Uprooted: Potential Changes in Tree Habitat Under Climate Change

By Louis R. Iverson, Stephen Matthews, Matthew Peters and Anantha Prasad, USDA Forest Service's Northeastern Research Station

An increasing number of cases are appearing in scientific literature that document changes among species patterns. Such changes include the timing of migration, the timing of appearance in spring and disappearance in autumn, and flowering dates, just to name a few. Evidence is mounting that these changes will continue to accelerate through the century.

Though tree habitats change slowly relative to most animals and many herbaceous plants, the fossil record and multiple models show that they too are destined for changes in composition and abundance. Catastrophic events like fire or ice storms could hasten these changes as well, even though large lag times may normally occur due to the long life spans of trees.

Our work was designed to show the potential changes in suitable tree-species habitat (not necessarily where the species will be) by 2100 under various scenarios of climate change. We model these potential changes by using forest-inventory data and 38 predictor variables, including: four land-use, one fragmentation, seven current-climate, five elevation, nine soil classes, and 12 soil-property variables. We do this by using a statistical modeling technique called Random Forests, which builds a thousand models from random subsets of data and predictors and then averages them together to produce one prediction model

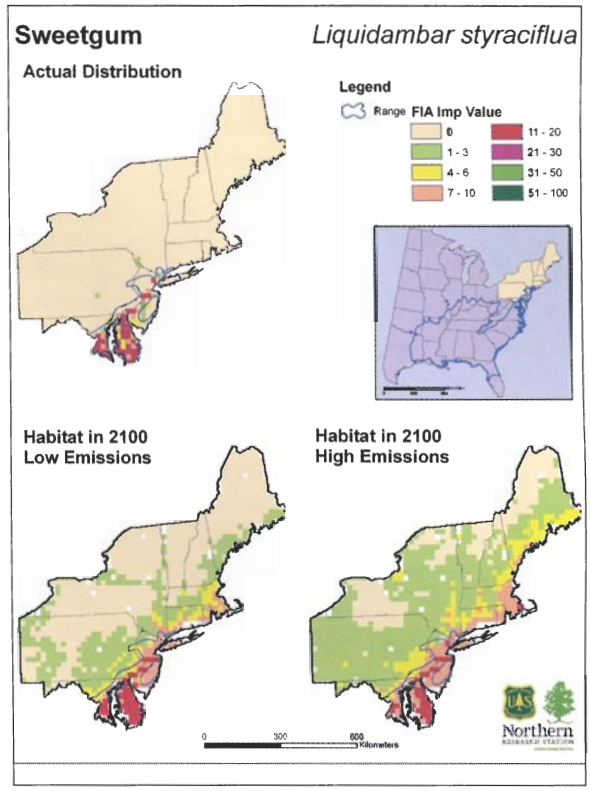
Results from this modeling effort show that the most abundant species will have sizeable changes in suitable habitat over the next century. In general, those species expected to increase or decrease under climate change will do so to a greater extent under higher emissions of carbon dioxide than lower emissions. For example, sweetgum shows an increase in Delaware Estuary habitat under climate change and, to a greater degree, under the higher-emissions scenario.

In Delaware, loblolly pine nearly doubles in abundance, sweetgum stays at a high level, southern red oak stays at a lower level, and the rest of the currently plentiful species are all expected to decline in importance. This is especially the case with black cherry, American beech and scarlet oak.

In New Jersey, sweetgum trees will more than double. In fact, it is the only species showing an increase under both emission scenarios. Black oak and sugar maple show a differential phenomenon where these species will have their suitable habitat enhanced under the lower-emissions scenario but incur decreases, especially with regard to sugar maple, under higher emissions. All the rest of the Garden State's species will decline, with sweet birch losing the highest percentage of suitable habitat

In Pennsylvania there are several important species that will have enhanced habitat under climate change: black gum will increase about 50 percent, white oak will increase roughly twofold, and black oak will increase more than two to threefold, depending on emissions. Sassafras will maintain its abundance, with a slight increase expected under lower emissions. And, as for the rest of the species, they would decline, with black cherry and American beech losing the most habitats.

In summary, climate change will provide a driving force over the next few decades to change the forest composition in the region surrounding the Delaware Estuary. These changes are expected to be gradual, however, as trees live a long time. And just because the climate is more suitable for a different species, that does not mean that already established trees will not survive well beyond the time their habitat is no longer as suitable. Thus, we cannot put a timeframe on the compositional changes discussed here.



As carbon dioxide emissions increase, so too does the suitable habitat for sweetgum and other tree species not normally found in the Northeast.

The larger, more noticeable changes are likely to occur as a result of direct human impacts, like land-use change and land management, or from large disturbance events such as ice storms, hurricanes, and escaped fires. However, large disturbance events could also serve as accelerators that move the community into compositions more akin to the suitable habitats discussed here.

For further insight into the work being done by the USDA Forest Service's Northeastern Research Station, including in-depth species analysis, please visit its website at www.fs.fed.us/ne. ■