Congressional Testimony

Statement of

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To the

House Select Committee on Energy Independence and Global Warming

Global Warming Mountaintop 'Summit': Economic Impacts on New England

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Mr. Chairman and Members of the Committee:

Thank you for the invitation and opportunity to speak with you here today regarding the impacts of global climate change on the northern hardwood forest, and in particular, on the maple industry of the northeastern United States.

The U.S. northern hardwood forest has immense significance in the history and culture of the New England/New York region. The tremendous forests of maple, beech, and birch, along with a mixture of other forest plant and animal species, provided material for shelter, fuel, food, and the raw materials for initial commerce during settlement. The maple tree and maple syrup are strongly intertwined with the culture and spirit of New England and New York. Sugar maple is the state tree of both Vermont and New York, with red maple for Rhode Island. Maple is the State "Flavor" of Vermont.

One of the most important agricultural crops of the northern region from pre-settlement to the beginning of the 20th Century was maple sugar. Maple syrup and sugar are made by collecting the sweet sap that exudes from small wounds created in maple trees during the late-winter and spring, and concentrating it by boiling, a practice learned from the Native Americans. Maple sugar was important to the local economies during the Colonist-era and a hugely valuable export commodity from settlement times up until after the U.S. Civil War, with millions of pounds of maple sugar sent to markets throughout our expanding country. Because maple sugar was made locally by free and independent men, unlike the cane sugar imported by the British from the West Indies, it also played a role before and during our fight for independence by eliminating the need to purchase taxed imported sugar, and by helping to sustain our troops during their struggle for freedom. Maple sugar was also involved in the moral and ethical debate surrounding slavery before and during the Civil War, as it was considered to be free from the taint of forced labor.

Since those early times to present day, the maple industry has continued to thrive, largely as a supplier of a pure and natural sweetner useful in a variety of ways in cooking and by adding flavor to other products. It is still produced largely the same way it has always been, through the efforts of fiercely independent sugarmakers who, as careful stewards of the land, work long hours to collect and boil sap during the brief sugaring season each spring. It is a proud tradition, often passed from one generation to another, and represents one of the first agricultural products made in the U.S. each year.

Approximately 75% of the domestic U.S. maple syrup crop is produced in New England and New York, contributing millions of dollars to the local and regional

economies of these areas. The total economic impact of maple in Vermont alone is nearly $200 million each year.

Canada is the world's largest producer of maple syrup, with the Province of Quebec by far the dominant producing region. This was not always the case. Prior to 1900, 80% of the world crop was produced in the U.S. and 20% in Canada. Currently the situation has completely reversed, with 80% of the world syrup produced in Canada and 20% in the U.S. While much of this change has been driven by changing land-use and employment in the U.S., changes in sap collecting technology, and Canadian subsidies aimed at growing the maple industry, climate change is likely to also be partly responsible for the huge increase in Canadian production, especially in the past 30 years.

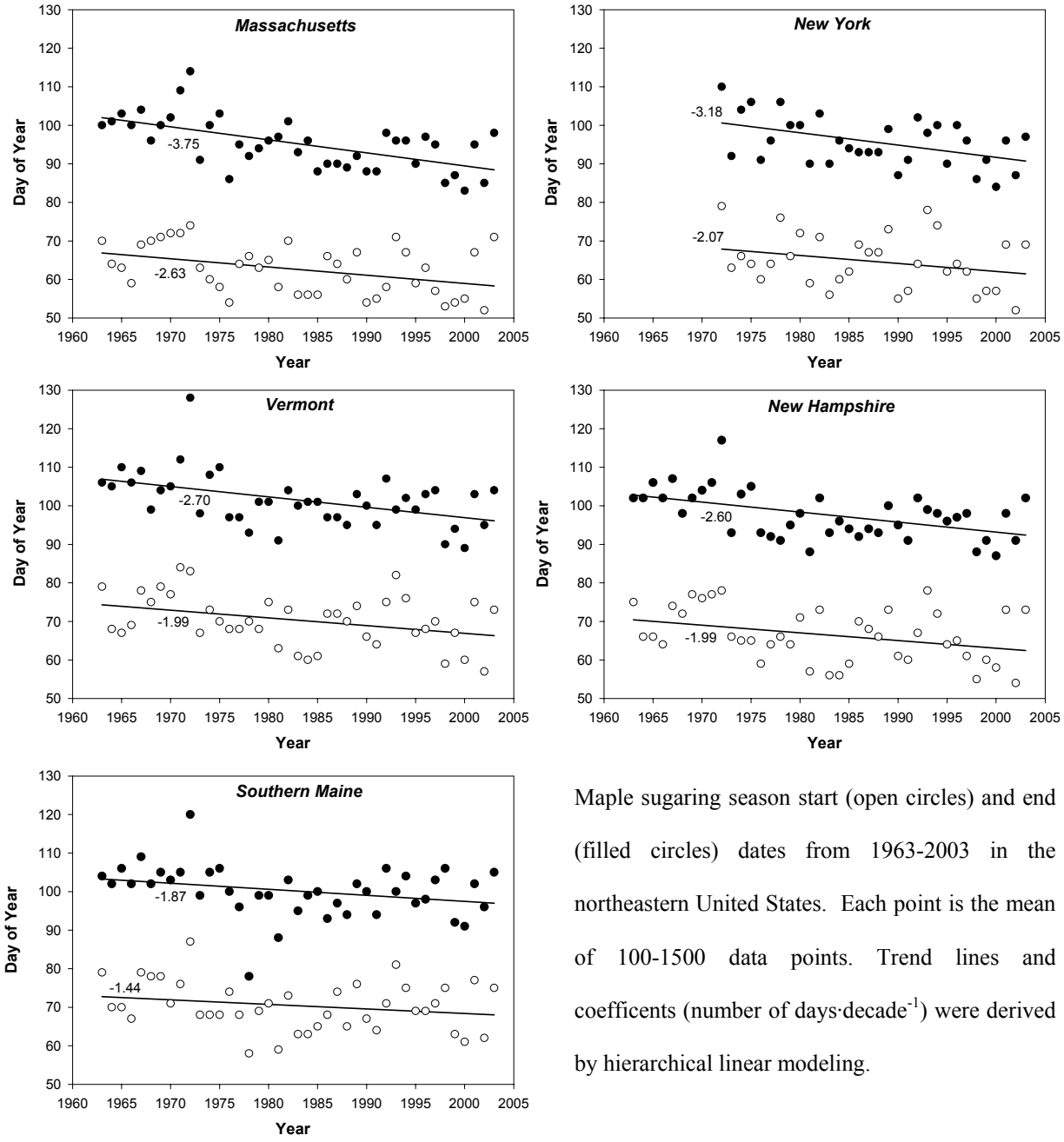
Currently, however, the U.S. maple industry and the culture of its practitioners are under threat. The flow of sap from maple trees during the spring season is controlled almost entirely by the daily fluctuation in temperature. Cold (below-freezing) nights cause contraction of air bubbles within the wood of the tree, causing a suction, and resulting in uptake of water from the soil into the vessels of the tree where it mixes with sugar and freezes. Warm (above-freezing) days result in thawing of the sap and bubble expansion, creating a pressure within the stem. Sap flows out of small wounds (tapholes) created by sugarmakers, and is collected in buckets or with tubing. The slightly sweet sap (approximately 2% sugar) is concentrated, most often by boiling, to produce pure maple syrup (66% sugar). Small changes in the day-to-day temperature pattern will have large consequences on sap flow. Climate change is therefore expected to alter the maple sugaring season in several ways. In the short-term (50-100 years), a change in climate may alter the timing of the season (making it occur earlier in the calendar year) and

reduce the duration of the collection season. In the long-term (100+ years), climate change is expected to shift forest composition, resulting in a loss of the maple-beech-birch as a dominant forest type throughout much of New England and New York.

Answers to specific committee questions follow.

1. *How has the duration and timing of the maple sugar season been changing as a result of global warming? Have these changes accelerated over time or in recent years?*

Historical evidence of the timing of the season, derived from two independent sets of survey data, show that the maple sugaring season has shifted significantly over the past several decades throughout the northeast. The season in New England and New York currently begins approximately 8.2 days earlier in the calendar year than it did 40 years ago. Similarly, the end of the season arrives, on average, approximately 11.4 days earlier than 40 years ago. The net result is that the season is currently 3.2 days shorter than it was historically, representing a loss of approximately 10% of the total season duration over the 40 year record. The observed changes do not appear to be related to changes in maple production methods or other identifiable explanations, but are consistent with observed changes in regional climate over the same time period. Although there is a great deal of variability from season-to-season, the trend is significant, and appears to be fairly consistent and linear over the time period and areas studied.



Maple sugaring season start (open circles) and end (filled circles) dates from 1963-2003 in the northeastern United States. Each point is the mean of 100-1500 data points. Trend lines and coefficents (number of days·decade^{-1}) were derived by hierarchical linear modeling.

2. *What effect has the changing duration and timing of the maple sugar season had on maple sugaring?*

To maximize yields it is important that producers tap trees immediately prior to the time in which sap begins to flow. In the past such decisions were in large part based upon historical tapping dates. A shift in the timing of the season causes uncertainly among producers as to the most appropriate time to tap. Tapping too early causes tapholes to "dry out" and yield less sap. Tapping too late results in the loss of sap during early flows with concomitant reductions in yield. Ongoing research at the University of Vermont Proctor Maple Research Center is aimed at helping producers assess the consequences of their decisions of tapping date on production.

The effect of the reduction in season duration has not, as yet, produced a discernible effect on syrup yield. This is most likely due to two factors -- the normally high year-to-year variability in yield and the more effective use of improved technology in sap collection, such as tubing systems, vacuum extraction, and overall system management. Producers not using vacuum extraction systems are reporting lower yields, especially over the past decade, although this will require more time and further study to quantify the magnitude of the effect.

3. *How do changes in climate affect maple trees and their ability to produce sugar?*

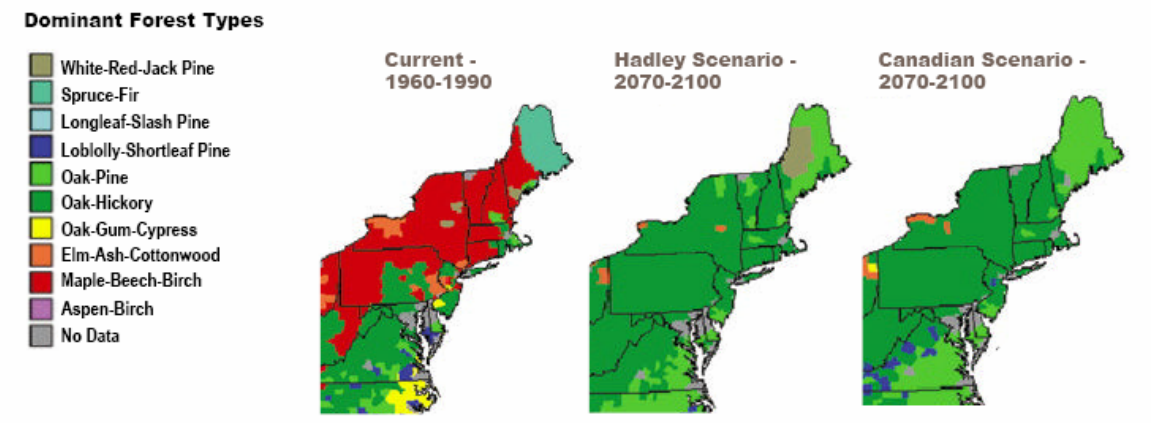
Increased CO_2 concentrations in the atmosphere often stimulate photosynthesis, resulting in a higher carbon assimilation rate and higher production of sugar. This is partially offset by higher respiration due to elevated ambient temperatures, and is also

dependant upon an adequate water supply and adequate nutrition. Many sites throughout the northeast are limited in their growth potential due to marginal soil nutrition, acidic deposition and other interacting stresses, and long-term nitrogen saturation.

4. *In general, what changes are we seeing in New England forests and in particular, on maple trees? What impacts could global warming have on the range or location of maple trees in New England in the future? How could these future changes impact the sugaring industry in the region?*

Changes to date are relatively small and subtle. The maple sap flow season is starting and ending earlier. Earlier flowering and leaf-out of tree and shrub species is reported in New England and New York. The growing season is somewhat longer. Although on the surface, these would seem like positive effects, the distribution of plants is dictated primarily by two climatic factors, temperature and precipitation, working in concert with competition. If the forecasts of models of temperature and precipitation prove to be correct, over time, vegetation will respond to these changes. Since we are interested in long-lived tree species, there will be a lag in response, and humans may try to influence or moderate the response. However given that the models forecast that New England and New York may have a climate resembling that of present-day Virginia to South Carolina, we can expect, over time, that the vegetation will respond and we will have forests resembling those of present-day Virginia to South Carolina. The results of both the Hadley and Canadian Climate models suggest that maple along with other components of the northern hardwood and boreal forests will be largely extirpated from New England and New York, and supplanted by an oak-hickory-pine dominated forest. Given that the

commercial producing regions of the maple sugar industry lie in upstate New York, northern Vermont, and upstate Maine, even a small northward shift in the distribution of maple will have a large negative impact on the domestic maple industry. More importantly, the fall foliage season, which relies on maple species for the brilliant display of red and orange colors, and which annually contributes billions to the northeast tourism-based economy, would be greatly impacted by a shift in tree species composition.



Based on the model of Neilson and Drapek (1998).

5. *How has the maple sugar industry adapted to changes in climate? Are there limits to these adaptation measures?*

There has been little investigation of adaptive strategies to reduce the impacts of global warming on the maple industry. We are currently investigating the effects of timing of tapping on syrup yield in order to provide research-based recommendations to maple producers. Further work on short-term ameliorative strategies for maple producers is necessary.

In the short term (< 50 yrs), use of high-yield maple production techniques may help to offset yield losses resulting from a reduction in season duration. Eventually, as the correct conditions for sap flow become more infrequent, commercial producers, which represent the bulk of syrup produced in the U.S., will cease investing in the maple industry. Hobby producers may continue for a somewhat longer period as they are less sensitive to the need for an income from maple production. We do not yet know the point at which the economics of commercial production will fail, however given possible future temperature regimes predicted by existing models, a loss of the maple industry in the U.S. within the next 100 years would appear to be inevitable. In the long-term, the migration of the maple resource will render even hobby maple production impossible in the U.S.

Summary

If the northeast regional climate continues to warm as projected, we expect that the maple industry in the U.S. will become economically untenable during the next 50-100 years as the conditions for sapflow become less prevalent, thereby resulting first in the loss of commercial producers, and eventually hobby producers. Over the succeeding 50-150 years we will see a continued shift in species distribution from a northern hardwood dominated forest of maple-beech-birch, to one composed primarily of oak-hickory, pine. These changes will have profound implications on the character and economy of New England and New York.