



Scientists, managers, and assisted colonization: Four contrasting perspectives entangle science and policy



Mark W. Neff*, Brendon M.H. Larson

Department of Environment and Resource Studies, University of Waterloo, 200 University Avenue West, Waterloo, Ontario N2L 3G1, Canada

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ABSTRACT

Assisted colonization is a contentious climate change adaptation strategy, but we have limited understanding of the bases of disagreement amongst scientists and far less has been done to understand the views of other stakeholders. To establish an initial empirical understanding of the terms of the debate, we conducted a Q method study of the views of scientists and resource managers, a key constituency because of their role in decision-making and implementation. We asked 24 forest managers in Ontario, Canada and 26 top-publishing ecologists and conservation biologists to evaluate their level of agreement with 33 statements about assisted colonization from the published literature and other relevant sources. The analysis revealed four main, contrasting perspectives, which we label Ecological Interventionist, Nativist Technocrat, Interventionist Technocrat, and Reluctant Interventionist; all but the Nativist Technocrats were open to assisted colonization. Disagreements between the four perspectives were defined by value-based and policy-strategic considerations at least as much as they were by varied understandings of technical issues. Assisted colonization as a climate adaptation strategy exists within the context of multiple competing and incompatible problem definitions even amongst these technical stakeholders. Based upon our findings and the relevant literature, we conclude that disputes surrounding assisted colonization will likely not be settled by additional scientific research. Rather, underlying non-technical considerations need to be brought to the fore and addressed.

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1. Introduction

Species distributions and ecosystem dynamics are already showing responses to climate change (IPCC, 2007). For species to survive given projected future climate change they must either tolerate the new conditions in their current ranges, or successfully colonize and occupy new areas with appropriate conditions. Projected rates of climate change, however, will make it difficult for some species to survive or to move rapidly enough, especially given extensive habitat fragmentation and other concurrent pressures (e.g., Schloss et al., 2012; Zhu et al., 2012). Accordingly, some conservation biologists have proposed utilizing assisted colonization (also known as assisted migration and managed relocation) – the deliberate movement of species or populations outside their indigenous range with the intent of avoiding extinction (IUCN/SSC, 2013) – as a pre-emptive conservation option.

Applied as a climate adaptation strategy, assisted colonization would entail moving taxa to higher latitudes or higher elevations where projected climatic conditions may enable them to survive (Hunter, 2007; McLachlan et al., 2007; Ste-Marie et al., 2011).

Assisted colonization is a contentious climate change adaptation option, and there has been a stream of opinion pieces in the scientific and management literatures arguing for and against it (e.g., Davidson and Simkanin, 2008; Hoegh-Guldberg et al., 2008; Ricciardi and Simberloff, 2009a, b). To help move these arguments forward, several recent analyses have sought to map its scientific, policy, and ethical dimensions (e.g., Camacho, 2010; Hewitt et al., 2011; Lawler and Olden, 2011; Richardson et al., 2009; Schwartz et al., 2012) and have distinguished different types of assisted colonization (Ste-Marie et al., 2011). However, conservation scientists' views of assisted colonization have not been empirically characterized. The extant literature presents a number of scientists' views, but there is no a priori reason to believe that they represent the breadth of opinion because we know that ecologists and conservation biologists harbor diverse views on both technical facts and conservation strategies (Moore et al., 2009; Neff, 2011; Sandbrook et al., 2011; Wallington and Moore, 2005; Young and Larson, 2011). Here, we treat scientific opinion of this conservation

* Corresponding author. Present address: Environmental Science Department, Allegheny College, Box E, 520 N. Main St., Meadville, PA 16335, United States. Tel.: +1 814 332 5347; fax: +1 814 332 5314.

E-mail addresses: mneff@allegheny.edu (M.W. Neff), blarson@uwaterloo.ca (B.M.H. Larson).

controversy as a subject of empirical social research in order to provide a richer understanding of the terms of the debate.

More importantly, the debate over assisted colonization has largely been framed by academic conservation scientists, so the views of other stakeholders remain underrepresented. To begin to redress this lacuna, we examine the views of the managers who would enact assisted colonization and evaluate its consequences on the ground. There is reason to suspect that managers' views will differ from those of scientists because their direct engagement with conservation practice makes them more intimately familiar with constraints to the application of ecological theory in conservation decision-making (Moore et al., 2009).

We characterize scientists' and managers' views alongside one another because many of the emerging questions about assisted colonization are situated at the contentious interface between science and values (Aubin et al., 2011; Camacho, 2010; Hewitt et al., 2011; Klenk and Larson, 2013; Minter and Collins, 2010), where their views may diverge. This is especially likely given that assisted colonization is at the forefront of tensions within conservation theory and practice about the role of humans in the ongoing transformation of ecological systems (e.g., Hobbs et al., 2009; Minter and Collins, 2010; Sandler, 2010). Pedlar et al. (2012), for example, enumerate several differences in how foresters and conservation scientists interpret assisted migration. In short, both managers and scientists have significant roles to play in selecting, evaluating, and performing conservation activities such as assisted colonization, and thus were of interest for this study.

The main question we seek to address here is “how do scientists and managers think about assisted colonization and where do their views conflict or concur?” Our results will provide a more nuanced understanding of the dimensions of this debate as well as potential challenges to implementing assisted colonization on the ground (e.g., where the two groups have diverging views). The results of this study also provide the groundwork for subsequent social scientific research on assisted colonization and related conservation adaptation options in the face of climate change.

2. Methods

Rather than employing a traditional survey, a method useful for evaluating the attitudes of investigator-defined groups of people along theory-derived axes, we utilized Q method (Watts and Stenner, 2012). Q method inductively elicits individuals' understanding of a topic in a way that allows their concerns to define the axes along which they are compared. The analysis identifies shared and contested thinking about a topic along these axes, thus revealing insights typically inaccessible via survey research. Q method has frequently been used to understand the dimensions of environmental debates (e.g., Addams and Proops, 2000) and conservation policies and practices (e.g., Mattson et al., 2006, 2011; Rastogi et al., 2013). The results of a Q method study can provide the basis for effective design of later surveys that allow generalization from samples of participants (Danielson, 2009).

In general, we applied standard Q method practices (Fig. 1), which have been thoroughly described elsewhere (Brown, 1980; McKeown and Thomas, 1988; Watts and Stenner, 2012; Weblar et al., 2009). We next describe the specific steps of our study as well as an innovative analysis that we developed to identify areas of agreement and contestation in the assisted colonization debate (Section 2.4).

2.1. Statement selection

Q method can be used to simulate a dialogue between participants and their colleagues by exposing them to statements made

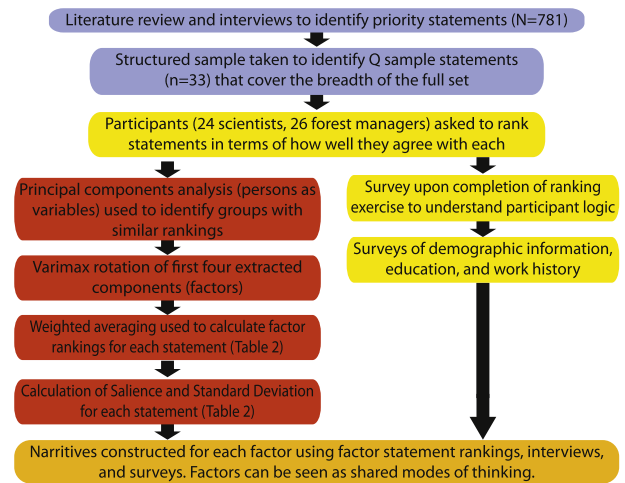


Fig. 1. Flow chart of methods. Q method comprises four major steps: statement selection (blue), administering the survey to participants (yellow), statistical analyses to identify groups with similar statement rankings and characterize those groups (red), and qualitative analysis of the findings (orange). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article).

by people like them, and allowing them to rank those statements and justify their rankings. We first collected 781 statements comprising technical and non-technical arguments about assisted colonization and related conservation measures from a variety of sources, including articles and commentaries from the peer-reviewed literature, relevant documents from resource management entities and other stakeholders, popular media documents, and 7 phone interviews with resource managers and conservation activists (published sources in Supplementary Table 1). We looked beyond the standard scientific literature because we did not want to presume that scholarly papers would represent the breadth of considerations that might exist amongst our pool of participants.

From this broad list of statements, we used an inductive semi-structured approach to select 33 that covered the breadth of views (see Table 2; Brown, 1980). We edited these slightly to ensure readability and consistent syntax while maintaining original intent. Statements were then pre-tested prior to study implementation.

2.2. Participant selection

The 50 participants for this study were recruited from two pools: scientists with expertise in disciplines that have engaged in the assisted colonization debate ($n = 24$), and forest managers in Ontario, Canada ($n = 26$) (demographic information in Supplementary Table 2). To provide a wide cross-section of scientific perspectives on assisted colonization, we recruited the scientists from the top publishing researchers (based on ISI Web of Science, as of July 2011) in five journals that focus on different scientific aspects of conservation: *Biological Invasions*, *Conservation Biology*, *Ecology*, *Global Change Biology*, and *Restoration Ecology*. We contacted 159 scientists; 24 completed the study (10 female and 14 male).

To contrast with the views of these scientists from around the world, our resource managers were foresters from Ontario, Canada. Our selection of participants from one region reflects the fact that decisions about assisted colonization will ultimately be made in local contexts. There is nonetheless significant impetus for assisted

Table 1
Forced choice Gaussian distribution.

Ranking value	−4	−3	−2	−1	0	1	2	3	4
Number of items	2	3	4	5	5	5	4	3	2

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