Potential predictors of tap wound volumes in five maple species for sustainable tapping practices

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What are NWCs?

A cross-section and a longitudinal section of the trunk help us understand how healthy trees react to, and recover from tapping.
This tree was tapped properly then thinned out as other nearby crop trees grew larger.

Wood samples by Curle's Maple Products

Stained wood accumulates with each season as non-functioning sapwood. Stain columns form in spring as internal plugs, to stop the flow of sap out of the tree. Small diameter spiles help minimize the volume of stain columns. With proper tapping, a healthy tree should grow new sapwood faster than stain column volume accumulates.

Experiment: NWC and syrup yield in 5 maple species

- 5 species with 15 tapped trees each in Durham and Dover NH. Tapped FEB 2023 & 2024.
- 10” Minimum DBH (Except Boxelder 5”)
- Gravity system with one bucket per tree.
- Sap weighed and sugar concentration measured regularly.
- Trees scanned using sonic and resistance tomography at beginning and end of experiment.
- Wood samples collected for carbohydrate analysis.

Why NWCs matter to producers

Tapping into NWCs will yield little to no sap
Connecting a vacuum sap collection system to an NWC will lead to vacuum leakage and reduced yield
Re-wounding NWCs leads to greater NWC sizes and increased risk of compartmentalization failure
Growth needs to outpace NWCs to be sustainable

Nonconductive Wood Effects on Sap and Sugar Yield Questions

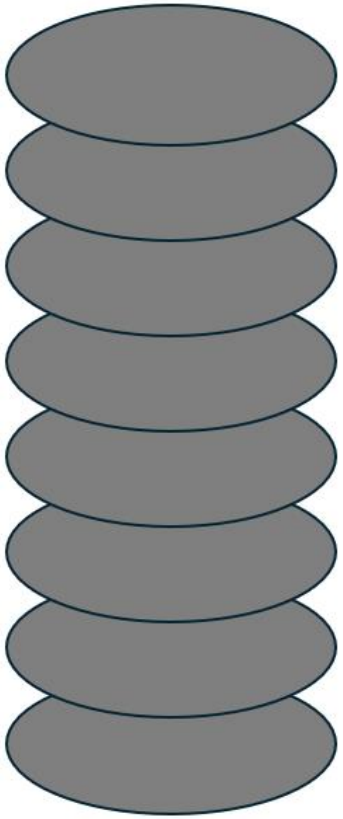
Question 1:
Is there a relationship between sap yield in Acer spp. and the volume of nonconductive wood formed?

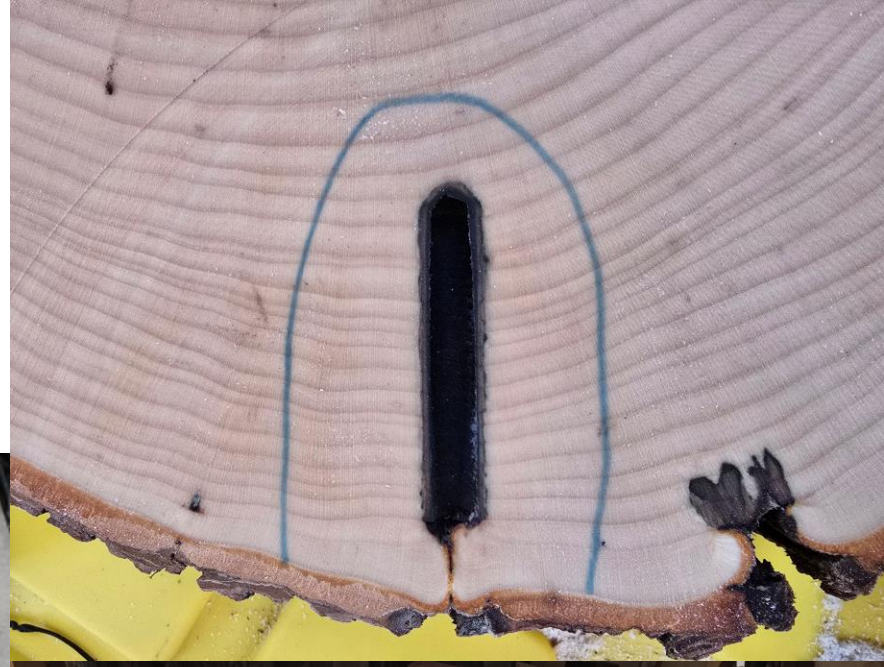
Question 2:
Is there a relationship between average tapping season sugar concentration in the sap of Acer spp. and the volume of nonconductive wood formed?

Question 3:
Do nonstructural carbohydrate (NSC) levels within the sapwood affect the volume of the nonconductive wood columns formed?

How are NWCs measured?

- Cookies
- Tomography (Maybe)





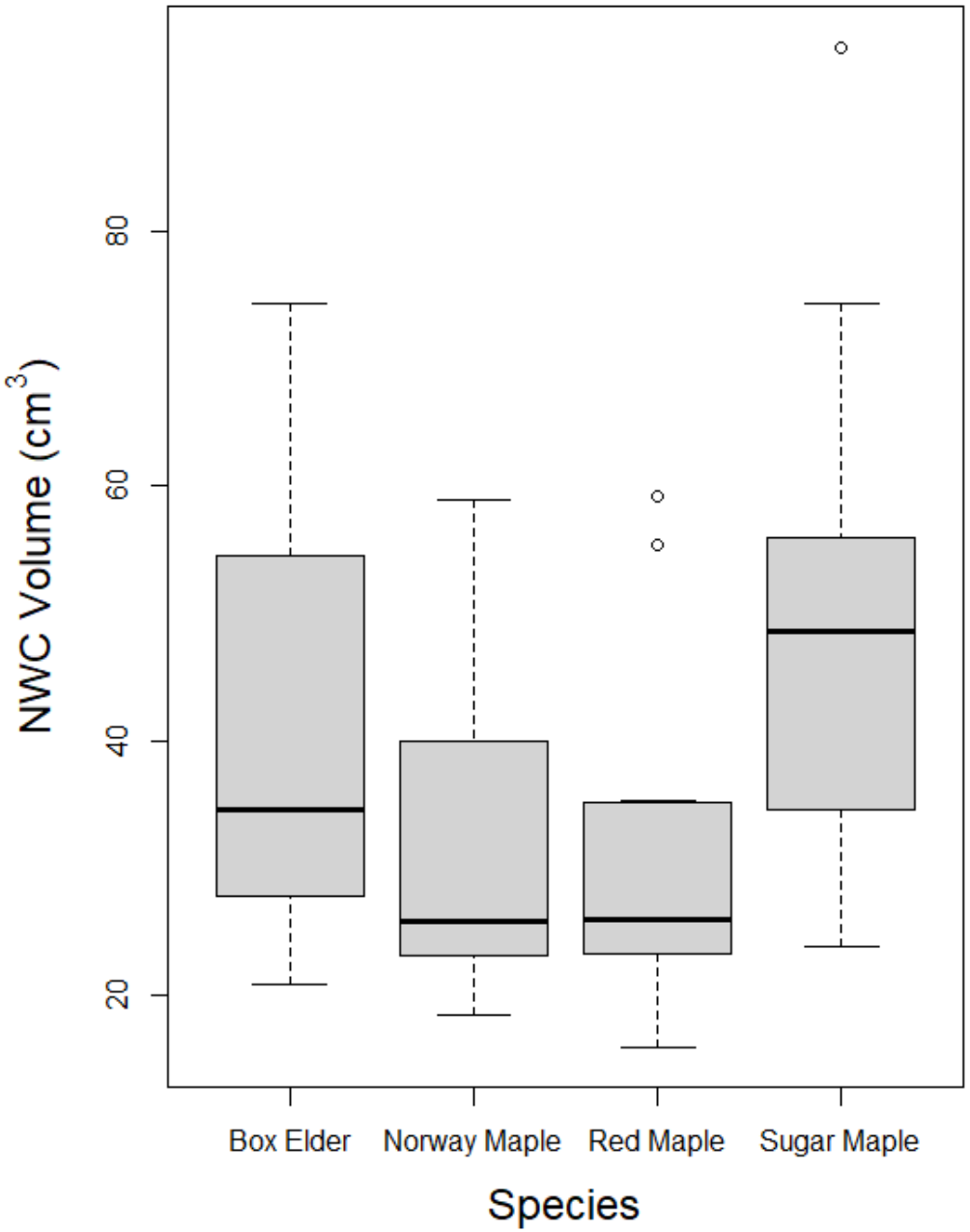

LT300

Examples of wood cookies cut from Sugar Maple during the project

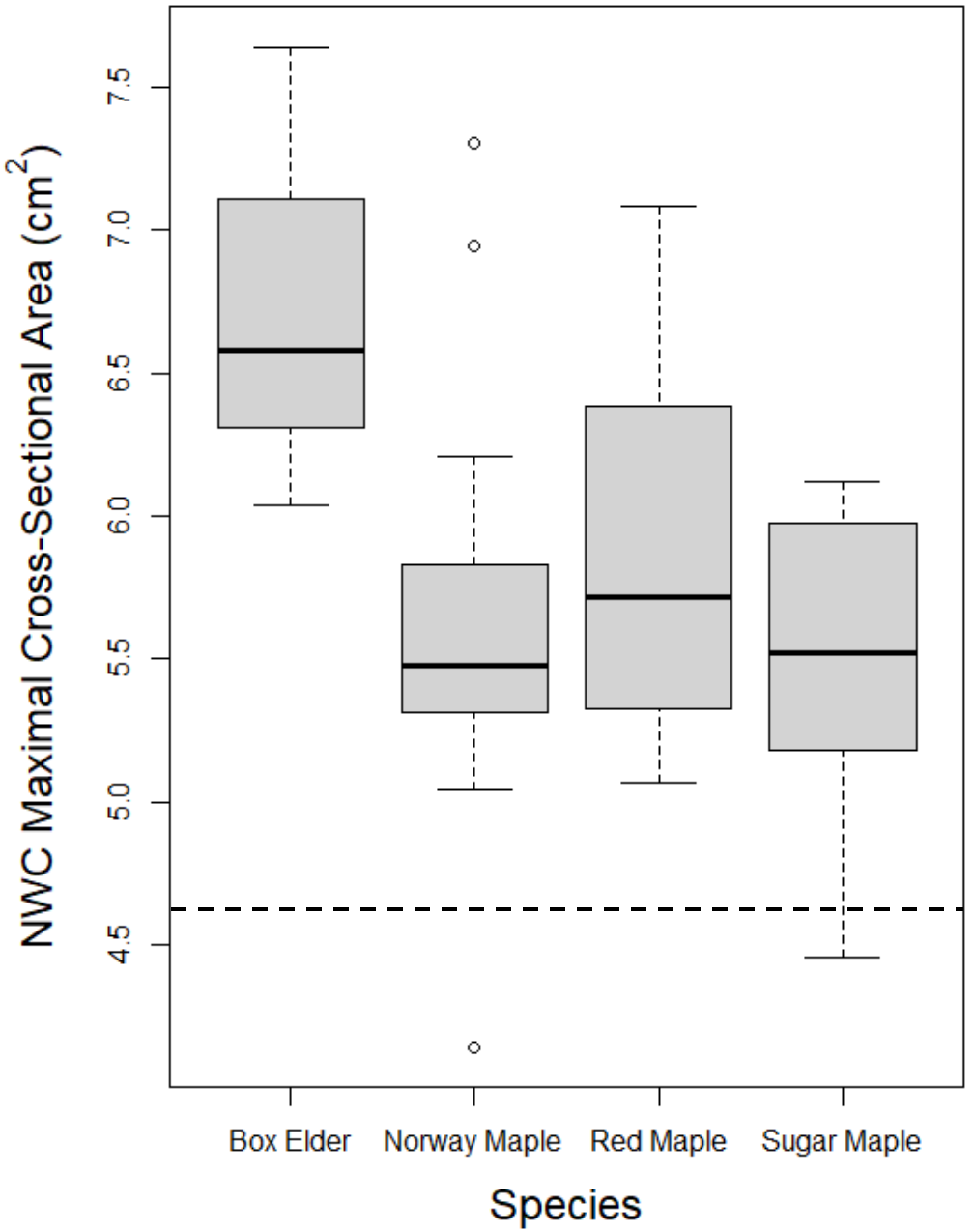
Are maple tapping guidelines universal?

- Shigo (1965) - Red maples have larger taphole wound zones than sugar maple
- Wilmot (2016) - Red maple taphole wound zones not larger than sugar maple
  - Red maples vary more in heartwood depth than sugar maple
- Van den Berg (2021) - Taphole zones that intersect heartwood or other wound zones are much larger
- Nothing published on NWC in other maples?

Volume of Nonconductive Wood by Species



Maximal Cross Sectional Area of Nonconductive Wood

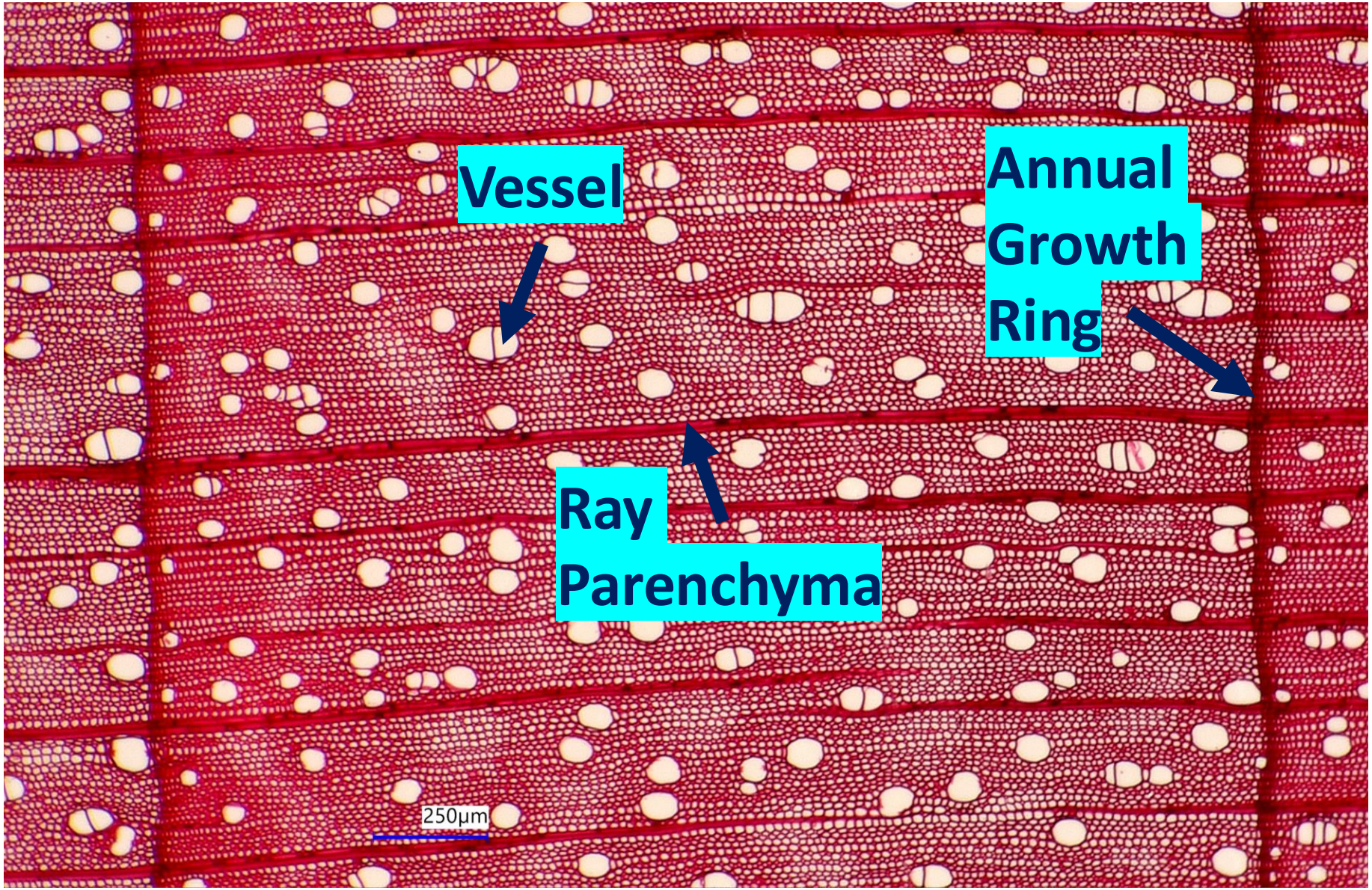


Other northeastern maples – an "untapped" resource?

	VT	NY	ME	WI	MI	NH	PA	OH	MA	CT	IN	MN	WV
Red 10"+	614	**1,145**	**1,891**	930	886	**4,351**	**2,947**	**1,287**	**5,143**	**6,689**	508	868	**1,614**
Silver 10"+	5	44	4	113	84	25	18	140	54	29	220	228	15
Boxelder 8"+	8	19	1	157	18	-	32	174	4	-	178	706	48
Norway 10"+	-	2	1	<1	1	-	10	-	13	39	-	-	1

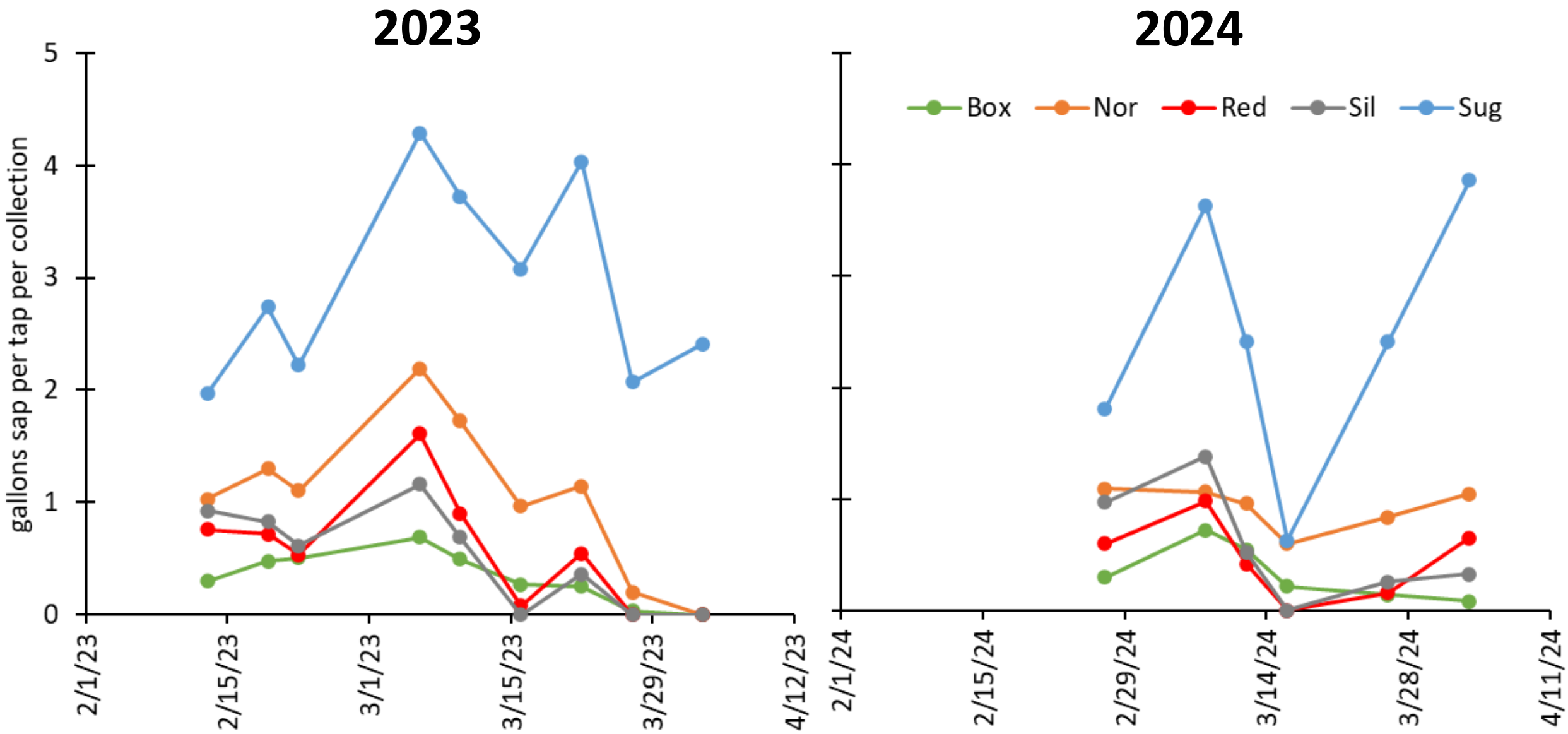
Table 1. Statewide estimates of other maple species per thousand 10"+ sugar maples *based on FIA data. There are substantially more red maples than sugar maples in most syrup-producing states (bold values). Boxelder and Norway maple are likely severely under-represented in these data, because these species are preferentially found in locations that don't meet FIA sampling criteria. For example, no 8"+ boxelder were tallied in NH by FIA, but we have already identified several possible boxelder study locations in Durham NH. States with the greatest potential to expand production using boxelder and silver maple include MN, IN, WI, and OH. From Norway maple, CT, MA, and PA would gain the most.*

Why might sap yield affect NWCs?

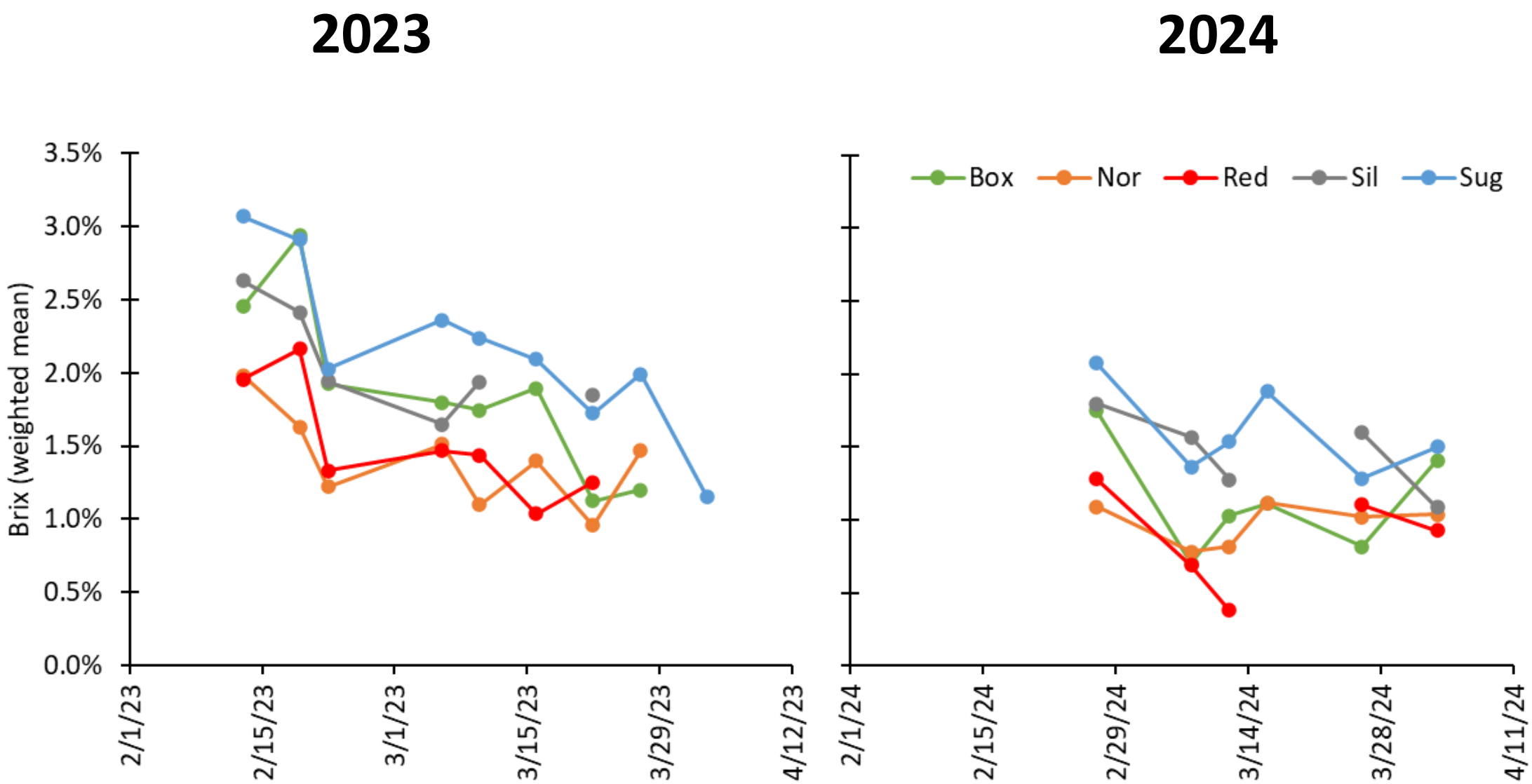


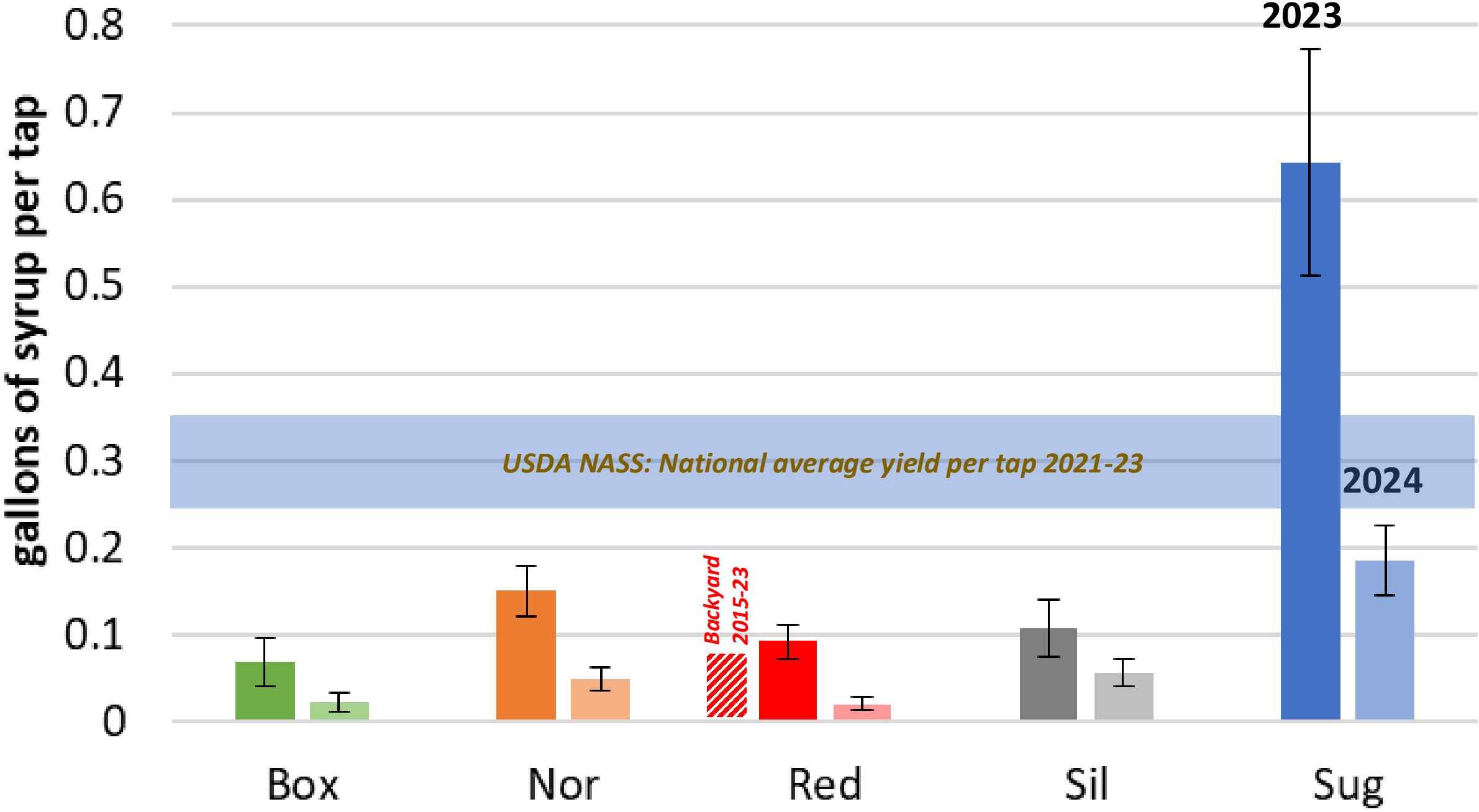
Photomicrograph by JP Limbach
microlabgallery.com

Sap yield by species



Sap sweetness by species





n= 14-15 trees per species. Error bars are 2SE

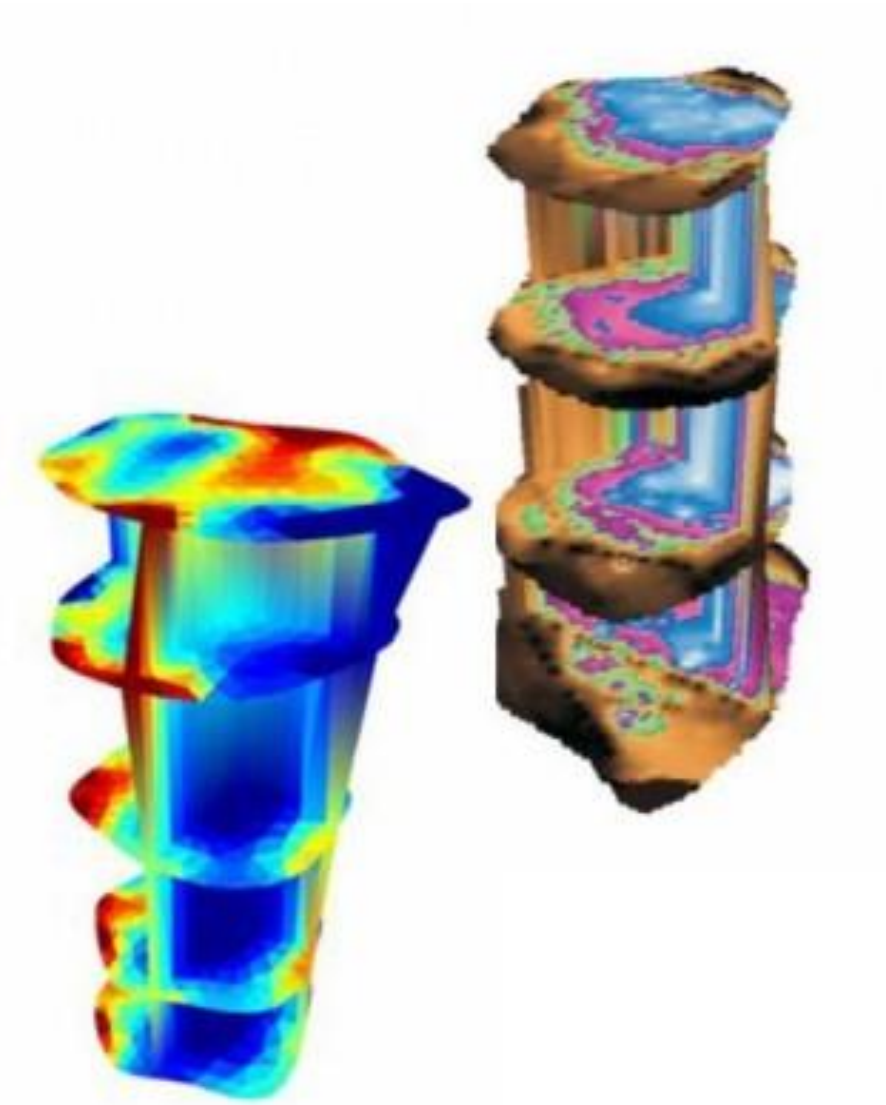
In Summary of current data…

- Other maple species have potential for tapping but need guidelines
  - Unique flavors of Norway and Boxelder (by limited observations)
  - Boxelders had marginal yield
  - All results were on gravity systems
- NWC volumes were similar across species in study
- Current tapping guidelines may support Silver, Norway, and Red maple but boxelder needs more information due to shallow heartwood
- The seasonal average of sap sweetness nor sap yield appear to be predictors of NWC size

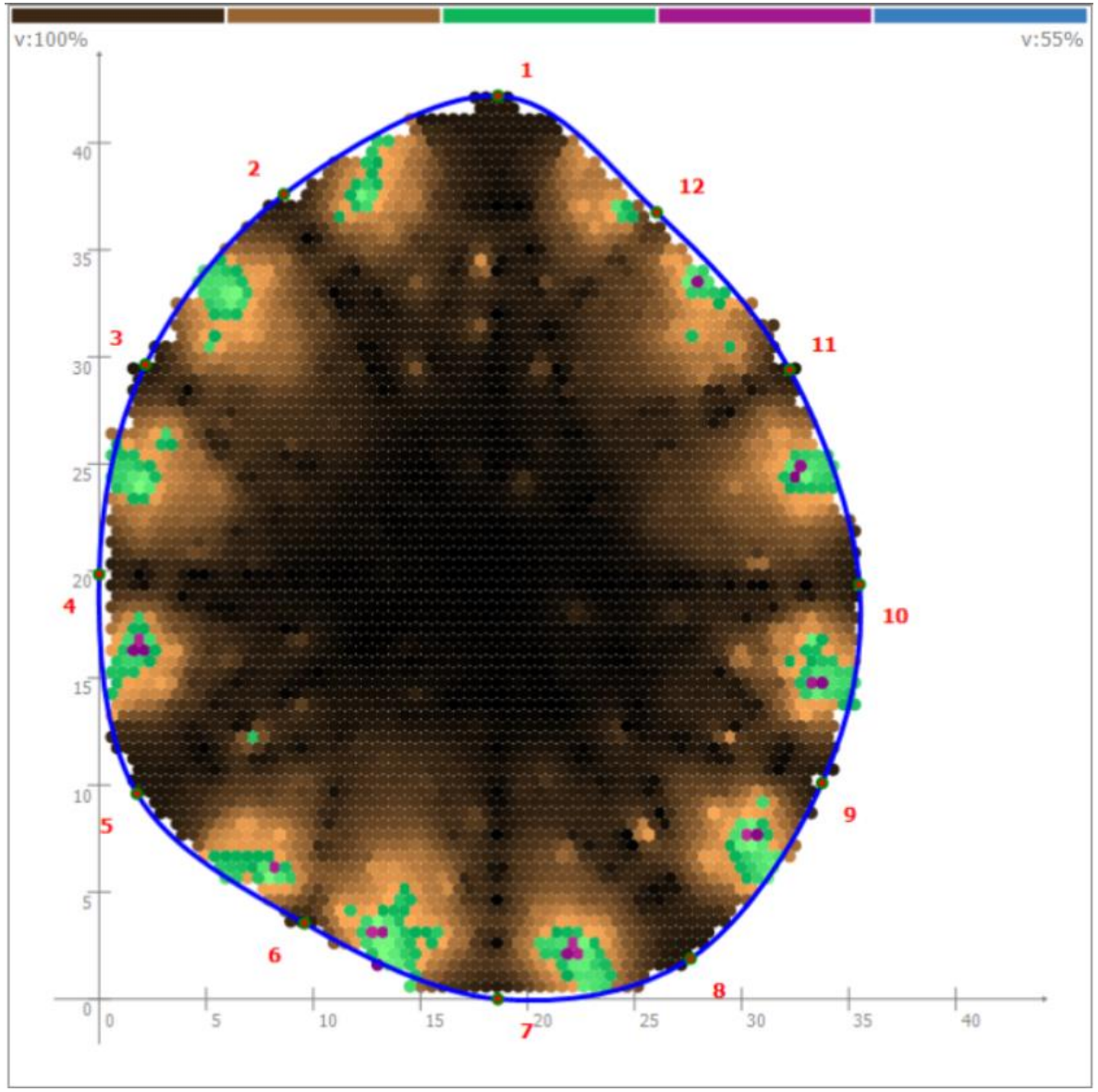
Attempts at nondestructive measurements…. Tomography!

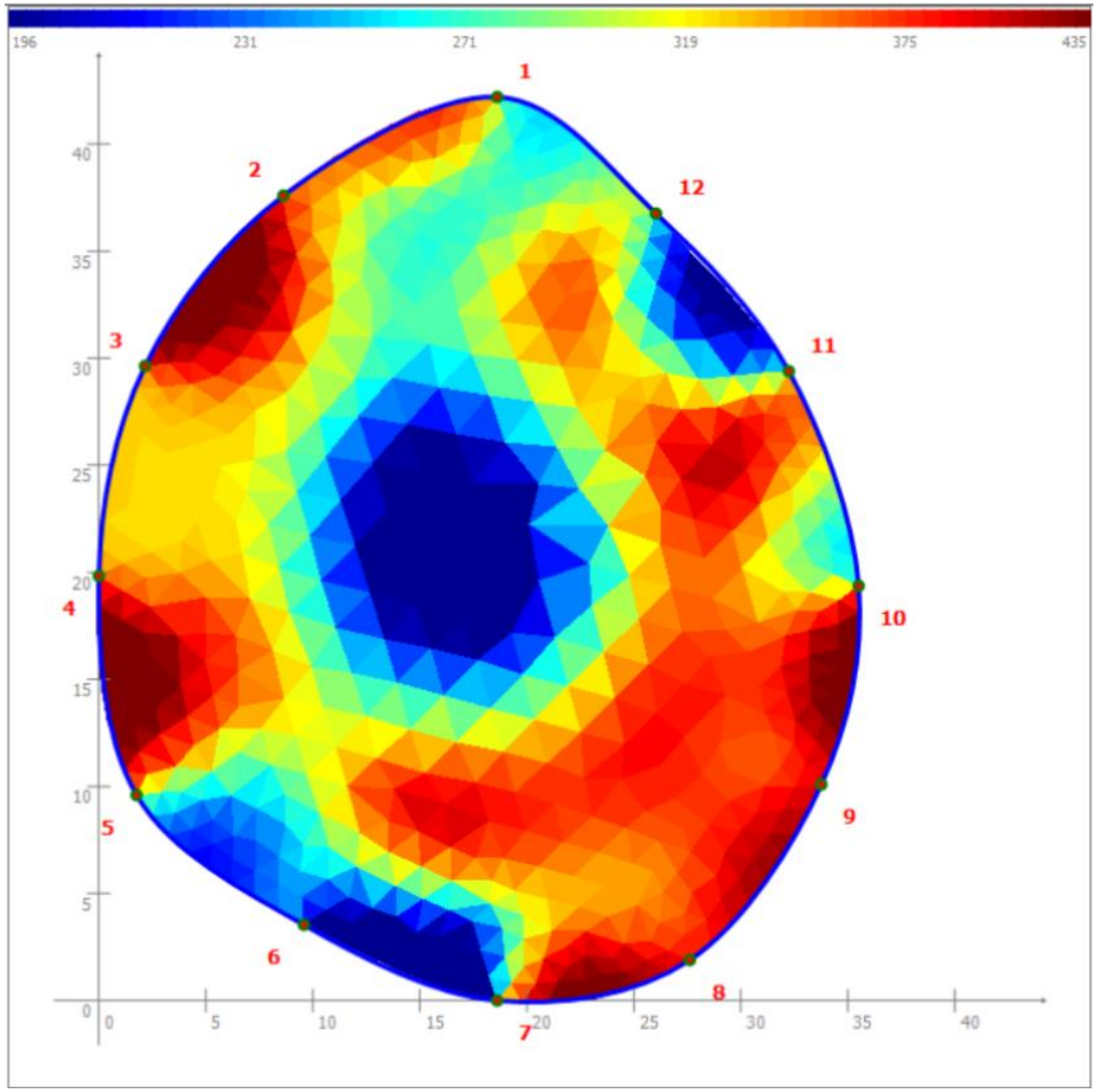
https://www.iml-electronic.com/product/picus-sonic-tomograph/

Tomography



Examples of tap tomography





Tomography Results

- Ultimately, tomography is not reliable in looking for such small wounds
- These systems were designed to look at large scale incipient decay, rot, and cavities within trees
- Could yield interesting sapwood data for future studies
- Better left as a tree structural diagnostic tool in it’s current state

Next steps…

- Felling of silver maple study trees
- Completion of image analysis of NWC volumes
- Lab analysis of sapwood carbohydrates
- Lab analysis of wood anatomy traits
- Synthesis of all results into literature

Thank you for your time!
Questions/Comments?

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