

## Towards a standardized framework for managing lost species

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**Response**

**Towards a standardized framework for managing lost species**

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We thank Biggs *et al.* (2023) and Fisher (2023) for their thoughtful commentaries on our simple overview of lost terrestrial vertebrate species (Martin *et al.* 2023). We agree with these authors that reducing the Latimerian knowledge shortfall is dependent on both coordinated fieldwork efforts and the development of a well-managed, standardized framework for administering lost species data. We focus this response on further discussion of such a framework and highlight some of the challenges involved.

We agree that important steps toward developing a robust lost species management framework include a systematic expansion of last-seen dates on IUCN Red List accounts, standardizing terminology regarding lost species (Long & Rodríguez, 2022), and curating a single, authoritative list. We also agree with including species that have been lost for less than 50 years on such a list. As a recent example, the Critically Endangered Bahaman Nuthatch (*Sitta insularis*) was last observed <4 years ago at the time of writing, but there are fears it could already be extinct following the impacts of Hurricane Dorian in 2019 (Mlodinow *et al.*, 2021). Highlighting such species of conservation concern after a short absence can be valuable.

However, the call of Biggs *et al.* to produce an annually updated list of all taxa unobserved for >5 years may prove challenging, for several reasons. First, systematically obtaining data on species missing for shorter time periods (e.g. five years) may prove difficult. As Fisher (2023) reminds us, most of the players involved (including the SSGs that coordinate the red list assessments) are volunteers, such that new species accounts are often asynchronously updated on longer time scales - unless, like the Bahama Nuthatch, the species in question is of high conservation concern. For more conspicuous taxa, citizen scientist platforms may provide useful data on recent records, although limitations of citizen scientists' detection

skills may be a real impediment for more cryptic taxa (Kremen *et al.*, 2011). Indeed, groups sufficiently cryptic to be dependent on expert-level identification are rarely uploaded to such platforms (Haelewaters *et al.*, under review). Second, numbers of species in need of curation increase rapidly when shifting to shorter timeframes, and when including taxa beyond terrestrial vertebrates. In addition, large proportions of under-studied taxa are likely to *de facto* qualify as lost species. For example, a case study of a poorly-researched fungi taxon (Laboulbeniomycetes) by Haelewaters *et al.* (under review) found that, from a sample of 1,117 species, 73% have no published records in the literature or on online data platforms after their initial description, and 51% had not been observed in >50 years. If similar patterns occur elsewhere (e.g. in marine invertebrates), this would present an extremely unwieldy number of lost species to administer. It may also be difficult to assign categorical reasons behind the lost status of many of these cryptic species, given so little information is known about them. Finally (and not independently), many groups of organisms possess a complex and often chaotic taxonomy (Garnett & Christidis, 2017). Even generally well-studied taxa have their problems: Fisher (2023) points out that some 40 species of mammals had only a single record by 2012; many of these would be the putative type specimen. From our database (based on IUCN data for species unobserved for >50 years) we identified 47 mammals (slightly higher than reported by Fisher; in likelihood due to subsequent taxonomic splitting), three birds, 54 amphibians, and 123 reptiles known only from their holotypes; many of these could also possess dubious taxonomies.

Another issue to consider is what ‘counts’ as a species rediscovery (Fisher, 2023). Long & Rodríguez (2022) suggest guidelines, but nuances may require further discussion. Peer-reviewed publications or information on Red List accounts remain a gold standard for this, but these may not always be available, especially for species rediscovered in shorter

timeframes. Is direct physical evidence via a specimen, photograph, or video necessary (with consideration to the fact that even such media can be controversial – see, e.g., discussion in Troy & Jones, 2022)? What about expert observations without supporting evidence? Can sound recordings, tracks and signs, or eDNA signals provide sufficient evidence in isolation? Are records on citizen science platforms such as iNaturalist (<https://www.inaturalist.org/>) acceptable? And indeed, are strict guidelines regarding what constitutes a rediscovery desirable, or is it better to assess data on a case-by-case basis, e.g. via a committee?

Biggs *et al.* (2023) highlight important actions towards developing a standardized framework for the management of lost species, and Fisher (2023) reminds us of the strengths and weaknesses of the Red List. We suggest that further steps could involve decision-making on which species to prioritize, how to refine the ‘rules’ on rediscovery, and where best to curate an authoritative list. Given the importance of Red List ‘last seen’ dates for keeping track of many lost species, and because species included on the Red List benefit from having a set taxonomy and at least some published information available (not least regarding their conservation status), it may be practical for a centralized list to primarily focus on species with a Red List account (at least initially). This would still represent a daunting undertaking given the IUCN curates data on >42,100 species, but is probably realistic. Indeed, given the central importance of the IUCN and its IT infrastructure for both obtaining data on lost species and for implementing recommendations regarding the status of these species, it may be advantageous for any decision-making committee on lost species to be integrated into the organization, perhaps through the creation of an IUCN-sanctioned Specialist Group or Task Force under the Species Survival Commission. Regardless of who convenes this, the establishment of a global standardized framework for the management of lost species seems a worthy, perhaps pressing, endeavour, and we hope the IUCN, organizations like Re:Wild

(Biggs *et al.*, 2023), specialist field scientists (see, e.g. <https://www.lostsharkguy.com/about>), and conservation experts will help spearhead the process. Given what we know (Fisher, 2023; Martin *et al.*, 2023), we could start with Reptilia.

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