



Potential species replacements for black ash (*Fraxinus nigra*) at the confluence of two threats: emerald ash borer and a changing climate

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The emerald ash borer (*Agrilus planipennis*; EAB) is causing widespread mortality of ash (*Fraxinus* spp.) and climate change is altering habitats of tree species throughout large portions of North America. Black ash (*F. nigra*), a moist-soil species common in the Northwoods, is under a double threat of losing habitat from climate change and near annihilation from EAB. Because black ash often occurs in nearly pure stands, planting non-ash species is a management strategy already underway or being planned for thousands of acres. This study explores the implications of threats to black ash ecosystems by using analyses of field data and models to assess both the threats to, and potential replacement species for, black ash in Minnesota. For our analysis we (1) assessed the status of ashes and co-occurring species in forest inventory plots throughout Minnesota; (2) modeled the risk of EAB attack for multiple years in Minnesota; (3) modeled potential impacts of climate change on tree species with current or potential future habitat in Minnesota; (4) evaluated species co-occurring with black ash in plots in Ohio and Michigan, southeast of Minnesota; and (5) synthesized these results to provide a classification for candidate replacement species, both from within Minnesota and from points farther south. We provide a list of 46 non-ash species and rank their capacity to thrive as replacements for black ash in the Northwoods; these include swamp white oak, a species from farther south but one thriving well in planted sites on the Chippewa NF.

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