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Editorial: Forest assisted migration

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Editorial on the Research Topic
Forest assisted migration

Introduction

Recent research indicates that Forest Assisted Migration (FAM) may help mitigate climate change impacts on forests, with nearly 60% of studies supporting its use (Xu and Prescott, 2024). However, FAM poses risks, such as introducing invasive species and maladaptation (Chen et al., 2022), increasing susceptibility to pathogens (Grady et al., 2015), and raising social concerns (Hagerman et al., 2021).

This Research Topic considers the application of assisted migration practices to forest management. We have curated contributions from 65 authors studying 25 species across 11 articles grouped into four subtopics. All articles were published in a special *Frontiers in Forests and Global Change* Research Topic titled "*Forest Assisted Migration*." This Research Topic highlights the interdisciplinary nature of the research. The subtopics include:

1. Genetic and environmental factors influencing plant traits.
2. Assisted migration practices through field trials and silvicultural methods.
3. Social attitudes toward FAM and its implications for forest planning.
4. Models for improving the accuracy of seed transfer and species selection.

Some contributions cross multiple subtopics. Individually and collectively, this Research Topic substantially enhances our understanding of FAM's application.

Genetic and environmental factors

The establishment of provenance trials and common gardens are used to test tree species' responses and performance, often involving transfers across latitudinal or elevational gradients. Moving beneficial alleles may aid populations in adapting to climate change. Lebel Desrosiers et al. showed that acorn provenance (i.e., genetics) and site conditions (i.e., microclimate) can affect *Quercus rubra* survival and growth, with local provenances that are under water stress exhibiting the poorest overall survival. Streit et al. presented a large common garden study that will monitor (over the next 3–5 decades)

the intraspecific variability and adaptability of 14 different genera, including 15 native and three non-native species, across a range of colder (and wetter) environments than those found in existing European experiments. Sáenz-Romero et al. found that environmental factors, particularly site climate (e.g., cold temperatures), had a greater impact than genetic factors on the responses of *Abies religiosa* populations, with seedling survival identified as the most critical response variable. Finally, Di Fabio et al. studied phenotypic plasticity and growth stability across species and emphasized the need for choosing stable provenances for assisted migration. They found that long-term climate conditions are more important than climate variability in predicting growth stability.

Field trials and silvicultural methods

Several papers use field studies to examine FAM's efficacy. Pedlar et al., leveraging their long-term experimental results (7–13 years), compared *Quercus* species on former agricultural sites, including seed sources from several hundred kilometers south of their study area, concluding that range expansion of broadleaf species has a good likelihood of success. Streit et al. described the rationale for a new experiment in Switzerland that includes 57 sites, 18 species, and 117 seed sources, emphasizing the need to include a wide range of climate and environmental conditions in common garden studies. Lebel Desrosiers et al. examined local and southern seed sources of *Q. rubra* in Quebec, Canada, finding that southern sources had higher survival and growth than local sources, and that soil moisture may be a limiting factor in range expansion. Nolet et al. presented a silvicultural framework for FAM using a patch-cutting approach that created a range of planting environments and provided replication of FAM at the stand-scale to aid monitoring. A study by Sáenz-Romero et al. examined the transfer of *A. religiosa*, the winter host of the Monarch butterfly, concluding that *A. religiosa* can be established up to 300 m above its current elevation limit, expanding the range of the species.

Social issues and forest planning

Social considerations, including stakeholder perceptions and public involvement, are crucial for successfully implementing assisted migration strategies. In the study by Moreira et al., a series of semi-structured interviews of stakeholders in Quebec, Canada, demonstrated support for assisted migration. However, the stakeholders emphasized the need for a cautious approach and pilot projects to test and verify impacts. Clark et al. also interviewed 33 natural resource managers in the Northeastern USA already engaged in climate change adaptation. The respondents were interested in diversifying current assisted migration approaches but were hesitant to engage with afforestation or the long-distance translocation of exotic species. Nolet et al. proposed that a patch-cut system represents an interesting low-intensity method to integrate assisted migration that could be more socially acceptable than planting after clearcuts. Bower et al. put forward and tested a practical FAM framework for planning assisted migration that should be suitable for all landowners and will aid future learning and implementation. Streit et al. emphasized the critical role of stakeholder collaboration in the Swiss Common Garden network. The stakeholders were consulted throughout the project's development phase, leading to more informed decision-making. Finally, work by Sáenz-Romero et al. exemplifies the need for assisted migration for conservation purposes, as demonstrated by the translocation of *A. religiosa* to higher altitudes for future Monarch butterfly habitat.

Models of seed transfer

Several articles within this Research Topic on FAM use innovative methods for modeling seed transfer and species selection. For example, Richardson et al. presented seed transfer approaches that identified climate analogs for North American biomes using Euclidean distance. In contrast, Adams et al. identified climatically-compatible seedlots for the eastern USA using climate projections based on the sigma (dis)similarity index. These models aim to match the future climate of a target site with the current climate of other locations. Species-independent approaches provide practical tools for identifying suitable planting locations, particularly for species with limited genetic data. These methods use a range of climatic variables, with temperature and moisture emerging as critical factors influencing the success of seed source transfers. Streit et al. established an extensive common garden network across Switzerland for species-specific insights. This network is a model for long-term, large-scale evaluation of multiple species and provenances, providing valuable data for future research and practical applications. Similarly, Sáenz-Romero et al. developed a predictive model based on field studies to assess the growth and survival of *A. religiosa* that offers crucial insights into creating potential future habitats for the Monarch butterfly.

Conclusions

Our Research Topic integrates innovative studies on genetic and environmental factors, field trials, social considerations, forest planning, and modeling techniques for seed transfer and species selection to guide the successful implementation of FAM practices into operational forest management. It highlights the importance of provenance trials and local adaptation for improving species' resilience to climate change. Engaging stakeholders and securing public acceptance are necessary to successfully apply FAM, requiring collaboration among researchers, managers, and communities. By adopting these interdisciplinary and collaborative approaches, we can help ensure sustainable forests that preserve biodiversity and support ecosystem services in a changing climate.

Author contributions

PM: Conceptualization, Writing – original draft, Writing – review & editing. BP: Writing – original draft, Writing – review &

editing. PN: Writing – original draft, Writing – review & editing. AM: Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

Generative AI statement

The author(s) declare that Gen AI was used in the creation of this manuscript. Elicit Pro was used for conducting a literature search (Elicit: The AI research assistant; https://elicit.com; accessed November 12, 2024). Grammarly Premium was used to check grammar and conduct plagiarism and AI text checks (Grammarly Premium; https://app.grammarly.com; assessed December 3, 2024).

Publisher's note

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