cent of mollusks collected in the Maldives [16].

There is no doubt that the actual number of occurring species in the world is an underestimate and that we lack information for wide swathes of a region as research efforts vary greatly and even amongst particular taxa. A quick examination of recent publications reveals the magnitude of the gaps. The number of species is a function of search effort and taxonomic expertise; thus, an updating is always advisable [17].

Additionally, in case the checklists cover a wide taxonomic range and an extensive sampling design, then it may be possible to extrapolate statistically robust information to map local and regional patterns of species abundance [18].

Up to now, many taxonomists and many countries do not have built or updated faunal checklists yet, though open-access journals offer a platform to share and disseminate such core information and most of the recent checklists have demonstrated the disclosure of an unexpected diversity all over the world.

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