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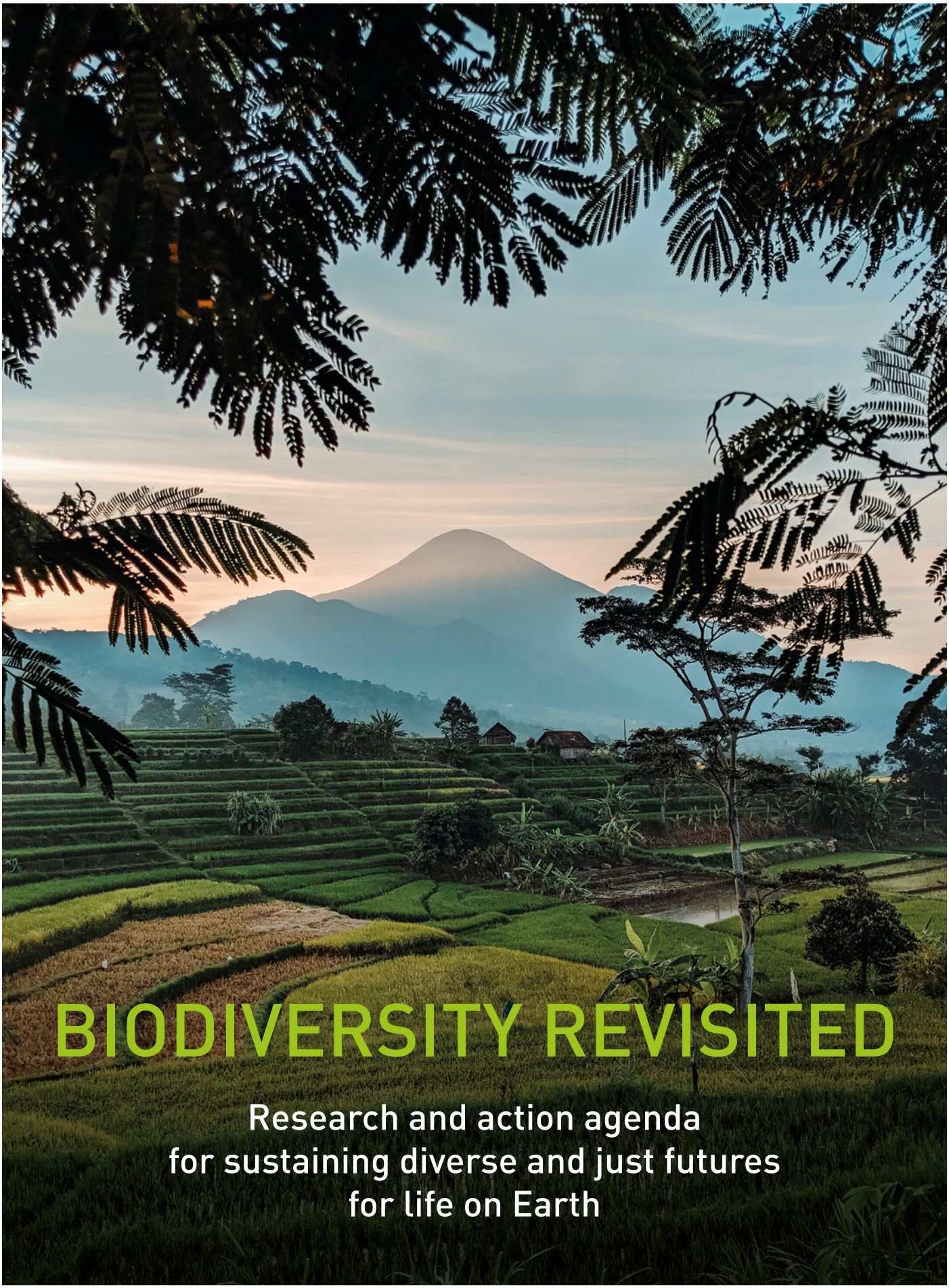

BIODIVERSITY REVISITED

Research and action agenda for sustaining diverse and just futures for life on Earth

Biodiversity Revisited is an initiative of the Luc Hoffmann Institute, in collaboration with WWF, Future Earth, ETH Zürich Department of Environmental Systems Science (ETH Zurich), University of Cambridge Conservation Research Institute (University of Cambridge), and the Centre for Biodiversity and Environment Research at University College London (UCL).

The initiative is governed by a Secretariat led by Melanie Ryan (Luc Hoffmann Institute), and a Steering Committee chaired by Adil Najam (Pardee School of Global Studies, Boston University) which includes Jon Hutton (Luc Hoffmann Institute), Neville Ash (UNEP-WCMC), Jaboury Ghazoul (ETH Zurich), Julia Jones (Bangor University), Amy Luers (Future Earth), Georgina Mace (UCL), Kristal Maze (SANParks), Chris Sandbrook (University of Cambridge), Rebecca Shaw, and Bhaskar Vira (University of Cambridge).

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INTRODUCTION

Life on Earth is facing severe challenges. Human action is leading to a deterioration in natural resources and ecosystems, and widespread declines in populations of wild species. This presents an existential threat to humanity by undermining the capacity of biodiversity to support human well-being. The Biodiversity Revisited research and action agenda (hereafter 'this agenda') calls for new ways of thinking and acting to address the urgent, complex, and interconnected challenges facing humanity. Recognising the severe degradation in the diversity of life on Earth that sustains humanity[1], this agenda seeks to catch a changing tide in the biodiversity research community focussed on a more integrated and transformative approach to research and action. For decades, biodiversity research has generated important knowledge about the trends, distribution, diversity, and abundance of genes, species, and ecosystems. However, the coupled nature of social-ecological systems requires policy and practice to be informed not only by the ecological, but also the social, cultural, political, and economic dimensions of biodiversity. This implies recognising that, through history, biodiversity science and conservation have not typically addressed those dimensions, resulting in inequality and injustice. The importance of including diverse voices and forms of knowledge in science and policy must be underscored. This changing tide can also be seen in calls by funding bodies, environmental assessments, and research leaders to embrace inter- and transdisciplinary approaches that engage with traditional and local knowledge, and place-based social and ecological contexts and needs.

This agenda responds to calls for more diverse and just approaches to biodiversity research and action. It is the culmination of a two-year dialogue that took place through the Biodiversity Revisited Initiative, involving six multi-day meetings attended by 300 people of 46 nationalities. The initiative had an explicit focus on elevating the voices of early career professionals and bringing together an interdisciplinary mix of expertise from across social and biophysical sciences, the humanities, and law. Biodiversity Revisited intended to contribute to the 2020 'super year for nature[1]. However, the COVID-19 pandemic dramatically altered plans for international meetings and agreements. At the same time, it has revealed the potential for rapid transformative change by other means, impacting both lives and livelihoods in unanticipated ways. This juncture presents an opportunity to pause and reflect, and to open up new trajectories of research and action, rather than defaulting to the status quo. It signals the potential for more collaborative and creative engagement between existing communities, policy frameworks, and institutions. During this moment of reflection, this agenda seeks to chart a pathway that overcomes the hierarchical, disciplinary, and institutional barriers that have so far constrained biodiversity research and action.

This agenda was written by and for those who have engaged with the Biodiversity Revisited Initiative and their networks, institutions, communities, and organisations. We hope it will inspire and catalyse collaborations that continue the Biodiversity Revisited journey. Beyond this nascent network, the agenda speaks to broader communities of researchers and practitioners from within academia, government, institutions, non-governmental

* In June, the International Union for Conservation of Nature (IUCN) was to harness the solution nature offers to global challenges at its World Conservation Congress. The congress was to be held from 7-15 January 2021. At the time of writing, it was unclear whether the UN General Assembly would hold its 75. Leader's Biodiversity Summit in September. In October, the United Nations Convention on Biological Diversity (CBD) was to set out its Post-2020 Biodiversity Framework, The meeting was postponed to an as yet unscheduled later date. The UN Framework Convention on Climate Change (UNFCCC) was to consider how climate change and biodiversity action can be mutually supportive at COP26 in November 2020, but the event was postponed to 1-12 November 2021. Meanwhile, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is conducting a scoping assessment on transformative change and options for achieving the 2050 vision for biodiversity.

organisations (NGOs) and research-funding organisations, as well as their partners, who collaborate with these entities doing research on, for, or about biodiversity and its connections to diverse and just futures for life on Earth.

Developing the Biodiversity Revisited research and action agenda

Through a series of reflective meetings and written provocations, Biodiversity Revisited sought to critically reflect on the current practice of biodiversity research and think creatively about the future. Background reviews were conducted on biodiversity concepts[2], narratives[3], science[4], governance[5], systems[6], and futures[7]. Critical assessments of the status quo were formulated and compiled in a collection of essays called *Seeds of Change*[8]. These essays cover a wide variety of issues and concepts that respond to the provocation:

> *Biodiversity has not, broadly speaking, proven to be a compelling object for sufficient action to halt the degradation of the diversity of life on Earth. At the same time, the fragmentation of research and policy efforts into overlapping agendas around biodiversity, climate, oceans, land degradation, sustainable development, and so on has prevented the conservation community from developing a holistic approach to sustaining the diversity of life on Earth. Furthermore, the predominant focus of research on describing biophysical change does not provide the necessary insight into the social and policy dynamics that would facilitate effective action.*

This problem statement will be unpacked in the following chapter. The background reviews and *Seeds of Change*[8] were the primary inputs to the Biodiversity Revisited Symposium. Held in Vienna in September 2019, the symposium was attended by 64 experts from a variety of career stages, disciplines, and nationalities. Subsequently, 22 of these experts coalesced to write this agenda through a collaborative process. In addition to online meetings, several of these authors met in February 2020 at The Rockefeller Foundation Bellagio Center, Italy, and then in Davos, Switzerland, at the World Biodiversity Forum to finalise the agenda.

The insights and reflections gathered throughout the Biodiversity Revisited Initiative pointed towards an overarching goal for the agenda: ***to contribute to sustaining diverse and just futures for life on Earth***. By charting a direction of travel for research, this document makes a modest step towards this goal. We hope this accommodates the aspirations of many biodiversity researchers, regardless of discipline. The agenda acknowledges and draws from the diversity of existing approaches, methods, and practices that are used to understand and examine the diversity of human and non-human life on Earth.

Agenda overview

Before turning to thematic chapters, we first set out the rationale behind revisiting approaches and priorities for biodiversity research and action through the Biodiversity Revisited Initiative. In revisiting biodiversity research and action, we articulate the perceived problems with the status quo of biodiversity research, and outline the 'Biodiversity Revisited Approach' that we have developed and adopted in this agenda. The substantive chapters then introduce four major themes of interlinked research. These themes emerged as important areas of inquiry during the Biodiversity Revisited Symposium and were refined by the authors during subsequent meetings. They offer cutting-edge areas of research and novel thinking that we deem essential to addressing the challenges of revisiting biodiversity.

We start with "Revisiting biodiversity narratives" (Chapter 1). Here, we address the growing recognition that dominant conceptualisations of biodiversity, human-nature relationships, and human well-being tend to

entrench narratives that separate humans, cultures, economies, and societies from nature and its biodiversity. Taking forward the narrative that humanity is part of biodiversity, and biodiversity is part of humanity, we then bring together “Anthropocene, biodiversity, and culture” (Chapter 2) to consider contextually relevant ways to reconfigure current practices. As the core drivers of biodiversity loss, economic and financial systems must be central to any effort to reconfigure current practices (Chapter 3: “Nature and economy”). These threads culminate in our response to the growing calls for transformative change to fundamentally re-shape relationships between human and non-human communities on Earth (Chapter 4: “Enabling transformative biodiversity research and change”). For each theme, we have identified broad questions that could be addressed through a range of approaches including basic research, which focuses on ‘blue sky’ or theoretical innovation; applied research, which involves active engagement in making change in the world; and anything in between. The questions are exemplary, indicating the kinds of inquiry that could be undertaken, and should not be viewed as the only important research under a theme. We conclude with an open invitation to begin anew, highlighting four cross-cutting priorities that emerged from the thematic chapters, and by making note of what researchers and practitioners can do in practical terms to take this agenda forward.

Conclusion

Following the agenda’s commitment to diversity and justice, we encourage readers to consider how the directions of travel identified here might be adapted and developed in response to their own contexts and concerns. We intentionally leave the research agenda as an open and iterative proposition, subject to further evolutionary, experimental, and emergent developments. While our agenda is intentionally distinct from existing agendas for biodiversity research and action[9–13], we recognise the need for many approaches to learn from and flourish alongside each other. We hope that this agenda can inform future scholarship and influence investment in research and action that generates positive changes in the way society thinks and acts to sustain diverse and just futures for life on Earth.

REVISITING BIODIVERSITY RESEARCH AND ACTION

Carina Wyborn, Jasper Montana, Nicole Kalas, Santiago Izquierdo Tort, Victoria Pilbeam

This chapter examines the rationale and approach of the Biodiversity Revisited agenda. We first consider what biodiversity is and why it might need to be revisited. We articulate the diverse, and potentially irreconcilable, answers to the question,'What is wrong with biodiversity?' and present the Biodiversity Revisited Approach, a roadmap for research that has diversity and justice at its heart.

What is 'biodiversity'?

The concept of biodiversity is anything but straightforward. Coined in the 1980s as a contraction of biological diversity, 'biodiversity' sought to replace notions such as 'nature' and 'natural heritage' with a more 'scientific concept'[14]. It commonly refers to the variety and variability within living organisms and is believed to contribute to the stability and resilience of living systems[15], while directly supporting human livelihoods and welfare, especially of the rural poor[16]. The Convention on Biological Diversity (CBD)[17] recognises biodiversity as encompassing all life on Earth, i.e. "the variability among all living organisms from all sources…and the ecological complexes of which they are part", including the "diversity within species, between species, and of ecosystems". The CBD defines conservation (in-situ) as "conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties"[18]. None of these definitions address measures and policies to conserve biodiversity, which have to date been piecemeal and largely ineffective[19]. As this chapter shows, this understanding of biodiversity is necessarily incomplete; however, it serves as a useful starting place for the Biodiversity Revisited Initiative.

To date, biophysical science research on biodiversity has largely focussed on specific aspects of biodiversity: species, habitats, and ecosystem traits and their interactions; prioritisation of geographical areas for conservation; taxonomic groups; and threatening processes[4]. Social science research primarily falls into two arenas: research 'for conservation' that provides insights into the social, political, and economic processes that could enhance the attainment of conservation goals, or 'on conservation': studies that investigate the conservation movement as a social phenomenon. This research can be critical of conservation, and unlike research 'for conservation', it does not explicitly seek to advance the mission of the movement[20]. Biodiversity research could be distilled by simply saying that 'biodiversity' research is concerned with non-human nature, and is therefore the remit of the biophysical sciences, while 'conservation' – a social and political process undertaken to conserve non-human nature – is the remit of the interdisciplinary social sciences. However, these distinctions create problematic boundaries whereby certain disciplines either in the natural or social sciences have authoritative knowledge, and the right to identify and define the legitimate object of concern. They also allow some disciplines to ignore the work of others, and consider their contributions to understanding biodiversity out of scope and irrelevant, when natural and social systems are in fact highly interconnected.

Of course, much scholarship already cuts across these boundaries (for example, scholarship on 'social-ecological systems'[21–23], 'ecosystem services'[24], 'nature's contributions to people'[25], the 'more-than-human'[26], 'socio-natures'[27], and 'nature-cultures'[28,29], as well as scholarship focussed on the intrinsic, instrumental, and relational values of nature[30], conviviality[31], and biocultural diversity[32]. All this research demonstrates the

interconnected character of social and natural systems and/or the role of nature in supporting humanity. It also expands the focus of 'biodiversity' beyond those who study the genes, species, and organisms that comprise natural systems, and enters it firmly into the terrain of the social sciences and humanities. There is now a wealth of research that acknowledges that biodiversity cannot be fully understood in isolation of the human societies that live alongside it, have shaped it, and are shaped by it – and this extends beyond questions of conservation. Indigenous peoples and local communities hold considerable knowledge about the environments they inhabit, a fact that is both deeply social and ecological in nature, as well as recognised to have value for its own sake. Even biodiversity that exists in the apparent absence of people, such as deep-sea sulphur-reducing bacteria and the snails that feed on them, can also be tied to humans through social efforts to understand, categorise, and protect them. This means that the remit of biodiversity research includes the social practices of scientific communities, the organisation of political communities, and everything in between. When we refer to biodiversity research, we do not rest on one 'true' definition of biodiversity. Instead, we acknowledge that biodiversity in research relies largely on operational definitions that are inevitably incomplete and selective. These definitions, which shape both research and policy priorities, shift over time, are socially constructed, and often normative. Privileging one particular concept or definition of biodiversity is an act with real consequences on who is empowered or marginalised, which forms of knowledge are legitimised, and what comes into view, be that organisms, entities, relationships, cultures, systems, structures, or processes. There is a need, therefore, to acknowledge this diversity. In enacting this agenda, interventions (research or other) should start by reflecting on what biodiversity is understood to be and how that understanding shapes the remit of the research and the practice that ensue, as well as which voices and perspectives are silenced by it, and how diverse forms of knowledge can be brought into the process.

And why does 'biodiversity' need to be 'revisited'?

Biodiversity Revisited began with a seemingly simple question: 'What is wrong with biodiversity?' The diverse responses to this question suggest that the apparent problem with biodiversity stems from multiple places: the effectiveness of responses put forward to halt the degradation of nature; the enterprise underpinning research and action on biodiversity; and the concept itself. These can be summarised as follows.

First, despite decades of scholarship on the components of biodiversity and why it is valued, biodiversity is reported to be declining at unprecedented rates[1,33]. This is confounding for many, given the decades of global conservation targets and mitigation efforts[17,34,35], National Biodiversity Strategies and Action Plans (NBSAPs)[35,] and millions of civil society members and conservation NGOs working to conserve biodiversity. Yet many localised conservation successes[36,37] have not addressed the systemic drivers of species extinction, habitat destruction, and unsustainable resource exploitation[38]. Given what is known about these systemic drivers, it can be difficult to understand why there has not been sufficient action to address them. A related question asks, 'Are our interventions working?' and requires interdisciplinary research to examine the impacts and efficacy of various interventions.

Second, research from the social and political sciences, the humanities, and law has examined how biodiversity interventions are received in local communities, which narratives are mobilised to justify them, how they are enacted in national or international law, and what their impacts might be on economies, cultures, people and nature. Much of this scholarship highlights mixed impacts on local communities[39–42], including dispossession from protected areas[43–46], constraints on economic development[42,47,48], forced changes to traditional agricultural practices[49,50], human wildlife-conflict[51,52], and many more. Conversely, other studies have shown that impoverished and marginalised communities, women, and Indigenous peoples bear a disproportionate burden of the consequences of the degradation of biodiversity[53,54]. Taken together, this work begs the question of why

the rights of local communities are often neglected in the design of biodiversity policies and interventions. This requires us to question the normative agenda underpinning biodiversity, and the role of social justice in efforts to sustain diverse and just futures for life on Earth.

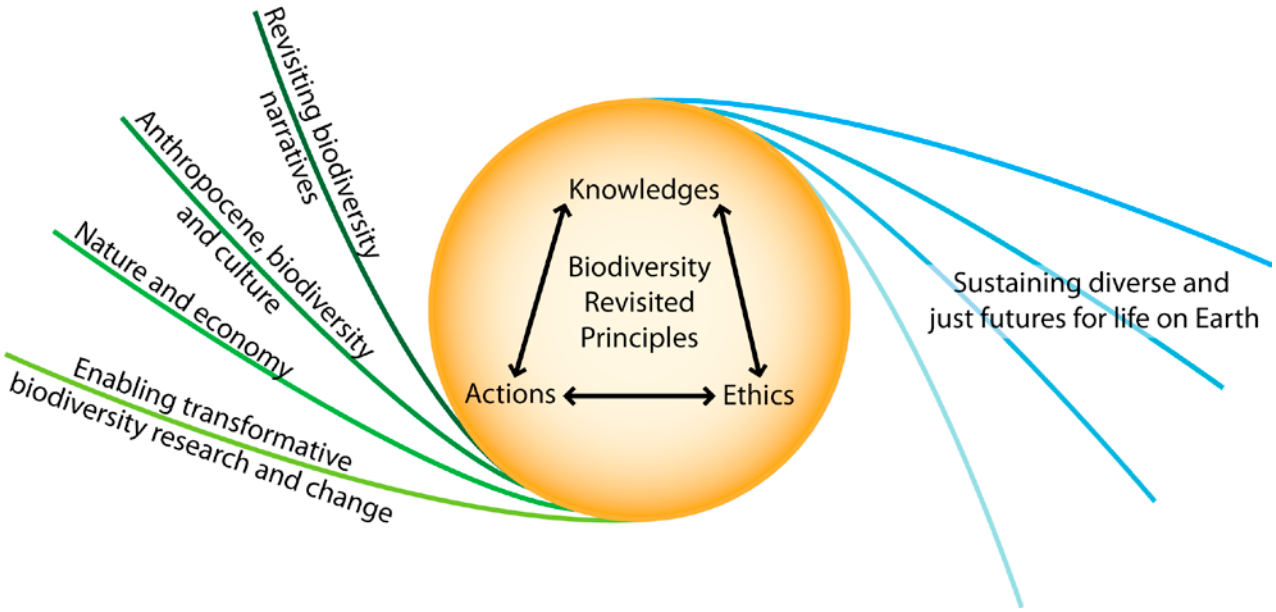
Third, Biodiversity Revisited also asked whether there is a more inherent problem with how 'biodiversity' is conceptualised, studied, and managed, which undermines action across various scales from the individual to the global community[2]. Previous research has shown, for example, that the concept is vague and the systems involved are complex[55]. The key drivers of biodiversity loss are poorly captured by metrics that measure progress on biodiversity conservation[56]; there remains a fundamental misalignment between research and policy about the major drivers of biodiversity loss[57], and a rudimentary understanding of what constitutes a dangerous degree of biodiversity loss[58]. The concept of biodiversity has become part of a worldview that separates humans from nature, fails to recognise that humans have historically shaped nature, (conceptually and materially) and that humans have also historically been shaped by nature[28,29]. There is also a growing recognition that research documenting the biophysical processes of change and degradation do not provide insights into the social and political processes that motivate behaviour changes that would ameliorate these threats[59]. Given these conceptual challenges, is 'biodiversity' even the right object of study? This leads to questions that interrogate the assumptions, methods, and methodologies guiding our research.

In short, there are potentially many things 'wrong' with biodiversity research and action. The Biodiversity Revisited Initiative sought to include these diverse and potentially irreconcilable views by expanding the scope of what has traditionally been considered core to 'biodiversity research'. In doing so, we created a platform where diverse types of knowledge and practice could co-create an enriched picture of the problem and possible solutions to address it. We developed an approach based on a set of principles and practices that could create a common focus across diverse perspectives, and could underpin research and action. Importantly, this approach is intended not only to provide new knowledge about the world, but also to mobilise actions and ethics that take account of the consequences of this knowledge on both people and the planet.

The Biodiversity Revisited Approach

The overarching goal of the Biodiversity Revisited agenda is to contribute to sustaining diverse and just futures for life on Earth (Figure 1). The agenda is centred on 'Life on Earth' because this concept is inclusive and avoids the boundaries that are too easily drawn around biodiversity. Here, we take 'Life on Earth' to encompass the myriad life forms, including people, their cultures, and their interactions. In doing so, the agenda promotes a holistic, integrated, collective, and cultural approach. Attention to *diversity* in the goal reflects a long-held normative position of biodiversity research focussed on the intrinsic value of the biotic diversity of organisms[60], but extends this to include humans and their cultures. Attention to *justice* recognises that historical and contemporary injustices shape the day-to-day lived reality of people all over the world. In particular, the distribution of costs and benefits of past and present conservation actions have been inequitable, and that any effort to strive for diverse and just futures for life on Earth must attend to and seek to rectify these injustices. Justice as an academic concept has a long history in philosophy and social sciences. Here, we understand environmental justice as a multidimensional concept encompassing the distribution of rights and responsibilities, costs, and benefits of biodiversity interventions (distributive justice), the role and ability of different stakeholders to contribute to decision-making (procedural justice), and the recognition of different histories and identities[61–63]. Given the focus on all life on Earth, we draw on concepts of justice that include human and non-human communities[64].

Figure 1. *The Biodiversity Revisited Approach*



The Biodiversity Revisited Approach adopts a way of seeing the world that recognises that the concepts and definitions we use – our *knowledges* – are connected to the ways in which we respond to social-ecological changes – our *actions* – and to the value systems that we draw upon to do so – our *ethics*. Simply put, we suggest that it is not possible to think about action on or for biodiversity without drawing on a range of knowledges that inform what might be done, and how, and that actions are situated within a set of ethics that guide judgements about what is right, what is appropriate, and what is desirable. These ethics and actions are guided by how an individual comes to know the world and what is known about it. This way of seeing the world underpins how we approached the four themes of the agenda and the priority research areas we identified. As such, the agenda touches on aspects of knowledges, actions, and ethics throughout, not in a mechanistic way, but rather as part of an inherent awareness of the interconnections between these domains, which has coloured how we approach the subject matter and made judgements on what is important.

Biodiversity Revisited recognises that conservation as action, knowledge, and as an ethic is never neutral. As such, nine principles (Table 1) shape how we approach the complex and contested problems inherent in the agenda's goal. These principles were developed iteratively throughout the Biodiversity Revisited Initiative, and informed the co-design of this agenda. We acknowledge that many of these principles are related and reinforcing, while some spark important tensions. They are also ideals, which must be considered and enacted in the particular contexts they are to be applied. This may mean that some principles are more relevant to some initiatives than others, and that they will be interpreted differently across contexts. We suggest that these principles are broadly applicable to research and action for biodiversity and offer them as a starting point for those wishing to contribute to the Biodiversity Revisited agenda.

Table 1. Principles underpinning Biodiversity Revisited research and action

1. Pluralist	Explicitly recognises that there are multiple ways of knowing, doing, and valuing life on Earth. Pluralism emphasises the benefit that comes from this diversity of thought rather than forcing consensus or privileging dominant approaches[1,65–67].
2. Reflexive	Emphasises the value of being open-minded and aware of our own assumptions and biases, to engage in ongoing learning and improvement. Reflexivity enables flexibility, adaptation, and innovation, and – if required – transformation, in the face of change[66,68].
3. Humble	Humility is vital in urgent and uncertain times, as it compels us to listen and to consider the ethical implications of actions, and to cultivate an awareness of the limitations of our knowledge and actions in a globally connected and complex world[69,70].
4. Adaptive	Adaptability acknowledges that change is constant, unexpected, and often contested, and therefore enhances the ability to respond to changing conditions as they emerge[71,72].
5. Pragmatic	Pragmatism emphasises a middle ground where knowledge is gained through practical experience and adjusted through observation, experimentation, and conscious reflection on existing knowledge, habits, and beliefs[73,74].
6. Inclusive	Inclusivity fosters meaningful participation of new or previously unacknowledged and/or underrepresented human and non-human voices. Inclusivity values diverse contributions to change, and shared leadership in sustained and equitable outcomes[65,68,75].
7. Fair	A commitment to fairness is rooted in solidarity with and response-ability towards the diversity of human and non-human life on Earth now and in the future. This requires us to actively work against sources of injustice in research and practice[76,77].
8. Innovative	Innovation fosters creativity, embraces experimentation, and removes unnecessary barriers to exchanging and developing new ideas. It recognises learning beyond academic institutions, to facilitate open source solutions and knowledge exchange[77].
9. Accountable	Accountability, includes responsibility for, is sensitive to, and is explicit about the (un) intended implications throughout the process of research and practice. It emphasises the need for a shared liability and commitment[77].

The principles underpinning Biodiversity Revisited are not, on their own, new. Indeed, they stem from a range of research and policy traditions that foreground the ethical dimensions of research. A number of these principles are increasingly emphasised by research programmes and funding bodies, such as the European Union's *Code of Conduct of Research Integrity*[76], the *Guiding Principles of Forest Landscape Restoration*[72], and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)[65]. However, there are opportunities to improve where and how these principles are enacted by those in the biodiversity arena (i.e. researchers, policymakers, practitioners, NGOs, businesses, funders, etc.). This can be done through sharing research and experience that examines the extent to which specific methods and approaches contribute to enacting these principles.

There is also a need to confront the limitations of the status quo, including vested interests, power dimensions, institutional inertia, and a legacy of doing biodiversity and conservation in 'a certain way'. Misaligned incentive structures, short-term funding cycles, overly simplistic or prescriptive investments and interventions, and narrow and instrumental forms of impact evaluation all undermine efforts to foster more effective collaborations across sectors and scales. The application of these principles can be facilitated by using inclusive methods and approaches that bridge different scientific, local, and Indigenous knowledge systems and values[51,52]. These can include transdisciplinary and co-production approaches, companion modelling and participatory scenario analysis, citizen science, living-lab approaches, art-science collaborations, or co-management institutions[78–84]. Researchers and practitioners have used these methods to create collaborative knowledge production processes and facilitate discussion and learning across knowledge systems, values and perspectives. The efficacy of these methods in enabling inclusive, legitimate, and transformative outcomes depends on the extent to which they enable dialogue and learning[85–87]. To this end, reflexive monitoring, narrative analysis, and other assessment methods can track the quality of the collaborative approaches that create opportunities to reflect, learn, and adapt[88,89].

Conclusion

The Biodiversity Revisited Initiative established a set of principles and a normative goal to guide the design and implementation of research and action, while recognising that the enactment of such ideals will always be partial. We suggest that, when conducting research that contributes to this agenda, individuals and collaborations should adopt these principles and then document and periodically reflect on the assumptions, limitations, contradictions, and synergies that emerge from their use, or lack thereof, so we can learn from these experiences, and share and improve our research and practice. These principles remind us that the themes and priorities set out in this agenda document are not – and never could be – all encompassing, nor are they the only areas for fruitful inquiry in the service of the agenda's goal. As such, we welcome other areas of inquiry related to biodiversity and justice for life on Earth. We encourage biodiversity researchers and conservation practitioners to consider the challenges articulated in the agenda and to reflect upon the extent to which the four themes and research priorities might be applicable to their contexts and concerns. While the themes and priorities will change over time, the principles may be an enduring way to connect the disparate work being conducted by those seeking to contribute to the Biodiversity Revisited agenda around the world. The interconnections between knowledges, actions, and ethics present a way of seeing the world that transcends themes and priorities, and could be applied in many more domains seeking to sustain diverse and just futures for life on Earth.

1. Revisiting biodiversity narratives

Elena Louder, Tim Forsyth, Gretchen Henderson, Emmanuel Nuesiri

Narratives can be powerful, emotive stories that incentivise collective action. Narratives frame an issue, determine which actors are included or excluded, define cause and effect, assign culpability, and prescribe action. Most discussions about biodiversity are organised into, or around, narratives. For example, an ecocentric biodiversity narrative that suggests that humans should set aside untouched land because it has intrinsic value can be seen in the Half Earth campaign to conserve 50% of the Earth's surface. Another example is the anthropocentric narrative – the storyline that humans must save nature because it underpins our economies and societies. This can also be seen in the New Deal for Nature campaign, whose advocates argue that humans must conserve nature because the goods and services it provides to humans are worth trillions of dollars annually[1]. A third high-profile narrative tells the story that human impact on Earth is so pervasive and so profound that nature as independent and separate from, and un-impacted by humans, no longer exists: we live in the geologic epoch of the Anthropocene[90]. These narratives are not necessarily mutually exclusive; however, each foreground and emphasise certain elements over others.

Narratives are not neutral descriptions of reality: they selectively frame a problem and have real implications on what sort of action should be taken. Narratives can convey specific causal beliefs, while also reflecting underlying worldviews. In both the ecocentric and anthropocentric narratives, humans and nature are conceived of as separate, interacting categories. In other perspectives (for example, many Indigenous worldviews), humans and nature are conceived of as inseparable, resulting in a different narrative and different action. The analysis of narratives can identify the underlying beliefs and worldviews that inform strategies and courses of action, as well as the shortcomings of these narratives. By questioning narratives, we can see beyond popular convention, and look more deeply into the values, histories, knowledge systems, and worldviews that shape how we see biodiversity and human-nature relationships, and gain insight into how biodiversity research and action can be more diverse, effective, and just.

Context

Scholars from a wide range of disciplines explore the significance of narratives on scales from individual decisions to collective policy- and decision-making. Cognitive science scholars suggest that human brains quite literally process the world through narratives[91]. Literary and cultural studies explore ways that biodiversity shapes stories that communities tell about themselves: narratives of origins, evolving identities, and possible futures[64]. From development studies and policy analysis, scholars show how narratives determine the ways that problems are defined, which actors should do what, and which solutions are desirable[92,93] (see [3] for a more detailed review). As such, narratives can be a powerful tool to shape the world and mobilise individuals and groups. However, once entrenched and embedded, narratives can be hard to supplant, even in the face of contradictory evidence[94]. Despite what we might like to think, from individuals to multilateral institutions, we act on the stories we tell ourselves and each other; emotionally compelling narratives drive much of human action[95]. So, critical analysis of dominant and marginalised narratives is key to understanding our current ecological crisis, and how we move forward to sustain life on Earth.

As biodiversity continues to decline, many voices from the biodiversity community explicitly call for a 'new narrative'. Bird Life International, for example, asks for 'new narratives' and even provides a toolkit on 'reframing nature' to help people think about the words they use to discuss nature[96]. Calls for new narratives may come

from distinct academic and practical perspectives but they share a common thread: a growing sense that the biodiversity stories of old are stale and have failed to achieve the intended goals. Moreover, many interventions to conserve biodiversity have resulted in unintended negative social impacts. For these reasons, biodiversity researchers and practitioners need to think critically about the narratives they deploy, how those narratives sit amongst alternative narratives, and which narratives will be needed going forward.

Focusing research and action for the next five years

We have identified three core areas on which to focus research on narratives over the next five years.

1. Empirical examinations of the narratives that underpin destructive systems

Research should continue to examine what makes current, dominant narratives authoritative and stable despite the existence of counter-evidence. Such critical analysis can unpack the political and cultural implications of accounts that ostensibly present facts and evidence, and shed light on both origins and outcomes of existing narratives. Research should examine narratives that perpetuate unjust and unsustainable outcomes, focus on the distribution of costs and benefits of current systems, and make explicit political implications and power relations that may be naturalised in narrative. Research should work to understand how current beliefs about biodiversity – whether globally, within specific countries, or on social networks – may be driven by narratives that unhelpfully reduce and simplify debate. Researchers could examine:

- Why do some narratives become authoritative, while others are silenced or deliberately ignored, and what are the results?

2. Bringing diverse approaches to narrative together to enrich biodiversity research

Research should use narrative as an approach to bring diverse knowledge systems and disciplines into productive discussions. Narrative approaches focus on understanding, analysing, and making explicit the narratives that underpin thought and action. Such approaches could enable researchers to proceed with humility and awareness of the ways in which all narratives are partial, situated, and contingent – including narratives deployed by the research community. Rather than assume that 'we', the research community, have the answers, researchers should learn from and listen to existing narratives, and ones that have not traditionally been considered in biodiversity research – whether from distinct knowledge systems, worldviews, or disciplines. This may help biodiversity researchers engage with Indigenous and local knowledge systems, and those within the arts, humanities, psychology, and cognitive science. Narrative approaches can complement objectivist scientific understandings of biodiversity with those entangled with human emotion, meaning, and culture. We call for research that looks at:

- How can biodiversity research listen to and learn from narratives that have been traditionally outside biodiversity research?

3. Exploring the role of narrative in imagining alternative futures and enabling transformative change

Narrative is an important means through which to engage more creative and emotive ways of imagining the future. Researchers increasingly suggest the need to envision radically different and positive futures through participatory processes that overcome the limitations of technocratic approaches[97]. Scholars claim that narrative is a powerful tool in this context, as it can foster understanding of complexity, systemic interactions, and uncertainty that are inherent to engaging with the future in ways that can effectively motivate action and change behaviour[98]. Such critical engagement with narrative is essential for imagining different ways of seeing, doing, and being. The Anthropocene concept, which suggests that there is no 'nature' untouched by humans, provides a useful anchor to exploring different narratives that may emerge where humans and nature are seen

as mutually dependent and intertwined, and opens up possibilities to story a hopeful future despite a deeply altered planet. Researchers should examine:

- How can narratives and narrative approaches be used to foster productive engagement with contested and uncertain futures?

Towards narratives of and for (ex)change

Future biodiversity research should take narratives seriously, not treating them as stories that innocently describe the world, but rather, as those that actively shape it and delimit what is possible and thinkable. Future research can begin through using narrative as a critical analytical tool for deconstruction, illuminating how received wisdom, or storylines about biodiversity, often simplify complex sets of drivers and experiences, and shape how we understand systems and actors. Transformative change may require questioning the very categories that comprise biodiversity narratives – such as humans, nature, native species, and objective scientific knowledge – but this cannot begin without awareness of our own narratives.

Narratives can also serve as a way to think about 'unprecedented listening' – where collaborations, or society as a whole think together, listen carefully, and generate new possibilities[98]. This can be brought about by questioning which knowledge sources hold authority, and what other knowledges and options these close down. We suggest abandoning searches for *the* narrative in favour of a narrative of narratives. Narratives can cultivate change if equitable spaces for exchange are created to enable narrators to reflect on their own positions and narratives. By steering research towards listening to myriad narratives, some of which have been silenced, marginalised, or excluded from biodiversity conservation, we will make biodiversity knowledge more diverse, inclusive, and ultimately, more effective. For example, there is a growing body of narratives that critique the underlying colonial/capitalist worldviews[99] of many conservation interventions, and these could be more meaningfully listened to in biodiversity practice. Similarly, by drawing attention to how humans actually behave and act in the world, narrative can recast social sciences, humanities, arts, and cognitive science as essential biodiversity knowledges, and draw explicit links between biodiversity, human emotion, and action.

We argue that the entire biodiversity research community should consider narratives more carefully. For some people this will mean drawing from multiple disciplines to analyse explicitly how narratives function, and what work they accomplish. For example, recent studies on climate narratives show how building climate change adaptation measures on local narratives of change may result in more meaningful adaptation, rather than those based purely on biophysical climate science. In one case study, Krauß[100] details climate risk management measures built from local narratives where climate change was framed as a problem of a wasteful, stressful way of life, rather than a techno-economical problem of carbon reduction. Measures were then built upon local narratives of restoring place-based land uses and agricultural practices, which blended carbon reduction with cultural restoration. This work illustrates how different narratives lead to different outcomes; more of this type of narrative analysis is needed going forward. For others, engaging with narrative will be more implicit – simply being aware that all research perpetuates narratives that are partial and situated, and anchor a particular way of knowing and being in the world. Deep reflection on narratives may also reveal why calls from within the biodiversity community for superficial changes in messaging may not result in transformative change.

Conclusion

Narratives are an important part of communicating and incentivising action among researchers, policymakers, funders, practitioners, and local communities. However, narratives also simplify complexity, and while they are important mobilisation tools, they must be used cautiously and with humility. Revisiting biodiversity

requires seeing how narratives underlie the ways that we understand biodiversity, and how we strive for social political change. Moreover, revisiting biodiversity through narratives means acknowledging who is narrating and facilitating equitable spaces for exchange, and respect the power of listening. We must make room for narratives that have been silenced or excluded from biodiversity conservation (for example, those focussed on decolonisation), draw insights from diverse disciplines, and find conditions that enable new, fairer, and more life sustaining narratives.

2. Anthropocene, biodiversity, and culture

Sarah Clement, Madhurya Balan, Anna Deplazes-Zemp, Michelle Lim, Maria Jose Martinez Harms, Jasper Montana, Sylvia Wood

The "Anthropocene, biodiversity, and culture" theme focuses on interdisciplinary research that responds to unprecedented human impacts on the biosphere, bringing planetary change research to the challenge of achieving just and sustainable futures. Most of today's landscapes, cultures, and biodiversity have been shaped through place-based co-evolution of humans and non-human species (for example,[13,101]). This diversity is intimately linked (linguistically, culturally, biologically) and mutually sustaining[102]. The world's centres of biological diversity are some of the most linguistically diverse, and the loss of biodiversity, cultural, and linguistic diversity often co-occurs[103]. Further, growing evidence globally emphasises the value of Indigenous peoples, knowledge systems, lands, and practices to maintaining intact biodiverse ecosystems[104]. Yet, the value of culture in biodiversity conservation is underexplored. Participation, resource distribution and cultural recognition matter to biodiversity research and action, and raise important questions about justice[105]. We suggest that these factors are central to understanding the relationship between biodiversity and diverse communities around the world, including research and policy communities.

This theme connects the Anthropocene concept to scholarship that explores relationships between biodiversity and culture. The Anthropocene provides a framing for thinking about sustainable futures because it makes the prominent place of humans in nature explicit and draws attention to the novel scale, scope, and source of recent social and ecological change[7]. Although the Anthropocene is often treated as a unifying concept for the whole planet, these changes will unfold in diverse ways, shaped by place-based biodiversity and culture. The concept has been critiqued for evoking a 'unitary human' that conceals responsibility and accountability for both past change and future remedies/directions (example[106]). Rather than focusing on how humans might navigate towards a shared global trajectory in the Anthropocene, this chapter suggests a plural understanding of Anthropocene, biodiversity, and culture. We find that a variety of disciplinary perspectives and framings of human-nature relationships provide a more productive lens for shaping the future of the planet.

The vibrancy and diversity of life on Earth stems from multiple, linked, co-evolving social-ecological systems. The Anthropocene is a global challenge; however, its causes and solutions are not monolithic and therefore require a diversity of context-driven approaches. The unprecedented and rapid pace of the transition further complicates efforts to confront the challenges of the Anthropocene. Uncertainty is amplified, as there is no analogous historic state from which to draw lessons[107]. This epoch therefore presents challenges for *all* knowledge systems. Embracing plural understandings of nature and culture cannot fully resolve this uncertainty and complexity. However, in this era of rapid environmental and social change, diversity provides important insights, directing us to promising pathways towards more just, sustainable, and diverse futures.

Context

Mounting scientific evidence suggests that humanity is the significant driver of the widespread changes to Earth's systems. If left unchecked, these future projections for both social and ecological systems are grim. Some changes could be irreversible, adding to the urgency needed to redress destructive human impacts. As humans have both agency and responsibility to address these impacts, new directions must be purposefully co-created through interdisciplinary research and action. Complex, globally interconnected social, economic, and ecological systems mean that biodiversity and culture are increasingly impacted by distant actors and

actions (for example, telecoupling)[108–110]. Human culture has shaped almost all of Earth's biodiversity, through consumption, pollution, protection, scientific assessment and beyond. 95% of the Earth's land area and 87% of the marine environment show evidence of human impact[111,112]. These impacts are driven by existing approaches, values, and underlying cultural assumptions. As such, research at the interface of biodiversity and culture is therefore a productive focal point for sustaining diverse and just futures.

We note the wealth of research and research agendas on the 'Great Acceleration' and the Anthropocene[113] that characterise the dynamics of recent environmental change[9–13]. The Anthropocene concept has catalysed research with transformative potential across a range of disciplines[7,114,115]. However, this potential will be limited if a simplified narrative of the Anthropocene is promoted that does not take account of diversity, equity, responsibility, and the fundamental economic drivers of degradation in social-ecological systems. Following others who note the positive potential of the Anthropocene concept, we aim to advance research that examines what constitutes a 'good Anthropocene' or, at the very least, better versions of the Anthropocene[116,117], which promote just, prosperous and ecologically diverse futures[116].

The contributions of research to just and sustainable futures must account for the fact that biocultural diversity is being lost as land use, diets, and biotic communities are homogenised[118] through globalisation, urbanisation, and standardisation[119]. In doing so, we acknowledge the need to invite a more comprehensive understanding of what might constitute 'desirable' futures for both ecosystems and cultures in this new epoch[120]. We call for forward-looking research to consider contextually-appropriate innovations in the relationships between biodiversity and culture, rather than focusing on how to revert to some ideal past state.

Focusing research and action for the next five years

We have identified five core areas on which to focus research on the Anthropocene, biodiversity and culture over the next five years.

1. Cultivating deeper understanding of interconnected social-ecological systems

Research that seeks to understand the world's social-ecological systems (their origins, composition, functions, and dynamics) continues to be fundamental. Such research includes understanding people and cultures, both in terms of their co-evolution with biodiversity, as well as their values and aspirations. Together, these can help to better understand why communities choose to enhance some aspects of their environments and degrade others, and how the reciprocal impacts of biodiversity shape cultural norms, values, and actions. We call for continued research that examines:

- What physical, psychological, and philosophical connections and conditions are important to shaping human actions and values towards nature in different places?

2. Re-considering human agency, accountability, and responsibility in shaping the Anthropocene

Justice is a core component of this theme. Research is therefore needed to explore the historical and future distribution of human agency, accountability, and responsibility with respect to shaping the Anthropocene. Examining these elements should extend to the many diverse communities that interact with the living world, including research and policy communities. Scale must be considered, as agency, accountability and responsibility differ across scales and governance arrangements for biodiversity[5]. This research should be both forward looking and retrospective, focusing on different conceptualisations of the future that enable and empower actions that foster more just, diverse and sustainable futures. We call for research that examines:

- How can governance and management be revised to better account for uncertain social-ecological futures and acknowledge differential agency, accountability, and responsibility for change?

3. Developing solutions that embrace appropriate context-based knowledge and multiple values

Research is needed to identify and develop solutions to the biodiversity crisis that embrace appropriate context-based knowledge and multiple values. This research should consider an array of possible change mechanisms, such as emerging technologies, social activism, alternative economies, urbanisation, and changing livelihoods, and in doing so consider their positive and negative impacts in shaping social-ecological systems. Here, context-based knowledge incorporates knowledge that is local in scale, as well as knowledge that is relevant and appropriate to the context in which it is to be applied. Global knowledge, for example, is contextual when applied to support some kinds of collective action at international scales, such as global trends in deforestation to support multilateral agreements. Values will also differ within and across locations, particularly given the increasingly telecoupled nature of social-ecological relationships. It is therefore important to consider what scale is relevant in each context, and who gets to decide this (see research area 4 below). We therefore encourage research that explores:

- What mechanisms of change lead us towards more just, prosperous, and ecologically diverse futures?

4. Balancing the needs for context-driven responses to widespread global challenges

One paradox of the Anthropocene is that the challenges are global, but many of the solutions must necessarily be at smaller scales and reflective of context-specific factors if they are to be effective. There is recognised value in research and policy arrangements that explore global mechanisms for responding to degradation in social-ecological systems, such as intergovernmental negotiations and scientific assessments. However, the place-based character of culture and biodiversity means that a one-size-fits-all approach is likely to be both ineffective and unethical. Similarly, there is a need to acknowledge the operational challenge of fostering actions that involve everyone everywhere, while taking account of all values at all times. Recognising this tension, we invite research that examines:

- What modes of social and political organisation might balance contextualised concerns that promote and support difference and desires for cooperation and coordinated responses that span sites and scales?

5. Strengthening interdisciplinary collaborations to facilitate ‘good Anthropocenes’

The urgency and complexity of this theme means that ‘business-as-usual’, including for research, is no longer viable. There is a need for research that challenges current practices, ethics, and paradigms to shape ‘good Anthropocenes’. There is growing recognition of the need to engage multiple perspectives and values in biodiversity research. This includes broadening understanding and experience with decolonised and localised systems of knowledge, but also rethinking some of the knowledge foundations that underpin education, science, economics, politics, law, and governance to open up more diverse and just futures for life on Earth. This could include experimenting with approaches, such as citizen science to study biocultural co-evolution, and other innovative approaches to integrate insights from research into management. We call for new research to consider:

- How can biodiversity researchers be empowered and enabled to embrace new ways of working that promote a more sustainable and just relationship with the planet?

Towards just, sustainable, and diverse Anthropocenes

The three interconnected elements of this theme (the Anthropocene, biodiversity, and culture) are intended to challenge researchers and other communities to explore the mix of visions and worldviews that can contribute to just, sustainable, and diverse Anthropocenes. Although many of the dynamics of social-ecological systems are out of our control, there are ways to influence their trajectory. This includes generating new understandings of what the Anthropocene means, beyond grim predictions of global change.

All forms of biodiversity and conservation research must engage with broader scholarship, knowledge systems, reflective processes, and practical decisions, while being explicit about the underlying assumptions and values that researchers bring to their research. One common assumption of research is that more knowledge of a problem leads to more meaningful action to respond to it. However, we suggest that there is a need to move beyond merely focusing on education and awareness about the problem of biodiversity loss, and instead harness new knowledge, narratives, and pathways for transformative collective action with new partnerships. This could involve incorporating Indigenous and local knowledge into research, as well as bridging different knowledge systems together. As part of this, we need to understand the links between biological and cultural diversity. To do so, we must account for major processes, such as colonisation, industrialisation, globalisation, and financialisation. The negative and positive influences of these processes on social-ecological systems remain deeply contested, but more explicit attention must be given to the implications they have for past, present, and future agency, accountability, and responsibility. Such research should also rethink how we restore and renew degraded spaces to provide new habitats and resources, and also opportunities to rebuild human-nature relationships to promote biocultural diversity.

Conclusion

The questions posed in the “Anthropocene, biodiversity, and culture” theme call for greater understanding of complex, interconnected human and biophysical changes occurring across our planet, and how these understandings shape our actions. This theme builds on the preceding “Revisiting biodiversity narratives” discussion by asking how we harness the power of underlying stories about diverse cultures and biodiversity in its many forms to shape and motivate action for desirable futures in the Anthropocene. It feeds into the “Nature and economy” theme that follows by setting the scene for considering the key drivers of the degradation of natures and cultures, and provides context for “Enabling transformative biodiversity research and change” within and beyond academic and research communities.

3. Nature and economy

Natalie Knowles, Josie Chambers, Lucas Christel, Esther Turnhout

Over the past 50 years, the global economy has grown four-fold and global trade has grown ten-fold. The extant patterns of production, trade, finance, and consumption that drive this growth are some of the primary drivers of biodiversity loss[1]. Continued growth will intensify these drivers, and meaning fundamental changes in the global economy are required[1]. As Covid-19 has disrupted global economies on an unprecedented scale, it is an important moment in time to reflect on the failings of current economic logic, rethink economic narratives, and rebuild economic systems that are not only more just and sustainable, but also more resilient. In doing this, researchers, practitioners, and society must take the drivers of loss and the links between biodiversity and the economy much more seriously than they have before.

Context

Backed by the logic and language of economic growth, current economic models and paradigms commonly prioritise particular interests over collective social-ecological well-being, leading to environmental degradation and social inequalities[121]. Modernist concepts of nature and society that separate nature and its biodiversity from society and its economy have enabled a dominant way of valuing nature as a resource or capital for human production, consumption, or exchange. As a result, biodiversity conservation is often construed as contrary to human development and well-being, suggesting that the best way to conserve nature is by valuing it in the economy and submitting it to market and exchange logics[122–124]. To transform the way society conserves biodiversity, we must transform the global economic system together with underlying narratives about how humans and biodiversity relate to and depend on each other. In thinking more broadly about nature and economy, we aim to promote research and action that challenge existing economic models, explore new financial responses to the biodiversity crisis, and catalyse innovative ways of understanding and transforming global socio-ecological systems.

Focusing research and action for the next five years

We have identified three core areas on which to focus research on nature and economy over the next five years.

1. Challenging 'business-as-usual'

Within existing economic paradigms and models, nature and economy have been framed as separate, leading to a sectoral approach to conservation that has largely left economic growth unchecked with little or no consideration for ecological implications. Agricultural subsidies, infrastructure development projects, and tax policies and havens continue to be justified primarily on economic grounds, with potential biodiversity impacts obscured from view[125]. Biodiversity researchers and practitioners currently operate in a world where subsidies for oil, gas, and agriculture are much larger than global government conservation funding[126].

Common approaches to researching economy and biodiversity have often further reinforced their separation by ignoring how they impact each other. For example, studies may examine how corporate social responsibility affects only profitability, or how effectively protected areas conserve biodiversity with little regard for social impacts. Emergent research increasingly questions these separate actors and frames, emphasising the importance of sustainability for the functioning of the economy[127], and revealing the broader ecological and

social considerations of dominant economic policies, such as the *EU Common Agricultural Policy*[128]. Yet, despite growing evidence of the negative ecological effects of dominant economic practices, political and practical change has proven difficult. To better understand the processes and powers that reinforce the ongoing separation of biodiversity and economics in policy and practice, space is needed for researchers and practitioners across diverse social-ecological fields to collectively investigate the following questions:

- What factors (for example, actors, beliefs, values, logics, interests, discourses, institutions, and practices) underlie current economic paradigms and practices, how do they reinforce a separation of nature-economy relations, and how can these factors be reshaped?
- What are the effects of dominant economic policies and practices (such as trade, finance, risk, tax, insurance, and industry) on society, biodiversity, and nature, and how can they be robustly documented and communicated?

2. Exploring incremental change

While there has been a growth in initiatives seeking to prioritise biodiversity in response to the failings of mainstream economic practices, they do so without dramatically changing existing economic systems[123]. Diverse approaches and tools have emerged to give nature increased economic value to incentivise environmental protection, like 'natural capital', 'payments for ecosystem services', 'REDD+', and most recently, 'natural climate solutions'[122]. On the demand side, there have been efforts to nudge consumer behaviour towards sustainable alternatives. These initiatives aim to make sustainability more visible and they use market logics to incentivise sustainable production, trade, and consumption[123]. To this end, they make use of specific metrics and standards to measure sustainability impacts, and monetary valuation to highlight the economic value of nature and biodiversity[122].

Despite widespread positive claims by proponents of these interventions and much research examining how and whether they function according to particular measures of 'success', their broader and long-term implications remain poorly understood[124,129]. In addition, many researchers are beginning to emphasise how this thinking replicates and reinforces the logics, narratives, and inequalities prevalent in the dominant economic systems that have produced systemic environmental problems in the first place. Research is needed to critically explore existing incremental approaches by improving methods to monitor and understand the effectiveness of these proposed solutions from a long-term and integrated perspective, including investigating leakages, substitutions, impacts across scales, and fairness. We call for a critical examination of the following question:

- How can incremental efforts support (rather than inhibit) transformative efforts towards just, equitable, and sustainable nature-economy relations?

3. Catalysing fundamental change

This approach seeks to transform nature-economy relations to become more balanced, sustainable, and ethical. Several alternative proposals have emerged to reshape the global economic system to value nature using alternative and pluralistic narratives (for example, post-consumerism, economies of sufficiency, degrowth, universal basic services)[130–132]. Fundamental changes to nature-economy relationships require large-scale, systemic shifts in knowledge, values, and beliefs, patterns of social behaviour, and enabling institutional environments across multilevel governance and management regimes. However, they also necessitate legitimate and pluralistic processes to negotiate different values and determine pathways for change.

These radical initiatives require more clarification over how they work in practice and the long-term implications of what is actually 'transformed'. It remains unclear which processes and actors are needed to truly reshape global nature-economy relationships. Research in this area has often been highly theoretical and removed from

practice. Existing efforts such as the *Genuine Progress Indicator*, *Happiness Index* or *Degrowth* communities have only been implemented at small scales, making it difficult to conceptualise how such efforts could be enabled through simultaneous action at broader scales and contexts. Despite assumptions that transformative initiatives produce positive impacts, a lack of applied research leaves their potential outcomes unclear. Research should be conducted in partnership with a wide range of actors, including those considered to be 'non-experts' in biodiversity and economy, to explore how relations between nature and society can be transformed and address the following questions:

- How can diverse, emergent approaches to transforming economies at multiple scales be harnessed to form broader narratives and strategies that counter dominant economic logics and nature-economy relations?
- How can research engage diverse actors from business and society in joint efforts to understand and reshape nature-economy relations, and what are the risks and ethical implications of such engagements?

Towards sustainable and just economies

Despite overwhelming evidence of the current economic system's negative social and ecological effects, powerful forces with extensive resources reinforce 'business-as-usual' approaches. The shift of nature-economy relationships to more sustainable and just modes of production and consumption will face significant challenges. Each approach, in challenging 'business-as-usual', exploring incremental change, and catalysing fundamental change, has the potential to transform nature-economy relations across multiple scales and timeframes. The boundaries between these approaches overlap, highlighting that change requires effectively critiquing and improving practice and research within the dominant economic system, while at the same time offering viable alternatives to both incrementally and fundamentally transform systems.

Ultimately, transformation will require us to change the dominant narratives and metrics of nature and biodiversity, as well as human-nature relations, economies, and human well-being. By revisiting nature-economy relationships, research can speak to a wider audience and propose dialogues with the private sector, governments, NGOs, grassroots groups, local communities, and Indigenous peoples. It is critical to create spaces in research, policy, and practice to integrate multiple values for and of nature into societal narratives, including those aspects of nature that are not amenable to pricing, valuation, or markets[130,133]. Research that draws on different perspectives, encourages participatory reflection, and iteratively integrates these into practice will improve the understanding of the implications of existing and proposed interventions, identify narratives that generate change, and create more powerful approaches to addressing global social-ecological challenges.

Conclusion

The entrenched language and logic of the existing economic system will make it difficult for research alone to interrupt and challenge the mental models and management routines underpinning multilevel economic processes affecting biodiversity. Therefore, as we explore shifts and transformations towards a balanced and fair relationship between nature and economy, we seek a new economic narrative. A narrative that understands the full impact that current economic activities have on biodiversity, provides evidence-informed approaches on how to collectively transform the global economy across a range of time scales, and engages broader societal systems, cultures, actors and values. Such innovative research and practice has the potential to create different kinds of economic systems that are more resilient and conducive to environmental integrity and social justice.

4. Enabling transformative biodiversity research and change

Federico Davila, Nicole Kalas, Laura Pereira

Transformative change is systemic in nature, and profoundly influences the underlying paradigms and values that impact human decisions on technologies, governance, economic structures, and nature[1,134]. Social-ecological systems have experienced transformative changes in the past. These changes are sometimes planned, like the invention of the wheel, or unplanned, like catastrophic weather events displacing people and damaging ecosystems. Regime shifts – persistent changes in structure and function of ecosystems – are a type of transformative change often driven by human actions, such as fisheries collapsing or forests turning into savannahs[135]. Yet systems are also resilient and can either withstand or rebound from transformative change, or actively resist it. In this chapter, we focus on what individuals and institutions can do to embrace and open up spaces for transformative change. These spaces focus on plurality of knowledges, values, and culture in biodiversity research to enable and foster transformative change[68].

The concept of transformative change is inherently normative – it assumes that human actions to reduce biodiversity loss and improve human and ecological well-being are not working. The importance of transformative change to counter this 'business-as-usual pathway' is acknowledged by the United Nations (UN) and research institutions globally. For example, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has highlighted the importance of transformative change in its *Global Assessment*[1] and is embarking on a thematic assessment of the determinants of transformative change to achieve the CBD's *2050 Vision for Biodiversity*[136]. Transformative changes are needed across different scales[2] and levels[3], and across complex and diverse socio-political and social-ecological contexts in an increasingly unpredictable and changing climate – and they must happen soon if we are to halt the trajectory of biodiversity loss.

While the preceding chapters have explored transformative changes through their respective thematic lenses, this chapter revisits the disciplinary foundations that have shaped the transformations discourse. We, then focus on individual and institutional approaches to transformations research and change for biodiversity.

Context

Transformative change concepts have primarily emerged in the realms of governance[137], sustainability science[68,138], socio-technical studies[134,139,140], climate change[141], and sustainable development[142]. For example, research on ecological regime shifts[143], social-ecological systems transformation[144], sustainability transitions[137], transformative adaptation[145], and sustainability pathways[146]. The approaches differ in their prioritisation of context, spatial and temporal variables, the role of technologies, production and consumption patterns, power structures, individual agency, institutions, and social-ecological dynamics. However, there is an increasing recognition that regime shifts, and wider transformations, ought to be analysed through a more interdisciplinary lens. For example, the history of agrarian change highlights the co-evolution of the agricultural environment with changes in land management, shifts in market systems, and social structures around food production and trade. These regime shifts in agricultural systems exemplify how transformations can only be fully understood

2. Scales relates to spatial, temporal and analytical dimensions of a specific phenomenon, e.g. transformations can take place over temporal and spatial scales.

3. Levels relate to the individual, collective, and social-ecological spheres[153].

in all their dimensions through an integrated application of biophysical and social science approaches[147]. Yet such interdisciplinarity is only one of several principles that inform transformative change and action for sustaining diverse and just futures for life on Earth. The Biodiversity Revisited Initiative proposes wider range of principles to guide transformative research and action (see Table 1, p.8).

Focusing research and action for the next five years

We have identified four priority areas for research that can support transformation. The field of transformative change is already vast, and is core to current science and policy activities in biodiversity. Here we propose general questions that can help us better understand and implement different types of transformations-focussed research on biodiversity conservation.

1. Learning from past transformations

Key to the implementation of actions and processes leading to transformative changes are the agency and transformability of individuals and institutions. While acknowledging the multitude of determinants of change, we focus on three broad approaches to transformations that can be useful for individuals and institutions in their research practices[148]. First, *structural transformative* approaches to biodiversity research analyse human-environment relations within their historical context and political ecology. Second, *systemic transformative* approaches focus on the interactions between different parts of a system (social-ecological, economic, and technological) and their influence on overall system outcomes. Lastly, *enabling approaches* seek to emancipate and empower individuals, notably the marginalised, in transformation processes. Enabling approaches therefore focus on the values, relations, and processes that underlie both structures and systems and emphasise new ways of doing research. We call for research that critically evaluates past experiences of these broad approaches to transformations to help identify common elements of previous transformations, so as to understand and unpack the types of transformations of which we are now part. Research could consider:

- How have previous transformative changes to biodiversity occurred, and how can understanding these past transformations help us plan for the future?

2. Institutional and individual roles in transformative change

Individual action relates to each person's ability, willingness, and capacity to realign their work to exploring transformative research frontiers and implementing innovative practices. Transformative thinking and learning affect how individuals engage with social-ecological change, and other individuals and institutions that are part of that system. This may include developing inter- and transdisciplinary capacities, skills, and networks for change or building new capacities, such as the ability to cope and to work effectively with the inherent uncertainties of complex social-ecological systems (thresholds, tipping points, feedbacks, unintended consequences, trade-offs)[149,150]. *Institutional* action then relates to an institution's capacity, willingness, and leadership to enable and promote transformative research and action. This can apply to research institutions, such as universities, institutions, and other organisations that generate research and inform practice on transformative change. It can also pertain to institutions that support biodiversity conservation, such as implementing agencies, governments, community groups, social enterprises, and corporations with biodiversity conservation targets in their social corporate sustainability portfolios, as well as those entities that fund both research and action. A more robust understanding of the role of change within institutions can help us improve biodiversity research in the future. This leads us to pose a reflexive question focussed on the institutions that seek to conduct transformative biodiversity research:

- How is our work contributing to understanding, or enabling, transformative change towards diverse, sustainable and just futures?

3. Inclusive and plural transformations

Doing transformative research requires changes in the ways that institutions fund, conduct, and value research and conservation practice. Traditional funding mechanisms tend to focus on research that is tightly bound to a singular focus area with clearly defined objectives and outcomes, and often adheres to particular disciplinary areas of interest. For monodisciplinary university research groups, or single-focus NGOs, this could mean adopting novel, more flexible, inclusive, adaptive research and action objectives. These include unlocking funding to support inter- and transdisciplinary research and practice, integrating diverse knowledges and people across various stages of their careers, and creating equal opportunities for new and marginalised voices. While there has been increased focus on interdisciplinarity (especially in projects involving large consortia), which has enabled researchers of different academic backgrounds to collaborate and co-create, there continues to be a lag in effectively including non-academic voices in the research process, notably marginalised communities.

For transformative changes to occur, positive interactions and feedbacks between individuals and institutions are essential. The ability of individuals and institutions to transform are co-dependent and equally guided by their underlying ethics, paradigms, and discourses around the purpose of their research and the processes and methods of conducting it. Institutions play a crucial role in setting the enabling systems for individuals to pursue transformative research and action. Yet institutions in turn depend on the leadership of individuals to meaningfully advance diverse and just research on, and for, biodiversity transformations. As such, we suggest further research is needed to examine how to enable research and action that is inclusive and plural. We suggest two areas of work in this regard, guided by the following questions:

- What are the mechanisms for breaking entrenched power relations and for enabling diverse knowledge systems, especially the voices of marginalised peoples, to become integral to transformative biodiversity research?
- What tools, narratives, and approaches are needed to promote societal acceptance of a plurality in perspectives on what transformations should occur, and to provide pathways for multiple futures that can exist through embracing diversity and plurality?

4. Research and action in light of uncertainty

A major challenge for understanding and planning for transformative change is the inevitable uncertainty that comes in actually *knowing* when an event is transformative or not, and our limited ability to predict how systems will respond. Our ability to plan for change is also affected by the severity of climate, economic, and other shocks impacting social-ecological systems. Since the early decades of the ‘sustainable development’ narrative, the precautionary principle has driven actions in light of uncertainty and unavailable data[151]. Uncertainty is the hallmark of the Anthropocene, and with it come more extreme shocks and an amplification of impacts across scales and at higher speeds. Such interdependence makes understanding and planning for change complex. Research can play a role in exploring this uncertainty through developing new skills and capacities among individuals and institutions to understand and navigate the various uncertainties that characterise biodiversity futures[7]. This priority emphasises the need to build new capacities about how we think about the future and anticipate change so that we can make more informed decisions in the present, while acknowledging the uncertainties of the future[152]. This question then focuses on the inevitable uncertainty and knowledge gaps relating to how social-ecological systems will transform in the future:

- How can we build capacities to anticipate transformations and still take action despite the inevitable uncertainties of how social-ecological systems respond to change?

Towards transformative biodiversity research and action

Transformative change research is taking place in a world where competing values and interests exist, where there is an urgent need for decisions and actions, and where the stakes of inaction are high. The priority areas and questions presented in this chapter are a useful guide for current practice as well as future research for individuals and institutions seeking to develop transformational skills and practices. We hope they spark new research programmes that support knowledge diversification, help navigate tensions between disciplines, knowledges, ethics, and actions, and work towards research and practice that are comfortable with this plurality of perspectives around specific biodiversity challenges.

Conclusion

As transformative biodiversity change research and practice is gaining traction and increasingly focusing on actionable, tangible outcomes, research institutions and individuals within them are in a unique position to realign their thinking and enhance their transformational capacities and agency. Their ability to transform will enable them to co-produce answers and innovative solutions in a pluralistic environment, and in a complex, uncertain and unpredictable world. Throughout the chapter, we focussed on the roles of individuals and institutions to catalyse transformative change. Transformative thinking is relevant to the other themes within this agenda, as they all have a focus on elements of radically shifting how we think and act, the narratives we tell ourselves and others, how we relate to nature and impact the biosphere, and the economic structures we support. The future is not yet written; we have the power now to collectively make better decisions that will drive transformative change to sustaining diverse and just futures for life on Earth. To do this, we must ask transformative questions. Explore the ones presented in this chapter and add your own. We are only limited by our imaginations.

INVITATION TO BEGIN ANEW

The Biodiversity Revisited research and action agenda calls for new ways of thinking and acting to ***sustain diverse and just futures for life on Earth***. In the preceding chapters, we sought to illuminate novel approaches, narratives, and perspectives that resteer biodiversity research and practice to respond to the challenges of the Anthropocene. These are presented as an open invitation to biodiversity researchers to begin fresh by pursuing new trajectories of knowing and doing to co-produce pathways to more sustainable futures that reframe relationships between human and non-human communities on Earth.

What is *really* wrong with biodiversity?

Throughout the Biodiversity Revisited Initiative, we have discussed many things potentially 'wrong' with biodiversity; from the narrow definition of biodiversity that silences some voices to the insufficient recognition of the diverse cultures and communities for whom biodiversity matters. We have acknowledged a need to grapple with the full range of narratives, relations, structures, and mechanisms of change, and have noted that powerful interests are likely to block efforts to mobilise changes to the status quo – across research, governance, and economic systems. We have recognised that transformative approaches are by no means easy, and institutions and individuals must leverage what they can to bring about change. The 'problems' with biodiversity may be multiple and perhaps irreconcilable, however we share a broad view that new ways of thinking and acting are needed to foster a collective journey towards diverse and just futures for life on Earth. Indeed, the conversation about what is wrong with biodiversity has only just begun.

Through this research and action agenda, we call for a more comprehensive understanding of biodiversity that embraces the messy, political realities of social-ecological systems and thereby reveals the agencies, accountabilities, and responsibilities of individuals and institutions in bringing about incremental and transformative change. The Biodiversity Revisited Approach in which knowledge, action, and ethics are taken to be inherently intertwined (Figure1, p.7), and the new directions presented here provide guidance for biodiversity research and action in the coming years.

Priorities for the next five years of biodiversity research

The details of research priorities are set out in the individual chapters, and fall into four broad areas.

1. Identify and analyse the structures that shape thought and action with respect to social-ecological systems to foster alternatives.
In particular, there is a need to understand the impacts of problematic dualisms, for example, between people and nature, nature and economy, or environment and development. These dualisms permeate both conceptual structures (such as narratives and concepts used in scientific research) and physical structures (such as the institutions that generate policies and can undermine efforts to address interconnected problems in social-ecological systems). More empirical and theoretical research is needed that sees beyond these dualisms to cultivate deeper understanding of interconnected social-ecological systems, builds alternative approaches, and considers their implications.

2. Examine the multi-scalar mechanisms of change.
This agenda has identified a number of ways of theorising and mobilising change: in narratives, cultures, economies, individuals, and institutions. Empirical research is needed in different contexts and across multiple scales to examine how change occurs, what enables and constrains it, and how it can be harnessed to reshape pathways towards diverse and just futures. Research could examine past experience to inform current action, be cognisant of complex institutional dynamics, and explicitly engage with the tensions that arise around desires for cooperation and coordinated responses, while supporting differences, diversity, and contextualised concerns.

3. Develop a more nuanced understanding of change processes and their implications.
Research is needed to consider where and how transformative change is required, and where more incremental changes can lead to transformative outcomes. This research should acknowledge and seek to understand the power of vested interests and the mechanisms that could be used to destabilise existing power dynamics and give voice to marginalised actors. Theoretical and empirical research is required to better understand the role of individuals and institutions in bringing about changes in governance and economic systems. A related line of work could empirically examine the dynamics and social-ecological implications of unintentional processes of change as well as intentional efforts to foster prescribed human behaviours.

4. Create spaces to examine biodiversity futures that build capacity for anticipatory decision-making.
The biodiversity community needs to develop innovative methodologies that enable communities, organisations, and society as a whole to consider a range of possible biodiversity futures. These processes should embrace the inherent uncertainty of decision-making for the future and empower individuals and institutions to take responsibility for anticipatory action. Research should consider what types of tools, narratives, and processes can enable actors to consider the trade-offs and consequences of different pathways, and what individual or institutional capacities are required to enable a plurality of responses to emerge and co-exist.

Revisiting how biodiversity research is conducted

The unprecedented challenges humanity faces require new approaches. Specifically, this involves developing spaces for exchange that are respectful of diverse perspectives and approaches, while at the same time recognising the urgent need for change. This agenda seeks to inspire, rather than prescribe, collaborative and creative engagement between different sectors of society and academia. A research agenda is a commitment to new research, new projects, and ultimately new actions. It will not stop here. We leave the agenda an open and iterative proposition subject to further evolutionary, experimental, and emergent developments. This is just the start of the Biodiversity Revisited journey. We invite you to join us by reflecting how you, as a researcher, practitioner, policymaker, funder, or other stakeholder, can take this agenda forward and radically shift how you and your networks think and act for diverse and just futures for life on Earth.

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Editors:

Carina Wyborn (Luc Hoffmann Institute), Jasper Montana (University of Oxford, UK), Nicole Kalas (ETH Zurich, Switzerland), Megan Eaves (communication consultant, UK).

Authors:

(in alphabetical order; at the beginning of each chapter, the lead author is listed first, f ollowed b y t he co-authors alphabetically)

Madhurya Balan (The Forest Way, India), Josie Chambers (Wageningen University, The Netherlands), Lucas Christel (National University of San Martin, Argentina), Sarah Clement (University of Liverpool, UK), Federico Davila Cisneros (University of Technology Sydney, Australia), Anna Deplazes-Zemp (University of Zurich, Switzerland), Tim Forsyth (London School of Economics and Political Science, UK), Gretchen Henderson (Georgetown University, USA), Santiago Izquierdo Tort (ITAM Centre for Energy and Natural Resources, Mexico), Nicole Kalas (ETH Zurich, Switzerland), Natalie Knowles (University of Waterloo, Canada), Michelle Lim (Adelaide Law School, Australia), Elena Louder (University of Arizona, USA), Maria Jose Martinez Harms (Pontificia Universidad Católica de Chile), Juliana Merçon (Universidad Veracruzana, Mexico), Jasper Montana (University of Oxford, UK), Emmanuel Nuesiri (African Leadership University, Mauritius), Laura Pereira (City University of London, UK), Victoria Pilbeam (Clear Horizon Consulting, Australia), Esther Turnhout (Wageningen University, The Netherlands), Sylvia Wood (Future Earth, Canada), Carina Wyborn (Luc Hoffmann Institute).

Contributors:

Isis Alvarez (Global Forest Coalition, Colombia), Olga Biegus (Luc Hoffmann Institute), Megan C. Evans (University of Queensland, Australia), Edson Gandiwa (Chinhoyi University of Technology, Zimbabwe), Mike Harfoot (UNEP-WCMC, UK), Noor A. Noor (UK), Jason Landrum (Lenfest Ocean Program, USA), Unai Pascual (Basque Centre for Climate Change, Spain), Sarobidy Rakotonarivo (École Supérieure des Sciences Agronomiques, Madagascar), Melanie Ryan (Luc Hoffmann Institute), Jeffrey Sayer (University of British Columbia), Ed Straw (Open University, UK), Emma Woods (The Royal Society, UK).

Reviewers:

Georgina Mace (University College London Centre for Biodiversity and Environment Research, UK), Chris Sandbrook (University of Cambridge Conservation Research Institute, UK), Bill Adams (University of Cambridge, UK), Megan C. Evans (University of Queensland, Australia), Jason Landrum (Lenfest Ocean Program, USA), Eszter Kovacs (University of Cambridge, UK), Heejoo Lee (Independent consultant).

Biodiversity Revisited Steering Committee (SC):

Adil Najam (SC chair; Boston University, USA), Neville Ash (UNEP-WCMC, UK), Jaboury Ghazoul (ETH Zurich, Switzerland), Jon Hutton (Luc Hoffmann Institute), Julia Jones (Bangor University, UK) , Amy Luers (Future Earth, Canada), Georgina Mace (University College London Centre for Biodiversity and Environment Research, UK), Kristal Maze (SANParks, South Africa), Chris Sandbrook (University of Cambridge Conservation Research Institute , UK), Rebecca Shaw (WWF, USA), Baskhar Vira (University of Cambridge, UK).

Alternates and observers:

Bill Adams (University of Cambridge, UK), John Garcia Ulloa (Luc Hoffmann Institute Fellow alumnus and ETH Zurich, Switzerland), Louise Glew (WWF, USA), Han Meng (UNEP-WCMC, China), Edward Perello (Arkurity, UK), Sylvia Wood (Future Earth, Canada), Emma Woods (Royal Society, UK).

Biodiversity Revisited Secretariat:

Luc Hoffmann Institute (Luc Hoffmann Institute): Jon Hutton, Melanie Ryan (Secretary General, Biodiversity Revisited), Anaïk Anthonioz-Blanc, Nikki Chapman (exited July 2019), Adrian Dellecker, Richard Gauld, Sandrine Jimenez, Jessica Villat, Carina Wyborn.

Other: Olga Biegus (project management consultant), Megan Eaves (communication consultant, UK), Lindsey Elliott (Open University, UK), Nicole Kalas (ETH Zürich, Switzerland), Anna Knee (communication consultant, Switzerland; exited May 2020), Randall Krantz (Value Web, Switzerland; exited October 2019), Gillian Martin Meyers (Bright Green Learning, Switzerland), Jasper Montana (University of Oxford, UK), Gemma Parks (communication consultant, Switzerland; exited October 2019) Niki Rust (Newcastle University, UK; communication consultant; exited December 2019).

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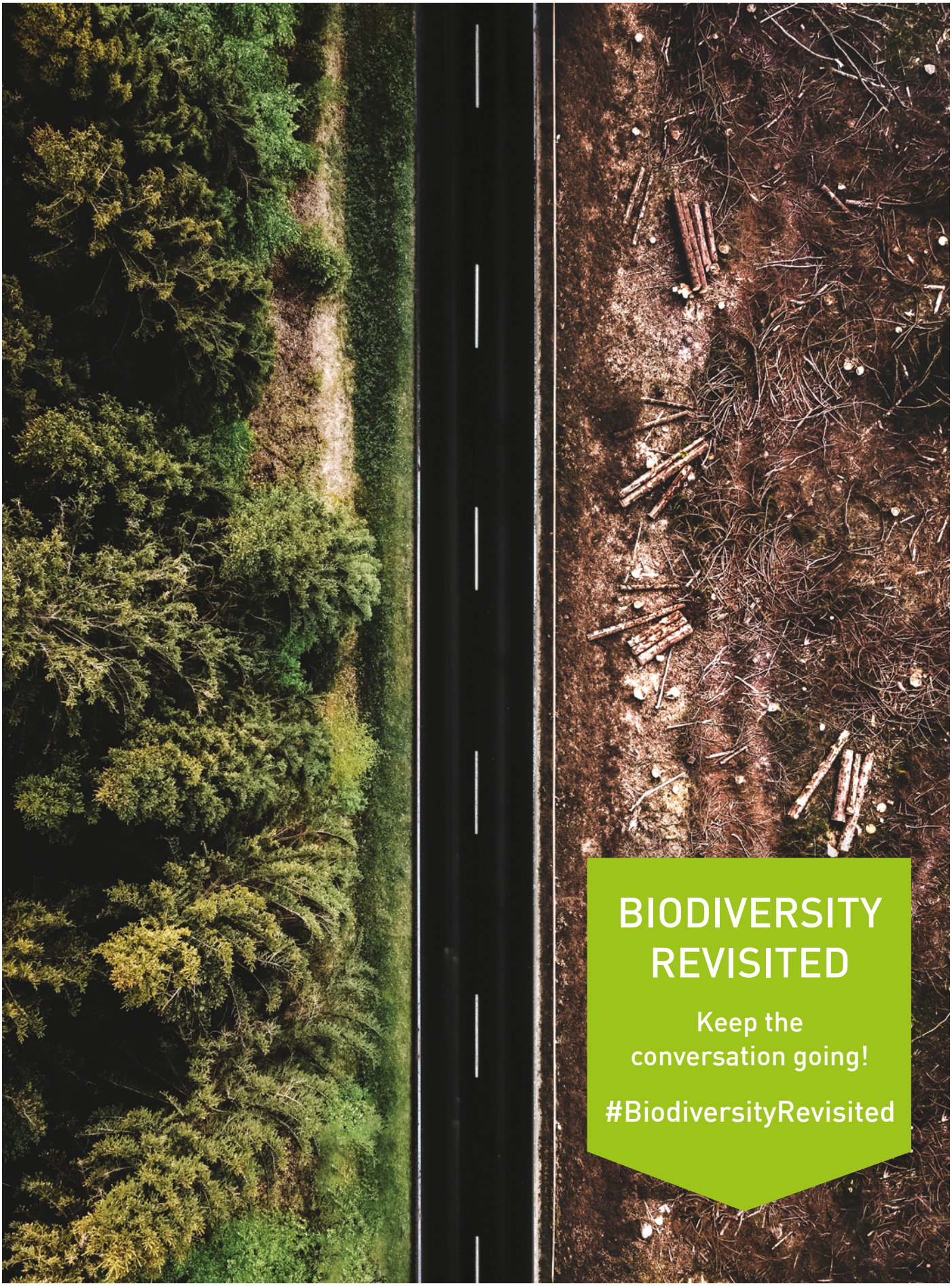

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