



Human Responses to Climate Change will Seriously Impact Biodiversity Conservation: It's Time We Start Planning for Them

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The consequences for biodiversity of human-driven climate change cannot be ignored. The rate at which the earth is warming is accelerating, and it is likely to take centuries for the climate system to sync back to a natural climate cycle, regardless of the mitigation policies implemented. The quantity of greenhouse gases in our atmosphere is such that climate change can now no longer be considered a 'future threat'. Across the planet we are already witnessing, among other things, change in species' phenology, distributions and abundance, mass coral bleaching events, changes in fire frequency, and the loss of ecosystems due to rapid de-glaciation and sea-level rise.

The chorus of concern on what climate change means for biodiversity has driven an extraordinary increase in research into both impacts and, sometimes, potential solutions. Over the past decade the number of articles published in the peer-reviewed conservation literature has grown on average by 20% per annum. This growth is both staggering and laudable as it highlights how serious

the conservation science community is about tackling the threat that human-driven climate change poses.

Nevertheless, a quick examination of the climate change literature reveals that when assessing how, where and why species and ecosystems are vulnerable to climate change, and the different adaptation strategies that need to be implemented to cope with the challenges climate change presents, most conservation scientists usually ignore the single most significant impact: how humans are likely to respond and adapt. In almost all impact and planning assessments published to date, the reality that many species' abilities to respond to climate change is already impaired by a myriad of interacting threatening processes driven by human activities (e.g., habitat destruction, fragmentation, altered fire regimes) is ignored. Furthermore, as humans continue to respond to a changing climate, these threatening processes are likely to either change and/or intensify in both space and time.

The ways in which humans respond to climate change is already driving many of the climate-related

ecological degradation we are witnessing across the globe. For example, retreat of sea-ice has facilitated the recent opening up of the Arctic for oil and gas mining and transport route development that is directly exacerbating impacts on polar biodiversity. Expansion of agricultural activities due to more favorable rainfall regimes across the Albertine Rift and the valleys of the Congo Basin is now increasingly threatening the most biodiverse regions in Africa. These are human responses to the ongoing effects of climate change that are to some degree predictable.

There are also extreme (and abrupt) climate change impacts that promote unanticipated responses from humans that can lead to sometimes rapid and severe losses of highly vulnerable species' populations. On all inhabited continents in the past year, we have witnessed the economic and physical displacement of human populations due to flooding and drought, which in turn, has overwhelmed natural systems, converting them to other uses, or degrading their productivity. These events often leave human populations highly vulnerable and can lead to new types of behavior that can seriously ramifications for biodiversity. For example, there is often a substantial increase in poaching of tiger and deer species during floods in southern and southeastern Asia. Floods are likely to be more frequent in the regions these species reside under even the most moderate of future climate change scenarios.

Beyond poaching, there are also increasing numbers of unanticipated adaptations by humans to climate change impacts that are not well planned but are necessary for our short-term survival, and which may have dire consequences for biodiversity. For example, the construction of (often ineffective) seawalls aiming to slow the impact of sea-level rise in Papua New Guinea has led to the wholesale destruction of some of the most biodiverse and protein-productive coral reefs in the world. Understanding human behavior and both the immediate reactive and planned responses to climate change effects will be essential for mitigating the impacts on biodiversity of human's responses to climate change.

We need to recognize that this will require a fundamental shift when it comes to understanding the impacts of climate change and the planning strategies we need to pursue. This means a change of mindset for the vast majority of conservation scientists who have focused their entire efforts on understanding the ecology of species and

their likely responses to climate change. By doing so they have overlooked a basic tenet of our field: conservation is fundamentally about people.

We need to change the way we frame our science on climate change vulnerability. When we think about the impact of climate change on biodiversity, future research needs to be focused not only on modeling the probable impacts of climate change on particular species, but also on how direct human-driven causes of extinction will change as a consequence of climate change and what the anticipated new drivers of extinction are likely to be. This focus on drivers will lead us away from a species and ecosystem centric view on climate change vulnerability to one that focuses primarily on how biodiversity's major threat – humans – are likely to respond. Realigning our focus in this way will allow us to identify strategies that consider how humans are going to respond to a changing climate. The most effective responses will be those that allow both vulnerable species and ecosystems and human communities to most rapidly and continuously adapt to the challenge. Scenario planning is clearly an important tool in this process; however, it will be ineffective unless there is a formal integration of ecology and climatology with the social, economic and political sciences, which will better facilitate understanding of the theory and practical methodologies suited to the study of human responses to climate change.

It is time to reflect on what has been achieved over the past decade in the conservation literature when it comes to climate change and reframe our collective view on what needs to be done in the future. Failure to predict likely human adaptations to climate change commits us to identifying a series of adaptation responses that will be wholly inadequate to the demands of the coming century. It will result in flawed conservation planning, ineffective strategies and potentially avoidable dire consequences for biodiversity.

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