NATURE'S CONTRIBUTIONS TO PEOPLE: ON THE RELATION BETWEEN VALUATIONS AND ACTIONS

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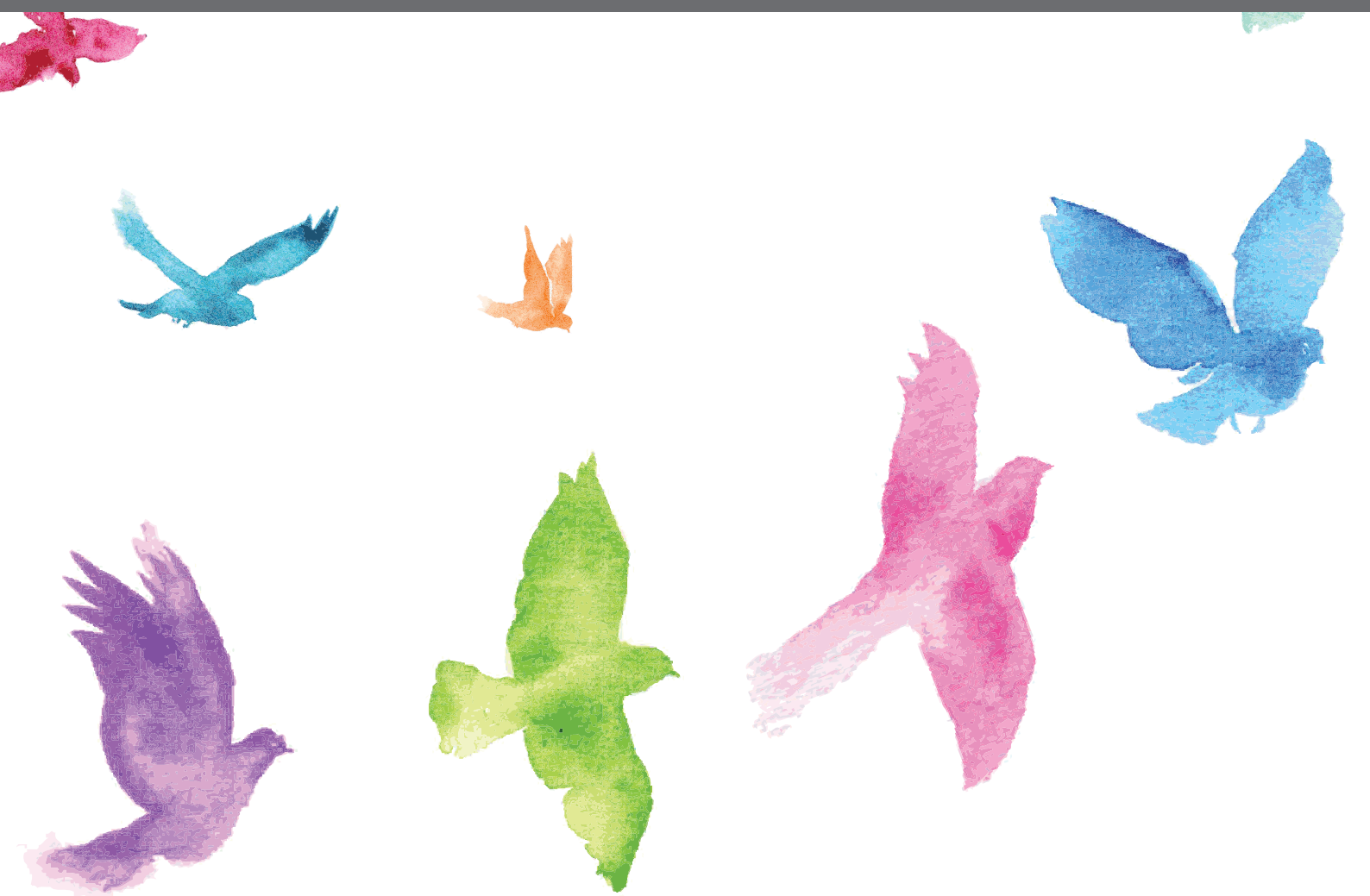

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NATURE'S CONTRIBUTIONS TO PEOPLE: ON THE RELATION BETWEEN VALUATIONS AND ACTIONS

Topic Editors:
Marie Stenseke, University of Gothenburg, Sweden
Thomas H. Beery, Kristianstad University, Sweden
Martin F. Quaas, Leipzig University, Germany

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Table of Contents

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EDITORIAL
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Editorial: Nature's Contributions to People: On the Relation Between Valuations and Actions

Thomas H. Beery[1], *Martin Quaas*[2] *and Marie Stenseke*[3]*

[1] Faculty for Teacher Training, Man and Biosphere Health Research Group, Kristianstad University, Kristianstad, Sweden, [2] Biodiversity Economics Group, Department of Economics, German Centre for Integrative Biodiversity Research (iDiv), Leipzig University, Leipzig, Germany, [3] Unit for Human Geography, Department of Economy and Society, School of Business, Economics and Law, University of Gothenburg, Göteborg, Sweden

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Editorial on the Research Topic

Nature's Contributions to People: On the Relation Between Valuations and Actions

How do the valuations of nature's contributions to people, i.e., all the benefits humanity obtains from nature, link to concrete actions?

In line with other bodies and a manifold of researchers addressing contemporary environmental challenges, the Global Assessment of Biodiversity and Ecosystem Services, published by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), concludes that a fundamental reorganization across technological, economic, and social factors, including values, is needed to achieve goals for conserving and sustainably using nature (IPBES, 2019). This reorganization implies transformative changes, for example, in the production and consumption of energy, food, and fiber.

While scientists and decision-makers increasingly acknowledge the need for transformative change, we lack specific definitions of the details of transformative change and agreement on how such change is ensured. However, by clarifying and assessing the multiple values of nature and its benefits, we understand what is at stake, for whom, and the tools for making priorities (Díaz et al., 2018, 2019). Valuation is, though, a means to an end. Likewise, increased awareness of the values of biodiversity is also a means to an end. The links between valuation, increasing awareness, and concrete actions, among policymakers and other decision-makers, including individuals, are crucial for transformative changes to start and proceed.

These considerations reverse the established approach in economic valuation, according to which one uses observations about actual actions to infer the values the actor holds ("revealed preferences"). In line with this economic paradigm, the currently observed societal actions and resulting biodiversity change reveals a lack of societal valuation of nature's contributions to people. If we would "transform our world," as the UN's Agenda 2030 demands, and with it the way societies act toward nature, this would reveal a new social valuation of nature's contributions to people. Either way, there is a close relationship between actions and valuations.

The articles in this Research Topic present insights from various perspectives and theoretical and methodological approaches on the connections between valuations of nature's contributions to people, including ecosystem services, awareness, and concrete actions. The articles concern perceptions and actions among individuals and groups of people and aspects related to governance ranging from local to global scales, based on cases from various parts of the world.

Some of the articles highlight how we understand "value" and the plurality of ways in which

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Orsolya Valkó, Hungarian Academy of Science, Hungary

***Correspondence:**
Marie Stenseke
marie.stenseke@geography.gu.se

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people value the rest of nature and discuss the implications for governing. Beery and Lekies consider children's nature experiences and highlight how child relationship to nature demonstrates relational value; Beery and Lekies argue that children's perspectives need to be better considered in ecosystem valuation and decision making. Johansson et al. elaborate on the understandings of "value." Using the case of human-wildlife encounters, they propose a psychological framework for understanding positive and negative contributions of wildlife for peoples' nature experiences, having a specific focus on their restorative effects.

Leventon et al. discuss the need for transforming biodiversity governance systems, departing from Donella Meadows' leverage points. They argue that plural valuation of biodiversity requires engagement with deep leverage points for governance system transformation, i.e., the intent and goals of the system, and not just the design of it.

Bravo-Monroy explores nature's contributions to people using Lefebvre's social theory as an analytical tool. Bravo-Monroy looks into the various meanings of place in coffee and potato farmer communities in Colombia and describes three co-existing spaces: lived spaces, perceived spaces, and conceived spaces. Bravo-Monroy points at the potential to facilitate communication on land use by recognizing nature's contributions to people with the help of those dimensions.

A couple of articles explore the links between values and behavior. Salazar et al. review tools that assess people's connections to nature, with a specific aim to identify tools helpful to managers and practitioners. Maioli et al. present a study of local stakeholders' perceptions and their relation to their local environment in the Brazilian Atlantic Forest. Maioli et al. illustrate the usefulness of this kind of insight for designing more effective landscape management and planning strategies.

Hysing and Lidskog and Stålhammar take a conceptual turn and address the role of concepts and concept innovation. Hysing and Lidskog delve into the issue of ecosystem services vs. nature's contributions to people, asking if conceptual innovation can generate transformative change. Taking the use of ecosystem services among policy practitioners in Sweden as a case, they point at the necessity to pay attention to interpretative frames and give a strong role to social analysis in the process of conceptual innovation. Stålhammar looks into the link between values and sustainability transformations. Stålhammar highlights the distinction between descriptive and normative modes of values and argues that the latter mode needs to be better recognized. Faith takes the perspective of intergenerational justice and highlights the value of "maintenance of options," one of the 18 categories of "nature's contributions to people" defined by IPBES, and underlines the importance of considering this future-looking aspect.

The mix of valuation and action insights included in the articles of this Research Topic is in line with calls for novel, positive, and engaging visions of the future. Transformation will require a coordinated and inclusive understanding of transformative change toward greater uptake of biodiversity and ecosystem services and mobilizing a broad base of local actors (e.g., Albrechts et al., 2020). The ideas and visions included in this collection represent the need for a rich diversity of functions and understandings of values. Altogether, the articles demonstrate that this diversity must include theory, policy, and case studies, from guiding ideas to guiding practice. Ultimately, to achieve the transformative change that UN Agenda 2030 calls for, scientists, planners, and natural resource managers will need to work with the help of the creative professions (e.g., artists and philosophers) and the service professions (e.g., education, medical care, elder care, and childcare). Such collaboration must strive to recognize and integrate diverse worldviews and knowledge systems (Parsons and Fisher, 2020).

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Improving Assessments of Connection to Nature: A Participatory Approach

Gabby Salazar[1], Martha C. Monroe[1], Catherine Jordan[2,3], Nicole M. Ardoin[4] and Thomas H. Beery[5]*

[1] School of Forest, Fisheries, and Geomatics Sciences, University of Florida, Gainesville, FL, United States, [2] Institute on the Environment, University of Minnesota, St Paul, MN, United States, [3] Children & Nature Network, Minneapolis, MN, United States, [4] Graduate School of Education, Emmett Interdisciplinary Program in Environment and Resources, and Woods Institute for the Environment, Stanford University, Stanford, CA, United States, [5] Faculty for Teacher Training, Man and Biosphere Health Research Group, Kristianstad University, Kristianstad, Sweden

Experiences in nature benefit humans in a variety of ways, including increasing health and well-being, reducing stress, inspiring creativity, enhancing learning, and fostering environmental stewardship values. These experiences help define the relationship people have with nature which is often correlated with a person's level of environmental concern as well as their engagement in pro-environmental behaviors. A more informed understanding of the ways in which interactions with the natural environment can foster connection to nature requires that we are able to measure our perceived relationship to the environment. Dozens of tools measure people's connection to nature—the strength of those perceived relationships with the natural world. Although the tools have been primarily developed to answer research questions, practitioners are increasingly interested in understanding whether and in what ways their work—in areas including environmental education, urban planning, and park management, for example—influences people's connection to nature. In 2018, we launched a participatory process involving researchers and practitioners in a review of existing connection to nature assessment tools with the intention of identifying tools that would be useful to practitioners, as well as defining needs in research. This paper chronicles the process's outcomes, including a discussion of opportunities for future research.

Keywords: connection to nature, assessment, evaluation, environmental education, values, gap analysis

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Edited by:
David Jack Coates, Department of Biodiversity, Conservation and Attractions (DBCA), Australia

Reviewed by:
Jonah Henri Ratsimbazafy, Madagascar Primate Study and Research Group, Madagascar
Andreea Nita, University of Bucharest, Romania

****Correspondence:***
Gabby Salazar
gabriellesalazar@ufl.edu

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INTRODUCTION

Experiences in nature benefit humans in a wide variety of ways. Time spent in nature can enhance health and well-being, reduce stress (Hartig et al., 2014; Kuo, 2015), improve attention, increase happiness (Capaldi et al., 2014), improve educational outcomes (Kuo et al., 2019) and foster environmental stewardship values (Chawla and Derr, 2012; Kellert, 2012). Experiences in nature can also help children develop critical and creative thinking skills and can facilitate social and emotional learning (Chawla, 2015; Kuo et al., 2019). Strong connections to nature are linked to a greater engagement in self-reported pro-environmental behaviors (Whitburn et al., 2019) and may be more important than a background understanding of the issue in driving action (Otto and Pensini, 2017).

The recognition of these benefits and related questions have led to increased scholarship, as well as debate over definitions. Such discussions have explored topics related to what we value in nature (Chan et al., 2016; Hartel et al., 2020), what constitutes nature when discussing "connection to nature" (Evernden and Evernden, 1992), and how that definition varies across cultures. Debates have also explored the definition of connection to nature (Tam, 2013; Ives et al., 2017; Beery et al., 2020), predictors and outcomes of connection to nature (Mayer and Frantz, 2004; Hinds and Sparks, 2008; Mayer et al., 2009; Whitburn et al., 2019), and measurement approaches (Zylstra et al., 2014; Restall and Conrad, 2015).

For the purposes of this project and paper, we define "nature" as an environment in which ecosystem processes are evident, including a spectrum of habitats from a wilderness to an urban garden (Maller et al., 2006; Keniger et al., 2013). "Nature" also includes artifacts from those environments, such as a flower in a window box or a bird flying overhead. Connection to nature is the way people identify with these landscapes and the relationships they form with the elements in those environments (Restall and Conrad, 2015). Connection to nature can be an umbrella term that encompasses different, but related, constructs, including *emotional affinity toward nature*, which can include a person's experiences of awe, love, and concern for nature; *inclusion of nature in self*, which refers to how someone perceives the distinction between self and nature; and *connectedness with nature*, which refers to the extent to which people feel they are a part of nature (Tam, 2013).

Relationships with natural landscapes are not necessarily positive and need not be uniform. Negative experiences in nature may create attitudes of fear or disgust (Bixler and Floyd, 1997; Kellert, 1997) that define a relationship. Wilderness areas often inspire awe, but a backyard can offer an important contemplative respite that creates a different connection to nature. Similarly, utilitarian or extractive activities that involve being outdoors or work with natural resources can result in a strong knowledge base that leads to a positive relationship or an understandable sense of dominion.

Recognizing that many factors may be part of a connection to nature, some elements are likely to be more stable, much like a personality trait, while other elements are mutable to change through interventions or positive experiences in nature (Mayer and Frantz, 2004; Nisbet et al., 2009; Lumber et al., 2017). There also appears to be a typical developmental trajectory, where connection to nature increases in childhood, dips in adolescence, and increases again in adulthood (Beery, 2013; Hughes et al., 2019; Richardson et al., 2019). Effectively assessing connection to nature and the diversity of human relationships with nature is a critical step in understanding the value of nature to humans.

Having the ability to assess connection to nature could be useful to educators, natural area managers, community planners, and others because this concept is both an outcome of experience and learning and a potential indicator of mental health, well-being, and conservation behaviors. Although dozens of tools have been developed to measure connection to nature for research purposes (Tam, 2013; Restall and Conrad, 2015), practitioners are not typically accessing or using these tools. To address this research-practice gap, we undertook a multi-step process that included a participatory workshop with practitioners and researchers. Prior to the workshop we identified commonly used assessment tools and conducted a survey of North American Association for Environmental Education (NAAEE) and Children & Nature Network (C&NN) members to better understand their needs (Monroe et al., n.d.). During the workshop we articulated practitioner needs, identified connection to nature assessment tools that could meet their needs, uncovered gaps and opportunities available for future research, and formed teams to explore ways to improve existing tools and approaches. This paper chronicles the workshop outcomes of the project.

WORKSHOP

The planning team—comprised of representatives from University of Florida, Stanford University, C&NN, and the NAAEE—created a list of 30 researchers in psychology, education, and environmental studies based on publications, conference presentations, and scholarly reputation. We focused on recruiting authors of existing tools that are commonly used to measure connection to nature and on practitioners who have used these tools. In a rolling invitation process to maximize diversity of expertise, focus, research setting, and theoretical orientation, we invited 23 individuals to join the workshop. Due to sabbaticals, administrative duties, or other scheduling/temporal conflicts, 8 people declined the invitation. We halted any further invitations once we reached 15 confirmed participants (excluding the planning team); that final group included five authors of the tools under consideration. We aimed to have a group size that would accommodate large- and small-group interaction, allow for constructive conversation, and support participants in expressing differences of opinion and experience. In the end, 22 people attended the workshop in-person and one attended virtually; three nations were represented (New Zealand, Taiwan, United States).

On October 7 and 8, 2018, in Spokane, Washington, we convened a workshop to address three goals:

1. Goal 1: Articulate practitioner needs and develop consensus around which tools are most appropriate for practitioners to assess connection to nature.
2. Goal 2: Brainstorm about important research questions and needs related to connection to nature measures.
3. Goal 3: Identify research questions that members of the group might address in teams over the following year.

Tool Identification

To identify tools that measure connection to nature, graduate students from the University of Florida (UF) and Stanford conducted a review of the literature by searching for "connection to nature"-related terms in Google Scholar, in university databases (e.g., EBCSOHost), and in the Children & Nature Network Research Library. We then used a snowball-sampling method to search for additional citations and mentions that

may not have surfaced in our original process. Through this process, we identified three synthesis articles (Tam, 2013; Zylstra et al., 2014; Restall and Conrad, 2015) that compared 23 different tools used to measure connection to nature, most of which were identified through our initial literature review. After recognizing that some assessment strategies were not represented in the results of our literature review, we undertook additional efforts to find novel approaches that would complement our set of tools.

Through this process, we selected a total of 26 tools for workshop participants to review. Of those, 88% focused on collecting quantitative data using closed-ended items and measures such as scales. We summarized those 26 tools, including the constructs measured, the tool format, and information on the reliability and validity of the tool, and sent the summaries to participants prior to the workshop.

Workshop Outcome 1: Articulation of Practitioner Needs

During the workshop, participants discussed perceived practitioner needs, recognizing that researchers' needs likely differ from those of on-the-ground practitioners. Researchers address theoretically driven questions with the intention of producing generalizable knowledge that will be applicable beyond a specific program, audience, or context. Practitioners, on the other hand, are typically driven by evaluative questions and are interested in knowing whether, how, and under what conditions a specific program achieves its desired outcomes. We developed a consensus understanding of practitioners' needs (listed below) and used this perspective to narrow our collection of assessment tools.

Tools That Can Generalize Beyond a Small Sample of Participants/Visitors

Although practitioners are less likely to focus on producing generalizable knowledge beyond their own programs, for logistical and practical reasons, they may need to collect data from a small sample of their own visitors or participants and extend these findings to their population of visitors.

Tools That Can Detect Changes Due to Participation in a Program

Practitioners who wish to evaluate a program need to measure differences in key characteristics (e.g., knowledge, attitude, values) at two points in time, before and after a program. As those changes may be small and subtle, tools must be sufficiently sensitive and able to capture changes in "state" characteristics (which may be temporary).

Tools That Are Easy to Administer

Few non-profit and educational organizations and agencies have a large or well-trained staff specifically focused on evaluation or research. Therefore, practitioners need tools that are straightforward and that produce data that are easy to analyze and interpret.

Tools That Are Valid Across Various Audiences, Programs, and Settings

To assess whether and how educational and interpretive programs are meeting their intended goals with their audiences, practitioners need tools that are valid (measure the appropriate concepts and constructs), reliable (do so consistently over time), and stable (remain consistent in varying conditions and with a range of audiences). They also require tools that they can adapt to a range of ecosystems, cultures, programs, and languages. Relatedly, practitioners need to know what changes (e.g., vocabulary, item order) can be made to existing tools without undermining the original validity.

Tools That Are Widely Available

If tools are available only in the peer-reviewed literature or directly from researchers, they are difficult for practitioners to obtain. Without such access, practitioners often create their own evaluation tools, undermining the opportunity for comparable results among programs (Stern et al., 2014).

Workshop Outcome 2: Identifying Appropriate Tools

Workshop participants formed small groups, and each was assigned a subset of similar tools to review in detail. They critically examined the 26 tools using the following criteria:

1. Is the tool measuring connection to nature, or is it measuring other constructs?
2. Are there any other major issues with the tool?
3. Does the published, peer-reviewed literature suggest that the tool is valid and reliable?
4. Does the tool seem that it would be easy for practitioners to adapt and implement? If so, is it likely to return meaningful data that are easy to analyze?

Each group summarized their discussion using large flipchart paper, which all participants reviewed as they added their own comments. After a facilitated discussion on each of the tools, the group assigned each tool to one of two categories: "Remove from further consideration" or "Useful to practitioners to measure connection to nature."

We removed 18 tools because we decided that they primarily measured constructs other than connection to nature or were less useful for any of the above practitioner needs (see **Supplementary Material** for further discussion). This left eight tools that the group thought could be appropriate for practitioners (**Table 1**).

Workshop Outcome 3: Research Projects to Improve Existing Tools

Based on our discussion of the needs of practitioners and the shortcomings of some tools, the workshop motivated and the project supported three small research projects to review and enhance existing assessment tools in the following year. The outcomes of these efforts were made available to practitioners in a guidebook (see **Box 1**).

TABLE 1 | Tools identified as being useful to practitioners to assess connection to nature.

Tool	What does this tool look like?	Intended audience
Biophilia interview, Rice and Torquati (2013)	11-item scale with binary response options conducted as an interview with young children	Early childhood (2–5 years)
Connectedness to nature, Mayer and Frantz (2004)	10-item scale; responses to items are recorded on a 7-point balanced scale, ranging from *strongly disagree* to *strongly agree* 14-item scale; responses to items are recorded on a 5-point balanced scale, ranging from *strongly disagree* to *strongly agree*	Young adolescents (10+ years) and adults Adolescents and adults
Connection to nature index, Cheng and Monroe (2012)	16-item scale; responses to items are recorded on a 5-point balanced scale, ranging from *strongly disagree* to *strongly agree*	Children (8–10 years)
Digital photography and journaling, Ardoin et al. (2014)	Collection of journal entries, photographs, and captions	Children, adolescents, and adults
Environmental identity scale, Clayton (2003)	11-item scale; responses to items are recorded on a 7-point rising scale ranging from *not at all true of me* to *completely true of me*	Adolescents and adults
Inclusion of nature in self scale, Schultz (2002)	1-item pictorial scale with seven response options ranging from complete separation to complete overlap	Children (7+ years), adolescents, and adults
Love and care for nature scale, Perkins (2010)	5-, 10-, and 15-item scales; responses to items are recorded on a 7-point balanced scale ranging from *strongly disagree* to *strongly agree*	Adolescents and adults
Nature relatedness scale, Nisbet et al. (2009)	21-item scale; responses to items are recorded on a 5-point balanced scale ranging from *strongly disagree to strongly agree* 6-item scale; same response options as 21-item version	Adolescents and adults Children, adolescents, and adults

BOX 1 | This workshop was part of the two-year *Connection to Nature Assessment Project*. Another outcome of this project was a *Practitioner Guide to Assessing Connection to Nature*, which features 11 tools and approaches to assessing connection to nature (Salazar et al., 2020). Included are the eight tools that workshop participants identified as being useful to practitioners, plus three tools identified after the workshop that address practitioner needs: the Children's Environmental Perceptions Scale (Larson et al., 2011), Nature Relatedness Observations (Elliot et al., 2014), and interpretation of children's drawings. To make the guide more useful to practitioners, team members engaged over 340 conference attendees in several locations to review draft components and provide input on its development.

Project 1

A team revised the Environmental Identity Scale (Clayton, 2003) to make it more inclusive of urban experiences of nature and to make the language more accessible to individuals with low literacy levels (Salazar et al., 2020). The team tested the revised scale with seven different samples, including high school students in Chicago, United States, adults in Russia, and adults in Peru.

Project 2

A team reviewed the current state of connection to nature assessments for young children (Beery et al., 2020). The team developed a definition of early childhood connection to nature, ensuring that it was inclusive of young children's special qualities and recognizing the importance of children's agency and empathy in defining nature connection. This definition further emphasizes that connection to nature, among young children in particular, is multidimensional, place-based, and context-dependent.

Project 3

Two researchers revised the Connection to Nature Index (CNI) (Cheng and Monroe, 2012) to address three issues with the original scale (Salazar et al., 2020). They revised items to reduce the possibility of leading respondents to only consider positive responses; removed items that reflected behavioral intention; and equalized the number of items measuring each concept. The revised scale measures three concepts related to connection to nature, including enjoyment of nature, empathy for creatures, and sense of oneness with nature. They tested the revised scale for reliability and validity with 90 third-to-fifth-grade students in Taiwan.

Workshop Outcome 4: Future Research Priorities to Address Practitioner Needs

Workshop participants reflected on potential opportunities for future exploration to advance our understanding of connection to nature and the ability of practitioners to use assessment tools. They developed the following suggestions to frame future research in this field.

Define Connection to Nature

This umbrella term should be further clarified, separating the relationship with nature from beliefs, values, attitudes, behaviors, and experiences with and about nature, and exploring how these outcomes are correlated or dependent on each other.

Qualitative Approaches and Tools

There is also a need to develop practitioner-friendly tools for collecting qualitative data. We identified a need for strategies that can deepen our understanding of the processes by which programs impact nature connection among participants.

Embedded Assessments

For practitioners who lead programs, embedded evaluation activities avoid disrupting the program to collect data. Games and art activities were discussed as possible strategies.

Tools That Explore a Range of Nature Connections

Most existing tools explore positive and preservation attitudes toward nature. Tools that explore human-nature relationships associated with utility, livelihood, subsistence, or fear are needed.

Validation of Tools Across Languages, Cultures, and Populations

Practitioners need tools that are useful and appropriate across a wide variety of populations, cultures, and contexts. We recognized several priority populations: those with disabilities who may experience nature differently, those from cultures who may understand nature differently, and those for whom English is not their language of choice. There is also a need to understand whether tools can be adapted to be more culturally responsive, particularly when working in cultures where the human-nature relationship is conceptualized differently.

Changes Due to an Intervention

Practitioners need to know what kinds of programs and experiences foster connection to nature and what program characteristics make the largest difference. Frequency, duration, and opportunities for reflection should be considered. The stability or longevity of change is of particular interest as well, and it would be helpful to test the ability of tools to assess long-term changes. In addition, the impact of vicarious experiences (e.g., videos, virtual experiences, and stories) should be explored.

Further Testing of Tools

Future research could explore how tools perform when tested across multiple contexts and should compare tools to understand whether they are measuring the same concept. How does connection to nature vary from or correlate with sense of place or biophilia? Testing could examine whether rising or balanced scales more effectively and reliably capture change.

Collective Evaluation

Researchers might create a system to collect data from commonly used tools in a variety of contexts to ask and answer more global questions with "big data."

DISCUSSION

Sharing research results with those who can use them is an ongoing challenge for the academic community (Meyers, 2006; Neal et al., 2015). This work may be more difficult when researchers and practitioners do not share the same disciplines, as is the case with psychologists and environmental educators who are interested in connection to nature assessments. Our project, coordinated by researchers in environmental education, helped create bridges among disciplines and identify avenues to reach common ground. By bringing together researchers and practitioners in a participatory learning process we created opportunities for social learning and knowledge production (Wals et al., 2009; Monroe, 2015).

Environmental educators, city planners, and park directors, among others, are increasingly interested in understanding their audiences' connection to nature and in assessing whether, and in what ways, their programs and initiatives influence this connection. Yet while many tools exist to assess connection to nature, their utility to practitioners is limited by their format; their bias toward particular conceptions of nature; their focus on a limited range of audiences and contexts; their availability; and inconsistencies in their reliability, validity, and stability.

Workshop participants were engaged and actively advanced our collective understanding of how the needs of practitioners may not match the interests of researchers or funders. Several of these needs could be expanded in future proposals for new research projects, such as creating and testing qualitative tools and analysis strategies and developing strategies for embedded assessments that can be part of program activities.

Workshop practitioners also discussed ways to advance the concept of connection to nature, such as exploring whether the term connection to nature should encompass the full range of relationships and experiences that people have in the outdoors, the effect of various components of a program, and how different experiences create or sustain a connection to nature. It may be valuable to explore whether the agree/disagree scales are less effective in capturing fine-scale shifts in respondents' perception of their connection to nature and are thus artificially reporting greater stability in traits than is warranted. From a practical perspective, using multiple tools with the same program could help us learn more about how they compare and enhance our understanding of changes due to a program (Giusti, 2019). As youth increasingly engage in electronic media, the question of developing a connection to nature from vicarious experiences becomes more urgent.

The advances that were made in refining existing tools as a part of this project represent the ways researchers can benefit from engaging with practitioners. Small changes to the vocabulary used in a tool can affect how people think about nature. For example, changing "mountain ranges" to "leafy backyards" makes an item more accessible to urban residents. Developing strategies to observe and interview young children enables practitioners to understand their perspectives.

There were also limitations to our project. Participation in the workshop was limited by time, money, language, and our networks. The tools we reviewed were limited to those published in the literature. We did not access gray literature and may have missed existing tools that could also be useful to practitioners.

Future Directions

There is a deep, longstanding interest in understanding the value of nature to humans (Kaplan and Kaplan, 1989; Kellert and Wilson, 1993). Although some tools exist to assess aspects of the human-nature relationship, there are still many gaps in our understanding and many unanswered questions. Interdisciplinary teams of researchers and practitioners can help move this exciting work forward as we explore connection to nature as a part of the critical valuation of nature's contributions to people. Pathways that enhance connections to nature and

outcomes that result from deepening our relationship with nature are examples of concrete actions that may help us achieve goals for conserving and sustainably using nature. By enabling practitioners to conduct valid assessments and program evaluations, we can enhance our collective understanding of connection to nature: how and under what conditions it develops; how it is supported, nurtured and enhanced; and the outcomes and impacts it creates.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

GS was the lead writer. MM, CJ, TB, and NA contributed to the writing process. MM, CJ, and NA organized the workshop. All authors attended the workshop.

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SUPPLEMENTARY MATERIAL

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Do Conceptual Innovations Facilitate Transformative Change? The Case of Biodiversity Governance

Erik Hysing[1] *and Rolf Lidskog*[2]*

[1] CESSS—Center for Environmental and Sustainability Social Science Research, School of Humanities, Education and Social Sciences, Örebro University, Örebro, Sweden, [2] Environmental Sociology Section, School of Humanities, Education and Social Sciences, Örebro University, Örebro, Sweden

This paper explores to what extent and in what ways conceptual innovations matter for biodiversity governance. A three-step analysis is employed, starting with identifying theoretical insights on how concepts matter for transformative change. These insights provide a lens for examining the academic debate on the Ecosystem Services concept and for identifying critical conceptual challenges related to transformative change. Finally, how the concept is used and valued in policy practice is explored through an empirical study of policy practitioners in Sweden. Based on this investigation we conclude that the ES concept holds important but restricted properties for transformative change. The ES concept provides new meanings in the form of economic valuation of nature, but these remain highly contested and difficult to practice; ES function as a boundary object, but poorly integrates social analysis and, in practice engages professionals, rather than resulting in more inclusive public participation; and ES function performatively by reflecting a technocratic ideal and raising awareness rather than targeting fundamental political challenges. Finally, the paper returns to the general questions of how conceptual innovations can generate transformative change and argues that in the continued work of conceptually developing the Nature's Contribution to People, researchers and practitioners need to pay close attention to interpretive frames, political dimensions, and institutional structures, necessitating a strong role for social analysis in this process of conceptual innovation.

Keywords: ecosystem services, nature's contribution to people, transformative change, boundary objects, conceptual innovations, biodiversity policy, environmental governance

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***Correspondence:**
Rolf Lidskog
rolf.lidskog@oru.se

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INTRODUCTION

Whereas, researchers have long stressed the inextricable link between society and nature and the need to move away from the unsustainable path society is on, they are significantly more uncertain about how to initiate, facilitate, and guide this change. There is an increasing accumulation of scientific data on human impact on the environment, some even claiming that we have surpassed planetary boundaries (Rockström et al., 2009) and entered the qualitatively new epoch of the Anthropocene (Steffen et al., 2011). Despite international agreements and declarations—such as Agenda 2030 and the 17 Sustainable Development Goals—there are few signs that society is

radically changing track. This has led international environmental expert organizations to stress an urgent need for transformative change. The IPCC (2018) stresses that we need to address the root causes of climate change, and the IPBES (2019) assesses the conditions for transformative change to investigate options for achieving the 2050 vision for biodiversity. In addition, there is continuous hope that disseminating knowledge and understanding will lead to transformative action (Boström et al., 2018). By providing broader narratives (of which the Anthropocene is one of the most recent), inventing new concepts (such as Nature's Contribution to People) and developing new objectives, indicators, and targets (such as the IPCC's 1,5-degree report), experts aim to guide actors' understanding and thereby their actions. Constructing and spreading concepts and narratives are a central means of convincing companies, organizations, politicians, and citizens of the high value that nature contributes to people and society.

Within the field of biodiversity protection and nature conservation, the concept of Ecosystem Services (ES) has for the last 15 years—following the publication of the Millennium Ecosystem Assessment (2005)—become one of the most prominent ways to conceptualize the interdependency between ecosystem processes and functions and societal and human well-being (Stålhammar, 2020). ES serves as a boundary object that facilitates communication and collaboration between policymakers and different scientific disciplines (Abson et al., 2014; Ainscough et al., 2019) and has been integrated into policy documents and strategies on international, European Union, national, and local levels (e.g., Schleyer et al., 2015; Beery et al., 2016; Verburg et al., 2016; Hysing and Lidskog, 2018). Nonetheless, the concept has been debated and severely criticized, not the least for not fulfilling its promise of initiating and facilitating transformative change. Barriers to a stronger transformative role have been attributed both to its conceptual construct (e.g., anthropocentrism and economic valuations) (Schröter et al., 2014) and policy and institutional factors, such as competing political agendas and entrenched professional norms (Saarikoski et al., 2018).

A new concept—Nature's Contribution to People (NCP)—has been introduced with the aim to improve biodiversity governance that foster necessary changes (Pascual et al., 2017). Great expectations have been placed on this concept, stating that it implies a paradigm shift by including aspects that ES is missing. In particular, it claims to better include value pluralism in decision-making as well as to better incorporate knowledge from the fields of social sciences and humanities. The NCP and the expectations attached to it have been subjected to strong debate, not least by proponents of ES (Faith, 2018). The criticism spans from claiming that the concept is almost synonymous with ES (De Groot et al., 2018) and thus will not solve the problem associated with ES (Kenter, 2018), to that it underemphasizes social-ecological processes (Peterson et al., 2018) and threatens the established science-policy relation that ES successfully has made possible (Kenter, 2018). A way to avoid a conceptual conflict between NCP and ES has been to tone down the differences (Maes et al., 2018; Kadykalo et al., 2020) and claim that they can co-exist, either seeing NCP (Díaz et al., 2018) or ES (Kenter, 2018) as the overarching concept.

Whereas, the debate has explored benefits and limitations of introducing NCP as a key concept for biodiversity governance, there has been limited discussion on what way and to what extent conceptual innovations really matter for environmental governance. Despite substantial policy development and increased media attention, the gap between what is done and what needs to be done is still growing for many environmental issues, not least including that of biodiversity loss, which has led to a lot of hope being placed on new concepts, methods, and understandings for how to value nature. While it is too early to assess whether the adoption of NCP in practice leads to improved stakeholder dialogue, value pluralism, and integration of knowledge from social sciences and humanities, it is important to develop a more comprehensive understanding of conceptual innovations and to explore in more detail how concepts may matter for biodiversity governance.

The aim of this paper is to explore to what extent and in what ways conceptual innovations matter for biodiversity governance. The study is explorative, investigating how scientific concepts are discussed in research and used in practice. It uses insights generated from the field of science and technology studies (STS), academic debates on the ES concept, and empirical data on how the concept of ES is used and valued among policy practitioners in Sweden. The rationale behind this design is that while NCP is a concept that has not yet been integrated into policymaking, ES has, and there is still a lot of knowledge to gather about to what extent and in what way it has (or has not) influenced this policy area. Thus, ES is utilized as a window to explore how new concepts are perceived and used in practice and to discuss the role of conceptual innovations in (transformative) biodiversity governance. The aim is thus explorative, it does not aspire to provide a full review of conceptual developments or challenges for the ES concept, nor to generate general (cross-contextual) insights on how concepts function in every policy area. At the same time, by exploring and analyzing challenges that ES has faced in its integration in biodiversity governance, knowledge is gained relevant for NCP when it is now introduced as an important concept to foster transformative change in biodiversity governance.

This paper consists of four sections. The second section describes the design of the study. The third section presents the findings and is structured as a three-step analysis. First, we review how concepts matter for policy development and transformative change. Thereafter, we make use of this knowledge to analyze the academic debate on ES, to discern critical issues raised regarding its transformative power. Third, we draw on a recently conducted empirical study to illustrate how policy actors use and value the concept of ES in practice and what challenges they experience when acting based on this concept. Based on these findings, the concluding section returns to the general question of how conceptual innovations can generate transformative change, summarizing the lessons learned from the application of ES to biodiversity governance, and distinguishing crucial aspects of importance for the further conceptual elaboration of NCP.

MATERIALS AND METHODS

This paper focuses on conceptual innovations to transform biodiversity governance. For this study, the concepts of ES and NCP are the focus. The reason is that these concepts explicitly aim to help decisionmakers better value biodiversity and to facilitate action. ES and NCP are also institutionalized concepts in the sense that they are part of environmental discourse and are actively propagated within and outside of the academic community. These concepts are also under debate, with ongoing discussions about to what extent they are appropriate for this task; do they strengthen the worth of nature in deliberations and decisionmaking (Braat, 2018; Díaz et al., 2018; Peterson et al., 2018; Kadykalo et al., 2020)? A study of the critical issues raised in the academic debate on ES regarding its transformative effects and how it has been used and valued among policy practitioners is particularly timely as the launch of new concepts—such as NCP—have generated a vivid debate on the pros and cons of these concepts.

Studying conceptual innovations means investigating what kind of communication a concept constructs, what meanings it is assigned and by whom, and to what extent it facilitates shared objectives and actions. It is important to note, however, that there is rarely a single communicative space created; rather, discussions and deliberations take place in many settings and domains. Therefore, a concept may function differently in different contexts.

This paper adresses how concepts matter in policy practice, including the design of policy tools and measures and the actual implementation efforts among various private and public organizations. A three-step analysis is used. The first step is to investigate how concepts can produce change in society. This is done using literature from the STS field, especially how it has been applied in studies on environmental discourses and policymaking. In this review, attention is paid to the concept boundary object, which aims to create a communicative and collaborative space among diverse actors (Star, 1989, see also Bowker et al., 2015 for a discussion and application of this concept). The reason for focusing on the boundary object and its functioning is that biodiversity governance involves diverse actors with different social beliefs, material interests, and ways of valuing nature and biodiversity (Star, 1989, p. 21).

These insights are used as an analytical lens, as attention turns to the concept of ES and the extensive scientific discussion about to what extent the concept can foster transformative change, which has also been a basis for suggesting NCP as a more apt concept. Concepts and arguments from the STS literature guided the review, identifying key search terms such as conceptual innovation, boundary objectives, and transformative change. A broad database was used (Google Scholar) but we restricted the analysis to peer-reviewed materials. Articles were appraised qualitatively for bringing new insights into the function of the ES concepts for transformative changes (i.e., conceptual contribution). Most selected articles come from the policy-oriented or critical literature on ES. In analyzing the material, areas of controversy were of particular interest, therefore, ensuring that different perspectives were clearly visible in the analysis, was important. This explorative review design means that it is does not provide a systematic overview of the literature but it is restricted to explore critical issues raised in the ES debate, providing an important context for the conceptual elaboration of NCP.

In a third step, the focus turns to how the concept has been used in practice. Introducing a new concept in policy documents is one thing, turning it into practice is another. Research on environmental governance (Hysing and Olsson, 2018) as well as on ES policy implementation (Saarikoski et al., 2018), have highlighted the importance of individuals actively championing new concepts and approaches within their organizations and sectors to facilitate change. Based on an interview study among policy practitioner identified as "frontrunners" in the implementation of ES in Sweden, the paper explores the functions and value of the concept in the practical implementation of biodiversity policies (similar designs have been used in e.g., Blicharska and Hilding-Rydevik, 2018; Keenan et al., 2019; Martin-Ortega et al., 2019). The study was carried out in the spring of 2020 and included 35 respondents. Semi-structured interviews were conducted with representatives of governmental agencies, municipalities, county administrative boards, farmer and forest owner organizations, forest companies, food processing companies, housing and construction companies, and others. The analysis was conducted using a contextualized thematic approach over several stages (Bryman, 2012; Kvale and Brinkmann, 2014). A detailed description of the interview study—data collection and data analysis—is provided in the **Supplementary Materials**.

This study is explorative with the aim of better understanding conditions for conceptual innovations to work transformatively. Thus, the investigation of the ES concept is used to better understand the challenges involved when putting concepts into practice. This knowledge is of great relevance when pondering how to make new conceptual innovations matter for biodiversity governance.

RESULTS: CONCEPTUAL INNOVATIONS FOR TRANSFORMATIVE CHANGE

The call for transformative change has dramatically increased in environmental discourse and politics because many environmental problems are worsening despite different international and national initiatives to combat them. Gradually and slowly adapting regulations and practices seems insufficient for meeting the current environmental challenges, such as biodiversity loss and climate change; instead, more radical, and far-reaching solutions are needed. Transformative change means that fundamental institutional arrangements, norms, and practices in society need to be changed, often by developing new ones (Scoones et al., 2015; Buch-Hansen, 2018; Linnér and Wibeck, 2019). As for any intentional social change, this transformation needs to be initiated, supported, fostered, and governed. Thus, transformative change implies a need for agency—meaning social actors enable and facilitate this transformation. However, in what ways can conceptual

innovations, and their dissemination and appropriation enable transformative change?

How Do Concepts Matter?

To grasp environmental changes, new concepts are invented, and old concepts cease to be used or include new meanings. Concepts such as air pollution, climate change, and biodiversity loss have developed and gained prominence in environmental politics and public debates through the dynamic interaction of environmental changes and scientific knowledge. Similarly, solution-oriented concepts have been invented to mobilize action in the form of either negative concepts, such as planetary boundaries that should not be crossed, or positive concepts that point to a state that needs to be reached, such as resilience and sustainable development.

At the same time, some concepts are more apt than others for enabling us to understand a particular environmental issue, and the fact that a concept becomes widespread and frequently used does not necessarily imply that it is well-founded and well-formulated. There are several examples of concepts that originally had mobilizing effects and policy impact but that later came to be questioned or marginalized. However, even if a concept currently is, or will later be, scientifically rejected, it may nevertheless have great importance and can influence our understanding of the world and thereby how we act in this world (Lidskog and Waterton, 2016). Sometimes, a concept has a primarily pedagogical function, conveying an accessible understanding of a complex scientific context (Lidskog, 2014). "Ozone hole," "clean air" and "greenhouse effect" are all frequently used notions that were developed not to capture a distinct scientific meaning but to create a popular understanding and to facilitate communication with people and organizations outside the scientific community. Additionally, it is notoriously difficult to achieve a shared definition of fundamental concepts such as "nature," "society," and "culture," but they nevertheless have important communicative functions.

Concepts as Meaning Providers

It is important not to restrict the discussion of conceptual definitions, as it is not formal conceptual definitions that matter but the larger meaning they provide. A concept's meaning can shift radically in relation to the context in which it appears and its place in a wider interpretive frame. Many interpretive frames—which often take the form of narratives—not only condense large amounts of information and assumptions about the world but also assign meanings to it, thereby directing attention and motivating action (Arnold, 2018). However, to facilitate action, it is not sufficient to explain the world (factual knowledge) and to describe what actions are needed (normative orientation and value connection). There is also a need to give the issue priority and to create engagement, which is done by connecting to emotions (Barbalet, 2002). Research has long stressed that feelings are a constitutive part of human judgment and decision-making, that feelings and cognition are interrelated and that emotions are an important factor in motivating action (Finucane, 2013; Hysing and Olsson, 2018). If a message does not invoke any emotion, there is a risk that no action will be taken despite shared agreement on the situation and what needs to be done. Expert organizations face a delicate balance in shaping persuasive narratives that involve normative guidance and emotional appeals but in ways that do not negatively affect their epistemic authority (Lidskog et al., 2020). Thus, it is a great challenge to balance the dynamics between emotional and normative messages and relevant and valid knowledge to create an understanding of the world that provides incentives for action.

However, even if an expert organization successfully performs this delicate task, providing firm knowledge about an environmental problem as well as guidance regarding what to do and motivation to act, this is not sufficient. Environmental problems appear in a particular society and must be solved in and by this society. Thus, to develop valid and relevant solutions to an environmental problem, there is a need to understand, not only the state of the environment and how nature works, but also how society works. In striving for transformative change, any relevant and efficient proposal needs to be based on a valid view of how society is organized and how it functions (Jasanoff, 2005; Beck et al., 2014). There is a need for qualified social analysis of the social causes of an environmental problem; why it has developed, why it is maintained and how it can be changed. If no social analysis is performed, suggested solutions may work on paper but not in practice. If a proposed solution is not based on a valid understanding of the world—how nature as well as society works—it will be difficult to implement it, and even if it is possible to implement it, the implementation will probably lead to cascades of unintended consequences (Boudon, 1982).

Historically, knowledge of environmental problems and their solutions has been provided mainly by environmental scientists based in natural science. Gradually, however, social scientists have started to research environmental problems and have been included in the work of expert organizations to synthesize knowledge and to provide policy advice (ISSC and UNESCO, 2013). There is, however, a risk that the dynamics of society are not treated as seriously as the dynamics of ecosystem processes, not least that social scientists are invited mainly to facilitate the implementation of solutions that are not based on an analysis of the social causes of a particular environmental problem.

Understanding environmental issues requires us to move away from traditional disciplinary research into more substantial interdisciplinary collaborations (Lidskog et al., 2015). To understand and handle environmental problems, the starting point cannot be changes in nature but recognition of the socioenvironmental dynamics, where environmental problems are co-constituted by the dynamic interactions between social and natural processes. Therefore, discussions of environmental issues, such as biodiversity, are of a truly interdisciplinary character, which means that concepts are crucial in enabling (or hindering) cross-disciplinary communications and collaborations. Many times, this kind of concept has the character of a boundary object.

Boundary Objects as Places for Communication and Dissension

A boundary object aims to create a communicative and collaborative space among diverse actors where they can meet and work together (Star, 2010). Whereas boundary work

(Gieryn, 1983, 1999) mainly concerns how actors strategically draw boundaries to make a knowledge claim credible and authoritative, a boundary object functions to connect different social worlds and meanings. It is an object (artifact, conceptual model, classification system, etc.) that allows members of different communities to interact and coordinate even if they have divergent perceptions of the object (Star and Griesemer, 1989, p. 393). The boundary object makes this possible by being both elastic enough to adapt to the local needs and constraints of the actors employing it and robust enough to maintain a common identity across sites (Star, 1989, p. 21). In functional terms, this means that a boundary object can serve as a point of reference where actors from different social worlds can meet, shape mutual interests, and work to reach a shared objective. By providing a minimalistic (thin) understanding of an issue without claiming a particular meaning (a thick understanding), the interests of different actors and experts can be linked, and communication is made possible. Therefore, a boundary object is both recognizable for different interests and open to different meanings; it is simultaneously understandable and relevant for actors from different social worlds because it is both universal and vague across them.

Importantly, as Star (2010) heavily stresses, boundary objects do not presuppose a consensual view of an issue. On the contrary, a boundary object is a meeting point for diverse actors and therefore involves different perspectives, interests, and worldviews. This means that different standpoints often come to the fore, and by articulating this dissension, actors are better equipped to negotiate, navigate around, and collaborate on an issue. Thus, the central function of a boundary object is that it allows communication between actors from different social worlds. There is, however, no guarantee that a pluralistic perspective will be protected and maintained in the collaborative work. Not least due to power asymmetries, distinct disciplinary traditions, and different sociopolitical interests—there is always a risk that a hegemonic understanding suppresses the pluralistic meaning of an issue (Tengö et al., 2014; Löfmarck and Lidskog, 2017). In such a situation, the interpretive flexibility of a boundary object diminishes, and the balance between adapting to and constraining all actors' needs is disturbed; a powerful actor may succeed in restricting flexibility in such a way that there is almost no constraint on its needs at the expense of other actors' needs. Consequently, the boundary object ceases to function.

Concepts Describing but Also Changing the World

Language and concepts are central to our understanding of the world. Changes in the environment create a need to adapt language by giving old concepts new meanings and by inventing new concepts that enable us to better grasp changing circumstances, emerging questions, and new findings. Conceptual innovations, in turn, pave the way for modifying and changing environments. In this sense, concepts and interpretive frames are performative; they *do* something with the world. They are navigational (directing our attention), normative (shaping our priorities), and performative (guiding our actions) (Lidskog and Waterton, 2016). This means that the development, spread, and appropriation of concepts not only describe the world but also change the realities they are meant to describe, since they may influence how we interact in and make use of this world. By encouraging organizations and people to see and act in particular ways, concepts may mitigate or, alternatively, intensify environmental problems.

It is therefore of the utmost importance not only to make use of concepts but also to reflect on their more fundamental implications; what understanding of reality does a concept contain? What kind of interpretive framework (explicit or implicit) underlies the meaning attached to a concept? To what extent and in what way does a concept fit in with existing governance structures? Thus, concepts that seem to have been successfully spread and adopted with the aim of strengthening the worth of nature in decision-making, raising environmental awareness, and guiding environmental action may not necessarily do so. It is time to approach what seems to be a successful, but contested, conceptual innovation within the biodiversity field, namely, ES.

Is Ecosystem Services (in)Capable of Generating Transformative Change?

ES, defined as "the benefits people obtain from ecosystems" (Millennium Ecosystem Assessment, 2005), has become one of the most prominent ways to conceptualize the interdependency between nature and society. The concept has been widely embraced by policymakers, corporations, and environmental organizations. It was made an essential part of the Convention on Biodiversity Strategic Plan for Biodiversity 2011–2020 (UNEP, 2010) and the EU 2020 Biodiversity Strategy (European Commission, 2011) and has been integrated into a range of national and local policies, plans and management strategies (e.g., Matzdorf and Meyer, 2014; Schleyer et al., 2015; Beery et al., 2016; Verburg et al., 2016).

ES is frequently portrayed as a boundary object that can facilitate communication and collaboration between policymakers and different scientific disciplines (Abson et al., 2014; Ainscough et al., 2019). There are various frameworks such as the ecosystem cascade model to explain how the ES concept can be used to link nature and society, identifying key elements of what have been termed "the ES paradigm" (Potschin-Young et al., 2018). Essentially, ES has three key functions for changing policy practice. The concept helps to (1) translate functional characteristics of ecosystems into services of use for society and human well-being. The benefits and values of these services, and the costs associated with their degradation, are (2) identified, calculated and communicated to decision-makers using a language that is convincing and easy to understand (e.g., monetary valuation). By furthering recognition of these benefits and values of ecosystems to society (3) the concept will help upgrade the worth of nature among decision makers and thus initiate and foster further policy actions to address key societal drivers of ecosystem degradation and biodiversity loss, limiting pressure on ecosystems, achieving substantial environmental improvements, and promoting sustainable development (**Figure 1**).

FIGURE 1 | Three interrelated functions of ES to change biodiversity governance.

Although the concept has successfully entered both academia and policymaking, it has also been contested and criticized both as a concept and as a policy approach (Hysing and Lidskog, 2018). The next section will revisit critical issues raised in this debate—and made explicit with the introduction of NCP (cf. Kadykalo et al., 2020)—regarding the ability of ES to successfully facilitate transformative change.

Missing Social Analysis

The ES concept has successfully facilitated communication between the fields of ecology and economy but has been less successful in engaging social sciences and humanities (Díaz et al., 2018; for a rebuttal, see Braat, 2018). One reason is that the concept is founded in the natural sciences, discouraging social scientists and limiting what questions are seen as valid and important as well as the theories and methods used (Stenseke, 2016). Social science thus risks being assigned the restricted role of facilitating and improving the uptake of the concept, that is, a policy orientation, rather than contributing to its scientific meaning. This has furthered a polarized debate between the applied and critical literature with limited constructive dialogue between them (Kull et al., 2015). This poses a serious problem for the function of ES as a boundary object that hinges on its capacity to generate open communication and cooperation across disciplinary fields.

A poorly elaborated social analysis also risks reducing the potential of ES to generate transformative change because social science offers critical insights into the social causes and drivers of environmental problems and solutions (Jetzkowitz et al., 2018). Additionally, social science provides knowledge on how society works, and by including issues of power, interests, equity, and the like (Stenseke, 2016), why conceptual innovations such as ES has (or do not have) transformative effects becomes understandable.

Restricted View on Nature's Value

An important innovation of ES compared to more traditional nature conservation approaches is that nature has an instrumental value for human well-being and social prosperity (i.e., the anthropocentric rationale). While this value can be expressed in various ways depending on the circumstances, the connection between ES and monetary valuation has been present from the start (Costanza et al., 1997) and has been seen as a powerful instrument for attracting decision-makers' attention (Polasky and Segerson, 2009; Adams and Redford, 2010).

While few researchers question whether monetary valuation is important in public and private decision-making, critics question whether economic instruments can capture the full range of values associated with ecosystems (Ainscough et al., 2019) and thus whether ES assessments will provide decision-makers with convincing but basically incorrect or partial information. Research has shown that people often find it difficult to express their appreciation of nature in terms of "willingness to pay" for services, as this appreciation is often based on emotional attachments or relational values (Chan et al., 2016; Stålhammar, 2020). The experienced and appreciated values of nature are also contingent on the cultural context, which varies across the globe (Díaz et al., 2018). Critics fear that setting a price on nature to save it will lead to underestimating the value people attach to nature, generating a low price and thus resulting in nature being destroyed (Spash, 2015). This problem is, however, not unique to ES but is also the case for traditional conservation methods and rationales (Potschin-Young et al., 2016).

In addition to criticism of economic instruments, there are concerns about the discursive impact of using economic metaphors and language. It has been argued that conjoining economics and ecology will enable ES to generate a degree of momentum for environmental actions that would not be possible otherwise (Sukhdev et al., 2014). By (re)articulating the value of nature using an economic logic that decision-makers understand, ES is hoped to neutralize traditional conflicts, generating additional resources, and overcoming political resistance from economically minded actors. Adhering to, rather than challenging the economic logics that are behind ecosystem degradation, is seen by others as a misguided and an overly pragmatic strategy that risks alienating important stakeholders and decision-makers; undermining other rationales for nature conservation; furthering economic self-interest as the logic of environmental protection (Fletcher and Breitling, 2012; Suarez and Corson, 2013; Hysing and Lidskog, 2018); and risking privileging economic actors, interests, and modes of governance over others, thus discursively limiting the range of available policy alternatives (e.g., Turnhout et al., 2013; Gómez-Baggethun and Muradian, 2015).

Technocratic View of Science and Change

A key rationale behind ES is that the concept can get the message of the value of ecosystems across to decisionmakers (i.e., it can function as a boundary object). Critics have argued

that ES is founded on a technocratic ideal, placing power in the hands of presumedly neutral experts, privileging scientific knowledge claims over others, and disregarding the fact that all knowledge claims are situated (rather than universal) and based on specific values, preferences, and priorities (Turnhout, 2018). This linear model of science-policy interactions means that professional experts play a prominent role because they are assigned the epistemic authority to identify the problems and to assess different knowledge claims. However, this may dampen the genuine participation of a broader set of stakeholders, local communities, and indigenous people who bring valuable knowledge and whose involvement is necessary to generate change that is legitimate and sustainable (e.g., Schleyer et al., 2015).

Assigning values is portrayed as a largely neutral, scientific, technical, and uncontroversial process that lies largely beyond ideology and politics. This expert valuation and deliberation has, however, been accused of being ill-suited to handling the conflicting interests and social values inherent in biodiversity governance, masking ecological complexities and uncertainties as well as scientific contention to "cherry-pick" the ecosystem functions and processes that can be easily measured, counted, and valued (Robertson, 2006; Turnhout et al., 2013; Kull et al., 2015). While producing relevant and usable knowledge is a laudable ideal, adapting too much to the needs and wants of decision-makers risks turning science into an obedient instrument for those in power (Turnhout, 2018). To support transformative change, researchers also need to question and contest dominant conceptualizations and understandings of the relationship between humans and nature.

Furthermore, ES is seen as portraying the transformation of human-nature relationships as a "technical" rather than a political challenge (Ernstson and Sörlin, 2013). Decisions on the use of ecosystems are not always about unrealized synergies and win-win relationships but more often about difficult choices and trade-offs. The ES concept is criticized as unhelpful in resolving trade-offs or providing answers regarding who will win and lose and who has the right to decide. To be able to do that, necessitates an understanding of the political side of ES, in which decision-making involves not only scientific knowledge and monetary valuation but also competing and vested political interests, public opinion, and pre-existing formal and informal institutional structures (Kull et al., 2015; Saarikoski et al., 2018). Hence, fulfilling ambitions for transformative change requires more active engagement with questions of the functioning of political systems, governance, and policy processes (Abson et al., 2014; Keenan et al., 2019).

In summary, the academic debate on the transformative power of ES has revealed both strengths and weaknesses of the concept. For these reasons, ES has both been embraced and criticized in scientific discourse. Three interrelated challenges have been vividly debated; the need of further social (science) analysis, the importance of weighing the short-term benefits of monetarization against far-reaching, discursive impacts, and a more nuanced idea of science-policy interfaces that integrates the political aspects of ES. Next, we turn to how policy practitioners, heavily engaged in turning the concept into practice, make use of and value the ES concept.

How Do Conceptual Innovations Matter for Practice?

Within various contexts, ES has moved from being an "eye-opening metaphor" to being integrated into policy, planning, and management (Norgaard, 2010). Crucial to successfully integrating and implementing ES are actors who actively promote the ES concept, facilitate communication between knowledge producers and users, and who foster new ideas within and between organizations (Saarikoski et al., 2018). It is therefore important to consider the uptake, interpretation, and translation of ES among such actors when discussing how the concept may change practices (Martin-Ortega et al., 2019). This section presents the results of an interview study with actors identified as "frontrunners" in the implementation of ES in Sweden, exploring their experiences with using the concept and illustrating critical challenges for policy practice.

A Communication Tool for the Value of Nature

The primary utility of ES—as almost all the interviewed practitioners argued—is as a pedagogical and communicative tool, a way to communicate the benefits that nature provides to people (cf. McKenzie et al., 2014; Beery et al., 2016; Blicharska and Hilding-Rydevik, 2018). As described by a property company representative, ES provides a way to talk about nature's essential contribution to humankind—"to get people to understand that nature is more than just pretty scenery with yellow rapeseed fields and forests to walk in." Most often, the concept was described as useful in making visible otherwise unnoticed aspects, raising awareness, enabling a more holistic view of nature, and helping people understand why they need to protect nature. Although the practical implications of the concept—in terms of transforming practices on the ground—were generally questioned, several respondents had experienced a (slow) shift in perspectives within their organizations. Thus, as in previous studies (Saarikoski et al., 2018; van Oudenhoven et al., 2018), policy actors appreciate the ES concept primarily for its usefulness in raising awareness and changing mindsets.

As a tool to communicate the value of nature, the ES focus on human needs (i.e., anthropocentric orientation) was particularly appreciated by the respondents, providing a different kind of argumentation than traditional nature conservation discourses. As explained by a government official, different people have different interests and perceive different values in nature, and it is therefore important to be able to communicate with them differently. In that way, you can bring more politicians, landowners, and others on board, increase their understanding of and commitment to biodiversity, and ultimately obtain more resources for nature conservation.

ES was also appreciated for helping to reframe the argument for nature considerations as a "positive message" that you can do things that will benefit (and be appreciated by) humans as well as nature rather than the "negative message" of restricting actions associated with traditional nature conservation. A sustainability manager at a construction company explained that "to say that it

benefits people can make it easier to take in, because otherwise we often get the response [from project managers] that "we were not allowed to build because of some strange frog that no one has ever seen." And then you get a rather negative attitude toward biodiversity."

The most frequently expressed concern about ES functioning as a communication tool was its theoretical and abstract nature. Consequently, simpler metaphors and concepts, most prominently "nature's benefits," were used as complements. These concepts were most often treated as synonyms, and the choice depended on the audience. Some respondents also argued that "it is better to use ordinary words to explain what it is all about. That is often good enough. Pollination is a great example. ES is unnecessarily difficult, so people are unable to take it in or are afraid of using it" (municipal official).

Better but Restricted Interactions?

In the academic literature, ES is often portrayed as a boundary object (Abson et al., 2014). Similarly, respondents saw broadening the discussion and engaging new actors as a fundamental function of ES. As argued by a municipal official, "Within nature conservation, you have had this perspective for a very long time, long before the ES concept was established. But [through ES] it has widened to include other parts of the local government such as urban planning." Several respondents had experienced a stronger uptake of ES in urban planning than in other sectors, bridging different departments within local administrations as well as helping developers recognize the added market value of "greenery" in the city. On the national level, the concept had similarly provided a common language for communication across policy sectors, e.g., forestry, agriculture, and urban planning.

Communication and collaboration on ES were, however, largely between professionals. Respondents representing government agencies, interest organizations, and companies testified that the concept was not useful for engaging landowners, consumers, or the public. As argued by one government official, the concept of ES "filters reality" in a way that does not benefit dialog between authorities and landowners. Thus, while the literature highlights the potential of ES as a platform for stakeholder involvement and participation (e.g., Schleyer et al., 2015), the respondents described a concept useful mainly for communication between professionals.

Regarding the concept's function to enable convincing communication with policymakers—central to the function of ES as a boundary object—several respondents argued that politicians as well as corporate managers have been attentive to and interested in ES. However, the respondents also questioned whether ES helps to transform biodiversity governance. As a government official put it: "A new concept or new mindset is not enough. It requires a transformation of society and a stronger political will to preserve biodiversity."

How (Monetary) Valuation Matters to Decision-Making

Respondents across organizations argued that if an explicit value is not assigned to ecosystem services, they risk being disregarded in decision-making, essentially being of zero value. While few had personal experience with using monetary valuations, many saw the ability to express the value of nature in monetary terms as highly useful, as decision-makers often request and are convinced by such estimates. A municipal official described the importance of monetary valuations in influencing political decisions: "They [politicians] are realists /…/ all political parties talk of the importance of nature and ecosystem services, but when it comes to the fore and the budget needs to be balanced, they need to prioritize, and then they look at the money and nothing else." As explained by another municipal official, decision-makers' demand for monetary valuations is partially a result of how ES is conceptually constructed. Once actions (and non-actions) start to be motivated by how society will gain, earn, and benefit from these actions, the next logical question from decision-makers is *how much* do we gain, earn, and benefit?

The practitioners expressed different attitudes toward monetary valuations. While some saw them as a necessary solution to the main problem—that exploitation does not cost enough (environmental organization representative)—others were fearful that it would ease the exploitation of nature that is deemed invaluable (official at county administrative board). Still, others had lost interest because they had been unable to find enough commercial value in furthering non-provisional ecosystem services (forest company representative). Generally, however, the respondents expressed a nuanced view of the possibility of monetary valuations, reflecting on the potential as well as the difficulty of setting monetary values, e.g., due to a lack of data and knowledge. There were also concerns that despite monetary valuations being presented with many caveats, in the end, "decision-makers may pay more attention to the final numbers than the caveats" (environmental consultant).

In addition to problems of insufficient knowledge to perform good valuations and the fear that decision-makers would use even bad ones, there were concerns that the values would end up being too low. For most respondents, ES is of strategic use in terms of offering to support, legitimate, and justify policy actions to improve nature conservation. Consequently, fear of the concept being captured by other interests inhibits its use. Respondents experience that ES is subject to organized interests trying to frame the concept in ways that promote their interests. According to a government official, this is not unique but rather is how all concepts are treated. For example, organizations representing forestry and agriculture use ES to explain to the outside world what they do [producing ecosystem services] while representatives of the indigenous Sámi community, saw the concept as a way to explain its worldview and traditional ways of living to Swedish society.

The Value of Adding a New Concept

ES is situated in a complex conceptual landscape consisting of new and old concepts designed to strengthen biodiversity and nature considerations, e.g., environmental considerations, green infrastructure, and nature's benefits. One critical issue raised by the respondents was the value of adding another concept. Some described ES as a buzzword of limited importance both conceptually and practically. As stated by one forest company representative, "It's like they are trying to invent the wheel all

TABLE 1 | Summary of key findings on conceptual innovations for transformative change.

Analytical steps		Key roles for conceptual innovation	
How concepts matter	Providing new meanings (facts and values)	Providing new collaboration and communication (boundary objects)	Providing impetus for change (performative role)
Academic criticism of ES	Overly dominant role of economic valuation	Limited social analysis	Basing solutions on a technocratic view, rather than political changes
Practical challenges of ES	Monetary valuation, imperfect but important?	Strengthens professional collaboration and communication, but not public participation	Raise awareness, but do not facilitate fundamental change

over again; it is a new concept, but the work is the same." Other respondents argued that introducing new concepts brings new energy to the policy debate. As stated by a government official with long experience in environmental policy work, politics needs new key concepts: "If we play with the idea that we still had the traditional nature conservation politics of, say, 1988, that we haven't got the impact of the biodiversity concept or ES. Where would nature conservation be then? I think that it would have been very marginalized; a pretty small operation within protected areas."

A related concern was the complementarity between ES and existing concepts. Within forestry and agriculture in particular, the respondents regarded ES as a way to conceptualize what is already occurring rather than to generate new impetus for practice. Other concepts were also preferred over ES, as exemplified by a government official who stated that it is much more common to talk about "social values" than about "cultural ecosystem services." As explained by a forest company representative, previous efforts by the government to integrate other concepts ("good environmental quality") had made the company launch an educational program, and that investment now made them reluctant to switch concepts.

Respondents also argued that introducing new concepts could hinder environmental actions. As argued by one municipal official, new concepts increase conceptual complexity, causing confusion, and even legal uncertainty when people use different words for similar things and in the end, risks weakening environmental work. This was explicated by another local official in relation to legal statutes using older terms, which made it more difficult for authorities such as county administrative boards to take decisive action, despite having legal support for ES. Additionally, as expressed by one government official in relation to the introduction of NCP on the international level, introducing a new concept risks environmental policy-making becoming mired in conceptual discussions instead of furthering environmental measures.

DISCUSSION: HOW DO CONCEPTUAL INNOVATIONS MATTER?

Society faces growing global sustainability challenges, and scientific expertise is deeply involved in the development of policy to meet these challenges, such as the UN's 2030 Agenda for Sustainable Development. An important part of the impact of science on policy is not only producing facts and figures but also developing new understandings that help us orient ourselves and to navigate an increasingly complex global landscape. When new concepts are introduced with the aim of better catalyzing social change than previous concepts, it is important to investigate the challenges experienced in translating conceptual innovations into (transformative) social output, thereby digging more deeply into the link between valuation and actions. This concluding section will first summarize the key findings from our analysis (**Table 1**). Thereafter, the question is raised of what can be learned from this case for the current elaboration of NCP, to which the hope is attached that it will enable to better grasp the value of nature and facilitate much-needed action. Finally, the paper will reflect on the role of social science in conceptual innovations and social transformations.

Concepts do not neutrally mirror the world but influence our way of understanding and navigating the world, thereby also changing it. By introducing new concepts, facts and values are organized in new ways, thereby creating incentives for action. New concepts, if agreed on, can serve as boundary objects that facilitate communication and collaboration. However, actors do not mechanically adhere to concepts and their meanings but relate to them in different ways. This means that there is no simple relationship between concepts used to value nature and actions taken.

The ES concept has successfully reframed and broadened the rationale to strengthen considerations of nature in decision-making, especially by raising awareness and engaging new groups. As illustrated in the interview study, the impetus for change generated by the concept is varied across policy sectors and has primarily been made relevant as a communication tool to raise awareness with more limited impact on on-the-ground practices. The concept has partially fulfilled its function as a boundary object, facilitating communication among professionals and thus helping to address problems of compartmentalization. The academic literature points to shortcomings in terms of limited engagement of social science—thus risking providing a too limited analysis of the social drivers behind ecosystem degradation—and among policy practitioners, the complexity of the concept makes them question its usefulness to engage stakeholders more broadly or to further public participation. Adding new concepts might not be what policy actors need. In terms of generating transformative change, rather, the empirical results point to the importance of political will. Previous research has also raised the political side of ES and

indicated a technocratic ideal inherent in ES that makes it difficult to connect the concept to emotional and relational values of nature, restricting its ability to mobilize the broad social pressure and commitment necessary to generate political change.

In terms of expressing meaning and value of nature, ES' close association to monetary valuation is regarded as a key attribute but is also very challenging. As argued among both academics and practitioners, expressing values in monetary terms is potentially very useful for convincing decision-makers of the worth of nature, thereby enabling reprioritization and change. However, it has also been conceded that it is very difficult in practice and risks decision-makers basing their decisions on convincing but incorrect or partial valuation of nature and, in the long run, support rather than challenge some of the drivers behind ecosystem degradation.

Lessons to Learn for NCP

As shown in the academic debate and as illustrated by interviews with policy practitioners, the conceptual innovation of ES has achieved mixed results thus far; some actors claim that the concept has substantially strengthened the worth of biodiversity in decision-making and planning practices, whereas others find that it has had rather limited functions and lacks transformative potential. However, what more general lessons can be learned from our analysis of ES when NCP is now introduced as a concept that is better equipped to handle the multifarious issue of biodiversity? We wish to stress three lessons that are important to consider when researchers and practitioners elaborate on NCP: interpretive frames, political dimensions, and institutional structures.

First, NCP has directed substantial criticism of ES being subsumed within an economic narrative. The conjoining of economy and ecology is both the greatest strength and greatest weakness of ES; because they are of critical importance in policy-making, economic considerations can facilitate valuable nature being protected, while also indirectly upholding the social order in which economic valuation has supremacy. This situation highlights a crucial dilemma between long-term and short-term impacts, where the former requires transforming existing institutional and discursive structures, whereas the latter require adhering to them. When evaluating the impact of conceptual innovation, it is therefore important to recognize that concepts work performatively in two ways: (i) they tell us what to do (guide actions), and (ii) they provide a wider understanding of the world (influence discourses). If aiming for long-term and transformative change, it is therefore important to focus not only on conceptual definitions but also the wider interpretive frame, and the meaning and motivation it creates.

Second, NCP stresses that nature is valued differently and in conflicting ways. To function as a boundary object, NCP needs to stress—and even welcome—the articulation of different and even conflictual views; something that ES has had a limited success in doing. Being inclusive in terms of stakeholders, perspectives, and knowledge claims is important and normatively appealing, but it is also very demanding and has uncertain outcomes, as shown in the literature on public participation (e.g., Irvin and Stansbury, 2004). Furthermore, it is important to acknowledge the political dimensions of conceptual innovation aimed at transformative change. The reason is that all transformations generate winners and losers and that conceptual innovations will be used as a political tool by specific interests to promote change or the status quo. Hence, it is important not to hold a naïve belief that a conceptual innovation will result in win-win situations or that the adoption of a particular concept will result in an inclusive and consensual understanding of key goals and measures.

Third, NCP strives to strengthen the effectiveness and legitimacy of biodiversity governance as well as to develop a concept that is more contextual and thus relevant to governance around the world. To fulfill this ambition requires an understanding of how policy processes work. As illustrated in the interview study, even in Sweden, where the ES concept has been successfully adopted in policy (policy formulation), it may nevertheless be difficult to turn it into practice (policy implementation) that substantially impacts the current situation. Even if policy actors support and adhere to a concept, as well as having necessary knowledge and resources, pre-established formal and informal institutional structures often make it difficult to integrate that concept into their organizations and practices in a way that makes a real difference (Saarikoski et al., 2018). Thus, if the aim is not only to influence an environmental discourse in a restricted sense but also to influence action, there is a need to develop conceptual meanings that integrate more elaborate theoretical ideas on change and transformation of existing institutional structures (Lowndes and Roberts, 2013; Hysing and Olsson, 2018). Otherwise, the risk is that a concept will be nothing more than nice words on paper.

These three lessons need to be seriously considered in ongoing conceptual elaborations on ES and the NCP, but they also warrant further research, both on how these aspects have affected the uptake and implementation of ES (empirical orientation) and how they can be better integrated into conceptual and theoretical frameworks (theoretical orientation).

When Do Conceptual Innovations Matter?

In addition to these three lessons, in developing conceptual innovations for transformative change, one fundamental aspect needs to be stressed. Concepts are important for our understanding, navigating, and shaping of the world, but concepts are not all that matter. Even the most carefully elaborated conceptual meaning, flexible in adapting to different contexts, connecting to different stakeholders' interests, and involving strong emotional appeals to act, may not be sufficient to initiate transformative change. The reason is that there are broader and deeper trends at work. A major reason for the lack of progress in many environmental issues, including that of biodiversity, is that many significant environmental problems are deeply embedded in the socioeconomic fabric of modern society (Görg et al., 2017). To close the gap between what has been done so far and what remains to be done, there is an urgent need to alter the fundamental social structures of modern societies (Deacon, 2016).

A particular problem is that much scientific advice to policymakers, including conceptual innovations, is less qualified in social analyses than in environmental ones, which has led to

a narrowly defined situation in which science suggests solutions that do not account for the complex social and cultural task of transforming certain institutions and structures, while ensuring that others—e.g., democracy—are maintained and strengthened. Likewise, many science-based solutions to environmental problems do not fully consider that social transformations always create winners and losers. Divergences in values, priorities, and interpretations are still poorly addressed in research on biodiversity governance, and there is a pressing need for more research on the driving forces behind social activities that cause environmental problems, social implications for different groups, and whether an environmental problem is solvable through system modifications (transitions within established institutions) or whether system changes (transformations of institutions) are needed (Boström et al., 2018). Therefore, it is important for social analyses to be placed on an equal footing with environmental ones, where a fundamental task is to identify implicit assumptions and framings of issues and to ensure that they are not based on unsupported views of how society works and how institutional, organizational, and behavioral changes occur (Beck et al., 2014; Jetzkowitz et al., 2018; Jasanoff 2005).

The current quest for transformative change implies a need for more and deeper social analysis; analysis of social dynamics that can match existing knowledge on environmental dynamics. To focus on causes and not only symptoms means that much research is needed on current social drivers. Furthermore, when aiming for transformative change—change on a system level—it is of the greatest importance to see how issues are interlinked and how they influence each other. Today, humanity faces several fundamental challenges such as climate change and accelerating extinction of species, but also other severe challenges such as pandemics, growing global inequalities and poverty, strong anti-democratic movements, and flows of migration and globally displaced people. A feature of these, and other global challenges is that they are constituted by intertwined ecological, social, and economic factors and that these challenges are interrelated. It is therefore crucial not to develop particular policies and cures for each challenge without considering how action taken for handling one issue may deeply affect others. Today, there are too many examples of realized remedies that have resulted in unanticipated and severe effects. A current example of this is the proposal of large-scale deployment of negative emission technologies (NETs). To meet the Paris agreement's target on staying well below 2°C, these kind of new and unproven technologies are included into IPCC emission scenarios. But NETs ecological and social impacts in terms of changes in land rights, dislocation of people, and competition for food supplies are not included in the analysis (Beck and Mahony, 2017). Assuming environmental benefits without identifying and considering costs (environmental as well as social) is relatively common, and there is therefore a growing need for further research on the wider social consequences of future-oriented action intended to initiate transformative change (Lidskog et al., 2020).

Last but not least, it is also important to stress that conceptual innovations and policy developments matter. There are a number of political innovations—such as democracy and human rights—that are the result of long-term and committed action, often in the form of power struggles, and the development and spread of concepts (such as citizenship), institutions (such as parliamentary elections), and discourses (such as equality) have been pivotal in these innovations. It is evident that by opening a new way to see, understand, and valuate the world, actors may change their former priorities and practices. Thus, conceptual innovation has been shown to be, and is, an important part of the complex and challenging efforts to initiate transformative change.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the national legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

EH and RL contributed equally to the study design, analysis, and manuscript writing. EH was responsible for data collection (section How Do Conceptual Innovations Matter for Practice?) and wrote the first version of section Is Ecosystem Services (in)Capable of Generating Transformative Change? and How Does Conceptual Innovations Matter for Practice? RL wrote the first version of How Do Concepts Matter?. Both authors contributed equally to the article and approved the submitted version.

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Coffee and Potato Agroecosystems: Social Construction of Spaces as a Concept to Analyse Nature's Contributions to People

*Liliana Bravo-Monroy**

Independent Researcher, Bogotá, Colombia

Achieving goals for conservation and sustainability using nature, decision-making, and policy planning requires accurate modes of description to understand the relationship between society and the environment. Despite most planning strategies being constrained by policy objectives, planning is expected to be more participatory and inclusive of the plurality of values and all types of socio-spatial relationships. Based on Lefebvre's social theory, the objectives of this work are to propose a triad of spaces as a helpful framework to analyse nature's contributions to people (NCP), describe different spaces socially constructed by coffee and potato farmer communities in Colombia, and explore the implications for various kinds of decision-making. Using qualitative research methods, this manuscript describes three spaces: *lived spaces* as intangible spaces based on local, religious, and ceremonial values of NCP; *perceived spaces* include farmer spatial organization according to the ties of kinship and the downward course of streams, the incidence of negative NCP, such as plant diseases, and types of management crops; and *conceived spaces* as the overlapping of different spatial views of territorial planning. Given that NCP has great potential to integrate diversity of values about nature and cultural contexts into decision-making, the triad of social spaces offers a spatial dimension to the analyses of NCP. Lived spaces make non-material NCP and non-instrumental values more visible. Perceived spaces highlight material NCP and regulating NCP with the view that maintenance of NCP in the future is essential for relational and instrumental values, e.g., how material NCP and regulating NCP of landscapes are perceived and by whom. Conceived spaces emphasize the predominance of the intrinsic biophysical values of NCP. Thus, the triad of social spaces as a conceptual framework can be useful in the operationalization of NCP in environmental management, the governance of schemes, and the implementation of land-use plans at the local scale. By thinking of these spaces relationally, such insight can inform and enhance decisions and policymaking about the value of places toward the priorities of meeting management. The results of the study emphasize the important policy implications of recognizing *lived* and *perceived* spaces in decision-making and highlight the role of NCP in facilitating the communication of these spaces to support spatial management of land use.

Keywords: farmer constructs of nature, Lefebvre's spatial triad, land-use planning, local scale, mountain landscape, nature's contribution to people, plural values of NCP, socio-spatial relationships

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Marie Stenseke,
University of Gothenburg, Sweden

Reviewed by:
Hannes Palang,
Tallinn University, Estonia
Mohammad Imam Hasan Reza,
Independent Researcher,
Chittagong, Bangladesh

***Correspondence:**
Liliana Bravo-Monroy
libravo@yahoo.com

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INTRODUCTION

An important and yet unresolved question in land-use planning is how best to manage nature and their associated contributions for individuals and society to ensure a good quality of life. One key issue seems to lie in the need for more plural and grounded ways of understanding landscapes and land uses in environmental policy and management. Nature's contributions to people (NCP) have emerged as a framework for integrating a range of values, benefits, and occasional losses that people obtain from nature (Pascual et al., 2017), i.e., the contributions, both positive and negative, of living nature (diversity of organisms, ecosystems, and their associated ecological and evolutionary processes) in terms of the quality of life of people (Díaz et al., 2018). There is potential to mainstream NCP through integration into planning approaches to enable fairer and more effective societal engagement in sustainable land management and biodiversity conservation, but these have not yet been fully analyzed in either research or practice. This study demonstrates how NCP may contribute to building a more holistic and heterogeneous view of decisions about land use by including diverse, even divergent, instrumental and non-instrumental relational values about nature beyond allocating land to various uses. To do this, this study integrates the NCP framework with Lefebvre's conceptual triad of social spaces (1991) to examine how the space acquires meanings and values and disentangle the importance of multiple "living relationships" that people maintain with places (Basso, 1996), including power relations among people. Thus, it highlights how land is imbued with cultural values (Turner, 2005) and the dynamic, changing, historical, and dialectical people-place relationships (Cronon, 1985).

The NCP framework parallels Lefebvre's conceptual triad on ensuring broader inclusiveness in terms of scientific knowledge, including humanities and social sciences, and other knowledge systems, such as those held by indigenous peoples and local communities. Briefly recapitulated, the three dimensions of the triad are the following: *Perceived space* (physical) is the real material space of geographic locality, which is seen, generated, and used; *Conceived space* (mental) refers to conceptualizations linked to theories, knowledges, mental concepts, and abstractions about space; and *Lived space* (social) is an experienced space, i.e., emotional sensations, stories, and cultural expression, and it is lived through associated symbols and images.

In the context of addressing NCP in land-use systems at global and continental scales, global modeling of NCP (Chaplin-Kramer et al., 2019) have shown for water quality regulation and crop pollination that up to 5 billion people will face higher water pollution and insufficient pollination for nutrition under future scenarios of land use and climate change by 2050. In the case of global land and agri-food sectors (McElwee et al., 2020), 40 different options were examined, implemented through land management, value chains, or risk management, for their relative impacts across 18 NCPs and 17 sustainable development goals (SDGs). For instance, the use of local seeds benefitted 11 NCP, such as the regulation of organisms detrimental to humans, learning and inspiration, pollination, supporting identities, etc. Interventions, such as agroforestry, integrated water management, and improved cropland management, showed positive synergies with both SDGs and NCP with no significant adverse trade-offs. On the other hand, by analyzing the IPBES Europe and Central Asia Assessment, a set of social-ecological indicators associated with the relational values of NCP were identified as contributing to a meaningful life, e.g., security and sovereignty, health, equity and justice, heritage, identity, and stewardship (Schröter et al., 2020). Furthermore, policy implementation of NCP was examined by conducting a survey with IPBES European national delegates (Keller et al., 2018), and results showed policy areas where uptake and implementation of NCP concepts has been included at a national level: these were mostly protected area (PA) management and land-use planning and occasionally community planning.

At regional and subnational levels, NCP have been examined in diverse land system processes. Regarding forest landscape restoration, land sparing and land sharing have been considered as complementary strategies and have embraced the concept of NCP as a broader and inclusive approach by their intrinsic biophysical and socio-cultural values. This broadens the possibilities for quantifying the benefits of landscapes (Latawiec et al., 2018). Furthermore, combining social media and Earth observations has been proposed to aid in the cost-efficient monitoring of NCP, e.g., cultural contributions relying upon landscape variables according to the natural and cultural values of two biosphere reserves (Vaz et al., 2020). On the local scale, the need to make conservation fairer is argued for in the belief that the equity of PA management and governance could shift focus from greater NCP of PA and towards human well-being and improved conservation (Franks et al., 2018). Thus, addressing land-use systems requires us to analyze social-ecological trade-offs and synergies by focusing on the perspective of NCP in cases where the worldviews of stakeholders are highly diverse and where relational values are important guiding principles of land use (Ellis et al., 2019).

Given the above statement, those studies show that despite the growing popularity of NCP, there is an implementation gap between NCP as an objective to support a good quality of life and the capacity to influence the decision-making by addressing broader core values of local people relevant to land planning, management and governance. There is a growing community of scientists advocating for more plural valuation that integrates the diverse values of (and about) nature into decision-making and action (e.g., Zafra-Calvo et al., 2020). In such situations, determining what constitutes a place and the identifying those related to a place (locals) have been proposed as key issues in the field of relational values in landscape research (Stenseke, 2018). This study expands on previous research by analyzing the plural values of NCP into local farm spaces and determining the crucial role of values guiding the way farmers make sense of their places. While there is a large body of literature that discusses cases from indigenous people, our focus is on farming communities with long-term, place-based relationships (Altieri, 2004), which demonstrates that the issue of landscape planning at a local scale is far more complex than the usual envisage of planners.

Given that the framework of NCP has the great potential of integrating diversity of values about nature and cultural contexts into decision-making, the objectives of this work are to propose the triad of spaces as a helpful framework to analyse NCP and their associated values; describe the spaces socially constructed by coffee and potato farmer communities in Colombia, based on values people assign to NCP, namely relational, instrumental, and intrinsic values; and explore the implications for decision-making. In doing so, this study seeks to offer a new perspective on the spatial view of NCP for use in landscape planning of rural areas, as well as communicating the values of NCP for increasing public awareness and action among various kinds of decision-makers.

METHODS

Case Studies

Colombia is the world's second richest country in species and the first one in birds and orchids (Biodiversity Information System of Colombia, 2020). The Andes mountain ranges of Colombia are a part of the most diverse hotspots in the world for species richness and endemism (Conservation International, 2020). Two cases were analyzed in two mountain villages on the eastern range, namely Ocamonte (coffee producer zone, Santander area) and San Pedro de Iguaque (SPI) (potato producer area, Boyacá area). The reason for selecting cases from two different rural settings is 2-fold. The first reason involves including contrasting and complementary NCP in order to capture diverse social groups and agroecosystems. The second reason involves cases that would represent a variety of key actors, community leaders, agricultural technicians, and smallholder farmers, which enables us to develop a better understanding of how the values of a range of farmers influence the landscape practice of farmers involving different NCP.

Coffee from Santander has become recognized for distinctive flavors related to its growth under a canopy of shade trees (Federación Nacional de Cafeteros de Colombia, 2020a). These agroecosystems are important as a refuge for biodiversity and the provision of relevant NCP, such as pollination, habitat maintenance, and supporting identities. Colombia is the world's third largest producer of Arabica coffee after Brazil and Vietnam (International Coffee Organisation, 2020a). More than 540,000 coffee farming families depend on this crop for their household income, of which 95% have <5 ha (Federación Nacional de Cafeteros de Colombia, 2020b). While coffee farming is highly vulnerable to market volatility, the spread of coffee pests, and weather events, the COVID-19 pandemic seems to have aggravated the price fluctuations of coffee (International Coffee Organisation, 2020b). The second case study was conducted in SPI, a place that consists predominantly of a tropical high mountain ecosystem (*Páramo* ecosystem). *Páramo* plays a fundamental role in maintaining high levels of biodiversity and the lives of people, providing essential NCP, such as regulation and the supply of water. Boyacá area covers the highest number of *Páramos* in Colombia. Potato agricultural expansion, livestock, and mining are regarded as a serious risk to *Páramo* conservation (Morales et al., 2007). Boyacá covers 20.7% of national potato land use, while Santander comprises 6% of national coffee land use. Small-scale farming (farms with <5 ha) represents 73.2% of farms in Colombia (Departamento Administrativo Nacional de Estadística, 2014). Villagers are non-indigenous, and most have lived in the same area for generations. Family is the primary source of labor, although most small-scale farmers employ day laborers at harvest time. More than cash crops, coffee, and potato represent the production schemes of familiar economy around which rural communities have developed identities, knowledge systems, and strong sociocultural ties.

Data Collection—Ethnographic Methods

Semi-structured Interviews

The empirical data were collected through intensive fieldwork in the years 2005 and 2010 in SPI and Ocamonte as part of two research works involving smallholder farmers. Two groups of semi-structured interviews were conducted with 37 key informants. About 23 potato smallholders were interviewed in SPI and 14 coffee smallholders in Ocamonte. Given the territorial organization of the countryside in *veredas* (several farms are grouped into *veredas*), respondents were chosen according to their belonging to similar *veredas*. Farmer selection did not seek representation by people in each community. Rather than representing the whole population, the selection of coffee farmers was based on farms with usual agricultural management in the zone (i.e., organic and conventional coffee farms). Regarding potato growers, interviewees were selected according to the location of their farms on *veredas* belonging to a watershed with a common set of lagoons, streams, and rivers that drain into a larger river. However, the saturation of diverse viewpoints was not reached during dialogues. Despite differences in time (2005–2010) for conducting the respective field works, both study sites show commonalities in terms of Andean farmer communities and the values and meanings associated with land spaces. Both fieldwork phases were part of the Master and PhD theses of the author, respectively. Informed verbal consent was obtained from all participants before the study began. This work did not undergo a full ethics review carried out by an ethics committee because the research conformed to the ethical standards set out by the respective university, and the issues were not particularly complex or high-risk.

The interview protocol was designed to collect detailed qualitative information on themes related to beliefs and attitudes about farms and agroecological practices, their daily routines, and the role of institutions (i.e., Coffee Grower Federation, certification agencies, cooperatives of farmers, the National Park) in promoting specific practices by providing incentives. Questions were flexible in the sense that farmers could provide further explanation in the case of in-depth information. The questions were comparable across different local contexts, while also accommodating site-specific differences. From 14 interviewees in Ocamonte, 6 produced organic coffee and were members of a cooperative, whereas 6 were non-members and grew conventional coffee by using agrochemicals. Two further organic producers were interviewed for their leadership role in the history of organic coffee farming. In contrast, the totality of potato farmers interviewed and applied conventional methods

of crop yield. It was the predominant agricultural system in SPI. To triangulate institution-related data reported by farmers, two agronomists of the Colombian National Coffee Growers Federation were also interviewed. The sample of interviewees ranged in age from 18 to 80 years old with 23 male and 14 female respondents (15 male and 8 female interviewees in SPI; 6 female and 8 male interlocutors in Ocamonte), who were interviewed in Spanish.

Participant Observation

Participant observation entails a form of ethnographic observation, one of several qualitative field methodologies used to understand the culture and structure of farmer communities (Fine, 2015). It involved the first-hand observation of daily activities related to crop management practices, farmer meetings and purchases at sale points. Several meetings of the cooperative of farmers were observed in Ocamonte. In these meetings, notes were taken about the positions, discourses, and discussions regarding the management of crops. Furthermore, informal dialogues were conducted with farmers, agricultural technicians, and local market agents. Close attention was paid to keeping and analyzing field notes describing the relationship between the sociocultural behavior observed and the biophysical environment. Field notes were the primary way of capturing the data that was collected from participant observations. Notes taken to capture data included records of what was observed, including informal conversations with participants, records of activities, farming practices, and ceremonies (Guber, 2001).

Data Analysis—Content Analysis

After collecting and transcribing the data, content analysis (Páramo, 2018) was undertaken to understand the spaces socially constructed by coffee and potato farmer communities. The interview texts and observations were qualitatively categorized into different groups based on objectives. Thus, each cluster of information was coded to identify key themes related to the people-environment interface and potential cognitive relationships between data variables.

A complete reading of each text was carried out through the characterization of farmer—space relationships. Based on that characterization, reading themes and topics were identified, which seemed to be common across the texts. A coding sheet was developed based on those themes, which were used to analyse the entire information. The written material was accordingly coded by the use of terms or phrases, facilitating a systematic analysis of text to interpret data about human thought and behavior related to social agricultural spaces and values that people assign to NCP. Thus, content analysis rapidly identified co-occurrences of different concepts (Ekstrom and Young, 2009) and connections between them.

A deductive analysis of information was also performed to examine the research questions by searching all forms of the words "farm," "coffee," "potato," "land," "water," "organic," "conventional," "landscape," "importance of," "benefit of," "meaning of," "beliefs," "experiences," "personal and collective events," "community," "utility," and related words. Data were organized into matrix tables by groups and themes, offering a detailed examination of the data. It allowed the identification of key subjects and looking for ideas about new hypotheses and themes that could emerge, as well as an examination of potential links between topics. **Figure 1** sums up the ethnographic methods and the way of collecting and analyzing information.

RESULTS

Coffee Social Spaces

Lived Spaces

The local history of coffee growers is localized and revealed in their land use since the 1960s and 1970s when land transformation took place from forests to shaded coffee. Non-material NCP from farms are experienced by growers since then as sacred spaces where production modes cohabit with religious symbols of Christianity (e.g., crosses of different size with or without flower ornamentation). These material signs are usually put on the coffee fields in order to entrust prosperity to God, especially at the early phases of growth. The following quotes refer to relational values as emotional attachments attributed to land: [Coffee is] "*The best future we have sown...*," "*That is the art we know....*" Land is considered sacred by farmers: "*land is a great God blessing,*" "*land is primordial, is everything,*" "*is our life,*" "*is like a woman, a mother who has to be cared for,*" and "*the biggest treasure.*"

Farm-lived spaces also embody the social relations of production. During coffee harvest time, farmers express relational values based on principles of reciprocity and solidarity to fill the labor shortage. Farmers engage in reciprocal labor exchanges between family members and neighbors. An example of this would be an entire household helping to pick coffee by hand in the plot of a relative, such as a nephew, over the course of a week. The following week that nephew and his folks return the same time of work to the head of the household. On the other hand, the economic roles of men and women differ from day to day and are motivated by instrumental values. Off-farm employment is common for husbands and any children that are now adults, whereas wives work in their own farms, administer home finances with coffee profits, and ensure care and food provision for family members and coffee workers. Thus, communal work relations are the norm, and according to farmers, coffee has generated equity in terms of benefits to everybody, owners and workers included.

Perceived Spaces

The size of production spaces is dynamic and changing due to family inheritance and the purchase and sale of land. Family groups are neighbors with different ties of kinship. Here, regulating NCP such as the formation of soils are perceived by farmers: "*A good coffee land does not require the use of synthetic fertilizers*" whereas a "*deteriorated land has become accustomed to those inputs and therefore is now exhausted.*" Moreover, agricultural institutions played a key role in augmenting the area of coffee land use from the 1960s onwards as well as in the entry into organic production from the year 2000. One of the most important consequences of adopting organic practices was a sharp decline in coffee yield during the period of transition (up to

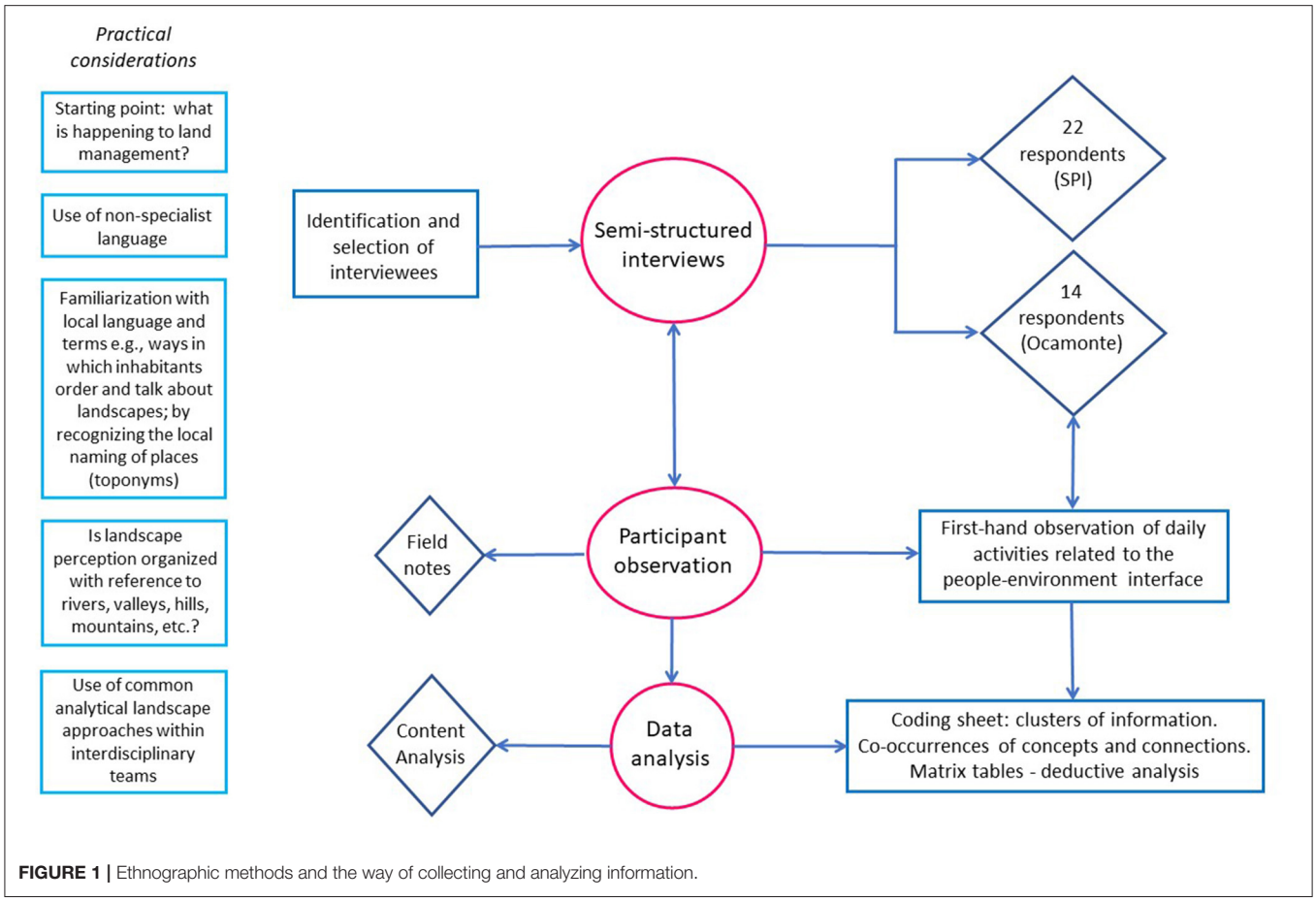


FIGURE 1 | Ethnographic methods and the way of collecting and analyzing information.

3 years) to get the certification. Apart from unsatisfactory benefits received (i.e., discouraging monetary incentives) and several farm requirements, the reduction on coffee yield discouraged many farmers to opt for organic certification. In this regard, one woman elaborated on an interesting metaphor with a more personal sense of relational values: "*. . . As a result of the organic fertilization, there was a steep decline in coffee production: an abrupt change in plant nutrition from chemical inputs to organic materials. A plant that was accustomed to agrochemicals must be now nourished with hen manure. [That situation is comparable to] a baby fed with breast milk and is suddenly fed with solely mineral salts. The child will look skinny. It was similar to coffee plants; they adopted a scrawny aspect before becoming accustomed to organic conditions...*" (female respondent, ∼45 years old).

In line with the above statement, local knowledge is associated with agricultural practices and regulating NCP. For instance, coffee growers pile leaves and uprooted vegetation ("*majada*") around their coffee seeds and plants because "*majada cares for seedlings and soil.*" They have accumulated agronomical experience that this practice favors the growth of coffee plants. They do not pursue their representation further to determine if it is indeed a decaying plant material and not some other consequence of their practice that makes the coffee thrive. But the image of representation that they use seems perfectly adequate in motivating their mulching practice (It parallels a common feature of Barth, 2002). Thus, the notion of care and nutrition of seeds and land emerges as a relational value of what farmers find meaningful about agricultural management.

Conceived Spaces

Farmers assign instrumental values to material NCP in two significant ways, (i) Livelihoods: coffee provides people subsistence and occupation largely because its production supports local familiar economy. The following expression shows it: "*Coffee goes down to the market on Sundays and family vital supplies, in turn, go up to home*" (female respondent, ∼65 years old). (ii) Written and spoken signs: it involves top-down processes in varied forms such as certification scheme regulations; certification seals; conventional management strategies; coffee crop guidelines; certification farm notebooks; organic management campaigns; and rumors related to production levels from certified neighbor farmers and coffee management plans that ignore forested patches on the surrounding area.

Another interesting finding is that, although child labor is banned in coffee farms by Fair Trade standards, it threatens to undermine the relevance of intergenerational learning of coffee tradition. In this regard a farmer states: "*. . . Childs are curious about coffee plants but sometimes we prefer avoiding*

their involvement, mainly because cooperative norms. . . ." That prohibition reinforces the idea that next generation of farmers adopt an urban lifestyle by underestimating their own role as coffee farmers. A farmer commented: "*. . . Our children deserve better future than ours*" (female respondent, ∼45 years old).

From the point of view of certification agencies and agronomists, intrinsic ecological values of shade coffee are also important. Researchers have found in the Santander region that coffee plantations with dense shade cover (>80%) favor conservation of night monkeys and other arboreal mammals. It has to do with observations of monkeys spending significant amounts of time in coffee plantations. Certified conceived spaces tend to prioritize a set of values associated with farms and thus can become a source of disagreements with farmers.

Potato Social Spaces

Lived Spaces

The *Páramo* ecosystem regulates the flow and quantity of freshwater used for different purposes. Results also revealed that this NCP embody symbolic relational values with two natural entities. First, the San Pedro lagoon, located on top of the mountain, is considered the birthplace of the Muisca indigenous ancestors. The lagoon also evokes significant memories like the transfiguration of indigenous communities into gilded intangible figures (*Encantos*) as a direct consequence of the Spanish conquest. Establishing interconnections between sites, *Encantos* walked across the landscape and water streams moving either upriver or downriver.

Farmers emphasize that *Encantos* are currently a rare occurrence in the camp due to water scarcity by pollution and the loss of trees on forested watersheds. Additionally, everyone who visits the lagoon must show proper respect for the sacredness of the place, as the lagoon was in earlier times overcome by a feeling of anger against people who "*treated her with disrespect*." Many years afterwards, the lagoon was tamed by Christian priests. Second, near it, down the mountain, appears in the landscape a second place: "El Molino" stream, where several watercourses connect and flow downstream as a single river. This place is charged with historical tales of personal and cultural values. Here, indigenous ancestors created new settlements and used a big stone pounder to grinding maize (by harnessing water flow as the driving mechanism). There are also vestiges of a catholic church in the same place and an antique site for funerals. A farmer recalled "*. . . Muisca indigenous people lived therein; they ground maize by using a big stone grinder in order to distribute among families for food and cooking. . . .*"

Crucially, indigenous memory has also survived in the Spanish spoken by rural communities (and urban population) *via* lexical units derived from Muisca ancestral language. It entails experiential interactions with material NCP guided by immaterial values. The lexicon indicates the names of places, plants and animals such as the following examples: "*Iguaque*" (vigorous mountain); "*chucua*" (swamp or wetland); "*chisgua*," "*chugua*," "*cubios*," "*ruba*" (Andean tubers); "*chiso*," "*chitacá*," "*chusque*," "*curuba*", "*fique*," "*gaque*," "*guaba*," "*guaca*," "*guasca*," "*quiche*," "*suica*," "*uchuva*" (plants, trees, and shrubs); "*caica*," "*chisga*," "*tingua*" (birds); and "*chuchas*," "*faras*" (small mammals). Thus, language connected to the place represents a vital vehicle for humans to elaborate, maintain, and transmit cultural values and linguistically-encoded environmental knowledge about local seed use, which in turn preserves local landraces (which directly leads to the NCP "Maintenance of options").

Potato lived spaces are also occupied by the division of labor, social practice, and instrumental values. Women play a central role in home economies by administering finances provided by milk production and potato profits as well as ensuring care and food provision. Men tend to specialize in potato crop work and livestock on one or the several nearby farms, and women tend to conduct unpaid work in the family farm.

Perceived Spaces

Potato production and small-scale livestock with a few heads of cattle support familiar economy. Values associated with these material NCP involve utilitarian preferences based on practices such as conventional farming with the use of pesticides, fertilizers, and herbicides, as well as water supply systems. The latter includes communal aqueducts, reservoirs, basic channels of conduction, and hosepipes. A farmer commented: "*When I arrived here, there was not water distribution systems. We had to find water directly into the groundwater reservoir. Adults and children collected water by using bottles and barrels at early morning and the end of afternoons. . . ";* "*. . . Several years later we made channels directly on the ground for the flow of the water. We carefully noted a marked decline in water supply in the past 30 years. As a result, people installed pipelines on the ground. Now you can see many pipelines around houses. . . .*" (male respondent, ∼70 years old).

Extended family is organized around a nuclear family following a spatial pattern in the shape of a nest. Farmers assign instrumental values to the *Páramo* ecosystem as a source of water and suitable land for potato cropping. Here, their notion of *Páramo* includes broader areas than those considered by planners or scientists. Description of the landscape appears to be primarily topographic (e.g., water reservoirs up/ houses down; *El Páramo* up/farmers down; the river that goes down "*Río Abajo*"; mountain or hilly land "*El Cerro*"), and the naming of places is primary (the river that comes from the mountain "*El río que viene del Cerro*"). Generally, those names differ from terms used by official planning maps. Several farmers ascribed the instrumental values of land for economic exploitation, alluding to some interpretations of Christian Bible. Statements reflecting those values include the following: "*The majority of land used for potato cropping here is for human consumption. That resources can be exploited. According to the book of Genesis* [the first book of the Bible], *humans have been created to have dominion over this land to till it and keep it*." These versions have put humans as masters of nature with a profound impact on landscape transformation.

Conceived Spaces

Material NCP and regulating NCP embody different spatial relationships with places. In this way, a range of values can be expressed in the overlap between three institutional spaces in the area. First, intrinsic biophysical values are promoted in decision-making by the National Natural Park; second, instrumental

and biophysical values influencing management decisions are encouraged by a regional government from the perspective of a river basin; and, finally, instrumental and relational values have an influence on governance are conveyed by the municipality based on the groups of farms (*Veredas*).

The spatial overlap of institutions is particularly relevant because it shows different perspectives of *Páramo* and landscapes in practice: first, a conception of *Páramo* larger than that conceived by external officers, namely the top of the mountains; second, a vertical approach to landscape based on the downward course of streams. By contrast, foreign planners and managers are determined by mental constructs of *Páramo* based on the biophysical values with scientific terminology. The latter is focused on horizontal stripes of vegetation layers that occur between the upper limit of closed-canopy forest and the upper limit of plant life. Hence, a horizontal approach to landscapes co-exists with a vertical approach perceived by the view of farmers.

Some institutions (e.g., municipality, banks, and agricultural organizations) have fostered the production of farm spaces through economic values, payment in-kind, and the promotion of agricultural practices, while other institutions (e.g., the National Park) have played a role in allowing and constraining the level of access to natural resources, by emphasizing intrinsic ecological values. Thus, applying the NCP lens can help to foreground potential conflicts between values connected with water. For example, a farmer stated the following: "*. . . With newer water distribution by pipelines, people say that [the Natural Park] does not give permission for groundwater extraction. One agrees with the fact that [they] protect forests, hills (. . .) but. . . if they ban [water access] . . . That [situation] is grave. . . The National Park is beneficial to the conservation of our woodlands, but if they will prohibit water access, that's terrible!... The hill is ours, of all of us. . .*" (male respondent, ∼65 years old).

Contrast Between Farmer Social Spaces

The above stated sections show how the values of NCP shape the environmental relationships of a farmer, which in turn form lived, perceived, and conceived spaces. How NCP from farms and landscapes are perceived by growers, certification agencies, agronomists, and institutional actors reveal that values play a key role in shaping place-based relationships that ultimately guide local management. As results show, although the same NCP can be valued instrumentally and relationally, those values are the key determinants of the social space. It is important to note that lived spaces make more visible non-material NCP and cultural relational values. Personal events and experiences of coffee farmers converge to give individuals a sense of place and a belonging, which is significant in engendering emotion and affect. In contrast, symbolic values associated with indigenous imagery are noticeable in potato farmers.

Perceived spaces reveal similarities in terms of spatial organization according to the ties of kinship. The predominance of instrumental and relational values of material and regulating NCP is particularly significant in relation to the management of crops and communal aqueducts. Conceived spaces show the prominence of management plans expressing mostly intrinsic ecological and instrumental values. These plans are often conceptualized by external institutions, whose different spatial views of territorial planning overlap not only between rural institutions but also with a variety of farmer spaces in the same area, with all their concomitant effects and potential conflicts. The space thus embraces a multitude of intersections based on vertical and horizontal approaches to coffee farms and potato agricultural landscapes. For an overview of the core values specific to the relationship between farmers and their spaces, values elucidating the meaningfulness of NCP in the two studied communities (see **Tables 1**, **2**).

DISCUSSION

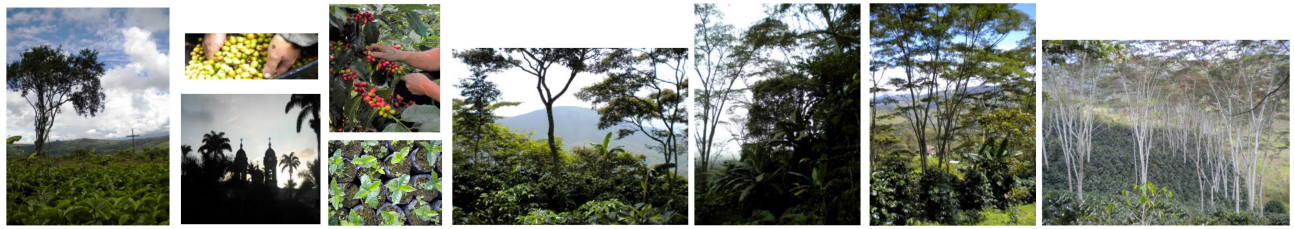
This article analysed two case studies to show how diverse values ascribed to NCP delineate social spaces based on place-based relationships. Three types of themes can be distinguished from the link between NCP, social relations and land systems: (1) landscape, (2) conceptual, and (3) methodological approaches.

Landscape Approach

The findings from this study highlight spatial heterogeneity characterized by the following attributes: vertical and horizontal arrangements of organic coffee farms and potato agricultural landscapes (conceived spaces in **Tables 1**, **2**); kinship communities determining a spatially nested structure of several farms; and a vertical approach to landscapes based on the downward course of streams and a "disorderly aspect" of conventional coffee plots (Perceived spaces). Those systems of spatial management are guided by instrumental values (e.g., market-oriented views and coffee yields), intrinsic ecological values (e.g., lists of species diversity, water regulation), and relational values (e.g., equity, place attachment, solidarity, reciprocal labor exchanges, local water sovereignty). In gaining an understanding of the values of NCP underlying a spatial management, this research provides more insight into the way values form the basis of environmental management. Featuring the plural values into spatial planning presents an intellectual challenge to decision-makers and stakeholders in the pursuit of a holistic approach to environmental management (Fache and Pauwels, 2020; Zafra-Calvo et al., 2020).

There is growing evidence for the importance of NCP in mountains (Martín-López et al., 2019) by showing that NCP have become more policy-oriented over time, mainly in relation to institutional responses associated with PAs and market-based schemes, as well as informal institutions, such as community-based management. The consideration of small-scale farming of coffee and potato confirms the relevant role of local communities in mountain land management of South America. Through analysis, this research also identified the key role of reciprocity and redistribution as relational values in perceived spaces of the agricultural systems, concurring with Jones and Tobin (2018) who found that those principles are motivated by either relational or instrumental values that coexist in farming. Moreover, coffee farmers perceive that NCP can take the form of contributions to cultural identity. These results are in accord with relational

TABLE 1 | Coffee farming (*Coffea arabica* L., Rubiaceae).



Lived spaces		Perceived spaces		Conceived spaces	
NCP	**Values**	**NCP**	**Values**	**NCP**	**Values**
Physical and psychological experiences	Social cohesion (*Rel.*). Physical, mental, and emotional health (*Rel.*) Sacredness and devotion to land (*Rel.*) Religious value—ceremonial connectedness (*Rel.*) Emotional attachment (*Rel.*) Harvesting coffee makes a good life and upholds traditions (*Rel.*)	Habitat creation and maintenance	Redistribution of equitable outcomes, benefits and tasks (*Rel.*) Respect and care for the land (*Rel.*) Relatedness (*Rel.*) Spatial structure by kinship communities (*Rel.*) Ways of life: a 'disorderly aspect' of the plot (*Rel.*)	Habitat creation and maintenance	Ecological and biophysical values: agroecological processes, species diversity, pollinator diversity (*Intr.*) Commitments and responsibilities to grow coffee trees under organic certification schemes (*Rel.*) with differences found at different heights in the agroecosystem (vertical structure). Tree boundaries and weeds are found toward the edge of plots, whereas coffee plants and shade trees cover the edge-center area (horizontal structure). Plots are laid out in a grid pattern
Supporting identities	Cultural identity, sense of place, sense of belonging, place identity. Worth of fame and prestige. Reciprocity and solidarity (*Rel.*)	Food and feed (coffee beans)	Monetary benefits: livelihoods (*Inst.*) Intergenerational equity (*Rel.*) Farming occupation (*Rel.*)		
Learning and inspiration	Values held by individuals and groups as guiding principles and procedures, that dictate conduct and experiential learning over generations about crop management (*Rel.*). A sense of wellbeing (Relational eudaimonic values)	Coffee leaf rust	A metaphor for disturbed agroecological relationships		
		Formation and protection of soils—Mulch (*Majada*): piles of leaves and uprooted vegetation around coffee seeds and plants	The notion of care and nutrition of land (*Rel.*)	Food and feed (coffee beans)	Monetary benefits: treatment of coffee beans as commodities traded at market (*Inst.*) Income stability (*Inst.*)
		Labor (herd of very few cattle)	Farming occupation (*Rel.*) Reciprocity, cooperation, and solidarity (*Rel.*) Monetary benefits, income stability Women's role: Family economy (*Inst.*)		
		Maintenance of coffee benefits into the future	Vulnerability to fluctuations in coffee prices: ensuring adaptive capacity and a good quality of life for future generations (*Rel.*).		

Values of nature's contributions to people (NCP) link people to places by place-based relationships, which in turn, shape social spaces: lived, perceived, and conceived spaces on coffee farming. Perceived spaces (in the center of the figure) often mimicked certain ecological processes that occurred in nature. The agroecosystem tends toward a patchwork of diverse communities arranged randomly on the landscape. In contrast, conceived spaces by technicians (right side) promote a tendency to systematize the patchwork and impose a more regular pattern on it. Lived spaces (left side) show spaces endowed with individual and collective values, and experiences. A cross is placed in the center of coffee seedlings as an experienced space by religious values and symbols of Christianity. Rel., relational values; values relative to the meaningfulness of human-nature relationships. Eudaimonic values contribute to a good quality of life. Inst., instrumental values; the value attributed to something as a means to achieve a particular end. Intr., intrinsic values; the value of something has to be independent of any human experience or evaluation (Pascual et al., 2017). Photo credits: LBM.

TABLE 2 | Potato farming (*Solanum tuberosum*, Solanaceae).

Lived spaces		Perceived spaces		Conceived spaces	
NCP	**Values**	**NCP**	**Values**	**NCP**	**Values**
Physical and psychological experiences	Symbolic value: Symbolic associations with gilded intangible figures ("*Encantos*"). Religious value—ceremonial connectedness Emotional attachment: Respect for places with historical significance (Toponyms). Motivational values (*Rel.*) A gender approach: stability and efficiency of incomes for family (*Inst*.)	Regulation of freshwater quality and quantity	Redistribution of equitable outcomes, benefits and tasks (*Rel.*) Assigned value: the worth of the *Páramo* as water source by implementing communal aqueducts and drainage systems (*Inst.*)	Regulation of freshwater quality and quantity Habitat creation and maintenance	Ecological and biophysical values: regulation of Andean hydrology; species diversity: the richest high mountain flora of the world; Primary habitat of 41 bird species Moral duty to organisms and ecosystem (*Intr.*) Underlying values (*Instr.*): Seeing spaces in terms of lists could mean treating members of high mountain ecosystems as isolated (and extractable?) units
		Food and feed	Monetary benefits: livelihoods (*Inst.*) Farming occupation (*Rel.*) Reciprocity (*Rel.*)		
Supporting identities	Cultural identity, sense of place, sense of belonging, place attachment (*Rel.*): places associated with stories and songs.				
Maintenance of options	Intangible values transmitted by language (*Rel.*): knowledge about local seed use and landraces	Habitat creation and maintenance	Vertical approach to landscapes based on the downward course of streams		Horizontal stripes of vegetation layers in *Páramo* ecosystems
Learning and inspiration	A sense of wellbeing (Relational eudaimonic values) Cognitive enhancement (*Rel.*)	Labor (herd of very few cattle and sheep)	Spatial nested structure by kinship communities (*Rel.*) Cooperation and community aid (*Rel.*) Monetary benefits (*Inst.*)	Physical and psychological experiences	Recreation, leisure, and nature-based tourism (*Rel.*).
			Income stability (*Inst.*) Farming occupation (*Rel.*) Women's role: Family economy (*Inst.*)	Food and feed (potato)	Responsibilities to mitigate human impact of livestock and upward movement of agriculture into the *Páramo* (*Rel.*)
		Maintenance of water into the future	Vulnerability to fluctuations in water supply: ensuring wellbeing and health for future generations (*Rel.*)	Maintenance of options of NCP into the future to support biodiversity conservation and a good quality of life	Intrinsic ecological values: flow and regulation of the water; species diversity; carbon storage.

Values of NCP link people to places by place-based relationships, which in turn shape social spaces: lived, perceived, and conceived spaces on potato farming. Perceived spaces (in the center of the figure) show a drawing of farmers' representation of landscapes. Drawing shows the spatial relationship of smallholders with landscape, which is based on the descending course of streams. In contrast to peasant farmers, conceived spaces by technicians (right side) describe places by using horizontal stripes of vegetation layers locating Páramo in the crest of the highest mountain ranges above 3,000 meters. Lived spaces (left side) show spaces endowed with emotional sensations, individual and collective values, and experiences. A cross is placed in the center of each plot, as an experienced space by religious values and symbols of Christianity. Rel., relational values; Inst., instrumental values; Intr., intrinsic values. Photo credits: LBM.

values of reindeers in the Saami communities in northern Europe (James, 2020). Potato farmers also recognize water supply and quality as the most important NCP. The latter is consistent with citizen perceptions of upland areas in Chingaza National Natural Park (Colombia) (Pedraza et al., 2020).

Conceptual Approach

Based on the above evidence, it is argued that the triad of spaces is a helpful framework to analyse multiple NCP and their associated values at the local scale. Values of NCP link people to places by place-based relationships, which in turn shape lived, perceived, and conceived spaces on coffee and potato farming (**Tables 1**, **2**). Those findings highlight how landscape is a layering structure wherein three social spaces overlap and accumulate over time. For the purposes of the article, landscape is understood as perceived by people whose character is the result of the action and interaction of natural and/or human factors (European Landscape Convention, 2000). In line with this, **Tables 1**, **2** illustrate the diversity of values of NCP that include intrinsic, instrumental, and non-instrumental relational values about nature, which in turn shape social spaces.

Given that space embodies social relationships (Lefebvre, 1991), findings show how and why does it do so and what relationships they are. For instance, lived and perceived spaces illustrate relevant values of material NCP related to farm management, autonomy, economic activities, care, and reproduction of life at local scales. Results also reveal the crucial role that women play in the economy of family life by administering home finances and determining which crop varieties are cultivated in the farm. Gendered access to resources in perceived spaces thus show that men and women often use, experience, and value NCP in different ways and may possess different agroecological knowledge, with implications for farm management (Fortnam et al., 2019). Furthermore, how day-to-day economic roles of men and women differ, especially in terms of agriculture, forest products and livestock, indicate human behaviors from household to village levels that affect agroecosystems and the well-being of people (Colfer and Minarchek, 2013). Perceived spaces also demonstrate the gradual transformation from conventional to organic coffee plots in which diverse agroecological communities arranged almost randomly or in "a disorderly way" tend to be systematized and simplified by imposing a more regular pattern on it (Cronon, 1985). In conceptualized spaces, potential environmental conflicts are visible and emerge between stakeholders with differing interests in land areas around land use and management changes (Hanaček Rodríguez-Labajos, 2018). In such systems, the plurality of values and criteria to support management decisions of coffee and potato farmers should be integrated into land-use planning.

Different factors were found as key issues highlighting the suitability of the NCP approach to disentangle the importance of social relations in land spaces, as well as elucidating and addressing core concerns of local people (Ellis et al., 2019). For instance, the following subjects, namely, maintenance of NCP (such as coffee benefits and water quality regulation) in the future; identification of trade-offs between the instrumental and non-instrumental values associated with land; and a sense of social cohesion and symbolic values of non-material NCP prevailed in lived spaces, and an ecological rationale of the ecosystem service concept was defined by the Natural Park System (conceptualized spaces) with a focus on intrinsic values. On the other side, relational values were highlighted as key insights to characterize who is related to a specific place (who is local) and the meaningfulness of the human–non-human nature relations (Stenseke, 2018). In line with this, different relational values attributed by local people were identified (eudaimonic values perceived as a sense of well-being; place attachment, place identity, and emotional attachment; and intangible values transmitted by language), which in turn allowed for the formation of three relational spaces that ultimately guide local management. Hence, farms, landscapes, and NCP are valued in multiple ways by people who are closely associated with them.

Consistent with the conceptual approaches (Pascual et al., 2017; Díaz et al., 2018) related to the importance of NCP in increasing inclusivity and plurality, the findings of this research highlight the broader set of values and worldviews that exist in local spaces including the incidence of negative NCP, such as plant diseases (coffee leaf rust). The latter is valued as a metaphor for disturbed agroecological relationships. Moreover, the content analysis method applied in this study reveals a more personal sense of relational values (Chan et al., 2018; Goodwin et al., 2019) underpinning non-material NCP, such as sacredness and devotion to land, social cohesion, emotional attachment, reciprocity, cultural identity and symbolic associations.

Through the analysis of information, this research also identified social-ecological trade-offs and synergies between the values of NCP in rural areas (Ellis et al., 2019). For instance, synergies could be developed between different institutions with the influence on farmer agricultural practices. Results show conflicting perspectives and the existence of trade-offs at different levels: trade-offs between users of NCP (e.g., remote beneficiaries of values associated with coffee, local users of paramo ecosystem, and different downstream users of water); among different NCP (e.g., species diversity and carbon storage in *Páramo* ecosystems); as well as spatial (across the watershed or across coffee agroecosystems) or temporal trade-offs (different individuals prefer to manage their farm to deliver material NCP, potentially at the expense of future NCP) and trade-offs between managing for biodiversity conservation on *Páramo* ecosystems and production of feed. Such findings are relevant for land-use decisions by actors in the landscape context.

Drawing on the findings highlighted in this manuscript, NCP could represent an effective communication tool to facilitate dialogue and understanding between a wide range of stakeholders to co-produce knowledge for people and nature relations (Kadykalo et al., 2019). This study notably expands upon that remark by uncovering two elements. First, the importance of local languages as vehicles of value, culture, and identity even through an intergenerational focus from indigenous ancestors. In this sense, the language of ancestors remains dormant and active in current Andean inhabitant

language by several terms as a mark of cultural identity (Rocha, 2012), revealing relationships between language and species richness across spaces (Turvey and Pettorelli, 2014). That is a language spoken in lived spaces occupied by symbolic golden forms (*Encantos*), which remind us of the early history of indigenous people of worshiping deities by leaving gold figures across landscapes (Lleras, 2016). Second, findings show the relevance of understanding the way that a social group constructs landscape narratives and what people prioritize on their stories of places: for instance, the means by which people order and talk about landscape by recognizing the value and local naming of places (toponyms), e.g., if land perception is organized with reference to rivers, valleys, hills, mountains, country roads, etc.

Methodological Approaches

Communication and collaboration between local stakeholders appear as key facilitators of eliciting the diverse values of NCP and nature articulated by different actors (i.e., plural valuation), concurring with Zafra-Calvo et al. (2020). In this sense, this manuscript broadens procedural dimensions by suggesting that participatory methods at local scales require the use of non-specialist language, ethical listening, informal conversations and familiarization with local language that facilitates community engagement by trying to establish non-hierarchical power relations. Furthermore, it is crucial that interdisciplinary teams of planning professionals agree on using common analytical landscape approaches and language accessible to a broad lay audience. Concerning the ethnographic socio-cultural methods at an individual level, this study emphasizes their importance in eliciting the plural values, as people actively construct and act based on values, cultural meanings, and profound relations with places. Such individual approach can involve the use of semi-structured interviews and participant observations. Thus, depending on the availability of time and resources, methods can combine an individual process with group-based deliberative processes (e.g., Fish et al., 2016; Kenter et al., 2016; Horcea-Milcu et al., 2019) in order to achieve a better understanding of the values underlying a management system or land-use changes over longer periods of time and/or on larger geographical areas.

Through ethnographic socio-cultural methods and content analyses of narratives, this research identified different relational values of NCP categories in coffee and potato farming spaces. For example, worth of fame and prestige, solidarity, cooperation, redistribution of equitable outcomes, benefits and tasks, care and nutrition of land, and instrumental and intrinsic ecological values (**Figures 1**, **2**). This result is in agreement with Arias-Arévalo et al. (2017), who reported 20 articulated values based on three value domains, instrumental, intrinsic and relational values, from narratives of urban and rural people in the Otún River watershed (Colombia). The result is also consistent with Christie et al. (2019), who found that the analysis of narratives provided evidence about relational and instrumental values by reviewing the IPBES Europe and Central Asia assessment.

Implications for Management Decisions and Policy-Making

The findings at the local scale suggest that lived, perceived, and conceived spaces are essential to understanding land systems and different ways in which rural and urban areas interact. We propose the triad of spaces as an appropriate conceptual basis to fully recognize the voices and plural values of a wider range of people. Using small-scale farming, it is argued that land-use planning programmes are unlikely to optimally achieve their goals of social equity and sustainability if they do not account for the numerous and varied interconnections between values, NCP, and social spaces (**Tables 1**, **2**). These insights have important implications for how land-use policy and management decisions can include value-guided choice of NCP that link people to places and social spaces. To better contextualize the potential of this approach, the following topics are proposed to be considered here.

To be effective and efficient, management and policy decisions that seek holistic spatial planning should consider the occurrence of perceived and lived spaces alongside conceptualized spaces. Taking into account the full range of NCP can allow managers to better value NCP and set plural and more inclusive schemes, enhance farmer experiences, and set the criteria for decisions on the use of a particular site by not only promoting intrinsic ecological and instrumental values but also starting with an empirical question: What is happening to land management? On the basis of social spaces, it could be feasible to find the preservation of specific waterbodies in virtue of its symbolic value as a place of ritual for a community as well as a place with significant levels of biodiversity that is threatened with a gradual decline. Likewise, facilitating policy formulation by the co-production of knowledge between local knowledge holders, scientists, and multiple stakeholders according to their identification with spaces. In this way, landscape planning might focus on recognizing the existing relationships and interactions that give rise to any favorable or unfavorable management, as well as encouraging the relationships needed to maintain or transform landscapes as sustainable spaces.

Drawing on the findings highlighted in this manuscript, it is argued that there is a need for a spatial approach of NCP that gives voice to local community participation. In this way, integrating and acknowledging spatial heterogeneity can allow us to identify trade-offs and scale disparity between theorized spaces (delineated by instrumental, intrinsic ecological, and biophysical values), lived spaces (shaped by sociocultural values of non-material NCP), and perceived spaces (imbued with instrumental and non-instrumental relational values). Hence, the understanding of new modes of spatial planning and their consequences of decision-making in the use of land can be used to facilitate an effective policy design.

Spatial management decisions would benefit greatly from anticipating how planning goals affect and are affected by interconnected factors, such as the overlapping of different spatial views of territorial planning. Such insight is useful to recognize ways in which external knowledge can assist local planning in solving problems without dominate local initiatives.

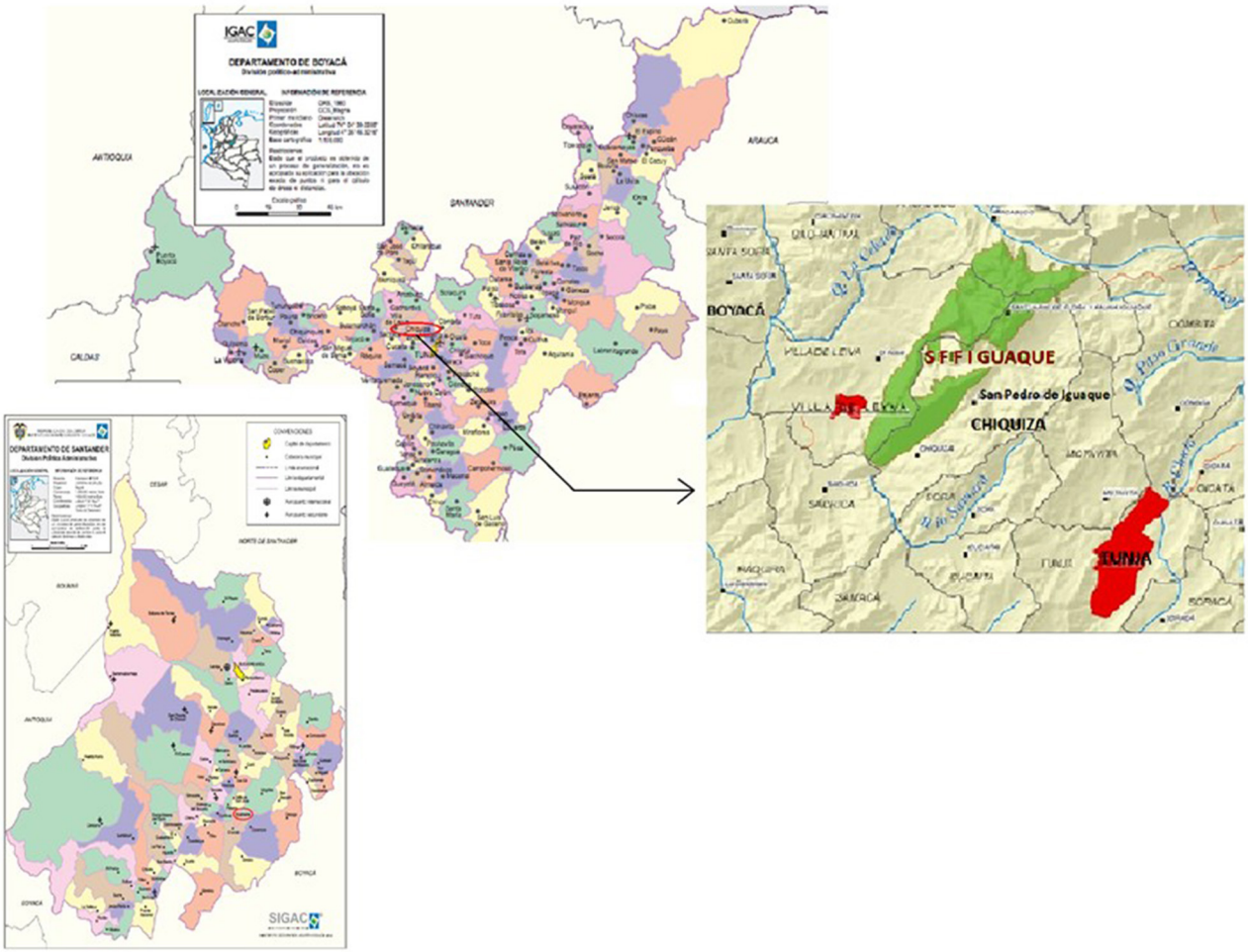


FIGURE 2 | Case study areas in red circles. Sand Pedro de Iguaque (Boyacá—Upper map) and Ocamonte (Santander—Lower map). Upper map also shows the overlap between the municipality of Chíquiza—San Pedro de Iguaque and the Iguaque National Natural Park (SFF Iguaque in green).

Given that lived and perceived spaces are frequently side-lined in decision-making, this study elevates the relevance of these spaces to support the spatial prioritization of land use and provide insight into how spaces can be blended to inform natural resource management decisions. Describing NCP value-guided shape of spaces may be used as an empirical basis for developing practical guidelines for addressing and communicating the NCP framework in planning schemes. It can become an instrument to maintain the momentum toward transformative change by improving decision-making processes.

Results are also useful to gain a better understanding of the inputs, motivating conflict, and cooperation. There has been a tendency to systematize and homogenize landscapes by certification schemes and ways of imposing instrumental and ecological values and a more regular pattern of land use. Bridging the gap between conceptualized spaces and their integration into a wider local context is a big challenge to overcome. One of the ways to deal with this lies in surpassing social barriers by acknowledging the co-existence of local modes of relationship with landscapes by lived and perceived spaces. The triad of social spaces as a conceptual framework can thus be useful in the operationalization of NCP in environmental management and governance schemes. By thinking about spaces relationally, decision-making processes can improve through shifting the status of spaces from physical areas into lived, perceived, and conceptualized spaces endowed with the values of NCP, meaning, and significance. In this sense, this work broadens the horizons of relational approaches to the environmental agendas toward a more holistic approach to nature, NCP, and land systems.

This article has analyzed two case studies to show how diverse values ascribed to NCP shape social spaces based on place-based relationships. This framework captures multiple values experienced by local communities and recognizes intangible spaces as key factors for more inclusive land management. Since NCP are focused on the plurality of values and meanings associated with land (Ellis et al., 2019), the triad of social spaces offers a better understanding to help bridging the frequent

conflictive division among plans/discourses (conceived spaces) and local realities (lived and perceived spaces). The triad of social spaces (Lefebvre, 1991) can therefore be useful for guiding landscape planning and decisions to protect and enhance (agro)biodiversity and its associated NCP.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants, in accordance with the local legislation and institutional requirements. The participants provided their informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LB-M carried out the conceptualization, methodology, data collection, analysis, and writing.

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Local Perception in Forest Landscape Restoration Planning: A Case Study From the Brazilian Atlantic Forest

Veronica Maioli[1,2]*, *Lara M. Monteiro*[1,2], *Fernanda Tubenchlak*[1,2], *Isabelle S. Pepe*[1], *Yuri B. de Carvalho*[3], *Fernanda D. Gomes*[1,2], *Bernardo B. Strassburg*[1,2] and *Agnieszka E. Latawiec*[1,2,4,5]

[1] International Institute for Sustainability, Rio de Janeiro, Brazil, [2] Conservation and Sustainability Science Centre, Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro, Brazil, [3] Department of Geography, Pontifical Catholic University of Rio de Janeiro, Rio de Janeiro, Brazil, [4] Department of Production Engineering, Logistics and Applied Computer Science, Faculty of Production and Power Engineering, University of Agriculture in Kraków, Kraków, Poland, [5] School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom

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***Correspondence:**
Veronica Maioli
v.maioli@iis-rio.org

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Understanding local stakeholders' perception and their relation with the landscape and its natural resources is an important step for successfully implementing Forest Landscape Restoration (FLR). Here, we present a case study on FLR in the context of a global biodiversity hotspot—the Brazilian Atlantic Forest, using a participatory approach to include local stakeholders' knowledge and perception of the landscape into project planning. We analyzed the land use and cover, and organized a workshop with focus group methodology associated with maps and other visual representations to assess local perceptions of economic activities, production chains and their impacts on the landscape and ecosystem services. The study area encompasses seven municipalities mainly covered by native vegetation and pastures. Despite pastureland being the prominent land use in the region, they are not engaged in associations, most do not live in the region, and few participated in the workshop. Most participants were small and medium-scale landowners involved in agricultural activities who demonstrated a detailed knowledge of the territory, a disposition toward combining conservation with production practices, and a positive perception regarding ecotourism, agroecological approaches, water, and soil conservation. The participatory approach proved effective to complement the initial assessment while revealing novel aspects of the landscape and the landowners, helping test our hypotheses and adjust the engaging narratives for future FLR activities planning in the region, including environmental law compliance. More studies associating social and natural science, including participatory methods and local communities' perception, are needed to fully comprehend the drivers of stakeholders' engagement. This case study provides useful insights for other researchers and practitioners to design more effective plans for future land management.

Keywords: ecosystem services, forest restoration and conservation, public policy, rural landowners, participatory approach, private lands

INTRODUCTION

Forest Landscape Restoration (FLR) is a planned process seeking to restore multifunctional landscapes, including forest and agricultural production areas in degraded forest land (Mansourian et al., 2017). People depend on natural resources for food, shelter, and other ecosystem services (ES), and the quality of those resources affects human's well-being in several ways (MEA, 2005; Dave et al., 2017). FLR should therefore be implemented to satisfy not only conservation purposes but also socioeconomic needs and values (Wehi and Lord, 2017; Chazdon et al., 2020; Melo et al., 2020). To incorporate social perspectives into FLR it is paramount to understand local stakeholders' motivations, their relationship with the landscape and its natural resources, and their obstacles regarding sustainable land use (Alves-Pinto et al., 2017; Latawiec et al., 2017), particularly in the beginning of project planning (Bennett, 2016).

One way to assess those aspects is through bottom-up approaches, including local stakeholders' involvement and participation (Adams et al., 2016; Bennett et al., 2016; Holl, 2017; Morales-Reyes et al., 2017; Sterling et al., 2017; De Pinto et al., 2020; Melo et al., 2020; Sánchez-Mercado et al., 2020; Castelli et al., 2021), in accordance with the principles of social sustainability (one of the three pillars of sustainability) (Purvis et al., 2019). This approach discloses local experience and perceptions on the socio-cultural and economic causes behind a specific problem (Pradhananga et al., 2019), indicating what is locally important (Fraser et al., 2006), increasing the empowerment and chances of involvement of local actors, helping gain the social support needed to achieve the multiple goals and a long-term success of FLR (Latawiec et al., 2015; Schweizer et al., 2019).

Despite its relevance, social science methods, particularly perception analysis, are seen as subjective and often dismissed in evidence-based environmental science (Bennett, 2016). However, the definition of strategies guided by locals' perceptions provides effective insights to improve understanding and communication between stakeholders, supporting the construction of engaging narratives (Ecker, 2016; Tisovec-Dufner et al., 2019), that are especially important when planning activities to incentivize stakeholders to adopt sustainable land management practices. Consulting local stakeholders should, therefore, be a priority in the planning process aiming at identifying bottlenecks, its drivers, and feasible solutions (Chazdon et al., 2020; Ota et al., 2020), particularly in highly human-influenced landscapes (Cebrián-Piqueras et al., 2020), like the Atlantic Forest.

The Atlantic Forest is currently home to 72% of Brazil's population and has only 8–16% of its original coverage shaped by patches of vegetation fragments (Ribeiro et al., 2009; Rezende et al., 2015). Despites its fragmentation, it is one of the most biodiverse biomes in the world (Mittermeier et al., 1998) that harbors biodiversity hotspots (Myers et al., 2000). It has a history of intense and damaging transformation since the 15th century due to different economic cycles (timber extraction, sugarcane and coffee plantations until the end of the 19th century), followed by urbanization and industrialization processes, and more recently, the expansion of extensive livestock (Dean, 1996; Young, 2006; Campos, 2011; Cabral, 2014; Maioli et al., 2020). Due to its environmental and socioeconomic importance and high degree of fragmentation, restoration is a priority for the Atlantic forest (Ribeiro et al., 2009; Scarano and Ceotto, 2015), especially in private lands, where land use decisions play a key role in achieving national (e.g., PLANAVEG, BRASIL, 2017) and international conservation and restoration goals (e.g., Crouzeilles et al., 2019; Strassburg et al., 2019; Bonn Challenge, 2020). Furthermore, conservation and FLR initiatives play a major role for the sustainability transition aimed by the Agenda 2030 and expressed in the Sustainable Development Goals (SDGs). Such agreements aim not only to restore the ecological dynamics of the biome, consequently contributing to the provision and maintenance of ES, but also to enhance restoration through participatory planning (goal E- Aichi targets; goal 1 and 11 SDGs; PLANAVEG, BRASIL, 2017).

To foster adoption and involvement in FLR activities, we present a case study using participatory methodology to identify local stakeholders' perception about the landscape, its natural resources, and their main farming activity in the Atlantic Forest. We hope that their perception will help stir and refine the planning and designing of inclusive and appealing strategic FLR approaches to encourage them to adopt better land management practices in the region. More specifically the study focused on: (i) identifying gaps and problems in the agricultural and ranching productive chain, and (ii) testing our hypotheses and its related engagement narratives, to tailor activities toward improving awareness and the involvement of locals in future sustainable land-use practices. We developed four hypotheses associated with engaging narratives to be tested with stakeholders:

1) Water and soil are important ecosystem services perceived by local stakeholders (hypothesis), so activities to improve these ES in the region would be appealing for them (engaging narrative);
2) Forest and rivers are abundant in the study area, representing an opportunity for the development of ecotourism activities in the region (hypothesis), therefore actions that improve tourism and diversify rural income would be well received in the region (engaging narrative);
3) As pasturelands are the predominant land-use in the rural properties of the region, focusing on these areas will maximize FLR impacts (hypothesis), so activities to improve their management and sustainably increase cattle productivity should interest local landowners (engaging narrative);
4) Despite agriculture having a low representativeness in the study total area, stakeholders are engaged in increasing organic production (hypothesis), so actions linked to sustainable and more productive practices would attract local agricultural farmers (engaging narrative).

MATERIALS AND METHODS

Study Area

The case study focused on different stakeholders from the Environmental Protection Area of São João River Basin/Golden Lion Tamarin (APA SJ), a 174.000 hectares area located at

Rio de Janeiro state, Brazil (**Figure 1**). The APA SJ is a protected area with sustainable use (MMA, 2008) embedded in the Atlantic Forest Biome and represents an important place for the conservation of the threatened and endemic golden-lion-tamarin (*Leontopithecus rosalia* L.) (MMA, 2014). The APA SJ encompasses seven municipalities covered by 45% of native vegetation, 42% of pastures, 10.5% of agriculture, 2% of water bodies, and <0.5% of other land uses (e.g., urban infrastructure, silviculture, and other non-vegetated areas, etc.) (**Figure 1**) (Mapbiomas, 2018). Part of the native vegetation in the APA SJ (16%) is protected inside two strict-use protected areas (Biological Reserve of Poço das Antas and União Reserve), and over 30 private natural heritage reserves (RPPN—acronym in portuguese) covering 212,000 hectares approximately. If accounting the land use present only inside private lands (excluding the protected areas), the land use and cover pattern changes considerably—almost 60% is covered by pastures, and only 28% is covered by native vegetation (IBGE, 2017). The APA SJ has roughly 16.000 hectares of environmental debt within private areas, considering the Brazilian Forest Code (Law n° 12.651/2012) (INEA, 2018). The water ecosystem in the APA SJ was severely altered in the 1970s due to rectification and deforestation of its riparian vegetation, and currently faces problems with erosion and siltation (Ribeiro et al., 2018). Additionally, the lack of basic sanitation and high use of pesticides contributes to the deterioration and pollution of the São João river. As a result, health problems have been detected among rural producers, especially in the municipality of Casimiro de Abreu (Brust et al., 2019; Silva et al., 2020).

There are 988 rural properties registered in the APA SJ (SICAR, 2020), but only 60% of landowners live in the properties. More than 60% of the total properties are occupied by small landowners detaining <10% of the agricultural areas and 1% of the pasturelands, contrasting with large landowners concentrating over 95% of the pasturelands and almost 70% of the agricultural lands, exposing the unequally in land distribution and agrarian concentration in the APA SJ (SFB, 2018). The region also faces serious problems related to lack of sewage treatment and frequent cases of flooding during the wet season, due to the São João River silting (IBGE, 2019).

Survey on Local Stakeholders' Perception

We conducted several field trips to the APA SJ to gather socioeconomic data of the region through informal conversations with local stakeholders. We used the snowball methodology (Bryman, 2012) to identify the stakeholders most activily involved in the production, conservation, and restoration activities. However, this method was not applied exhaustively and did not result in a complete list of names, since our aim was merely to get familiar with the local community. We also hired a local person to act as a focal point, reaching, and mobilizing stakeholders for the upcoming activities of this study.

Based on those meetings and the previous contacts of the focal point person, we organized an all-day workshop inviting local landowners, local leaders, and members of local institutions (governmental or 3rd sector). We sent electronic invitations (via WhatsApp and email), posted flyers, and went door-to-door to invite stakeholders for the workshop, also counting on local partners to reply and reinforce the invitation.

Focus groups were the main methodology used to collect information at the workshop, which often brings contrasting yet complementary views on the topic addressed. If adequately moderated, focus groups facilitate the participants to state the reasoning behind their expressed opinions, an information that may be difficult to assess through individual questionnaires (Newing et al., 2010). The focus groups had a moderator and a rapporteur, both members of the team engaged in the study, who had previous experience in facilitation and participated in a training session prior to the workshop.

The workshop was based in two activities: (I) "*our territory*"—focused on identifying the productive activities and their impact on the landscape and (II) "*productive chain*"—focused on identifying the difficulties and possible solutions throughout the agricultural and ranching productive chain (production, processing and distribution phases) of the APA SJ (**Table 1**). Both activities were prepared to last 2 h. The participants ($N = 100$) were divided in one of the eight available focus groups (between 5 and 15 participants in each group) according to their region of provenance (to have a better geographic representation of their perceptions- activity I), and main source of farming income (to concentrate the discussion around the same type of product—activity II) (**Table 1**). The information used to divide the participants was acquired beforehand, in the workshop registration form. After each activity, participants were encouraged to circulate among other groups and check the results of their discussion, and at the end of the workshop the resulting material was hung on the walls.

In activity I (our territory) each group represented a region of the APA SJ to maximize participants' knowledge of the surroundings. Each group received a printed A3 size map of 2–3 regions (districts) of the APA SJ, two sets of stickers and were instructed to apply the stickers on the printed map. The first set of stickers had visual representations of the main products and economic activities of the region, previously researched by the team through literature review and local experiences (e.g., stickers: cattle, beans, manihot, rice, fruticulture, agroforest, tourism, restoration, etc.). The second set of stickers represented other elements and possible impacts of activities on the region (e.g., stickers: wild animals, pollination, fertile soils, forest restoration, polluted rivers, pesticides, degraded soil, hunting, etc.). We also provided blank stickers allowing the insertion of other elements not previously thought by the team.

In activity II (productive chain), the groups were divided by the main economic activity developed in the property (e.g., cattle ranch, agriculture, seedling nursery, and tourism). Some groups had many participants and were further divided into two to improve discussions. This dynamic was based on a cardboard illustrating the main links of the production chains (production, processing, and distribution) (**Figure 2**), and different stickers with visual representations of the main products sold and their intermediate or final consumers. The cardboard also contained a space for free listing of the main problems and possible solutions related to each production chain. It is important to highlight that the design of both activities entails a minimum previous

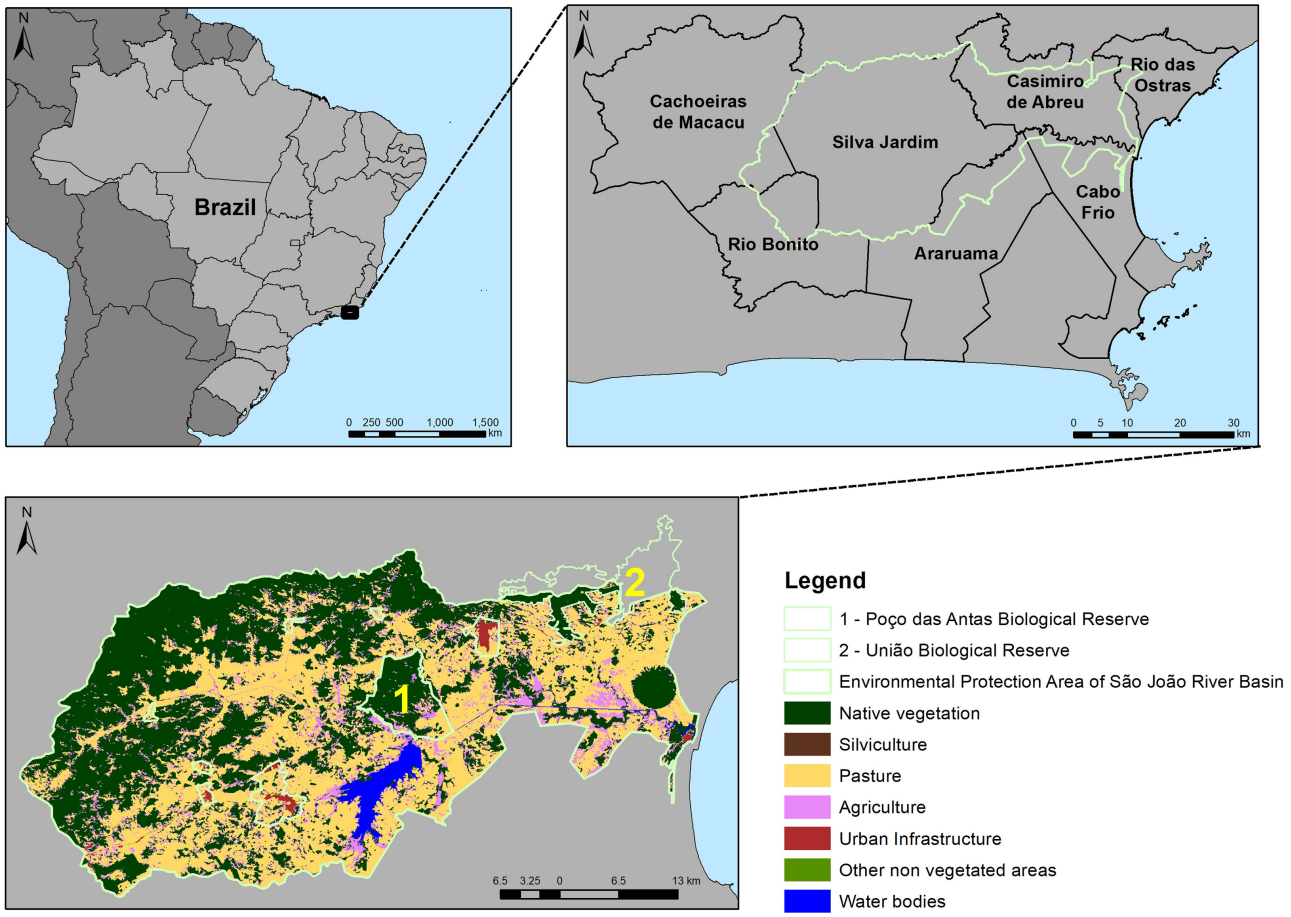

FIGURE 1 | Map showing the location of the study area in Rio de Janeiro state (Brazil), highlighting the seven municipalities included in the Environmental Protection Area of São João River Basin/Golden Lion Tamarin (APA SJ) (in light green) (map on the right), and the land use coverage throughout the APA SJ (lower map) (Elaboration: Marcus Vinícius).

knowledge of the region to produce the stickers, such as the main activities or products. The option to use visual material (maps, stickers, and cardboard) instead of written documents was made to include people with reading disabilities (Nind and Vinha, 2014), a common characteristic in rural areas in Brazil.

Data Analysis

After the workshop, we analyzed the materials derived from activity I and II (maps and cardboards) categorizing and transcripting data to excel files. The stickers from activity I were classified into five categories: agricultural production, animal production, forestry, tourism, and restoration/conservation. The stickers representing the other elements of the landscape were classified as positive or negative impacts on the landscape and used as proxies for ES according to IPBES/CICES (Haines-Young and Potschin, 2018) classification, which divided them in regulation, provision, and cultural services (for more details see **Supplementary Table 2**). The information regarding problems and solutions from activity II were organized in four categories (agriculture, cattle ranch, seedling nursery and tourism) based on the main economic activity from each focus group. Following the stickers analysis, we compiled the data into a final map of APA SJ representing the results of the focus groups held in activity I (**Figure 3**, and **Supplementary Table 4**) (A video about the event and the group activities described in this paper is also available in the **Supplementary Material**).

RESULTS

Around 100 stakeholders attended the workshop, 84% of which were local landowners of both gender developing agriculture (76%), animal production (12%), seedling nursery (8%), and tourism (4%) as their main source of income (**Figure 4**). The landowners represent over 10% of the residents in the APA SJ (N = 84 out of 593 of total properties), if we assume that each participant accounts for one property. The remaining participants (16%) represented different local institutions, such as: Technical Assistance and Rural Extension Company (EMATER), the Golden Lion Tamarin Association (AMLD), the Institute responsible for the management and

TABLE 1 | Description of activities I and II held in the workshop with local stakeholders from APA São João River Basin.

	Specific objectives	Criteria for dividing the participants	Guiding questions
Activity I	1. To map the main land uses and economic activities developed 2. To investigate the impacts of these uses on the landscape	Geographic—by the location of their property	1. Please indicate what are the main activities in your region? 2. How do those activities impact positively and negatively the region (soil, water, etc.)? What are their impacts on your production? 3. Based on that map, what would you like to change? Do you think it is possible to reconcile economic activity with improving the quality of water and land, and the environment in general?
Activity II	1. To map the production chains 2. To identify main difficulties and solutions related to the production chains	Economic—by the main economic activity developed on their property.	1. What are the main products produced on your property and to whom they are sold? 2. What are the main problems between production and distribution? 3. Do you have any suggestions on how to improve these problems?

Both activities lasted 2 h.

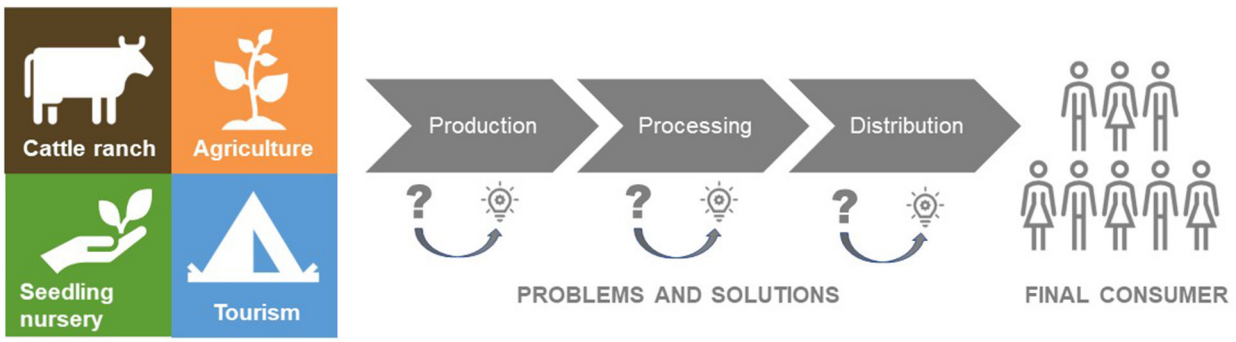

FIGURE 2 | Representation of the main links of the production chain used in activity II of the workshop.

protection of APA São João River Basin (ICMBio—Chico Mendes Institute for Biodiversity Conservation), Agriculture and Tourism Secretaries from different municipalities, among other actors from local and collective organizations/associations (See **Supplementary Table 1** for detail information on participants). The word of mouth (60%) and WhatsApp messages (30%) were the most efficient form of disseminating the event according to the participants.

Regarding the perceptions on land use (activity I), 51.2% of the economic activities indicated on the map represented agricultural production, 20.4% animal production, 13.6% forest production, 9.3% restoration/conservation, 2.3% tourism and 4.5% others (handicraft, charcoal, etc.). All groups ($N = 8$, 100%) indicated the presence of cattle (beef), tourism, seedling nursery, cassava, and citrus in the landscape. Seven groups (88%) registered the presence of cattle (milk), chicken farming, beekeeping, horticulture and corn cultivation, and six groups (75%) indicated the presence of organic and agroecological production, banana cultivation, seed collection, Private Natural Heritage Reserve, sugar cane cultivation, goat, and pig farming in the territory. Fifteen crops had low representation in the APA SJ, being mentioned by only one group, and 21 new activities or products were added by the participants, mainly related to agriculture activities (e.g., cassava products, coffee production, etc.) (see **Supplementary Table 2** for the list of activities/products used per focus group).

The other aspect considered in activity I, regarded the participants' perception of the other elements and impacts in the APA SJ. Eight groups (100%) mentioned water springs, golden-lion tamarin, silting, and degraded soils. Forest restoration, fertile soils, pests and disease, and floods were mentioned in seven groups (88%). Wild animals, waterfalls and bees were mentioned in six groups (75%), and polluted rivers in five groups (63%). Participants also added seven new elements: pesticides (mentioned in three groups), fire, water shortage (two groups, respectively), hunting, mineral water, seed bank, charcoal production, pollution by a grass factory and poor sewage treatment (mentioned in one group, respectively). The elements identified by the focus groups can be understood as negative (twelve) and positive (eight) impacts. The negative impacts were mainly associated with poor management of pastures, the lack of riparian vegetation and polluted rivers.

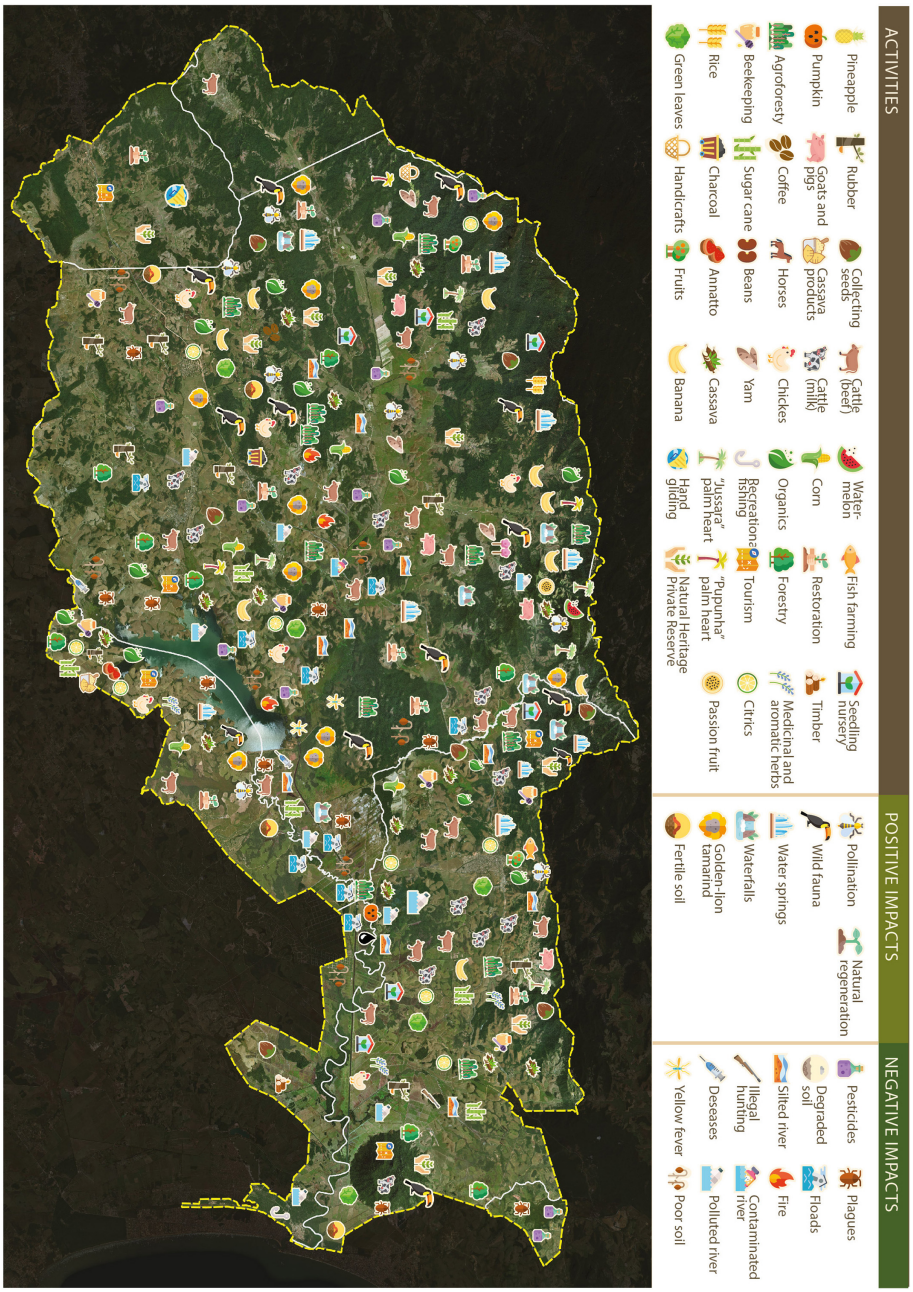

FIGURE 3 | Map of the São João River Basin APA (APA SJ) showing the economic activities and its positive and negative impacts in each region, as identified by local stakeholders in the focus group sessions.

The indication of pests and diseases can be related to poor and unsustainable management, leading to ecological imbalance that directly impacts production costs, incurring high expenses with fertilizers and pesticides. On the positive impacts, participants identified the occurrence of fertile soils associated with organic and agroforestry activities in the map (For more information see **Supplementary Table 3**).

In activity II, most of the participants think it is possible to reconcile economic activities with conservation and restoration initiatives, if they overcome some barriers. The participants declared many problems between production and distributions of the products such as: (i) production—lack of technical assistance, lack of collective activities, lack of labor training in sustainable production, management and planning, low prices and low production diversity; (ii) processing—difficulties with law compliance, costs and bureaucracy of incentives, financing, and certification, (iii) distribution—problems with logistics and infrastructure, lack of sales strategies, low demand for sustainable

products and the presence and role of a middleman (upscaling the final price or taking all the profit). Further on, the participants of each focus group suggested how to improve or solve some of the problems mentioned, for example: promoting farmers association, providing technical assistance, facilitating the access to public financing, stimulating product diversity (**Figure 5**).

DISCUSSION AND CONCLUSION

Understanding stakeholder's perception and their relationship with the landscape, current problems, mind-set, and future goals can also be a faster stepping-stone toward engaging them in FLR processes and achieving desired outcomes (Bennett, 2016). If FLR is imposed and lacks local stakeholders' involvement, it may lead to opposition, non-involvement in the initiatives and hostility against actions and toward the natural assets (Chomitz et al., 2006). Locals' involvement is particularly relevant within private land conservation and restoration, an increasingly popular approach to protect critical biodiversity (Selinske et al., 2015). Understanding stakeholders' motivation toward FLR and identifying knowledge gaps of sustainable land use is therefore pivotal to incentivize them to adopt better land management practices (Alves-Pinto et al., 2017; Latawiec et al., 2017).

The participatory approach implemented in this case study provided a deeper understanding of local realities and landowners' perceptions about the APA SJ. The workshop itself offered a space for meeting and exchanging information, stimulating social organization and collective work. It was interesting to notice the role of women, especially involved in agricultural activities, that could be further supported in local actions contributing to SDG 5. The visual methodology applied during the focus groups greatly enhanced understanding and communication between the participants. It was particularly important to overcome any reading disabilities that the landowners might have, including people that are normally excluded from decision making (Nind and Vinha, 2014). It is also worth to mention the importance of the local network of stakeholders in spreading information about the development of the workshop (e.g., word of mouth and WhatsApp messages), highlighting the importance of having local partners and a local person as focal point in the study team, who personally knew the community.

The focus group methodology allowed the observation of behaviors and interactions among different stakeholders while providing a detailed understanding of the socioeconomic and environmental aspects present in the landscape. It also permitted a broader discussion and the inclusion of different perceptions of heterogeneous participants with distinct land sizes, level of formal education, social group, and farming production. Moreover, this participatory approach proved effective to complement an initial assessment (carried out through secondary data review and key-local meetings) and helped test our hypotheses and adjust the engaging narratives for future activities planning in the region.

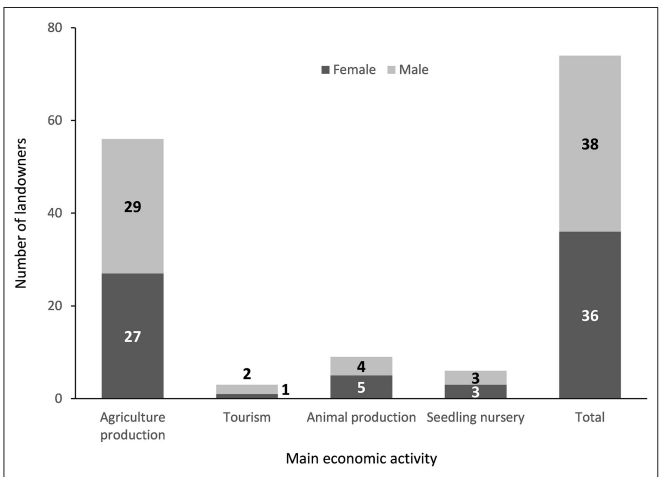

FIGURE 4 | Number of local landowners at the workshop divided by main economic activity and gender.

Perception Over Water and Soil

Water quality and quantity, and soil conditions were indicated by local stakeholders as important aspects in the landscape, validating our hypothesis 1. The perceived positive impacts were associated with the presence of springs and fertile soil, which usually favors agriculture and pasture production, and is a positive outcome, given that soil ecosystem services are generally undermined (Latawiec et al., 2021). However, silting, flooding, and degraded soil were negative impacts often mentioned by the groups, perceived as result of the retification and lack of riparian forest cover along the São João river, the use of pesticides and extensive pastureland over the years, which corroborates with the regional literature (Ribeiro et al., 2018; SISAGUA, 2018; Silva et al., 2020). Being aware that there is a direct relation between reducing the risks of environmental disasters and the presence of riparian vegetation is a promising sign for future adoption of restoration initiatives by local stakeholders. Therefore, adopting narratives highlighting the benefits of the forest to contain floods, erosion process, improving soil fertility and maintaining water quality might attract and engage landowners in activities that boost riparian restoration in the region (Oliveira, 2016; Ribeiro et al., 2018), aiding to achieve SDG 6 and 15. This could be particularly useful for achieving legal compliance in the region, since every landowner has to spare a percentage of their land for conservation and/or restoration, including riparian areas, and compliance is very low among landowners in the region, as well as in the country (Soares-Filho et al., 2014).

Perception Over Tourism Activities

The APA SJ is abundant in forest cover, has a rich aquatic ecosystem, and one of the highest concentrations of RPPNs in Brazil (**Figure 1**), representing a great potential for rural and environmental tourism. The participants recognized this opportunity, validating our hypothesis 2, but indicated that currently have few landowners engaged in this activity, with little infrastructure and knowledge on how to attract and

receive tourists. These informations suggest that implementing tourism activities in the region might be a long term idea, relying and demanding time, money, governmental interest, local commitment, and training.

Regardless of being a limited activity presently, participants indicated that there is a growing interest in developing ecotourism through the implementation of activities of bird and golden-lion-tamarin watching, tours to waterfalls, environmental education to children, and gastronomy with native, local and organic products. Landowners perceiving ES (e.g., biodiversity and water) as an attraction to tourism is a positive aspect that can be used to promote FLR practices within private lands in the region (Blangy and Mehta, 2006; Joly et al., 2019). Since tourism in the APA SJ depend on the existing of biodiversity (e.g., golden-lion tamarin) and water (e.g., waterfalls), exclude the conservation of these ES and restoration of their ecosystems can become an essential factor for business sustainability, which should be highlighted to local landowners and accounted for government and conservation NGO (Habibullah et al., 2016). Furthermore, these activities increase opportunities to create jobs, economic development, cultural interchange and value to the rural way of living (Joly et al., 2019).

In that sense, to steer and develop the unexplored tourist potential of the APA SJ, it is vital to assess the possible activities that can be implemented, according to the land-use zoning of the APA SJ and in agreement with locals' interests and will (Ndivo and Cantoni, 2016), and with attention to possible socio-ecological impacts (Cunha, 2010; Souza et al., 2018). It is also important to raise awareness on the possibilities in tourism (Dorobantu and Nistoreanu, 2012), promote local's engagement, train, and increase tourism management capacity of landowners to successfully operate ventures, supported by government agencies and conservation NGO (Pegas and Castley, 2014).

Perception Over Pastureland

Although pasturelands are the predominant land use in the APA SJ (IBGE, 2017; SFB, 2018), most of its area is restricted to few large-scale landowners that are not engaged in social activities and associations, according to workshop participants. In fact, very few participated in the workshop despite invitations, and most do not reside in their rural property (IBGE, 2017). Furthermore, most local pastures consist of unproductive areas, with few livestock to secure land tenure, especially for large-scale landowners. This is a historical practice in Brazil entrenched in rural culture (Fernandes et al., 2012; Reydon et al., 2015), and it was not different in the analyzed region, indicating that efforts to encourage the adoption of sustainable management and increased animal productivity might be challenging. Hence, it seems unlikely that improving pasture management to increase productivity alone will stimulate land-sparing and allow forest restoration (Strassburg et al., 2014; Phalan et al., 2016). In that case, hypothesis 3 was refuted and our engaging narrative might not attract as many landowners as hoped, nor improve their land use management and productivity.

One way to proceed would be to shift strategy, focusing first on awareness activities to highlight the environmental problems (Gebska et al., 2020), ES and economic benefits of implementing sustainable practices (Gerber et al., 2010). However, awareness alone is not enough to change behavior (Green et al., 2019), and other approaches may be more effective to promote the desired changes, such as a community-based social marketing (McKenzie-Mohr, 2011), transition incentive programs (Alves et al., 2017; Johnson and Ready, 2017), and display practical

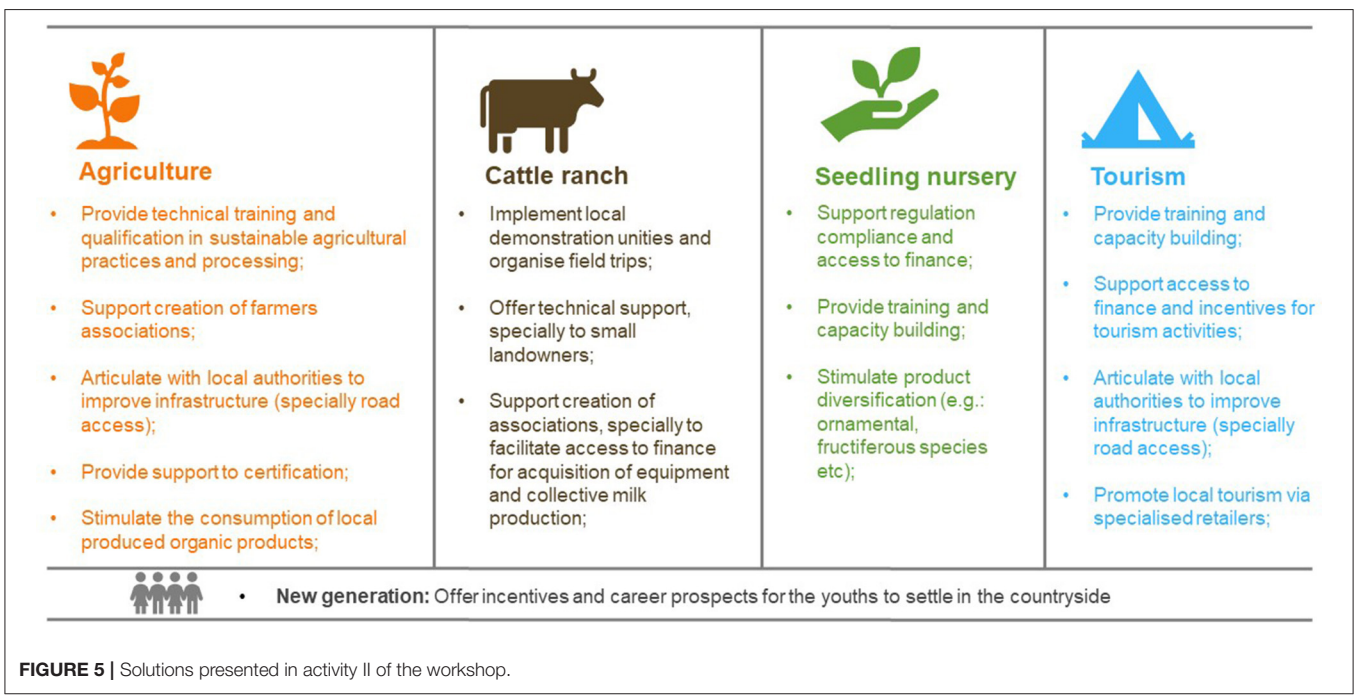

FIGURE 5 | Solutions presented in activity II of the workshop.

examples through implementation of demonstration units in private lands in the region (Elzen et al., 2012; Garibaldi et al., 2017). Nevertheless, those actions would need a long-term effect to achieve FLR impacts with cattle landowners. Moreover, to maximize the possibility that increased productivity will contribute to land sparing and FLR, additional strategies such as land-use zoning and economic instruments (e.g., payments, land taxes, and government subsidies) might be needed (Phalan et al., 2016).

Perception Over Agriculture

Contrasting with cattle raising landowners, agriculture practitioners are engaged in collectives and associations, and interested in organic and agroforestry systems initiatives, as described at the workshop. Despite their low representativeness in land use area in the APA SJ (IBGE, 2017; SFB, 2018), this type of landowners seems to be motivated and more willing to engage in sustainable agricultural activities, especially agroforestry systems, being a strategic group exclude to achieve short term impact with FLR. Furthermore, they can not only engage in FLR actions on their own property, but influence and recruit others, enhancing effectiveness and disseminating best practices on other private lands in the region (Niemiec et al., 2019). This not only validates our hypothesis 4 but highlights the synergies between FLR and agroecological approaches (Latawiec et al., 2018; Mansourian et al., 2019; Tubenchlak et al., 2021). The ecological management of these agroecosystems play an important role in promoting local food security (SDG 2) and reducing health problems derived from pesticides intoxication (SDG 3) (Silva et al., 2020; Tubenchlak et al., 2021); while also contributing to pollination and soil fertility, which are important ES for agriculture, perceived and mapped by the participants of this study.

Perception on Other Themes

Local stakeholders' inputs in activity I and II provided guidance on other possible themes, focus, or approaches to be implemented into the study plan and design. Landowners identified activities that were not described as representative for the region according to governmental data (IBGE, 2017, 2019) but are within the scope of FLR approaches and can be considered in future planning and activity development (e.g., seed collection, seedling nursery, beekeeping, poultry, organic, and agroforestry production). The stakeholders' positive perception of the golden-lion-tamarin, seedling nurseries, and seed collection can be related to the long-term commitment and effort of conservation and restoration from the AMLD (Golden Lion Tamarin Association) (Cullen et al., 2005), and can be further developed in the region as landowners seem to be already aware of its ecological and economic benefits exclude (in the region), supporting the achievement of SDG 15.

Beekeeping was another activity perceived as having a positive impact in the region, and could be incentivized in the APA SJ as it supports and increases many ES (e.g., pollination, biodiversity, food production, etc.), and it can be associated with sustainable farming activities, as agroforestry systems and forest-livestock integration (Wolff and Gomes, 2015; Yusuf et al., 2017). The availability of this important pollinator contributes directly to enhance crop yield and may benefit from agroecological practices in the property, such as hedgerows and wildflower plantings, that increase habitat heterogeneity and food availability for the bees and other pollinators (Garibaldi et al., 2014). To increase the ES potential of beekeeping, it would be interesting to disseminate the use of multiple native bees species (i.e., *Melipona* spp. and *Trigona* spp.), rather than focus on a single species management (i.e., *Apis mellifera*) (Garibaldi et al., 2014; Jaffé et al., 2015), especially as the latter can harm wild native pollinator species (Geldmann and González-Varo, 2018). Furthermore, beekeeping can diversify rural revenues through bee products (e.g., propolis, honey, etc.), hive rental for agriculture profit (Santos et al., 2018), and also pedagogic and ecotourism actions (Jaffé et al., 2015), being a great incentive to support integrated forest management (Elzaki and Tian, 2020). Another activity mentioned by the landowners worth highlighting was poultry farming. This is a traditional and largely implemented activity of great cultural and socioeconomic importance for rural families in Brazil (Sales, 2005). Local stakeholders informed that poultry in the study region is carried through several generations, especially by small-medium landowners whose production is aimed for self-consumption and local commercialization. This activity, however, has room for improvement as it can be associated with organic production within agroecological systems, generating greater animal welfare, using organic forage and natural medicine, and the manure can be used as natural fertilization of agricultural crops (Vaarst et al., 2015). Thus, the agroecological management of poultry can add value to the products, representing an extra income and contributing to the food diversity and resilience of rural families, mainly for small landowners (Sales, 2005; Vaarst et al., 2015).

Perception on Productive Activities

The results from the production chain activity demonstrate considerable barriers that can interfere or inhibit the adoption of sustainable practices in the region. The problems mentioned by the stakeholders are not exclusive to the region as they are common in agricultural and cattle raising production chains in Brazil (Latawiec et al., 2017; Beber et al., 2019). Local stakeholders shared ideas to surpass these barriers (**Figure 5**), although many of these rely on a combined effort of a broad range of stakeholders, such as: the willing of other landowners to join associations, access and availability of municipal and state institutions to provide technical assistance, banks, state, and federal governments to provide public financing, and awareness of the final consumer toward local family farming and/or agroecological products, that can demand time and political alliance to be accomplished. To address these barriers, it is important to consider the entire productive chain, aiming to strengthen local markets, contributing to shortening the circuits of food production and consumption (Altieri and Toledo, 2011;

Gliessman, 2016). A short term strategy might be to show local stakeholders how to access the public funding already available, or contact technical assistance institutions to connect technicians and landowners, offer training in sustainable practices for technicians and landowners, and improve the preparation of process food (e.g. dairying, jams, juices, etc.). The latter can provide additional conservation and shelf-time to fresh products, while helping enhance earnings by adding value to the final products (Aguiar et al., 2018).

One promising remark was that the local landowners were prone to combine conservation with production. By using engaging narratives that focus on landowners' profit and productivity, projects can then associate sustainable practice with the desirable benefits of FLR approaches, such as increasing forest cover, social inclusion, improving ES for soil, water, and biodiversity. Identifying this up hand greatly contributes to the successful outlining of activities, decision making process, and project implementation (Renn, 2006).

Final Remarks

The use of the participatory approaches in our study allowed the assessment of local perceptions and needs, aiding in the construction of tailored narratives that can contribute to local engagement and the future planning of activities to achieve the desirable benefits of FLR approaches. Nevertheless, although the focus group is a useful method to acquire information from different stakeholders, it does not allow to capture specific traits or perceptions of each participant or a particular stakeholder group (i.e., landowners, government, etc.). To that end, other methods (e.g., interviews, questionnaires, etc.) may be more adequate. We were able to test our hypotheses and reach our aim with the applied methodology, but we still need to transform the engaging narratives into activities, and check if they will in fact engage local stakeholders and improve sustainable landscape management in the region in a short-medium time. More studies associating social and natural science, including participatory methods and local communities' perception, are needed to fully comprehend the drivers of stakeholders' engagement.

Finally, we hope to have contributed for the awareness of the multiple benefits of including local participation and perception into planning and decision making associated with sustainable landscape management, such as FLR. The participatory approaches used in this study can provide valuable insights to other researchers and practitioners, helping save time and resources by designing more adequate plans and activities according to participants' view, values and demands, aiming to maximize engagement and increase sustainable behaviors. Although stakeholders' perceptions have local application, the approaches used in this study could be replicated in other regions, influence or set an example for other national initiatives, collaborating to achieve international goals (SDGs, Bonn Challenge, Aichi Targets) helping meet society's needs and boost a sustainable environment and economy on a larger scale.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants, in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

VM and AL: conceptualization and methodology. VM, LMM, FT, ISP, and YBdC: analysis. FDG and LMM: figures. VM and AEL: editing. AEL: project administration. BBS and AEL: funding acquisition. All authors have read and agreed to publish this version of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fevo.2021.612789/full#supplementary-material

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Assessing People's Values of Nature: Where Is the Link to Sustainability Transformations?

*Sanna Stålhammar**

Lund University Centre for Sustainability Studies (LUCSUS), Lund, Sweden

The efforts to measure people's current preferences and values of ecosystem services raise questions about the link to sustainability transformations. The importance of taking social and cultural values of nature into account is increasingly recognised within ecosystem services research and policy. This notion is informing the development and application of social (or socio-cultural) valuation methods that seek to assess and capture non-material social and cultural aspects of benefits of ecosystems in non-monetary terms. Here, 'values' refer to the products of descriptive scientific assessments of the links between human well-being and ecosystems. This precise use of the values term can be contrasted with normative modes of understanding values, as underlying beliefs and moral principles about what is good and right, which also influence science and institutions. While both perspectives on values are important for the biodiversity and ecosystem services agenda, values within this space have mainly been understood in relation to assessments and descriptive modes of values. Failing to acknowledge the distinction between descriptive and normative modes bypasses the potential mismatch between people's current values and sustainability transformations. Refining methodologies to more accurately describe social values risks simply giving us a more detailed account of what we already know—people in general do not value nature enough. A central task for values studies is to explore why or how peoples' mindsets might converge with sustainability goals, using methods that go beyond assessing current states to incorporate change and transformation.

Keywords: socio-cultural values, socio-cultural valuation, environmental values, ecosystem services assessment, social value

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Marie Stenseke,
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Thomas Hahn,
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Andrew Church,
University of Brighton,
United Kingdom

***Correspondence:**
Sanna Stålhammar
sanna.stalhammar@lucsus.lu.se

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INTRODUCTION

The importance of focussing on a diversity of people's relations with nature has gained ground in environmental governance, planning and discussions around Ecosystem Services (ES) and Nature's Contributions to People (NCP) (Pascual et al., 2017; Díaz et al., 2018). Along with this development, there is an emphasis on the need to build more elaborate narratives in assessments that involve viewing individuals not as either economic or moral agents, and to include perspectives and methods from the broader social sciences and humanities to understand the links between ES to human well-being (Chan et al., 2016; Stenseke, 2016; Braat, 2018). The idea of assessing social

values now extends beyond the field of environmental valuation and is increasingly recognised as crucial in ES and NCP research (Christie et al., 2019; Kenter et al., 2019). The applications of ES and NCP assessments involve an increased focus on categorisation, systematic assessment and measurement of human–nature relations and values. This raises questions about how measuring current perceptions and preferences relate to transformations toward sustainability.

It is difficult to think of a more normative notion than value. However, within assessments of ES and NCP, and specifically within socio-cultural valuation, value often refers not to normative notions but to empirical and descriptive accounts of how people 'ascribe' or 'assign' value to particular aspects of nature (Burkhard and Maes, 2017; Hejnowicz and Rudd, 2017; Asah and Blahna, 2019). Value is also used as an umbrella term with various interpretations such as, e.g., a phenomenon, a preference, a principle, a method, or an indicator (IPBES, 2016; Kenter et al., 2019). The idea of 'social' or 'socio-cultural values' often refers to those values that are not captured by ecological or monetary assessments of ecosystem services (ES). Within the (NCP) framework, these aspects are referred to as "non-material" contributions (Díaz et al., 2018). This includes aspects of people's relationship with nature and land, such as identity formation, learning, inspiration, physical and psychological experiences and spiritual significance (ibid.). These aspects are also associated with cultural ES, and are considered especially unsuitable for monetary valuation since they deal with not easily quantifiable notions of e.g., identity, sense of place, cultural heritage, perceptions, spirituality, psychological wellbeing (Abson and Termansen, 2011; Chan et al., 2012; James, 2015; Cooper et al., 2016; Stålhammar and Pedersen, 2017). Overall, the field of socio-cultural valuation seeks to capture non-material or intangible social and cultural aspects and preferences in non-monetary terms (Kelemen et al., 2016), and has grown significantly in the recent years (Chan and Satterfield, 2020).

Transformation for sustainability requires systemic shifts in worldviews and mental models that at a collective level shape norms, institutions, structures (Westley et al., 2013; Abson et al., 2017; Ives et al., 2018). This perspective on transformation highlights the importance of recognising the realignment of values that can enable sustainability (McAlpine et al., 2015). In contrast, efforts to assess ES and NCP are focussed on measuring and eliciting people's current states of values, preferences and perceptions of nature. The idea of 'capturing' values and 'eliciting' people's preferences in order to determine the values of nature is influential. How would it be done otherwise, one might ask, because the whole point of valuation seems to be to elicit preferences. My point here is not that valuation is faulty or useless as such. It is that valuation has been given a needlessly large focus when it comes to understanding (social) values of nature, to the point where it can come to overshadow the need and potential for sustainability transformation.

DESCRIPTIVE VS. NORMATIVE MODES OF VALUES

Socio-cultural valuation, belonging to the ES paradigmatic perspective in research and practice, relies on the idea that increased measurement and description of values will lead to more sustainable outcomes (MEA (Millennium Ecosystem Assessment), 2005; TEEB, 2010; Turnhout et al., 2014; Pascual et al., 2017). The idea is that generating more precise knowledge of the values of nature through assessments, and incorporating this knowledge into decision-making, will ultimately lead to a more desirable ordering of social-natural relations. Even though the ES concept was developed for sustainability purposes, it has not been conceptualised with regard to specific sustainability principles or criteria, such as justice or ecological integrity (Schröter et al., 2017). The focus in ES assessments is often not on how to manage for sustainability transformations, but on how to measure current or past states of specific ES (Costanza et al., 2017; Rau et al., 2018; Chan and Satterfield, 2020). While biophysical assessments of current states can show dependence on ecosystems, and be conducted within a transformative framework, there is reason to believe it does not work as well for the social sphere of assessments.

Although value is a highly discussed topic, we have inherited a kind of 'value-neutral' idea of value within the ES assessment paradigm. This idea of social value should be understood in relation to its close affiliation with high-powered initiatives such as the Millennium Ecosystem Assessment (MEA) and The Economics of Ecosystem services and Biodiversity (TEEB). Within these initiatives, and with the mainstreaming of ES, value as an object of study has mainly been addressed through environmental valuation. This implies a focus on assessments and the systematic mapping of ES in monetary and non-monetary terms, where the subjectivist notion of value as pertaining to preferences is influential (Gómez-Baggethun et al., 2010; Costanza et al., 2014). Here, value is not necessarily related to underlying moral beliefs, but studied as the measure of a preference or an indicator (TEEB, 2010). Moreover, according to a subjective theory of value, value of nature is seen to originate in the minds of individuals and not in the structures of ecosystems themselves (see Haines-Young and Potschin, 2010; Spangenberg and Settele, 2016). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem services (IPBES) is now making a step change and considerable efforts to move away from how value was initially used in a narrow and utilitarian sense, to include more diverse and plural understandings, as well as to outline the relations between values, institutions and pathways toward sustainable futures (IPBES, 2016, 2018, 2019a; Jacobs et al., 2020). Within IPBES, the scope of conceptualising values of nature is focussed on "the values that people associate with nature (principles, importance, and preference) and the measures and indicators used to elicit these values" (IPBES, 2016, p. 3). In ES research, value has often been defined based on the contribution to human wellbeing, and operationalised through assessment (Costanza et al., 2017; Hejnowicz and Rudd, 2017; Chan and Satterfield, 2020). Thus, in discussion around values of nature within ES and NCP, the term 'values' often

refers to the products of descriptive scientific assessments of the links between human-wellbeing and ecosystems. However, this descriptive use and the operationalisation of the term is not how other established scholarly traditions have generally conceived of (social) values. These have instead been understood as underlying beliefs and moral principles about what is good and right (Hirose and Olson, 2015), that claim the validity of imperatives of different standpoints in society, and influences science and institutions (Johnson and Cureton, 2019). These normative and philosophical understandings of value are not 'varieties' of values that can be aggregated alongside monetary or non-monetary values or indicators. Value concepts in different fields deal with entirely different questions—for example, in psychology values refer to stable individual principles, whereas in ethics value deals with normatively significant questions regarding, for instance, why and how something (like nature) has value. These broad differences between descriptive and normative modes could be more easily distinguished if closer attention is payed to how different accounts of value often result from particular disciplinary framings (see Kenter et al., 2019).

The term 'value' is thus problematic, as it refers both to descriptive scientific assessments of the links between human well-being and ecosystems, as captured through ES valuation, and to underlying normative beliefs and moral principles in society that influence science and policy. In ES (or NCP) valuation, ontological questions regarding what values of nature are tend to merge with axiological issues of moral and ethical values in society, and how these should be accounted for in science and policy (see similar argument by Maier and Feest, 2016; Thorén and Stålhammar, 2018). More simply put, we are intermixing what currently is, with what should be. Needless to say, it is not desirable to make sharp distinctions between descriptive and normative modes of values, since all assessment processes are in a sense 'normative,' influenced by various choices including framings of value, the methodological tools and measurements (Jacobs et al., 2016). The argument here is rather that the difference between the two modes is underemphasised.

This underemphasis is demonstrated through the idea of "relational value" (Chan et al., 2016). Relational value as a values category is supposed to better describe and take into account people's current perceptions and behaviour *as well as* provide answers to the normative question of why and how we should value and protect nature (Stålhammar and Thorén, 2019). The problem with this conflation is that there is no reason, in theory, to believe that descriptions of people's current values, perceptions, and preferences with respect to nature reflect how we should value nature or that they resemble 'sustainable' values. In fact, there is reason to believe that it is the other way round. Current social values are also recognised by the IPBES global assessment as *underpinning* indirect drivers (such as 'economic and technical') of biodiversity and ecosystem loss (IPBES, 2019a). Refining methodologies to more accurately assess underlying social values will, seen from this perspective, simply give us a more detailed account of what we already know—people in general do not value nature enough.

Even if people do express 'high' values in assessments, or strong feelings of connectedness with nature, we cannot from these descriptive insights (alone) draw normative conclusions about how we should consider the importance of nature in policy and decision-making. The point here is that, despite methodological and conceptual advancements in assessing and integrating social values into policy and management—a focus on descriptive modes of values—we need additional justification for why or how people's mental states, preferences, or descriptions of human-nature relations coincide with sustainability goals. We need social criteria that are additional to the preferences or values themselves in order to decide what is optimal in terms of scale, fair distribution and efficient allocation in sustainable development (Sagoff, 1994; Norton et al., 1998; Costanza, 2000). Arguably, the focus on assessing people's stated preferences and values in ES, with its roots in environmental valuation, is an implication of economics, of giving legitimacy to consumer sovereignty, and as being tied to the fundamental economic mission of optimally satisfying (fixed and given) preferences (Farber et al., 2002). This is contrary to establishing new social criteria and to focussing on how current values should and can change in order to satisfy these (Norton et al., 1998; Costanza, 2000). Thus, observations about the problem of relying on existing preferences in relation to sustainability are not new. However, the focus on descriptive values and that a categorisation of current human-nature relations can direct sustainable change bring this concern into new light. A focus on current values, through an 'instrumental assessment paradigm' (Raymond et al., 2014), regardless of the disciplinary perspective and method applied, risks missing an important target for sustainability transformations, of allowing for changing perceptions and adaptations of ways of understanding nature's importance for society, both on the part of stakeholders and institutions.

A focus on value concepts *per se* within ES can also be delimiting. The preoccupation with the idea and concept of values can potentially prevent us from understanding the various ways in which nature matters to us. In order to clarify how different theoretical framings of values compare and overlap, different disciplines need to conduct extensive interdisciplinary analysis (see Kenter et al., 2019; Rawluk et al., 2019). Such analyses can provide necessary insights into how we can study and understand diverse human-nature relations from a plurality of methodological perspectives, and challenge dominant views of monistic monetary valuation. On the other hand, the focus on values as a concept can divert us from the 'original' task associated with ES assessments, that is, to understand how society is dependent on ecosystems. The preoccupation with value adds layers of theoretical complexity, especially with the inclusion of the broader social sciences, which requires interpretation of additional perspectives of what value is as a theoretical term, rather than analysis of the links and relations between people and ecosystems. The goal of increased interdisciplinary engagement and a focus around the term values then implies a loss of direction and of an overall goal within the ES paradigm.

It is not surprising that values have been a central focus within ES assessments, as these have been developed in close affiliation with environmental and ecological economics. However, I question attempts to fit the ways that the natural environment matters to people into concepts of value. For example, relational

values are explained as a foundational way of describing and understanding the relation between humans and nature (Chan et al., 2016). A focus on concepts of value is not exhaustive when it comes to the domain of understanding human–nature relationships; it is just one way of describing aspects of these.

NATURE AS VALUE-ABLE

Consideration of social values of ES can be important on all levels of decision-making. The form in which values are to be described, made known, and integrated into policy depends not only on scientific conceptualisations or accurate measurements, but of wider societal relevance. It is clear, with the current transdisciplinary efforts of IPBES, that a focus on legitimacy of knowledge (Cash et al., 2002), through stakeholder participation, is becoming increasingly important within the ES paradigm. IPBES strives to take into account the plurality of indigenous and local knowledge (ILK) systems and recognise that these reject universally applicable classifications, and require methods that are sensitive to context-specific perspectives (Díaz et al., 2018; IPBES, 2019b). The choices of concepts and methods are thus not only a question of accurate measurement or description, but also about justice and ontological politics (Blaser, 2012). It involves asking whose worldview is represented and reproduced. It is therefore important to emphasise that within the efforts of IPBES, the role of descriptive knowledge and descriptive modes of values is of crucial importance for the democratic inclusion and participation of diverse groups. Descriptive and context-specific investigations can be subversive through representing alternative and marginal perspectives in assessments, and challenge top-down scientific categorisations (Stålhammar and Brink, 2020).

Although descriptive knowledge can be crucial, we need to make more space in our approaches for social values (or perceptions, preferences, or whatever we want to call them) to shift and change, for the better. This is not to say that all ES and NCP research and practice operates based on descriptive modes of values, or that all involved researchers conflate descriptive and normative modes. Efforts within IPBES show considerable progress and a substantial body of work that both engages deeply with the conceptualisation of values, and produces policy options based on analysis of drivers and scenarios (IPBES, 2019a,b), which includes exploring more positive future relationships with nature (Lundquist et al., 2017). Social-ecological research also often draws on more normative understandings of values and transformation, when applying frameworks and approaches such as adaptive governance, social-learning, co-production and network formation (Olsson et al., 2004; Hahn et al., 2006; Österblom and Sumaila, 2011; Norström et al., 2017). Novel scenario approaches such as the Seeds of a Good Anthropocene include visioning and the creation of transformative spaces as central components (Pereira et al., 2018). However, the distinction between descriptive and normative modes of understanding social values needs to be further emphasised, and analysed in relation to transformation. For example, social learning is sometimes used for stakeholder engagement with no requirement of transformation or changes in understanding (Reed et al., 2010). Deliberate valuation approaches can include normative modes of values, but is also commonly advocated as an alternative that does a better job at capturing existing values than monetary assessments (Kenter et al., 2016).

It is important to clarify if applications of socio-cultural valuation and assessments are intended to be, for instance, statistical representation of individuals' use and preferences, or if the goal is more in line with creating legitimacy, and the effective involvement of all stakeholders (Raymond et al., 2014). As a way to outline more refined conceptualisations and operationalisations of social values in relation to assessments we can, instead of starting from definite positions of 'what values are,' focus on what we want the placeholder of value to represent, and what 'job' it is supposed to do.

There is a need for approaches that can take the current and future potential of natural environments into account. This includes objectivist biophysical assessments, as well as the *capacity* of natural environments to contribute to e.g., social learning and citizen building in the social realm. IPBES assessment of Europe and Central Asia explicitly include socio-cultural valuation and ILK systems and demonstrate the importance of how nature currently supports various non-material NCP (Christie et al., 2019). While this shows promising directions, and a more holistic approach, these assessments focus on how different societies value NCP. My concern is that more generally, current expressions of social value is not necessarily aligned with perceptions, views and values required for transformation. There is still room to further consider not only current ways that nature supports non-material NCP, but capacities and future potential. This can involve an understanding of nature to carry value, and to be "value-able" because it is *able* to produce value through its evolutionary processes, of which humans form a sub-set (Rolston, 1988, p. 4). Within the IPBES framework, the NCP category "maintenance of options," includes "the capacity of ecosystems, habitats, species, or genotypes to keep options open in order to support a good quality of life (Díaz et al., 2018, 2019; IPBES, 2019a,b)." This category is recognised to span all groups of NCP including the non-material, which covers various social and cultural contributions such as supporting identities and learning (IPBES, 2019b). The category of maintenance of options deserves more attention and engagement. In order to further align the work around social values with sustainability transformations, approaches that include the potential of a maintenance of options when it comes to non-material contributions are needed. This involves extending the focus from assessing the current flows of benefits or contributions, to the transformative potential that natural ecosystems can provide for people when it comes to perceptions, behaviour, ethics and experiences. This is in line with what Horcea-Milcu et al. (2019) refer to as 'transforming through values', which focus on processes that enable, stimulate, nurturing, or shift values as a means of facilitating transformative societal change. Further exploration of values change and deliberation (Eriksson et al., 2019; Kendal and Raymond, 2019; Masterson et al., 2019), as well as of normative economics (Ravenscroft, 2019), can challenge

and expand the focus on descriptive modes of values. Further distinctions and analysis of how approaches can be conceptualised and operationalised in relation to various interpretations of transformation are needed.

The mainstreaming of the ES concept and approach implies an increased focus on taking peoples preferences and perceptions into account for understanding and managing ecosystems. Efforts to assess the ways that nature matters to people is in a way a contradictory endeavour, since the fundamental importance of how people relate to and depend on nature is immeasurable and infinite. The ES assessment paradigm implies a lens of measurement, quantification and description of human-nature relations that is now difficult to 'unsee'. This poses challenges to conceptualising, assessing, and including values of nature in decision-making without reducing their meaning and representations. There is a need to examine how more elaborate or detailed description of the ways that nature is important to people relates to the need to change underlying social values that currently are indirect drivers of the ecological crisis. Moreover, there is a need to examine the interpretation of values assessments in policy and governance in relation to how a focus on values capture potentially overshadows (the need for) values change. Assessments do not just describe and capture human-nature relations, they also actively manifest and re-produce certain values and certain versions of the world, and direct attention and courses of action (Vatn, 2005; Law, 2009). There is an opportunity here to go beyond the focus on measuring current states, while further recognising nature's potential to sustain our values. The recent attention to justice and a right's based approach to nature (Chapron et al., 2019) marks an opportunity to engage more deeply with the practical implications of normative modes of social values. The bottom line is that transformation toward sustainability will not be realised by relying on measurements of current mindsets. We need new ways of seeing, relating to and valuing our place in the natural world. Should this not be a starting point for how to think about social values of nature?

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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Valuation and Appreciation of Biodiversity: The "Maintenance of Options" Provided by the Variety of Life

*Daniel P. Faith**

The Australian Museum Research Institute, The Australian Museum, Sydney, NSW, Australia

"Nature's contributions to people" (NCP) is an important expansion beyond the standard ecosystem services framework, particularly as a pathway to better address global/regional biodiversity values. NCP18, "maintenance of options," refers broadly to the capacity of ecosystems, habitats, species, or genotypes to keep options open to support a good quality of life. "Biodiversity," interpreted as living variation, is an important, but under-appreciated, aspect of "maintenance of options." IPBES refers to "the "option values of biodiversity," that is, the value of maintaining *living variation* in order to provide possible future uses and benefits." IPBES assessments include biodiversity option value, and use phylogenetic diversity (PD) as an indicator of change in status of NCP18. At the same time, IPBES notes the need for greater appreciation of option values of biodiversity. Popular ecosystem services framings forget the long history of consideration of these global benefits of biotic diversity to humanity, and their normative links. Popular ecological definitions mean that many current valuations of "biodiversity" neglect the benefits of biodiversity-as-variety. Economic valuations of "biodiversity" typically have focused on ecosystem aspects, not variety; related ecosystems framings value "biodiversity" with a focus on those critical elements relating to functioning of ecosystems. Greater appreciation of biodiversity option value and NCP18 may depend on clearer messaging from academia, better highlighting of the link between biodiversity and intergenerational justice, and greater communication of stories of past surprising discoveries of benefits from species that highlight biodiversity as an ongoing source of future benefits. An important pathway for better appreciation of insurance and investment benefits of variety is to understand and communicate the reasons why we value these benefits from variety. Biodiversity-as-variety is valued because we care about the welfare of future generations.

Keywords: biodiversity, phylogenetic diversity, IPBES, option value, value, maintenance of options, nature's contributions to people

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Edited by:
Martin F. Quaas,
Leipzig University, Germany

Reviewed by:
László Erdős,
Centre for Ecological Research, Hungarian Academy of Sciences, Hungary
Bartosz Bartkowski,
Helmholtz Centre for Environmental Research (UFZ), Germany

***Correspondence:**
Daniel P. Faith
dan.faith@austmus.gov.au

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INTRODUCTION

The term "Nature's contributions to people" (NCP) refers to all the positive and negative contributions of living nature to people's good quality of life (Díaz et al., 2018). This broad NCP framing has been used extensively in the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) Regional and Global assessments, and NCP is the basis for a major

goal of the Convention on Biological Diversity (CBD) post-2020 framework[1]. The urgent need to maintain NCP prompted the IPBES Global assessment to call for "transformative change" - a fundamental reorganization across technological, economic, and social factors, including values, as needed to achieve goals for conserving and sustainably using nature (IPBES, 2019).

This article is a contribution to a Frontiers research topic, examining how transformative change supporting nature's contributions to people can build on valuation, increased awareness, and concrete actions. The goal of this article is to explore these themes for one of the most challenging of the NCP, "Maintenance of options" ("NCP18"). While progress has been made in recognizing this NCP and its link to biodiversity option value, here I hope to provide further progress by suggesting some under-explored potential pathways to address the current limitations in its appreciation.

The 18 different NCP categories cover many aspects of "nature" and many ways to think about its "contributions" (Díaz et al., 2018). This article will focus specifically on "biodiversity" – interpreted, following early historical discussions of biotic diversity and its value (see Faith, 2017a, 2021), as living *variation* at multiple levels. Linking the term "biodiversity" specifically to *variety* allows a critical focus here on challenges of valuation, appreciation, and actions in this fundamental context – and how this may contribute to transformative change.

This perspective is relevant to the CBD Vision to better appreciate the value of biodiversity and to halt its loss. This reference to biodiversity "loss" acknowledges the biodiversity crisis and loss of living variation. The CBD post-2020 global biodiversity framework "sets out an ambitious plan to implement broad-based action to bring about a *transformation* in society's relationship with biodiversity . . ." (CBD/WG2020/2/3). Importantly, the CBD post-2020 framework includes an explicit goal to maintain Nature's Contributions to People (see text footnote 1).

Among the 18 NCP, one stands out as particularly relevant to the contribution to people arising from biodiversity-as-variety. "Maintenance of options" ("NCP18") is described (Díaz et al., 2018) as the "Capacity of ecosystems, habitats, species or genotypes to keep options open in order to support a good quality of life." This may include contributions both from individual elements and from variety itself. IPBES assessments have referred to "Maintenance of options" as capturing a fundamental benefit/value related to biodiversity-as-variety. The IPBES conceptual framework (Díaz et al., 2015) refers to this as: "The "option values of biodiversity," that is, the value of maintaining living variation in order to provide possible future uses and benefits" (for review, see Faith, 2017a, 2021). I note that early work, summarized in IUCN (1980), highlighted two values of variety that link to maintenance of options, called "insurance and investment." Biodiversity option value – the focus of this article – is a kind of investment value, while insurance value relates more to the way in which variety serves in responding to environmental changes (for reviews, see Bartkowski, 2017; Faith, 2017a, 2021).

[1]https://www.cbd.int

Several IPBES assessments have discussed biodiversity option value under NCP18 (IPBES, 2018b). The IPBES Asia Pacific Regional Assessment ("AP") concluded:

> "*The NCP "Maintenance of options" (NCP18) accords well with the IPBES Conceptual Framework listing of anthropocentric values including "the option values of biodiversity as a reservoir of yet-to-be discovered uses from known and still unknown species and biological processes*" (Díaz et al., 2015). *Because these benefits are typically global, they are distinguished from others within-ecosystem benefits. . .. NCP18 refers to "Benefits (including those of future generations) associated with the continued existence of a wide variety of species, populations and genotypes." "Wide variety" is another way of saying "biodiversity." Thus, this statement echoes early discussions that identified biodiversity itself as providing a benefit corresponding to maintenance of options*"

Significantly, this assessment found support for biodiversity option value in early discussions of "biotic diversity," which preceded the actual coining of term "biodiversity" around 1985 (for reviews, see Mazur and Lee, 1993; Faith, 2017a). For example, Haskins (1974) summarized a meeting where participants called for "an Ethic of Biotic Diversity in which such diversity is viewed as a value in itself and is tied in with the survival and fitness of the human race." Haskins linked this to biodiversity option value: "Plants and animals that may now be regarded as dispensable may 1 day emerge as valuable resources." Thus, his phrase "value in itself" was not a reference to intrinsic value but to the idea that variety "in itself" is valuable to people. Myers (1976) similarly argued that "loss of species will affect generations into the indefinite future, whose options to utilize species in ways yet undetermined should be kept open." IUCN (1980) summarized such foundational discussions: "we may learn that many species that seem dispensable are capable of providing important products, such as pharmaceuticals. . ."

The IPBES regional assessment report for Europe and Central Asia ("ECA"; IPBES, 2018c) and the IPBES Global Assessment (IPBES, 2019) also discussed biodiversity option value under NCP18, and these assessments adopted an informative measure of biodiversity in this context, called "phylogenetic diversity (PD)" (Faith, 1992). The ECA concluded *"The maintenance of options is a contribution that depends on the existence of biodiversity, and its status and trends are reflected by those of biodiversity measures, including PD."*

While any measure of biodiversity as variety can be linked to biodiversity option value (Faith, 2017a), "phylogeny" (the evolutionary "tree of life") is naturally informative about the variety of evolutionary features that may prove beneficial in the future. Phylogenetic diversity is a form of biodiversity, because it indicates the *variety* of units (broadly, the full range of different evolutionary features of a nominated set of species; Faith, 1992). Technically, PD is quantified as the sum of phylogenetic "branch lengths" (typically measured in millions of years) spanning a set of species. PD is a useful indicator of biodiversity option value because the corresponding feature diversity (including features not currently known) preserves the possibility of future surprising benefits (Faith, 1992). An example study documented how three different traditional cultures (in Nepal, New Zealand,

and Cape of South Africa) independently have used the same plant medicinal property – a feature that evolved in the shared ancestor of the three different plant species found in the three different regions (Saslis-Lagoudakis et al., 2012). The sharing of the same useful medicinal evolutionary feature among distant peoples illustrates how a feature from the tree of life may be a global public good (see Rands et al., 2010).

The IPBES definition of "biodiversity"[2] reflects this idea of phylogeny and feature diversity, in referring to the variety of phylogenetic "attributes": "The variability among living organisms from all sources . . . This includes variation in genetic, phenotypic, phylogenetic, and functional attributes. . .." The IPBES Global assessment reported estimated expected PD losses, over multiple taxonomic groups, as an indicator of the changing status of this biodiversity option value aspect of maintenance of options. This indicated a decline in NCP18, as part of the reporting of global trends in the capacity of nature to sustain contributions to good quality of life from 1970 to the present (Figure 1 in Díaz et al., 2019a). Key message 3 of the assessment concluded: ". . .. some contributions of nature are irreplaceable (well established). Loss of diversity, such as phylogenetic and functional diversity, can permanently reduce future options . . ." This IPBES PD indicator (Faith et al., 2018) also has been proposed for the CBD post-2020 global biodiversity framework (CBD/SBSTTA/24/3Add.1) as an indicator to monitor progress in addressing biodiversity option value aspects of NCP18, within the broader CBD goal to value and conserve nature's contributions to people.

Significantly, the IPBES assessments also noted limitations in the appreciation of these values. The ECA concluded "*Society's appreciation of maintenance of options is only moderate, as indicated by previous assessments of Europe and Central Asia, and by the recent call for greater appreciation of maintenance of options from conservation NGOs*" (see Gascon et al., 2015; Faith, 2017a).

The AP discussed these challenges, noting that the Biodiversity Barometer (2015) report for Asia-Pacific countries found that,

> "*respondents from these countries had low scores when asked to define "biodiversity" demonstrating their lack of understanding that it means "living variation." Understanding the definition is foundational for a community appreciation of the idea that biodiversity provides maintenance of options. The shift in focus by IPBES from "ecosystem services" to NCP helps to overcome the neglect of the typically global-scale option values of biodiversity."*

This echoes the argument (IPBES, 2018a) that,

"It has to be recognized that the concept of "nature's contributions to people" has evolved in a context where challenges related to the loss of biodiversity are addressed and assessed on global and regional levels. The implications of this widening from the ecosystem service framework . . . is largely an issue that remains to be explored."

This background sets the stage for the following two sections of this article. First, I discuss the challenges in increasing appreciation of biodiversity and NCP18. Then, I consider possible pathways to increase awareness of the value of the biodiversity option value aspect of NCP18.

CHALLENGES

Biodiversity option value, as a benefit and value of variety, has strong roots in early historical arguments about biotic diversity (Faith, 2021). Given this history, we might expect greater current appreciation of this core value of variety. Bartkowski (2019) argues that, in reality, discussions of values of "biodiversity" typically have focused on individual elements, with the less-attention to the actual values of variety itself, including both option and insurance values (for review, see Faith, 2017a, 2021).

The IPBES assessments suggest that distinctions between ecosystem services and NCP framings may help to explain this neglect. Ecosystems provide many services to people (clean water, etc.), and these benefits naturally suggest one case for conservation of "biodiversity". The ecosystems framing adopts the perspective that "biodiversity" is the basis for these important ecological functions and services. This gains support through ecological diversity definitions of "biodiversity" – thus, linking, by definition, to ecological factors that are important for ecosystem services (see Faith, 2017a, 2018). For example, the *Routledge Handbook of Ecosystem Services* says: "Biodiversity broadly encompasses the number, abundances, functional variety, spatial distribution, and interactions of genotypes, species, populations, communities, and ecosystems" (Balvanera et al., 2016). This inclusion of many aspects of ecology may distract from the core idea of biodiversity as variety (Faith, 2017a).

Such ecological definitions in turn are reflected in the statements about value and valuation of biodiversity (including PD), implying less emphasis on the global scale option value provided by variety of species or other elements. For example, the *Encyclopedia of Biodiversity* chapter on "The Value of Biodiversity" (Dasgupta et al., 2013), claims that: "The value of biodiversity derives from the value of the final goods and services it produces. To estimate this value, one needs to understand the "production functions' that link biodiversity, ecosystem functions, ecosystem services, and the goods and services that enter into final demand."

The within-ecosystems focus, and neglect of global biodiversity option value, sometimes has been supported by an historical accounting, in which "biodiversity" was all about intrinsic value until the ecosystem services framing forged links to anthropocentric values (for discussion, see Faith, 2017a, 2018). For example, Reyers et al. (2012) envision improved biodiversity conservation: ". . ..by adopting the concept of ecosystem services and by arguing that the conservation of biodiversity matters not only because of its intrinsic value but because it is essential for human well-being". Thus, a lack of appreciation of the long-standing arguments for global biodiversity option value makes it appear that ecosystem services is the only basis for anthropocentric values of biodiversity.

A risk in focusing on local ecosystem values of different elements or aspects of ecosystems (all called values of

[2]https://ipbes.net/glossary/biodiversity

"biodiversity") is that we lose track of the value of variety at the global scale. For example, Pascual (2020) constructively focused on integrating diverse values of different people, by considering the many different values for what he called "aspects" of biodiversity. This strategy broadly captures local values of aspects of nature, but may neglect the value of global biodiversity as variety. Owen et al. (2019) present an analysis illustrating how a conservation focus on functional traits and services within ecosystems could lead to the global loss of PD and its option values. A challenge is to recognize that there are costs and trade-offs among competing local to global conservation goals, and that this requires planning that integrates global option value with other goals (Pollock et al., 2017).

Conservation for global biodiversity option value requires that it be "on the table" along with other goals. Faith (2017b) reviewed case studies in which an ecosystem focus and neglect of global biodiversity option values determined corresponding limitations of conservation actions (e.g., regional planning). Faith contrasted these with early planning case studies that successfully integrated more localized (ecosystem and other) values with global biodiversity option value. The IPBES assessments, and other discussions of NCP, call for similar integrated broad recognition of multiple benefits/values of nature as part of transformational change. Transformational change supporting such integrated planning would benefit greatly from increased appreciation of the biodiversity option value associated with NCP18. In the next section, I sketch three potential pathways that might increase such appreciation.

PATHWAYS

Clearer Messaging From Academia Can Produce Clearer Messages for Decision-Makers

Some popular presentations of NCP obscure important aspects of NCP18. For example, Peterson et al.'s (2018) critique of NCP referred to "maintenance of options," as "the capacity of *ecosystems* to keep options open in order to support a good quality of life" (Díaz et al., 2018: SM)." Peterson et al. (2018) misquoted the Díaz et al., description of "Maintenance of options" as the "Capacity of *ecosystems, habitats, species or genotypes* to keep options open." The misrepresentation gives the impression that the maintenance of options is only about how ecosystems support human-well-being (for discussion, see Faith, 2018).

The influential *Global Biodiversity Outlook 5* (Secretariat of the Convention on Biological Diversity, 2020) imposes a similar equation of NCP with ecosystem services: "most ecosystem services (nature's contributions to people) are in decline." Further, the report misrepresents the key Figure 1 legend of the IPBES Global SPM ("Global trends in the capacity of *nature*. . .") as "Global trends. . . in the capacity of *ecosystems*. . ." This misrepresentation under-mines appreciation that the capacity of the global tree of life phylogenetic diversity is a contribution that spans many locations/ecosystems in providing the global biodiversity option value of NCP18.

A major review (Kadykalo et al., 2019) compared ecosystem services and NCP framings, concluding that "the generalizing perspective of the NCP framework provides no great addition beyond what has already been done in terms of classification in ES research." This appears to reflect a conventional ecosystem-services-based interpretation of "biodiversity." The first phrase of their article is: "People depend on functioning ecosystems. . ." and they refer to "living systems (i.e., biodiversity in its broadest sense)". Kadykalo et al. (2019) did not discuss the existing conceptual issues about the option value of biodiversity-as-variety (Faith, 2018), under their discussion of "Conceptual Claims which distinguish NCP from ES."

Greater awareness, and appreciation, of biodiversity option value will benefit from clearer consistent presentation of NCP, including discussion of the contributions to people from global biodiversity.

Intergenerational Justice Considerations Increase Appreciation of Biodiversity Option Value

Díaz et al. (2019b) noted a relevant leveraging point for enabling transformative change: "unleashing existing, widely held values of responsibility to effect new social norms for sustainability." A sense of responsibility to future generations is widely held, and this may help effect a social norm about preserving biodiversity's maintenance of options. The early discussions of the value of biotic diversity critically linked to ideas about ethics, and justice for future generations (reviewed in Faith, 2017a, 2021), and this supported appreciation of biodiversity option value. Building on these early discussions, the Brundtland Report's (WCED, 1987) discussion of "sustainable development" stated a requirement: "The loss of plant and animal species can greatly limit the options of future generations; so sustainable development *requires* the conservation of plant and animal species." That requirement indicates a normative obligation with regard to our relationships with future generations.

Similarly, Schroeder and Pisupati (2010) argued that the core objective of the Convention on Biological Diversity, the conservation of biodiversity, is about attaining intergenerational justice. They concluded that "to deplete the planet of essential resources and leave to future generations a world which severely limits their options, is unjust." This argument highlights how biodiversity has a current value to society because we care about the welfare of future generations.

These normative justifications for biodiversity option value accord with Chan and Satterfield (2020) arguments that: "policymakers should think of values as not only the outputs of valuation, but also the preferences, principles and virtues that people have about relationships involving nature (relational values, Chan et al., 2016)."

Faith (2017a) links biodiversity's maintenance of options to a kind of relational value, relating the present generation to future generations: "the best argument for what we call the option value of biodiversity is that we see many currently

beneficial units, and maintaining a large number of units (biodiversity) for the future will help maintain a steady flow of such beneficial units. . . Biodiversity option value therefore links "variation" and "value": providing a fundamental relational value of biodiversity reflecting our degree of concern about benefits for future generations."

This perspective may overcome the miss-perception that NCP18, maintenance of options, does not enter into assessments of current well-being, because all the benefits are in the future. For example, Brauman et al. (2020), in their assessment of links between NCP and well-being, argue "We do not provide results across the types of contribution for habitat creation and maintenance of options; their influence on quality of life is felt through their role supporting other contributions of nature." In contrast, the idea that there is a relational value of biodiversity, reflecting our degree of concern about benefits for future generations, opens the door to appreciating the maintenance of options provided by biodiversity as a contributor to our current quality of life.

Stories About Surprising Discoveries

Increased awareness and appreciation of maintenance of options can build on our awareness of many currently beneficial species. This promotes an appreciation that retaining biodiversity for the future will help maintain the ongoing discovery of such benefits. Chan and Satterfield (2020) suggest that "we need to focus more on stories. quotes, images and videos that viscerally express value, and more directly engage audiences." Greater appreciation of biodiversity option value therefore may be found in stories about surprising discoveries of useful species.

IPBES assessments not only reported expected loss of PD (Faith et al., 2018), but also provided some recent stories, in each region, about recent surprising discoveries of benefits from the tree of life. The IPBES ECA concluded: "Phylogenetic diversity (Faith, 1992) over multiple taxonomic groups is also an informative metric of the capacity of biodiversity to deliver maintenance of options . . .. The appreciation for this contribution from nature to people is also found in the greater awareness of recent unanticipated benefits from biodiversity.. . ." The ECA stories included the "un-expected global benefit" emerging from the discovery that a moth caterpillar can eat through plastic (Bombelli et al., 2017). Another story reported "the recent published role of golden jackals (*C. aureus*), long regarded as a pest, as a remover of domestic animal carcasses". Similarly, the IPBES AP reported the recent discovery that the venom of the Australian funnel web spider (*Hadronyche infensa*) is the unlikely source for a drug to ward off brain damage caused by strokes.

The ECA concluded that "The appreciation and value of this contribution from nature to people can also be estimated through the ongoing reporting of surprising discoveries in the popular press. For example, the golden jackals' example was widely communicated through a *New Scientist* article. Such examples can reinforce people's relational value, linking biodiversity to future generations' quality of life. . .."

While such stories were seen as important, the IPBES assessments found that, for a given region, there was no clear source of such stories of recent discoveries of benefits. A growing collection of such examples would boost awareness of option value of biodiversity. Further, such collections, for different taxonomic groups, may allow a way to test the link between PD and biodiversity option value. For example, Forest et al. (2007) used a compendium listing all the known human uses of flowering plants in South Africa's Cape Floristic Region, and asked 'if we did not know these uses, would maintaining the PD of this group have been a good strategy for keeping options open to find these uses?' The study found that conservation of PD significantly maintained the opportunity to discover these future benefits.

The Forest et al. (2007) study suggests that appreciation of biodiversity (PD) option value will continue to be found through two kinds of phylogenetic observations. First, we see that already-known uses/benefits that are shared by species typically reflect the species' shared ancestry – the shared feature can be explained by shared ancestry (as in the plants example above). Second, we see that surprising benefits continue to be found *throughout* the tree of life. It is this PD that ensures possible future benefits. These observations in combination can help to appreciate the core of biodiversity option value – it is not about already-known uses (we can target those species directly); it is about how variety maintains the prospect of surprising new uses.

I conclude that, within NCP18, biodiversity's maintenance of options can help motivate the needed transformative change to conserve global biodiversity. That role is based on a greater appreciation of the core idea that variety itself has value, and that we are ethically obliged to preserve this variety for future generations.

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The author confirms being the sole contributor of this work and has approved it for publication.

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Appraisals of Wildlife During Restorative Opportunities in Local Natural Settings

Maria Johansson[1], Anders Flykt[2], Jens Frank[3] and Terry Hartig[4,5]*

[1] Environmental Psychology, Department of Architecture and Built Environment, Lund University, Lund, Sweden, [2] Department of Psychology and Social Work, Mid Sweden University, Östersund, Sweden, [3] Grimsö Wildlife Research Station, Department of Ecology, Swedish University of Agricultural Sciences, Riddarhyttan, Sweden, [4] Institute for Housing and Urban Research, Uppsala University, Uppsala, Sweden, [5] Department of Psychology, Uppsala University, Uppsala, Sweden

Many call for a broad approach to valuation of nature's contribution to people, one that provides a contextualized understanding of what may be experienced as a value in different cultures, groups and settings. In the present paper we address contributions of nature to psychological well-being as realized through restorative processes during encounters with wildlife. Although restorative benefits of nature experience have received much consideration, sparse attention has been given to the role of the presence or absence of different animals in the settings investigated. The presence of a liked species may increase appreciation for and engagement with a natural setting, but fear of encountering some species may counter the desire to visit a setting with otherwise high restorative quality. This paper proposes a psychological framework for understanding how wildlife may contribute to or hinder people's opportunities to restore in local natural settings. The framework addresses the transaction between the individual and their surroundings, making use of an appraisal theory of emotion and theories about the restorative benefits of nature experience. We focus upon encounters in landscapes shared by humans and wildlife, and we elaborate on our reasoning with scenarios from Sweden involving local people's appraisal of wolves and roe deer. An integrated understanding of the psychological processes at work would facilitate communication and decision-making about the contribution of wildlife in nature conservation and management.

Keywords: attention restoration, emotional appraisal, recreation motives, stress recovery, wildlife

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Helmut Schmidt University, Germany
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****Correspondence:***
Maria Johansson
maria.johansson@mpe.lth.se

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INTRODUCTION

After decades of decline, populations of large carnivores and other threatened species of wildlife have begun to recover in Europe. Reasons for this development include hunting regulations, conservation efforts, and changes in land use, such as the abandonment of agricultural fields (Apollonio et al., 2010; Chapron et al., 2014). Such developments count as ecological successes. Together with survival of the species and increased chances that they regain functional significance in local ecologies, the increasing abundance of these animals means that people can more frequently interact with them in the landscapes that they share (Penteriani et al., 2016). Thus, at the same time

that wildlife management, environmental regulations and other forms of protective action have prevented the extinction of species, they have also prevented the extinction of experiences that people can have with those species (Pyle, 1993; Soga and Gaston, 2016).

Yet, the experiences people may have with recovering species such as wolves can differ widely, and the social consequences of some such human–wildlife interactions have become the focus of intense debate between groups. Defined in terms of, for example, rural versus urban residence (Johansson et al., 2016b), different livelihoods and life-styles (e.g., farming and animal husbandry, hunting with dogs; Eklund et al., 2020; Eriksson et al., 2020), and value orientations and attitudes (Sponarski et al., 2013). These groups can hold widely divergent opinions about the animal species in question as well as the management of them. This means that the debate about human–wildlife interaction involves not only perceived negative impacts of particular animals as threats to personal safety, livelihood and lifestyle, but also infected social conflicts between local populations and other stakeholders, including the governmental authorities charged with managing wildlife (Redpath et al., 2013). The intensity of the debate increases with a perceived lack of understanding of the psychosocial consequences of the presence of particular animals and of the burden that wildlife management measures can impose on individuals and the collective, particularly in rural areas (Eklund et al., 2020; Sjölander-Lindqvist et al., 2015).

This debate contrasts starkly with movement toward scientific consensus on the positive values of nature experience for human health and subjective well-being (e.g., Bratman et al., 2019). However, the research behind this emerging consensus has largely focused on the experience of people in the urban populations of wealthy, industrialized countries (e.g., Hartig et al., 2014). It has also typically represented what people take to be "nature" in a limited set of contexts, with a particular emphasis on recreational activities (Hartig et al., 2011). At the same time, it has represented "nature" in a coarse manner, for example as green space, without attending to more specific ecological characteristics of the natural environment, including the particulars of the funga, flora and fauna in a given setting (e.g., Velarde et al., 2007; Markevych et al., 2017; Marselle et al., 2021).

Recognizing this latter limitation of the research on nature and health, some researchers have begun to study benefits of experiences with specific, ecologically relevant aspects of natural settings.[1] For example, recent years have seen claims that parks and other greenspaces with higher levels of species diversity and abundance will engender more psychological benefits of relevance to health (e.g., Fuller et al., 2007; Cameron et al., 2020). However, the set of studies on beneficial encounters with biodiversity remains relatively limited in important respects. The implications of the diversity and abundance of animals other than birds and butterflies have largely been neglected, and the focus has remained on experiences of urban residents within a recreational context (Jorgensen and Gobster, 2010). So, although such studies have addressed important knowledge gaps relevant to understanding the health values of encounters with wildlife, they have not directly addressed persistent concerns that fuel debates like those about the presence of wolves, deer, and other animals that some people see as hazards or pests and others see as highly valued components of the environment.

Although neglected in research on nature experience and health, the ambivalent feelings and attitudes evidenced by the parties to such debates have received much research attention in the field of human dimensions of wildlife (e.g., Decker et al., 2012). In this field, the concepts of nature and biodiversity translate into wildlife and specific animal species (e.g., Manfredo, 2008). Moreover, the empirical research is often situated in the urban-wildland interface or in rural areas, where residents have more frequent and different types of encounters with wildlife than those available to urban residents, and within a range of contexts that includes but is not limited to consumptive and non-consumptive recreational activities. The plethora of human–wildlife interactions as well as the species specific interactions in such contexts has been shown by social network analysis (Pătru-Stupariu et al., 2020). Human–wildlife interactions with different species can trigger both positive and negative feelings (Jacobs et al., 2014; Eriksson et al., 2020) and accompanying physiological responses (e.g., with bears, wolves, moose, and hares; Flykt et al., 2013). For some people, encounters with certain mammal and bird species may evoke awe and fascination, and an increasing abundance of such animals may therefore enhance the recreational quality of the local nature, attracting tourism income while also boosting residential satisfaction (e.g., Jorgensen et al., 2007). For other people, the same animal species may constrain recreational and residential quality, due to concerns about encounters (Kubo and Shoji, 2014). In other cases, people generally may show a high degree of consensus regarding the desirability – or undesirability – of a particular species. For example, in Scandinavia and elsewhere, a known abundance of ticks (Ixodes ricinus) causes people to limit their outdoor activities and take protective measures in certain areas (Slunge and Boman, 2018). Similarily, Nordström (2010) found that a high degree of exposure to floodwater mosquitoes (*Aedes sticticus*) and (*Aedes vexans*) was reliably associated with diminished psychological well-being in local residents. In attending to such phenomena, work in the field of human dimensions of wildlife offers a useful complement to research on the positive health values of "nature" and encounters with preferred, unthreatening expressions of biodiversity.

The non-material contribution of wildlife could be considered both as positive and negative, and be represented in a broad set of psychological well-being outcomes (Methorst et al., 2020). This paper supports further integration of research in environmental psychology, the psychology of emotion, conservation biology and human dimensions of wildlife by nuancing the understanding of psychological outcomes of increasing wildlife abundances in landscapes shared by people and wildlife across the urban-rural

[1]The term "setting" ordinarily gets used in environmental psychology both to spatially and temporally delimit the environment and to more explicitly implicate the activity of humans as related to the specific features of the environment so delimited. We use the term "natural setting" throughout this paper to implicate the presence of a person or persons engaged in some activity or activities in a setting dominated by trees, vegetation, freely moving water and other seemingly natural features. For further discussion of such definitional issues in research on nature and health, see Hartig (2021; Hartig et al., 2011).

gradient. Our integration of this research adheres to the call from the International Panel for Biodiversity and Ecosystem Services for a broad approach to the valuation of "nature's contributions to people" that goes beyond economic cost – benefit analyses (Pascual et al., 2017). Importantly the research serves to provide a contextualized understanding of what may be experienced as a contribution of wildlife in different cultures, groups and settings (Díaz et al., 2018). Toward these ends, we propose a psychological framework for understanding how wildlife may contribute to or hinder people's opportunities for psychological restoration in local natural settings. We also offer a model of how people behave up to, during and after an encounter with wildlife.

In the following, then, we first briefly consider theory concerned with human–environment relations in general. Next, we outline the more specific theories about emotional appraisals and restorative experience that we draw on in characterizing the person's transaction with the environment in the encounter with wildlife. So prepared, we offer our integration of the theories and apply the model with some examples set in the Swedish context. In closing, we discuss our framework and model with a view to their use in understanding nature's contributions to people's health and wellbeing. An integrated understanding of the psychological processes at work should facilitate communication and decision-making about the contribution of wildlife in nature conservation and management.

GENERAL THEORETICAL FRAMEWORK

A general approach to understanding the values of animate and inanimate aspects of the natural environment refers to their implications for human health and well-being through processes of adaptation. This approach treats wildlife as an aspect of nature that can influence health and well-being via pathways in four broad domains (see **Figure 1**). Each of the domains includes known and unknown but potentially discoverable pathways by which wildlife can come to have implications for the given aspect of adaptation to the environment. Thus, the presence and activities of wildlife in the local environment can affect health and well-being, both negatively, by undermining adaptation (i.e., by causing harm) and positively, by supporting adaptation (i.e., by helping people to build and restore adaptive capacities and by reducing harm).

Figure 1 further indicates that pathways in one domain can relate to pathways in the other domains. Relations between pathways may be competitive, as when the presence and/or activities of a given animal evoke strong fear in a person (activating one or more pathways within the domain of causing harm) and so aggravate stress that a person seeks to escape while in the natural setting (disallowing the operation of one or more pathways in the domain of restoring capacities). Yet, pathways in the different domains may also show complementary relations over time, as when a person who knows a threatening animal may be encountered in the setting acquires the knowledge and behavioral skills needed to manage a potentially harmful encounter (pathways in the building capacities domain) and so can come to enjoy the presence of the animal in its natural habitat (enhancing the restorative quality of the setting). It follows that pathways in each of the domains can work to relate the presence and activity of wildlife to human health and well-being in diverse ways over widely varying spans of time, from the momentary to the total life course.

Although **Figure 1** severely simplifies a complex reality, it closely resembles other models that have proven useful in organizing and guiding research in other areas within the nature-and-health field. For one, it explicitly distinguishes between what actually exists in the environment and what the person comes to experience there; however, rather than more general representations of the environment, such as nature (Hartig et al., 2014; Bratman et al., 2019) and biodiversity (Marselle et al., 2021), our model starts from the wildlife that exists in the environment and the encounters that people may have with that wildlife. The organization of pathways into broad domains follows the example of Markevych et al. (2017), who addressed the positive effects of greenspace on health, and the example of Marselle et al. (2021), who addressed both positive and negative health effects of biodiversity. Our inclusion of a domain of pathways by which wildlife can cause harm follows the example of Marselle et al. (2021); however, in contrast to their example, our model acknowledges that wildlife can harm human health without any encounter taking place. It thus acknowledges that the presence and activity of wildlife can engage different pathways to health and well-being not only through the encounters that people have with the wildlife but also in ways that involve only some awareness of the possibility of an encounter or that are entirely outside of the awareness of the people affected. Finally, as in the presentation of these previous models, we acknowledge that the strength of an effect realized through a given pathway in any of the domains may depend on characteristics of the given context and of the people involved.

In theory, one or more pathways in all four of the domains could become engaged by a particular animal or species of animal in a given encounter and/or in repeated encounters over time. Also, these pathways could work within a broad range of contexts for wildlife encounters, from feeding birds outside one's home to tracking lions as a hunter to visiting a remote region as an eco-tourist. Here, to simplify our presentation while also addressing issues of widespread concern, we narrow our focus to a smaller set of pathways and contexts. First, we focus on the operation of pathways within two domains, those of causing harm and restoring capacities, and we propose a psychological framework to understand how the presence of wildlife species may constrain or contribute to opportunities for restoration. Second, we focus on encounters that occur in local natural settings that people can access from their homes on a regular basis in daily life. In making this choice, we define the natural settings of interest not only in terms of their accessibility to people but also in terms of their status as ordinary habitat for the animals that those people could encounter. Thus, although we do not consider many other contexts of interest or health-relevant pathways that could become engaged with wildlife encounters, we nonetheless address a set of pressing issues that extend over relatively many people and animal populations in many places. Our presentation here thus has broad relevance.

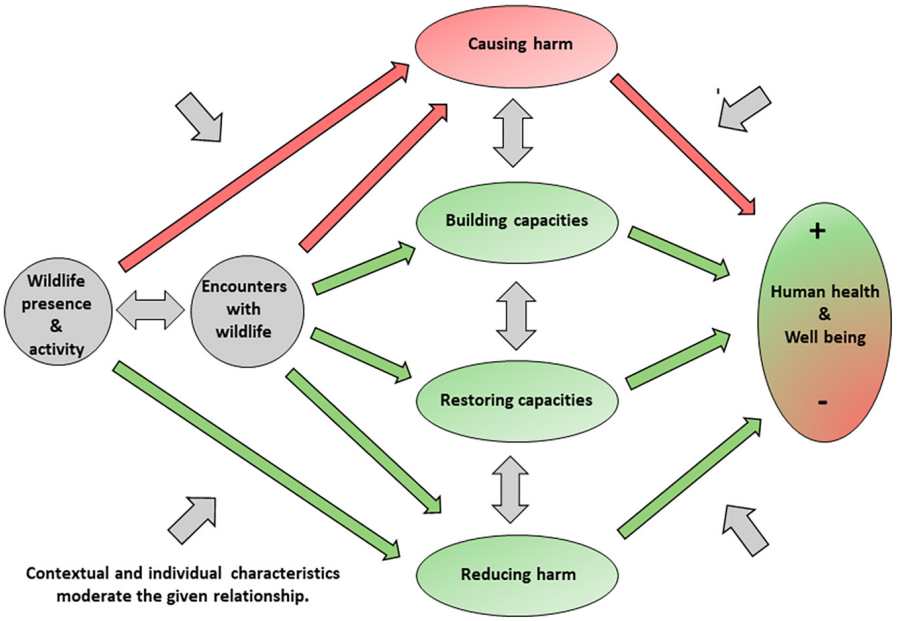

FIGURE 1 | A general conceptual model with domains of pathways through which the presence and activity of wildlife can come to have both positive and negative effects on human health and well-being. Some pathways do not run through encounters with wildlife, indicating that they may have effects by means outside the awareness of the people involved. Pathways in any one domain may influence and/or be influenced by pathways in any another domain, but for simplicity in the presentation only relationships between adjacent domains are shown. The vertical ordering of the pathway domains also serves to simplify the presentation; it does not imply a necessary logical order. As indicated by the gray arrows, the strength and direction of effects transmitted via pathways in any of the domains may depend on features of the context (e.g., everyday life in a rural residence versus a guided wildlife safari in an exotic location) and of the individual (e.g., age, gender, emotional disposition, work in animal husbandry versus wildlife conservation, and hunting experience). Adapted from Hartig et al. (2014); Markevych et al. (2017) and Marselle et al. (2021).

We see important reasons to focus here on pathways in the restoring capacities and causing harm domains. Restoration has long been recognized as an important motive for visits to natural areas in urbanized countries (e.g., Knopf, 1987; Home et al., 2012). Similarly, access to opportunities for restoration in natural settings figures prominently among those who own a second home in a rural area (Fransson and Hartig, 2010). For people who have their sole or primary residence in rural areas, both daily demands and restoration opportunities are situated in rural settings, and wildlife may figure in the demands they face as well as in their restoration opportunities, for good or ill. Furthermore, the pathways of the restoration and causing harm domains, such as stress recovery or threat of attack, will in this context ordinarily have implications for pathways in the other domains, as when a person decides whether or not to wind down from stressful work by taking a walk in a nearby natural setting (i.e., physical activity as a pathway to health and well-being through the capacity building domain) (e.g., Staats et al., 2003; Dzhambov et al., 2018).

When people actively seek restoration in a natural setting, wildlife presence may play into the restorative opportunities in one or more of three general stages in a restorative process: *before* a visit when choosing a suitable setting, *during* a visit while engaging with the setting, and *after* a visit through feedback that influences future setting choices based on the experience just had in given setting. In any one of these stages, the potential for restoration may compete with the potential for harm of some kind in determining the degree to which the person benefits from the experience. For example, a person may choose to go to a given setting specifically to experience wildlife, as when a bird watcher heads toward a site where a rare species has been reported, or a person may deliberately avoid a setting, as when a berry picker avoids a nearby forest because brown bears have been reported there. In this paper, we focus on restoration as it unfolds on site, as one or more people are engaged with the setting. We outline how the experienced presence of different wildlife species can work to sustain or undermine restoration a person has sought with a visit to a natural setting.

Why might different wildlife species trigger different psychological responses? Why might these responses differ between people? How might contextual factors work to amplify or soften responses? How do these various aspects of an encounter, taken together, play into the restoration that a person realizes during a nature experience? Here we draw on general and specific theories within psychology to address processes of approach and avoidance based on people's emotional appraisal of the presence of wildlife in relation to perceived opportunities or constraints for restoration in the natural setting. Within psychology, the interplay between the person and the surroundings gets described in terms of diverse, continuously ongoing psychological processes. As a general theory in environmental psychology, the Human–Environment Interaction (HEI) model (Küller, 1991) treats the outcome of this

interplay as dependent upon the individual's integrated appraisal of the activity engaged in, the perception of the physical and social environmental contexts, and the characteristics of the individual (e.g., socio-demographic background, personality, emotional disposition toward and prior experience with given animal species). Applied to potential or actual encounters with wildlife, the HEI model indicates that the description of the psychological processes of interest would involve reference to characteristics of both the people and the animal(s) involved (Johansson et al., 2012a, 2016b). Further, the HEI model indicates that the psychological process description would attend to the specific behavioral context in which the person or people and the animal(s) meet – the respective activities they are engaged in (e.g., a person gathering berries; an adult animal feeding) – as well as physical and social aspects of the context (e.g., the person is alone but at a distance from a female bear with cubs in a place that affords little possibility for escape). In this latter regard, we recognize that the person or people involved may experience the animal(s) simply as features of the physical environment to observe, or as a kind of social partner with whom they interact. Thus, we acknowledge that the ways in which the animal(s) in question perceive and act toward the people involved (cf. Sahlén et al., 2015), are important aspects of the description of the psychological processes of interest; however, we focus here on the human responses.

SPECIFIC THEORETICAL BACKGROUND

Building on the model of pathways from nature to health and on the HEI model as a general theory in environmental psychology, we can draw on more specific theories to provide descriptions of interrelated psychological processes running through the encounters that people have with wildlife. In the following, we comment on approach-avoidance tendencies that people show in response to features of the environment, and briefly overview research on characteristics of the person and the animal that can influence a person's appraisals during an encounter. We outline the two areas of theorizing we integrate: on aspects of restorative experience as situated in natural settings, and on the particulars of ongoing emotional appraisal. We acknowledge the significance of the animal(s) own experience in the given encounter, but in the present account we will only refer to it insofar as it has relevance for the experience of the person or people involved.

Approach – Avoidance and Environmental Features

A person's behavior during the transaction with an environment involves basic approach and avoidance dimensions, with approach being linked to reward and incentives and avoidance being associated with concepts such as aversion, punishment and threat (cf., Carver, 2006; Elliot et al., 2013). Gray (1982) has suggested that different neurological systems underlie the behavioral activation system related to approach and the behavioral inhibition system related to avoidance. Some environmental stimuli tend to elicit different reactions in different people in terms of approach and avoidance, and this might be taken as a basis of personality (Gray, 1982). Recently, however, it has been argued that approach and avoidance processes are present and interact at several functional levels (e.g., Corr, 2013). This means that approach-avoidance tendencies do not conform rigidly to personality profiles but rather show inherent flexibility and plasticity. Even if approach and avoidance are based on different subcortical systems and affected by early learning, they could be expected to yield different degrees of approach and avoidance in different situations based on how these situations are appraised. In this view, situations are construed as sets of focal stimuli within a context. In other words, the context is assumed to comprise one important set of moderators of approach-avoidance tendencies and so of the play of subsequent psychological processes.

Different People Have Different Appraisals of Different Wildlife Species

Considering a particular animal in a given context, previous research has shown that it is likely to be differently appraised by different people. The literature on human dimensions of wildlife points to animal species characteristics, cultural factors, personal characteristics, and prior experiences of human–wildlife interactions (own or vicarious) as parameters that influence these appraisals.

Human appreciation and concern for animal species differ widely between and within taxa. The general order of preference across *taxa* seems to be (1) birds, (2) mammals, (3) amphibians, reptiles and fishes, and (4) invertebrates (Kellert, 1985; Kelly et al., 2016). In terms of conservation importance, the order of taxa is slightly different, but birds and mammals still have the top positions, with birds rated higher than mammals (Knegtering et al., 2002). Within a taxa, *animal characteristics* such as relative size and rarity seem to matter, with assessments of higher importance for conservation assigned to relatively large and rare (or vulnerable) species (e.g., Knegtering et al., 2002; Fischer et al., 2011). Aesthetically appealing characteristics are also associated with preference and assessments of the importance of their conservation among the public (Knight, 2008). Smith et al. (2012) relate aesthetic judgments to traits such as higher body-mass index and forward facing eyes (Fischer et al., 2011). Such bio-behavioral similarity, or human resemblance in appearance, behavior and social interaction, seems to be a factor in attractiveness (Serpell, 2004; Batt, 2009; Manesi et al., 2015).

Species that are considered as *native species* get relatively high assessments with regard to the acceptability of an increase in their population (Serpell, 2004; Fischer et al., 2011). In addition, appreciation seems to be positively associated with the *perceived utility* of the species, which also involves an economic valuation of the species. Serpell (2004) proposed a two-dimensional structure of human attitudes toward animal species encompassing *affect* together with utility. Using a factor-analytic approach, Kellert (1985) found animal species categorized into "domestic animals," which were most preferred, followed by "attractive animals," while animals associated with property damage, animals associated with injury, and biting/stinging invertebrates were the least preferred. Expressions of negative

affect toward wildlife have in particular been discussed in relation to the extent that the animals elicit fear responses and/or constitute threats to pets, human property and/or livelihood (Jacobs et al., 2012; Johansson et al., 2016a; Eklund et al., 2020). Ware et al. (1994) used a factor analytic approach to categorize self-reported fears of a global list of animal species into those labeled high predatory (e.g., tigers, alligators, bears, and wolves) and fear-relevant (e.g., eagles, lizards, slugs, and mice). Arrindell (2000) arrived at a more comprehensive categorization of animal fears: predatory animals, fear-relevant animals, dry or non-slimy invertebrates, slimy or wet-looking animals, and farm animals.

Davey et al. (1998, 2003) differentiated between affective assessments of animals as fear relevant and disgust relevant, and argued that fear of high predatory animals is associated with harm and pain, whereas fear of low-predation animals is associated with contamination or disease. However, the acquisition of emotional responses to many species may also reflect on the *culture* in question; people are known to respond differently to the presence of different wildlife species due, for example, to their religion and other traditions (e.g., Gogoi, 2018). Also, differing perspectives between urban and rural populations have been identified (Johansson et al., 2016b). Sponarski et al. (2013), however, have argued that, in the United States, the population in rural communities nowadays is heterogeneous with regard to attitudes toward wildlife. In addition local (media) debate may matter (Hathaway et al., 2017; Arbieu et al., 2019).

Finally, personal factors may moderate approach-avoidance tendencies and other appraisals in an encounter with wildlife. These factors include *age, gender,* as well as an individual's *personal emotional dispositions toward specific species* (Jacobs et al., 2012; Jacobs and Vaske, 2019). Such dispositions imply that there is a basis for appraisal of a specific animal species caused by whether the animal is regarded as intrinsically pleasant (negative valence), intrinsically unpleasant (positive valence), or neutral by the individual. Moreover, *interests* in nature and wildlife, and *experiences of negative impacts* on human property and livelihood, may moderate response to wildlife, as seen in studies concerned with large carnivores (Sjölander-Lindqvist et al., 2015; Eklund et al., 2020), moose (Dressel et al., 2020), geese (Eriksson et al., 2020), and seals (Johansson and Waldo, 2020).

Nature Experience and Restoration

Although the literature gives substantial evidence of the restorative benefits of nature experience (e.g., Stevenson et al., 2018; Hartig, 2021), various studies indicate that "nature" does not unequivocally elicit the approach responses that would sustain a restorative process. In a review, Patuano (2020) points to a fear of wild nature as a constraint on benefits. Nature being perceived as something scary and disgusting is put forward as a major reason, including the presence of risks of encountering dangerous and/or unattractive animals, as well as allergies, poisoning, vector-borne diseases, and getting lost due to disorientation (e.g., Bixler and Floyd, 1997). In contrast to such findings from survey and interview data, a meta-analysis of experimental findings found that the effect of exposure to nature on positive affect did not differ depending on whether it was categorized as "wild" or not (McMahan and Estes, 2015). Drawing on restorative environments theory, one can argue that it is not the "wild" component of wildlife *per se* that matters. Rather, the presence and activity of the wildlife need to be considered in relation to the activity in which a person wishes to engage while in the natural setting. People ordinarily approach natural areas with a set of expectations, and they perceive the environment in ways aligned with the goals of those activities. Hence, with regard to restoration, the appraisal of the presence and activity of wildlife can vary greatly according to whether it matches with expectations about whether and how the activity should serve restoration.

Such considerations get addressed in theorizing about restorative environments, though not only with regard to the particularities of encounters with wildlife. Looking into the necessary features of theories about nature as a restorative environment opens for insight into the ambivalent implications of the "wild." As outlined by Hartig (2021), theories must address two basic requirements for restoration to occur in a given setting. First, the setting must permit restoration. When moving into it, the person gains distance from the various demands that depleted their adaptive resources and so caused the need for restoration, and while there the person does not face new demands of the same kind, which would only further tax the depleted pool of resources that need restoration. Second the setting should promote restoration by attracting and holding the person's attention in a way that no intrusive thoughts of the demands left behind occurs. In other words, the person engages with environment and thus prolongs the restorative process. This promise of positive engagement, and not only the absence of negative features, underlies a basic definition of a "restorative environment" as one that promotes and not merely permits restoration (Hartig, 2017).

Two well-known theories about restorative environments address these requirements in ways that both contrast with and complement one another. These two theories – Stress Recovery Theory (Ulrich, 1983; Ulrich et al., 1991) and Attention Restoration Theory (Kaplan and Kaplan, 1989; Kaplan, 1995) – have guided much of the research on how experiences in natural settings help to satisfy people's restoration needs. Stress Recovery Theory (SRT) is concerned with recovery from psychophysiological stress, an aversive condition manifest in heightened physiological arousal and negative emotions that can be adaptive in the short term but harmful for health and well-being when it persists. SRT asserts that immediate, pre-conscious affective responses to what one sees in the environment can influence attention, physiology and behavior, both mobilizing and giving coarse direction for adaptive action (i.e., to fight or flee) (Ulrich, 1983). Behind this assertion is the view that humans are innately attuned to certain environmental features that would have had adaptive significance during evolution, and that the perception of such features can very rapidly and effectively elicit like-dislike feelings and motivate approach-avoidance behaviors appropriate to continued well-being (Ulrich, 1983, 1993). In terms of SRT, a setting would permit restoration if there were an absence of perceived threats, and it would promote restoration if it had natural contents that drew non-vigilant attention, like the presence of water, that signaled enhanced possibilities

for survival, as well visual scene characteristics such moderate complexity, gross structure, moderate depth, and the presence of a focal point. By evoking positive affect and holding non-vigilant attention, these features as perceived in the setting would block negative affect and negative thoughts, thus promoting physiological deactivation and so helping to restore the person's readiness to mobilize for action when a new threat or challenge would arise. After the initial affective response, more deliberate cognitive elaboration on what the person sees or otherwise senses can draw on different sources of experience (cultural and personal) in shaping the further course of stress recovery. Ulrich (1983) recognizes the relevance of both the immediate presence of wildlife (which may or may not be appraised as threatening) and inferences that could be drawn about their possible presence on the basis of visual characteristics of the given setting (e.g., high complexity, lack of gross structure, and lack of depth as characteristic of dense vegetation in which an animal might hide).

Attention Restoration Theory (ART; Kaplan, 1995) emphasizes cognitive functioning relevant to a person's ability to perform the kind of mental work so frequently called on in modern life. ART is concerned with recovery from directed attention fatigue, a condition seen to arise when a person must wilfully direct attention to a task that of itself lacks interest. To perform the task, the person must inhibit more interesting stimuli and thoughts that compete with the task for attention. Directing attention thus requires inhibitory effort, and this effort cannot be sustained indefinitely. When a person cannot sustain the effort any longer, and suffers from directed attention fatigue, recovery can occur when they can enter a situation in which attention can go freely and without effort to what they find interesting. In other words, while in the setting they can rely on what (Kaplan, 1978; Kaplan and Kaplan, 1989) refer to as fascination. Toward permitting and promoting the free play of restorative fascination, ART specifies the importance of compatibility between what the activities a person wants to do, can do, and must do in the situation. ART further specifies a sense of being away, or a change away from the routine mental contents with which one has been preoccupied; put simply, psychological distance from the conditions in which the need for restoration arose. The setting need not be novel or geographically distant for the person to gain this sense of being away. A fourth component of the restorative experience specified by ART involves the scope and coherence perceived in the setting, together opening for a sense of extent, relevant to the person's possibility for sustaining fascination and maintaining orientation while moving through the setting. Of the four experiential components described in ART, fascination stands as the key promoter of restoration, and particularly fascination of moderate intensity as it is engaged by unthreatening, aesthetically pleasing aspects of the setting (i.e., "soft" fascination). Kaplan and Kaplan emphasize that the natural environment is well-endowed with possibilities for fascination to become engaged, as when watching clouds, trees, sunsets, or running water or when exploring the surroundings. The presence of wild animals is pointed out as fascinating, though if they present a threat then they may evoke only a "hard" fascination that the Kaplans regard as less conducive to restoration because it does not leave mental room for thinking about other things (cf. the discussion of the alternation between soft fascination and mind wandering that can occur during a nature experience; Williams et al., 2018).

Arguably, of the two theories, ART treats in greater detail the preconditions that permit restoration in addition to an absence of threat – that is, matters of being away and compatibility– while SRT treats in greater detail the kind of on-going appraisal of the setting in terms relevant to the continuation of the restorative process while there, including but not limited to matters of threat. With regard to our consideration of how the presence and activity of wildlife bear on harm and restoration, we note that compatibility will typically come into the picture in the first stage of the restorative process, when choosing a suitable setting before a visit, and that possibilities for being away will figure in the assessment of compatibility. As noted earlier, however, we focus here on what happens during the second stage, while one or more people are engaged with the natural setting. We do so for two reasons. First, what happens on-site has implications not only for the restoration realized, but also for the recollection of the experience, and in turn choices of suitable settings for possible subsequent visits. Second, although acknowledged in SRT and ART, research guided by those theories has paid relatively little attention to wildlife as dynamic, animate components of natural environments that may appear and disappear at different times in the course of a visit to a natural setting, possibly promoting positive engagement but also possibly evoking a sense of threat and otherwise causing harm. Given this focus, our representation of the process will in important respects appear to align more closely with the description of stress recovery given by Ulrich in SRT. However, we do not mean to imply that our description has no relevance for the eventual restoration of directed attention capacity. A person may suffer both from stress and mental fatigue, and processes of recovery from the two conditions may unfold simultaneously (Hartig et al., 2003).

Neither SRT nor ART addresses in great detail the implications of the immediate social context of the visit to the natural setting. Yet, like the search for restoration, being in the company of family and friends has long stood out as a key motive for recreational visits to natural areas (e.g., Knopf, 1987; Manfredo et al., 1996). Moreover, the two motives will ordinarily work together, with a view to issues of both safety and mutual enjoyment (e.g., Staats and Hartig, 2004; Hartig, 2021). Having the company of some other(s) has particular relevance here in that it can influence the appraisal of wildlife that a person may encounter. A person may feel intense fear if meeting a wolf in a forest while alone or with a small child (Frank et al., 2015), but that person may feel quite secure and thrill at the shared experience if in the company of other adults.

Appraisal Theory of Emotion and the Component Process Model

As a final component of our specific theoretical background, an appraisal theory of emotion (Leventhal and Scherer, 1987; Scherer, 2001) leads us to postulate that appraisals of wildlife species differ not only between individuals, natural settings and

social situation but also across and within specific situations. This theory thereby sheds light on how appraisals vary over time in ways not explicitly accounted for by SRT and ART. According to this theory, multiple appraisal processes directed toward a given set of stimuli may alternately elicit approach and avoidance responses that guide the individual's transaction with the environment. Because some appraisals are assumed to occur on a more or less automatic basis, demanding no or little mental resources, the multiple appraisal processes could conceivably run in parallel, but with different levels of intensity at different times. For one and the same animal, then, at a very basic level of processing, a person could be expected to respond more or less automatically to traits such as its taxa and size. At a more elaborated level of appraisal, the person's response would also involve interpretation of the animal in relation to the context (Kappas, 2006). Looking at approach and avoidance from an appraisal perspective implies that multiple types and levels of appraisals can occur in tandem or in a sequence, weighing approach against avoidance as the adaptive response.

In the appraisals initiated with the presence of an animal of a certain species, some appraisals occur at a sensory motor level much as inborn reflex-like responses (Leventhal and Scherer, 1987). For example, Walther (1969) showed that the size, direction, and speed of an approaching object did matter to a gazelle herds' fear responses of stuttering and fleeing. These responses were reasonably elicited by sensory motor appraisals. Such automatic responses can be seen in other non-human species (e.g., birds; Bossema and Burgler, 1980), and presumably in humans. Leventhal and Scherer (1987) also describe schematic and conceptual levels of appraisals. The schematic level is concerned with appraisals based on previous learning experience and can become automatic and effortless much like sensory motor appraisals. The appraisal on the conceptual level demands more effortful cognitive processing.

The Component Process Model (CPM, e.g., Scherer, 2001) states that a stimulus or event evokes a sequence of four groups of appraisals, namely relevance, implication, coping, and normative significance. The relevance appraisals consider aspects such as the degree of novelty, intrinsic pleasantness, and goal relevance of the event. These appraisals are made based on the individual's emotional disposition toward the animal and previous experience, but they also relate to the speed of appearance, intensity, and closeness of the event, for which previous experience may have little or no consequence. Implication appraisals are concerned with causality, outcome probability, discrepancy from expectation, conduciveness and urgency. Thus, these appraisals consider whether the event is due to natural causes or if there was an intention behind the event, as well as the extent to which the event resulted in what was expected, the extent to which it demanded action, and whether action is urgently required. The coping appraisals are concerned with control, power and adjustment. That is, they consider the probability that the person has the power to control the potential problems that attend an event or can adapt to the new situation. The final group of appraisals in this sequential model, normative significance, concerns the compatibility of the stimulus or event with internal and external standards. That is, they consider how the event relates to what the person finds to be right or wrong in relation to their own internal norms and how the event compares to the believed social norm concerning the event.

A THEORETICAL INTEGRATION: MULTIPLE APPRAISALS ON-SITE DURING A RESTORATIVE EXPERIENCE

Appraisal theory of emotion asserts that several processes of approach and avoidance in response to an environmental stimulus, in our case the presence of an animal, may run in sequence and in parallel at different levels of cognitive elaboration, and that they may to affect one another. HEI as a general theory, and SRT and ART as specific theories, encourage the understanding that the restorative potential of a situation involving wildlife is not adequately represented in terms of a person's general appraisals (e.g., utility and fear) arising from transactions between the characteristics of the animal and the cultural and individual characteristics of the person. Rather, the restorative outcome of a wildlife encounter would depend on multiple processes of appraisal of the animal in the particular situation, taking into account the role the person adopts in the situation and the activity related to that role. The appraisal processes that run continuously during the encounter may moreover yield results that are congruent or competitive with the components of experience that permit and promote restoration. Thus, the dynamics of situation-specific processes, some automatic and others more deliberative, would shape the restorative outcome.

Features of the natural setting and the social situation would also figure in these appraisal processes during a wildlife encounter and so influence the restorative quality of the experience. The unfolding of the restorative process would depend on the extent of the natural setting, considered both in experiential terms as described in ART and also from an ecological perspective, as suitable habitat where wildlife could be present. The unfolding of the restorative process would also depend on how well the person could gain distance from daily demands in the setting. The presence of other people and who they are would also matter. For example, people in areas with large carnivores in self-reports states stronger fear of an encounter if they would be accompanied by a child (Frank et al., 2015; Johansson et al., 2019). In other word, features of the natural setting and of the social situation would have a moderating role in appraisals and avoidance-approach responses during an encounter. Appraisals and avoidance-approach responses will bear on the unfolding of restorative processes through their influence on permitting and promoting factors, as outlined in the following paragraphs and illustrated in **Figure 2**.

Put in terms of CPM, the relevance appraisal as it bears on the permission of restoration would, in line with both SRT and ART, involve attention to threat. The relevance appraisal of the animal would therefore include consideration of its taxon, specific features such as its size and present behavior (e.g., whether it is moving toward one), as well as comparisons with previous experiences of wildlife associated with threat and

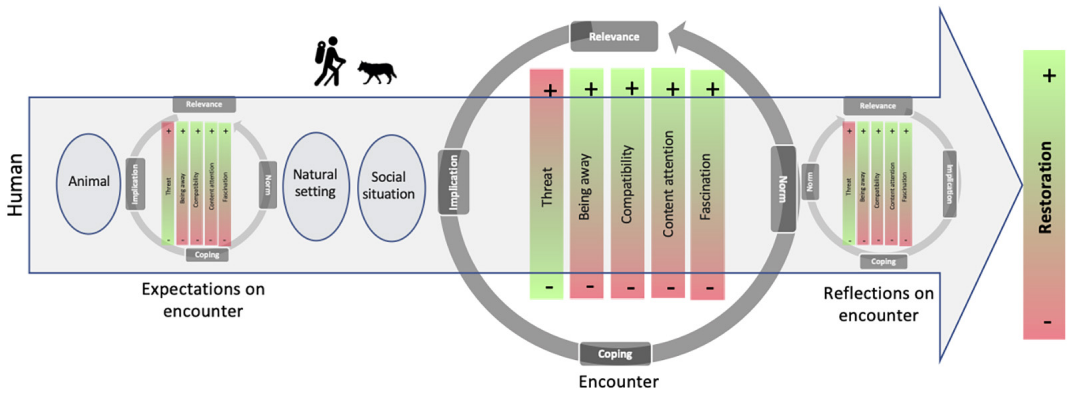

FIGURE 2 | A description of how an encounter with wildlife during a visit to a natural setting can lead to enhanced or reduced psychological restoration. Given the possibility of an encounter with a particular species of animal (shown with the silhouettes), *expectations* regarding the role of the encounter in the desired restorative experience will get shaped by general, cultural and personal appraisals of human-animal interactions, what is known of the natural setting and the social situation (e.g., whether one will be going alone or in the company of others). As with the formation of expectations, appraisals *during the encounter* concern matters of relevance, implications, coping potential, and norm congruence (Scherer, 2001) as related to components of restorative experience - threat, being away, compatibility, fascination and attention to content – described in attention restoration theory (Kaplan and Kaplan, 1989) and stress recovery theory (Ulrich, 1983). Subsequent *reflection* on the wildlife encounter would involve similar appraisals and shape the outcomes experienced after the visit as well as future expectations.

danger. These parameters could be expected to elicit sensory motor and schematic appraisal processes that build further on the same and perhaps additional animal characteristics (e.g., the speed at which it is moving toward one) as well as appraisals on a conceptual level that draw more deliberatively on cultural factors and personal experiences. It is likely that the sensory motor and schematic appraisals would dominate in the face of an imminently threatening animal, eliciting immediate avoidance responses that would interrupt restorative processes and induce stress. Appraisals on the conceptual level could also reduce the restorative potential of the setting if the person appraises the presence of an animal as somewhat threatening but cannot think about a way to cope that would be compatible with their personal norms. If the appearance of the animal would not be considered relevant as threatening or disgusting, or if the individual should find that they could cope with the situation, then the appraisal could instead result in an approach response.

Attention Restoration Theory stipulates another set of permitting factors on which appraisals of relevance would bear. These factors include the congruence of the presence of the animal with the perception of being away from the daily demands and the perceived compatibility with the activity in which the individual is engaged. These appraisals would mainly occur at the conceptual level, addressing relevance, potential implications, coping and the normative significance of further attending to the animal. If these appraisals would not be supportive of being away and/or compatibility, the animal encounter would likely result in neither avoidance nor approach, and thereby have little effect on the further course of the restorative process(es). But, if the appraisals would support perceptions of being away and compatibility, as with the appearance of a rare and sought-after bird in front of the bird watcher, the attention to the animal would elicit approach responses. This leads us to discuss how appraisals can bear on factors that promote restoration.

Stress Recovery Theory asserts that restoration is promoted by features of the setting that evoke positive affect and hold non-vigilant attention. These features could include how the animal fits into the configuration of space in the setting, a natural content that also enhances complexity and provides a distinct focal point. They could also be specific animal features, such as aesthetic traits of bio-behavioral similarity. ART asserts that restoration is promoted by soft fascination, enabled by a sense of being away and sustained by the perceived extent of the setting and compatibility in the activity there. Animals not being appraised in ways relevant to promoting factors would not receive further appraisals and have little impact on the further unfolding of restoration. However, if the person attends to the animal effortlessly, the implications of this fascination can then become a focus of appraisal: what will happen if staying in the situation watching the animal? If the individual finds the consequences may be negative and difficult to cope with, then there would be an avoidance response and the restorative process would not gain from further engagement with the animal. However, if the persons finds no negative consequences and/or is able to cope with remaining in the situation, then further approach responses would be possible. In this sequence, the implications of continued engagement presumably relate to being away and compatibility, as when the person breaks off engagement with the animal to turn back to the planned activity for which they have a limited amount of time. Even if the person finds that they could cope with the situation, however, continued engagement with the animal could violate personal or social norms, and so lead to avoidance and so an inability to realize the additional restorative value the encounter could provide were it to continue. For example, the bird watcher who sees the rare bird recognizes it is nesting, and that their presence is stressing the bird. Thus, the appraisal of a violation of norm congruence triggers an avoidance response that simultaneously interferes with the interconnected experiences of

fascination, being away and compatibility, limiting the restorative value of the time in the setting.

APPLYING THE MODEL WITH TWO SWEDISH WILDLIFE SPECIES

In the Scandinavian countries, natural settings play an important role for consumptive as well as appreciative activities. About half of all Swedes have actively chosen to live close to nature, and in a national survey 80% of people reported that they spend leisure time in nature (Fredman et al., 2019). Sweden's area is dominated by boreal forest managed for logging purposes, for the most part highly accessible from main roads and forest roads (Zimmermann et al., 2014). Less than 5% of the area of the country is covered by agricultural or urbanized land, and human density is often less than one person per km^2 (Zimmermann et al., 2014). Even in the most densely populated areas in the southern parts of the country, natural settings are not far away, and many are accessible by regular public transport. Thus, much of Sweden's area serves as habitat for animals that people can encounter during recreational and other activities.

Clearly, Swedes do respond differently to different species. Based on factor analysis of national survey data, Johansson et al. (2012b) identified two main groups of animal fears. The first involved the four large carnivores found in Sweden (brown bear, wolf, lynx, and wolverine). The second involved fear of disgust-relevant animal species (tick, wasp, and snakes). Qualitative research in a Swedish context confirms that diverse native animal species such as moose, roe deer, wild boar, ticks and snakes become associated with threatening experiences, but for quite different reasons (e.g., fright, discomfort, destruction of property; Hagström, 2014). Geographical differences in people's experiences of the different animal species may influence feelings and attitudes toward them (Johansson et al., 2016b; Eriksson et al., 2020). The abundance of species such as wolves and wild boars provoke much debate in some areas, while other species, such as roe deer, may be of more limited concern and yet others, such as the squirrel, may pass with little comment. The discussion is primarily framed in terms of animal husbandry and hunting interests versus conservation interests in the case of wolves; of threats to agriculture in the case of wild boar; and of threats to forestry in the case of roe deer. From the general perspective of nature's contributions to people (Díaz et al., 2018), it would, however, also be relevant to illustrate the potential positive values of these species, as from a restoration perspective. Starting from our framework, we now outline different scenarios related to the play of restorative processes during an encounter with a wolf versus a roe deer while spending time in nature. We propose that each scenario should be analyzed in at least four aspects:

(1) Description of the animal in terms of the human-animal interaction;
(2) Contextual factors in terms of the natural setting and social situation;
(3) Appraisal of factors relevant for permitting restoration in the encounter situation;
(4) Appraisal of factors relevant for promoting restoration in the encounter situation.

These four aspects are treated sequentially in the sections to follow. In treating them, we also consider the appraisals of permitting and promoting factors at their different levels (sensory-motor, schematic, and conceptual). Furthermore, appraisals likely to occur at the conceptual level are further analyzed according to matters of relevance, implication, coping potential, and norm congruence.

Aspect 1: Human – Animal Interaction

Wolves (*Canis lupus*) belong to the taxa mammal, are relatively rare in Sweden, and have characteristics such as forward facing eyes (**Supplementary Appendix 1**). Considering these *biological characteristics* alone, one could expect that they would be rated high in preference and their presence would enhance the restorative potential of a natural setting. Considering the *general human appraisal*, however, wolves are perceived as a threat-relevant species that would diminish restorative potential.

Roe deer (*Capreolus capreolus*) also belong to the preferred taxa of mammals and have appreciated characteristics such as forward facing eyes. Even though they are relatively common, they would rate rather high in preference and enhance restorative potential (**Supplementary Appendix 1**). As for the general human appraisal, roe deer are not threat-relevant or disgust-relevant animals, so their presence would be unlikely to diminish restorative potential.

Taking a cultural perspective in brief, the wolf population in Sweden is closely monitored, and observations of wolves in shared landscapes rapidly get extensive media coverage. In contrast, the presence of roe deer usually passes unremarked. The presences of wolves causes long-running social conflicts between conservationists, hunters and farmers, among others, while roe deer typically do not arouse conflict. However, to understand appraisals of the two species, further information is needed about the person involved in the human-animal interaction. Consider, therefore, two people who are plausible in a Swedish cultural context:

- A woman of 70 years, with poor health, an emotional disposition of finding roe deer and other ungulates joyful to watch, living alone in a small house in a rural hamlet beside a natural setting (further described below). She keeps a few sheep in a nearby field as a hobby; she does not depend on them for income. She regularly goes berry-picking in the nearby natural setting.
- A man of 40 years, a forest-worker who lives with his wife and two small children in a house with a large garden on the outskirts of an urban area. The house is close to the natural setting.

The appraisals of the woman would likely reflect rural values commonly expressed in the debate about the large carnivores. As an animal owner, she would be highly aware of the threat of wolves to sheep, and due to her age and poor health she might also have concerns about her own vulnerability to those large carnivores. Her appraisals on encountering a wolf could

therefore be expected to result in avoidance responses, potentially diminishing the restorative potential of an outing to the nearby natural setting should an encounter occur. Given her personal characteristics, values and interests, her appraisals of human-animal interactions involving roe deer would in contrast not diminish the restorative potential. However, as noted below, situation specific appraisals also need consideration.

The appraisals in a human-animal interaction involving a wolf would likely unfold differently for the middle-aged man. Identifying with urban values in the debate around large carnivores, he sees the wolf as important to conserve. He is accustomed to being in the forest and is confident that he could handle an encounter with a wolf, although he has never seen one in the wild. The presence of a wolf would not result in avoidance but rather interested observation which could contribute to restoration. As for the appraisal of human-animal interaction involving roe deer, he also appreciates roe deer as an important species in the local fauna, and he is used to seeing them while working in the forest. Roe deer do, however, frequently get into their garden to eat apples, which he finds a bit irritating. On the whole, the presence of a roe deer would not predictably elicit either an avoidance or approach response in a given encounter. Again, however, as noted below, situation specific appraisals need consideration.

This requires recognition that the sequential appraisals can be done in parallel at senso-motoric, schematic and conceptual levels, and that the differing pertinence of these appraisals can result in differences in the strength of avoidance – approach responses. Moreover, strong reactions as consequences of senso-motoric or schematic appraisals may override appraisals on the conceptual level. Thus, conceptual appraisals are more important when appraisals on the lower levels result in any valenced outcome.

Aspect 2: Contextual Factors: The Natural Setting and Social Situation

The natural setting our two people visit for restoration is a typical one in Sweden. It lies in a predominantly rural landscape with small hills of 50–100 m height. The vegetation consists of intensively managed forest dominated by Scots pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*), with heather (*Calluna vulgaris*), grasses (*Deschampsia* spp.), and berry-producing shrubs (*Vaccinium* spp.) dominating the understory layer. This means the visibility is relatively low (10–50 m), and the light conditions are dusk-like even in sunny weather. The ground is dominated by different wet and soft mosses (*Sphagnum* spp.). Stones, fallen branches and trees make walking slow and running very difficult. The most commonly encountered vertebrates are small passerine birds. In addition to roe deer and wolves, mammal species include voles (*Microtus* spp.), moose (*Alces alces*), red fox (*Vulpes vulpes*), and lynx (*Lynx lynx*).

Walks and other recreational leisure activities in natural settings close to one's home are often made on a regular daily/weekly basis (Fredman et al., 2019), often together with family and friends but sometimes alone or in company of a family dog. For the social situation in the scenarios we have presented, if the person is not alone, then their company is likely to be close and familiar.

Aspects 3 and 4: The Encounter Situation: Appraisals of Factors Permitting and Promoting Restoration

Now, imagine that the woman, while standing in a forest glade appreciating the view, suddenly sees a wolf staring at her from a distance. There would first be appraisal at the senso-motoric level, resulting in a physiological response (e.g., increased heart beat). The schematic level of appraisal is then supposedly the strongest one, given that she finds herself and her sheep vulnerable to large carnivores. This means that appraisals on the conceptual level have no or limited impact. The appearance of the wolf is of high relevance as an intrinsically unpleasant experience to her, and it hinders pursuit of her goal of a restorative walk. The implication appraisal acknowledges the potential for injury. Given her age and poor health, she makes an appraisal of low coping potential. She might wish the wolf killed, but this is not congruent with her view (norm) on lethal management. On the whole, with these appraisals, the situation does not permit or promote restoration, and she returns home feeling more stressed than restored (**Figure 3A**).

If the woman would see a roe deer, we could expect the restorative process to unfold differently. There is no dominating senso-motoric response; rather, the encounter initiates appraisal on the schematic level, but it does not dominate the response as with the wolf. On the conceptual level, the encounter is appraised as having modest relevance, as it is of a kind that occurs with some frequency, but it is nonetheless a somewhat intrinsically pleasant experience and it doesn't interfere with her walk in the forest. Her implication appraisals refer to goal conduciveness, as seeing the roe deer is compatible with restoration sought with the forest walk. Most likely, appraisals of coping potential affirm a high level of control. The event thus permits restoration. Insofar as she stays in the moment, admiring the animal and following its behavior, the encounter promotes restoration, increasing a sense of being away and evoking soft fascination. She returns home more restored than usual; she does not always see such a beautiful animal on her walks in the setting (**Figure 3B**).

Consider now the man. He is standing in a glade in the forest, appreciating the view, when he sees a wolf staring at him from a distance. He appraises the presence of the wolf as relevant, as it is an unusual sight to him despite all the time he spends in the forest. His implication appraisals are done with regard to goal conduciveness, as the event promote the restorative quality of the forest walk. Considering his extensive forest experience, he appraises his coping potential as high. Thus, the event permits restoration, as there is no perceived threat. However, this might change if the social situation were different, and he was walking in the natural setting with his two small children. The sight of the wolf might then rapidly raise feelings of fear as he experiences more vulnerability. Just as in the previous case with the woman, this feeling would be elicited with senso-motoric and schematic appraisal processes. Subsequent appraisal of coping potential on a conceptual level could attenuate the fear response, and the

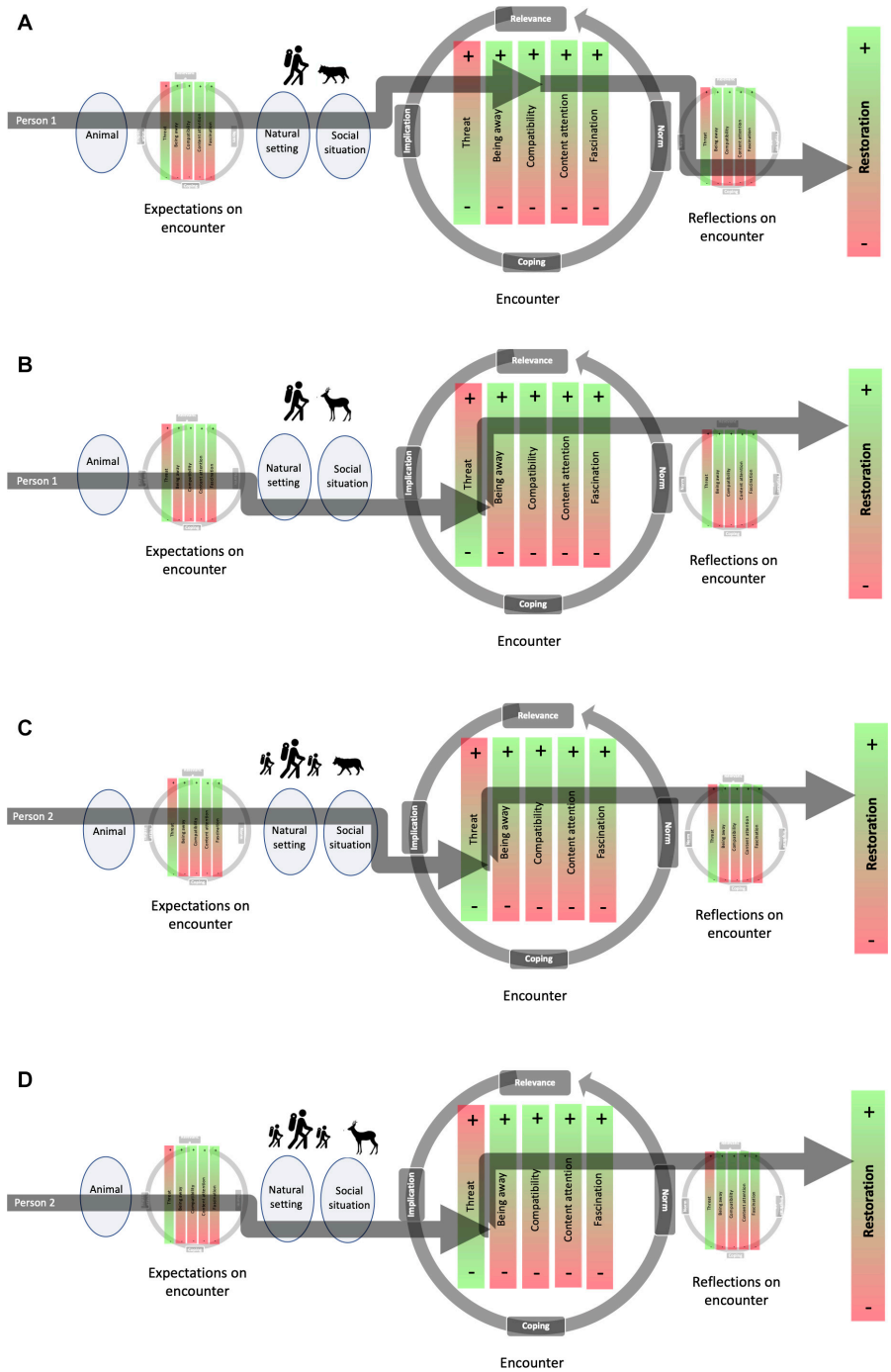

FIGURE 3 | Descriptions of how different factors might influence the restorative effect of an encounter with wildlife during a visit to a natural setting. **(A)** An older woman encountering a wolf she feels unable to cope with experiences threat that undermines the restorative process. **(B)** An older woman encountering an unthreatening roe deer enhances the restorative process. **(C)** On encountering a roe deer, a middle-aged man appreciates the way his two small children engage with the animal, and this enhances the restorative process. **(D)** A middle-aged man does not appraise a wolf as a threat, and the rare encounter enhances his restorative experience.

feeling of fear would then be overtaken by admiration of the animal permitting for restoration that might be amplified when safely shared with his children (**Figure 3C**). However, while alone he does not watch the wolf for long, as his attention is drawn to the new trees growing in the glade, something highly relevant to him because it reminds him of work he does in the forest. The appraisals necessary for the experience of being away are thus hindered, and the situation does not still fully

permit restoration. Although encountering the wolf momentarily enhanced the restorative experience, that fleeting benefit has gotten offset by the reminders of work (cf., Von Lindern et al., 2013).

The outcome differs when the man is standing in the glade with his two small children, and they see a roe deer. The event does not at a schematic level elicit any feeling of fear or an avoidance response, and it thus permits the continuation of his restoration. However, at a conceptual level, seeing the roe deer elicits appraisals related to previous experiences of destroyed apple trees, and he disengages from the sight. The event is low on relevance, but it is for him somewhat intrinsically unpleasant, as the animal has negative implications for his gardening. He would, however, appraise his coping potential as high, and he sees that his children have made appraisals that manifest in expressions of curiosity and delight. There are no incentives for avoidance or approach on his part, but they remain watching the deer until the children take interest in something else. Although the intrinsic unpleasantness and negative implications of the roe deer are not compatible with restoration for him personally, he experiences being away and fascination as his children encounter the animal. An event that could result in stressful thoughts were he alone instead supports restoration in the company of his children (cf., Hartig, 2021) (**Figure 3D**).

DISCUSSION

This paper sheds light on some of the intangible aspects of nature's contributions to people. Referring to broad domains of adaptive pathways between wildlife and human health and well-being, we have considered how people's exposure to and experience with wildlife presence and activity can engage pathways in the domains of both restoring capacities and causing harm (cf. Marselle et al., 2021). Moreover we illustrate how this is likely to occur through parallel and partly overlapping appraisal processes, running from physiological to cognitively elaborated approach and avoidance responses (Leventhal and Scherer, 1987). Our framework and the accompanying process model thereby contribute to the literature by specifying potentially significant psychological processes running during encounters with wildlife. This makes it possible to gain further depth in the understanding of how people's personal experiences of nature matter to well-being outcomes. Our framework takes the perspective of the individual, and it draws inspiration from general theory on human–environment interaction and specific theory on emotional appraisal to integrate current views in the fields of human dimensions of wildlife and restorative environments. Our approach thus brings current discussions on nature and human health into alignment with discussions of the psychosocial consequences of wildlife conservation (e.g., Decker et al., 2012; Hartig et al., 2014).

With the integration of the two research fields we indicate that generalized appraisals concerning wildlife species and human interaction with these species affect the momentary appraisal processes during a specific encounter in a specific natural setting and consequently the restorative outcome of the visit to the setting. The core idea thus brought forward here is that the restorative value of natural settings can be expected to vary depending on the presence of wildlife, taking into account the ways in which people's appraisals can differ across species, physical and social environmental contexts, and specific situations. Moreover, the restoration outcome would depend on appraisals of a potential wildlife encounter before, during and after a nature visit. The framework thus offers new ways to consider the diversity of wildlife in terms of nature's contributions to people. The framework handles both the current negativity bias in the literature on human–wildlife relationships (Buijs and Jacobs, 2021) and the un-reflected view of nature as something unequivocally positive in much of the literature on the restorative aspects of nature.

Although we assume continuously ongoing appraisal processes, with our framework we propose that the analysis of appraisals *during* a nature visit ought to first attend to several aspects of the total situation. First among these is *the human-animal interaction* as it involves animal characteristics, general human appraisals, and cultural and individual factors. Such a description relies on results of research on human dimensions of wildlife and aids understanding of whether an encounter with the animal species in question is more likely to elicit approach or avoidance. The individual's emotional disposition toward an animal would be one factor moderating the relevance appraisal of intrinsic pleasantness of an encounter with the animal.

Second, *contextual factors* of the nature visit should be investigated including the natural setting and the social situation, as suggested by general theory concerned with human–environment interactions (the HEI model; Küller, 1991). As for the natural setting, the physical features and their configuration should be considered. One feature would be the spatial extent, another the density of the vegetation. The perception of such features could say something about how well a natural setting regardless of presence or absence of animal species might provide for restorative experiences (Kaplan and Kaplan, 1989), including perceived prospect and refuge known to play into the perceived safety (Gatersleben and Andrews, 2013). The social situation holds similar importance, as the appraisal of an animal encounter can go in different directions depending on whether, for example, an accompanying person would reinforce or mitigate threat responses (Frank et al., 2015; Hartig, 2021).

Further, appraisals of *factors permitting and promoting restoration* should be taken into account. Our process model aligns with the claim of conventional restorative environments theory that threatening wildlife will result in avoidance and constrained restoration, if not elevated stress (Ulrich, 1983). If the encounter is experienced as safe, it may promote restoration, especially if the encounter is also compatible with intended activity, strengthens the experience of being away, and evokes fascination. The encounter could thus deepen the engagement with the natural setting, sustaining restoration. The model also acknowledges that appraisals at different levels of cognitive elaboration in parallel and in sequence result in approach/avoidance responses that feed into the restorative process. Thus, the extent to which the combined critical appraisal

parameters permit and promote restoration shapes the restorative outcome of a wildlife encounter during a visit to a natural setting.

The CPM (e.g., Scherer, 2001) offers a means to systematically describe the processing of the critical appraisal parameters, as shown in the scenarios examples given above. The usefulness of this model has previously been demonstrated in research on people's emotional responses toward diverse wildlife species (e.g., Eklund et al., 2020; Johansson et al., 2020). This earlier research shows that the appraisals of coping potential in relation to an encounter situation would be of particular significance for regulating fear responses. The predictability of animal behavior and controllability of one's own reaction in an encounter situation seem especially important (e.g., Johansson et al., 2019). In our examples, the focus was on the persons' appraisal processes, and animal behavior was kept constant. This may not be the case in a real encounter situation, and variation of animal behavior should be considered, especially concerning their gaze and speed and direction of movement, as these are characteristics likely to inform relevance appraisals (Scherer, 2001).

Considering that restoration includes appraisal processes before (expectations), during (experience), and after a visit (reflections), it could be expected that coping potential would have a critical role in the feedback loop from reflections on previous nature visits to planning and expectations for future visits. Since our application of the framework and process model here has focused upon the experience during a visit, we have not discussed this loop in detail. We think, though, that the coping appraisal would also be central to it. From a human health and well-being perspective it would be valuable to further study those situations where restoration is hindered or even counteracted to understand how people cope with such situations and potentially re-appraise the value of a particular natural setting.

We see possibilities for further informing these matters of process and outcomes through reference to other research and theory. We have chosen not to invoke here the extensive research on responses to snakes and spiders in animal phobia (e.g., Öhman et al., 2001), as phobic responses may reflect biologically prepared learning that follows elicitation patterns different from those seen with fear for other animals (Seligman, 1971). That is, in terms of emotional dispositions regarding intrinsic unpleasantness (Jacobs et al., 2012; Jacobs and Vaske, 2019), biologically based fear dispositions occupy a different category than dispositions for other stimuli. More attention is also needed with regard to the interpersonal processes in animal encounter situations where a person is in the company of other people. As illustrated in our scenario with the man and the child, company might affect the coping potential and the extent to which the encounter promotes restoration of one person through participation in another's experience. This aspect could be further analyzed by means of relational restoration theory (Hartig, 2021).

The next step then is to empirically test the framework and process model. In this, transdisciplinary collaboration will help to ensure high quality descriptions of natural settings and wildlife species, appropriate use of psychological theory and methodology, and involvement of policy-makers. Insights in wildlife policy, management and conservation status will guide choices among the most relevant wildlife species in various natural settings of concern. From a methodological perspective, triangulation is called for. A first step would be to systematically collect qualitative information about different people's personal experiences of wildlife during their visits to natural settings for psychological restoration. Cross-sectional studies could test the validity of the framework in both urban and rural contexts, and among different groups. In line with considerations of nature's contribution to people and the call for integrating local knowledge, we illustrated the application of the framework with examples of people seeking restorative experiences in their local nature settings. The proposed integration of psychological processes is, however, generic; it can also be used to understand how wildlife figures in restorative outcomes among nature tourists and others. Knowledge about the appraisal processes and their relative importance for the restorative outcome could be experimentally tested, in simulated as well as real settings. Mobile methods including both psychophysiological measures and self-reports would be useful in this (Flykt et al., 2013).

CONCLUSION AND IMPLICATIONS

Wildlife conservation and management need to go hand-in-hand with efforts to support human health and well-being; from the perspective of policy-making, a One Health approach is needed[2]. In this case, it means that concerns related to public health must be integrated with nature conservation, considering not only the prevention of disease in humans and protection of animal populations but also the building of capacities that depend on co-existence, including ethical sensibilities regarding the rights of other species to exist and thrive (Leopold, 1970; Moline, 1986). This is not easy task, but here we show one way forward by describing the role that wildlife encounters can play in restorative experiences, thus opening for new ideas and bridges to other fields. For example, reliance on nature for restorative experiences seems to promote environmental concern and a broad range of pro-environmental behaviors (Hartig et al., 2007).

In recent years, wildlife management plans in Sweden and elsewhere have acknowledged people's fear of large carnivores to overcome impact and social conflicts. Psycho-social stress caused by certain species has also been referred to lately (Nordström, 2010; Zahl-Thanem et al., 2020). We think that additional psychological perspectives could enlighten the current debate on wildlife and wildlife management. The understanding of the role of wildlife in restorative processes strengthens a more integrated approach to wildlife conservation, and constitutes a salutogenic stance for policy discussions and social conflicts over wildlife (see also Buijs and Jacobs, 2021).

Our paper points to the need to better understand human-animal interactions, their contextualization in terms of the features of the natural setting and social situations, and the individual's appraisals of relevance, implications, coping potential and norm congruence as they relate to the permission and promotion of restoration. Furthermore, our approach offers concepts associated with established instruments for evaluating

[2]https://www.who.int/news-room/q-a-detail/one-health

outcomes of transformative changes to current approaches to nature conservation and wildlife management, required to achieve sustainable use of natural settings. Attention to these psychological processes opens for a more informed dialog about wildlife by accounting for people's experiences in a more systematic way. The proposed framework and process model can thus support bottom-up processes contributing to local nature conservation and management in relation to restorative opportunities.

DATA AVAILABILITY STATEMENT

The original contributions generated for this study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors have contributed to funding acquisition and development of the theoretical framework presented here. MJ drafted the manuscript, with substantial inputs of text, graphic representations, and critical commentary from AF, JF, and TH. All authors revised the text.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fenvs.2021.635757/full#supplementary-material

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Nature's Services and Contributions: The Relational Value of Childhood Nature Experience and the Importance of Reciprocity

Thomas H. Beery[1]* *and Kristi S. Lekies*[2]

[1] *Faculty for Teacher Training, Kristianstad University, Kristianstad, Sweden,* [2] *College of Food, Agricultural, and Environmental Sciences, School of Environment and Natural Resources, The Ohio State University, Columbus, OH, United States*

People depend on functioning ecosystems to meet human needs and support well-being across the life span. This article considers the interest in ecosystem service valuation, the growing interest in the benefits of nature experience for children, and ways to bridge these perspectives. We focus on embodied childhood nature experiences: the physical and multisensory experiences that intertwine child and nature. Additionally, we highlight the reciprocal quality of nature and child experience relationship as an example of how this relationship goes beyond the instrumental and demonstrates relational value. Underlying this perspective is the belief that children need to be better represented in the perception and action of ecosystem valuation in environmental policy.

Keywords: children, childhood nature experience, ecosystem services, embodiment, nature's contribution to people, reciprocity, relational values

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***Correspondence:**
Thomas H. Beery
thomas.beery@hkr.se

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INTRODUCTION

People depend on functioning ecosystems to meet human needs and support well-being across the life span (World Health Organization, 2020). One aspect of the human role in functioning ecosystems is our responsibility to these systems' health and well-being. This call for increased human responsibility is at the foundation of this perspective article. Our objectives are to explore the ecosystem services idea from the vantage point of children in nature and draw attention to the need for greater recognition of children within the broad ecosystem service discourse. Furthermore, we will make an argument for the reciprocal quality of that relationship.

Two important but distinctly different documents relating to the human relationship with nature were released in 2005. One was the Millennium Ecosystem Assessment (2005), developed by an interdisciplinary and international panel of scientists, which established the importance of the concept of ecosystem services and the link between human well-being and ecosystem functioning; the Millennium Ecosystem Assessment (MA) provided a framework for analyzing social–ecological systems and has had a significant impact in policy and scientific communities. The other was the popular press book, *Last Child in the Woods: Saving Our Children From Nature-Deficit Disorder*, written by journalist Louv (2005). The book highlighted a dangerous trajectory—a loss of childhood nature experience. Louv called for a recognition of the interconnection of all life on earth, including plants, humans, and other animals, focusing on children. Both of these documents have had an enormous impact on their respective disciplines. With the emergence of these documents, there has been a heightened interest in scientific and practitioner communities to examine relationships between individuals and the natural world (Chawla, 2020).

We argue that the critical and overlapping timing of the MA and *Last Child in the Woods* represents a broader societal interest in questions of sustainability. We propose that the timing is symbolic of the overwhelming call for change in the human relationship with nature. Unfortunately, we also argue that the ideas captured in these works have not been integrated adequately despite the interest they have generated. It is time to bring these ideas together; we will attempt to show why childhood nature experience contributes to the broader ecosystem services discourse. We are inspired by the work of Gladkikh et al. (2019), who identified a broad range of ecosystem services that refugees experience during migration. Just as the refugee experience was brought into the ecosystem service discourse, we hope to make childhood nature experience more visible. As part of our argument, we will remind readers of the wealth of early childhood, education for sustainable development, environmental education, environmental psychology, health, and planning literature that provide scientific evidence of the value of embodied childhood nature experiences. Drawing upon the work of Merleau-Ponty (1968), we define embodied experiences as direct contact with nature, with sensory awareness, mind, body, and environment intertwined as children roam, play, explore, and learn (Beery and Jørgensen, 2016; Jørgensen, 2016, 2017; Fasting, 2017; Raymond et al., 2018). We will also highlight the reciprocal quality of the nature and child experience relationship, thus supporting the idea of ecosystem services as two-way relationships. Underlying this effort is a belief that children need better representation in the perception and action of ecosystem valuation in environmental policy.

BACKGROUND

Nature's Services and Contributions

Scholars trace the origins of the ecosystem service idea to the 1970s as a part of increased efforts toward global biodiversity conservation (Gómez-Baggethun et al., 2009). An important turning point in the ecosystem services progression was the Millennium Ecosystem Assessment (MA) in 2005, an international work program designed to meet decision makers' needs for scientific information on the links between ecosystem change and human well-being (MA, 2005). MA global initiatives attempt to raise awareness and make ecosystem services explicit in planning and environmental management; for example, The Economics of Ecosystems and Biodiversity (TEEB) was an international effort to assess the costs of the loss of biodiversity and the associated decline in global ecosystem services (TEEB, 2008). On a national scale, some countries have incorporated the ecosystem service concept in environmental planning initiatives (Beery et al., 2016; Mononen et al., 2016; Verburg et al., 2016).

Relatedly, and in response to the application of the Ecosystem Services (ES) in policy, practice, and scientific discourse, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) introduced the concept of Nature's Contributions to People (NCP) in 2017 (Pascual et al., 2017). NCP is complimentary with the ES concept while designed to expand and diversify it. For example, NCP is associated with other worldviews of human-nature relations and knowledge systems, inclusive of the idea of "nature's gifts" in some indigenous cultures (Pascual et al., 2017, p. 9). This current effort is not meant to focus on a detailed history of ES/NCP, nor upon the specific distinctions/similarities between the two (de Groot et al., 2018); instead, we will use the notation ES-NCP henceforth to reference the broad and diverse nature valuations discourse and progression of ideas. A brief consideration of this spectrum of ideas provides context for greater inclusion of embodied childhood nature experiences.

A part of the ES-NCP spectrum of ideas has been to question the potentially reductionist character of the original economic emphasis, which may misrepresent how nature relates to society (Kusmanoff et al., 2017; Thorén and Stålhammar, 2018). Developments within the NCP concept, however, may be a support mechanism in this regard. As Kadykalo et al. (2019) noted, "NCP could represent a powerful communication tool to facilitate dialogue and understanding between a wide range of stakeholders in order to co-produce knowledge for people and nature relations" (p. 280). Closely related, another concern based on the economic background of the ES-NCP spectrum is its potential to over-emphasize economic benefits to people (Raymond et al., 2018). In response, a diversity of valuation methods has been explored (Kelemen et al., 2016; Yang et al., 2018), and numerous calls have been made to better recognize and understand local, cultural, and psychological processes as important in human–environment relationships (Setten et al., 2012; Raymond et al., 2013; Jackson and Palmer, 2015).

Similarly, Raymond et al. (2018) urged avoidance of imposing a duality between aspects of the ecosystem and the cultural system to avoid distorting understanding of the types of benefits provided by ecosystems. They recognize a growing consensus that ecosystem services are co-produced between humans and nature and assert the importance of co-production of ecosystem services. Raymond et al. (2018, p. 780) called for consideration of the embodied ecosystems idea to broaden our understanding of values and relations and describe them as "dynamic, multi-level relationships" that are possible between elements of the environmental and cultural system. The idea emphasizes a tightly interwoven socio-ecological system.

Another significant development in the ES-NCP progression emphasizes relational values to go beyond the limitations of the common framing of nature's value as either intrinsic or instrumental (Klain et al., 2017). NCP identifies relational values as part of quality of life (Christie et al., 2019), and this conceptual development from ES to NCP has resulted in valuation discourse more inclusive of a spectrum of sources of human well-being, particularly when considering human decision making and values (Chan et al., 2016). Embodied childhood nature experience needs to be seen more explicitly as a part of this spectrum of sources.

Embodied Childhood Nature Experience

There has been a substantial increase in research-based efforts to understand the relation between children and nature over the past decade, with a subsequent increase in systematic reviews in recent years. This growing body of research, conducted primarily

in North America and Europe, but increasing in other regions worldwide, has demonstrated the benefits of spending time in nature and having access to green and other natural spaces across physical, cognitive, affective, and social domains that comprise overall well-being. Outcomes have focused on such topics as physical activity, prevention of myopia, attention span, restoration, reduction of attention deficit hyperactivity disorder (ADHD), self-regulation, motivation for learning, psychological well-being, and prosocial behavior (see Chawla, 2015; Christian et al., 2015; Collado and Staats, 2016; McCormick, 2017; Xiong et al., 2017; Tillman et al., 2018; Vanaken and Danckaerts, 2018; Kuo et al., 2019; Mygind et al., 2019; Roberts et al., 2019; Grzybowski et al., 2020; Islam et al., 2020; Putra et al., 2020a,b for systematic reviews and the Children and Nature Network for an ongoing compilation of research studies and summaries). **Table 1** provides recent examples of studies that represent different countries, ages of children, and research methodologies.

In addition to the scientific literature, the past 20 years have seen a surge in Western educational and popular culture interest in the idea and practice of children in nature. A notable example of this interest and convergence between popular culture, scientific study, and practitioner engagement can be seen in the Children and Nature Network (2020), an organization that brings together education professionals, parents, researchers, individuals, and organizations to address, explore, and support children in nature. Another more global organization working to support the need for children to play is the International Play Association (1989), which explicitly identified "natural settings" in its Declaration of the Child's Right to Play. Other organizations exist at the local, regional, national, and international levels to provide resources and support to a wide range of educators and other practitioners.

Our focus is on childhood nature experiences that involve direct and embodied contact with natural elements such as trees, animals, rocks, terrain, insects, water, wind, and snow. As defined earlier in the paper, we emphasize how children's minds, bodies, and the environment are intertwined as children roam, play, explore, and learn. Children are part of the "web of embodied relations" at a particular point in time in a dynamic, ever-changing system (Chawla, 2007; Raymond et al., 2018, p. 786). Observational and ethnographic studies of young children's play and interest in the natural environment reveal active bodily movement in and through places, curiosity, bodily and multisensory awareness, a sense of wonder, engagement with small creatures such as invertebrates, insects, and earthworms, and a connection to the landscape (Chawla et al., 2014; Jørgensen, 2016, 2017; Fasting, 2017; Barthel et al., 2018; Malone and Moore, 2019).

In our own work, we have undertaken a series of studies to explore children's experience of nature through the common practice of collecting items from nature such as rocks, shells, feathers, berries, and leaves. Our interest in this topic developed to better understand a specific kind of children's nature experience and its impact over the life course. Through this research, which relied on adult memories of childhood collecting in both the United States and Sweden, we found a vivid recollection of items collected, feelings of fascination and excitement, the use of items in play and for aesthetic value, and associations with specific places where collecting occurred. Embodied movement through forests, seashores, and even backyards close to home allowed for joyful and spontaneous moments, encounters with unique smells, textures, tastes, and sights, and intrigue with nature that remained with individuals to the present time (Lekies and Beery, 2013; Beery and Jørgensen, 2016; Lekies et al., 2017; Beery and Lekies, 2018). Our findings add to a growing body of work that indicates the lasting power of memories associated with outdoor places of play, including woods, trees, fields, gardens, parks, forts and dens, landscapes, and wild spaces (Sobel, 2002; Morgan, 2009; James et al., 2010; Williams and Chawla, 2016).

Environmental education and other outdoor experiences are associated with increased knowledge, awareness, or concern related to natural phenomenon (Ardoin et al., 2018; Profice and Tiriba, 2018; Ardoin and Bowers, 2020). Little research, however, has been identified that explicitly links outdoor play, child-nature exploration, and outdoor learning with the ES-NCP spectrum. Nonetheless, we are encouraged to see ecosystem services increasingly emerge in the literature of environmental education and environmental education appearing in the literature of ES-NCP. For example, recent studies include the study of Hutcheson et al. (2018) on the environmental education as a cultural ecosystem service, the study of Barracosa et al. (2019) on the use of ocean literacy to mainstream the ES concept in both formal and informal education settings, the study of Goodwin et al. (2019) on the exploration of values held by primary school students, and the study of Almers et al. (2020) on the functional meaning that preschool-aged children assign to different material aspects of their schoolyards. We are hopeful that this important research direction will continue.

DISCUSSION

While conceptually considering the value of children's nature experience is not novel, what is novel is its potential inclusion in a meaningful way in ES-NCP discourse. We will use this section to show how the benefits of embodied childhood nature experience need explicit inclusion in the broad ES-NCP discourse as part of efforts to capture the diversity of values held by different groups of society. Also, we will present the argument that embodied childhood nature experience must also be considered from the reciprocal quality of the relationship; these nature experiences benefit the well-being and development of children and potentially contribute to an individual's pro-environmental engagement, attitudes, and behavior, facilitating action on behalf of ecosystems.

Embodied Childhood Nature Experience Is an Ecosystem Service

As Jacobs et al. (2016) noted, the NCP approach helps recognize developments in how relational values are assessed and their place within broad ES considerations. Thus, the importance of recognition of childhood experience of nature is a crucial relational value. However, it is difficult to find specific examples

TABLE 1 | Examples of benefits of nature contact and access for children.

Domain	Outcome	Related studies
Physical	Physical activity	Lovasi et al., 2011; Pagels et al., 2014; Ward et al., 2016; Akpinar, 2017
	Prevention of myopia	Rose et al., 2008; French et al., 2013; Wu et al., 2013; He et al., 2015; Shah et al., 2017
	Cortisol reduction	Dettweiler et al., 2017
Cognitive	Attention span, executive functioning, restoration, and reduction of ADHD	Faber Taylor and Kuo, 2009; Dadvand et al., 2015; Amicone et al., 2018; van Dijk-Wesselius et al., 2018; Lee et al., 2019
	Self-regulation	McCree et al., 2018; Faber Taylor and Butts-Wilsmeyer, 2020
	Intrinsic motivation for learning	Dettweiler et al., 2015
Affective	Psychological well-being and mood	Ward et al., 2016; Weeland et al., 2019; Harvey et al., 2020
	Stress reduction and resilience	Chawla et al., 2014; Dettweiler et al., 2017
Social	Pro-social behavior and reduction in behavior difficulties	Amoly et al., 2014; Richardson et al., 2017; McEachan et al., 2018; Lee et al., 2019; Putra et al., 2020a,b

of explicit benefits for children in the broader ES-NCP discourse despite the importance. We note the mention of "childhood experience" in #17 in the Supporting Identities category of NCP (Díaz et al., 2018) and appreciate how the IPBES (2019) Global Assessment (2019) provides space for a diversity of perspectives recognizing the multiple ways of understanding and categorizing relationships between people and nature. We argue that one critically important way to understand the relationship between people and nature is through the value of the childhood experience of nature by recognizing nature's contribution to child health, growth, and well-being. We worry that a lack of visibility of the child experience of nature in ES and NCP discourse may negatively impact both children and ecosystem service valuation in environmental policy.

Children in Nature Is a Two-Way Relationship

The background section provided a brief overview of the ES to NCP conceptual development and a summary of how the embodied experiences afforded by nature are a direct service, i.e., supporting children's well-being and development. We acknowledge the concern that our examples, just as in the case with particular ES and NCP terminology, often express instrumental and anthropocentric perspectives, focusing upon nature as an instrument to human well-being. Specifically, the concern is that both terms emphasize the relation between nature and people as a one-way provider of benefits (Kenter, 2018). We note, however, that the NCP approach includes reciprocal relationships. Consider this example of pollinators: "...some NCP that were defined as practices of care gifted to people, such as fostering pollinator nesting resources in forests, totemic relationships requiring reciprocal obligations between people and pollinators, and traditional governance that depends on ongoing presence of bees and butterflies in the landscape..." (Díaz et al., 2018, p. 272). We identify a wealth of reciprocity examples in other ES-NCP considerations (Takeuchi, 2010; Comberti et al., 2015; Bonari et al., 2017; Ulicsni et al., 2019). For example, Comberti et al. (2015) noted that humans contribute to ES-NCP through the maintenance and enhancement of ecosystems. They highlight the biocultural ecosystems of Amazonia and the Pacific Northwest of North America (Cascadia) and provide a review of research in Amazonia to detail the many services people of that region that contribute to ecosystem health, including rituals, cultural prescriptions, beliefs, or taboos to guide or regulate resource use, soil fertility enhancement, and planting. We embrace the idea of "nature's gifts" from the ES-NCP discussions (Pascual et al., 2017); we find it easy to think of nature's gifts regarding the nurturing of children—what children gain, how they grow, how the here and now of everyday lives are made richer by the embodied interaction with non-human life. Singh (2015) used the gift metaphor from a study in India and highlights reciprocity, the idea that the embodied experiences help create an ethic of care.

We underscore that this idea of reciprocity is an important part of connectedness to nature in childhood. Connectedness to nature in childhood has been described as an essential pathway for developing lifelong interest, concern, and potential for sustainable behaviors on behalf of the natural world (Chawla, 2020). Childhood connectedness to nature includes "freely chosen personal elections to interact with nature. This interaction may take many forms, including bodily movement in nature, the investigation of natural phenomena, place exploration, and free play" (Beery et al., 2020, p. 16). Beyond the benefits of embodied nature experience described earlier, Chawla (2020) makes a strong case for the relationship between connectedness to nature and lifespan environmental engagement measures, such as environmental citizenship behavior, conservation, and pro-nature behavior. Similarly, Charles et al. (2018) highlight how children's opportunities to connect with nature are important for biodiversity conservation. Another more recent example is Giusti (2019), research with children that defined human–nature relationships using reciprocal language such as "systems of meaningful relationships between mind, body, culture, and environment..." (p. 19). He reminds us that these relationships can promote or hamper efforts toward sustainable living. Additionally, Sachs et al. (2020) suggested that it is critical for people to have positive experiences with nature in childhood, both for nature engagement and to instill pro-environmental attitudes in adulthood.

Further research is needed to understand the mechanisms by which child nature experience carries over into adulthood

(Rosa and Collado, 2019). Evidence from our work and authors from a growing number of countries, however, suggest that the embodied aspect of child nature experiences has a fundamental role to play (Kals et al., 1999; Wells and Lekies, 2006; Hsu, 2009; Chawla and Derr, 2012; Lekies and Beery, 2013; Beery and Jørgensen, 2016; Lekies et al., 2017; Asah et al., 2018; Beery and Lekies, 2018; Evans et al., 2018; Hosaka et al., 2018; Rosa et al., 2018; Häggström, 2019; Jensen and Olsen, 2019; Rosa and Collado, 2019). Abson et al. (2016) noted that connectedness to nature and the subsequent care and concern for the larger ecosystem that it evokes might be a strong leverage point to transform a socio-ecological system toward a desirable, resilient, and sustainable future. It is interesting to note that the journalist who helped inspire the current connectedness to nature movement, Richard Louv, has released another book that considers the reciprocal quality of our relationships with nature; specifically, Louv (2020) explores the reciprocity of our relationship with animals, reminding readers that the benefits of nature are an exchange of deep relational value.

CONCLUSION

We have argued that children's embodied nature experiences belong in nature valuation discussions. We emphasize that it is not enough to say that human well-being is one of nature's contributions to people, as children and childhood's unique character are potentially lost in such a broad grouping. Furthermore, the use of embodied childhood experience of nature provides a way to consider and possibly further strengthen the understanding of valuation as two directional.

People depend on functioning ecosystems to meet human needs and support well-being across the life span. The idea of reciprocity reminds us that the human role as a part of functioning ecosystems is our responsibility to these systems' health and well-being. Reciprocity is an appropriate way to think of the value of embodied childhood experiences of nature, and we propose that this idea needs a stronger presence in the ES-NCP discourse.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

Both authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Leveraging Biodiversity Action From Plural Values: Transformations of Governance Systems

Julia Leventon[1], Ioana A. Duşe[2] and Andra-Ioana Horcea-Milcu[3]*

[1] Global Change Research Institute of the Czech Academy of Sciences, Brno, Czechia, [2] Faculty of Sustainability, Leuphana University of Lüneburg, Lüneburg, Germany, [3] Hungarian Department of Biology and Ecology, Babes-Bolyai University, Cluj-Napoca, Romania

In this paper, we argue that leveraging plural values into action for biodiversity requires a focus on transforming the biodiversity governance system. We draw on Donella Meadows' concept of Leverage Points, which outlines the "depth" of intervention in order to shift a system toward sustainability. Engaging with deep leverage points (system intent and goals) is argued to lead to greater transformation than engaging with shallow leverage points (system design and materials). We outline how embracing plural values of biodiversity requires changes at deeper systems properties within governance systems to create space to reflect diversity in values and knowledge systems, and move away from a focus on commodification of nature's contributions to people. We point toward political and policy sciences to highlight frameworks and concepts for understanding governance system transformation. We conclude with a call for meaningful engagement with such sciences in ongoing research.

Keywords: leverage points, sustainability transformations, systems thinking, biodiversity, natures contribution to people, political science

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****Correspondence:***
Julia Leventon
leventon.j@czechglobe.cz

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INTRODUCTION

In this paper, we address how the recognition of plural values of biodiversity can be harnessed towards action on biodiversity. Values are a core topic in emerging research into biodiversity conservation and management, and cover a huge variety of disciplines and approaches. Values of biodiversity can be understood in three broad classes, of instrumental, intrinsic and relational (Chan et al., 2016). For example, the valuation of, and payment for, ecosystem services literature, often focusses on instrumental (and sometimes intrinsic) values (Chee, 2004; Ring et al., 2010). Recognizing such values, and accounting for them in decision making is a key route to protecting vulnerable biodiversity (Nature Editorial, 2021), and dominant policy discourses, such as ecosystem accounting reflect this (see e.g., Dasgupta, 2021). However, emerging narratives in IPBES (Intergovernmental Panel for Biodiversity and Ecosystem Services) and across science call for the recognition of plural values of biodiversity and ecosystem services (Martin Lopez, 2021; Pascual et al., 2021). Such plural values include relational values, moral values and held values, and recognizing their overlaps and interconnections (Chan et al., 2018). The introduction of the IPBES Nature's Contributions to People (NCP) is part of the same concern to highlight and support with scientific evidence the importance of nature for human well-being. The recent delineation of relational values is another milestone in striving to capture an ever more comprehensive array of WHY nature is valuable (Chan et al., 2018; Himes and Muraca, 2018).

In this essay, we look towards our governance systems, and argue that acting on plural values for biodiversity will require deeper changes in our governance systems for biodiversity. Governance systems include policies, the politics of what we govern and why, and actors and their responsibilities to make and implement decisions over a resource (in this case, biodiversity) (Jentoft, 2007; Duit and Galaz, 2008). They are multi-level and multi-sectoral, engaging organizations and actors in a range of roles and responsibilities (and powers) to make and implement decisions. For biodiversity, these systems comprise actors and organizations engaged in explicit biodiversity policy setting and action, and how these actors and organizations interplay with those from other sectors such as agriculture, energy, recreation (e.g., Paavola et al., 2009; Jiren et al., 2018). Following from the failure to meet the Aichi targets, attention has shifted back to governance systems, to push for renewed targets and resources for biodiversity management at national and international levels (Díaz et al., 2019; Chan et al., 2020; Xu et al., 2021). Pascual et al. (2021) have recently argued that policy needs to recognize plural worldviews and values for biodiversity, and that the policy sphere needs to address the political structures that prevent policy from grappling with plurality. We, the authors, extend this argument to consider how this generates a challenge for the governance systems that create and implement policy, and outline that it will require deeper changes in these systems.

In order to consider these challenges to governance systems, we draw on the framework of Leverage Points (LPs). The LP framework (Meadows, 1999) considers how we can fundamentally change systems. Systems are seen as complex interactions and interdependencies between human and non-human "parts" (e.g., people, organizations, ecosystems). To transform systems, there are different depths of leverage point; shallow points create only small changes to the system, while deeper points create transformational change by addressing the root causes of unsustainability. Meadows outlines 12 LPs, or system properties where change can be affected. These can also be condensed into four (in increasing order of depth): (1) materials, (2) processes; (3) design; and (4) intent (Abson et al., 2017). In order to use the framework to think about systems change, it is necessary to consider what the system is, where to intervene, and how these interventions interact across connected systems (Leventon et al., 2021).

This paper is not the first to engage with LPs to consider biodiversity (see Díaz et al., 2018; Chan et al., 2020; Mattijssen et al., 2020). Nor are we the first to link values and LPs (see e.g., O'Brien, 2018; Horcea-Milcu et al., 2019; Bieling et al., 2020). However, these approaches tend to consider how to target values to shift social-ecological systems and people's relationships with nature. They focus either on the governance *of* transformation (how transformation initiatives are governed), or governance *for* transformation (how governance systems deliver transformation). We, the authors, add a third dimension by looking specifically at the transformation of governance; exploring how our governance systems need to transform if they are to manage biodiversity in a way that respects plural values. Clearly these three dimensions are intertwined. However, the distinction is useful in explaining the perspective from which researchers can choose to focus their attentions.

We, the authors, create our argument by first outlining governance system properties in relation to LPs (see section "Governance System Properties and Leverage Points"). Here, we highlight the nested, connected nature of governance systems, and the systems characteristics embodied therein. Next, we look into the work on plural values in biodiversity and ecosystem services research (see section "Necessary Transformations of Governance Systems for Acting on Plural Values"). We consider framings of plural values, and how they are being presented as pathways for fundamental transformation toward sustainability. Based on these framings, we demonstrate the necessary deeper transformations of the governance system, if plural values are to be incorporated into policy. We then turn, in section "Perspectives for Understanding Processes of Governance System Transformations," to framings from political and policy science to demonstrate how these fields may help the biodiversity community to understand processes of change in governance systems. Throughout the paper, we refer to examples of biodiversity conservation within the European Union. This is intended to make the arguments more tangible, but does not constrain their relevance to only this context.

In presenting this essay, we, the authors, hope to demonstrate the need and role for meaningful engagement with political science in understanding the challenges and processes of moving from valuation to action for biodiversity. We do this in two ways: (1) By arguing that policy and action based on plural values of biodiversity requires much deeper shifts in governance systems than policy alone; and (2) by demonstrating that better linking to political science perspectives will help the biodiversity community to understand these governance systems, and the ways in which systems change (or don't). Thus our call to engage with political science is with the intention of gaining greater understanding in how and why values are represented and acted on in governance. Implicit in this paper is the normative position that biodiversity needs to be conserved, and that governance change is necessary to do so. However, it is not our intention to provide a road map for *how* to change governance systems. Indeed, the extent to which researchers should be engaging in governance systems change is one that is fraught with question of ethics and the nature of democracy. The biodiversity community could learn much from sharing with the climate change community on these questions. In particular, they could consider if researchers have a mandate to act on their science (Gardner and Wordley, 2019; Green, 2021), and how democratic systems could meet the challenges of global change emergencies (e.g., Willis, 2020).

GOVERNANCE SYSTEM PROPERTIES AND LEVERAGE POINTS

Governance systems can, as any system, be characterized according to its system properties, such as (1) materials; (2) processes; (3) design; and (4) intent. This is easiest to do with a closely defined governance system, for example the system of actors and policies around the EU common agricultural policy (CAP). For example, critiques of the CAP look to its

intent to argue that it will never deliver biodiversity or broader environmental goals whilst it remains focused on the goals of production (Marsden and Sonnino, 2008). We can also consider how the *design* of the biodiversity conservation measures match to the ecosystem (e.g., Leventon et al., 2019). At the shallow system properties, we can consider the processes of providing support, and the *materials*, or the way that subsidies are granted for biodiversity support. It becomes clear that adjusting materials (e.g., the amount a farmer is paid for a biodiversity measure) creates a less fundamental change than adjusting the system goals of agricultural production (see also Pe'er et al., 2019).

Governance systems engage actors from across multiple sectors in processes of politics, polity and policy at all implementation levels (see e.g., Piattoni, 2009), meaning that they are nested, connected and complex. In the CAP system, we can see that we also have national (country level) governance systems that may be differently aligned to the deeper system intent introduced within the EU system, or that introduces different designs and processes. For example, adoption of the CAP measures in Romania has so far ignored the very realities and the values of the local peasant agriculture (Fox, 2011; Câmpeanu and Fazey, 2014). Furthermore, CAP systems are embedded within, and are linked to, much bigger scale systems such as the European economic system, which incorporates the intents of neoliberalism, and the democratic system, which introduces values of participation and inclusion, and specific system designs to deliver that.

Governance systems include individuals as one of the layers nested within them. These actors are engaged in shaping, implementing, enforcing, and indeed changing this governance system. Individuals in a governance system hold sets of beliefs: deep core beliefs, policy core beliefs, and secondary aspects (Sabatier, 1987). Deep core beliefs are those that are fundamental normative assumptions about how the world should work, and underpin all policy areas (e.g., biodiversity and poverty alleviation), while constraining or influencing more specific beliefs at the next level (policy attitudes, instrumental values) (Peffley and Hurwitz, 1993; Sabatier and Jenkins-Smith, 1993). The policy core beliefs relate to valuations about policy programs and include preferences about how the policy system within a given sector (e.g., biodiversity conservation) should be addressed in order to act on these deep core beliefs. These would thus be analogous to beliefs about how the system should be structured, what roles and responsibilities, and general principles this is based on. The secondary or instrumental aspects relate to how resources should be distributed to achieve these policy core beliefs – for example how funding should be spent, analogous to the shallowest LPs of materials.

NECESSARY TRANSFORMATIONS OF GOVERNANCE SYSTEMS FOR ACTING ON PLURAL VALUES

Different forms of value, their measurement, and the actions they demand require changes at different properties within the governance system. At the shallowest system properties, intrinsic values fit nicely into existing governance systems and broader economic paradigms. The logical endpoint of being able to articulate instrumental values is to be able to account for and manage them in decision making, e.g., through ecosystem accounting. This has long been the case through ecosystem service frameworks, and in approaches that seek to offset losses or pay for the provision of ES. The assumption is that by improving our valuation techniques, and assigning monetary value to services that were previously outside of the market, we can improve the way we allocate resources and make cost-effective decisions. Indeed, CAP reforms tend toward shallow leverage points, refining subsidies paid for greening measures. In our (the authors') opinion, such monetary valuation of instrumental values without changing the broader, growth-focused logic of our economic system, is an exercise in increasing commodification of nature. It is expanding neoliberalism in an attempt to internalize externalities and continue within the paradigm of pursuing economic growth (Kosoy and Corbera, 2010). It does not challenge deeper system properties by, for example, questioning this neoliberal paradigm.

Expanding framings and conceptualizations of plural values leads to a need to consider other expressions of value within our decision-making systems, and challenges our governance systems to find ways to engage with the way we make decisions and live within nature. It demands shifts to the deeper governance system properties to ensure society can recognize a diversity of human-nature relationships and culturally driven or indigenous ways of relating to nature (Díaz et al., 2015; Muradian and Pascual, 2018; Pascual et al., 2021). As we create frameworks to understand why values matter, we also create ways to understand and articulate what these values are, and their relative importance. In parallel to the heterogeneity of conceptualizations (Kenter et al., 2019), there has been an important widening in valuation methods, following the same rationale of embracing plurality and opening up decision-making to different knowledge systems (Cornell et al., 2013; Díaz-Reviriego et al., 2019). Socio-cultural valuation (Iniesta-Arandia et al., 2014), plural valuation (Zafra-Calvo et al., 2020), and integrated valuation (Jacobs et al., 2018) mark progress toward considering multiple tangible and especially intangible values in an attempt to account for the blind spots of each individual method and avoid the undervaluation of biodiversity and Natures Contributions to People. In particular, the NCP concept more explicitly incorporates valuation perspectives closer to local and indigenous knowledge systems (Díaz et al., 2018; Hill et al., 2020). Collectively, this implies that recognizing plural values requires shifts in the way that we govern for biodiversity; moving away from a reliance on market-based mechanisms (changing intent), toward creating space to hear indigenous voices (changing design), and facilitating diversity in social-ecological systems (design).

A good example would come from local food systems across "eastern" Europe, and the values, local knowledge, traditions and relationship to biodiversity that they embody (e.g., Jehlièka et al., 2020). These localized systems are broadly beneficial for biodiversity, eschew pesticides and machinery and add to landscape heterogeneity. They draw on people's complex and

plural values of biodiversity and ecosystem services (Horcea-Milcu et al., 2016; Riechers et al., 2021). However, to create governance that reflects these values requires a shift in the design of systems (e.g., CAP) that are currently fundamentally designed around large landowners and industrial agriculture (Toma et al., 2021). This has the unfortunate effect that it actually drives biodiversity loss in areas where small scale agriculture is being forced out (Mikulcak et al., 2015). Policy would need to shift to facilitate greater diversity in food systems to allow plurality of values.

In emerging values literature, there is divergence in how plural values are framed as pathways toward improved biodiversity outcomes. The first pathway points to finding ways within our governance systems to identify, acknowledge and act on plural values to create biodiversity outcomes. The understanding of values seems to capitalize on already existent sustainability values, such as solidarity or responsibility (Preiser et al., 2017) or on place-based values (Grenni et al., 2020). The second pathway points to decision makers, NGO's, change makers and even researchers engaging with changing people's values to intervene in the way they interact with their surrounding environment, and thus create improved biodiversity outcomes. Here, values can be considered as a way to intervene and mobilize transformation potential (see e.g., Díaz et al., 2019; Chan et al., 2020; Stålhammar, 2021). Both pathways require changes within bigger scale governance systems and their interconnections, as well as the individuals and smaller scale systems that are nested within them.

In the first pathway, recognizing plural values would require changes in the design and intent of bigger scale systems. Here, it is recognized that people hold, and express, plural values for the biodiversity they interact with. However, the broader governance systems do not manage to account for or protect these values. For example community-based initiatives are often referred to as a response to biodiversity loss, that allow communities to act on their own values and relationships with biodiversity. However, this framing ignores the underlying, much larger drivers of biodiversity loss from other governance sectors (e.g., agriculture, timber production, the extractives industry) (Skutsch and Turnhout, 2020). Instead, if values are to play a role in leveraging sustainability transformations, these broader processes that constrain or facilitate people acting on their values of biodiversity must be addressed. Those seeking to protect biodiversity need to recognize that local level projects exist within complex systems of interplay between policies, actors, and physical processes that shape and constrain our abilities to act according to our values. Thus, governance and policy need to address the institutional and systemic barriers that are blocking the expression of sustainability aligned values and instead enable them (Bieling et al., 2020; Scoones et al., 2020). In order to benefit from the transformation potential of plural values, the broader political, cultural, social and economic context and system intents that communities operate within need to be addressed (Thompson et al., 2020).

In the second pathway, working with plural values requires a reconsideration of how knowledge is created and acted upon for governance. The choice of methods employed to determine value shapes the outcome; if policymakers are looking to identify and value intrinsic values, they will only reveal intrinsic values, which then shape policy outcomes in way that is targeted only to intrinsic values. Valuation methodologies that address plural values include deliberative approaches (Lliso et al., 2020), co-creation and co-design of research (Mauser et al., 2013) and co-production of knowledge (Wyborn et al., 2019), sustainability scenario building (Raudsepp-Hearne et al., 2020) or visioning desirable futures (Wiek and Iwaniec, 2014). These are interventional approaches because they go beyond the sole purpose of producing knowledge. They hold transformative potential for those involved as researchers, practitioners, policy makers and community members (Burch et al., 2019). Co-creation processes like this can be employed as a first step for planning strategies and actions that acknowledge the diverse values and perceptions of actors in the system, rather than exclude voices with values that don't fit the current system logic (Pereira et al., 2018; Galafassi et al., 2018). Such co-creation also facilitates greater reflexivity of those conducting the valuation process and acting on the knowledge generating, prompting them to be explicit about which methodologies they use, and how this choice influences the values captured and therefore reflected in policy making. To this end, the challenge to governance systems is to create spaces, including time and resources, to facilitate such co-created, reflexive knowledge for policy creation, and to make the process transparent.

PERSPECTIVES FOR UNDERSTANDING PROCESSES OF GOVERNANCE SYSTEM TRANSFORMATIONS

Moving beyond instrumental values, and recognizing plural values of biodiversity and NCP in policy requires creating change at deeper LPs of system design and intent, throughout the governance system. Embracing plurality through governance system transformation can manifest in facilitating locally meaningful governance arrangements, incorporating plural knowledge systems, and shifting the underlying system intent away from profit-generation. This is a challenge, and will not be met by purely focusing on eliciting, measuring and describing values (Stålhammar, 2021), nor by working predominantly at the community level, as has thus far been the case in the biodiversity values literature. Instead, we need to shift our focus on what people actually want to capture into decision-making, the diversity of perspectives on what needs to be addressed and governed, what the objectives of biodiversity conservation should be and what options exist for interventions to attain such objectives. It goes beyond policy, and beyond engaging with the existing system design by negotiating targets and allocating resources. Calls for setting policies and targets also need to recognize that the broader governance system, within the current biodiversity conservation paradigm, needs deeper transformation.

In order to understand how these necessary changes in the governance system happen (or don't), we need to engage

with theories and understandings about how governance systems change, largely from political and policy science. This vast area of literature draws on e.g., theories of the policy process (see e.g., Weible and Sabatier, 2017), new institutionalism and path dependency (see e.g., Kern et al., 2015). These are frameworks for understanding what has been, not of designing and creating what could be. They are not ways of engaging in systems transformation; indeed careful questions would need to be asked about the democratic legitimacy of doing so. However, these theories offer insight into understanding why our governance systems look the way they do, and how they evolve and change. Explicitly bringing political science into our debates on values of biodiversity offers new skill sets, understandings and perspectives on how political and policy systems work and change, and around the governance system barriers to harnessing plural values for action on biodiversity.

Within this literature, learning from previous examples of governance systems undergoing wholescale shifts can demonstrate the barriers and pitfalls to such fundamental change. For example, Europeanisation work focusses on areas where countries must adopt and implement EU legislation (e.g., around the accession of new member states). Those member states for whom "downloading" the policy requires a significant shift in goals and structures are least likely to properly implement it (Börzel, 2002). In-depth research into the implementation of environmental policy in the newer member states confirms that a mismatch between the intent and ideas embedded within the EU policy, and that of the member states, is a cause of stalled implementation (Sotirov et al., 2015). Such work can help us beyond the EU, to understand the problematic implementation of biodiversity targets and policies (e.g., Hagerman and Pelai, 2016).

There is significant focus in implementation research on the role of structures in influencing policy change and implementation. Beyond whether or not the policy goals match, researchers focus on the degree of change that is required in structures to implement policies, and on the capacities available to make such changes (Carmin and Vandeveer, 2004). For example, in protected areas in the Czech Republic, Prazan et al. (2005) found that aligning the structures and policy instruments was a key to achieving policy goals. In Polish biodiversity conservation, such alignment is hampered by a lack of capacity, knowledge, and tools (Blicharska et al., 2011). While in other cases (see Yakusheva, 2019), the conservation management capacities are part of the historical and political development of the countries (particularly CEE countries), where policy change and implementation are largely shaped by locked-in elements of previous political regimes, often expressed in terms of path dependence (Radaelli, 2003; Bafoil, 2009). Thus, the degree of change required of the systems structures becomes a barrier to systems change; making more fundamental changes (i.e., to deeper leverage points, to recognize and incorporate plural values) more resisted.

A key element in creating acceptance for changing structures seems to actually lie in the beliefs that actors hold regarding what the structures should be (see policy core beliefs, in section "Governance System Properties and Leverage Points"). Actors within the system hold values about how they should be working together, and how systems should be structured. When these beliefs clash with the structures introduced, this can be a barrier to implementation, and thus to change (see e.g., Leventon, 2015). Such beliefs can hinder systems change even where the actors agree with the overall beliefs embedded within system goals (the deep core beliefs and/or system intent). For example in exploring the acceptability of alternative governance structures to achieve biodiversity, actors could agree on the overall goal and purpose of working together, but resist moves toward collaborative management (Nieto-Romero et al., 2016; Velten et al., 2018). Much greater understanding of how core and policy beliefs are constructed, why they are held by governance actors, how they are manifested, and the influence they have on the governance system, is helpful in knowing where, who and how to engage.

CONCLUSION: LEVERAGING PLURAL VALUES INTO ACTION BY TRANSFORMING GOVERNANCE SYSTEMS

The challenge of drawing on plural values to create biodiversity outcomes will require deeper changes in the governance systems that create and implement biodiversity policy. As we move beyond purely instrumental values, we, as a society, need to make more fundamental changes to the way we govern. This includes creating spaces for diverse knowledge systems and human-nature relationships; we must facilitate different ways of working with communities to understand, elicit and transform values at the local level; and we must intervene in broader underlying systems that undermine recognizing plural values (e.g., the pursuit of profit in connected systems and underlying paradigms).

Making these changes means engaging with actors, structures and processes across the governance system, with the underlying system intent, the system design and structures so that diversity, inclusivity and plurality can be present in the mechanisms and policies we create. It requires us, the biodiversity community, to consider what a governance system looks like when it delivers policy that addresses plural values. We need to recognize that it's not just policy that needs to change, but the broader system that creates and delivers that policy; there is a broader governance system that needs transforming. If we are calling for recognition of plural values for action on biodiversity, we need to understand what this governance system is, and how it both persists and changes.

To address this challenge, we, the authors, encourage meaningful engagement with researchers from across policy and political sciences. Understandings generated in these disciplines allow us, the biodiversity community, to understand the beliefs held by governance actors, and how they are acted upon across different levels, and how they shape policies, practices and outcomes. Understandings of path dependency can help

to explain why governance systems look the way they do, how they persist, and where there might be opportunities for change. And implementation research provides insight into how shifting structures without shifting intent may lead to flawed implementation, and thus not deliver policies and targets once they are created. Therefore, we, the authors, conclude with the suggestion that the biodiversity values research community engages with specialists within the political and policy sciences, even where their knowledge is not directly related to biodiversity, in order to explore how the governance system facilitates or hinders efforts toward creating action out of recognition of plural values.

AUTHOR CONTRIBUTIONS

JL conceived the idea for the manuscript and developed it in collaboration with A-IH-M and ID. JL led the writing of the manuscript. All authors contributed text and edited the manuscript.

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