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Aligning sustainability fellowships with the dimensions of social-ecological systems

Kaleigh Karageorge[1], Emily Pappo[2], Graham Diedrich[3*], Luca L. Morreale[4], Frédérique L. Fardin[5,6], Anne E. Tamalavage[8], Holly Cronin[6,9,10], Waleska Gravena[11,12], Abigail S. L. Lewis[8], Petiangma Dereck Mbeh[6,7], Sara M. Melo-Merino[8], Benjamin Utting[13,14] and Vera Solovyeva[15]

*Correspondence:
Graham Diedrich
diedgr@umich.edu

Full list of author information is available at the end of the article

Abstract

Research fellowships are a potentially effective mechanism for supporting sustainability science, yet the design of these positions is rarely examined in relation to the goals they aim to achieve. We propose applying the theory of institutional fit, the congruence between institutions and the social-ecological systems they govern, as a way to investigate fellowship design. We argue that considering how fellowship structures match the social-ecological systems they aim to influence might facilitate improved fellowship design and outcomes. To demonstrate the utility of institutional fit in this context, we present fellowship-evaluation questions motivated by four dimensions of fit (spatial, temporal, relational, and functional). Rather than offering a prescriptive blueprint of how fellowships can better achieve fit, we present institutional fit as a useful theoretical lens to advance a research agenda on improved sustainability fellowship design. As large changes in social-ecological systems continue, intentional fellowship design will be essential to realizing the full potential of fellowships as instruments for sustainability transformations.

1 Introduction

Research fellowships—here defined as time-limited, funded positions that support independent or collaborative investigation—serve as instruments to advance research, nurture leadership, foster innovation across disciplines, and, more recently, advance transformative sustainability outcomes [1]. Recent programs like the Smithsonian Life on a Sustainable Planet Initiative (in which all the authors participated, see Positionality Statement), Holcim Foundation Design Incentives for Change, and MIT Climate & Sustainability Consortium Impact Fellowship exemplify this trend [2–4]. In these programs, sustainability broadly entails maintaining ecological integrity and advancing just social systems, as these two goals are generally recognized as inextricable [5, 6]. Sustainability fellowships therefore are fellowships that aim to understand, evaluate, or advance initiatives or processes that help to achieve those goals.

Fellowships are particularly appealing instruments for advancing sustainability because they can provide the agility and intellectual flexibility needed to address urgent

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and complex environmental and societal problems. Global grand challenges such as climate change, biodiversity loss, and resource insecurity are "wicked problems" characterized by intertwined systems dynamics that demand intellectual risk-taking, experimentation, and collaboration across traditional disciplinary boundaries [7–11]. The nature of these challenges also makes sustainability fellowships uniquely high-stakes and presents an opportunity for them to be distinctly transformative.

Past work has considered the benefits of fellowships more broadly [1, 12]. Historically rooted in academic patronage, fellowships have evolved into organized programs that provide financial support, mentorship, and connections to important professional networks for both early- and later-career scholars and practitioners [13]. In addition to providing benefits to fellows—such as time for focused research, opportunities to expand professional networks, and the establishment of new collaborations—fellowships also provide value to host research organizations [14]. Fellowships can create flexible pathways for a host organization to support emerging initiatives, experimental disciplines, or strategic objectives that may be more difficult to integrate into permanent staff positions [15]. Often, this allows for fellows to test new ideas, build interdisciplinary bridges across academic fields, support transdisciplinary collaborations with non-academic stakeholders, and inject fresh perspectives into established organizations [16]. In this way, fellowships operate as adaptive tools for both individual career development and organizational innovation.

Despite their promise, fellowships can also pose challenges, including short-term project timelines, limited institutional support, and difficulties translating fellowship work into lasting organizational change [17]. In response, a growing body of literature has examined how fellowship design may better support both fellows and host organizations. Fork et al. and Lowman et al., for example, describe how collaborative cohort models that foster community may help fellows and other researchers in temporary positions mitigate isolation and strengthen professional development [18, 19]. They also identify promising opportunities for improving fellowship design, including structured skill sharing, social bonding/cohesion oriented activities, and peer-to-peer learning mechanisms [18, 19]. This scholarship underscores that fellowship structure matters and can influence outcomes for both individuals and organizations.

The extant literature that focuses on improving fellow experience serves as an important foundation for designing *all* fellowships. However, it does not explicitly consider how fellowship design may support stated sustainability outcomes. Because sustainability fellowships seek to address problems that are long-term, geographically diverse, and functionally complex, [2–4] this necessitates unique design considerations. To address this gap, we propose viewing sustainability fellowships through the lens of *institutional fit*, which describes the congruence between social-ecological systems and the institutions intended to manage them [20]. Institutional fit has been widely applied to evaluate how well institutional norms, rules, structures, and incentives align with the systems they aim to shape [20, 21]. Here, we outline how the theoretical lens of institutional fit is relevant to sustainability-oriented fellowships along four dimensions of fit (spatial, temporal, functional, and relational), providing a foundation for future inquiry on sustainability fellowship design and desired outcomes. We do not aim to provide a prescriptive framework to guide specific fellowship design decisions, as providing such generalized advice runs contrary to the notion of institutional fit [22]. Instead, we suggest that

viewing sustainability fellowship design through the lens of institutional fit can serve as a springboard for more systematic design and evaluation, eventually identifying how to optimally structure fellowships to most effectively achieve their sustainability goals.

2 Theory

2.1 Institutional fit

The theory of institutional fit posits that institutions must be aligned with the social and ecological contexts in which they operate [20]. We refer to these contexts as social-ecological systems, defined as an integrated system where human and biophysical elements are linked [23–26]. *Institutions* are broadly defined as systems of formal and informal rules, norms, and organizational structures that shape and govern behavior and decision-making within a society [27, 28]. *Fit* describes the degree of alignment or congruence between an institution and the characteristics of the system it is intended to govern, which can vary through time and in response to larger structural societal changes [21]. The theory asserts that strong institutional fit leads to a higher likelihood of achieving preferred outcomes, whereas institutional misfit, where the institution operates at the wrong scale relative to the system it attempts to manage, weakens the likelihood of achieving desired outcomes [29, 30].

Scholars have identified several dimensions of institutional fit relevant to the governance of social-ecological systems [20, 21, 31]. Spatial fit refers to geographic alignment between the jurisdictional boundaries of governing institutions and the physical space of an ecological system [20, 31]. A classic example of poor spatial fit is managing a fishery across several multiple local, regional, and national jurisdictions, rather than a single unified authority. Temporal fit concerns the overlap between the pace or timescale of social-ecological processes and the interventions seeking to govern them [21, 32]. Processes like climate change involve complex long-run dynamics, including feedback loops, cumulative effects, and delayed consequences [33]. Institutions may find it difficult to manage social-ecological systems in the face of rapid change and uncertain outcomes. Relational fit describes how well interpersonal connections between actors align with the social aspects of institutional structures they inhabit [34]. In the context of social-ecological systems, this might involve ensuring that communication mechanisms in a resource management body are culturally appropriate. Finally, functional fit concerns how well an institution's processes and mechanisms, such as feedback, interdependencies, and linkages, match those of the natural system in which it operates [20, 31, 35]. Functional fit is achieved when different actors collaborate to manage an overlapping ecological concern, such as farmers, local government, and conservation groups working together to address soil erosion.

Institutional fit has been increasingly applied in different contexts across environmental and sustainability studies [36, 37]. In relation to environmental governance, for example, research shows that a one-size-fits-all regulatory approach is unlikely to be uniformly successful across ecosystems and social-ecological systems that differ in scale, ecological dynamics, or social organization [30, 38]. For instance, efforts to expand renewable energy deployment have led to systematically different outcomes across local contexts, with acceptance or opposition shaped less by aggregate public attitudes than by local institutional capacity, land tenure arrangements, and the degree to which affected communities are meaningfully incorporated into governance processes [39–41].

This example illustrates the core thesis of institutional fit: a management system that does not account for the specific social organization of the communities it governs is unlikely to achieve its intended outcomes, regardless of its technical or policy merits. The same logic applies broadly, any institution that seeks to enact effective change must be designed in alignment with the social-ecological contexts they seek to shape.

2.2 Fellowships as institutions

Despite growing attention to institutional fit in environmental governance and sustainability policy, far less attention has been paid to whether academic structures that enact and support sustainability initiatives and actions exhibit similar alignment. Here, we propose viewing sustainability fellowships through the lens of institutional fit. Although fellowships are more often understood as funding mechanisms or professional positions, they can also be understood as institutions in the theoretical sense. Sustainability fellowships organize and structure research agendas, allocate resources, define temporal boundaries of work, evaluate success, and define goals, therefore creating a set of formal and informal rules that dictate how to work toward sustainability in their specified context(s). These positions aim to implement initiatives or enact change in the environment(s) in which they operate. As such, they represent institutions, and — through the lens of institutional fit — the social-ecological system their goals are centered around is the context they must align with to most effectively achieve stated goals (Fig. 1).

Understanding fellowships through the lens of institutional fit necessitates very intentional fellowship design. It asserts that when fellowship structures (e.g., duration, integration, cohort design, and administrative support) better align with a social-ecological system, we would expect more effective outcomes. If a fellowship aims to inform widespread, transformative climate solutions, biodiversity conservation, or

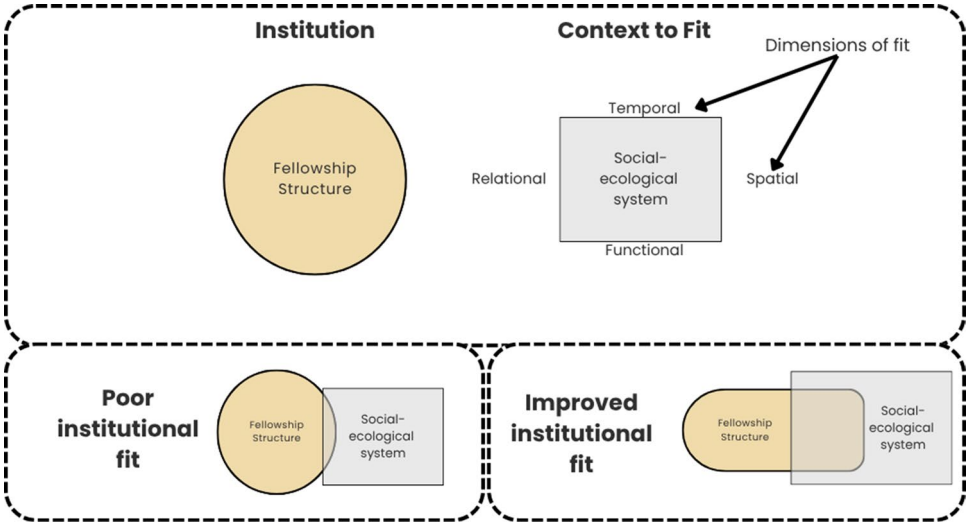


Fig. 1 Illustrates this framework of institutional fit as applied to sustainability fellowships. The top panel depicts a fellowship structure (the institution) and its surrounding social-ecological system (the context), which must align across four dimensions of fit: temporal, spatial, functional, and relational. The bottom panels contrast two outcomes: *poor* institutional fit, where the fellowship structure and the social-ecological system overlap only minimally, constraining the capacity to generate meaningful or lasting impact; and *improved* institutional fit, where the fellowship structure is reshaped to more fully encompass the relevant social-ecological system, expanding the scope for the fellowship to translate into effective, context-appropriate research

Table 1 Examining institutional fit of sustainability fellowships. Each row consists of one dimension of (mis)fit paired with some ways fellowship design may fall short or perform well on this dimension

Type of Fit	Definition	Area of inquiry examples
Spatial Fit	Geographic alignment between the jurisdictional boundaries of governing institutions and the physical space of an ecological system. [20,31]	Are fellows connected to the geographic regions where they aim to enact change? Are the goals a particular fellowship aims to achieve international or local in scope relative to the geographic location of fellows?
Temporal Fit	Overlap between the pace or time-scale of social-ecological processes and the interventions seeking to govern them. [21,32]	Are short-term fellowships aimed at addressing short or long-term social and ecological processes? What structures ensure continuity across short-term fellowships when addressing long-term processes?
Functional Fit	How well an institution's processes and mechanisms match those of the natural system it operates in. [20,31,35]	Do fellowships include communication, collaboration, and reporting mechanisms that are aligned with the complexity of natural systems?
Relational Fit	How well the interpersonal connections between actors align with the social aspects of the institutional structures they inhabit. [34]	Are fellowships centered on community based participatory research supporting and involving community members as well as fellows?

community-engaged sustainability transitions, its structure should exhibit temporal, spatial, functional, and relational alignment with those broad goals. Thus, by seeing fellowships as institutions, researchers might better evaluate the strengths and weaknesses of fellowship design, examining how those might impact desired sustainability outcomes.

3 A research agenda for assessing fellowship social-ecological systems fit

3.1 Positionality statement

All fourteen co-authors listed on this paper are previous or current fellows in the Smithsonian Institution's *Life on a Sustainable Planet* Fellowship Program. Our experiences in this program shaped our interest in the area of fellowship design and informed our ideas about this field. During this fellowship program, our co-authors engaged in collaborative discussion about our fields' theoretical contributions, eventually applying these theories to our ongoing observations and experiences. The following theoretical application of institutional fit to examine fellowship design is therefore a product which has emerged from these discussions and experiences, which began in 2024.

3.2 Application

Sustainability fellowships, like other institutions in sustainability research, may struggle to achieve long-term outcomes when they rely on short-term project windows, lack institutional integration, and treat systematic challenges as discrete projects (see [42–44]). By allowing for the identification of possible mismatches between fellowship design and social-ecological processes, this framework may help future research develop fellowships better equipped to transform the systems they target (Table 1). Rather than prescribing solutions, we intend this lens to catalyze empirical work on fellowship design, including indicators, evaluation criteria, and assessment procedures for assessing institutional fit. In short, we contend that applying this theoretical lens to this context could serve as a catalyst for future research in this area to better design and evaluate fellowships.

3.2.1 Spatial fit

Here, the spatial dimension of fit includes characteristics related to the size, position, and shape of systems [20, 31]. Social-ecological systems vary vastly in size, scope, and geographic location. While sustainability challenges are global (e.g., climate change adaptation across six continents), fellowships may define a specific spatial boundary in which they seek to enact change. For example, they may restrict or expand the scope of their goals in accordance with factors such as geographic proximity to an issue or size of a cohort. Because solely using fellowships to address the full scope of a global challenge across all continents is infeasible, it is important to account for spatial considerations of fit in intentional fellowship design.

Acknowledging spatial fit in fellowship design necessitates consideration of the geographic location(s) of institutions and fellows, as well as the number and composition of fellows relative to the stated goals of the program. Observing whether fellows are representative of the geographic scope of the focal social-ecological system can facilitate research into how (mis)matches affect outcomes. For fellowships that have a broader geographic scope (i.e. national, international, or global), does this necessitate having a larger and/or more geographically diverse cohort? When the cohort is not geographically diverse, can only smaller-scale goals be accomplished?

Going beyond a fellowship's intended reach, through overlooking cohort size, fellow location or connections to communities and partners, it may be that less is achieved than when programs have a local goal and small cohort, but are geographically proximate to an area—thus exhibiting a spatial match. Here, we may not only consider the geographic diversity of fellowship cohort members, but also where they are spatially located relative to the target social-ecological system.

3.2.2 Temporal fit

Temporal fit references the degree to which an institution is aligned with the time-scale of a social-ecological system [21, 32]. The temporal component of environmental challenges is vital given that the natural system dynamics can span incredible lengths of time, even while perturbations to natural systems can happen rapidly and demand urgent attention. As an example, consider the case of longitudinal geologic studies conducted by multiple research teams over decades, versus issues like ozone depletion that required immediate observation and action, despite the consequences of global actions only being fully realized decades later. Ecological tipping points are another high-profile illustration of why institutions can benefit from aligning on temporal dimensions with the environmental systems they govern [45].

Individual fellowships certainly cannot achieve full fit with the time-scales necessary to solve long-term global dilemmas or slow-emerging sustainability problems. Research that focuses on designing fellowships to better accomplish sustainability goals might consider how to deal with this inevitable temporal mismatch. Possible approaches might include developing collaborative, long-term, institutionally supported and funded research pipelines with well-developed onboarding processes to get new members acquainted with old data and longstanding communal relationships. By integrating a single fellow into a fellowship agenda that spans long time periods, greater temporal match may be achieved, depending on a program's goals.

The temporal dimension of fit includes the time horizons of social relations that constitute social-ecological systems. Effective environmental research necessitates community-centered, long-lasting, non-extractive, and reciprocal solutions, relying fundamentally on trust and local agency [46–48]. Durable sustainability outcomes rarely emerge from short-term, externally imposed interventions. Instead, they depend on relationships built over time, shared decision-making, locally grounded knowledge, and governance that strengthens rather than bypasses community capacity and contributes to durable benefits [49, 50]. Yet, the very temporary nature of fellowships does not allow for the time needed to develop these deep relationships. Researchers serious about creating effective sustainability fellowships must take this mismatch between academic and other timelines seriously. Fellowships misaligned with their specified social-ecological contexts on this dimension have the potential to create compounding negative effects [30]. The impacts of temporary and extractive relationships that lack trust may persist, diminishing institutional credibility and contributing to reputational risk of fellows and institutions for long past a fellow's tenure. Thus, in considering temporal fit in fellowship design, we encourage researchers to also consider the serious stakes that funders and institutions have in questions of temporal misfit.

3.2.3 Functional fit

Functional fit considers how well an institution's processes and mechanisms match those of the social-ecological system it operates in.[20,31,35] Social-ecological systems are complex. Climate change, biodiversity loss, and resource insecurity are interconnected issues that cannot be fully understood or addressed without understanding them from a whole systems approach [51]. Viewing ecological environments through a systems thinking lens emphasizes that human-nature relationships are interconnected and that the distinction between social and ecological systems is often artificial or arbitrary [25, 52]. Social-ecological systems include multiple ways of knowing and being, include feedback that links ecological and social dynamics.

To achieve functional fit, fellowships may use cohorts with a diversity of disciplines to account for the complexity of natural systems. Fellowship design grounded only in biophysical science may miss social acceptance, durability, or governance constraints. Conversely, approaches grounded only in social analysis may miss ecological thresholds or functional dynamics that shape environmental outcomes. Interdisciplinary work may reveal these blind spots and support robust and actionable solutions [53, 54]. An interdisciplinary and diverse cohort might provide fellows with diverse methodological toolkits—from qualitative social analysis and quantitative approaches to long-term ecosystem monitoring—and can deepen understandings of how sustainability problems may be interconnected [46, 51].

A research agenda that seriously considers functional fit, might investigate the relative importance of different questions, ranging from fellows' disciplinary composition to organizational structure. Relevant areas of inquiry could include investigating what amount of disciplinary diversity is required for different goals (e.g., improving resilience or developing resilience policies). Or, it may be that it is more important to focus on organizational systems within the host institutions. Research into the importance of facilitating collaboration among fellows or the existence of robust internal feedback systems could help improve functional fit and, therefore, overall fellowship design. Another

area for inquiry could involve understanding the potential benefits and tradeoffs for the fellows, fellowships, and host organizations, of providing opportunities for engagement and collaboration across disciplines and projects. Relatedly, functional fit also entails examining fellowships' evaluation and governance mechanisms. A fellowship that is designed to establish deep, transformative change but is assessed on publication metrics poses a functional mismatch. The evaluation mechanism of quantifying publications is not necessarily aligned with the complex social-ecological systems that sustainability fellowships aim to transform.

3.2.4 Relational fit

The last dimension of fit examined here, relational fit, concerns the alignment of social and interpersonal relationships between system and institution [34]. Matches on this dimension are vital because social relations are as central to fellowships and their specified environments as spatial, temporal, and functional dynamics. Mentorship, documentation, knowledge-sharing, and community-building are all practices related to relational fit [55]. These may strengthen institutional memory, reduce barriers for future collaborators, and foster a culture of accountability and sustained engagement across projects [56]. Here, we may ask questions about how to accommodate culturally appropriate communication mechanisms into fellowship design and how to better align the relations of fellows and institutions with those populations that they seek work with.

While the temporal component of reciprocity and trust-building are vital, relational fit also matters here. Reciprocity and trust are particularly critical in contexts where research and action intersect with livelihoods, cultural values, and longstanding social institutions. Without these elements, sustainability action risks becoming extractive by removing data, resources, or legitimacy from communities without contributing to durable benefits and, in some cases, may lead to maladaptation where communities are unable to respond to climate disturbances accordingly [57]. Avoiding exploitative and self-serving actions is critical in sustainability research because effective interventions require continuity and meaningful engagement, not only technical expertise. When solutions are co-produced with communities or, ideally, led by communities, they are more likely to persist beyond the duration of a project or funding cycle [46, 58]. Conversely, when initiatives are short-term, externally driven, or poorly integrated into existing social structures, their impacts may be limited and trust may be eroded.

If fellowships are designed with an exclusively technical focus, they may become exclusionary or inaccessible to community members residing in the social-ecological context a fellowship operates in, making progress difficult. Questions surrounding relational fit may ask how fellowship design and execution can better accommodate shared, accessible languages or other communication methods. A clear example of a relational misfit is a research project that is primarily conducted in English, despite primarily taking place in a Spanish-speaking country. However, relational fit entails design characteristics that are more thorough than that, including accommodating cultural norms and mores. In this way, research that evaluates fellowships on the dimension of relational fit or examines how relational fit of fellowships may influence their sustainability goals should be concerned with questions of community-led research design and community based participatory research. We particularly encourage investigating what the orientation of the fellowship should be in relation to community members. For example, could

co-designing the fellowship structure with community partners lead to stronger sustainability outputs? Can an alumni network bridge the gap if a fellowship design fails to embed current fellows into local power structures? By designing a cohort based on technical capacity rather than collective community ties, might this limit the fellowships final impact? Should a program's recruitment strategy target well-connected community leaders or high-potential outsiders who lack local connection? These questions may focus on how to promote bottom-up engagement and empower communities to engage in fellowship processes.

4 Discussion

Though applying institutional fit to fellowship design may represent a promising way forward to better evaluate and achieve sustainability outcomes, it also presents some challenges. For one, fellowships may be unable to precisely fit the enormous and intricate contexts they aim to influence, requiring consideration on whether they are the best unit of analysis in which to consider fit. Second, potential tradeoffs may arise both in designing fellowships to accommodate several different types of fit and in deciding to what extent limited resources should be devoted to achieving fit, including whether doing so should take priority over sustaining the fellowship itself.

In considering whether they are an appropriate unit of analysis, we argue that fellowships are a small unit in a broader constellation of a nested, polycentric network that seeks to understand and manage social-ecological systems. The broader literature on environmental institutions responds to this argument, putting forth the principle of "nested" and "polycentric" systems [59]. In nested enterprises, environmental management is tiered, aligned, and takes place at multiple scales. Relatedly, the concept of polycentricity describes a system of nested enterprises in which there is no central loci of decision making but rather a broader connected network of autonomous but mutually dependent actors [26, 60]. Indeed, ensuring institutional fit of fellowships necessitates viewing them as a part of a broader apparatus and accordingly taking strides to incorporate them into those broader systems. Though fellowships themselves cannot fully address longstanding, complex, dynamic environmental challenges, fit can be optimized on smaller scales. For this reason, fellowship calls that put forth global goals such as "ending climate change" are uncommon compared to calls that may seek to assist with adaptation measures for a local community. Thus, while the small scale of fellowships and the global nature of sustainability challenges may seem to render it impossible to achieve spatial fit, we argue that viewing fellowships as one small piece of a broader polycentric system encourages the pursuit of change in more dynamic ways. Rather than stating ambitious goals that are unattainable in isolation, a fellowship might instead be compelled to scale-up their initiatives through fostering broader academic and community collaborations.

Closely related to the above conversation are the likely tradeoffs that exist in accommodating several types of fit at once, as well as the overarching potential tradeoff between prioritizing fit in fellowship design and working with limited resources. Overcoming sustainability problems is often challenged by tradeoffs across multiple objectives [61]. While working toward several dimensions of fit can at times be complementary, in other cases, achieving two or more types of fit can run counter to one another, complicating achieving fit in fellowship design. A social-ecological system that

calls for an interdisciplinary cohort of fellows may constrain the flexible research agenda required by changing systems dynamics. A program that requires long-term collaboration with one community may limit the ability to build connections with other communities whose perspectives are necessary to solving a broader sustainability challenge.

There is also a possible broader tradeoff for fellowship-hosting organizations between better accommodating fit and managing limited organizational resources. For sustainability fellowships, needs are often multifaceted, including resource capacity (e.g., funding, materials), technical capacity (e.g., training, knowledge), operational capacity (e.g., administrative support), relational capacity (e.g., collaboration, external partnerships, mentorship), and political capacity (e.g., credibility, social capital). If a fellowship does not have the adequate resources to generate fit with the systems they aim to transform, does this mean the fellowship should be eliminated? If an institution lacks the research and technical capacity to host interdisciplinary fellows despite operating in an environment that requires interdisciplinarity, they might have to decide between disregarding fit, eliminating the fellowship, or modifying the context or goals of this fellowship.

The potential tradeoffs identified above elucidate the importance of further examining how fit might be optimized in fellowship design and identifying the prospects and benefits of achieving certain types of fit. For situations where types of fit are in conflict with one another or there are inadequate resources to generate strong fit in a fellowship, future work might consider how one might identify what the optimal level of fit is when designing a fellowship. In fellowships where there is a likely tradeoff between two types of fit, future research might consider how to balance those "fit tradeoffs" to best work toward fellowship goals. In fellowships that have too few resources to generate strong overall fit, it may be the case that fit can be optimized enough to produce favorable outcomes or mitigate unfavorable ones. If fit could be optimized enough to meet this threshold, it would justify preserving the fellowship. If this threshold was not met, it might be best to dissolve or modify the fellowship to better promote fit.

Ultimately, while we argue that examining fellowships through the lens of institutional fit can generate some useful design principles, albeit with possible tradeoffs, we also recognize that institutional barriers to uptake still exist. Thus, further examining fellowship design through the lens of institutional fit will not necessarily guarantee greater fit in practice. Funders, institutions, and fellows have constraints and individual incentives that can impede achieving the best fit. More research into the distribution of institutional funding might reveal which positions may have more capacity to intentionally design sustainability fellowships with fit in mind. Relatedly, future research can better understand the impacts of design choices by more thoroughly examining the broader sustainability funding environment. While a number of high-profile sustainability fellowships have emerged in recent years, these only constitute a small portion of the sustainability research occurring more broadly.

Further study and reflection are needed to evaluate fellowship models across disciplines, host organization types, and national or international contexts. Studies that compare long-term outcomes of cohort-based versus. individual fellowship models or those that identify effective metrics for evaluating institutional fit for sustainability would help to inform adaptive learning cycles that continuously improve fellowship programs. By thoughtfully designing fellowships, they may become a more effective mechanism for supporting sustainability research and realizing a more just and resilient planet.

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Author contributions
K.K., E.P., G.D., L.M., F.F., and A.T. served on the lead authorship team. In this role, each shared the responsibility of drafting the manuscript, preparing the cover letter and manuscript for submission, and coordinating full-team meetings to discuss updates and provide space for writing sessions. A.L. prepared Fig. 1. Table 1 was created by the lead authorship team, driven primarily by K.K. and E.P. All authors, including H.C., W.G., P.M., S.M., B.U., and V.S., played an important role in developing the conceptual model behind this piece. All authors reviewed the manuscript prior to submission.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethical approval
This article is a scholarly perspective and does not report original research involving human participants, animals, or identifiable personal data. Therefore, ethics approval and informed consent were not required.

Consent to participate
Not applicable.

Consent to publish
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Department of Environmental Studies, Knox College, Galesburg, IL, USA
[2]Migratory Bird Center, Smithsonian's National Zoo and Conservation Biology Institute, Washington, DC, USA
[3]Department of Political Science, University of Michigan, Ann Arbor, MI, USA
[4]Appalachian Laboratory, University of Maryland Center for Environmental Science, Frostburg, MD, USA
[5]Nippon Foundation Ocean Nexus Program, Seattle, WA, USA
[6]Smithsonian Tropical Research Institute, Panama City, Panama
[7]Disaster Management Training and Education Center for Africa, University of the Free State, Bloemfontein, South Africa
[8]Smithsonian Environmental Research Center, Edgewater, MD, USA
[9]School for the Environment, University of Massachusetts, Boston, MA, USA
[10]Department of Geography, McGill University, Montreal, Canada
[11]Laboratório de Mamíferos Aquáticos, Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil
[12]Mammal Division, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
[13]Department of Anthropology, University of Connecticut, Storrs, CT, USA
[14]Human Origins Program, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
[15]Arctic Studies Center, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

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References

1. Horlings LG, Nieto-Romero M, Pisters S, Soini K. Operationalising transformative sustainability science through place-based research: the role of researchers. Sustain Sci. 2020;15(2):467–84. https://doi.org/10.1007/s11625-019-00757-x.
2. Smithsonian Institution. Life on a Sustainable Planet [Internet]. 2026 [cited 2026 Feb 23]. Available from: https://science.si.edu/who-we-are/fellowships/.
3. Holcim Foundation. Holcim Foundation Fellowship [Internet]. 2026 [cited 2026 Feb 23]. Available from: https://www.holcimfoundation.org/fellowship.
4. MIT Climate & Sustainability Consortium. Impact Fellows Program [Internet]. [cited 2026 Feb 23]. Available from: https://impactclimate.mit.edu/get-involved/impact-fellows-program/.
5. Kates RW, Parris TM, Leiserowitz AA. What is sustainable development? Goals, indicators, values, and practice. Environment. 2005;47(3):8–21. https://doi.org/10.1080/00139157.2005.10524444.
6. Isgren E, Longo SB. Social sustainability: more confusion than clarity. J Environ Stud Sci. 2024;14(4):820–5. https://doi.org/10.1007/s13412-024-00978-2.
7. Rittel HWJ, Webber MM. Dilemmas in a general theory of planning. Policy Sci. 1973;4(2):155–69. https://doi.org/10.1007/BF01405730.
8. Lazarus RJ. Super wicked problems and climate change: restraining the present to liberate the future. Cornell Law Rev. 2009;94(5):1153–234.
9. Reid WV, Chen D, Goldfarb L, Hackmann H, Lee YT, Mokhele K, et al. Earth system science for global sustainability: grand challenges. Science. 2010;330(6006):916–7. https://doi.org/10.1126/science.1196263.

10. Perry J. Climate change adaptation in the world's best places: a wicked problem in need of immediate attention. Landsc Urban Plan. 2015;133:1–11. https://doi.org/10.1016/j.landurbplan.2014.08.013.
11. George G, Howard-Grenville J, Joshi A, Tihanyi L. Understanding and tackling societal grand challenges through management research. Acad Manage J. 2016;59(6):1880–95. https://doi.org/10.5465/amj.2016.4007.
12. Moore ML, Olsson P, Nilsson W, Rose L, Westley FR. Navigating emergence and system reflexivity as key transformative capacities: experiences from a Global Fellowship program. Ecol Soc. 2018;23(2):38. https://doi.org/10.5751/ES-10166-230238.
13. Coben S. Foundation officials and fellowships: innovation in the patronage of science. Minerva. 1976;14(2):225–40. https://doi.org/10.1007/BF01107887.
14. Seeyave S, Krug LA, Urban E Jr, Beckman FA, Sathyendranath S, Twigg E. Developing capacity for ocean science through visiting fellowships. Oceanography. 2025;38(1):14–9. https://doi.org/10.5670/oceanog.2025.134.
15. National Academy of Sciences. The postdoc and the institution. Enhancing the Postdoctoral experience for scientists and engineers: a guide for postdoctoral scholars, advisers, institutions, funding organizations, and disciplinary societies. Washington, DC: National Academies; 2000.
16. Goodrich KA, Sjostrom KD, Vaughan C, Nichols L, Bednarek A, Lemos MC. Who are boundary spanners and how can we support them in making knowledge more actionable in sustainability fields? Curr Opin Environ Sustain. 2020;Advancing the science of actionable knowledge for sustainability42:45–51. https://doi.org/10.1016/j.cosust.2020.01.001.
17. Rotem A, Zinovieff MA, Goubarev A. A framework for evaluating the impact of the United Nations fellowship programmes. Hum Resour Health. 2010;8:7. https://doi.org/10.1186/1478-4491-8-7.
18. Fork ML, Anderson EC, Castellanos AA, Fischhoff IR, Matsler AM, Nieman CL, et al. Creating community: a peer-led, adaptable postdoc program to build transferable career skills and overcome isolation. Ecosphere. 2021;12(10):e03767. https://doi.org/10.1002/ecs2.3767.
19. Lowman HE, DeSiervo M, Hall RO, Jahner JP, Jimoh SO, Laughlin DC, et al. Collaborative consortia can boost postdoctoral workforce development. Proc Natl Acad Sci. 2024;121(28):e2401812121. https://doi.org/10.1073/pnas.2401812121.
20. Young OR. The Institutional Dimensions of Environmental Change: Fit, Interplay, and Scale. Cambridge, MA: MIT Press; 2002. https://doi.org/10.7551/mitpress/3807.001.0001.
21. Epstein G, Pittman J, Alexander SM, Berdej S, Dyck T, Kreitmair U, et al. Institutional fit and the sustainability of social–ecological systems. Curr Opin Environ Sustain. 2015;Open Issue14:34–40. https://doi.org/10.1016/j.cosust.2015.03.005.
22. Ostrom E, Janssen MA, Anderies JM. Going beyond panaceas. Proc Natl Acad Sci. 2007;104(39):15176–8. https://doi.org/10.1073/pnas.0701886104.
23. Berkes F, Folke C, editors. Linking social and ecological systems: Management practices and social mechanisms for building resilience. Cambridge: Cambridge University Press; 1998. p. 459.
24. Berkes F, Colding J, Folke C, editors. Navigating social-ecological systems: Building Resilience for complexity and change. Cambridge: Cambridge University Press; 2003. p. 393.
25. Folke C, Resilience. The emergence of a perspective for social–ecological systems analyses. Glob Environ Change. 2006;Resilience, vulnerability, and adaptation: A cross-cutting theme of the international human dimensions programme on global environmental change16(3):253–67. https://doi.org/10.1016/j.gloenvcha.2006.04.002.
26. Ostrom E. A general framework for analyzing sustainability of social-ecological systems. Science. 2009;325(5939):419–22. https://doi.org/10.1126/science.1172133.
27. North DC, Institutions. Political economy of institutions and decisions. Institutional change and economic performance. Cambridge: Cambridge University Press; 1990. https://doi.org/10.1017/CBO9780511808678.
28. North DC, Institutions. J Econ Perspect. 1991;5(1):97–112. https://doi.org/10.1257/jep.5.1.97.
29. Young OR. The Architecture of global environmental governance: Bringing Science to bear on policy. Glob Environ Polit. 2008;8(1):14–32. https://doi.org/10.1162/glep.2008.8.1.14.
30. Cumming GS, Cumming DHM, Redman CL. Scale mismatches in social-ecological systems: causes, consequences, and solutions. Ecol Soc. 2006;11(1).
31. Folke C, Pritchard L, Berkes F, Colding J, Svedin U. The problem of fit between ecosystems and institutions: ten years later. Ecol Soc. 2007;12(1):30. https://doi.org/10.5751/ES-02064-120130.
32. Munck af Rosenschöld J, Honkela N, Hukkinen JI. Addressing the temporal fit of institutions: the regulation of endocrine-disrupting chemicals in Europe. Ecol Soc. 2014;19(4):3. https://doi.org/10.5751/ES-06954-190403.
33. IPCC. Climate Change 2022: Mitigation of climate change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Internet]. Cambridge: Cambridge University Press; 2022 [cited 2026 Sep 1]. Available from: https://www.ipcc.ch/report/ar6/wg3/ https://doi.org/10.1017/9781009157926
34. Topal C. A relational perspective of institutional work. J Manage Organ. 2015;21(4):495–514. https://doi.org/10.1017/jmo.2015.13.
35. Ekstrom JA, Young OR. Evaluating functional fit between a set of institutions and an ecosystem. Ecol Soc. 2009;14(2):16. https://doi.org/10.5751/ES-02930-140216.
36. Rubiños C, Bernedo Del Carpio M. Institutional fit in the water sector. In: Oxford research encyclopedia of environmental science [Internet]. Oxford University Press; 2022 [cited 2025 Dec 1]. Available from: https://oxfordre.com/environmentalscience/display/10.1093/acrefore/9780199389414.001.0001/acrefore-9780199389414-e-787?rskey=b2PlOI&result=1.
37. Olivier T, Vallury S. Institutional fit and policy design in water governance: Nebraska's Natural Resources Districts. Policy Stud J. 2024;52(4):809–32. https://doi.org/10.1111/psj.12550.
38. Ostrom E. A diagnostic approach for going beyond panaceas. Proc Natl Acad Sci. 2007;104(39):15181–7. https://doi.org/10.1073/pnas.0702288104.
39. Devine-Wright P. Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. Wind Energy. 2005;8(2):125–39. https://doi.org/10.1002/we.124.
40. Devine-Wright P, Rethinking, NIMBYism. The role of place attachment and place identity in explaining place-protective action. J Community Appl Soc Psychol. 2009;19(6):426–41. https://doi.org/10.1002/casp.1004.
41. Batel S, Devine-Wright P, Tangeland T. Social acceptance of low carbon energy and associated infrastructures: A critical discussion. Energy Policy. 2013;58:1–5. https://doi.org/10.1016/j.enpol.2013.03.018.
42. Lozano R, Garcia I. Scrutinizing sustainability change and its institutionalization in organizations. Front Sustain. 2020;1:1. https://doi.org/10.3389/frsus.2020.00001.

43. Marquardt J, Fünfgeld A, Elsässer JP. Institutionalizing climate change mitigation in the Global South: current trends and future research. Earth Syst Gov. 2023;16:100163. https://doi.org/10.1016/j.esg.2022.100163.
44. Cerne A, Jansson J. Projectification of sustainable development: implications from a critical review. Int J Manag Proj Bus. 2019;12(2):356–76. https://doi.org/10.1108/IJMPB-01-2018-0009.
45. Lenton TM, Milkoreit M, Willcock S, Abrams JF, Armstrong McKay DI, Buxton JE, et al. editors. The global tipping points report 2025 [Internet]. Exeter: University of Exeter; 2025 [cited 2026 Sep 1]. Available from: https://research.bangor.ac.uk/en/publications/the-global-tipping-points-report-2025/
46. Norström AV, Cvitanovic C, Löf MF, West S, Wyborn C, Balvanera P, et al. Principles for knowledge co-production in sustainability research. Nat Sustain. 2020;3(3):182–90. https://doi.org/10.1038/s41893-019-0448-2.
47. Tuck E. Suspending Damage: A Letter to Communities. Harv Educ Rev. 2009;79(3):409–28. https://doi.org/10.17763/haer.79.3.n0016675661t3n15.
48. Smith LT. Decolonizing Methodologies: Research and Indigenous Peoples. London ; New York : Dunedin, N.Z. New York: Zed Books; 1999. p. 224.
49. Beaty F, Domínguez-Sánchez PS, Nalven KB, Palacios-Abrantes J, Oken KL, Ban NC, et al. Centering relationships to place for more meaningful research and engagement. Proc Natl Acad Sci. 2024;121(25):e2306991121. https://doi.org/10.1073/pnas.2306991121.
50. Chambers JM, Wyborn C, Ryan ME, Reid RS, Riechers M, Serban A, et al. Six modes of co-production for sustainability. Nat Sustain. 2021;4(11):983–96. https://doi.org/10.1038/s41893-021-00755-x.
51. Jerneck A, Olsson L, Ness B, Anderberg S, Baier M, Clark E, et al. Structuring sustainability science. Sustain Sci. 2011;6(1):69–82. https://doi.org/10.1007/s11625-010-0117-x.
52. Colding J. In: Berkes F, Folke C, editors. Linking Social and Ecological Systems: Management practices and social mechanisms for building resilience. Cambridge: Cambridge University Press; 2002. p. 476.
53. 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. Sci Total Environ. 2017;579:1215–27. https://doi.org/10.1016/j.scitotenv.2016.11.106.
54. Maxwell K, Hubbell B, Eisenhauer E. Institutional insights on integrating social and environmental science for solutions-driven research. Environ Sci Policy. 2019;101:97–105. https://doi.org/10.1016/j.envsci.2019.08.003.
55. Nokkala T, Aarnikoivu M, Kiili J. Multidisciplinary peer-mentoring groups supporting knowledge sharing in doctoral education. Scand J Educ Res. 2022;66(5):865–78. https://doi.org/10.1080/00313831.2021.1939142.
56. Risner LE, Morin XK, Erenrich ES, Clifford PS, Franke J, Hurley I, et al. Leveraging a collaborative consortium model of mentee/mentor training to foster career progression of underrepresented postdoctoral researchers and promote institutional diversity and inclusion. PLoS ONE. 2020;15(9):e0238518. https://doi.org/10.1371/journal.pone.0238518.
57. Schipper ELF, Maladaptation. When adaptation to climate change goes very wrong. One Earth. 2020;3(4):409–14. https://doi.org/10.1016/j.oneear.2020.09.014.
58. Arnott JC, Neuenfeldt RJ, Lemos MC. Co-producing science for sustainability: Can funding change knowledge use? Glob Environ Change. 2020;60:101979. https://doi.org/10.1016/j.gloenvcha.2019.101979.
59. Ostrom E. Governing the Commons: The evolution of institutions for collective action. Cambridge University Press; 1990. p. 298.
60. Ostrom V, Tiebout CM, Warren R. The organization of government in metropolitan areas: a theoretical inquiry. Am Polit Sci Rev. 1961;55(4):831–42. https://doi.org/10.2307/1952530.
61. Assubayeva A, Marco J. Methodological approaches on synergies and trade-offs within the 2030 Agenda. iScience. 2024;27(11). https://doi.org/10.1016/j.isci.2024.111100. PubMed PMID: 39555419.

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