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PERSPECTIVE

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Conserving biodiversity in the face of rapid climate change requires a shift in priorities

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Abstract

The field of conservation aims to protect biodiversity—the diversity of life on earth in all its forms. Traditional conservation objectives and measures have already been expanded and modified in response to shifting social values and climate-related challenges. As climate change progresses, we argue that these changes will need to be accelerated. First, an even greater fraction of conservation objectives will need to prioritize the basic well-being of humans, especially in areas where humans are strongly dependent on their natural surroundings. For example, urban biodiversity and low-impact forms of agriculture and forestry that reconcile biodiversity and contributions to humans should increasingly be viewed as compatible with conservation objectives. Second, more conservation measures will need to allow for, and even foster, changes in biodiversity. Indeed, changing species' characteristics and biotic community composition are not only adaptive responses to inevitable climate change but will, in many instances, also be necessary to maintain functioning ecosystems. Conversely, attempts to maintain biodiversity in a historical state will likely become increasingly difficult, expensive, and possibly counterproductive. Finally, in addition to continuing climate adaptation work, conservation efforts will need to focus more on reducing atmospheric carbon concentrations. We explore how collectively these changes are transforming the field of conservation and how they have the potential to lead to a more just and sustainable world despite impending climate change.

This article is categorized under:

Climate, Ecology, and Conservation > Conservation Strategies
Climate, Nature, and Ethics > Comparative Environmental Values
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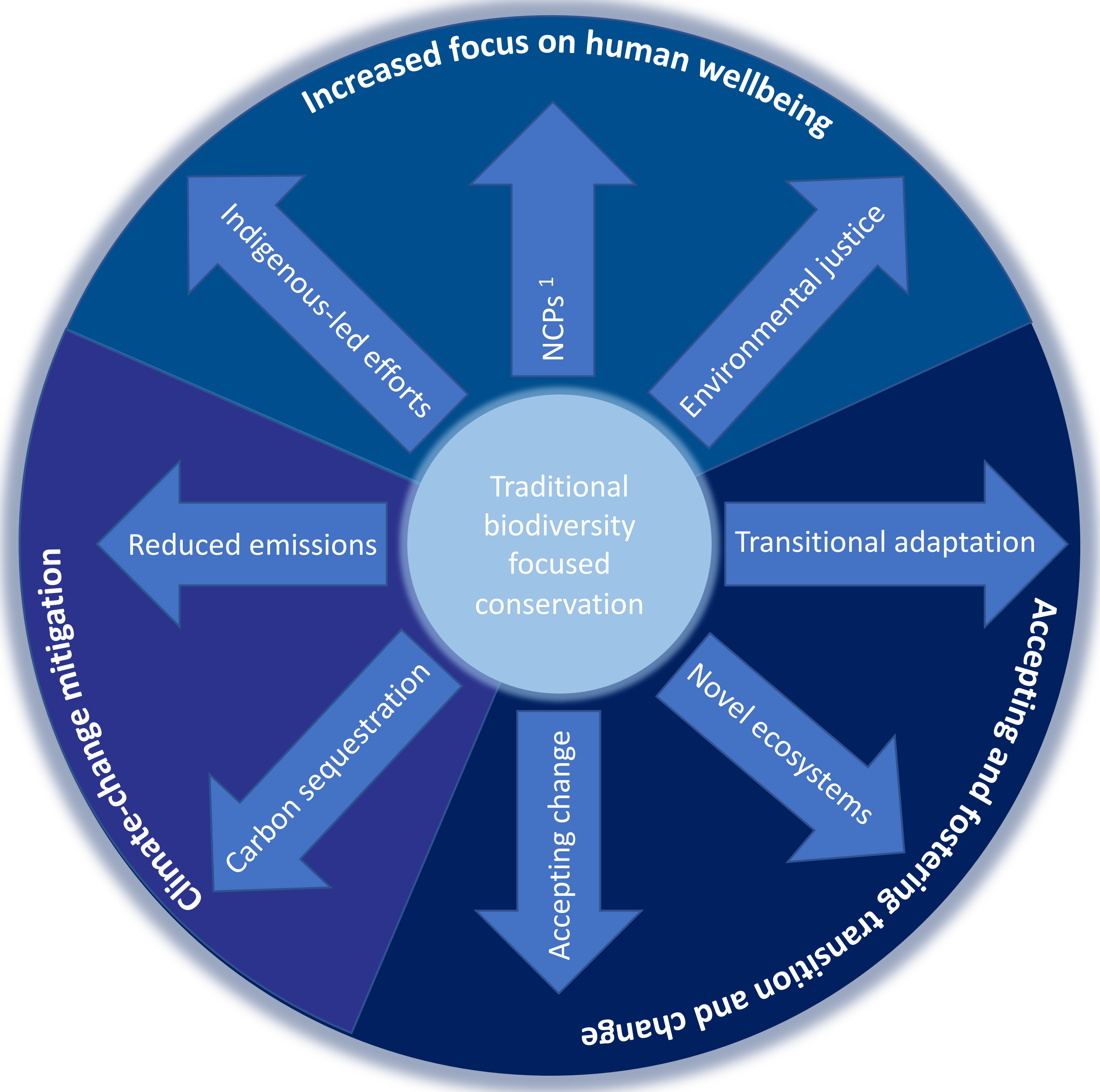
biodiversity, conservation, non-native species, protected areas, values



Increased focus on human wellbeing
Indigenous-led efforts
NCPs 1
Environmental justice
Traditional biodiversity focused conservation
Reduced emissions
Transitional adaptation
Carbon sequestration
Accepting change
Novel ecosystems
Climate-change mitigation
Accepting and fostering transition and change

1 | INTRODUCTION

Two of the main environmental challenges of our times, climate change and the biodiversity crisis, are inextricably intertwined. Without serious, concerted efforts to reduce greenhouse-gas emissions, both the absolute extent of change (Δ°C) relative to pre-industrial climate and the rate of climate change (Δ°C/decade) will significantly alter many life-systems on earth. The sustained and strong directional selection of rapid climate change may surpass the capacity of many species to track suitable living conditions (Foden et al., 2019). For example, between 8% and 20% of global vegetation is likely to be at risk of severe ecosystem change with an increase in global mean temperature of 2°C, and 20% to 38% of global vegetation will likely be at risk with a 3°C rise in global mean temperature (Warszawski et al., 2013). With an increase in the global average temperature of 2°C, 3%–18% of assessed terrestrial species are likely to face high risk of extinction, increasing to 3%–39% with a 4°C increase (IPCC, 2022). Furthermore, even if global warming is limited to 1.5–2°C, some temperature-sensitive ecosystems such as coral reefs and mangroves will be unable to persist beyond the 2040s based on conservation and restoration efforts alone (IPCC, 2022). Novel conservation approaches will be necessary to prevent numerous ecosystems from disappearing along with their contributions to human societies.

Recent studies have argued that the protection of biodiversity and efforts to address climate change are largely aligned (Pörtner et al., 2021; Shin et al., 2022). Indeed, some undisturbed, species-rich ecosystems such as mangroves and wetlands tend to be efficient at carbon sequestration. In addition, measures that reduce the anthropogenic emissions of greenhouse gases also reduce the threat to biodiversity (Boulton et al., 2022; Morecroft et al., 2019). Despite some elements of alignment, rapid climate change represents a fundamentally novel type of challenge that will reshape both conservation objectives and tactics. Indeed, until now, conservation efforts have focused on slowing rates of human-induced changes and reducing the ecological footprint of our species. Such efforts should remain a priority. The long time-lag of greenhouse gases, however, implies that climate change will inevitably occur and is locked-in (i.e., irreversible) for centuries to come (Clark et al., 2016).

As a result, conservationists will need to shift from a mental model of "resist and reverse all forms of change" to "identify which forms of changes need to be resisted, and which changes are necessary and desirable." Specifically, we surmise that rapid climate change requires conservation strategies to (1) focus more strongly on simultaneously addressing both human needs and biodiversity, (2) to be more accepting of certain novel systems and to manage for transitions to novel environmental conditions, and (3) to focus on climate mitigation (reducing atmospheric carbon concentrations). Calls for each of these individual changes have been previously made by others (e.g., Kareiva & Marvier, 2012; Lynch et al., 2021; Morecroft et al., 2019; Stein et al., 2014). Furthermore, these changes have been embraced to varying degrees by different conservation organizations and different sectors of the conservation movement. However, they are not happening fast enough (Gardner & Bullock, 2021), nor has their collective necessity been recognized as a force that will require a fundamental shift in conservation philosophy. Here, we make the case that climate change requires a much more rapid and concerted change to help society reach the dual global sustainability goals of remaining within planetary limits (Steffen et al., 2015) while ensuring basic human needs (O'Neill et al., 2018; Raworth, 2017; Table 1).

2 | CONSERVATION FOR NATURE AND PEOPLE

To understand the multiple challenges that rapid climate change represents for the preservation of biodiversity, we first briefly retrace the evolving motivations underlying the conservation movement (Mace, 2014). The founders of western conservation organizations identified industrialized human societies as threats to nature and species (Soulé, 1985). In practice, this resulted in the creation of large, protected areas that were designed to function as bulwarks or fortresses against human impacts, and the development of legal frameworks designed to protect species and habitats from extirpation. Importantly, the western conservation movement is originally based on a very specific form of idealized nature that is free of human influence, and in which species are believed to have co-evolved into self-regulating form of equilibrium (Cronin, 1995). Social scientists have highlighted the human-costs incurred by conservation strategies that seek to exclude (and sometimes expropriate) humans from protected areas that focused on preservation (Büscher & Fletcher, 2020; Callicott, 2000; Cronin, 1995; Fletcher et al., 2021; Kareiva et al., 2011; Kull et al., 2015). Other researchers have questioned whether protected areas from which humans are excluded send the false signal that "nature" only exists in the absence of humans, and whether such preservationist values may represent significant barriers to sustainability in general, and alternative worldviews in particular (Büscher & Fletcher, 2019; Callicott, 2000;

TABLE 1 Examples of conservation objectives and tactics that are changing in importance considering emerging conservation trends (greater human focus, acceptance of biotic novelty, and systemic thinking) driven partially by climate change

Objectives	Tactics	Future needs	Rationale
Increased focus on human wellbeing	Conservation and management of lands for both Nature's Contributions to People (NCPs) and biodiversity	↑	A continued shift from preservationist to commensal values addresses both moral imperatives and practical needs.
	Indigenous-led conservation and decolonization	↑	An increased shift in leadership from specialists and international conservation non-governmental organizations (NGOs) with western values to local and indigenous groups will both address a moral imperative and better capture space-, time-, and culture-specific values.
	Protected areas	↓↑	Protected areas are, and will continue to be, critical for climate adaptation. However, they also reinforce the notion that humans are separate from nature (dualism) and tend to exclude local disenfranchised populations.
	Environmental justice	↑	Neither the impacts of climate nor the benefits of NCPs are equitably distributed. To be just, conservation actions will need to be anti-racist, protect vulnerable populations, and equitably benefit all people.
	Recognition of beneficial non-native species	↑	Non-native species are more likely to persist than natives under future climate change. The risks of future invasions by non-native species need to be weighed against current and future instrumental values for local peoples.
Accepting and fostering transition and change	Transitional adaptation approaches	↑	Continued rapid climate change will require a greater shift from resistance- and resilience-based approaches to transitional adaptation approaches.
	Indefinite, costly management to protect all native ecosystems and endangered species in situ from novel, permanent forces (e.g., climate change)	↓	It will become even more difficult to manage some populations and ecosystems to maintain their current or historical states. Alternatives include translocations or trusting eco-evolutionary processes (i.e., potentially allowing local extirpations).
	Restoration efforts to return ecosystems to historical states	↓	Restoration efforts risk creating ecosystems that are evolutionary dead-ends. Instead, transitional tactics should be forward looking, and climate-compatible.
Climate-change mitigation	Focus on nature-based climate solutions	↑	By amplifying efforts to protect and conduct climate-compatible restoration of ecosystems that sequester and store large amounts of carbon, conservation organizations can directly reduce climate change.
	Efforts to enact and facilitate policies and practices that reduce greenhouse-gas emissions	↑	Increased efforts by conservation organizations traditionally focused on land and species protection to engage in climate policy will address one of the root causes of biodiversity loss.
	Intensive conservation efforts that generate greenhouse gases	↓	Conservation NGOs should be exemplary and also reduce their own fossil fuel intensive activities, including air travel by conservationists and scientists.
	Systemic, interdisciplinary analyses	↑	Addressing the causes of climate change will require an increased emphasis on socio-environmental systems approaches and analyses and greater inclusion of social sciences.

Guiaşu & Tindale, 2018; Lahsen & Turnhout, 2021; Sagoff, 2020). Nonetheless, creating and expanding human-free protected areas remains a widespread target within the conservation movement, especially among western biologists (Büscher & Fletcher, 2019; Convention on Biological Diversity (CBD), 2021).

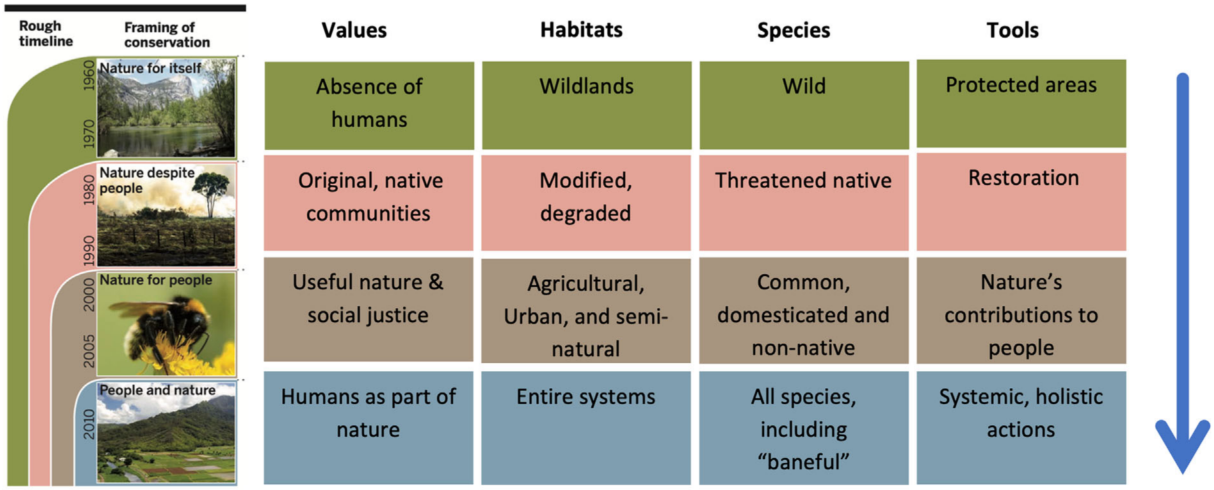


FIGURE 1 The perimeter of conservation targets has expanded its focus over time, from protected areas to semi-natural areas. Including all forms of biodiversity and habitats into a holistic consideration will be necessary to identify a human–nature vision that is compatible with sustainability. Expanded upon Mace 2005

In 1987, the Brundtland Report *Our Common Future* explicitly linked human welfare to the state of the environment. Thus, nature was to be protected not just for itself (intrinsic values) but also for its contributions to human development and poverty alleviation. One way in which the conservation movement integrated human-based values was through the development of the ecosystem services concept (Daily, 1997), which renders explicit the contributions of ecological functions to human well-being. Since then, major biodiversity initiatives (Convention on Biological Diversity [CBD]; U.N. Sustainable Development Goals), international platforms (IPBES, IUCN), and major conservation NGOs (e.g., WWF International, The Nature Conservancy) have all broadened their mission statements to include some variation of "nature and people" and explicit valuation of nature's contributions to people (NCPs; Díaz et al., 2018). An interesting consequence of the continued rapprochement between the fields of conservation of biodiversity and human development is the heightened awareness regarding the immense diversity of values that emanate from nature and how these are often site-, time- and culture-specific (Díaz et al., 2018; Fletcher et al., 2021; Kohler et al., 2019; Obura et al., 2021; Pascual et al., 2017, 2021; Zafra-Calvo et al., 2020).

Thus, the values within the conservation movement have expanded during the last 20 years to also include human-centered (instrumental and relational) values (Figure 1). Although this shift has resulted in some high-profile debates in which *conservation of biodiversity* and *nature for people* were pitted against each other (Marvier, 2014; Soulé, 2013), the conservation movement is, in reality, composed of a multitude of schools of thought, contrasting values and motivations, and infinite nuance. More recently, there have been numerous calls for the conservation movement to better capture this diversity of worldviews and values (Díaz et al., 2018; Fletcher et al., 2021; Kohler et al., 2019; Obura et al., 2021; Pascual et al., 2021).

Climate change is already having profound impacts on human communities around the world. These include impacts on health, livelihoods, shelter, economies, food and water resources, and security resulting from changes in extreme weather events and rising sea levels (IPCC, 2022). In light of these impacts, in addition to protecting biodiversity, conservation organizations have a moral imperative to address issues of environmental justice and with it the interests of communities (including vulnerable, Indigenous, and non-Indigenous communities) when addressing the impacts of climate change (Clement, 2021; Wyborn et al., 2020). A greater focus on the needs of groups that have historically been underrepresented and that are being most impacted by climate change will require greater power to be placed on local stakeholder groups and their value systems. Such a shift will include inter alia more Indigenous-led conservation and decolonization.

3 | EMBRACING NOVELTY AND TRANSITION

To prevent the loss of biodiversity, conservation measures have historically focused on limiting human influences. This was implemented, for example, through the creation of protected areas, removing invasive species, restoring and recreating former habitats, and species-specific management to boost populations of threatened species. The intensity and rapidity of climate change raise the question of whether all these traditional tactics will be efficient or even effective in the future.

3.1 | The limits of resistance and resilience

Until recently, climate change adaptation efforts for biodiversity have largely focused on strategies of resistance (attempts to maintain a system in its current state, despite climate change) and resilience (approaches that allow a system to return to a current or prior state after a climate-related perturbation). However, as climate change progresses, in many cases, tactics that seek to maintain species and ecosystems in a historical state will no longer be pragmatic (Camacho et al., 2010; Stein et al., 2014). Furthermore, as environments are modified by climate change, the gap between the systems managed for a current or historical state and their unmanaged surroundings will only increase (Mace & Purvis, 2008). This will leave the targets of resistance and resilience strategies increasingly out of sync with the rapidly changing environment and dependent on indefinite and costly human assistance.

3.2 | Transitional tactics

What should be done then for plant and animal species whose suitable habitat is disappearing because of climate change? The potential inadequacy of resistance and resilience approaches have required conservation practitioners to devise and apply adaptation approaches that allow species and systems to track changes in climate (Lynch et al., 2021; Stein et al., 2014) and practical guidance to facilitate adaptation through natural selection (Ashley et al., 2003; Carroll & Fox, 2008; Crandall et al., 2000; Schlaepfer et al., 2005). Such transitional strategies tacitly accept and even encourage certain changes in allele frequencies (within populations), species distributions, community composition, and basic ecosystem functions.

Transitional measures were first used to rescue threatened native populations. Examples include increasing the genetic variability of a species by mixing populations (Johnson et al., 2010; Westemeier et al., 1998), training native prey populations to avoid introduced predators (Blumstein et al., 2002; Salo et al., 2007; Schlaepfer et al., 2005), and assisting in the landward migration of coastal systems (Leo et al., 2019). As the rate of anthropogenic change has accelerated, more dramatic measures have been proposed and, in some cases, applied. These include assisted colonization—moving species out of their historical ranges to allow them to stay within their ecological niche—(Hoegh-Guldberg et al., 2008), assisted adaptation (Jones & Monaco, 2009), and actively transitioning vegetation communities or ecosystems to anticipate future change. For example, for corals, directed adaptation could include selective breeding, inoculating corals with temperature-tolerant algal symbionts, preconditioning corals to stress, and manipulating a coral's microbiome (Damjanovic et al., 2017; van Oppen et al., 2015, 2017). These human interventions are generally viewed as acceptable (although see Ricciardi & Simberloff, 2009) because it is deemed preferable to allow ecosystems and species to persist in a modified state than to let them disappear.

Although transitional strategies seem necessary and urgent (Colloff et al., 2017; Gardner & Bullock, 2021), they remain rarely implemented (Heller & Zavaleta, 2009; McLaughlin et al., 2022). Peterson St-Laurent et al. (2021) examined 104 climate adaptation projects and noticed only a small trend towards more transformation-focused projects between 2011 and 2019. The implementation of transitional measures may be hindered by a reluctance to accept change or to further intervene in changing systems. For example, proposals to translocate species outside of their historical range to assist the species' survival in light of climate change (Hoegh-Guldberg et al., 2008), to value the contributions of populations outside of their "native range" toward preventing extinction (Wallach et al., 2020), or to value all species for their intrinsic and instrumental values regardless of their origin (Davis et al., 2011; Schlaepfer, 2018) are routinely opposed by researchers with static, nativist world-views (Cuthbert et al., 2020; Pauchard et al., 2018; Ricciardi & Simberloff, 2009).

Transitional approaches raise both practical concerns (Pettorelli et al., 2021) and spark several interesting questions that lie at the intersection of biology and normative values (Guiaşu & Tindale, 2018; Lackey, 2009; Morecroft et al., 2019). To what extent is it acceptable for humans to intervene to putatively save a population or species? What risks are we willing to take when translocating a species outside of their "original" range to assist the species' survival in the face of climate change? Is it ok to plant non-native trees in urban centers to ensure that there are at least some living trees there in the future (Sjöman et al., 2016)? Do such actions unwittingly make human-induced changes more acceptable, thereby reducing pressure to mitigate the initial problem (Maron et al., 2016)? In addition, transitional approaches force us to revisit our nature-based values. Do ecosystems with novel species assemblages have less value than native assemblages (Hobbs et al., 2009; Schlaepfer, 2018)? Is it ok to plant endangered species in urban gardens to protect the species from extinction (Segar et al., 2022), and in doing so are we degrading the species' value? Is it desirable or undesirable to discover that non-native species make up a large fraction of a given community? Should the hybridization between native and introduced species that produces offspring with high fitness in their (novel, human-altered) environment, be cause for dismay or cautious optimism (Quilodrán et al., 2020; Box 1)? When, if at all, should one allow populations and communities to simply evolve without further human interference?

Answering these questions will require interdisciplinary approaches capable of blending scientific information, normative values (which capture, e.g., personal preferences, tolerance to different types of risk, and worldviews), and knowledge of local needs. Although international biodiversity organizations and initiatives will retain key roles (in assessing global biodiversity trends, and addressing global threats to biodiversity such as trade and telecoupling), the mantle of authority regarding biodiversity targets will logically shift toward grass-roots, local, and regional initiatives (Obura et al., 2021; Zafra-Calvo et al., 2020) to account for local needs, and cultural values.

In a related matter, indicators used to track biodiversity will also need to be updated to capture these evolving values. Too many indicators and laws still overlook biodiversity values and NCPs that emanate from human-modified habitats (Schlaepfer, 2018). Several promising elements have been inserted into proposals for post-2020 CBD indicators including integration of "modified" ecosystems as targets of biodiversity protection in Target A, greater sustainability of NCP use in Target B, and better valuation of urban biodiversity in Target 12 (Convention on Biological Diversity (CBD), 2021).

BOX 1 Alternative valuations of novel biological entities

A hallmark of a preservationist goal is to maintain and restore natural elements in some historical state. Novel species (as in, introduced, and novel hybrids) and ecosystems have generally been viewed as incompatible with traditional conservation goals. However, novel species should also be appreciated for their contributions to biodiversity and their ecological functions (Clement, 2021; Hobbs et al., 2009; Vellend et al., 2007). Take, for example, the case of hybrid tiger salamanders in California, USA (Fitzpatrick & Shaffer, 2007), which are the product of native and introduced sub-species. There are potential negative ecological consequences of the hybridization between introduced (sub)species and native species, and genetic introgression can be seen as undermining the putative *genetic integrity* (a value-laden term that refers back to a certain conceptualization of idealized nature without humans, in our opinion) of the local subspecies (Ryan et al., 2009). However, it is also possible that hybridization could improve the chances of having viable salamander populations under current (often modified) and future conditions. In addition, hybrid individuals could offer an improved phenotypic vessel to carry historical (native) alleles into the future, thus generating a form of resilience for genetic diversity (see Fitzpatrick et al., 2010; Quilodrán et al., 2020). It might be preferable for alleles of a threatened subspecies to be integrated into a novel phenotype that improves their chance of persistence, then to let them go extinct in their "native form."

Similarly, the growing fraction of non-native species that make up biotic communities (especially on islands and in urban environments; Sax, 2001; Schlaepfer, 2018) has the potential to be problematic because some of these non-native species have had large impacts on native species and ecosystem functions or may do so in the future (Guo et al., 2020). However, it is also possible that numerous regions of the world have a fraction of species that will be pre-adapted to future conditions. Recent work suggests that some novel species can rapidly blend into the local web of life and provide useful complex ecological functions (Mascaro et al., 2012; Matallana-Puerto & Cardoso, 2022; Ramus et al., 2017; Tablado et al., 2010; Vizentin-Bugoni et al., 2019). Under a transitional approach, the future risk of undesirable effects needs to be weighed against the value generated by pre-adapted life forms to future conditions (Schlaepfer et al., 2011). How novel biological entities are valued depends not just on scientific evidence, but also on the normative value system (Sagoff, 2020; Figure 2).

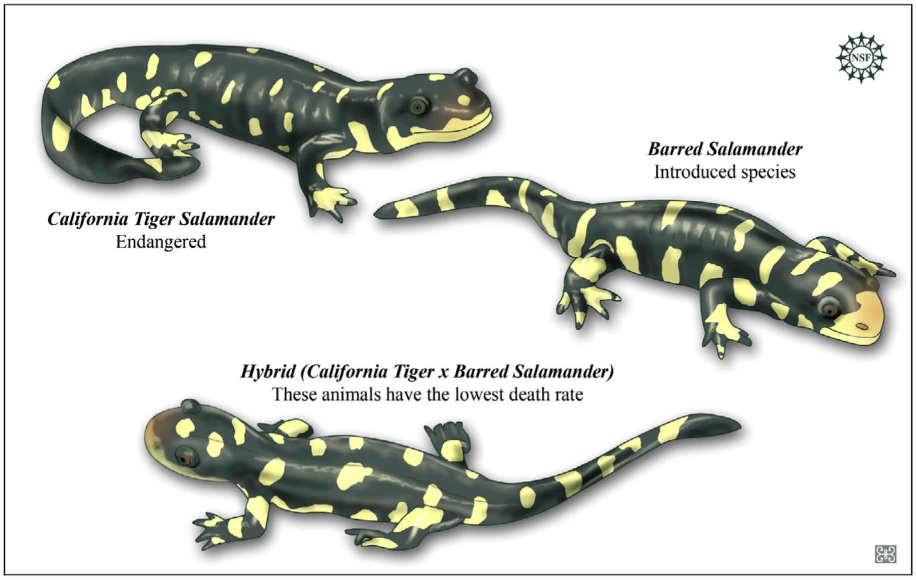


FIGURE 2 Native, introduced, and hybrid phenotypes of Ambystoma salamanders in California. *Credit*: Zina Deretsky, U.S. National Science Foundation

3.3 | Accepting certain forms of human-induced change

Rapid, contemporary changes in biodiversity have historically been viewed as antithetical to conservation targets, especially when induced by humans. We have argued above that conservation tactics will need to accept and even encourage certain biotic changes. Accepting change in some systems and protected areas relieves managers of the requirement to maintain the "original" ecosystems and species. However, how will practitioners determine which such changes are compatible with conservation targets, and which changes are undesirable? Unfortunately, there will likely be no easy answers and managers will have to co-construct an acceptable vision of the future with local stakeholders. This could, in some cases, result in greater acceptance of certain human-induced changes (such as changes in species distributions as a result of climate change, or some introduced non-native species) as bona fide components of future, desirable ecosystems (Hobbs et al., 2009). In Switzerland, for example, *Solidago* plants are still eradicated (pulled by hand) within protected areas on the basis that they compete with native species. Such management efforts must be repeated every few years, as the plant re-occupies its niche. But in addition to being well-adapted to their current environment, *Solidago* plants also provide aesthetic benefits, support pollinators, and provide medicinal products (Schlaepfer, 2018). In the future, management decisions to maintain a semblance of native ecosystems will appear increasingly futile, especially as the proportion of non-native species increases (Guo et al., 2020). Instead, management decisions will require assessing both negative impacts of non-native species and the potential values they bring to rapidly changing systems, even if doing so may require overcoming deeply engrained reflexes about which natural elements should have value.

4 | CLIMATE CHANGE MITIGATION

As climate change progresses, adaptation efforts for people and for nature will become exceedingly difficult and expensive to implement. Thus, mitigation efforts remain critical. Until relatively recently, biodiversity-focused conservation organizations have left mitigation efforts to other entities, concentrating instead on adaptation. The conservation community, as a sector of the economy, likely represents a tiny fraction of greenhouse gas emissions. But, we argue that the conservation community must be exemplary in this domain and must also do its share to become net-neutral within a decade or two. This can be achieved thanks to the conservation of carbon sinks, but also by dramatically reducing emissions of greenhouse gases related to conservation activities.

4.1 | Greater focus on ecosystems that sequester carbon

The conservation of biodiversity and NCPs requires mitigating climate change (Convention on Biological Diversity (CBD), 2021). Conservation organizations are doing so by prioritizing nature-based solutions for carbon sequestration. Forests, wetlands, grasslands, and mangroves, all have the potential to sequester and store carbon and simultaneously provide habitat for biodiversity (Morecroft et al., 2019). Although reforestation and avoided conversion of natural systems provide some of the largest carbon benefits (Griscom et al., 2017), nature-based solutions also include forest management to increase harvest rotation lengths, using cover crops, adding trees to croplands, and restoring wetlands, grasslands, and urban forests (Fargione et al., 2018; Robertson et al., 2021). Conservation biologists and conservation organizations can play a critical role in ensuring that the contributions of nature-based climate solutions are properly calculated and that solutions are designed not only to maximize carbon sequestration (e.g., through forest plantations), but also to protect functioning ecosystems and biodiversity (Seddon et al., 2019).

4.2 | Reducing emissions from conservation

Conservation organizations and individuals can also reduce their own contributions to atmospheric carbon concentrations by rapidly phasing-out or reducing high emission activities such as air travel for research, workshops, conferences, and invited seminars (Fox et al., 2009). Because carbon compensation can be ineffective (Anderson, 2012) efforts should focus on absolute reductions. Conservation scientists could commit, for example, to flying no more than once every 2–3 years for professional purposes. In addition, conference organizers, for example, will need to provide viable online alternatives to travel. Perhaps more importantly, conservation organizations that have traditionally focused on conserving biodiversity or protecting land can also engage in activities (beyond nature-based climate solutions) that directly support the reduction of greenhouse-gas concentrations. For example, the post-2020 CBD indicators rightfully include carbon mitigation as a key indicator of progress for biodiversity (Target 8; Convention on Biological Diversity (CBD), 2021).

4.3 | Trade-offs between climate mitigation and biodiversity

In addition to focusing more on ecosystems that serve as carbon sinks and nature-based climate solutions, conservation biologists can inform many of the critical decisions about mitigation actions by calculating the co-benefits of climate mitigation measures and informing the siting of mitigation projects to reduce impacts on biodiversity. For example, carbon storage capacity and species richness are not necessarily correlated (Beaudrot et al., 2016). Thus, maximizing carbon storage and biodiversity goals will require optimizing for both outcomes (Ferreira et al., 2018). In addition to helping to site nature-based mitigation projects, conservation scientists can also help to develop approaches to implementing solutions, such as reforestation, in ways that improve biodiversity outcomes (Di Sacco et al., 2021). There will, nonetheless, be trade-offs and some mitigation gains will come at the expense of local biodiversity. In some instances, it may be in the interest of global biodiversity to tolerate some localized negative impacts due, for example, to renewable energy infrastructure, especially if there are theoretical reasons to believe that populations can learn or adapt to overcome these negative impacts with time (May, 2015). Future research will need to develop methods that integrate both direct and indirect impacts of such situations.

5 | A NEW CULTURE OF CONSERVATION

Accepting some forms of human change, acknowledging the importance of human–nature dependencies, and increasing the importance of climate mitigation will have important implications for conservation goals. Here, we outline in broad strokes how conservation goals will need to continue to change as well as some of the scientific needs that those changes are generating.

Interdisciplinary initiatives such as the global and regional biodiversity and ecosystem service assessments coordinated by IPBES have helped highlight the global importance of protecting biodiversity, which has now become fully integrated into the challenge of transitioning the world to a sustainable future. Creating sustainable social-environmental systems will require reducing human impacts within planetary limits and ensuring more equitable opportunities and access to NCPs, especially in favor of the underprivileged (O'Neill et al., 2018). How to do so is not without challenges (Otero et al., 2020) as it will likely require an overhaul of our economic and societal models. Integral to such a transition is re-conceptualizing the human species as a modest, commensal species, one species among others. Although it is a gross simplification, in general, global conservation goals have been evolving from "preserving all species and ecosystems in their historical state" to "preserving ecosystems that are capable of adaption to rapidly changing conditions and that support people and biodiversity." This shift in goals explains why the perimeter of conservation biology and the biological elements deemed of interest has slowly been expanding with time beyond protected areas and endangered species (Figure 1) to include novel tactical approaches (Table 1).

We must ensure, however, that by considering NCPs we are not commodifying nature, but instead making explicit our dependencies. We must also ensure that by accepting humans as agents of change, we are not condoning reckless development, but merely accepting the changes we induce as natural (rather than "artificial", which separates us from nature). A non-dualistic view of "humans & nature" (Figure 1, Mace, 2014) also helps recognize that certain light-intensity land uses such as soil conservation farming, agroecology, and selective logging may provide acceptable levels of both biodiversity and NCPs. Despite the uncertainty and risks (Marvier & Kareiva, 2020) the shift underway has the potential to foster greater ethical awareness of the role of our species and the emergence of greater respect and responsibility.

5.1 | Scientific needs

The challenge of protecting biodiversity considering climate change and the need for societal transformation raises a suite of novel challenges that will need to be addressed through interdisciplinary research. For example, countries, institutions, and individuals need guidance on what can be done to promote biodiversity within the context of sustainability. Novel methods that draw on life-cycle analyses are needed to establish the relative impact of different measures. We suspect that too often measures have been chosen when they produce immediate, visible effects (e.g., establishing green roofs with pollinator-friendly plants, or establishing a tiny nature reserve) when a similar investment in, for example, reducing airtravel or meat intake, could have generated a much more positive (albeit invisible) impact for global biodiversity and with greater collateral benefits of reducing carbon footprints. In addition, conservation biologists will need to devise novel methods to help society distinguish between changes in biodiversity states that are desirable or benign (because they are likely to be adaptive or provide useful NCPs or attenuate climate change), from those that are likely to be detrimental (because they likely lead to permanent loss of unique biodiversity and loss of NCPs). Additional examples of needed research include identifying the suitable trade-offs between biodiversity and climate-change reduction in the sector of renewable energy production; providing a typology of alternative world-views and values that are compatible with global sustainability, and the trade-offs between various interests (climate, biodiversity, human well-being, etc.) that will be necessary to follow viable pathways towards a more sustainable world.

6 | CONCLUSION

We have argued on pragmatic and ethical grounds that success in the face of rapid climate change will require conservation organizations and practitioners to increase their focus on NCPs, further embrace transition, change, and certain novel biotic forms (species, communities), as well as slowing and reducing climate change by increasingly focusing on climate change mitigation. Over the last several decades, conservation foci have been slowly expanding beyond protected areas to include more human-influenced landscapes and a wider range of species (Figure 1). Simultaneously, the biodiversity challenge is being tackled with increasingly holistic and systemic tools. This expansion is well aligned with the changes that the conservation field will need to make to address climate change.

Some will argue that the expansion of the foci of conservation will promote shifting baselines and commodification of nature, both of which will only encourage further "deterioration" of nature. We do not advocate abandoning protected areas, forgoing all attempts to control invasive species, or ceasing management of all declining populations. These will still be important conservation strategies moving forward, not least because they are now part of our shared conservation history. We also acknowledge that including NCPs as conservation targets, fostering transitions, and accepting novel biotic entities potentially risks promoting, rather than reigning in, further human impacts. However, in addition to being critical for conserving biodiversity in the face of rapid climate change, these newer strategies have the potential to help foster a different human–nature relationship that offers the potential to bring us into a just and safe space for humanity (Raworth, 2017).

AUTHOR CONTRIBUTIONS

Martin A. Schlaepfer: Conceptualization (equal); writing – original draft (lead). **Joshua Lawler:** Conceptualization (equal); visualization (lead); writing – original draft (supporting); writing – review and editing (lead).

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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