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Move it or lose it? The ecological ethics of relocating species under climate change

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Abstract. Managed relocation (also known as assisted colonization, assisted migration) is one of the more controversial proposals to emerge in the ecological community in recent years. A conservation strategy involving the translocation of species to novel ecosystems in anticipation of range shifts forced by climate change, managed relocation (MR) has divided many ecologists and conservationists, mostly because of concerns about the potential invasion risk of the relocated species in their new environments. While this is indeed an important consideration in any evaluation of MR, moving species across the landscape in response to predicted climate shifts also raises a number of larger and important ethical and policy challenges that need to be addressed. These include evaluating the implications of a more aggressive approach to species conservation, assessing MR as a broader ecological policy and philosophy that departs from longstanding scientific and management goals focused on preserving ecological integrity, and considering MR within a more comprehensive ethical and policy response to climate change. Given the complexity and novelty of many of the issues at stake in the MR debate, a more dynamic and pragmatic approach to ethical analysis and debate is needed to help ecologists, conservationists, and environmental decision makers come to grips with MR and the emerging ethical challenges of ecological policy and management under global environmental change.

Key words: *climate change; ecological policy; ethics; managed relocation; species conservation.*

The U.S. Department of the Interior recently proposed designating more than 320 000 km^2 (>200 000 square miles) of land, sea, and ice along the northern coast of Alaska for the polar bear, which is losing critical habitat due to global warming (Broder 2009). While an important development, it is far from certain that this action will save the Alaska populations from the accelerating impacts of climate change. The polar bear will be in dire straits if a significant part of its habitat is lost with the continued melting of Arctic ice. But the polar bear is just the tip of the proverbial iceberg. If the predictions of current climate change models are accurate, the consequences for many plant and wildlife species will be profound.

Climate change is already linked to a range of biotic impacts at the species level, including physiological, phenological, and distributional changes (Root and Hughes 2005, Parmesan 2006). The broad effects of climate change are increasingly seen as posing a significant threat to the survival of many plant and animal species, one that joins (and combines synergistically with) habitat destruction, landscape fragmentation, and the spread of invasive species (Hannah et al. 2002, Root et al. 2003, Barnosky 2009). Indeed, one influential review predicts that, depending on the rate and magnitude of planetary warming, up to 35% of the world's species could be on the path to climate-driven extinction (Thomas et al. 2004).

We have spent decades trying to preserve wild species from direct threats like habitat destruction, overhunting, and pollution. Historically, humans have protected species by creating parks and reserves to safeguard them in their native ecosystems. In the United States, the Endangered Species Act of 1973 is a potent route to protection. But as the plight of the polar bear illustrates, climate change is forcing us to rethink what it means to save a species in the 21st century. If climate change continues unabated and as rapidly as a few models predict, saving at least some species will require solutions more radical than creating parks and shielding endangered species from bullets, bulldozers, and oil spills: It will require moving them.

Ecologists and conservationists are considering relocating threatened species to new locations before their historical ranges become inhospitable due to climate change (e.g., McLachlan et al. 2007, Hoegh-Guldberg et al. 2008, Richardson et al. 2009). This approach to saving species is defended when animals and plants cannot adapt quickly enough to local, changing environmental conditions and when dispersing to higher latitudes and altitudes on their own is impossible. For example, highways and cities can form inhospitable barriers too extensive for some species to cross unaided. Called "assisted colonization" or "managed relocation" (MR),

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the idea is controversial, mostly because it may disturb native species and ecosystems when these "climate refugees" establish themselves in new environments.

While some scientists think this is a risk that can be managed, and that the consequences of doing nothing are far worse (e.g., Sax et al. 2009, Schlaepfer et al. 2009), many believe the mere threat of creating invasive species through managed relocation (and the risk of disrupting historical evolutionary and ecological processes) disqualifies it as a viable conservation strategy (Davidson and Simkanin 2008, Ricciardi and Simberloff 2009, Seddon et al. 2009). In addition, concerns have been raised about the long-term population genetic ramifications of conservation translocations, including fears of hybridization and introgression of relocated and native populations (Ricciardi and Simberloff 2009), as well as worries about the introduction of maladapted genotypes into the receiving system and the "swamping" of recipient-system genetic complexes by relocated populations (Vitt et al. 2010). Such concerns would presumably be magnified by proposals to move species across great distances; suggesting, for example, that intercontinental translocations could be particularly risky and therefore strongly resisted by many conservation scientists and managers.

Furthermore, there is also no guarantee that the relocated species themselves will thrive after being moved to new areas; successful translocation is a complicated business. And managed relocation will likely be costly and will tax conservationists' financial and political capital. It could divert limited resources from more traditional conservation strategies.

Yet, managed relocation is already being done. A coalition of botanists and environmentalists called the "Torreya Guardians" recently planted the seeds of *Torreya taxifolia*, a conifer with a small and shrinking range in Florida's panhandle, in the unfamiliar soil of North Carolina (more information *available online*).[2] Forest scientists in British Columbia are moving more than a dozen species of tree seedlings to locations beyond their native range (Marris 2009*a*). A powerful motivation is finding a way of escaping pine beetle outbreaks attributed to climate change. Ecologists introduced two butterfly species in northern England, hoping the butterflies could survive in a new environment that might be more hospitable in the future (Willis et al. 2009). And in southern California, conservationists are considering relocating the endangered Quino checkerspot butterfly. This imperiled population will become even more so as Earth becomes hotter and drier. Already, the species' natural path of dispersal is blocked by a barrier of mammoth proportions: greater Los Angeles (Marris 2008).

While these cases are drawing much attention, sometimes moving a species is not an option. The polar bear is likely freeze-framed in ice that is melting all around it. Similarly, the fate of many species that live at high elevations hangs in the balance. A warming habitat may literally push them off the top of the mountain as their high-peak environments disappear.

The debate over managed relocation reminds us that the metabolism of conservation must accelerate if we want to keep up with changes that are outpacing traditional ways of managing species and ecosystems. Climate change, as well as large-scale land use changes and the global spread of disease-causing pathogens, pests, and invasive species, are putting enormous pressure on our traditional conservation values and policies (Collins and Crump 2009). Whereas historically we have taken on the role of preservers of species and ecosystems, in the 21st century we will likely find ourselves pressed into a very different role: makers of novel ecosystems for stressed populations, including animal, plant, and human. Such new ecosystems (places that have a significant human influence but do not require constant management to function) are generating increasing interest in scientific circles (Hobbs et al. 2009, Marris 2009*b*). Although they may seem to be ecological poor cousins of unaltered wildlands, these human-modified systems could play a critical part in the provision of ecosystem services such as water purification, nutrient cycling, and carbon sequestration. They could also provide new habitat for the plants and animals we may introduce in anticipation of harmful changes in "native" ecosystems.

The upshot is that we simply have no choice but to think beyond the traditional parks-and-preservation model if we wish to save species in an era of rapid climate change. This will require coming to grips with a significantly more activist and hands-on approach to species conservation than we have taken in the past. It will also mean redeploying our funds and research efforts as we shift them from traditional preservationist agendas toward more pragmatic and interventionist programs for conservation science and action on a rapidly changing planet.

There will be resistance to this new approach. The role of "planetary manager" is an uncomfortable one for many ecologists who see such a solution as little more than a cloak for the familiar human arrogance toward nature that has carved deep gashes in the landscape and defined our modern environmental history. It may also lead us to believe that we can avoid making even harder choices. Many would argue, for example, that relocating species is an excuse for not addressing the deeper ethical, economic, and political reasons global warming is happening. Proponents of this view believe that conservation scientists and policy makers should instead redouble their efforts on behalf of more traditional preservationist goals (and on climate mitigation strategies) rather than advocating more interventionist and adaptationist approaches such as managed relocation and novel ecosystems.

[2] ⟨http://www.torreyaguardians.org/⟩

One response to this latter concern, of course, is to argue that mitigation and adaptation policies must be pursued together to meet the challenges of climate change effectively (Gardiner 2004, Becker 2009). But it could also be asserted that MR, as an adaptationist strategy, has an important role to play in bringing the complex and intangible risks of climate change into sharper relief for citizens and policy makers; a role that could eventually pay dividends for public support for climate mitigation. Ecologists' and conservationists' concern about species survival under global warming, and subsequent proposals to move them under a program of MR, could focus critical media and public attention on observable harms that help bring the complexities of climate change science down to earth; and into living rooms. Consider the ubiquity of media images of polar bears clinging to melting ice sheets in recent years and the ability of such depictions to convey the biotic stakes of climate change in a way that more esoteric discussions of "parts per million" and "predicted mean temperature increase by the year 2100" might not be able to match.

Moreover, if traditional in situ conservation methods are no longer sufficient to save threatened species due to climate change, the wholesale rejection of managed relocation is itself a capitulation: to species extinction. While concerns about the risks of managed relocation are serious and should not be cavalierly dismissed, the rejection of proactive species conservation strategies represents a dramatic break with the longstanding ethical, economic, and policy commitment to saving species in the face of evolving anthropogenic threats. While climate change poses a different sort of impediment to species survival (i.e., indirect in nature, global in scale, and synergistic with a range of more traditional drivers of environmental degradation) it is an emerging, complex, and serious threat to planetary biodiversity, the response to which requires an appropriately innovative, anticipatory, and perhaps even radical conservation strategy. In turn, this new conservation strategy requires a more dynamic and activist understanding of what is considered mainstream conservation ethics and policy.

In our view, the key ethical and policy questions surrounding managed relocation are therefore ones such as the following:

1) Candidate species: What should be the process for choosing candidate populations for relocation (and selecting the recipient ecosystems)? Under what social and environmental conditions should MR be considered?

2) Institutional context: How does MR articulate with traditional ex situ approaches (e.g., species conservation in zoos, aquaria, and botanical gardens); and traditional in situ approaches (i.e., parks and protected areas)? What are the institutional, legal, and ethical implications of undertaking MR actions within the existing research and conservation environment?

3) Authorization and oversight: Who should make MR decisions and carry out particular managed relocations? To what degree should MR decision-making and practice also be a public, as well as a professional/scientific enterprise?

4) Motive: Should managed relocations be conducted for species survival under climate change purposes only, or should they also be considered for maintaining valued ecosystem services (which may be driven more directly by human economic and cultural interests)? Should we distinguish sharply between these motives in conservation/ecological policy?

5) Environmental responsibility: How can we ensure that MR efforts do not undermine the long-standing commitment to preserve ecological integrity, and that it will not weaken collective resolve to address the root causes of climate change via mitigatory efforts?

These are all critical ethical and policy questions, but again they do not address whether managed relocation should be done. Instead, they focus on the form that biologically careful and professionally supervised managed relocation efforts must assume in order to meet the high standards of being properly motivated, authorized, and conducted.

What is needed, we believe, is the development of a more pragmatic ethics of species relocation under climate change. This pragmatic approach to ethical decision-making in ecology and conservation should be less preoccupied with whether such efforts should be undertaken in the abstract. The attention should shift to outlining the conditions under which managed relocation should be considered as a realistic option and what criteria are relevant to distinguishing "good" from "bad" relocation proposals, and evaluating good and bad relocation efforts on the ground. While some observers have started the important process of devising basic decision protocols for species relocations (Hoegh-Guldberg et al. 2008, Richardson et al. 2009) and addressing some of the broader ethical dimensions of managed relocation as a question of moral duties to species (e.g., Sandler 2010), a far more explicit consideration of the value and policy implications of proposed relocation candidates needs to take place. The emerging ecological ethics framework we have developed in recent years (a pluralistic and deliberative model of ethical decision-making targeted at the unique moral dilemmas encountered in the ecology and conservation management communities) provides one possible method for making ethically explicit and justified decisions in specific relocation discussions (Minteer and Collins 2005*a*, *b*, 2008).

Although there are helpful ethical resources available to biologists and policy makers considering the managed relocation issue, the questions facing advocates of aggressive species conservation efforts under climate change are still undeniably hard to answer: Can we address the consequences of climate change as a new environmental reality, which will mean creating novel

species combinations in new ecosystems, without becoming destroyers of other species and ecosystems? And can we do this while owning up to the root causes of global warming in our shared values, lifestyles, and policies? Only time will tell.

Still, one thing seems perfectly clear: We have a rapidly shrinking set of options for saving many species threatened by a warming world. The biological stakes are high. If we value wild species and wish to bequeath a significant fraction of global biodiversity to future generations, radical strategies like managed relocation may well be our last best chance. Although risky, such bold efforts to preemptively move threatened species to new environments may offer the only hope to keep them from moving into museums and zoos—and haunting our ecological conscience.

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