Perspective

Manager characteristics drive conservation success

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ABSTRACT

The human aspect of conservation and restoration is implicit and widely considered in the literature. However, human traits are rarely if ever incorporated into models to explain actual quantitative measures of success or failure. A paper by Sher et al. recently published in a special issue of Wetlands filled this gap by exploring the impact of the characteristics of managers and managing organizations on restoration success among 243 sites where an invasive tree had been removed. Among the 15 human variables considered were how many agencies were involved in the project, the relative priority of particular goals, how intensive monitoring was, and what type of degree the manager had. Given that Sher et al. found that as much as 63% of the variability in restoration outcomes could be explained by such human factors alone, we argue that future studies seeking to understand conservation and restoration outcomes would do well to incorporate such variables in a more explicit way. Quantitative inclusion of the human element can expand our understanding of the processes at work and test theories regarding the importance of goal-setting and other often proposed recommendations about process and project organization. Given that to do so requires an interdisciplinary approach, we also make a case that greater integration between the social and natural sciences will improve our understanding of these systems and lead to better results.

1. Introduction

Successful conservation management requires an understanding of what types of strategies work, where, and why. Ultimately, the goal of conservation research and practice is to identify strategies that can be replicated across contexts so that conservation is effective and funding is spent wisely (Maas et al., 2019). Thus, a major focus of conservation science involves evaluating the effects of different environmental factors and management approaches. The results of such investigations provide important insights about successful interventions and are often used to derive recommendations for biodiversity management. Yet, as a recent paper by Sher et al. (2020) demonstrates, human dimensions of conservation success, especially the characteristics of managers and managing organizations, are less frequently studied. As a result, we may well be missing key determinants of success of conservation efforts.

For example, there is an extensive literature quantifying the success of vegetation restoration projects based on the impact of different management approaches and site characteristics on native plant

recovery. Hundreds of studies have investigated how restoration success is affected by planting techniques (Elliott et al., 2019), soil and hydrological factors (González et al., 2015), and grazing exclosures (Condon et al., 2020), just to name a few. Meta-analyses of restoration projects (Atkinson and Bonser, 2020) and large geographic-scale analyses (González et al., 2017) have helped to identify site characteristics and treatment effects that contribute to overall success, measured in terms of native plant recovery and the elimination of non-native invasive plants. In some analyses, as much as 50% of the variation in success can be explained by these factors (Sher et al., 2018). However, what is missing from these analyses are the traits and characteristics of the people and organizations conducting the work as a causal factor in success (Adams et al., 2019). Although the training, experience, and collaboration of conservation biologists have been discussed as being important to conservation practice (Toomey et al., 2017; Catalano et al., 2019), to our knowledge the actual impact of the characteristics of the project managers and managing organizations on conservation success has not before been quantified. One of the major challenges is that projects that

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fail or have a poor result are often not published (Godefroid et al., 2011; Catalano et al., 2019), contributing to the problem of identifying the characteristics that distinguish successful projects from failed projects if only relying on published studies.

2. Including managers and managing organizations in research designs

In an innovative study, Sher et al. (2020) address this missing piece of the equation and demonstrate that the characteristics of the managers and managing organizations carrying out conservation projects also significantly contribute to their success or failure. Using raw data from restoration sites across the USA southwest, they found that the human dimensions of restoration projects (e.g., organizations, managers, information sources, and goal-setting) may be as important or even more important for predicting conservation management success than environmental characteristics (e.g., geography, ecohydrology, and climate) and management techniques.

The analysis of Sher et al. (2020) considered 243 sites in the southwestern USA, where efforts were made to control the invasive tamarisk tree (*Tamarix* spp.; Fig. 1). Each site was paired with a control, with restoration success measured with a multivariate metric that captured the reduction in the cover of noxious, invasive plants as well as the restoration of native vegetation. The initial analysis showed that out of 17 physical and environmental characteristics considered, climate of the site (including precipitation and temperature), landscape features such as slope and distance to the nearest road, and the site treatments, such as how the trees were removed and whether or not herbicides were used, explained around 45% of the variation in restoration success.

Sher et al. (2020) then considered how the addition of human variables increased predictive power. These were 15 variables that included management decisions not directly involved with the plants themselves (such as monitoring frequency and information sources used),

organization (what agencies were involved and in what way), manager characteristics (such as education and experience), and the relative priority of goals the managers had set (e.g., plant-related versus people-related). This further analysis was possible because of the large number of studies involved, the high similarity of methods and results in each study (i.e., removing tamarisk trees and measuring vegetation recovery), and most importantly, because data on the managers was available (Clark et al., 2019). The Sher et al. (2020) study found that adding manager and management factors into the statistical models increased the amount of variation explained to between 63% and 78%, with an average of a 47% increase. When physical and environmental variables were then removed from the models, R-square values only decreased by about 15%. In summary, human variables were very important and did a better job of explaining variability in restoration success than environmental variables alone.

The most important human characteristics in the models were the type of agency managing the project, the number of information sources consulted by the manager, and the frequency of monitoring (Sher et al., 2020). On the agency level, state agencies were more effective than federal agencies, and projects were more successful when they involved multiple agencies rather than projects done by one agency. Presumably multiple agencies can share expertise and resources, and state agencies may be more flexible and people-oriented. This result sheds light on the importance of collaboration and transdisciplinary approaches as a key to conservation success (Bennett et al., 2018; Maas et al., 2019). Projects were also more successful when managers used more sources of information as well as more diverse sources of information, including both formal and informal sources. Formal information sources included peer-reviewed literature, best practices manuals, workshops, and seminars, whereas informal referred to consulting peers. Taken together, these results highlight the benefits of having a diversity of perspectives.

Surprisingly, the rate of success for projects declined with monitoring frequency, perhaps because sites with poor response to treatments

Fig. 1. Four stages in the restoration of river woodlands invaded by tamarisk in the Western USA. A. Tamarisk thicket with native cottonwoods in the background. B. Bulldozer with a mulching head attachment being used to remove tamarisk plants. C. Team of scientists and land managers evaluating a site after treatment. D. Successfully restored site with native cottonwood trees. Photos A-C from Anna Sher; Photo D from Tim Carlson.

inspired more frequent monitoring. However, if monitoring frequency itself was a cause, this raises two related questions: 1) is frequent monitoring diverting resources from site management activities like weed control and planting native species, and 2) is there an optimal balance of allocating resources to action and evaluation? These questions are addressed by some studies in the conservation literature (Lyons et al., 2008; Bennett et al., 2018; Bal et al., 2018), and this empirical result highlights the importance of resolving them.

The Sher et al. (2020) study also showed that characteristics of project managers themselves were related to the success of the project. Projects were less successful for managers who had multiple roles, had more advanced educational degrees, and had degrees in science rather than land or natural resource management. The lower success of managers with multiple roles makes sense if multiple roles prevent a manager from focusing on a single task effectively and giving it sufficient attention and resources. Similarly, it is intuitive that having a degree more directly relevant to applied restoration would provide more usable skills than a more academically-focused degree, although to our knowledge this is the first time the actual impact on vegetation outcomes has been measured. Meanwhile, the decrease in success with level of advanced degree seems less obvious or even surprising. One possible explanation is that managers with PhD's might be perceived as less accessible and less willing to collaborate and accept the suggestions from other people relative to those with only a Bachelor's degree. Projects' outcomes also improved when there were explicit plant-related goals, a finding consistent with recommendations (Shafroth et al., 2008), but never before quantitatively linked to restoration outcomes.

3. The human dimension in conservation projects

Of course, the human element, more broadly speaking, is a central component of much of conservation, wildlife, and restoration research. These fields frequently quantify the relationships between humans and nature embedded within social-ecological systems (Liu et al., 2007) - such as in cases of measuring the socioeconomic impact of management on local people (Wortley et al., 2013), or including indigenous expertise, also known as traditional ecological knowledge, in restoration and conservation planning (Uprety et al., 2012). Previous research has surveyed managers for their perspectives on restoration approaches (Druschke and Hychka, 2015; Nost et al., 2019), the traits of managers (Clark et al., 2020), and the relationship between manager attitudes and restoration choices (Curtis and de Lacy, 1998, Clark et al., 2019).

However, empirical studies rarely if ever include the characteristics of managers in their experimental design, and these are not used as explanatory factors for quantitative outcomes (Hershdorfer et al., 2007; Alexander and Allan, 2007). A recent meta-analysis found that sociological factors were frequently mentioned in published studies of "failed" projects (Catalano et al., 2019), lending more support for the need to quantify such elements and explore the relationship between these and more objective measurements of outcomes. Much of the unexplained variability in success rate of conservation, wildlife, and restoration projects may be closely linked to the varying characteristics of the managing scientists themselves and the organizations to which they belong rather than the inherent variabilities in ecosystems or restoration techniques. The Sher et al. (2020) article highlights the way forward for cross-disciplinary research designed to measure the causal relationships between human actors and conservation outcomes.

Ultimately effective conservation management requires repeatable, scalable, successful interventions. To be able to identify which interventions work where and why, we need to understand both the environmental and human dimensions of success. As the Sher et al. (2020) study suggests, the characteristics of the managers, workers, and organizations could be a highly significant but almost entirely overlooked component in evaluating the source of success of conservation, restoration and wildlife studies. That is, quantitative tools should be used to measure the often cited roles these human factors may be having

in these projects. We believe that developing cross-disciplinary projects that integrate human dimensions and expertise from both scientific and applied fields holds much promise to significantly advance conservation science and practice.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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