

# POTENTIAL REPLACEMENTS FOR NORTHWOODS BLACK ASH IN A CHANGING CLIMATE: THE CONFLUENCE OF TWO CHALLENGES

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## ABSTRACT

**Introduction** By most indications, the fate of all North American native and non-urban ash (*Fraxinus* spp.), in the wake of emerald ash borer (EAB), is bleak. This study is concerned with creating a better understanding of the potential replacements of black ash (*Fraxinus niger*) in native stands in the Northwoods (northern Minnesota, Wisconsin, and Michigan) as the ash dies out.

**Research Approach** We evaluated the current distribution and abundance of black ash and its co-occurring species in the eastern United States, according to US Forest Service Forest Inventory Data. With this information, along with 38 environmental variables, we create suitable habitat models for the species using the RandomForest statistical modeling tools (see <http://www.nrs.fs.fed.us/atlas>). We then model the suitable habitat for each species under various scenarios of climate change for ~2040, 2070, and 2100. The model outputs are intended to give some indication of potential changes in species composition under climate change.

Coupled with this effort is an analysis of Forest Inventory and Analysis (FIA) plots for Minnesota, and a field assessment of current co-occurring species within black ash ecosystems in Ohio and Michigan. With FIA, a total of 9427 FIA plots were assessed, with 23% of them recording black ash. A total of 182 plots in Ohio and 93 in Michigan were evaluated prior to, or in some cases, during, EAB invasion for seedlings, saplings, and overstory trees to assess potential species mixes in the next forest.

**Results** The climate change suitable habitat models, even when excluding the direct impacts of EAB, provide evidence that black ash (*F. nigra*) would lose much of its suitable habitat over the eastern US by 2100. In this study, we focus on species which presently or potentially in the future may co-occur with black ash, and how their habitats may change by the end of this century. The primary

species presently co-occurring with black ash in Minnesota included quaking aspen (*Populus tremuloides*), balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), and balsam poplar (*Populus balsamifera*). Major co-occurring tree species in the Ohio-Michigan, black ash-dominated plots included primarily elms (*Ulmus* spp.) and maples (*Acer rubrum*, *A. saccharinum*, *A. saccharum*) in Ohio, and maples, oaks (*Quercus* spp.), and basswood (*Tilia* sp.) in Michigan. These latter species may be potential replacements for black ash under a changed climate situation.

**Discussion** The short-term disturbance of EAB infestation will drastically overwhelm longer term impacts of climate change. By coupling plot-level (FIA) information with the overall trends in suitable habitat for co-occurring species, we provide new analyses on the possible future composition of these ecosystems. For example, current co-occurring species with black ash in Minnesota are the likely replacements initially, but the future northward expansion of the potential range of some non-ash tree species currently from Ohio or lower Michigan may allow them to move into areas where they currently do not co-occur with ash. Or, should managers and researchers decide to do so, this information provides a basis for potential species appropriate for experiments in assisted migration. Very subtle variations in topography, soils and genetics can greatly influence which species may be appropriate, so further studies and transplanting experiments are recommended.