5-1-2022

Reconceptualizing conservation

S. J. Cooke

Sarah Michaels

E. A. Nyboer

L. Schiller

D. B. R. Littlechild

See next page for additional authors

Authors

S. J. Cooke; Sarah Michaels; E. A. Nyboer; L. Schiller; D. B. R. Littlechild; D. E. L. Hanna; C. D. Robichaud; A. Murdoch; D. Roche; P. Soroye; J. C. Vermaire; V. M. Nguyen; University of Ottawa,; J. F. Provencher; P. A. Smith; G. W. Mitchell; S. Avery-Gomm; C. M. Davy; R. T. Buxton; T. Rytwinski; L. Fahrig; J. R. Bennett; and G. Auld

OPINION

Reconceptualizing conservation

S. J. Cooke[1,2,3]*, S. Michaels[2,4], E. A. Nyboer[1,2], L. Schiller[1,5], D. B. R. Littlechild[6], D. E. L. Hanna[1,2], C. D. Robichaud[1], A. Murdoch[1,7], D. Roche[1], P. Soroye[8], J. C. Vermaire[2,3], V. M. Nguyen[1,2], N. Young[9], J. F. Provencher[1,10], P. A. Smith[1,10], G. W. Mitchell[1,10], S. Avery-Gomm[10], C. M. Davy[1], R. T. Buxton[1,2], T. Rytwinski[1], L. Fahrig[1], J. R. Bennett[1,2], G. Auld[5]

1 Department of Biology and Canadian Centre for Evidence-Based Conservation, Carleton University, Ottawa, ON, Canada, **2** Institute of Environmental and Interdisciplinary Science, Carleton University, Ottawa, ON, Canada, **3** Department of Geography and Environmental Studies, Carleton University, Ottawa, ON, Canada, **4** Department of Political Science and the University of Nebraska Public Policy Center, University of Nebraska, Lincoln, NE, United States of America, **5** School of Public Policy and Administration, Carleton University, Ottawa, ON, Canada, **6** Department of Law and Legal Studies, Carleton University, Ottawa, ON, Canada, **7** Wildlife Conservation Society Canada, 169 Titanium Way, Whitehorse, YK, Canada, **8** Wildlife Conservation Society Canada, Toronto, ON, Canada, **9** School of Sociological and Anthropological Studies, University of Ottawa, Ottawa, ON, Canada, **10** Environment and Climate Change Canada, National Wildlife Research Centre, Ottawa, ON, Canada

* Steven_Cooke@carleton.ca

OPEN ACCESS

Citation: Cooke SJ, Michaels S, Nyboer EA, Schiller L, Littlechild DBR, Hanna DEL, et al. (2022) Reconceptualizing conservation. PLOS Sustain Transform 1(5): e0000016. https://doi.org/10.1371/journal.pstr.0000016

Editor: Chandra Prakash Kala, Indian Institute of Forest Management, INDIA

Published: May 31, 2022

Funding: The authors are variously supported by the Natural Sciences and Engineering Research Council of Canada (SJC, LF, JCV, JRB, CMD), the Social Sciences and Humanities Research Council of Canada (SJC, NY, VMN, GA), the Fulbright Canada Program (SM), the University of Nebraska Faculty Development Fellowship Program (SM), the Carleton University Multidisciplinary Research Catalyst Fund (SJC, JRB, TR, GA, VMN), the Liber Ero Fellowship Program (LS), the Mitacs Elevate program (AM), and Environment and Climate Change Canada (JFP, PAS, GWM, JRB, SA-G). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Abstract

Early definitions of conservation focused largely on the end goals of protection or restoration of nature, and the various disciplinary domains that contribute to these ends. Conservation science and practice has evolved beyond being focused on just issues of scarcity and biodiversity decline. To better recognize the inherent links between human behaviour and conservation, "success" in conservation is now being defined in terms that include human rights and needs. We also know that who engages in conservation, and how, dictates the likelihood that conservation science will be embraced and applied to yield conservation gains. Here we present ideas for reconceptualizing conservation. We emphasize the HOW in an attempt to reorient and repurpose the term in ways that better reflect what contemporary conservation is or might aspire to be. To do so, we developed an acrostic using the letters in the term "CONSERVATION" with each serving as an adjective where C = co-produced, O = open, N = nimble, S = solutions-oriented, E = empowering, R = relational, V = values-based, A = actionable, T = transdisciplinary, I = inclusive, O = optimistic, and N = nurturing. For each adjective, we briefly describe our reasoning for its selection and describe how it contributes to our vision of conservation. By reconceptualizing conservation we have the potential to center how we do conservation in ways that are more likely to result in outcomes that benefit biodiversity while also being just, equitable, inclusive, and respectful of diverse rights holders, knowledge holders, and other actors. We hope that this acrostic will be widely adopted in training to help the next generation of conservation researchers and practitioners keep in mind what it will take to make their contributions effective and salient.

Competing interests: The authors have declared that no competing interests exist.

Introduction

The concept of conservation is one that has existed in various forms for centuries [1–3], if not millennia [4]. From Indigenous conservation ethics [5] to Leopold's land ethic [6], and from the wilderness preservation movement [7] to the formal definition of the discipline of conservation biology [8] and conservation science [9], what conservation means has evolved across space, cultures, and time [10]. Over the last few decades conservation science and practice have become recognized as being fundamental to addressing the biodiversity crisis [11]. There have been calls for a "new conservation" that focuses on mitigating the underlying drivers of the biodiversity crisis (e.g., through raising consumer awareness, developing partnerships with industry) with a greater emphasis on humanitarian and financial perspectives [12–13]. This has led to much debate about what conservation is [see 13–15]. However, there have also been efforts to find a middle ground between perspectives focused on nature preservation and those that include human rights and needs [see 16] given the growing recognition that biodiversity loss affects human wellbeing [17], and that human behaviour is central to addressing the biodiversity crisis [18].

Defining conservation is more than an academic exercise because it provides structure and focus to collective action. Sandbrook [19] suggests that conservation can be defined as "actions that are intended to establish, improve, or maintain good relations with nature". Whether using this action-oriented definition, earlier issue-oriented definitions centered on scarcity and biodiversity [20], or disciplinary definitions of conservation biology [8] or conservation science [9], we suggest that available guidance on HOW conservation should be done is scoped too narrowly. Currently, the HOW of conservation is primarily guided by principles of western-science research design that seek to ensure credible, valid and robust knowledge claims. This guidance is incomplete and out of step with best practices, limiting the ability of conservation science and practice to have the greatest possible impact. Moreover, only a fraction of conservation research is useful for conservation policy or practice [21], and there is little evidence for the effectiveness of many routinely implemented conservation interventions [22]. Guidance on HOW conservation should be done is particularly important as meaningful actions that lead to on-the-ground benefits for biodiversity at ecological scales must often be achieved through partnership with diverse, multi-jurisdictional groups of rights holders and stakeholders. Given the diversity of actors affected, HOW we do conservation should also be equitable, inclusive and respectful of these actors.

We have reached a state where humans have had manifold impacts on biodiversity and the environment [23–24]. It is now widely understood that we are in the Anthropocene [25] with a need for urgent action to reverse the biodiversity crisis [11,26]. Conservation social sciences [27–28] as well as learning from mistakes [29] have revealed that how we do conservation work and who is involved, greatly influences if, and how, new knowledge or initiatives will be trusted, embraced and implemented. Thus, to achieve greater success in conservation we need to rethink how we engage in conservation science and practice [30–31].

Here, we present ideas for reconceptualizing conservation in an attempt to overcome current definitional constraints and repurpose the term in ways that better reflect the HOW of conservation. To do so, we developed an acrostic using the letters in the term "CONSERVATION" with each serving as an adjective (Fig 1). For each adjective we briefly describe our reasoning for its selection and describe how it contributes to a reconceptualized vision of conservation. The use of the acrostic is intended to serve as a simple and effective way of remembering how conservation should be approached. The intended audience spans knowledge holders, generators, and users, with a particular focus on early career scholars given that how they are trained and learn about conservation today will have a major influence on

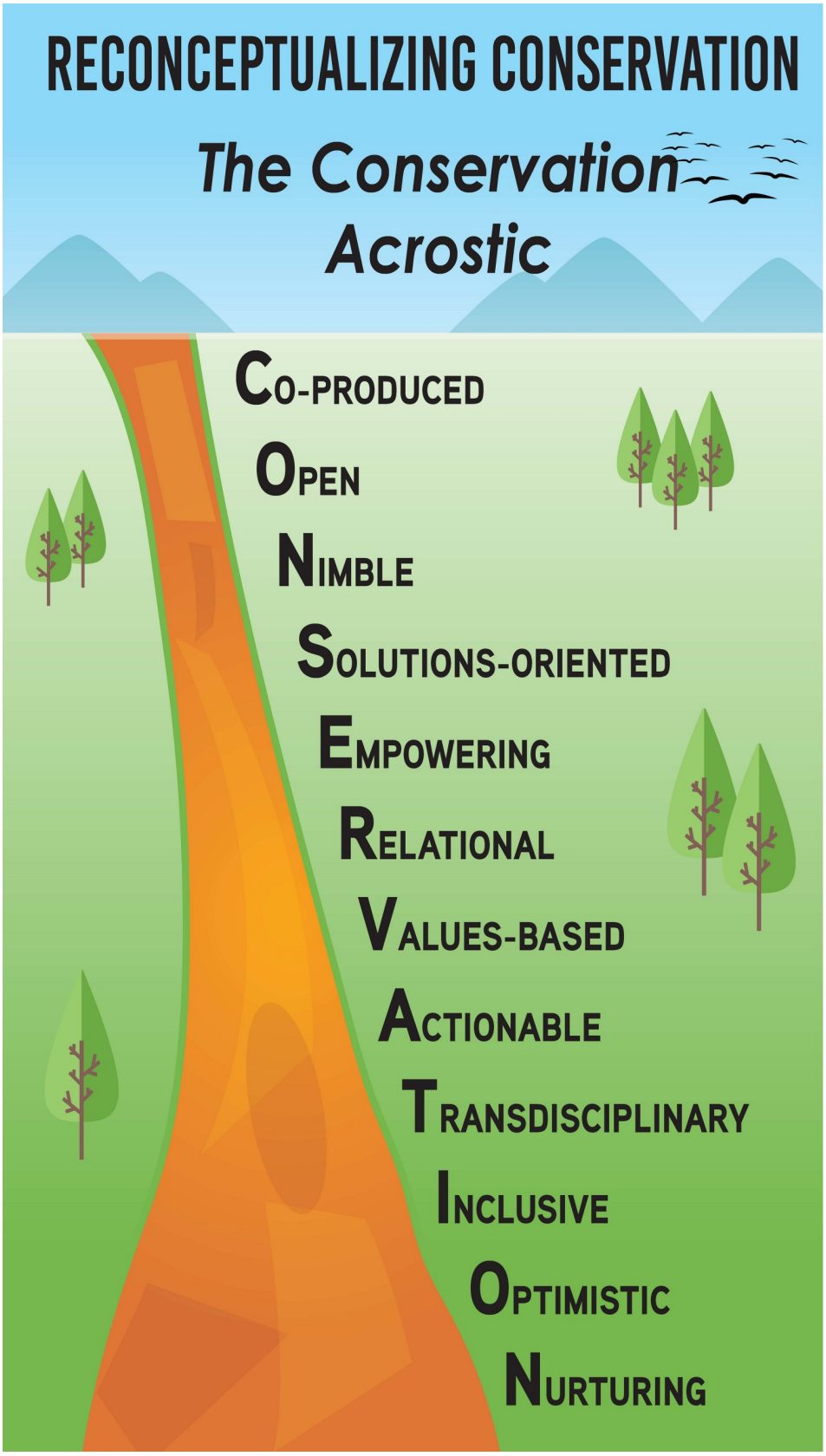

Fig 1. Reconceptualizing conservation through the use of a conservation acrostic.

https://doi.org/10.1371/journal.pstr.0000016.g001

tomorrow's conservation professionals and leaders. A reconceptualization of conservation also potentially benefits and informs those who may see themselves as tangential to the field, but are making decisions that impact conservation. The acrostic is an aide-mémoire for anyone confronting a choice where the outcome shapes the prospects of conservation. This may range from a municipal official deciding on the nature and location of a new park to a manufacturer deciding how 'green' to make a production process. Our team of contributors spans career stages (from early career to established), disciplinary expertise (social science, ecology, policy, law), and roles (from knowledge generators to knowledge users). We are all located in Canada but many of us engage in projects and issues that range from local to international in scale.

The Conservation Acrostic

Conservation should be. . .

C = co-produced

The knowledge-action gap in conservation science and practice occurs when research outputs do not result in actions to protect or restore biodiversity. Among the diverse and complex reasons for this gap, several barriers are fundamental: knowledge is often unavailable to practitioners and challenging to interpret or difficult to use [27,32]. This gap is vast and pervasive in conservation [27,33]. There has been recent progress on improving scientific processes to generate knowledge that can be readily applied, the most notable approach being knowledge co-production [34]. Co-production was defined by Wyborn et al. [35] as "processes that iteratively unite ways of knowing and acting—including ideas, norms, practices, and discourses—leading to mutual reinforcement and reciprocal transformation of societal outcomes". In more simple terms, co-production means that research is conducted collaboratively (e.g., with stakeholders, rights holders and decision makers), inclusively, and in a respectful and engaged manner–from the identification of research needs, to study design, data collection, interpretation, and application [36]. Co-production can increase interpersonal trust and ensure relevance [37–38] while promoting credibility, saliency and legitimacy [39]. As such, co-production disrupts the conventional model of unidirectional and isolated research practices that reinforce the knowledge-action gap [40]. Research has revealed that co-production is fundamental to bridging the knowledge-action gap [41–42], and thus should be widely embraced in conservation.

O = open

Knowledge can not be applied if it is unavailable to potential users; barriers that prevent practitioners and policymakers from accessing research outputs are another root cause of the knowledge-action gap [43]. By engaging in open science practices, researchers can improve how conservation knowledge is accessed, interpreted, and put into practice. This can be done in three ways [32]. First, open access publishing makes the scientific literature available to all [44], allowing conservation knowledge to reach end-users outside of the academic ivory tower [45]. Several models now exist for authors to avoid the prohibitive article publication charges often associated with open access publishing [46–47]. Second, open materials (publicly sharing research data, code, and protocols) promote transparency and reproducibility, allowing end-users to better interpret conservation research [48]. Third, open education resources provide a free and flexible means of enhancing capacity-building among scientists and practitioners worldwide [32]. For example, training materials assist end-users with open-source software (e.g., Marxan Connect; [49]), and free courses provide training on the principles and practice of evidence-based conservation in multiple languages (the Evidence in Conservation Teaching Initiative; [50]). Enhancing openness contributes to making conservation knowledge more

consumable and trusted, and therefore more usable by a wide diversity of actors. Adopting open science practices can help researchers and practitioners achieve conservation goals more quickly and efficiently, while reducing inequities in information and knowledge sharing among research groups and nations.

N = nimble

Successful conservationists need to be nimble, i.e., "able to move quickly and easily" [51]. Failure to act quickly can result in additional environmental degradation, species losses [24,52], and increased financial costs of conservation actions. Failure to adjust management actions is a common source of wasted resources [53–55]. Fortunately, there are a number of ways for conservation practitioners to be nimble, yet remain grounded in sound evidence-based decision making. For example, designing monitoring programs that are tightly aligned to information needs (e.g., issue-based versus surveillance-based monitoring) will increase the efficacy of the data, and ultimately, the speed at which it can be incorporated into decision making [56,57]. Decision science also provides conservation practitioners with tools to facilitate decision making when uncertainty is high or empirical data are lacking [58–59] or how to invest funds to maximize conservation benefit [55]. This is critical because the difficult decisions about where and when to invest in conservation can have a profound impact on our collective success, but resources available for conservation are insufficient, even in wealthy countries, and funding is a strong predictor of conservation success [60–61]. Finally, forward-looking tools such as horizon scanning and scenario planning can help to identify emerging threats and new opportunities. These tools can expedite actions by allowing conservation practitioners to plan ahead and better prioritize actions [62].

S = solutions-oriented

Conservation has often focused on identifying problems [63], which is necessary. However, problem identification alone will not elicit solutions or reverse declines in biodiversity. The problems have been well articulated at scales that range from a given species or site to the global UN Sustainable Development or Convention on Biological Diversity Goals. What is needed to solve these problems? Problem solving requires both the skills and mindset to develop solutions–something that is rarely fostered in contemporary conservation education [64]. When potential solutions are identified and even implemented, they may in fact not be effective [29,65], emphasizing the need for evidence-based approaches [66]. This must include robust tests of different interventions and evidence synthesis (e.g., systematic reviews; [67]) to determine the specificity and robustness of interventions. Solutions also need to be socially acceptable and durable so that they are future-proof [68–69]. The notion of nature-based solutions, centered on providing nature-inspired solutions to climate mitigation and adaptation challenges [70] at a variety of scales [71], is particularly promising. Whether inspired by nature, shared by Indigenous knowledge keepers, or identified by the Western scientific method, it is clear that we need to reposition conservation to focus on finding solutions to the many complex challenges that face the planet today and in the future.

E = empowering

The conservation challenges of today and tomorrow are often communicated as insurmountable global catastrophes [72–73]. This framing can lead to an increasingly disempowered state of anxiety or apathy in many people, especially children [74]. Indeed, we know our planet faces unprecedented environmental challenges, all of which were caused by humans. Equally, many of these challenges (as well as some attempted solutions) are coupled with longstanding

systemic social inequities and injustice [75]. However, humans are also the only species that can understand, analyse, and alleviate the wicked problems [76] we have created. This view of agency is important since, "empowerment is part of nearly everything social in conservation, at all scales from project development to policy implementation" [77]. When scientific, traditional, or local knowledge is valued, reinforced, and applied by stakeholders and rights holders with the capacity to implement on-the-ground improvements or influence policy decisions, conservation successes can occur at large and small scales [78–79]. Empowerment of individuals and communities is often driven by factual yet hopeful messaging [80–82], by documenting and celebrating conservation successes (e.g. [83–84]), and increasingly, by the successful assertion of fundamental human and property rights by historically disempowered groups including Indigenous peoples (e.g., [85]), youth (e.g., [86]), and policymakers from low-income jurisdictions (e.g., [87]). Such efforts should motivate scientists, decision-makers, and practitioners alike as we seek to better understand our impacts on the environment, re-invent our relationship with other species, and uphold our responsibility to safeguard our planet for future generations.

R = relational

The history of conservation in North America and Europe is underpinned by a separation of humans and nature that has facilitated colonial expansion [88–89]. This separation often results in an approach to conservation that aims to maintain "pristine" wilderness with limited human access which has long played a role in the displacement of Indigenous peoples [90]. However, we suggest that effective, contemporary conservation emphasizes the historical and continued relationships and responsibilities between people and land. Liboiron [91] describes "Land" as "fundamentally relational and *specific* to those relations"—that is, every person has a relationship to land and each relationship is unique. Conservation benefits from considering these land relations carefully, including the assumption of access when it has not been granted [91]. Developing a reciprocal relationship with land can change how we approach conservation, moving away from a separation between people and land to a positive, creative relationship [92–93]. This requires self reflection (What is my relationship to place?), a consideration of the history of the land (which communities have relationships to this place?), and of the non-humans the practitioner intends to assist [91–92]. A fundamental component of this work is developing relationships among the communities who have relationships to a given place. Relationships should be reciprocal, respectful, responsible, and engage enthusiastically with non-dominant knowledge systems [94]. Practitioners should reflect on trust, identity, and power dynamics among individuals when developing relationships for conservation [95], with specific attention given to systematic biases and historical exclusion [96–97]. Identifying the relationships between people and land is an important step for removing the separation between nature and human actions.

V = values-based

Values-based conservation ideally incorporates social, cultural, and even economic goals and values, to facilitate holistic decision making that has meaning to diverse groups and communities [68,98]. Fostering a values-based approach is also practical and strategic, given the importance of political support for conservation efforts in an increasingly uncertain global environment. Values-based conservation should be informed by diverse stakeholders, rightsholders, and communities to identify potential barriers to action and ultimately help establish trust and support of chosen outcomes [99–100]. A good example of this approach comes from Augustine and Dearden [101] who highlighted how the inclusion of Indigenous traditional

practices (e.g., clam gardening) in marine protected area planning resulted in a stronger conservation plan with minimal ecological effects. As protected areas often exclude all human activities, allowing for multiple uses such as Indigenous harvesting or strategic zoning of recreational activities may promote increased support for conservation activities among various user groups, many of whom have been excluded from past decision making [101–102]. Further, a values-based approach that identifies conservation activities that reinforce cultural connections to the land and water may yield more meaningful benefits to local communities than traditional top-down or exclusionary preservationist activities [103–104]. Finally, incorporating structured decision making, whereby both values and empirical data are included in conservation decision making, can provide a powerful framework for weighing competing values amid limited resources [105–106].

A = actionable

For conservation, having evidence that enables (or has potential to enable) action is key. Evidence is actionable "because it has the potential to inform decisions, to improve the design of implementation of public policies, or to influence [. . .] strategies, planning and behaviours that affect the environment" [107]. Many factors influence the extent to which evidence is actionable including how research is done (e.g., is it co-produced), who does it (e.g., is it relational, integrative, inclusive), the extent to which it is relevant and timely for decision making, and individual and institution values, experiences and contexts [38,43, 108–109]. Much of the knowledge generated by conservation scientists is not actionable because it is not trusted (e.g., has not been adequately validated through replication), is not accessible (e.g., behind paywalls), or not relevant to a given issue or context [27] leading to wasted data [48]. Gerber et al. [60] and Nyboer et al. [110] provide best practices for generating actionable science with guidance for individuals (e.g., engage in collaboration, be empathetic, build relationships and use diverse communication strategies) and organizations (e.g., incentivize actionable research, ensure early career professionals have training and resources for doing actionable research). More nuance may be needed given that there are different models of organized action relevant to conservation (see [111]). Yet, when engaging in mission-oriented applied science (such as conservation science), research needs to be actionable or it is not an effective use of limited resources [112].

T = transdisciplinary

Challenges to achieving conservation goals often stem from competing claims on natural resources and ecosystem services. There are thus many "whats" that need to be better integrated into conservation, including decision science, human dimensions, and economic perspectives, among others. The theory and practice of conservation thus requires recognition of the complex interplay among humans and the environment, and integration of knowledge and methodologies across disciplines and sectors [113–114]. Transdisciplinary methodologies have emerged as critical to conducting successful, solutions-oriented environmental research [30,115]. Transdisciplinary frameworks extend beyond multi- and inter-disciplinary approaches that integrate among two or more disciplines. They propose inclusive and cooperative practices that involve sustained collaborations with relevant partners, and consistent knowledge exchange across science, policy, practitioner, stakeholder, rightsholder, and governance boundaries [115]. Such methodologies inherently value and uphold the legitimacy and relevance of multiple ways of knowing [114] and diverse and sometimes conflicting interests [115]. Transdisciplinarity generally necessitates co-production, relational and values-based conservation approaches (*see above*), as well as an inclusive approach, where research teams

have diverse sectoral representation and partnerships that are maintained throughout the research process from beginning (i.e., question development) to end (i.e., communicating findings). Such approaches can enable conservation scientists and practitioners to understand a broad range of complex problems or barriers to ecosystem protection, resource sustainability, and biodiversity conservation [116–118], and can help ensure that the knowledge produced is inclusive, salient, credible, and practical [119].

I = inclusive

The biodiversity crisis affects everyone on the planet [120–121], and addressing it will require a holistic approach and the participation of everyone. Including all groups of people, especially those historically excluded from the field, and respectfully working with all sources and forms of knowledge into conservation will be critical to finding solutions [122–123]. Increasingly, the value of incorporating traditional ecological, community, and Indigenous knowledge is being recognized [94,123], and space for this information is being made alongside other Western sources of knowledge. Just as conservation needs to include all forms of knowledge, it needs to include all kinds of voices and integrate itself into all parts of society as well [124–125]. The biodiversity crisis, like the climate crisis, is a symptom of the unsustainable resource use and management of an exploitative and inequitable global society [126–127]. Environmental justice, nature-based climate solutions, and One Health approaches are all examples of how conservation can align and integrate itself into broader societal conversations, to the benefit of addressing the root causes of the biodiversity crisis. Beginning within itself, by re-examining historic biases and tearing down systemic inequities [96,128], including and valuing diverse voices and sources of knowledge [122], and aligning with broader societal movements [129], conservation has the opportunity to integrate caring for land, nature, and people into all aspects of society.

O = optimistic

Conservation is inherently focused on issues that can be dire (e.g., climate crisis, extinction). Consequently, anxiety [130] and pessimism [131] about the future of our planet and the potential for conservation are rampant. These perspectives are often reinforced by the focus of conservation on problem identification rather than solutions [132] and alarming stories in the media [133]. Yet, optimism is a concept that is vital to conservation professionals as well as the public [134]. To attract and inspire the next generation of conservation professionals there is need for a sense of purpose and optimism that they can solve these challenging problems [64,135]]; see also E = Empowering). Those working in conservation have the potential to change the negative narrative, striking a balance between optimism and fear [131]. One means of changing the narrative is the use of affect and positive framing of conservation messages. Describing conservation issues in terms that resonate with the broader public potentially leads to developing conservation strategies that more fully engage with public concerns [136]. It is important to highlight bright spots: good-news stories where conservation actions have benefited biodiversity [137]. Some good-news stories are featured as conservation wins (e.g. bowhead and grey whale population numbers and delistings), but the 'best' conservation action stories are often not widely shared because they were preventive actions (e.g. ongoing efforts to prevent the spread of an emerging salamander chytrid disease—a fungal disease that negatively impacts salamander populations—to North America). While promoting evidence informed conservation [131], it is constructive to share success stories and build a culture of hope and optimism that inspires pro-environmental behaviours [138].

N = nurturing

Nature is nurtured by conservation, for the essential ecosystem services it generates [139] and for the intrinsic value of biodiversity [140]. Nurturing occurs in nature, such as mother trees sustaining what surrounds them [141]. Conservation can be nurtured by people's beliefs and society's rules about what behaviors are acceptable [142]. Nurturing creates resilience capacity, the ability to deal with, adapt, and structure change in our rapidly evolving, complex world [143]. It encourages people to achieve environmental sustainability as an expression of ecological identity [144–146]. While power is the ability to influence what others do or think [147], nurturing is increasing the capacity of those influenced. It is a feature of engaging in a community of practice in which people are committed to what they do jointly over the long haul and learn to do it better through consistent, trust-building interactions with each other [148–150]. Nurturing creates opportunities for scientists and non-scientists to collaborate on environmental science research and monitoring projects, to extend understanding and increase the acceptance of results [150]. Nurturing adaptive capacity makes possible collaboration across interests, economic sectors, and organizational structures to recognize and respond to emerging opportunities and hindrances [139].

Synthesis and conclusions

It is time to reconceptualize conservation. The urgency is as great as ever. HOW we do conservation is increasingly recognized as key for achieving conservation success [30–31]. Using an acrostic for the word "conservation", we provide what we consider to be key elements that should define how we approach conservation moving forward. Although we offer these thoughts in a discrete acrostic (Fig 1), we recognize that these "hows" are themselves interconnected and relational. Interweaving these ideas throughout conservation research and practice should be a common goal of conservation professionals. To be clear, this is not just a checklist of independent attributes, as there are interactions and trade-offs among them. For example, being simultaneously inclusive and nimble can be a challenge. It is hard to make rapid, sharp turns, with many partners at the table. However, it is not impossible. The approaches described above (i.e., co-produced, empowering, relational, values-based, transdisciplinary, and inclusive) play a role in making it possible by building trust, encouraging mutual respect, and articulating the need for flexibility. These processes in turn are critical in alleviating one of the most difficult and challenging aspects of conservation—conflicts among stakeholders [151].

For established conservation professionals as well as newcomers to the field, some of the "hows" covered here may be unfamiliar or even daunting. However, there is opportunity for professional development courses to provide relevant training. Learning can also occur through collaboration with others and by approaching conservation with an open mind, acknowledging that how we have done conservation may not necessarily serve us well going forward [152]. Building a community of practice (e.g., through initiatives such as the conservation measures partnership) where we support each other and share experiences will be key. For the next generation of conservation trainees there is opportunity to revise conservation curricula to ensure that the "hows" are all covered with the same rigour as the scientific fundamentals [153]. It is our hope that this acrostic will be widely adopted in training to help the next generation of conservation researchers and practitioners keep in mind what it will take to make their contributions effective and salient. If upon graduation every trainee knew the conservation acrostic and applied it to their work, we posit that conservation would be more effective. Reconceptualizing conservation is valuable and feasible—it is a matter of having the courage to do so.

Acknowledgments

Carleton University is located on the traditional and unceded territory of the Algonquin peoples. We are grateful for the opportunity to work, live, and play on their lands and waters and do so with humility, respect, and gratitude. We acknowledge our many mentors, collaborators and partners who have helped to shape our thinking about conservation. Gillian B. Ainsworth provided thoughtful comments on our manuscript.

References

1. McConnell G. The Conservation Movement—past and present. Western Political Quarterly. 1954; 7: 463–478.
2. Meine C. The oldest task in human history. In Knight R. and Bates S., editors. A new century for natural resources management. Island Press, Washington, D.C.; 1995. pp. 7–35. https://doi.org/10.1111/1523-1747.ep12318985 PMID: 7636316
3. Franco JL de A. The concept of biodiversity and the history of conservation biology: from wilderness preservation to biodiversity conservation. História (São Paulo). 2013; 32: 21–48.
4. Berkes F. Context of traditional ecological knowledge. Sacred ecology. Routledge; 2017. pp. 1–22.
5. Johannes R. Did indigenous conservation ethics exist. Traditional Marine Resource Management and Knowledge Information Bulletin. 2002; 14: 7.
6. Leopold A. The conservation ethic. Journal of Forestry. 1922; 31: 634–641.
7. McCloskey M. Wilderness movement at the crossroads, 1945–1970. Pacific Historical Review. 1972; 41: 346–361.
8. Soulé ME. What is conservation biology? BioScience. 1985; 35: 727–734.
9. Kareiva P, Marvier M. What is conservation science? BioScience. 2012; 62: 962–969.
10. Meine C. Conservation biology: past and present. Conservation biology for all England: Oxford University Press. 2010; 1: 7–26.
11. Mace GM, Barrett M, Burgess ND, Cornell SE, Freeman R, Grooten M, et al. Aiming higher to bend the curve of biodiversity loss. Nature Sustainability. 2018; 1: 448–451.
12. Diversity C on B. First draft of the post-2020 global biodiversity framework. United Nations Environmental Programme Nairobi; 2021.
13. Soulé M. The "new conservation." Conservation Biology. Wiley Online Library; 2013. pp. 895–897. https://doi.org/10.1111/cobi.12147 PMID: 24073808
14. Kareiva P. New conservation: setting the record straight and finding common ground. Conservation Biology. 2014; 28: 634–636. https://doi.org/10.1111/cobi.12295 PMID: 24702652
15. Marvier M. New conservation is true conservation. Conservation Biology. 2014; 28: 1–3. https://doi.org/10.1111/cobi.12206 PMID: 24304269
16. Holmes G, Sandbrook C, Fisher JA. Understanding conservationists' perspectives on the new-conservation debate. Conservation Biology. 2017; 31: 353–363. https://doi.org/10.1111/cobi.12811 PMID: 27558699
17. Díaz S, Fargione J, Chapin FS III, Tilman D. Biodiversity loss threatens human well-being. PLoS biology. 2006; 4: e277. https://doi.org/10.1371/journal.pbio.0040277 PMID: 16895442
18. Schultz PW. Conservation means behavior. Conservation biology. 2011; 25: 1080–1083. https://doi.org/10.1111/j.1523-1739.2011.01766.x PMID: 22070255
19. Sandbrook C. What is conservation? Oryx. 2015; 49: 565–566.
20. Soulé M. Conservation biology: the science of scarcity and diversity. Sinauer Assoc., Inc., Sunderland, Mass. 584pp. editor. 1987. Viable populations for conservation. Cambridge Univ. Press, Cambridge, UK 189pp; 1986.
21. Sutherland WJ, Wordley CF. Evidence complacency hampers conservation. Nature ecology & evolution. 2017; 1: 1215–1216. https://doi.org/10.1038/s41559-017-0244-1 PMID: 29046534
22. Sutherland WJ, Dicks LV, Petrovan SO, others. What works in conservation 2021. 2020.
23. Vitousek PM, Mooney HA, Lubchenco J, Melillo JM. Human domination of Earth's ecosystems. Science. 1997; 277: 494–499.
24. Ceballos G, Ehrlich PR, Barnosky AD, García A, Pringle RM, Palmer TM. Accelerated modern human–induced species losses: Entering the sixth mass extinction. Science advances. 2015; 1: e1400253. https://doi.org/10.1126/sciadv.1400253 PMID: 26601195

25. Crutzen PJ. The "Anthropocene." Earth system science in the Anthropocene. Springer; 2006. pp. 13–18.

26. Salafsky N, Margoluis R, Redford KH, Robinson JG. Improving the practice of conservation: a conceptual framework and research agenda for conservation science. Conservation Biology. 2002; 16: 1469–1479.

27. Cook CN, Mascia MB, Schwartz MW, Possingham HP, Fuller RA. Achieving conservation science that bridges the knowledge–action boundary. Conservation Biology. 2013; 27: 669–678. https://doi.org/10.1111/cobi.12050 PMID: 23574343

28. Bennett NJ, Roth R, Klain SC, Chan K, Christie P, Clark DA, Cullman G, Curran D et al., Conservation social science: Understanding and integrating human dimensions to improve conservation. Biological Conservation. 2017; 205: 93–108.

29. Catalano AS, Lyons-White J, Mills MM, Knight AT. Learning from published project failures in conservation. Biological Conservation. 2019; 238: 108223.

30. Cooke SJ, Rytwinski T, Taylor JJ, Nyboer EA, Nguyen VM, Bennett JR, et al. On "success" in applied environmental research—What is it, how can it be achieved, and how does one know when it has been achieved? Environmental Reviews. 2020; 28: 357–372.

31. Karcher DB, Cvitanovic C, Colvin RM, van Putten IE, Reed MS. Is this what success looks like? Mismatches between the aims, claims, and evidence used to demonstrate impact from knowledge exchange processes at the interface of environmental science and policy. Environmental Science & Policy. 2021; 125: 202–218.

32. Roche DG, O'Dea RE, Kerr KA, Rytwinski T, Schuster R, Nguyen VM, et al. Closing the knowledge-action gap in conservation with open science. Conservation Biology. 2021. https://doi.org/10.1111/cobi.13835 PMID: 34476839

33. Nguyen VM, Ferreira CC, Klütsch CFC. The Knowledge-Implementation Gap in Conservation Science. In Closing the Knowledge-Implementation Gap in Conservation Science, pp. 3–21. Springer, NY, 2021.

34. Beier P, Hansen LJ, Helbrecht L, Behar D. A how-to guide for coproduction of actionable science. Conservation Letters. 2017; 10(3): 288–296.

35. Wyborn C, Datta A, Montana J, Ryan M, Leith P, Chaffin B, Miller C, Van Kerkhoff L. Co-producing sustainability: reordering the governance of science, policy, and practice. Annual Review of Environment and Resources. 2019; 44:319–346.

36. Chapman JM, Schott S. Knowledge coevolution: generating new understanding through bridging and strengthening distinct knowledge systems and empowering local knowledge holders. Sustainability Science. 2020; 15(3):931–943.

37. Young N, Corriveau M, Nguyen VM, Cooke SJ, Hinch SG. How do potential knowledge users evaluate new claims about a contested resource? Problems of power and politics in knowledge exchange and mobilization. Journal of Environmental Management. 2016; 184:380–388. https://doi.org/10.1016/j.jenvman.2016.10.006 PMID: 27745770

38. Nguyen VM, Young N, Corriveau M, Hinch SG, Cooke SJ. What is "usable" knowledge? Perceived barriers for integrating new knowledge into management of an iconic Canadian fishery. Canadian Journal of Fisheries and Aquatic Sciences. 2019; 76: 463–474.

39. Cash DW, Clark WC, Alcock F, Dickson NM, Eckley N, Guston DH, Jäger J, Mitchell RB. Knowledge systems for sustainable development. Proceedings of the national academy of sciences. 2003; 100 (14):8086–8091. https://doi.org/10.1073/pnas.1231332100 PMID: 12777623

40. Wamsler C. Stakeholder involvement in strategic adaptation planning: Transdisciplinarity and co-production at stake? Environmental Science & Policy. 2017; 75:148–157.

41. Fazey I, Bunse L, Msika J, Pinke M, Preedy K, Evely AC, Lambert E, Hastings E, Morris S, Reed MS. Evaluating knowledge exchange in interdisciplinary and multi-stakeholder research. Global Environmental Change. 2014; 25:204–220.

42. Cvitanovic C, McDonald J, Hobday AJ. From science to action: principles for undertaking environmental research that enables knowledge exchange and evidence-based decision-making. Journal of environmental management. 2016; 183:864–874. https://doi.org/10.1016/j.jenvman.2016.09.038 PMID: 27665124

43. Walsh JC, Dicks LV, Raymond CM, Sutherland WJ. A typology of barriers and enablers of scientific evidence use in conservation practice. Journal of Environmental Management. 2019; 250: 109481. https://doi.org/10.1016/j.jenvman.2019.109481 PMID: 31518795

44. Fuller RA, Lee JR, Watson JE. Achieving open access to conservation science. Conservation Biology. 2014; 28: 1550–1557. https://doi.org/10.1111/cobi.12346 PMID: 25158824

45. Larios D, Brooks TM, Macfarlane NB, Roy S. Access to scientific literature by the conservation community. PeerJ. 2020; 8: e9404. https://doi.org/10.7717/peerj.9404 PMID: 32714657

46. Alston JM. Open access principles and practices benefit conservation. Conservation Letters. 2019; 12: e12672.

47. Mekonnen A, Downs C, Effiom EO, Kibaja M, Lawes MJ, Omeja P, et al. Can I afford to publish? A dilemma for African scholars. Ecology letters. 2021 https://doi.org/10.1111/ele.13949 PMID: 34957647

48. Buxton RT, Nyboer EA, Pigeon KE, Raby GD, Rytwinski T, Gallagher AJ, et al. Avoiding wasted research resources in conservation science. Conservation Science and Practice. 2021; 3: e329.

49. Daigle RM, Metaxas A, Balbar AC, McGowan J, Treml EA, Kuempel CD, et al. Operationalizing ecological connectivity in spatial conservation planning with Marxan Connect. Methods in Ecology and Evolution. 2020; 11: 570–579.

50. Downey H, Amano T, Cadotte M, Cook CN, Cooke SJ, Haddaway NR, et al. Training future generations to deliver evidence-based conservation and ecosystem management. Ecological Solutions and Evidence. 2021; 2: e12032.

51. Oxford English Dictionary Online, December 2021, nimble adjective—Definition, pictures, pronunciation and usage notes | Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.com. Accessed 20 December 2021.

52. Van Klink R, Bowler DE, Gongalsky KB, Swengel AB, Gentile A, Chase JM. Meta-analysis reveals declines in terrestrial but increases in freshwater insect abundances. Science. 2020; 368: 417–420. https://doi.org/10.1126/science.aax9931 PMID: 32327596

53. Drechsler M, Eppink FV, Wätzold F. Does proactive biodiversity conservation save costs? Biodiversity and Conservation. 2011; 20: 1045–1055.

54. Martin TG, Nally S, Burbidge AA, Arnall S, Garnett ST, Hayward MW, et al. Acting fast helps avoid extinction. Conservation Letters. 2012; 5: 274–280.

55. Malcom J, Schwartz MW, Evansen M, Ripple WJ, Polasky S, Gerber LR, Lovejoy TE, Talbot LM, Miller JR, 1648 signatories. Solve the biodiversity crisis with funding. Science. 2019; 365(6459):1256. https://doi.org/10.1126/science.aay9839 PMID: 31604231

56. Qin Y, Xiao X, Dong J, Zhang Y, Wu X, Shimabukuro Y, et al. Improved estimates of forest cover and loss in the Brazilian Amazon in 2000–2017. Nature Sustainability. 2019; 2: 764–772.

57. Nichols JD, Williams BK. Monitoring for conservation. Trends in Ecology & Evolution. 2006; 21: 668–673. https://doi.org/10.1016/j.tree.2006.08.007 PMID: 16919361

58. Polasky S, Carpenter SR, Folke C, Keeler B. Decision-making under great uncertainty: environmental management in an era of global change. Trends in ecology & evolution. 2011; 26: 398–404.

59. Possingham HP, Wintle BA, Fuller RA, Joseph LN. The conservation return on investment from ecological monitoring. Biodiversity monitoring in Australia. 2012; 49: 58.

60. Gerber LR, Barton CJ, Cheng SH, Anderson D. Producing actionable science in conservation: Best practices for organizations and individuals. Conservation Science and Practice. 2020; 2: e295.

61. Gerber LR. Conservation triage or injurious neglect in endangered species recovery. Proceedings of the National Academy of Sciences. 2016; 113: 3563–3566. https://doi.org/10.1073/pnas.1525085113 PMID: 26976572

62. Cook CN, Inayatullah S, Burgman MA, Sutherland WJ, Wintle BA. Strategic foresight: how planning for the unpredictable can improve environmental decision-making. Trends in ecology & evolution. 2014; 29: 531–541. https://doi.org/10.1016/j.tree.2014.07.005 PMID: 25097098

63. Williams DR, Balmford A, Wilcove DS. The past and future role of conservation science in saving biodiversity. Conservation Letters. 2020; 13: e12720.

64. Gale A, Chapman J, White D, Ahluwalia P, Williamson A, Peacock K, et al. On embracing the concept of becoming environmental problem solvers: the trainee perspective on key elements of success, essential skills, and mindset. Environmental Reviews. 2021; 99: 1–9.

65. Rytwinski T, Soanes K, Jaeger JA, Fahrig L, Findlay CS, Houlahan J, et al. How effective is road mitigation at reducing road-kill? A meta-analysis. PLoS one. 2016; 11: e0166941. https://doi.org/10.1371/journal.pone.0166941 PMID: 27870889

66. Sutherland WJ, Pullin AS, Dolman PM, Knight TM. The need for evidence-based conservation. Trends in ecology & evolution. 2004; 19: 305–308. https://doi.org/10.1016/j.tree.2004.03.018 PMID: 16701275

67. Pullin AS, Knight TM. Doing more good than harm–Building an evidence-base for conservation and environmental management. Biological conservation. 2009; 142: 931–934.

68. Wyborn C, van Kerkhoff L, Dunlop M, Dudley N, Guevara O. Future oriented conservation: knowledge governance, uncertainty and learning. Biodiversity and Conservation. 2016; 25: 1401–1408.

69. Jordan AJ, Moore B. Durable by design?: Policy feedback in a changing climate. Cambridge University Press; 2020.

70. Nesshöver C, Assmuth T, Irvine KN, Rusch GM, Waylen KA, Delbaere B, et al. The science, policy and practice of nature-based solutions: An interdisciplinary perspective. Science of the total environment. 2017; 579: 1215–1227. https://doi.org/10.1016/j.scitotenv.2016.11.106 PMID: 27919556

71. Cohen-Shacham E, Andrade A, Dalton J, Dudley N, Jones M, Kumar C, et al. Core principles for successfully implementing and upscaling Nature-based Solutions. Environmental Science & Policy. 2019; 98: 20–29.

72. Kelsey E, Armstrong C. Finding hope in a world of environmental catastrophe. In: Learning for sustainability in times of accelerating change. 2012:187–200.

73. Kusmanoff AM, Fidler F, Gordon A, Garrard GE, Bekessy SA. Five lessons to guide more effective biodiversity conservation message framing. Conservation Biology. 2020; 34(5):1131–1141. https://doi.org/10.1111/cobi.13482 PMID: 32043648

74. Hickman C, Marks E, Pihkala P, Clayton S, Lewandowski RE, Mayall EE, Wray B, Mellor C, van Susteren L. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. The Lancet Planetary Health. 2021; 5(12):e863–873. https://doi.org/10.1016/S2542-5196(21)00278-3 PMID: 34895496

75. Solomonian L, Di Ruggiero E. The critical intersection of environmental and social justice: a commentary. Globalization and Health. 2021; 17(1):1–4.

76. Rittel HWJ, Webber MM. Dilemmas in a general theory of planning. Policy sciences. 1973; 4: 155–169.

77. Petriello MA, Redmore L, Sène-Harper A, Katju D. Terms of empowerment: of conservation or communities? Oryx. 2021; 55: 255–261.

78. Engen S, Hausner VH. Impact of local empowerment on conservation practices in a highly developed country. Conservation Letters. 2018; 11: e12369.

79. Wali A, Alvira D, Tallman P, Ravikumar A, Macedo M. A new approach to conservation: using community empowerment for sustainable well-being. Ecology and Society. 2017;22.

80. Nabi RL, Gustafson A, Jensen R. Framing climate change: Exploring the role of emotion in generating advocacy behavior. Science Communication. 2018; 40: 442–468.

81. Kelsey E. Hope Matters: Why Changing the Way We Think is Critical to Solving the Environmental Crisis. 2020. Vancouver, Canada: Greystone Books.

82. Molder AL, Lakind A, Clemmons ZE, Chen K. Framing the Global Youth Climate Movement: A Qualitative Content Analysis of Greta Thunberg's Moral, Hopeful, and Motivational Framing on Instagram. The International Journal of Press/Politics. 2021:19401612211055691.

83. Robbins MM, Gray M, Fawcett KA, Nutter FB, Uwingeli P, Mburanumwe I, et al. Extreme conservation leads to recovery of the Virunga mountain gorillas. PloS one. 2011; 6: e19788. https://doi.org/10.1371/journal.pone.0019788 PMID: 21687709

84. Duarte CM, Agusti S, Barbier E, Britten GL, Castilla JC, Gattuso J-P, et al. Rebuilding marine life. Nature. 2020; 580: 39–51. https://doi.org/10.1038/s41586-020-2146-7 PMID: 32238939

85. Estes N. Fighting for our lives:# NoDAPL in historical context. Wicazo Sa Review. 2017; 32: 115–122.

86. Urgenda v. Neth: http://climatecasechart.com/non-us-case/urgenda-foundation-v-kingdom-of-the-netherlands/

87. Aqorau T, Bell J, Kittinger JN. Good governance for migratory species. Science. 2018; 361 (6408):1208–1209. https://doi.org/10.1126/science.aav2051 PMID: 30237349

88. Jago R. Canada's national parks are colonial crime scenes. The Walrus. 2017; 30.

89. Fletcher M-S, Hamilton R, Dressler W, Palmer L. Indigenous knowledge and the shackles of wilderness. Proceedings of the National Academy of Sciences. 2021; 118. https://doi.org/10.1073/pnas.2022218118 PMID: 34580210

90. West P, Igoe J, Brockington D. Parks and peoples: the social impact of protected areas. Annual Review of Anthropology. 2006; 35: 251.

91. Liboiron M. Pollution is colonialism. Duke University Press; 2021.

92. Wilson S. Research is ceremony: Indigenous research methods. Fernwood Publishing; 2008.

93. Kimmerer RW. Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants. Milkweed Editions; 2013.

94. Wong C, Ballegooyen K, Ignace L, Johnson MJ, Swanson H. Towards reconciliation: 10 Calls to Action to natural scientists working in Canada. Facets. 2020; 5: 769–783.

95. Dietsch AM, Wald DM, Stern MJ, Tully B. An understanding of trust, identity, and power can enhance equitable and resilient conservation partnerships and processes. Conservation Science and Practice. 2021; e421.

96. Chaudhury A, Colla S. Next steps in dismantling discrimination: Lessons from ecology and conservation science. Conservation Letters. 2021; 14: e12774.

97. Rudd LF, Allred S, Bright Ross JG, Hare D, Nkomo MN, Shanker K, et al. Overcoming racism in the twin spheres of conservation science and practice. Proceedings of the Royal Society B. 2021; 288: 20211871. https://doi.org/10.1098/rspb.2021.1871 PMID: 34727721

98. Wyborn C, Louder E, Harfoot M, Hill S. Engaging with the science and politics of biodiversity futures: a literature review. Environmental Conservation. 2021; 1–8.

99. Bennett NJ, Roth R, Klain SC, Chan K, Christie P, Clark DA, et al. Conservation social science: Understanding and integrating human dimensions to improve conservation. biological conservation. 2017; 205: 93–108.

100. Coristine LE, Jacob AL, Schuster R, Otto SP, Baron NE, Bennett NJ, et al. Informing Canada's commitment to biodiversity conservation: A science-based framework to help guide protected areas designation through Target 1 and beyond. FACETS. 2018; 531–562.

101. Augustine S, Dearden P. Changing paradigms in marine and coastal conservation: A case study of clam gardens in the Southern Gulf Islands, Canada. The Canadian Geographer/Le Géographe Canadien. 2014; 58: 305–314.

102. Stigner MG, Beyer HL, Klein CJ, Fuller RA. Reconciling recreational use and conservation values in a coastal protected area. Journal of Applied Ecology. 2016; 53: 1206–1214.

103. Connors BM, von Finster A, Gustafson J, Bradford M, Trerice J, Zimmermann D, Wright H, Tamburello N. Yukon Chinook Stock Restoration Initiative: Technical Team Year 1 Final Report. 2016; 136.

104. Mistry I, Beaudoin C, Kotecha J, Evans H, Stevens M, Vermaire JC, et al. Action research to improve water quality in Canada's Rideau Canal: how do local groups reshape environmental governance? Local Environment. 2021; 26: 575–594.

105. Gregory R, Failing L, Harstone M, Long G, McDaniels T, Ohlson D. Structured decision making: a practical guide to environmental management choices. John Wiley & Sons; 2012.

106. Bower SD, Brownscombe JW, Birnie-Gauvin K, Ford MI, Moraga AD, Pusiak RJ, et al. Making tough choices: Picking the appropriate conservation decision-making tool. Conservation Letters. 2018; 11: e12418.

107. Palmer MA. Socioenvironmental sustainability and actionable science. BioScience. 2012; 62: 5–6.

108. Kirchhoff CJ, Carmen Lemos M, Dessai S. Actionable knowledge for environmental decision making: broadening the usability of climate science. Annual review of environment and resources. 2013; 38: 393–414.

109. Weichselgartner J, Kasperson R. Barriers in the science-policy-practice interface: Toward a knowledge-action-system in global environmental change research. Global Environmental Change. 2010; 20: 266–277.

110. Nyboer EA, Nguyen VM, Young N, Rytwinski T, Taylor JJ, Lane JF, et al. Supporting actionable science for environmental policy: Advice for funding agencies from decision makers. Frontiers in Conservation Science. 2021; 22.

111. Mermet L. Knowledge that is actionable by whom? Underlying models of organized action for conservation. Environmental Science & Policy. 2020; 113: 39–46.

112. Rose DC. The case for policy-relevant conservation science. Conservation Biology. 2015; 29: 748–754. https://doi.org/10.1111/cobi.12444 PMID: 25545991

113. Brandt P, Ernst A, Gralla F, Luederitz C, Lang DJ, Newig J, et al. A review of transdisciplinary research in sustainability science. Ecological economics. 2013; 92: 1–15.

114. Moewaka Barnes H, Harmsworth G, Tipa G, Henwood W, McCreanor T. Indigenous-led environmental research in Aotearoa New Zealand: beyond a transdisciplinary model for best practice, empowerment and action. AlterNative: An International Journal of Indigenous Peoples. 2021; 11771801211019396.

115. Kelly R, Mackay M, Nash KL, Cvitanovic C, Allison E, Armitage D, et al. Ten tips for developing interdisciplinary socio-ecological researchers. Socio-Ecological Practice Research 1, 149–161. 2019.

116. Cundill G, Roux DJ, Parker JN. Nurturing communities of practice for transdisciplinary research. Ecology and Society. 2015;20.

117. Fabian Y, Bollmann K, Brang P, Heiri C, Olschewski R, Rigling A, et al. How to close the science-practice gap in nature conservation? Information sources used by practitioners. Biological Conservation. 2019; 235: 93–101.

118. Kadykalo AN, Buxton RT, Morrison P, Anderson CM, Bickerton H, Francis CM, et al. Bridging research and practice in conservation. Conservation Biology. 2021. https://doi.org/10.1111/cobi.13732 PMID: 33738830

119. Cash DW, Clark WC, Alcock F, Dickson NM, Eckley N, Guston DH, Jäger J, Mitchell RB. Knowledge systems for sustainable development. Proceedings of the National Academy of Sciences. 2003; 100 (14):8086–8091. https://doi.org/10.1073/pnas.1231332100 PMID: 12777623

120. Díaz SM, Settele J, Brondízio E, Ngo H, Guèze M, Agard J, et al. The global assessment report on biodiversity and ecosystem services: Summary for policy makers. 2019.

121. Scheffers BR, De Meester L, Bridge TC, Hoffmann AA, Pandolfi JM, Corlett RT, et al. The broad footprint of climate change from genes to biomes to people. Science. 2016; 354. https://doi.org/10.1126/science.aaf7671 PMID: 27846577

122. Díaz S, Demissew S, Carabias J, Joly C, Lonsdale M, Ash N, et al. The IPBES Conceptual Framework—connecting nature and people. Current opinion in environmental sustainability. 2015; 14: 1–16.

123. Ban NC, Frid A, Reid M, Edgar B, Shaw D, Siwallace P. Incorporate Indigenous perspectives for impactful research and effective management. Nature ecology & evolution. 2018; 2: 1680–1683. https://doi.org/10.1038/s41559-018-0706-0 PMID: 30349090

124. Tallis H, Lubchenco J. Working together: A call for inclusive conservation. Nature News. 2014; 515: 27.

125. Matulis BS, Moyer JR. Beyond inclusive conservation: the value of pluralism, the need for agonism, and the case for social instrumentalism. Conservation Letters. 2017; 10: 279–287.

126. Hamann M, Berry K, Chaigneau T, Curry T, Heilmayr R, Henriksson PJ, et al. Inequality and the Biosphere. Annual Review of Environment and Resources. 2018; 43: 61–83.

127. Mikkelson GM, Gonzalez A, Peterson GD. Economic inequality predicts biodiversity loss. PloS one. 2007; 2: e444. https://doi.org/10.1371/journal.pone.0000444 PMID: 17505535

128. Baker K, Eichhorn MP, Griffiths M. Decolonizing field ecology. Biotropica. 2019; 51: 288–292.

129. Miriti MN, Bowser G, Cid CR, Harris NC. Overcoming Blind Spots to Promote Environmental Justice Research. Trends in Ecology & Evolution. 2021. https://doi.org/10.1016/j.tree.2020.12.011 PMID: 33483170

130. Clayton S. Climate anxiety: Psychological responses to climate change. Journal of Anxiety Disorders. 2020; 74: 102263. https://doi.org/10.1016/j.janxdis.2020.102263 PMID: 32623280

131. Kidd LR, Bekessy SA, Garrard GE. Neither hope nor fear: Empirical evidence should drive biodiversity conservation strategies. Trends in ecology & evolution. 2019; 34: 278–282. https://doi.org/10.1016/j.tree.2019.01.018 PMID: 30824194

132. Swaisgood RR, Sheppard JK. The culture of conservation biologists: show me the hope! BioScience. 2010; 60: 626–630.

133. Hart PS, Feldman L. Threat without efficacy? Climate change on US network news. Science Communication. 2014; 36: 325–351.

134. Garnett S, Lindenmayer D. Conservation science must engender hope to succeed. Trends in Ecology and Evolution. 2011; 26: 59–59. https://doi.org/10.1016/j.tree.2010.11.009 PMID: 21185618

135. Park A, Williams E, Zurba M. Understanding hope and what it means for the future of conservation. Biological Conservation. 2020; 244: 108507.

136. Ainsworth GB, Burns GL. 'Although I use science, it's an emotional thing': conservation practitioners' use of positive affect to frame messages about threatened birds. Australasian Journal of Environmental Management. 2020; 27: 351–377.

137. Bennett EM, Solan M, Biggs R, McPhearson T, Norström AV, Olsson P, Pereira L, Peterson GD, Raudsepp-Hearne C, Biermann F, Carpenter SR. Bright spots: seeds of a good Anthropocene. Frontiers in Ecology and the Environment. 2016; 14(8):441–448.

138. McAfee D, Doubleday ZA, Geiger N, Connell SD. Everyone loves a success story: optimism inspires conservation engagement. BioScience. 2019; 69: 274–281.

139. Schultz L, Folke C, Österblom H, Olsson P. Adaptive governance, ecosystem management, and natural capital. Proceedings of the National Academy of Sciences. 2015; 112: 7369–7374.

140. Rosauer DF, Mooers AO. Nurturing the use of evolutionary diversity in nature conservation. Trends in Ecology & Evolution. 2013; 28: 322–323. https://doi.org/10.1016/j.tree.2013.01.014 PMID: 23433638

141. Simard S. Finding the mother tree: uncovering the wisdom and intelligence of the forest. Penguin UK; 2021.

142. Foggin JM, Brombal D, Razmkhah A. Thinking Like a Mountain: Exploring the Potential of Relational Approaches for Transformative Nature Conservation. Sustainability. 2021; 13: 12884.

143. Schultz L. Nurturing resilience in social-ecological systems: lessons learned from bridging organizations. PhD Thesis, Department of Systems Ecology, Stockholm University. 2009.

144. Kumar M, Kumar P. Valuation of the ecosystem services: a psycho-cultural perspective. Ecological economics. 2008; 64: 808–819.

145. Clayton S, Opotow S. Introduction: Identity and the Natural Environment. 2003.

146. Lee H, Youn Y-C. Relevance of cultural ecosystem services in nurturing ecological identity values that support restoration and conservation efforts. Forest Ecology and Management. 2022; 505: 119920.

147. Weber M. Economy and society: An outline of interpretive sociology. Univ of California Press; 1978.

148. Wenger E. Systems thinker. Communities of practice: Learning as a social system. 1998.

149. Wenger E, McDermott RA, Snyder W. Cultivating communities of practice: A guide to managing knowledge. Harvard business press; 2002.

150. Danielsen F, Adrian T, Jensen PM, Muñoz J, Shirk JL, Burgess ND. Current Approaches to Citizen Science. Handbook of Citizen Science in Ecology and Conservation. University of California Press; 2020. pp. 25–30.

151. Redpath SM, Young J, Evely A, Adams WM, Sutherland WJ, Whitehouse A et al. Understanding and managing conservation conflicts. Trends in Ecology & Evolution. 2013; 28(2): 100–109. https://doi.org/10.1016/j.tree.2012.08.021 PMID: 23040462

152. Hessami MA, Bowles E, Popp JN, Ford AT. Indigenizing the North American Model of Wildlife Conservation. FACETS. 2021; 6: 1285–1306.

153. Andrade K, Corbin C, Diver S, Eitzel MV, Williamson J, Brashares J, et al. Finding your way in the interdisciplinary forest: notes on educating future conservation practitioners. Biodiversity and Conservation. 2014; 23: 3405–3423.