Navigating Assisted Migration:

A Climate Crisis Response in the Pacific Northwest

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The consensus over assisted migration remains divided among researchers and is likely to intensify as the climate crisis demands increasingly desperate measures. As threats from climate change increase, governmental agencies and global organizations turn to assisted migration as a mitigation tool. However, the scientific community's dialogue on the efficacy of assisted migration is less decisive, with approximately sixty percent of recent publications supporting its implementation, twenty percent expressing major concerns, and the remaining twenty percent being unsure (Hewitt et al., 2011). While many recent publications view assisted migration positively, additional research and firm mitigation guidelines are likely needed for a consensus in the literature. To evaluate the approach of assisted migration comprehensively, the potential ecological and socioeconomic impacts must be addressed. In this paper, I provide a cost-benefit analysis and propose risk mitigation strategies for implementing assisted migration in the Pacific Northwest.

The Need for Assisted Migration

The term "assisted migration" was coined in 1985 in response to the growing threat of global warming on nature reserves (Peters & Darling, 1985). Threats surrounding habitat fragmentation due to agricultural and urban development raised concerns about the consequences of biodiversity loss and its impact on civilization. Assisted migration, involving the intentional translocation of species outside their historic ranges to mitigate biodiversity losses from anthropogenic climate change, emerged as a strategy (Hewitt et al., 2011). The threat posed by the greenhouse effect nearly four decades ago, along with habitat fragmentation, continues to play a devastating role in biological communities globally (Mikhaylov et al., 2020). In 2007, climate projections anticipated severe impacts on forest growth and composition due to the mismatch in adaptation and migration rates of trees and climate change. The trees with slower dispersal rates and physical barriers, such as mountain ranges are especially vulnerable to the rapidly changing environmental conditions (Kusbach et al., 2023). This is because trees, dependent on temperature, precipitation, and light cues for phenological processes, become vulnerable to developmental mismatches, making them susceptible to other stressors like extreme weather events and pest damage (Williams & Dumroese, 2013). Thus, the strategy of assisted migration was designed to alleviate this mismatch and relocate trees to their projected ideal ranges.

The Ongoing Debate of Assisted Migration

Some of the proposed benefits of assisted migration include preventing species extinction, minimizing economic loss, and sustaining ecosystem services and biodiversity (Hewitt et al., 2011). Assisted migration stands out as a key strategy in the battle against species extinction and the preservation of biodiversity, primarily because it enables the

relocation of trees to suitable environments. This becomes crucial as their native ranges become increasingly challenging or even uninhabitable due to the impacts of climate change. In addition, it may be crucial in maintaining resilient forest ecosystems and safeguarding goods and services amid the accelerating rate of climate change (Gustafson et al., 2023). For instance, assisted migration could move commercial trees to ranges with suitable climatic conditions, preventing potential economic losses in the timber industry from climate change. Some argue that the basic framework for implementing assisted migration is present within commercial forestry due to its longstanding practices of moving genetic resources through silvicultural procedures (Williams & Dumroese, 2013).

Arguably, the largest proponent against implementing assisted migration is the uncertainty of its effects on an ecosystem. Examples of this uncertainty are present regarding the future genetic consequences and potential ecological harm caused by translocating a non-native species (Williams & Dumroese, 2013). Specifically, the act of intentionally relocating certain species to their non-native ranges comes with the risk of genetic diversity loss, introduction of maladaptive alleles, and hybridization (Williams & Dumroese, 2013; Chen et al., 2022). Without genetic diversity and robust alleles in the founding population, a species becomes limited in their adaptive potential, thus increasing vulnerabilities to new external threats (Chung et al., 2023). Mitigation strategies like sourcing propagules from multiple donor sites from different geographic locations can maximize genetic diversity and improve adaptive potential (Galatowitsch et al., 2009).

Another element of uncertainty present in the argument of assisted migration is the risk of introducing invasive species or pathogens to an ecosystem (Williams & Dumroese. 2013). Thus, the combination of strategic planning, modeling, and monitoring is key to minimizing invasion or maladaptive risks when implementing assisted migration. By using horticultural information, invasive species literature, and reintroduction case histories, species could be selected carefully and strategically (Hewitt et al., 2011). Respectively, the creation of policies to allow small scale experimental introduction tests to determine invasive potential would be pivotal in minimizing risk in a large-scale relocation effort (Sansilvestri et al., 2015). Furthermore, the possibility of pathogen introduction through the relocation of a species is also an associated risk of assisted migration. However, some argue the inadvertent introduction of pathogens is not merely a risk associated with assisted migration since the same risk of disease or pest introduction are present when native seedlings are utilized for restoration efforts from plant nurseries each year (Pedlar et al., 2012). While

phytosanitary practices greatly decrease the risk of pathogen-harboring plants from transmitting disease to focal populations, the risk is always present, whether plants are native to a region or not.

The Future of Assisted Migration in the Pacific Northwest

After discussing assisted migration broadly, it may be helpful to consider some areas where assisted migration may be applicable in the Pacific Northwest. One argument for the use of assisted migration is the idea of introducing coastal redwoods and giant sequoias to Washington State. Several climate models project substantial range shifts for these species as the effects of climate change accumulate faster than their ability to naturally migrate. Thus, the severe droughts and warming conditions continue to threaten the carbon sinks in the forests of California (Coffield et al., 2021). Assisted migration poses one option to addressing the anticipated carbon storage losses through relocating them in their projected suitable habitat ranges, largely in Washington State. Recent studies have further supported the redwoods' promising viability for assisted migration, as they found redwood seedlings can successfully establish in dry, hot conditions outside of their native range (Kerhoulas et al., 2020). Although the prospect of both minimizing the extinction risks of charismatic species like giant sequoias while safeguarding substantial carbon storage is attractive to many, more research is necessary before introducing these species to Washington ecosystems in large quantities. By assessing the invasive risk and potential for pathogen transmission associated with these species, we can gain a clearer understanding of the plausibility of implementing assisted migration in the Pacific Northwest.

Conclusion

In conclusion, through continued research and risk-mitigation driven policy, assisted migration can more thoughtfully and accurately be evaluated as a mediation effort against climate change and its associated threats. By continuing to assess potential risks and benefits of assisted migration, we can develop detailed mitigation strategies to take calculated risks moving forward in our efforts against species extinction and ecosystem health declines. In the Pacific Northwest, assisted migration may help protect species threatened by anthropogenic climate change, like coastal redwoods, but further research is needed to determine how implementation steps should be approached. While species preservation and safeguarding ecosystem services is ideal, the future of effective assisted migration depends on implementing research-backed mitigation strategies along with it. The introduction of invasives and pathogens, as well as the reduction of genetic diversity, poses legitimate risks associated with assisted migration efforts. Without proper precautions in place, these risks can lead to more harm than good.

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