(Re)expansion of the maple syrup industry in New England: where are the potential taps?

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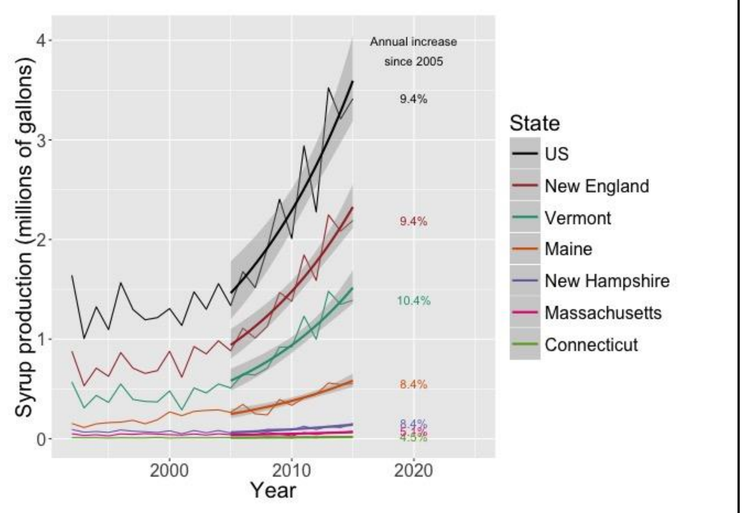
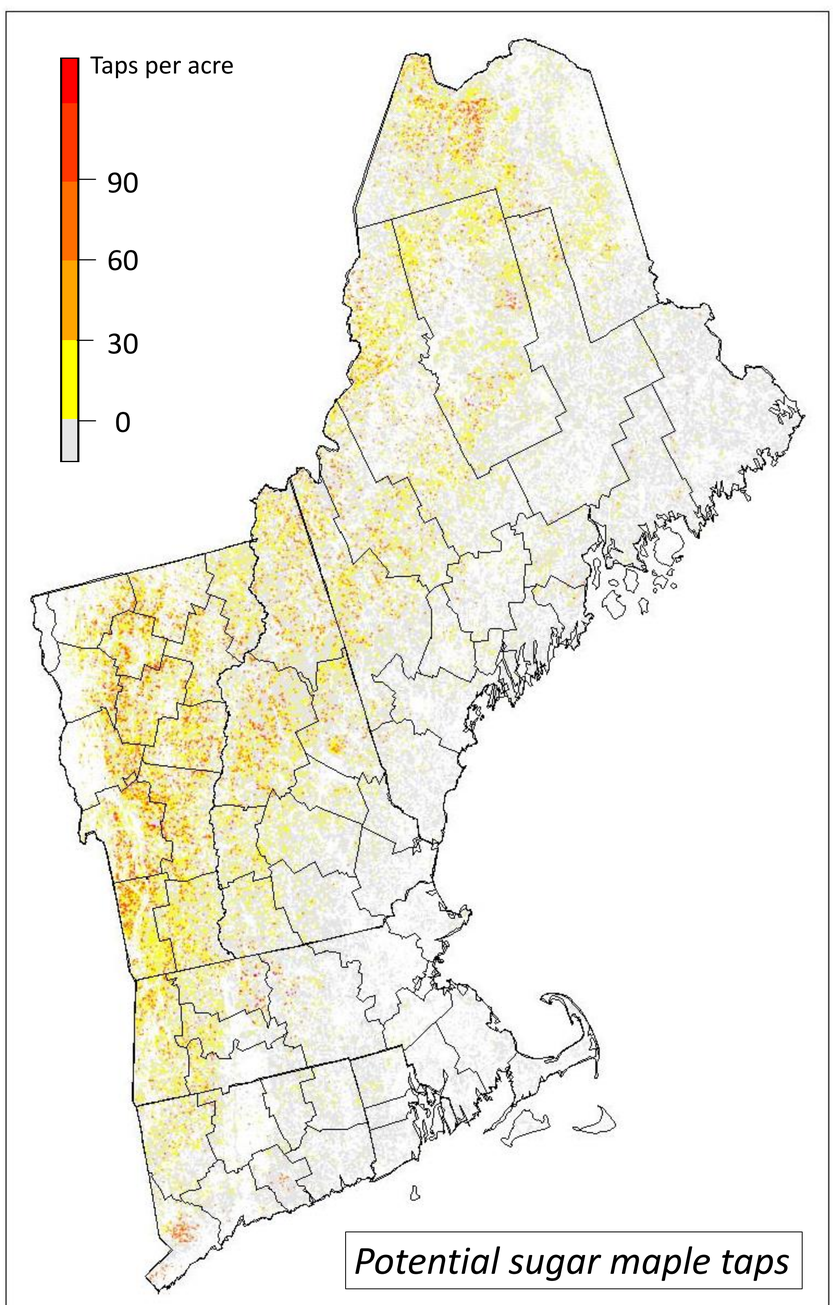
Research Motivation.
The cultural and economic importance of sugar maple is nearly unrivaled among trees in eastern North America. In addition to providing high value lumber and the brilliant backdrop for the "leaf-peeping" autumn tourist economy, its sweet sap is the raw material for maple syrup, one of the few wild-harvested agricultural products in North America. U.S. maple syrup production reached its peak around the Civil War with 6 million gallons of syrup produced per year, before beginning a long decline. During the 1970s – 1990s, syrup production hovered around 1 million gallons per year, but recent technological advances and rising demand has spurred new growth in the industry, with exponential growth at 9.4% for the past decade and current production at 3.5 million gallons per year. New England leads the U.S. in maple syrup production, with its growth driving the national trend.

Given these trends, what is the potential for continued expansion of the industry in New England? Where can new sugar bushes be located and how might changes in climate and land-use impact the availability of trees to tap?

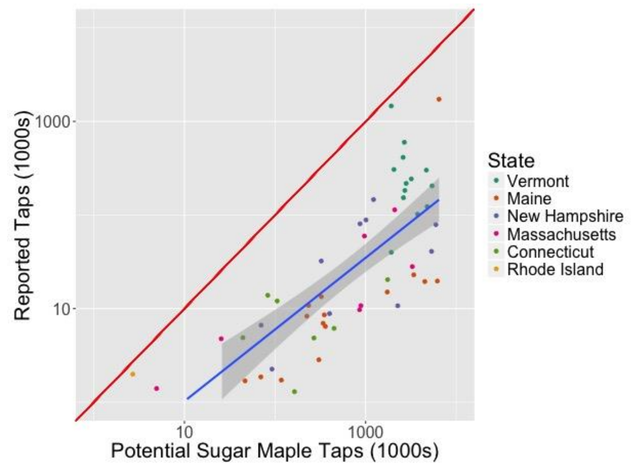


Mapping methodology.
To explore possible growth in the industry, we mapped the potential taps in New England using FIA data using a spatial imputation technique. Duveneck *et al.* (2015) published a map linking every forested 250 m x 250 m pixel in New England to a plot in the Forest Inventory and Analysis (FIA) network of the USDA Forest Service (Bechtold and Patterson *et al.* 2005). Using conservative tapping guidelines based on tree diameter from the North American Maple Syrup Council (Heiligmann 2006), we calculated the number of potential taps per acre in sugar maple (*Acer saccharum*) trees in each of the FIA plots included in the Duveneck *et al.* (2015) map, and projected the number of potential taps per acre across the forested areas of New England.



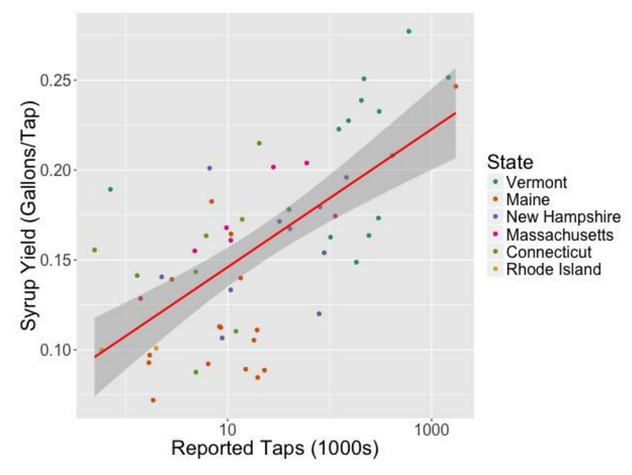
Potential sugar maple taps

Comparison with maple syrup production data.
We compared our estimates of potential taps to actual reported taps per county from the 2012 agricultural census by the National Agricultural Statistics Service (NASS 2015).

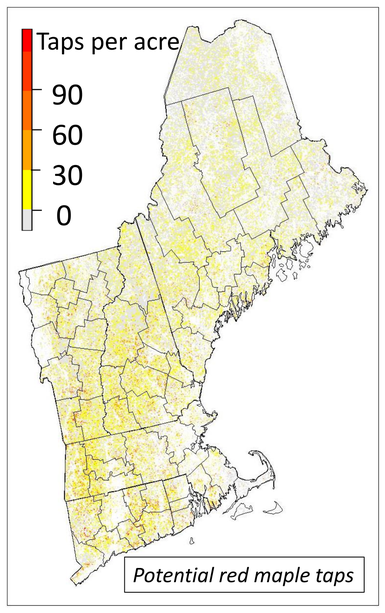


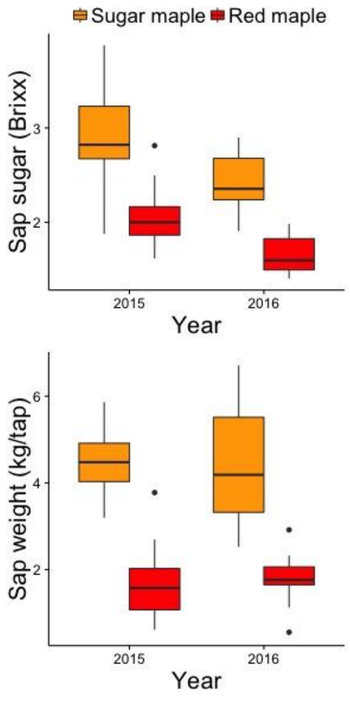
On a log-log scale predicted potential taps explained 51% of the variation in reported taps at the county level. Counties with reported taps above the trend line, and closer to unity (*red line*) are closer to reaching their tapping potential.

Counties with more taps had higher syrup yield per tap. This may reflect that locations with more sugar maple trees also had more productive trees in terms of sap flow, sap sugar content, or both. However, it could also reflect that areas with a developed maple industry are more likely to have producers using efficient technology such as tubing systems under high-vacuum to collect more sap per tap.



A role for red maple?
Many maple syrup producers also tap red maple (*Acer rubrum*), when it occurs within a sugar bush.
While considered to have a lower sugar content, red maple grows under a wider range of climatic conditions, including much warmer climates, than sugar maple (Landscape Change Research Group 2014), potentially making it more resistant to climate change. We mapped potential red maple taps and compared sap flow and sugar content of red maples to sugar maples at Harvard Forest.

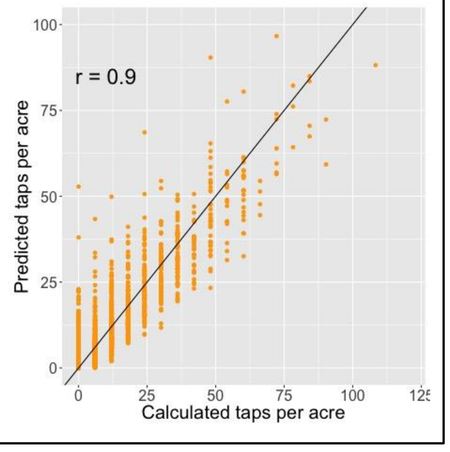




Our projections indicate that there are more potential red maple taps in New England than potential sugar maple taps. However, potential red maple per county was not correlated with maple taps reported by NASS. This suggests red maple is no more than a supplementary sap source, likely because of its low sugar content and weaker sap flow.

Next steps.
Next, we will project the number of taps across the landscape given likely scenarios of climate, land-use, and forest change. For this, we will use Landis II forest landscape model simulations, which provide biomass and age estimates for individual species at future time steps. To estimate tap numbers from stand biomass we used FIA data to correlate biomass and maximum species age to numbers of taps per plot.

At the plot level, estimates of tap density derived from biomass correlate well with the number of taps calculated directly from tree diameters, suggesting this approach will give realistic estimates when projected across the landscape.



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