

Extinction Targets Are Not SMART (Specific, Measurable, Ambitious, Realistic, and Time Bound)

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The post-2020 Global Biodiversity Framework (GBF) could shape the future of life on Earth, so great care must be taken in deciding its aims. The failure of all of the Aichi targets requires a rethinking of prior agreements (Woodley et al. 2019), and conservationists are now exploring new types of targets. One commonly suggested potential metric is extinction, with the goal of avoiding some number or percentage of species going extinct within a specific timeframe (Rounsevell et al. 2020). Although extinction seems to be a logical and conducive metric for global conservation targets and should certainly be prevented, its feasibility as a target remains unclear. To be effective, targets must be SMART (for *specific, measurable, ambitious, realistic, and time bound*, following Green et al. 2019, which demonstrated correlations between the completion of targets and their specificity, realism, and scalability). If these criteria are not satisfied, targets may be chosen that, although they are academically pleasing, are not actually achievable or measurable when examined carefully (CBD 2020). Although avoiding extinction is certainly an ambitious target and could be specific, it is not feasibly measurable, nor does it provide a realistic, achievable target, and it certainly cannot be achieved in a reasonable timeframe, as is necessary to avert or even dampen the ongoing biodiversity crisis.

Extinction is a nearly universally understood concept, defined generally as the complete loss of a species. More

specifically, the term *extinction* was formerly applied to any species not recorded in the wild for 50 years, but it has now been updated to applying only to species for which “there is no reasonable doubt that the last individual has died” (Smith and Solow 2012). Consequently, only around 538 species have been documented as extinct since 1500, likely a dramatic underestimation (Butchart 2006). Although intuitive and likely appealing to the public, we cannot prioritize these qualities above the concept’s actual value and practicality in conservation practice. Many claim that we need targets at multiple levels, from ecosystems to communities, species, and even genes, but if they cannot meaningfully contribute to conservation outcomes, then it becomes an effort in making targets for their own sake rather than to conserve biodiversity.

Can extinction be meaningfully measured?

The first question that needs to be asked for any target is whether it can be measured; targets that cannot be measured cannot be aimed for and achieved. In the case of extinction, the answer is irrefutably no, because the metrics of extinction rates require time for confirmation. Furthermore, the global majority of species are undescribed and untracked, and those species that have been described are mostly unmapped. Therefore, although targets of maintaining diverse habitats make sense, especially given that new approaches and remotely sensed data

make this simpler and more standardized than ever before, a target based on extinction metrics would fail to conserve the majority of species.

Undescribed species represent a major barrier to effective conservation, because we simply cannot protect the unknown, much less measure its loss. Although new attention has recently been paid to the predicted millions of undescribed invertebrate species in light of potential declines (figure 1, supplement), many undescribed species remain across the tree of life (supplemental table S1; see the supplement for all data sources). Even among vertebrates, the number of described amphibians has increased by 25% since 2004, and 1079 new mammals have been described in the last 13 years; 251 new reptiles have been described in just the last 1.5 years. Therefore, even for vertebrates, large numbers of species remain undescribed; as a result, measuring extinction rates accurately is likely impossible without untenable assumptions about relative total richness of undescribed and undiscovered species. These issues are not unique to animals, because these trends exist in other groups: Approximately 2000 plant species are described annually, and 2189 fungi were described in 2017 alone.

Considering species that have been assessed in terms of conservation status in the International Union for Conservation of Nature’s (IUCN) Red List of Threatened Species, only 9.6% of all described plant species have been assessed (estimated 0.54% when



Figure 1. The rare, recently described bee *Anthophora escalante* is only currently known from two protected areas in Utah, the recently downsized Grand Staircase-Escalante National Monument and Canyonlands National Park. An easily overlooked example of our lack of knowledge for most taxa and our inability to protect them.

including undescribed species, and among these species, 7% remain data deficient). The coverage is even worse for fungi, with only 0.2% of described species assessed, representing 0.002% of the estimated species. The estimates are similar for terrestrial arthropods, with approximately 0.9% of described species assessed, representing 0.15% of the estimated total species. It seems highly unlikely that the data required to assess these groups will suddenly become available in the near future.

It could be argued simply that too many invertebrates exist to be considered in such a target and that extinction-based targets can be developed that focus solely on vertebrates, for which monitoring is easier, given a larger research community, greater research funding, easier detection, and more complete assessments. Even accepting this gross oversimplification that could contribute to massive numbers of extinctions in understudied groups, however, issues remain. Although more than 90% of the described mammals and bird species have been assessed by the IUCN

(90.0% and 95.6%, respectively), the corresponding numbers are only 83.5% for amphibians and 70.0% for reptiles (see the supplement). Overall, 84.0% of vertebrates have been assessed, with 5778 described and an unknown number of undescribed vertebrate species unassessed (and poorly documented, rarer species could be at special risk). Given that mammals and birds are poor indicators of diversity and risk in other groups (Hughes 2017a), more detailed assessments are clearly needed outside these two groups.

What is more, many IUCN extinction risk assessments are now outdated, even if they are meant to be updated each decade. For instance, an estimated 61% of amphibian assessments were outdated by 2016, and only 45% of amphibian species described between 2004 and 2016 have been assessed. Many of these species come from poorly known tropical areas at risk, or the species themselves may be rare and so were only recently described. Therefore, even though information for terrestrial vertebrates

is orders of magnitude better than that for other taxa, it is still too poor to serve effectively as the basis for an extinction-based target.

Measuring extinction rates generally requires measuring long-term trends, but in global analyses (Brondizio et al. 2019), only a tiny percentage of species have such long-term data; even among species with IUCN assessments, the trends in many species are established on the basis of a single expert assessment rather than detailed population monitoring. Lazarus taxa are also not an insignificant issue; in 2011, it was noted that in 119 years 351 species of birds, amphibians, and mammals had been rediscovered after being declared recently extinct (Scheffers et al. 2011), but the Red List only lists 273 species within these groups currently extinct. The complexity of declaring extinction with certainty and the time and effort needed only cast further doubt on the feasibility of using species extinctions as the basis for a biodiversity target.

Is an extinction target realistic and realizable?

From the above discussion, it is clear that there are insufficient data to measure extinction rates for most species. However, we must also ask whether extinction-based targets are achievable. In theory, at least, frameworks could be developed around habitat protection and range coverage that would likely relate closely to extinction probabilities.

At the most basic level, we must know what percentage of species have some form of protection before we can know how feasibly they can be protected from extinction. Using species range polygons from IUCN, BirdLife, and GARD (the Global Assessment of Reptile Distributions; see the supplement) and protected areas polygons from the world database of protected areas, we calculated frequency distributions of different degrees of range coverage for vertebrate species and their total ranges. Among terrestrial vertebrates, 2491 (8%) species have no protection whatsoever (1025

Amphibia, or 18%, 309 or 3% of birds, 355 or 6% of mammals, and 802 or 9% of reptiles). However, these numbers are oversimplifications, because they do not account for what proportion of the species' range is protected. In terms of actual area of protected range, 9245 (30%) vertebrate species have at least 10% of their ranges protected (1990 or 34% of Amphibia, 2516 or 25% of birds, 1605 or 29% of mammals, and 3134 or 36% of reptiles). In fact, 12% of all mapped species have less than 10 square kilometers (km²; with Amphibia highest at 26%), and 23% have less than 100 km² protected (Amphibia 46%). Such numbers can only be calculated for vertebrates, but we anticipate that coverage would be similar or lower in other, lesser-known taxonomic groups, given that these are the biological data often used for planning when such data are used for delineating protected areas.

In summary, the representativeness of protected areas varies radically, even across groups that can be mapped, but vulnerability is often the inverse of protection (Hughes 2017b). In addition to protected area coverage, range sizes can help inform extinction vulnerability, and 3% of species had a total mapped range of under 10 kilometers (km; 1006 species), of which 620 are amphibians (11% of amphibian species, with 23% or 1309 mapped amphibian species having ranges of under 50 km, and 8% or 2491 of vertebrates overall having ranges of under 50 km²).

Better targets that protect species and systems

Given these considerations, extinction is clearly an impractical—even impossible—target for the GBF. Existing information is insufficient to measure contemporary extinction rates, even for better-known taxa such as terrestrial vertebrates, much less for undescribed or poorly known species, especially hyper diverse taxa. Furthermore, from what little information can be assembled, targets of reasonably low extinction probabilities are probably largely unreachable.

Setting goals that are simultaneously immeasurable and unreachable seems to be a particularly bad recipe for targets that are intended to motivate collective action toward achieving important global conservation goals.

It would take decades to gather the data required to erect extinction targets that are meaningful, representative, and quantitative. During this time, immeasurable effort and funding would go to funding initiatives and building data infrastructures just to begin understanding extinction rates, rather than preventing extinction itself. This time and expense would be at the cost of other, more practical conservation targets and solutions. Basing targets around extinction at present, given the data available, would likely only serve to exacerbate a focus on a relatively small suite of charismatic, well-known vertebrates, perpetuating the neglect of the full diversity of life on Earth.

The protection of representative areas and habitats should instead be prioritized. Aichi target 11 was intended to provide protection for species across 17% of the world's land surface. Although this target has perhaps been achieved on the basis of area alone, it fails to meaningfully represent the full diversity of ecosystems. Better targets would use the Red List of Ecosystems to ensure that the diversity of known ecosystems is represented (on the basis of community composition and distinctiveness), and to identify and preserve endemism hotspots. Other effective conservation mechanisms (OECMs) should also be integrated, and targets such as 11 on protected area coverage could be expanded to more representatively protect biodiversity using spatial analysis to target where the expansion of protected areas would be most effective. Although the use of such targets is still uncommon, greater provision of funding to identify and map ecosystems and set appropriate targets to representatively conserve them would more meaningfully provide protection for species across taxa than any species-specific target. Furthermore,

given that commodities and unsustainable development are often major drivers of species loss, setting targets that ensure the retention of natural habitat within working landscapes to maintain connectivity is both achievable and would better serve species.

Put simply, if the GBF is to enable effective conservation it should not only include achievable and meaningful targets in terms of area-based conservation and methods for representation, but also the drivers of species loss with clear guidance on modes of intervention. This will involve collaboration between conventions to provide frameworks not just to target landscape-level change (including frequently little-known UN treaties, such as the International Treaty on Plant Genetic Resources for Food and Agriculture) but also CITES (the Convention on International Trade in Endangered Species) to ensure that they offer adequate protection across taxa.

In summary, we are not yet at a point at which meaningful extinction-based targets can be developed. Therefore, we suggest that global initiatives should focus on more feasible and effective, ecosystem-based targets, via activities such as red listing ecosystems and assessing degree of protection. If we wish to conserve the highest number of species possible, we need to maintain intact, representative habitats, and use new technologies to monitor ecosystem health and maximize effective conservation.

Supplemental material

Supplemental material is available at *BIOSCI* online.

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