Grand challenges in global biodiversity threats

Health & Medicine

Most conservation research and its applications tend to happen most frequently at reasonably fine spatial and temporal scales—for example, mesocosm experiments, single-species population viability analyses, recovery plans, patch-level restoration approaches, site-specific biodiversity surveys, *et cetera* . Yet, at the other end of the scale spectrum, there have been many overviews of biodiversity loss and degradation, accompanied by the development of multinational policy recommendations to encourage more sustainable decision making at lower levels of sovereign governance (e. g., national, subnational).

Yet truly *global* research in conservation science is fact comparatively rare, as poignantly demonstrated by the debates surrounding the evidence for and measurement of planetary tipping points (Barnosky et al., 2012 ; Brook et al., 2013 ; Lenton, 2013). Apart from the planetary scale of human-driven disruption to Earth's climate system (Lenton, 2011), both scientific evidence and policy levers tend to be applied most often at finer, more tractable research and administrative scales. But as the massive ecological footprint of humanity has grown exponentially over the last century (footprintnetwork. org), robust, truly global-scale evidence of our damage to the biosphere is now starting to emerge (Díaz et al., 2019). Consequently, our responses to these planet-wide phenomena must also become more global in scope.

Conservation scientists are adept at chronicling patterns and trends—from the thousands of vertebrate surveys indicating an average reduction of 68% in the numbers of individuals in populations since the 1970s (WWF, 2020), to global estimates of modern extinction rates (Ceballos and Ehrlich, 2002 ;

Pimm et al., 2014 ; Ceballos et al., 2015 , 2017), future models of co-extinction cascades (Strona and Bradshaw, 2018), the negative consequences of invasive species across the planet (Simberloff et al., 2013 ; Diagne et al., 2020), discussions surrounding the evidence for the collapse of insect populations (Goulson, 2019 ; Komonen et al., 2019 ; Sánchez-Bayo and Wyckhuys, 2019 ; Cardoso et al., 2020 ; Crossley et al., 2020), the threats to soil biodiversity (Orgiazzi et al., 2016), and the ubiquity of plastic pollution (Beaumont et al., 2019) and other toxic substances (Cribb, 2014), to name only some of the major themes in global conservation.

But we are generally less successful in translating this evidence into meaningful policy and actions (Gibbons et al., 2008 ; Shanley and López, 2009 ; Rose et al., 2018). Nonetheless, many forward-thinking entities have emerged in recent decades attempting to stem the tide of destruction. The efficacy of some of these mechanisms is arguable, but the establishment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES. net) in 2013 heralded a new era in the required international coordination and response to the crisis (Díaz et al., 2019). While analogous agreements and directives in the past have largely failed to avert the biodiversity crisis (Adenle, 2012 ; Convention on Biological Diversity, 2020), IPBES has built on the successes of the Intergovernmental Panel on Climate Change (IPCC. ch), and can hopefully avoid many of the latter organization's as well as its predecessors' failures to coordinate a sufficient response among a majority of nations.

The complex, intertwined, and multi-scale mechanisms driving biodiversity loss (Game et al., 2014) and the erosion of ecosystem services this entails

require equally complex solutions backed by sophisticated approaches to provide the necessary evidence for meaningful interventions. The Global Biodiversity Threats section in *Frontiers in Conservation Science* is specifically dedicated to publishing this type of far-reaching research. In addition to articles finessing the global evidence for the erosion and loss of biodiversity, we are actively seeking and commissioning articles that address the *wicked problems* (Game et al., 2014) of interacting drivers and solutions at broad scales. Such complicated topics will of course include the ongoing challenges of measuring and predicting the effects of and mitigating solutions for climate change (Bellard et al., 2012), but will also invariably involve research on the necessary transformation of the energy sector (Brook and Bradshaw, 2015 ; Gasparatos et al., 2017 ; Moreira, 2019 ; Rehbein et al., 2020), tackling both the legal and illegal global trade in wildlife (Harfoot et al., 2018 ; ‘ t Sas-Rolfes et al., 2019), development of approaches that promote more sustainable agriculture (Foley et al., 2011 ; Dudley and Alexander, 2017 ; Green et al., 2019), aquaculture and fisheries (Blanchard et al., 2017), curtailing human population growth and consumption (Bradshaw and Brook, 2014 ; Crist et al., 2017), addressing the environmental effects of increasing human migration and trade (McNeely, 2003 ; Lenzen et al., 2012 ; Trouwborst et al., 2016), reducing the footprint of urbanization, investigating the nexus between environmental degradation and disease risk (Wall et al., 2015 ; Gibb et al., 2020 ; Nature Ecology Evolution, 2020 ; Rohr et al., 2020), and the biodiversity implications of technological advance in other realms of human endeavor (Sutherland et al., 2017).

In short, we will be emphasizing research on the “ big” topics in the conservation “ sciences” (i. e., including the social sciences), and placing as much (if not more) weight on the *solutions* as on the empirical *evidence* for change. While acknowledging my own partiality for mathematical modeling, I foresee that much of this research will probably depend to some extent on elements of complex-systems models to be able to tackle the ominous Scylla that life on Earth now faces. We encourage out-of-the-box thinking and atypical datasets, multidisciplinary approaches, simulation studies, science-policy interface perspectives, and a range of other innovative methodologies and analytical advances. Quite frankly, our discipline has never been as challenged as it is today by the complexity of these wicked problems, and so our research and the policy improvements they occasion have never been more important. The gauntlet has been thrown.

Author Contributions

The manuscript was authored solely by CJAB.

Conflict of Interest

The author declares that the research was done in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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