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proper contact times with the various sanitizers. The second area of tubing research is with the new 3/16" tubing: yields increase with the increase in elevation drop in these systems and vacuum is created without the aid of a vacuum pump or releaser. Just where these systems are best suited needs further study. Other research includes the use of low cost, limited area fencing to exclude deer with the hope that areas of sugarbush regeneration can be accomplished in over-browsed forests. Research on various spouts, lines and vacuum for birch production have been conducted for two years at the Arnot research forest and will continue in 2016. Research on improving the quality and labor efficiency of making maple value-added products is a continuing priority of the Cornell Maple Program.

In addition to research, the Cornell Maple Program is involved in several extension projects. The largest is the development of K-6th grade curriculum to improve maple education through NY Ag in the Classroom. This project creates age appropriate worksheets, videos, smartboard programs and whole class activities for each elementary grade. The Cornell Maple Program has also developed a series of recipe brochures for point of sale education of consumers on the variety of ways to use maple syrup and maple sugar. Third, the Program has developed training videos to instruct small and back yard maple producers in making and managing reverse osmosis machines for more energy and time efficient maple production.

Is there Another Invasive Pest in your Sugarbush?

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Years ago my Dad told me that earthworms were good not just for fishing but for the soil too. I believed everything he told me and I still do…that is most things. Earthworms are exotic species coming from Europe and Asia – everything seems to come from there these days. If it isn't an insect pest, it's something like chicken flu. These worms are disrupting the natural mix of plant species in our forests and becoming a serious threat to the biodiversity in our sugar maple forests. NO, they don't kill the trees we are tapping, but they will change the structure of the forest floor and its chemistry. What does this mean? Suddenly, and I mean suddenly, you may notice bald spots in your stands and little or no regeneration of sugar maples. These worms are aggressive and like other species reproduce rapidly allowing their populations to expand. The most destructive ones we call snake worms (Amynthas sp.), because of their wiggling behavior. In 2010 we found a sugar maple stand in Shelburne, Vermont with areas having no understory plants at all. When we investigated further we found significant populations of snake worms devouring the organic matter (leaf litter and other plant debris), causing soil conditions that discouraged growth of understory native plant species. Little is known about their distribution or even the total impact they have on our trees. They are spreading though in Vermont and other northern states. With funding from NAMSC we are looking at their distribution in maple stands throughout the region relative to forest management practices, and assessing their impact on understory diversity, maple regeneration and various soil characteristics.

How are we doing it? We have identified numerous sugar maple stands with active maple sugaring operations in USDA plant coldhardiness zones 3, 4 and 5 in New York, New Hampshire and Vermont. Some of these sites were established for a prior research project (funded in part by NAMSC and the Chittenden County Sugarmakers Association, VT) studying the relationship between the occurrence of insects and diseases and sugarbush tree composition. At each location, eight sub-plots were used. Earthworm damage was determined first using the Invasive Earthworm Rapid Assessment Tool (IERAT) and then earthworm abundance by hand-sorting and counting earthworm middens (mounds of debris created by Lumbricus terrestris, the nightcrawlers). Eleven additional sugarbushes in central to southern Vermont were surveyed for worm diversity and density and vegetation data were taken to increase the possibility of finding damaging levels of invasive worms. Worms were then collected, preserved, and keyed to species. The abundance of worms by species, and their density and biomass on an area basis will now be determined.

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Results to date. Nineteen sites were visited and plots established for invasive worm assessment. Of these, earthworms were detected in all but one site. Seven of the sites had the invasive earthworms called nightcrawlers. We found snake worms in two of the sites. In stands infested with either nightcrawlers or snake worms, we found an average of 3.99 and 0.63 sugar and red maple seedlings per plot, respectively, compared to 5.92 maple seedlings per plot in stands infested with neither of these worm species. The total number of understory plant species and percent ground cover in these sites followed a similar trend (Table 1). These data support the hypothesis that there is a definite impact of snake worms on the understory of maple stands. Using our statistical sampling tool (IERAT), it was revealed that the maximum damage class occurred when stands were either invaded by snake worms or nightcrawlers (where 1 = no disturbance and 5 = maximum disturbance, Table 1). In total, six different species of earthworms were found during our research in 2015. Elevation did not seem to be a reliable indicator of earthworm presence. Additional statistical analyses will be done this winter.

In summary, the presence of either snake worms or nightcrawlers clearly reduces the diversity of understory plant species and increases the amount of bare ground. This can lead to an increased potential for erosion and to changes in soil chemistry and texture. Finding populations of snake worms has proven difficult in northern and central Vermont and northern New York. High populations of nightcrawlers were more common in the zone 4 sites and are also known to negatively impact forest areas. Of 19 sites investigated during July and August 2015 two were found to have high populations of snake worms while seven sites had high populations of nightcrawlers. We found that high populations of both species can cause significant changes in understory plant species diversity and percent cover (area occupied by plants).

Table 1. Mean number of plant species and percent cover per square meter, and IERAT rating with and without *Amynthas* or *L. terrestris* worms

	Sites with no *L. terrestris* or *Amynthas* worms (n=14 sites, 56 plots)	Sites with *L. terrestris* worms (n=7 sites, 28 plots)	Sites with *Amynthas* worms (n=2 sites, 8 plots)
Mean # plant species/M2	4.70	3.20	1.63
% cover/M2	41.60	22.20	10.75
IERAT rating	1.84	4.75	4.8

What's next? Thirty additional sites will be located in regions closer to known snake worm populations and surveyed for worm abundance and species diversity. Study sites will be located by contacting state sugarmakera from nearby states known to have locally abundant snake worm populations such as in New York, Massachusetts, Connecticut, etc. to help find sugarmakers in their areas who either have noticed a lack of regeneration in their sugarwoods. Once located, four random 50 cm2 plots will be established at each of the 30 sites. Midden counts will be done at each plot and IERAT used to determine the impacts of invasive earthworms. At each of these subplots total worm species diversity will be determined using the hand-digging method. Work is underway to develop a sugarrmaker survey and a worm ID guide for distribution to NAMSC in the future to assist sugarmakers with evaluating the occurrence of invasive worms in their sugarbushes.

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