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Comment

Focusing on structure and process to integrate and mainstream the social sciences in conservation

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Introduction

Bennett et al. (2016) point out that calls to integrate the social and natural sciences in conservation are now routine. Yet, these calls have a limited effect because they continue to go unheeded, though, as Bennett et al. state, "everyone working in conservation, it seems, recognizes that natural science alone cannot solve conservation problems." Highlighting the need for more comprehensive integration, they present a "framework for a collaborative and integrated conservation science and practice" that ostensibly contains a set of structures for inter- or transdisciplinary team science. However, there is a conspicuous lack of explanation of these structures and, perhaps more importantly, no mention of the corresponding processes necessary to facilitate integration. By not detailing these aspects of their framework, Bennett et al. leave their intent implicit and miss a valuable opportunity to explicate the important role structures and processes perform in interdisciplinary research. As professionals in fields adjacent to conservation have come to understand, the synergistic relationship between structures and processes creates the hospitable environment required for integration and dispels the ad hoc approach to inclusion. Acknowledging the importance of both structures and processes is essential at this nascent and critical stage of emerging interdisciplinarity in conservation.

Structure and Process

In the context of interdisciplinary team science, a structure refers to a conceptual element that organizes, systematizes, and bounds the steps and objectives of research (distinguishing them from structures as institutional elements, e.g., departments or colleges) (National Academy of Science [NAS] 2005). The concepts of codesign, codefine, coproduce, and coimplement are examples of structures because they direct researchers toward an objective bound within a research framework. Processes are behaviors, skills, practices, or capacities researchers learn and develop (McGreavy et al. 2015). Processes operate between, within, or throughout structures to increase interdisciplinary capacity, develop effective practices, and accomplish research objectives (Table 1). For example, processes that train, improve, and evaluate interpersonal communication or project management skills are processes that interdisciplinary teams engage in to connect and realize structural objectives (Hall et al. 2012). The significance of processes is that they focus on the researchers: their behaviors, role or roles in the team, interactions with team members, and how those feedback into and affect the objectives of structures (Lang et al. 2012; McGreavy et al. 2015). By extension, processes can be salient and operate throughout the extent of a research project to enable the realization of multiple structures (Hall et al. 2012). For example, effective communication practices such as listening, openness, and negotiating are central to connecting codesigning to codefining, but are also needed to connect other structures and will likely operate throughout the course of the project (although these skills may not be innately possessed by researchers and may require practice and iteration to learn) (Thompson 2009; Mansilla et al. 2015; McGreavy et al. 2015).

Perspectives on Structures and Processes

For conservation, the structures and processes necessary to integrate knowledge and remove barriers do not necessarily exist within current institutional settings or may

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Table 1. Structures and processes of inter- and transdisciplinary frameworks from fields adjacent to conservation.

	Definition and examples	*References*
Structure	conceptual elements that organize, bound, and systematize the phase and objective of research	Bammer 2013
Codesign	identify and engage with relevant scientific and nonscientific stakeholders and end users in mutually developing shared research questions and design	Hall et al. 2012
Codefine	mutually discuss and define terms, concepts, and relationships across theoretical, methodological, and practical dimensions to create shared language	Lang et al. 2012
Coproduce	collaboration that entwines unique knowledge sets and skills within a shared research design to address codefined problems and produce integrated understanding	
Coimplement	ensure outcomes are disseminated and actualized such that they are useful and useable to end users	
Process	behaviors, skills, practices, and capacities that increase interdisciplinary capacity, which team members can draw on to better shape social and intellectual interactions within a team	Lindenfeld et al. 2012
Communication	skills related to listening, negotiating, decision making, identity and role, or psychological safety	McGreavy et al. 2015
Ideation	conceptual skills to synthesize ideas, theories, or methods and create a shared conceptual or mental models	Palmer et al. 2016
Management	project management, meeting planning, or facilitation skills; leadership skills (e.g., delegation of tasks and responsibilities and development of strategies to increase research efficiency or teamwork)	Thompson 2009

be unused, unrecognized, or undervalued (NAS 2005). As Bennett et al. highlight, current configurations in conservation do not accommodate the structures or processes needed to fully engage with and integrate other knowledge domains. Moreover, these necessary components cannot be shoehorned into existing research paradigms designed and practiced without interdisciplinarity in mind. The question of how to make it happen remains paramount, and the answer—or at least insights—may be found in adjacent fields (Game et al. 2014).

The fields of climate and sustainability science, like conservation, address complex issues of global significance that require integrative research (Meinke et al. 2006; Lang et al. 2012). As such, research from these fields more frequently employs frameworks analogous to that presented by Bennett et al. in their fig. 2. Referred to as transdisciplinary (Lang et al. 2012) or actionable science frameworks (Palmer 2012; Beier et al. 2016), they tend to be dynamic—reflective, iterative, and adaptive—in order to increase interdisciplinary capacity (Palmer et al. 2016). Essential elements of their dynamism are processes developed and implemented as means for researchers and organizations to learn new skills, evaluate practices and behaviors, and allow modification of structural objectives (Bammer 2013; Palmer et al. 2016). A structure, for instance, focuses a team on an objective, e.g., identify relevant partners and develop a shared research design; mutually define terms and concepts; produce outcomes that entwine integrated data, results, and recommendations; or implement outcomes in a manner that is useful to relevant stakeholders. Corresponding processes help research teams realize these objectives. For example, they help researchers understand team dynamics and research partners' roles; develop interpersonal communication and interaction skills, provide project-management and leadership training; improve computational proficiencies and facilitate integration of methods; and provide training in science communication and media relations (Hall et al. 2012; McGreavy et al. 2015; NAS 2015; Palmer et al. 2016).

These examples of processes and their relationship to structures stress how interdisciplinary skill development is integral to collaborative, integrative research (NAS 2005; Bammer 2013; NAS 2015). The emerging field of integration and implementation science, for example, emphasizes that researchers and institutions must develop new skills and approaches, similar to how one acquires disciplinary specialization, to facilitate comprehensive integration and mainstreaming (Bammer 2013). Similarly, Palmer et al. (2016) suggest that research teams need specific training to overcome barriers to integration, enhance interdisciplinary team effectiveness, and build communities of researchers with interdisciplinary competencies. These examples from adjacent fields underscore the need to address structures and processes, concurrently, as a means to remove barriers and facilitate integration.

Opportunities for Progress

Game et al. (2014) state, "borrowing concepts from other fields will not solve all our problems, but it broadens our range of options." Opportunities to borrow and broaden exist, and options from the adjacent fields mentioned above may be of interest to those in conservation who, given its growing centrality, want to engage with interdisciplinary team-science frameworks. The National

Socio-Environmental Synthesis Center (SESYNC) hosted by the University of Maryland (Palmer et al. 2016) and the Sustainability Solutions Initiative (SSI) at the University of Maine (McGreavy et al. 2015) are 2 examples of research centers funded by the National Science Foundation that focus on increasing interdisciplinary capacity and accelerating the production of integrative social-environmental research.

These centers recognize the importance of structures and processes to increase interdisciplinary capacity that can guide research teams past barriers, and eventually remove those barriers, particularly in the context of integrating the social sciences. The design of these centers provides teams composed of scientists, practitioners, policy makers, and end users with the support and training necessary to conduct interdisciplinary research. The National Socio-Environmental Synthesis Center supports projects that address issues at various scales, whereas SSI tends to support those with a local or regional focus, particularly in Maine. Both SESYNC and SSI draw on theory, research, and practice from psychology, organizational science, adaptive management, and the science of team science to design structures that facilitate team-based research and implement processes that increase interdisciplinary capacity (Bammer 2013; Mansilla et al. 2015; NAS 2015). For example, as part of the SESYNC process, the center provides teams with funding and facilities to conduct face-to-face meetings, training in teamwork dynamics and interpersonal communication, access to professional facilitators, and computational support and infrastructure to address issues of data integration and management. Coupled with a growing body of research on interdisciplinary team science, both centers identify factors that positively and negatively influence collaboration through practical application, experimentation, and empirical evaluation in an effort to develop best practices. The work of SESYNC and SSI—implementing, evaluating, and explicating structures and processes that develop interdisciplinary capacity—and the research conducted by the teams they support are building a community of scholars that is less hindered by barriers. These and similar research institutions represent an opportunity for those in the conservation field to complement what they know (i.e., barriers to interdisciplinary research and the need for integration of social and natural science) with what they do not know as well (i.e., structures and processes that facilitate effective interdisciplinary research and integration).

Conclusion

The routine calls Bennett et al. allude to emphasize the critical role social science plays in conservation in an effort to change attitudes or behavior (practices) that act as barriers to integration and mainstreaming. Perhaps, the prevalence of this perspective stems from the idea that "barriers manifest themselves in [the] behaviors and attitudes of researchers" (Lindenfeld et al. 2012). However, attitudes and behaviors are unlikely to change without addressing structures and processes that create them or allow them to persist. Although they provide a welcome commentary, by not providing more explanation of their framework, Bennett et al. missed an opportunity to address the larger and, perhaps, more pertinent issue of structures and processes in interdisciplinary conservation research. Although critical of this particular oversight, the intent of my comment is to complement their essay by providing an additional perspective, essential literature, examples of leading research centers, and encouragement to seek out opportunities as a means to accelerate integration and move conservation past routine calls.

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