Navigating translational ecology: creating opportunities for scientist participation

Lauren M Hallett[1]*, Toni Lyn Morelli[2], Leah R Gerber[3], Max A Moritz[4], Mark W Schwartz[5], Nathan L Stephenson[6], Jennifer L Tank[7], Matthew A Williamson[5], and Connie A Woodhouse[8]

Interest in translational ecology (TE) – a research approach that yields useful scientific outcomes through ongoing collaboration between scientists and stakeholders – is growing among both of these groups. Translational ecology brings together participants from different cultures and with different professional incentives. We address ways to cultivate a culture of TE, such as investing time in understanding one another's decision context and incentives, and outline common entry points to translational research, such as working through boundary organizations, building place-based research programs, and being open to opportunities as they arise. We also highlight common institutional constraints on scientists and practitioners, and ways in which collaborative research can overcome these limitations, emphasizing considerations for navigating TE within current institutional frameworks, but also pointing out ways in which institutions are evolving to facilitate translational research approaches.

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In the spring of 2014, the Colorado River ran from the Rocky Mountains to the Gulf of California for the first time since 1998, thanks largely to the efforts of a diverse international team of individuals representing government agencies and non-governmental organizations (NGOs). Karl Flessa, a professor of geosciences at the University of Arizona (Tucson, AZ) and a member of that team, said that watching the flowing Colorado was the highlight of his career, remarking, "It doesn't get any better than this" (Robbins 2014).

In a nutshell:

- Translational ecology brings scientists and stakeholders together to develop research that addresses environmental challenges
- Engaging participants with different perspectives can enhance the quality and applicability of science, but differences in participant incentive structures can pose a challenge to collaboration
- Early and iterative dialogue, potentially mediated by boundary organizations, can help to identify to understand each others' perspectives, constraints, and flexibilities
- Using one partner's flexibilities to overcome another's constraints can increase the success of translational research

[1]*Environmental Studies Program and Department of Biology, University of Oregon, Eugene, OR* *(hallett@uoregon.edu); [2]*Northeast Climate Science Center, US Geological Survey (USGS), Amherst, MA*; [3]*School of Life Sciences, Arizona State University, Tempe, AZ*; [4]*Department of Environmental Science, Policy, and Management, University of California–Berkeley, Berkeley, CA*; [5]*Department of Environmental Science and Policy, University of California–Davis, Davis, CA*; [6]*Western Ecological Research Center, USGS, Three Rivers, CA*; [7]*Department of Biological Sciences, University of Notre Dame, Notre Dame, IN*; [8]*School of Geography and Development, University of Arizona, Tucson, AZ*

Flessa's scientific research in the Colorado River Delta began in the 1980s, at which time his primary focus was on understanding the process of mollusk fossilization. Observing that water diversion decreased benthic productivity and biodiversity, he began to meet with representatives of government agencies and NGO partners to develop a research program that was relevant to contemporary policy decisions (Zamora-Arroyo and Flessa 2009; Glenn *et al.* 2013). Flessa spent countless hours in discussion with various stakeholders over the next three decades, time which could have instead been devoted to research publications and other activities that would advance his academic career. Ultimately, however, this community engagement increased the interest in and impact of the work, culminating in the pulse flow experiment that allowed the Delta to flood for the first time in 16 years (Figure 1).

Flessa's work highlights the trade-offs associated with what has come to be called "translational ecology" (TE; Schlesinger 2010; Enquist *et al.* 2017), a collaborative process in which ecologists, stakeholders, and decision makers work together to develop scientific research that informs decision making (Figure 2; Enquist *et al.* 2017). TE differs from applied ecology in that it requires direct and deliberate engagement of end-users of scientific information, and specifically acknowledges shared responsibility for delivering actionable research products (Enquist *et al.* 2017). Translational approaches help ensure that research is applied in a meaningful way. By exposing scientists to different perspectives on their research systems, it can enhance basic science by enabling scientists to identify novel questions and develop a fuller understanding of their field (Schlesinger 2010). However, the timelines and incentives of traditional scientific research can be at odds with TE approaches; although Flessa, a senior scientist, had the flexibility to think beyond the traditional reward structures of academia, this approach can be challenging for other scientists.

Here, we build on a growing body of work that outlines principles and offers practical advice for pursuing TE (eg Jacobs 2002; ACCCNRS 2014; Ferguson *et al.* 2014; Beier *et al.* 2015), with the objective of guiding scientists interested in TE (see Safford *et al.* [2017] for roadmaps aimed at practitioners). Elsewhere (eg Wall *et al.* 2017) TE has been framed in social–cultural contexts and in theory, highlighting the importance of building and establishing social capital by developing long-term trust relationships between researchers, practitioners, and stakeholders (the latter defined by Enquist *et al.* [2017] as people or organizations with an interest in a decision or outcome). We focus primarily on ways in which scientists can engage in TE within the existing institutional frameworks of academia and partner organizations (see Schwartz *et al.* [2017] for a consideration of workforce training and institutional changes). Although our emphasis is on academia and government agencies, since they employ the majority of scientists, we recognize that non-governmental scientists also represent an important group, faced with their own unique set of constraints. Scientist engagement in TE can be challenged both by cultural and institutional norms. We outline common cultural and institutional barriers to scientist engagement in TE, and provide guidelines on how to overcome these barriers.

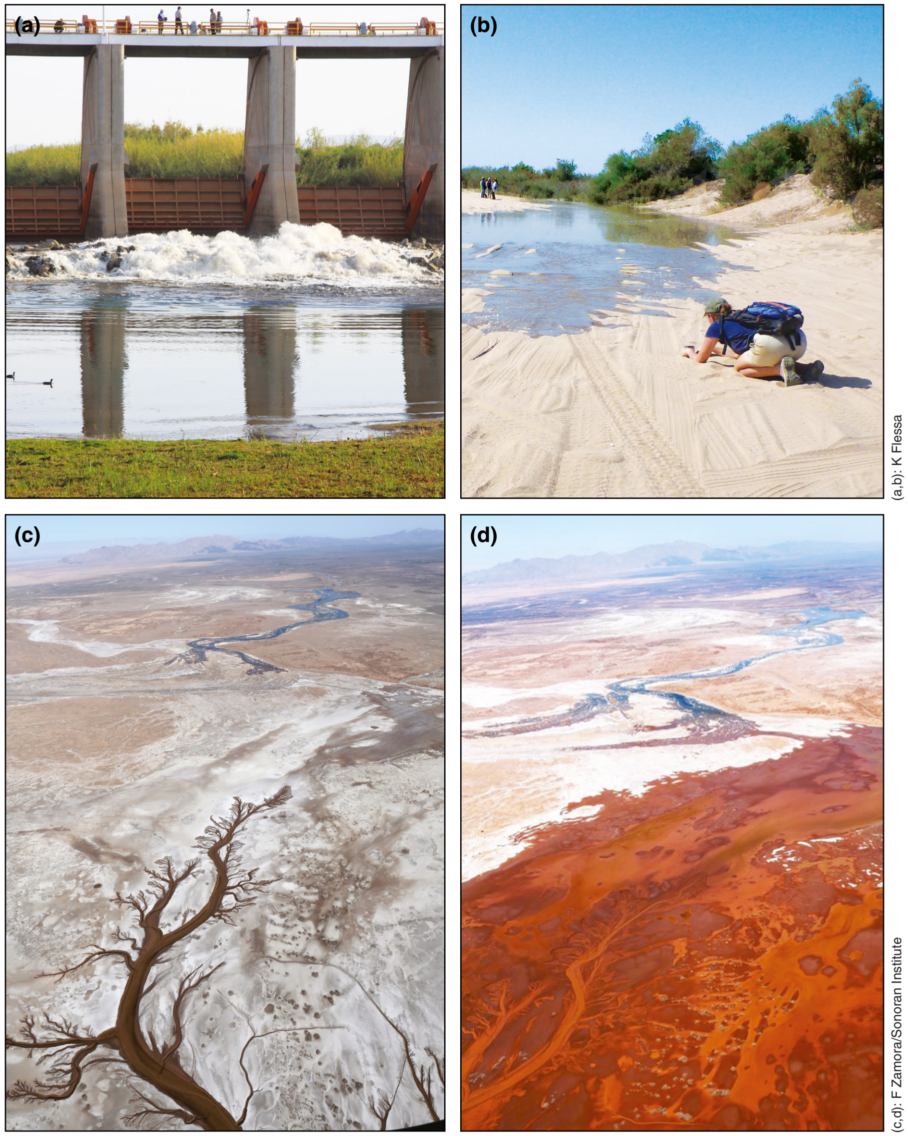

Figure 1. *Images of the Colorado River pulse flow – the result of a "translational" research partnership between academic scientists, government agencies, and NGOs – in which the flow of the Colorado River to the Colorado Delta was experimentally restored for a period of 8 weeks. (a) Water being released from the Morelos Dam; (b) water flowing down the dry river bed after being released from the dam; (c) the Colorado Delta on 12 May 2014 (the tidal channels of the Gulf of California are in the foreground, the river is in the background); (d) the Colorado Delta on 15 May 2014, after the river reached the Gulf of California.*

Building a translational culture

The majority of academic ecologists express a desire for their research to influence decision making, yet few spend the time necessary for building community partnerships (Singh *et al.* 2014). Time and institutional constraints may explain part of this disconnect (Whitmer *et al.* 2010), but cultural norms may also create strong barriers to engaged research (Singh *et al.* 2014). This may be especially true for TE, as, by definition, it brings together participants with diverse perspectives and different cultural expectations. The culture of academia may impede academics from meeting relevant partners or continuing to maximize the benefits of and engage in established projects. Below, we propose a set of guidelines for building strong cross-cultural relationships and suggest potential pathways to these relationships.

Bridging the cultural divide to maximize translational research

A diversity of perspectives can generate novel research outcomes and applicable findings, and an engaged science-to-policy process enhances both the perceived legitimacy

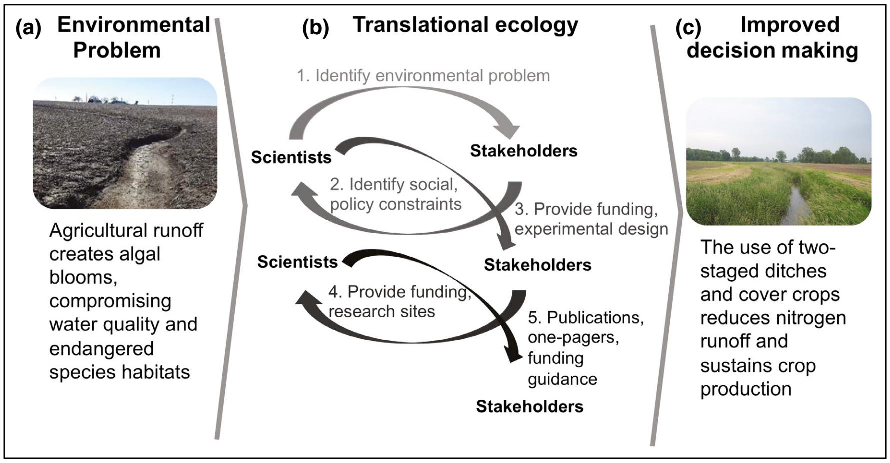

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Figure 2. *Translational ecology is an intentional process by which ecologists, stakeholders, and decision makers work collaboratively to develop scientific research via joint consideration of the sociological, ecological, and political contexts of an environmental problem, resulting in improved decision making. For example, the Indiana Watershed Initiative (Lawson* et al. *2017) employs a translational approach to help farmers choose conservation practices that reduce nutrient exports while maintaining profitable farms. In response to (a) environmental problems from agricultural runoff, the Indiana Watershed Initiative uses (b) translational ecology to identify and experimentally test conservation strategies. This process has (c) improved decision making by identifying ditch structures and cover crops that reduce runoff while maintaining production.*

and impact of the research on decision making (Posner *et al.* 2016). Initially, however, participants may experience a mismatch between the scientist's supply of and the practitioner's demand for information. For example, data derived from scientific research may be at a different scale, resolution, or organizational scheme than is needed for decision making (McNie 2007). Additionally, decision makers may face political or logistical obstacles that prevent the use of that information (Lemos and Morehouse 2005; Sarewitz and Pielke 2007). Several methodological approaches can be adopted to overcome such information mismatches, including joint fact-finding, iterative dialogue, and trust building.

For example, forest restoration in the Sierra Nevada mountain range of California is a multidimensional problem in which efforts to reduce fire risk – by clearing dead wood and thinning the forest – are often viewed as conflicting with efforts to conserve the California spotted owl (*Strix occidentalis occidentalis*). Translational research aimed at conservation must therefore recognize the constraints that land managers face (ie certain restoration and fuel treatments may be off the table, or increasing long-term owl viability may entail deliberate reduction of current habitat) (Figure 3). Spending time developing a mutual understanding of the decision context is therefore essential in helping researchers to form hypotheses that reflect the realm of possibilities. This situation also presents an opportunity for joint fact-finding (McCreary *et al.* 2001), an approach that can both build trust among stakeholders and refine the scientific question(s) of interest. Ultimately, such scientist–stakeholder partnerships can provide an important foundation for implementing adaptive management in accordance with the directives embodied in the most recent Planning Rule for the US Forest Service (USFS 2012).

In a similar vein, investing time early in the translational process enables partners to understand one another's contexts and interests, which helps ensure that the collaboration reflects the culture and meets the needs of each partner (Halofsky *et al.* 2011). Discussions early on can also help participants fully understand and articulate their own needs, allowing them to negotiate a research plan that can meet these needs (eg negotiating the timeline or study design, gap filling on grants, etc). Although this preliminary work requires time, initiating the translational process with an awareness of each participant's biases (eg what forms of knowledge each participant prioritizes) and constraints is key to creating trust, sustaining collaborations, and reducing potential conflicts (Simpson *et al.* 2016).

Equally important is maintaining a regular dialogue throughout all stages of the work (Garfin *et al.* 2016). Credibility and trust within multi-stakeholder groups is earned through commitment to the process and time (Lemos *et al.* 2012). For example, partnerships around politically complex watersheds (eg the Chesapeake Bay Program and the CALFED Bay–Delta Program) have been built on trust developed through long-term engagement (Heikkila and Gerlak 2005). Showing up to a meeting to deliver scientific results without further action is unlikely to have a lasting effect on outcomes (Posner *et al.* 2016); researchers should instead anticipate and plan for iterative interactions with stakeholders to ensure that a collaborative process is used to define problems, identify research needs, and produce actionable results (Lemos and Morehouse 2005). Including feedback mechanisms throughout the project enables an assessment of whether each partner's needs are being met during both project development and implementation (Ferguson *et al.* 2014). In addition to feedback, projects should include an evaluation component to ensure that lessons are learned (both what to do and what not to do) from the experience (Lemos and Morehouse 2005).

Entry points to TE

Take advantage of "information brokers" and boundary organizations

One important aspect of TE, resulting from its collaborative nature, is that there may be more than one individual who can instigate and sustain a project, and numerous possible pathways to be followed. Within academic or practitioner communities there is often one person who is familiar with both researchers and practitioners, and has developed the expertise to work as an "information broker" (Michaels 2009; Ferguson *et al.* 2014; Newman *et al.* 2016). Identifying and reaching out to information brokers can yield new contacts, and they can also often facilitate ongoing interactions among partners. Many government management agencies, such as the US Geological Survey and the US Fish and Wildlife Service (USFWS), employ scientists with academic backgrounds who are able to relate to both communities.

It is also possible to work within a framework of existing "boundary organizations" that function to connect both researchers and practitioners (Kirchhoff *et al.* 2015). Examples of boundary organizations include the Cooperative Extension Services of US land-grant universities and the National Oceanic and Atmospheric Administration's (NOAA's) Regionally Integrated Sciences and Assessment (RISA) program, which focuses on climate science and decision making (Clark *et al.* 2010; Parker and Crona 2012; Lubell *et al.* 2014; Parris *et al.* 2016). Support for boundary organizations is also becoming increasingly popular among academic institutions; for example, the primary goal of Arizona State University's Center for Biodiversity Outcomes is to cultivate interdisciplinary collaboration and co-produce solutions with government agencies, NGOs, foundations, and corporations.

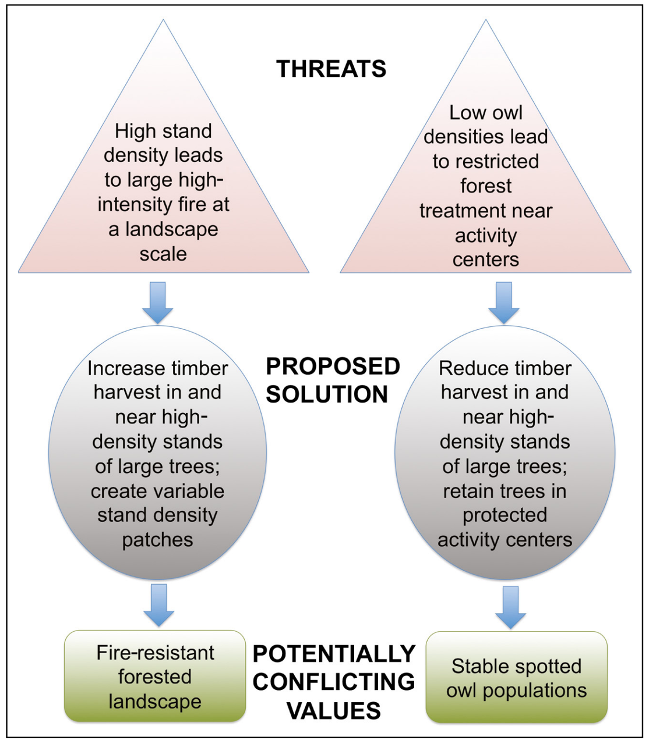

Figure 3. *Conceptual model of primary tensions involved in California spotted owl (*Strix occidentalis occidentalis*) management. Research that ignores the larger decision context and focuses solely on one goal (eg fire prevention or owl populations) will be less useable by government agencies tasked with forest management.*

Center partnerships around place-based research

Translational ecology is often shaped by a sense of place. Place-based research provides an intellectual and physical meeting point to frame sustained collaborations (Pulwarty *et al.* 2009). Forging partnerships around a shared location provides a common reference point for academics and stakeholders, and the nature of this research lends itself to long-term collaborations (Collins *et al.* 2011). In addition, delving deep into the workings of a single area often provides insights that can overturn long-held assumptions, ultimately leading to new generalizations while still recognizing the unique attributes of the setting (Billick and Price 2010). Moreover, the notion of "place" often holds a deeper meaning for stakeholders, based on their experiences, perceptions, and cultural values relating to a particular landscape (Davenport and Anderson 2005). This local attachment lends additional context to be considered in place-based research.

An early effort in climate-change adaptation took just such an approach, with government scientists and government managers (in this case primarily from the USFS) adopting a collaborative, case-study process. Through a multiyear, in-depth partnership in which junior scientists were closely involved with local forest managers and decision makers, specific needs were identified and tools and data portals were developed to meet those needs (Peterson *et al.* 2011). In contrast, failing to build a sense of place can lead to scientific misunderstandings that yield negative management outcomes (eg misidentifying intact grasslands as afforestation opportunities, as was highlighted by Veldman *et al.* 2015).

Embrace serendipity

Like much of science, TE frequently develops through unexpected observations and serendipitous events. For example, when Karl Flessa set out to study the Colorado Delta, it was to pursue an interesting scientific question: how shells become fossils. He did not set out to be discovered by NGOs interested in addressing environmental impacts. However, his openness to new collaborators and questions enabled the eventual development of a long-term, mutually beneficial translational research program. Similarly, identifying and acting on opportunities that arose led to the gradual expansion of the research program. Although translational research was a necessary component of the pulse flow, it was not sufficient to allow the study to be conducted. Instead, much of the political motivation for the experiment came in response to an earthquake in the Delta in 2010 and an extended drought in the Basin. Major

Panel 1. Overcoming barriers to translational research

Translational ecology is a "cross-cultural" enterprise between scientists and stakeholders. Diverse cultures and perspectives can enhance the quality and impact of science, but can also create different barriers to scientist and stakeholder engagement. However, scientists and stakeholders also have different levels of flexibility and this may allow them to help each other to tackle challenges (green arrows in Figure 4; Tables 1 and 2).

Table 1. Constraints on scientists (and how stakeholders can help overcome them; Figure 4a)

Scientist constraint	*Stakeholder flexibility*
Pressure to publish (academics)	Involve scientists in project design and implementation; include controls
Rigid timelines, such as academic calendar, degree lengths, and tenure (academics)	Adjust hiring to match academic calendar; be open to publishable sub-projects
Need for grants and funding (academics)	Strengthen broader impacts for traditional funding (eg NSF); expand funding options via boundary organizations
Mandated to avoid making direct policy recommendations (government scientists)	Shift from "should" requests and recommendations to "if, then" statements

Table 2. Constraints on stakeholders (and how scientists can help overcome them; Figure 4a)

Stakeholder constraint	*Scientist flexibility*
Pressure to act and move forward with available information	Provide iterative "one-pagers" as work progresses; ongoing experimentation
Penalized for unsuccessful trials; risk averse	Take responsibility and provide land or funding for higher-risk treatments

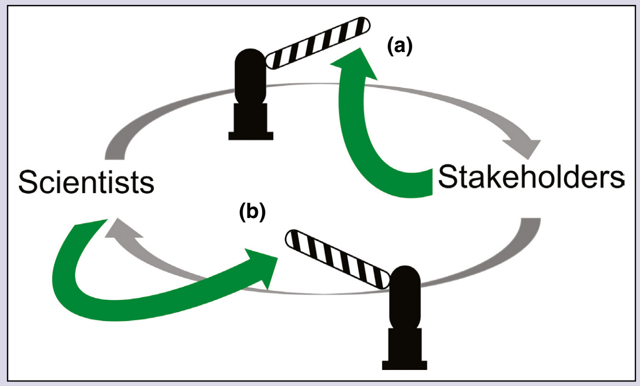

Figure 4. *Conceptual figure in which (a) stakeholders can overcome scientist-related barriers to engagement and (b) scientists can overcome stakeholder-related barriers to engagement.*

research advances resulted from a culture of openness that placed researchers and stakeholders in the right place and time – an opportunity more easily observed and acted on given the team's mix of scientific and policy backgrounds (K Flessa pers comm).

Overcoming institutional barriers to TE

The "cross-cultural" nature of TE is strongly shaped by the different institutional and professional expectations of scientists and stakeholders. Differences in the incentives driving each partner can create – or appear to create – strong barriers to participation, but partners may also have different levels of flexibility, allowing them to mitigate each other's challenges. Below, we describe common constraints on academics and stakeholders, and potential ways in which partners can accommodate them (Panel 1).

Constraints on scientists (and how partners can help overcome them)

Academic scientists

Throughout its history, ecology has developed as both a basic and applied science, and integrating research with environmental management has been increasingly valued within the discipline. Nevertheless, ecologists face trade-offs in terms of time and advancement metrics (eg graduation requirements, tenure review; Gordon *et al.* 2016). Thus, one way to enable academic ecologists to conduct translational research is to identify how to reduce an individual's time investment or to identify additional benefits that justify that investment (Enquist *et al.* 2017).

Academia can be both too fast and too slow for products that benefit all partners (Newman *et al.* 2016). The requirements for obtaining a tenure-track position or tenure itself mean that adding a few years to a project's timeline, which effective TE can sometimes require, may prevent early-career ecologists from engaging in this work (Foster *et al.* 2015). On the other hand, some management agencies want to produce a publication sooner than the researcher may be comfortable with publishing the data, or at least sooner than it takes to go through the process of peer-reviewed publication (Jacobs 2002; van Kerkhoff and Lebel 2006; Vogel *et al.* 2016). While the non-peer-reviewed "gray" literature can sometimes be produced more quickly, researchers generally do not receive the same (or in many cases, any) credit for these documents, and they are typically not widely cited nor read by academics.

Stakeholders and scientists can collaborate early on in a new project to enhance their chances of publishing quality results in a timely manner. By designing experiments and monitoring protocols from the beginning, academics can ensure that subsequent stakeholder efforts fit the expectations of academic publishing (eg including controls, ensuring adequate statistical power). A robust experimental design can both improve the chances of timely academic publication and give academic ecologists the incentive and confidence to incorporate the project into other aspects of their program that may be evaluated by hiring or tenure committees (eg student projects that fit within long-term studies, grant applications).

Similarly, stakeholders may also have some flexibility within a collaboration to make sure that the timing of treatments or actions fit a publishable design. For example, personnel hires in ecology often revolve around the academic calendar and can take time. Asking stakeholders to delay a project until a graduate student or postdoc is hired increases the likelihood of an academically worthwhile publication as well as achieving pedagogical outcomes. New journals that specialize in publishing articles focused on engaged research (eg *Ecology and Society*) are increasing the chances for ecologists to receive traditional rewards for practicing TE.

Grant opportunities represent a second key leverage point for which stakeholders like agency managers may be able to provide assistance. Historically, research funding allocation has been based on traditional metrics and questions that address theoretical issues in ecology. Several boundary-spanning organizations have been created to address applied issues in ecology and/or environmental science, among them NOAA's RISA program, the USFWS's Joint Ventures program, the US Department of Agriculture's Regional Climate Hubs, and the US Department of the Interior's Landscape Conservation Cooperatives and Climate Science Centers. These organizations generally require stakeholder-driven research and clear applications to resource management and conservation, often in the form of products beyond journal articles (eg maps, websites, workshops, manuals, etc).

Traditional science funders, such as the National Science Foundation (NSF), are also explicitly identifying and valuing engaged research in calls for proposals (eg NSF broader impacts and human dimensions requirements; joint programs between NSF, The Nature Conservancy, and Wildlife Conservation International; the Joint Fire Science Program's funding priorities). By engaging with stakeholders, academics may improve funding success via these pathways. Moreover, stakeholder agencies may be able to provide matching funds or supplementary funding between grants, providing continuity for research projects, as short grant cycles are not amenable to long-term engagement and projects from traditional science funders rarely receive repeat funding (Vogel *et al*. 2016).

Government scientists

Many of the constraints on government scientists – whether at the federal- or state-agency level – are comparable to those experienced by academic scientists. For example, government scientists feel similar pressure to rapidly publish their results in high-profile journals. But other constraints may be unique. Government scientists in many US agencies are not allowed to be co-authors on publications that make specific policy or management recommendations, and so may be unable to participate in translational research projects that make such recommendations. However, this particular restriction is less of a hindrance to publication than it might initially appear. For instance, "should" statements that recommend a particular course of action (eg "Policy makers and managers should implement X") are often easily replaced with "if, then" statements that highlight the same course of action without specifically recommending it (eg "If policy makers and managers wish to achieve outcome Y, then our findings suggest that the best course of action is to implement X") (NRC 2009).

In addition to undergoing traditional journal peer review, manuscripts authored by government scientists are usually subject to agency review and approval, which can slow the publication process. Although these delays can be substantial, particularly for manuscripts on contentious issues, in most cases such delays are relatively minor.

Scientists at NGOs

An increasing number of ecologists are employed by NGOs. These organizations range from conservation science providers (eg Conservation Biology Institute, Conservation Science Partners, Point Blue Conservation) to mission-driven organizations (eg The Wilderness Society, Wildlife Conservation Society). Although each of these organizations (and the constraints faced by the ecologists they employ) is unique, several key challenges transcend individual organizational identity. For example, such organizations are often funded through a mix of philanthropic donations, individual donations, and fee-for-service contracts. This funding structure tends to reduce the resources available for large-scale or long-term research studies, as grants and contracts are often allocated in smaller amounts over shorter periods than those offered by traditional academic funders. Furthermore, the research pursued by these ecologists must be compelling to the specific funders and/or be in service of the mission of the NGO. As such, ecologists working for NGOs face increased pressure to specify how their work ought to be applied rather than emphasizing the role of uncertainty in their results, creating a conflict between the social norms of the funding sources or land-management communities and those of the scientific community. Finally, these scientists often have to deal with questions about the legitimacy of their findings if their organizations have a mission, history, or source(s) of funding that focus on a specific agenda.

Partnering with scientists at academic and governmental institutions can offer opportunities for overcoming these constraints. Partnerships with scientists at governmental and academic institutions help diversify funding portfolios, allowing for longer-term and more field-intensive research. Cross-institutional research may also increase the credibility of research results.

Constraints on stakeholders (and how scientists can help overcome them)

Whereas academic ecologists have a mandate to discover, many stakeholders, such as federal and state land managers, have a mandate to act. Decisions often need to be made quickly (NRC 2009; Vogel *et al.* 2016), which can clash with academic culture, where scientists work slowly through the process of research design and implementation, frequently in the context of graduate student development, toward the ultimate goal of peer-reviewed journal publication (Jacobs *et al.* 2005; Hambrick 2007; Hoffman 2016). As such, scientists have been cautioned about publicizing results (ie giving "the answer") prior to publication.

However, academic scientists can be creative about how they relay preliminary findings. For example, the use and re-use of "one-pagers" and webinar series that summarize recent research outcomes can be shared and exchanged among partners, with the explicitly acknowledged caveat (included on the material) that the data are "in progress" and have not yet been peer reviewed. Sharing these at stakeholder meetings and field days can be an effective way to update research outcomes, and can assist partners as they move forward in decision making. For example, this approach is integral to the Indiana Watershed Initiative (Figure 2; Lawson *et al.* 2017). In addition, this ongoing exchange can shape future research trajectories, as ideas are exchanged and suggestions made by partners. This approach works best when partners have developed trust through collaboration (NRC 2009); for particularly contentious issues, however, sharing results prior to publication can backfire (Hemmati 2002) and cause scientists to avoid future engaged scholarship (Poliakoff and Webb 2007).

Stakeholders – both private landowners and employees of federal and state governments – also tend to be risk averse and concerned about potential litigation. For example, many contemporary environmental management issues are characterized as "wicked problems" (LaChapelle *et al.* 2003), where incomplete information and conflicting objectives lead to risk aversion in decision makers (eg Bormann *et al.* 2007). This can result in management actions that have little impact or ambiguous effects on the stated objectives (ie the effect size is too small to detect). From the perspective of a resource manager, engaging in these projects can be dangerous because results are not guaranteed and such attempts may alienate the public. From an academic perspective, however, these situations provide an ideal opportunity for experimentation, where the various positions (or preferred treatments) become integrated into the experimental design. Academic researchers can encourage stakeholders by taking responsibility for the high-risk elements of useful experiments (Ahern *et al.* 2014). This approach can provide a relatively "safe" place for stakeholders and decision makers to implement actions that are consistent with their various positions (as well as potential compromises) and objectively evaluate the outcomes together (Panel 1).

Efforts to manage grazing lands in the southwestern US, a long-standing source of conflict, demonstrate the benefit of scientists assuming responsibility for risk. The North Rim Ranches Partnership – a collaboration between state and federal natural resource managers, conservation organizations, and research institutions – was formed, in part, to address this issue within the context of a collaboratively designed experimental framework (www.grandcanyontrust.org/north-rim-ranches; Lytle and Williamson 2012). Treatments range from no grazing to substantial increases in grazing above current levels. Because the Partnership was committed to experimental evaluation of alternatives (each reflecting stakeholders' various beliefs about how the land "should" be managed), they were able to create the space for management alternatives that would otherwise have been considered threatening to the interests of either the ranching or conservation communities. Ideally, the results of these experiments will inform broader policy change, with implementation made easier by a data-driven process that considers multiple perspectives collected by a broad coalition of partners (and not by any single interest group). In addition, the use of robust experimental design ensures that the scientists involved will be able to publish their findings upon completion of the various phases of the research.

Institutional change toward TE

Just as new research approaches are emerging within ecology to deal with environmental realities, many universities are reinventing themselves to cope with challenging political and funding environments (Franz 2009). Translational ecology, and translational science more broadly, may provide potential solutions by linking research and pedagogy to new and varied funding streams. Emerging ideas for academic institutions to promote TE include funded graduate student extension programs (eg Leopold Leadership Institute; Center for Collaborative Conservation; Reid *et al.* 2012; Schwartz *et al.* 2017), sabbaticals designed to immerse professors in management environments as opposed to traditional research sabbaticals, and guidance on evaluation procedures that provide recognition and career advancement for achievements in outcome-centered research (Franz 2009). Collective experience will provide the basis for developing an evidence-based approach for best practices in TE. Other articles in this Special Issue (Enquist *et al.* 2017; Safford *et al.* 2017; Schwartz *et al.* 2017) detail these and other institutional changes that will enable translational ecologists.

Beyond changes to funding models, academic advancement, and pedagogy, we suggest that a fundamental change in the way society approaches environmental decision making is necessary to truly catalyze TE. Environmental decisions are often highly contested, and involve navigating diverse and competing objectives. We suggest that translational ecologists can play a key role in mediating the decision-making process by designing experiments in the specific context of the various objectives, so that they can evaluate proposed solutions to environmental problems more explicitly. The act of conducting research then can span boundaries between multiple stakeholders, helping to create a shared vision of success while providing knowledge about the mechanisms driving the response of the socioecological system at hand.

There are many ways to perform quality science, and TE will not always be necessary or preferable to other forms of basic or applied science. However, to generate scientific solutions to environmental issues, it is important to foster cultural and institutional norms supporting TE – an approach that can address complex environmental challenges (Lubchenco 2017). Here, we have emphasized ways that individual researchers can engage in TE within existing disciplinary and institutional frameworks. We are hopeful that increasing participation in TE will fuel ongoing institutional change to better support translational research in the future.

Author contributions

All authors collaboratively developed the content and structure of the manuscript; LH and TLM wrote the manuscript, with contributions from NS, JT, MW, and CW; and all authors edited the manuscript.

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