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Reconstructing a deconstructed concept: Policy tools for implementing assisted migration for species and ecosystem management

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ABSTRACT

Assisted migration (AM) is increasingly proposed to limit the impacts of climate change on vulnerable plant and animal populations. However, interpretations of AM as a purely precautionary action along with multiple definitions have hampered the development of precise policy frameworks. Here, our main objective is to identify what type of policy tools are needed for implementing AM programs as part of broader environmental policies. First, we argue that policy frameworks for translocations of endangered species that are subject to climatic stress are fundamentally different from translocations to reinforce climatically exposed ecosystems because the former are risky and stranded in strict regulations while the latter are open to merges with general landscape management. AM implementation can be based on a series of phases where policies should provide appropriate grounds closely related to extant environmental principles. During a "Triggering phase", AM is clearly a prevention approach as considered by the Rio Declaration, if unambiguously based on evidence that population decline is mainly caused by climate change. During an "Operational phase", we suggest that policies should enforce experimentation and be explicit on transparent coordination approaches for collating all available knowledge and ensure multi-actor participation prior to any large scale AM program. In addition, precautionary approaches are needed to minimize risks of translocation failures (maladaptation) that can be reduced through redundancy of multiple target sites. Lastly, monitoring and learning policies during an "Adaptive phase" would promote using flexible management rules to react and adjust to any early alerts, positive or negative, as hybridization with local individuals may represent an evolutionary chance. Our analysis of study cases indicates that except for two programs of productive forests in Canada, current AM programs are predominantly small-scale, experimental and applied to endangered species isolated from general environmental management. As the effects of climate change accumulate, policies could include AM as part of larger environmental programs like habitat restoration with common species seeking to provide stable ecosystems in the future.

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1. Introduction

The impact of climate change on biodiversity and ecosystems presents new challenges for the scientific community, managers and policymakers, obliging them to adapt research agendas, conservation practices and regulations to these changes. Among the many conservation strategies developed to lessen the impacts of climate change on plant and animals assisted migration (AM) is one of the options receiving increased attention. The rationale behind is a compensation for the dispersal limitations and potential lack of adaptive capacity of a given species resulting from the speed of current climate change. This concept encompasses several overlapping definitions (Ste-Marie et al., 2011) generating a great deal of debate (Hunter, 2007; McLachlan et al., 2007). Most of the time, AM refers to the movement within or outside the natural species range to mitigate the impacts of climate change (Aitken and Whitlock, 2013). In addition to this general notion, we find two other closely related concepts: assisted colonization (AC) which describes a movement beyond the range of species to limit human-induced threats (Seddon, 2010), and recently, assisted gene flow (AGF) which describes a movement of individuals (genes) inside the range of species to facilitate adaptation to anticipated local conditions (Aitken and Whitlock, 2013). Here, we consider AM to be a general technique corresponding to a human-assisted movement of biological entities (seeds, other propagules, individuals or populations) from a region where their survival is mostly threatened by climate change to a region where they could survive and maintain ecosystem services under current and expected future climates. On a more general perspective, AM would belong to actions seeking to repair the environment and ecosystems like in restoration or ecological engineering programs that have been recently dubbed ''manipulative ecology'' (Hobbs et al., 2011).

Despite the fierce debate that AM has recently produced between opposing actors who see more risks than benefits in AM initiatives and those seeking to act in the face of climate change threats (see Neff and Larson, 2014 and references therein), AM could be nevertheless seen simply as an extension of the practices of translocation and reintroduction of endangered species. In fact, the distinction between translocations and AM is becoming increasingly artificial because climate change makes parts of the historic ranges of many species unsuitable as reintroduction recipient sites (Dalrymple et al., 2011). Critics of AM invoke the high failure rate of translocation programs (Fischer and Lindenmayer, 2000) as a counter-argument. Translocations can fail for many reasons including when supposedly 'core habitat' is in fact marginal for the translocated population (Dalrymple and Broome, 2010) suggesting that lack of ecological knowledge and not the fact of translocating individuals itself is a frequent limiting factor. Nevertheless, AM is developing gradually in public policies of various institutions and countries more as a general objective than as structured programs with precise policies, methods and funding. For instance, preliminary AM considerations have recently been included carefully by the International Union for Conservation and Nature (IUCN) in its latest translocation guidelines for endangered species (IUCN & SSC [Species Survival Commission] 2013). Likewise, the Scottish government (Brooker et al., 2011), the Australian authorities (NCCARF National Climate Change Adaptation Research Facility, 1990), the European Union LIFE program (Silva et al., 2011) and Canadian forest seed planting regulations in Ontario (Eskelin et al., 2011), among others, have all included some sort of AM in their texts.

If AM is deemed necessary by a panel of experts its application requires not only sound ecological knowledge but also clearly identified policy frameworks (Schwartz et al., 2012; Shirey and Lamberti, 2010) that still need to be fully developed. AM policies do not need to start from scratch but can be built upon major principles of environmental law or ecosystem management. Here, our goal is to answer the main question of what kind of policy frameworks are needed for implementing AM programs. Our specific questions are: (1) what are the definitions, scale and risk issues related to AM actions that need to be clearly identified in environmental policies? (2) If AM is an extension of environmental management and translocation programs, what pre-existing regulations and policies can help its implementation? And (3) what can be learned from known cases of AM? To conclude, we provide some recommendations for policymakers when AM is implemented as an option within larger biodiversity and ecosystem management programs in response to climate change.

2. Definitions, scale and risks issues in assisted migration policies

At least three main factors are essential to consider before designing any policy framework for AM: establishing a clear definition of the main objective of the action, assessing as precisely as possible the scale of the proposed action, and assessing the risks related to the action (Fazey and Fischer, 2009; Hewitt et al., 2011; McLachlan et al., 2007; Richardson et al., 2009).

AM has been used as a generic concept describing multiple related actions that can be placed along a continuum (Aubin et al., 2011; Ste-Marie et al., 2011) each requiring different policy frameworks. At the extremes of this continuum, however, two contrasting ideas emerge: whether the migration is to protect by translocation a target population from climate related risks, or to maintain or restore the ecosystem function of a target site. The first case corresponds to what Pedlar et al. (2012) termed 'species rescue AM' where the unit moved is the same to be protected. Here we call this type of AM as 'species-centered AM'. In the latter case, migrations are made *into* a target ecosystem to reinforce ecosystem processes with local, neighboring or even exotic species. Thus, an ecosystem that we want to protect will not be moved obviously, but other genetic units supposed more robust are brought in. We call this process 'ecosystem-centered AM'. Species-centered AM could be implemented where endangered species represent have a low invasion risk, have few migration possibilities in low-connectivity landscapes, low migration rates, low adaptation potential, low population size and well documented life history traits (Loss et al., 2011; Vitt et al., 2010). In contrast, ecosystem-centered AM would be