Conservation science needs new institutional models for achieving outcomes

Earth is experiencing increasingly rapid environmental change with profound ecological and societal consequences. A gap persists between the science of conservation and the application of this knowledge to policy and decision making. Arguably, conservation science is not keeping pace with the increasing threats to, and loss of, biodiversity. Preparing for environmental changes requires new institutional models – governance arrangements for knowledge generation, decision making, implementation and learning – that not only cultivate innovation but also do so in the context of achieving conservation outcomes.

Producing knowledge in conservation science that informs concrete action is of public value. Yet, the way that biodiversity is valued varies across sectors and industries, and knowledge about biodiversity conservation is fragmented and compartmentalized. Historically, academics have remained in "ivory towers" while those who work for nongovernmental organizations (NGOs) respond to "crises", and there is little cross-fertilization of respective capacities. Despite broad recognition of the pressing need to address biodiversity loss, the knowledge required to achieve outcomes in conservation science is often inaccessible or irrelevant to decision makers and may also be incomplete. We are simply not making headway fast enough, or broadly enough, to stem the overall trend of biodiversity loss. This is not because we lack answers but because we are not collaborating in ways that can effectively address the drivers of biodiversity loss in a rapidly changing world. This represents a loss to society, where inquiry fails to match the needs of action.

Practical change must come – at least in part – from academic institutions in order to meaningfully expand the role of actionable conservation science. Some universities are investing in "boundary organizations" to cultivate outcome-oriented knowledge production with conservation practitioners. Boundary organizations provide a mechanism to examine how the production of actionable knowledge in conservation creates outcomes of public value. Despite the rich literature available on collaborative governance of natural resource systems, knowledge integration in conservation, and the role of boundary organizations, there is an absence of "actionable principles" for translating scientific discovery into conservation practice (see *Frontiers*' April 2016 Special Issue; https://bit.ly/2MuJYz8).

At Arizona State University (ASU), the Center for Biodiversity Outcomes (CBO) relies on an actionable science model that bridges academia with conservation practitioners to produce biodiversity conservation science that informs decision making at local-to-global scales (Figure 1). CBO staff are dedicated to improving upon this model, which relies on partnerships to connect science to policy or management by mediating the flow of information among scientists, decision makers, and other stakeholders, and to making the model replicable and scalable for other institutions worldwide. Universities such as ASU can perform the kind of science – synthetic, interdisciplinary, horizon-scanning – that NGOs (due to resource and disciplinary limitations) cannot. This disparity underscores the need for a particular kind of boundary organization in conservation science – one with interdisciplinary research capacity and "real-world" experience.

ASU's partnership with Conservation International (CI) was established to leverage the university's strengths in terms of protecting nature, promoting sustainable development models, and training the next generation of conservation leaders. Through this partnership (https://bit.ly/2MpTD9m), CI provides ASU with a mechanism for rendering its research actionable, fostering real-world applications with tangible impacts. ASU provides CI with a wealth of research capacity and an opportunity to interact with, train, and influence up-and-coming conservationists. This partnership represents an exciting opportunity to demonstrate an effective working model that addresses the pervasive "research–action" gap in conservation.

This is not the first university–NGO partnership designed to bridge the science–policy or science–action divide. For example, the Natural Capital Project (NatCap; https://naturalcapitalproject.stanford.edu) represents a partnership between Stanford University, the University of Minnesota, The Nature Conservancy (TNC), and World Wildlife Fund. NatCap's "coalition model" aims to deliver science and tools to bring natural capital to decision making. Similarly, the Cambridge Conservation Initiative (www.cambridgeconservation.org) partners with the United Nations Environment Programme and several conservation NGOs to "deliver transformational approaches to understanding and conserving biodiversity and the wealth of natural capital it represents". TNC is also piloting a so-called "Professor of Practice" (PoP) model with the University of Washington and with Cornell University.

Building on the successes of these other partnerships, there is ample opportunity to innovate and experiment with partnership models that yield conservation outcomes. For instance, the ASU–CI partnership aims specifically to (1) protect 1 million hectares of essential natural capital vital to human well-being, (2) transition 100 million food producers to sustainable production methods, and (3) train new conservation leaders inside and outside the classroom (WebFigure 1). Its graduate and postdoctoral training program provides an important mechanism to achieve these outcomes by connecting undergraduates, graduate students, and postdocs to CI through collaborative field-based conservation science initiatives. One unique feature of the ASU–CI partnership is its PoP program. In 2017, six of CI's leading scientists were hired on a part-time basis to actively engage with ASU scholars to advance outcome-driven research toward advancing the three goals mentioned above (WebFigure 1). These six scientists are co-developing research with ASU faculty, engaging students in

the classroom and at CI field sites around the world, and spearheading joint conservation efforts. Institutional support for CBO as a boundary organization has provided the scientists in the ASU–CI PoP program with an academic home for interaction with faculty and conservation initiatives across campus and beyond.

As universities and NGOs continue to explore new partnership models, it will be important to collect information on the individual and institutional characteristics that lead to conservation outcomes. We hope that ASU–CI partnership activities will yield insights for other scientists and decision makers to think outside the conventional concepts of historical states and resource management practices. By establishing and testing new models for academic engagement, such efforts will produce evidence-based outcomes that may be more broadly applied. Thus, while we at the ASU–CI partnership focus primarily on achieving outcomes to important environmental challenges, we urge other universities and NGOs to explore new models of engagement based on our experiential learning. We look forward to hearing from other ecologists about alternative models designed to achieve conservation outcomes.

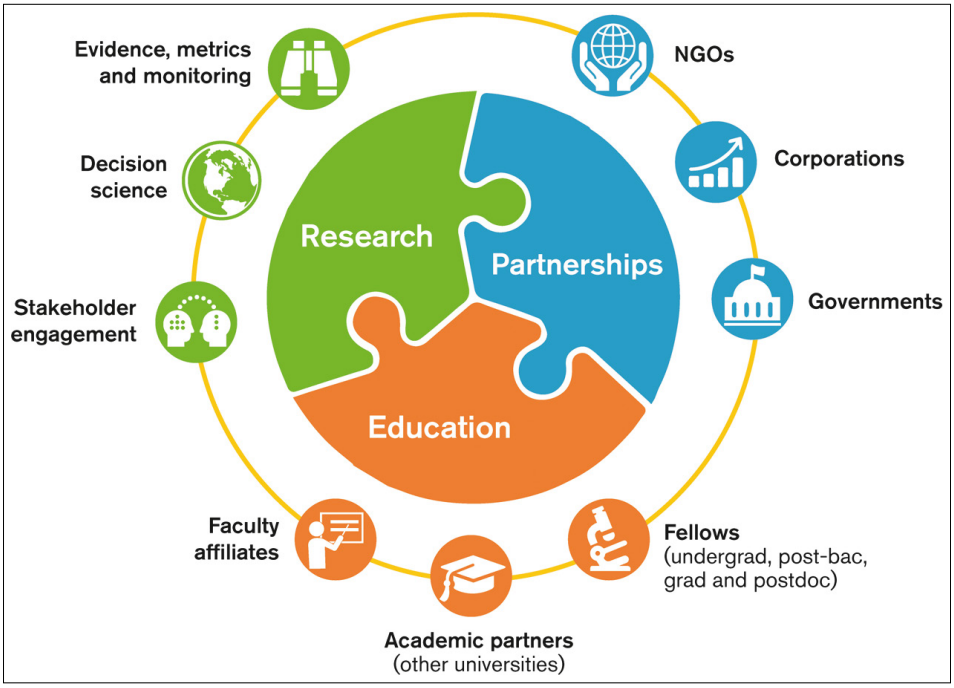

Figure 1. The Center for Biodiversity Outcomes employs an actionable science model to bridge academia and stakeholders to produce science that informs decision making at local-to-global scales. For research, we produce insights that transform understanding and management of biodiversity. For education, we draw on the intellectual capacity of Arizona State University to train the next generation of conservation leaders in how to communicate with non-specialist audiences to increase influence and reach. For partnerships, we engage partners from various sectors to apply innovative research results to achieve real-world change.

Acknowledgements

We thank D Anderson, M Burgman, B Lalasz, and A Scoville-Weaver for comments, and A Astudillo for assistance with the figures.

Leah R Gerber[1]*, and Daniela Raik[2]

*[1]School of Life Sciences and Center for Biodiversity Outcomes, Arizona State University, Tempe, AZ *(leah.gerber@asu.edu); [2]The Betty and Gordon Moore Center for Science, Conservation International, Arlington, VA*

Supporting Information

Additional, web-only material may be found in the online version of this article at http://onlinelibrary.wiley.com/doi/10.1002/fee.1951/suppinfo