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From novel ecosystems to *novel natures*

Ecologists, particularly restoration ecologists, were early to recognise the challenges of historically unprecedented combinations of species and abiotic conditions brought about by human intervention. However, to date, this ecological understanding has paid limited attention to sociocultural considerations. We propose the concept of novel natures to combine ecological and social dimensions in the perception and evaluation of novelty in nature, and to assist conservation and restoration decision-making in a time of rapid environmental change.

Jasper Montana , Tina Heger , Rosine Kelz , Armin Bischoff , Rob Buitenwerf , Uta Eser , Katie Kung , Julia Sattler , Andreas H. Schweiger , Adam Searle , Leonardo H. Teixeira , Bruno Travassos-Britto , Eric Higgs 

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Governments, businesses, and other non-governmental organisations are increasingly seeking to go beyond simply conserving existing nature. In efforts to limit biodiversity loss and mitigate the threats to long-term human wellbeing, these actors are attempting to restore, reintroduce, or even create (through biotechnology or other means) new forms of nature that help shift ecosystems in desired directions. The 2022 *Kunming-Montreal Global Biodiversity Framework*, for example, set ambitious goals to ensure that at least 30 percent of degraded land and sea areas are under effective restoration by 2030. Meanwhile, nature-based solutions and biodiversity markets are seen as mechanisms that use nature to tackle climate change and support development, while delivering a more “nature-positive” world in the years ahead. Conservation efforts are also exploring the use of biotechnological interventions, such as the genetic modification of coral reefs (Cleves et al. 2020) or the introgression of a blight tolerance transgene into American chestnut (Newhouse and Powell 2021).

This range of interventions in and with nature can affect deeply held values and moral beliefs, as well as unsettle public under-

standings and attitudes towards nature. They raise many questions. For example: Which forms of nature should count in targets for ecosystem restoration or in the implementation of nature-based solutions, biodiversity offsetting, and nature credit markets? Should genetic engineering play a role in the future of biodiversity conservation?¹ To what extent should non-native and invasive species have a role in ecological restoration projects? These questions are more than technical or ecological concerns, and require a diverse range of voices, including experts in culture, politics, and ethics to be adequately addressed. Yet, existing terminology about novelty in nature often results in the closing down of the sociocultural aspects of these questions.

Here we build on previous conceptual work on both novel ecosystems and ecological novelty and introduce the term *novel natures* to add a missing sociocultural layer to understandings that have so far been dominated by ecological science. *Novel natures*

¹ See Couto Pilz et al. (2024, in this issue), Rabitz et al. (2024, in this issue) and Eser (2024, in this issue) for further discussion.

Dr. Jasper Montana (corresponding author) | Australian National University | Australian National Centre for the Public Awareness of Science | Canberra | AU | jasper.montana@anu.edu.au

PD Dr. Tina Heger | Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) | Berlin | DE and Technical University of Munich | TUM School of Life Sciences | Freising | DE | t.heger@tum.de

Dr. Rosine Kelz | University of Bremen | Institute for Intercultural and International Studies | Bremen | DE | kelz1@uni-bremen.de

Prof. Dr. Armin Bischoff | University of Avignon | Mediterranean Institute of Biodiversity and Ecology | Avignon | FR | armin.bischoff@univ-avignon.fr

Assist. Prof. Dr. Robert Buitenwerf | Aarhus University | Department of Biology | Aarhus | DK | buitenwerf@bio.au.dk

Dr. Uta Eser | Büro für Umweltethik | Tübingen | DE | info@umweltethikbuero.de

Katie Kung, MA | Ludwig-Maximilians-Universität München | Rachel Carson Centre | Munich | DE | katie.kung@rcc.lmu.de

Julia Sattler, MSc | University of Regensburg | Regensburg | DE | julia.sattler@ur.de

Prof. Dr. Andreas H. Schweiger | Universität Hohenheim | Institut für Landschafts- und Pflanzenökologie | Hohenheim | DE | andreas.schweiger@uni-hohenheim.de

Adam Searle, PhD | University of Nottingham | School of Geography | Nottingham | GB | adam.searle@nottingham.ac.uk

Leonardo H. Teixeira, PhD | Vrije Universiteit Brussel | Research Group WILD, Functional Ecology of Plants and Ecosystems | Brussels | BE | leonardo.teixeira@vub.be

Bruno Travassos-Britto, PhD | University of Toronto Mississauga | Department of Biology | Toronto | CA | bruno.travassos@utoronto.ca

Prof. Dr. Eric Higgs | University of Victoria | Environmental Studies | Victoria | CA | ehiggs@uvic.ca

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is a concept supporting a call for inter- and transdisciplinary work, which emphasises cultural meaning and normative commitments about nature that can often be concealed behind ecological, science-based discussions. It emphasises that novelty is both culturally perceived and has social effects. It suggests that meaningfully engaging concerned communities in the deliberation and the production of biodiversity conservation and restoration efforts will be important.

Novel ecosystems

Starting in the late 1990s, ecologists began to argue that changes to ecosystems from varied sources (e.g., non-native species, climate change, land conversion, contaminants, excess nutrients, resource extraction, etc.) resulted in ecosystems with new species compositions and ecological processes. Restoration ecologists were at the forefront of this debate because they were already contending with the challenges of assisting the recovery of ecosystems either faced with persistent changes or already converted to new ecological communities highly resistant to change.

In response to such challenges, ecologists rallied to provide a new conceptual vocabulary and developed the idea of novel ecosystems, which constitute a relatively narrow class of ecosystems defined as “a system of abiotic, biotic and social components (and their interactions) that, by virtue of human influence, differ from those that prevailed historically, having a tendency to self-organize and manifest novel qualities without intensive human management” (Hobbs et al. 2013). The existence of a threshold, or circumstances in which the ecosystem has undergone modifications that are so significant that restoration becomes impractical, distinguished “novel” ecosystems from “hybrid” ecosystems, which combine both historical and novel elements.

The term “novel ecosystem” signals a distinct departure from a classical version of restoration rooted in historically contingent recovery targets (Hobbs et al. 2013). Novel ecosystems may be practically impossible to restore in a traditional sense (i.e., to replicate the biotic composition from a selected historical reference state) yet may concurrently function as self-organising ecosystems that support biodiversity and maintain ecosystem functions (Hobbs et al. 2013). This runs against the grain of long-held beliefs by many ecologists, who used to focus on “pristine” and semi-natural ecosystems, and overlooked highly altered ecosystems (Inkpen 2017). It also raises challenges to ways in which different ecosystem states are understood and governed by provoking new thinking about rapidly changing ecosystems and commitments to them. For example, the controversy over whether to restore Mount Sutro in San Francisco to a coastal scrub habitat or to conserve a more-than-century old novel ecosystem (Venton 2013) is one case that challenges what is perceived as degradation, and whether restoration to historically continuous composition and function makes sense, especially in ecosystems with practically impossible barriers to restoration (e.g., salinized or nitrogen-enriched soils that no longer support native species).

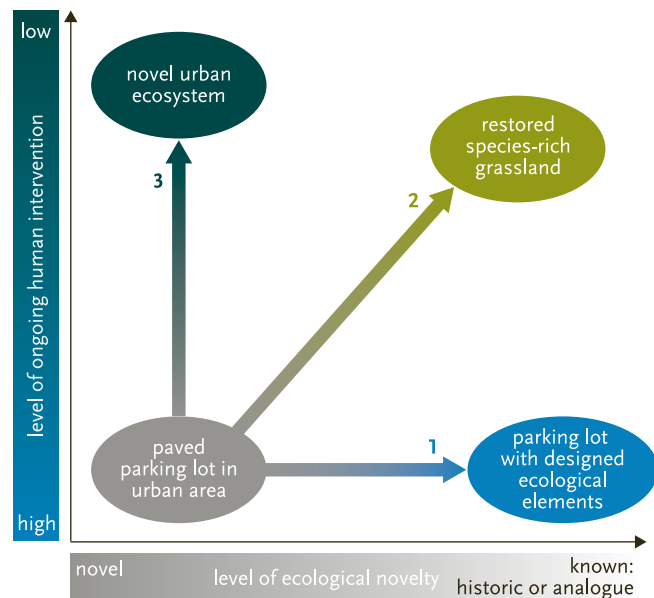


FIGURE 1: Three examples for possible interventions to increase the conservation value of impermeable parking lots: (1) the addition of designed ecological elements (e.g., nesting aids) can decrease the novelty from an organism-centered perspective while maintaining high levels of ongoing human intervention; (2) the de-sealing and restoration of the parking lot can lead to near-natural systems with relatively low levels of ongoing human intervention; (3) the de-sealing and hands-off approach can result in urban wilderness while maintaining high levels of novelty.

Ecological novelty

While the idea of novel ecosystems offered terminology for considering ecological assemblies without historical analogues from a human perspective, there was scope for exploring novelty also as experienced by organisms. Novelty from the perspective of an organism is not necessarily congruent with novelty as perceived by a human observer. Even though urban environments may seem highly novel from a human perspective (in the sense that they were not present in the deep past and are maintained by continued human intervention), for some species they do provide resources that can be used as an analogue to natural or near-natural situations. For example, the hard-surfaced walls of buildings in cities can resemble natural rocky habitats (e.g., rocky outcrops in the alpine area) and are therefore readily used by some cliff plants and mountain birds (e.g., the black redstart, *Phoenicurus ochruros*; Lundholm and Richardson 2010).

Building on the concept of novel ecosystems, Heger and colleagues (2019) suggested “ecological novelty” as a concept that could encompass both site- and organism-based novelty. In this sense, ecological novelty should not be regarded as being the opposite of “natural” or “wild”, but instead as addressing the extremes of two distinct gradients (figure 1). One gradient covers conditions from high to low levels of ongoing human intervention, and the other gradient ranges from “novel” to “historic/analogue” conditions (see Kowarik 2018).

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Ecological novelty is a descriptive and quantifiable parameter, observable with ecological methods (Heger et al. 2019, Schittko et al. 2020). It is not intended to define positive or negative changes and, hence, should not be read as a prescriptively normative concept. The terminology addresses states of the environment beyond the dichotomies of natural, near natural, and artificial, and can thus serve as a basis for discussing the aims for conservation and restoration (e.g., by indicating the aims of a particular measure in the conceptual space described by the two axes of ecological novelty and level of human intervention; Heger et al. 2020).

Towards recognising *novel natures*

The concepts of novel ecosystems and ecological novelty allow discussions about a wider set of aims in restoration and conservation. Specifically, they help expand the perceived management choices available that can enable nature to thrive, beyond restoring ecosystems to historic baseline conditions. However, these concepts do not immediately emphasise a wider suite of cultural, political, and ethical considerations that increasingly command attention. These considerations include, but are not restricted to, recent attention to coloniality, economic development, and diverse values in shaping conservation and restoration aims (e.g., Adams 2004, Avalos 2023, Brockington 2002, Büscher and Fletcher 2020, Hernández-Morcillo et al. 2017, Mace 2014, Pascual et al. 2023, Philips 1998, Sandbrook et al. 2019, Trisos et al. 2021).

To draw attention to sociocultural dimensions of novelty alongside ecological ones, we propose *novel natures* as an umbrella concept that provides a qualitative descriptor and a call to action to cover a wider range of novelty than afforded by the concepts of novel ecosystems and ecological novelty. The concept of nature itself is sometimes criticised for being too loose a term, and therefore of limited analytical utility. However, here, we embrace the concept's inclusivity to encompass the ecological, alongside the cultural, political, and ethical considerations that matter in human-environment relations (Castree 2005, Hinchliffe 2007).

We anticipate the *novel natures* concept could apply when there is a change in the way that biotic and abiotic assemblages are understood and valued by people following human intervention. This destabilises prevailing cultural meanings regarding nature and its place in society, and affects the assumed relations of care and responsibility. For example, an intervention into an ecosystem that was previously considered to be natural (i.e., an area of established forest) may lead to a state that is perceived as unnatural following clearance and regeneration (figure 2). The idea of *novel natures* draws attention to the sometimes uncertain relations between people and nature, and thereby invites questions such as: Who is historically responsible for past changes and for changes going forward? Are these *novel natures* desirable in this instance or not? Where do these *novel natures* fit within established frames of meaning (i.e., should they be considered natural or unnatural, etc.)? And what is to be done?

Novel natures can also describe situations where ecosystems are restored to a given historical, analogue condition (i.e., there is no measurable novel ecosystem or ecological novelty), but there is a strong human perception of novelty. This might occur, for example, where a culturally significant farming landscape is rewilded to forest cover (Mikołajczak et al. 2022), where a locally extinct species is returned to its previous range (Coz and Young 2020), or when trophic rewilding is achieved using non-native large herbivores as functional analogues for extinct species (Lorimer and Driessen 2014). In these cases, restoration may not lead to ecologically novel conditions per se, but there will likely be novel cultural, political, economic, and ethical considerations that need to be navigated.

In positing the *novel natures* concept, we are not claiming to be the first to consider the sociocultural dimensions that arise alongside novel compositional and ecological changes. These considerations have long been considered inside and outside academia. A recent report, for example, of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) notes shifting cultural attitudes with regards to the desirability of native and non-native species in some societies (IPBES 2023, p. 16), and explicitly considers the reported negative and positive impacts of species composition changes in the lives, cultures, and traditions of Indigenous peoples and local communities (IPBES 2023, p. 512). Indeed, the broader work of IPBES further highlights the need to negotiate multiple values through which nature conservation and restoration can be justified – be they intrinsic to nature, instrumental for people, or relational between people and nature (see Pascual et al. 2023). This work follows healthy debate about the multiple values and sociocultural considerations in responding to widespread human influence on the planet, sometimes termed the Anthropocene. This debate includes an interest in the role of capitalism and development in conservation (Büscher and Fletcher 2020, Sandbrook et al. 2019). It also includes different opinions about the extent to which boundaries between intact ecosystems and human environments should be policed or otherwise subject to a “new conservation” vision of nature that “exists amid a wide variety of modern, human landscapes” (Marvier et al. 2012), and as a “half-wild rambunctious garden, tended by us” (Marris 2011, p. 2). In contrast to some of this work, the *novel natures* concept does not signify a commitment to the positive or negative values of novelty in nature, nor align with any particular pathway for economic development. Rather, the concept asserts a need for the values and roles of nature in development pathways to be explicitly open for deliberation.

Scholarship in political ecology and environmental humanities has further developed parallel interests in novel forms of nature. Some of this writing extends the understanding of novel ecosystems to include more than the biological elements. It also includes the technologies and supply chains that collectively constitute the “emergent ecologies” of 21st century nature conservation and restoration (Kirksey 2015, p. 3). This scholarship often draws attention to the many human and non-human agencies



FIGURE 2: A near natural beech forest (on the left) and an abandoned urban industrial site colonised by birch trees, which is now used as a park (below; see also <https://www.natur-park-suedgelaende.de/en>). The resemblance between the two is striking, however one is considered pristine and natural, while the other is deemed unnatural. These differences raise questions such as: Who is responsible for these changes – both in the past, and going forward? Is this altered state desirable? etc. It illustrates that cultural meanings and moral commitments towards nature following human interventions are altered, and this affects the assumed relations of care and responsibility.

involved in the production of *novel natures*, and the need to attend to their emergent and unexpected effects (Latour 2012, 2016). It suggests that conservation and restoration efforts can be rethought as involving both “ecological and political uncertainty” (Braun 2015, p. 109), and that environmental management can open itself up to surprise and unexpected developments through more adaptive and open-ended approaches (Carver et al. 2021). Feminist and decolonial scholars, informed by Indigenous perspectives, have emphasised the need for a deep time perspective of care and responsibility for novelty in nature, which includes what came before, what comes after, as well what exists in the present (Haraway 2011, Rose 2004). This requires novelty to not simply be seen as part of a linear trajectory of progress, leaving the past behind. Rather, *novel natures* necessitate longer lasting commitments to responsibility (Haraway 2016). For this reason, defining future goals for conservation and restoration is likely to benefit from attending to both socio-cultural histories and natural histories, while averting a shifting baseline syndrome that can result in evermore simplified ecosystems (Soga and Gaston 2018).

Novel natures may be increasingly produced intentionally and unintentionally by human actions, but *novel natures* are not necessarily deterministic of the values held towards them. Rather, identifying appropriate actions and reactions related to *novel natures* needs societal deliberation and engagement with a wide range of affected communities (Lorimer and Driessen 2014, Braun 2015, Wyborn et al. 2020). Decisions on conservation and restoration require inputs from extensive life science research, as well as the inclusion of diverse cultural and ethical perspectives from the social sciences, humanities, Indigenous and local knowledges, and



beyond (Diaz et al. 2019, Trisos et al. 2021, Higgs et al. 2014). This should include serious engagement with issues of power, inequality, and expanding the democratic participation in both the formulation of policy, and the research and innovation that sometimes produces *novel natures* (Braun 2015, Robins and Moore 2013). This work will necessitate recognition that the perception of appropriate aims will be shaped by diverse histories, cultural conditions, and the forms of knowledge considered.

Conclusion

There is potential for new insights through greater attention to the quality of novelty in nature. The concept of *novel natures* may support a more conscious decision-making process in conservation and restoration, by helping scholars to explore states of nature that go beyond the natural/artificial dichotomy and purely science-based assessment. Activities such as delivering nature-based solutions and biodiversity offsetting involve decision-mak-

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ing about and/or the production of *novel natures*. They therefore involve negotiating the cultural meanings and moral commitments that different communities have towards the nature in question. The potential for *novel natures* as a concept that might assist such initiatives will be evidenced by the resulting new conversations within inter- and transdisciplinary research and practice. We invite further debate on the usefulness of the concept, on the questions that arise in this context, and whether the concept of *novel natures* is a permanent state or one that applies only temporarily while sociocultural considerations and new ecological relationships are being worked out. We aim to generate space for dialogue in nature conservation and restoration that is guided by humility and can help to develop a more encompassing, cross-disciplinary mindset, delivering the basis for the development of intentional and equitable decision-making on how to intervene in and with nature in the years ahead.

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Jasper Montana

Senior lecturer in science, society, and environment at the Australian National University, Canberra, AU, and honorary research associate in human geography at the University of Oxford, UK. Research interests: environmental governance, the politics of nature, biodiversity conservation, knowledge systems, and science and technology studies.



Tina Heger

Principle investigator at the Leibniz Institute of Freshwater Ecology and Inland Fisheries in Berlin, DE. Private lecturer at the Technical University of Munich, Freising, DE. Research interests: invasive species, novel ecosystems, ecological novelty, nature conservation, restoration ecology, environmental ethics, philosophy of science, knowledge synthesis, arts and sciences collaboration.



Rosine Kelz

Political theorist at the University of Bremen, DE. Research interests: theories of temporality in social and political philosophy, normative and conceptual issues in the life sciences and nature conservation.



Armin Bischoff

Professor at the Mediterranean Institute of Biodiversity and Ecology, Avignon University, FR. Research interests: plant ecology, population ecology, plant-insect interactions, agroecology, ecological restoration, evolutionary ecology.



Robert Buitenwerf

Assistant professor at the Center for Ecological Dynamics in a Novel Biosphere (ECONOVO), Department of Biology, Aarhus University, DK. Research interests: terrestrial ecology and biogeography, climate change, remote sensing, biodiversity conservation and restoration.



Uta Eser

Biologist and environmental ethicist, independent researcher and consultant, associate member of the Centre for Ethics in the Sciences and Humanities, University of Tübingen, DE. Research interests: environmental ethics, multiple values of biodiversity, biodiversity communication, ethical underpinnings of sustainable development.

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Katie Kung

MA in transcultural studies (Heidelberg, DE). Doctoral student at the Rachel Carson Centre, Ludwig-Maximilians-Universität München (LMU), DE, and affiliate in the international doctorate program *Rethinking Environment* by the University of Augsburg, DE, and LMU. Research interests: invasive species, environmental humanities, philosophy of environmental sciences.



Julia Sattler

Doctoral researcher in ecology and conservation biology, University of Regensburg, DE. Freelance environmental surveyor. Research interests: impacts of land use history on ecological processes, conservation and restoration ecology, peat lands and pristine aquatic habitats.



Andreas H. Schweiger

Tenure-track professor for plant ecology at the University of Hohenheim, Stuttgart, DE. Research interests: rewilding, non-equilibrium dynamics in ecosystems, ecological memory.



Adam Searle

Nottingham research fellow in the School of Geography and Institute for Science and Society, University of Nottingham, UK. Research interests: politics and relationships between humans, other animals, and technologies.



Leonardo H. Teixeira

Postdoctoral researcher in the research group on Functional Ecology of Plants and Ecosystems of Vrije Universiteit Brussel, BE. Research interests: restoration ecology, invasion ecology, functional ecology, plant ecology, as well as biodiversity and ecosystem functioning.



Bruno Travassos-Britto

Lecturer at the University of Toronto Mississauga and at Toronto Metropolitan University, CA. Research interests: philosophy of science, sociology of science, theory structure, community ecology, landscape ecology.



Eric Higgs

Professor in the school of environmental studies at the University of Victoria, CA. Research interests: ecosystem restoration, ecological novelty, historical ecology, and cultural and ecological change in mountain landscapes.