Extreme Climate Variability Should be Considered in Forestry Assisted Migration: A Reply

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Recently, Pedlar and colleagues (2012) stated that assisted migration in forestry (forestry AM) differs from species rescue assisted migration (species rescue AM) because the risks of invasiveness, hybridization with local species, and the spread of diseases are minimized in managed forests. The rationale behind this assertion for forestry AM is that it involves the translocation of populations within the existing geographic range of the species, whereas species rescue AM involves the introduction of exotic species.

However, although we agree that forestry AM is less risky than species rescue AM for the recipient ecosystem, not only can forestry AM fail, but it can also incur enormous financial costs. The failure of efforts that involved planting maritime pine (*Pinus pinaster* Aiton) trees in southwestern France (Aquitaine) with seeds from more southerly populations from Portugal for production purposes is a textbook case.

The climate variability in Aquitaine includes periods of intense frost that are sufficiently rare (every 10–20 years) to be overlooked when establishing tree populations. The frost of the winter of 1985 was the most intense frost event since records began, with temperatures dropping as low as –22 degrees Celsius (°C; Boisseaux 1986), affecting about 350 square kilometers of tree plantations in the region (Doré and Varoquaux 2006). The highest mortality related to frost was observed in populations harvested from Leiria, in Portugal, for which nearby records show that the absolute minimum temperature was only –7.8°C in the last 60 years. Climate averages over the last 30 years differ only slightly between Leiria and Aquitaine, which would erroneously suggest that samples from Portugal would have survived in the Aquitaine region.

Newly emerging climates (Williams et al. 2007) and the uncertainty related to extreme climate events (Easterling et al. 2000) will make the search for southern locations with climatic conditions similar to those of northern populations of trees extremely difficult. Policies of forest adaptation to climate change should account for extreme cold events in the target populations, even if climate change will likely decrease the number of extreme cold events (Easterling et al. 2000), which remain, in our opinion, the hidden element behind the maladaptation of southern populations to northern locations.

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References cited

Boisseaux T. 1986. Influence de l'Origine Génétique (Landaise ou Ibérique) des Peuplements de Pin Maritime sur les Dégâts Causés par le Froid de Janvier 1985 au Massif Forestier Aquitain. Third-year mémoire. École National des Ingénieurs des Travaux des Eaux et Forêts, Bordeaux, France.

Doré C, Varoquaux F, eds. 2006. Histoire et Amélioration de Cinquante Plantes Cultivées. Institut National de la Recherche Agronomique.

Easterling DR, Meehl GA, Parmesan C, Changnon SA, Karl TR, Mearns LO. 2000. Climate extremes: Observations, modeling, and impacts. Science 289: 2068–2074.

Pedlar JH, McKenney DW, Aubin I, Beardmore T, Beaulieu J, Iverson L, O'Neill GA, Winder RS, Ste-Marie C. 2012. Placing forestry in the assisted migration debate. BioScience 62: 835–842.

Williams JW, Jackson ST, Kutzbach JE. 2007. Projected distributions of novel and disappearing climates by 2100 AD. Proceedings of the National Academy of Sciences 104: 5738–5742.

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Responding to our recent article (Pedlar et al. 2012), Benito-Garzon and colleagues point out that extreme climatic events should be taken into account when selecting regenerative material for forestry-related assisted migration (AM) operations. Although technical considerations around seed movements were not the focus of our paper, we concur with their position and welcome the opportunity to expand on this topic.

Benito-Garzon and colleagues emphasize the importance of considering extreme minimum temperatures when matching planting material and planting sites under climate change. Drought, heat waves, and spring freeze phenomena (Gu et al. 2008, Reyer et al. 2013) should also be recognized as extreme weather events that potentially play critical roles in determining the outcome of AM efforts. Although Benito-Garzon and colleagues raise the issue of climate extremes in the context of forestry AM, climate extremes are likely to play an important role in other types of AM, as well (e.g., species rescue; Pedlar et al. 2012).

The considerable uncertainty regarding projections of extreme climatic events warrants further attention. Summarizing the accuracy of global circulation model (GCM) projections over the twentieth century, Seneviratne and colleagues (2012) reported that the highest accuracy was associated with broadscale, temporally averaged estimates of mean temperature, whereas the lowest accuracy was associated with estimates of climatic extremes at fine spatial and temporal resolutions. Although the latest round of GCM projections shows promise with regard to temperature extremes (Sillmann et al. 2013), accurately predicting extreme cold events (such as the one described by Benito-Garzon and colleagues), droughts, heat waves, and late frosts at specific locations remains extraordinarily challenging.

Our focus on climate extremes and their associated uncertainty is not intended to deter forest managers from cautiously exploring AM as a tool for climate change adaptation. In fact, as the climate changes, plantations regenerated using local seed sources are also expected to experience suboptimal growing conditions and changes in the frequency and magnitude of extreme events such as droughts and heat waves; thus, risks exist in the absence of AM, as well. The issues raised here underline the importance of managing risks at reforestation sites through recognized strategies such as employing multiple seed sources, using established field trials to guide seed movements, and exercising caution and humility when calculating migration distances.

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References cited

Gu L, Hanson PJ, Post WM, Kaiser DP, Yang B, Nemani R, Pallardy SG, Meyers T. 2008. The 2007 eastern US spring freezes: Increased cold damage in a warming world? BioScience 58: 253–262.

Pedlar JH, McKenney DW, Aubin I, Beardmore T, Beaulieu J, Iverson L, O'Neill GA, Winder RS, Ste-Marie C. 2012. Placing forestry in the assisted migration debate. BioScience 62: 835–842.

Reyer CPO, et al. 2013. A plant's perspective of extremes: Terrestrial plant responses to changing climatic variability. Global Change Biology 19: 75–89.

Seneviratne SI, et al. 2012. Changes in climate extremes and their impacts on the natural physical environment. Pages 109–230 in Field CB, et al. eds. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Cambridge University Press.

Sillmann J, Kharin VV, Zhang X, Zwiers FW, Bronaugh D. 2013. Climate extremes indices in the CMIP5 multimodel ensemble: Part 1. Model evaluation in the present climate. Journal of Geophysical Research: Atmospheres. (4 March 2013; *http://onlinelibrary.wiley.com/doi/10.1002/jgrd.50203/abstract*)

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Gender Bias Also Contributes to the Attrition of Women in Science

I read with interest the recent article by Adamo (2013). The underrepresentation of women across many subfields of academic science and medicine is a pressing issue, with serious implications for the future of our national competitiveness and scientific progress. Therefore, I was pleased to see this article exploring potential factors contributing to the attrition of women within the biological sciences and attempting to draw valuable lessons from the comparatively successful retention efforts in medical fields. However, I was struck by the author's omission of a discussion of gender bias as a potential factor contributing to the scarcity of women.

Recent research conducted by me and an interdisciplinary team of coauthors (Moss-Racusin et al. 2012) builds on a large body of social science work and demonstrates that both male and female science faculty members exhibit robust, measurable gender biases benefiting their male students. More specifically, biology, chemistry, and physics faculty members at research-intensive universities across the United States judged a female student to be less competent, less hirable, and less deserving of mentoring than an identical male student and also paid the female student almost $4000 per year less for a lab manager position. These data suggest that, in addition to the workload and motherhood factors discussed by Adamo, subtle gender biases favoring men may contribute to the gender disparity within science fields.

Indeed, gender bias may play a direct role in driving women out of science (e.g., if they encounter an obviously biased professor) but could also be playing a more subtle role (e.g., if women's motivation and enthusiasm for science are undercut by inadequate mentoring, unfair pay, and downgraded evaluations of their competence). Therefore, although I wholeheartedly agree that the scientific community should work to identify and interrupt the processes that undermine women's full participation in science, I would argue that gender bias should be considered as a potential cause for the loss of women in science, along with the other variables that Adamo considered.

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References cited

Adamo SA. 2013. Attrition of women in the biological sciences: Workload, motherhood, and other explanations revisited. BioScience 63: 43–48.

Moss-Racusin CA, Dovidio JF, Brescoll VL, Graham MJ, Handelsman J. 2012. Science faculty's subtle gender biases favor male students. Proceedings of the National Academy of Sciences 109: 16474–16479.

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Too Many Biologists: A Reply from Adamo

I am in complete agreement with Moss-Racusin that gender bias remains a barrier to women's participation in science. This problem was nicely demonstrated in her and her colleagues' paper (Moss-Racusin et al. 2012) and has also been shown previously (e.g., Wennerås and Wold 1997). My article was not meant to be an exhaustive survey of the various factors that impede women scientists. I wanted to focus on one critical issue that I think has been neglected—that is, that the oversupply