

EVOLUTIONARY HISTORY AND POPULATION GENETICS OF FRASER FIR AND INTERMEDIATE FIR, SOUTHERN APPALACHIAN ENDEMIC CONIFERS IMPERILED BY AN EXOTIC PEST AND CLIMATE CHANGE

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Two *Abies* (true fir) taxa are endemic to high elevations of the Appalachian Mountains, where both are restricted to small populations and are imperiled by the same exotic insect. Fraser fir (*Abies fraseri*) exists in a handful of island-like populations on mountain ridges in the southern Appalachians of North Carolina, Tennessee and Virginia. Intermediate or Canaan fir (*Abies balsamea* var. *phanerolepis*) occurs in scattered high-elevation bogs in West Virginia and on mountaintops in Shenandoah National Park in Virginia. Morphological and genetic similarities among Fraser fir, intermediate fir, and the northern, widespread balsam fir (*Abies balsamea*) have raised questions regarding the origin of the Southeastern fir taxa and have provoked debate about their taxonomic status. We used 10 microsatellite molecular genetic markers developed from Fraser fir to quantify genetic variation within Fraser fir and intermediate fir, and to examine the evolutionary relationships among Fraser, intermediate, and balsam fir. We found little genetic differentiation among these three taxa, suggesting that Fraser fir might better be classified as a variety of balsam fir (*Abies balsamea* var. *fraseri*) rather than as a separate species. The results further appear to reject the hypothesis that intermediate fir was of hybrid origin between balsam fir and Fraser fir. Intermediate fir and Fraser fir had lower genetic diversity than balsam fir by several measures, indicating that they have undergone at least some genetic degradation since they were fragmented and isolated from balsam fir at the end of the Pleistocene. Somewhat surprisingly, both intermediate fir and Fraser fir were most closely related to balsam firs from the Maritime provinces of Canada. The results help clarify how North American tree species have responded to the dramatic distributional shifts caused by long-term climate changes since the end of the last glaciation. The results may also prove important for *in situ* and *ex situ* gene conservation efforts for Fraser fir and intermediate fir. Fraser fir has experienced severe mortality across much of its range as a result of infestation by the balsam woolly adelgid (*Adelges piceae*), an insect from Eurasia, while intermediate fir stands in West Virginia have become infested more recently. Both Southeastern fir taxa face extirpation in the face of global climate change, which could make them unable to persist in their current natural stands while isolating them by great distances from the nearest suitable environments.

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