Fall Tapping and Taphole Longevity Strategies

Photos: Mark Isselhardt, UVM Extension

Timothy Perkins and Abby van den Berg
University of Vermont Proctor Maple Research Center
www.uvm.edu/pmrc

Early Tapping and Taphole Longevity Strategies

Goals of early tapping with or without "freshening"
(reaming wider, drilling deeper, both):

Take advantage of early sapflows
(potentially increase overall yields)

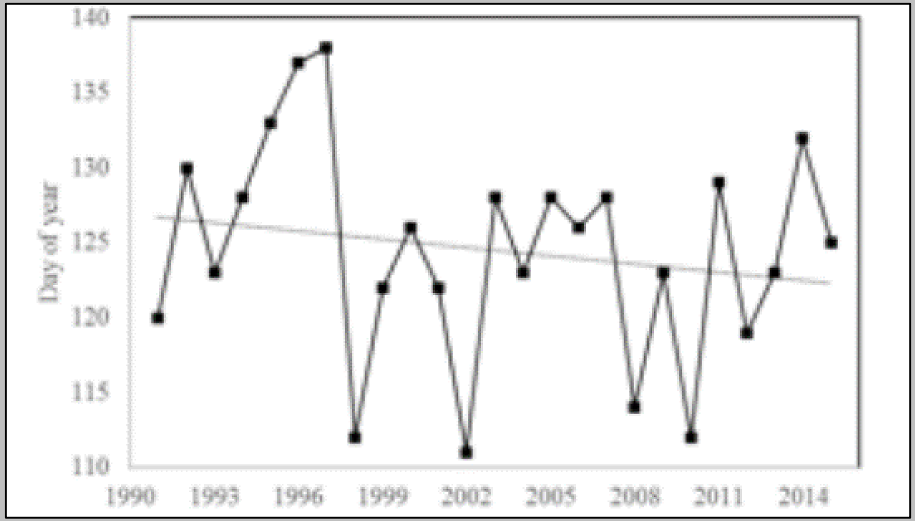
Mitigate trend for earlier season end

Mitigate risks of unusual or poor "standard" sapflow season:

Early warm temperatures that cause season to end early
Cold season with fewer than usual sapflow days
Warm season with fewer than usual sapflow days

Large operations – simply necessary to efficiently complete tapping, timely

Mark Isselhardt, UVM Extension



Long-term trend in the timing of sugar maple budbreak at the Proctor Maple Research Center (data from Duncan *et al.* 2016)

Sap Yields from
FALL AND SPRING TAPPING *of*
Sugar Maple

by Melvin R. Koelling

U. S. FOREST SERVICE RESEARCH PAPER NE-115
1968

NORTHEASTERN FOREST EXPERIMENT STATION, UPPER DARBY, PA.
FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE
RICHARD D. LANE, DIRECTOR

USDA FOREST SERVICE RESEARCH NOTE NE-134
1971

N E

FOREST SERVICE, U. S. DEPT. OF AGRICULTURE, 6816 MARKET STREET, UPPER DARBY, PA.

MAPLE SUGARING WITH VACUUM PUMPING
DURING THE FALL SEASON

ACER
Centre de recherche, de développement et de transfert technologique acéricole inc.

142, rang Lainesse
Saint-Norbert d'Arthaba
Québec (G0P 1B0)
Téléphone : 819-369-4
Télécopieur : 819-369-9

Projet de recherche : Rapport final

Exploration de l'entaillage d'automne
comme complément à l'entaillage traditionnel

Projet n° 7440

par

Yvon Grenier, ing. f., M. Sc.

2 mai 2008

Publication no 7440-FIN-0208

Early Tapping and Taphole Longevity Strategies

Questions of yields/economics:

Early tapping (with or without reaming):

More sap than standard spring tapping?

Less sap overall due to earlier taphole drying and wound response?

(level of compartmentalization/plugging vessels that can't be compensated for even with drilling deeper/wider)

If more sap than standard tapping:

Enough to offset increased costs?

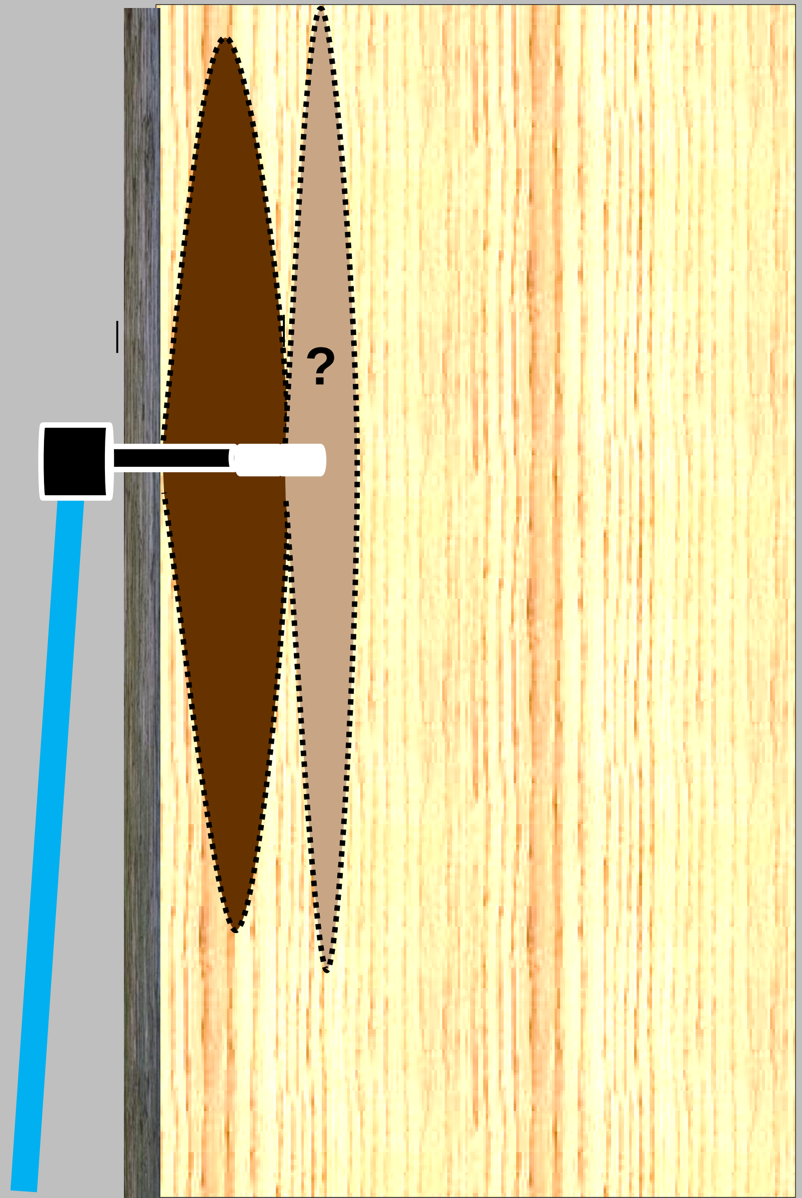
Early Tapping and Taphole Longevity Strategies

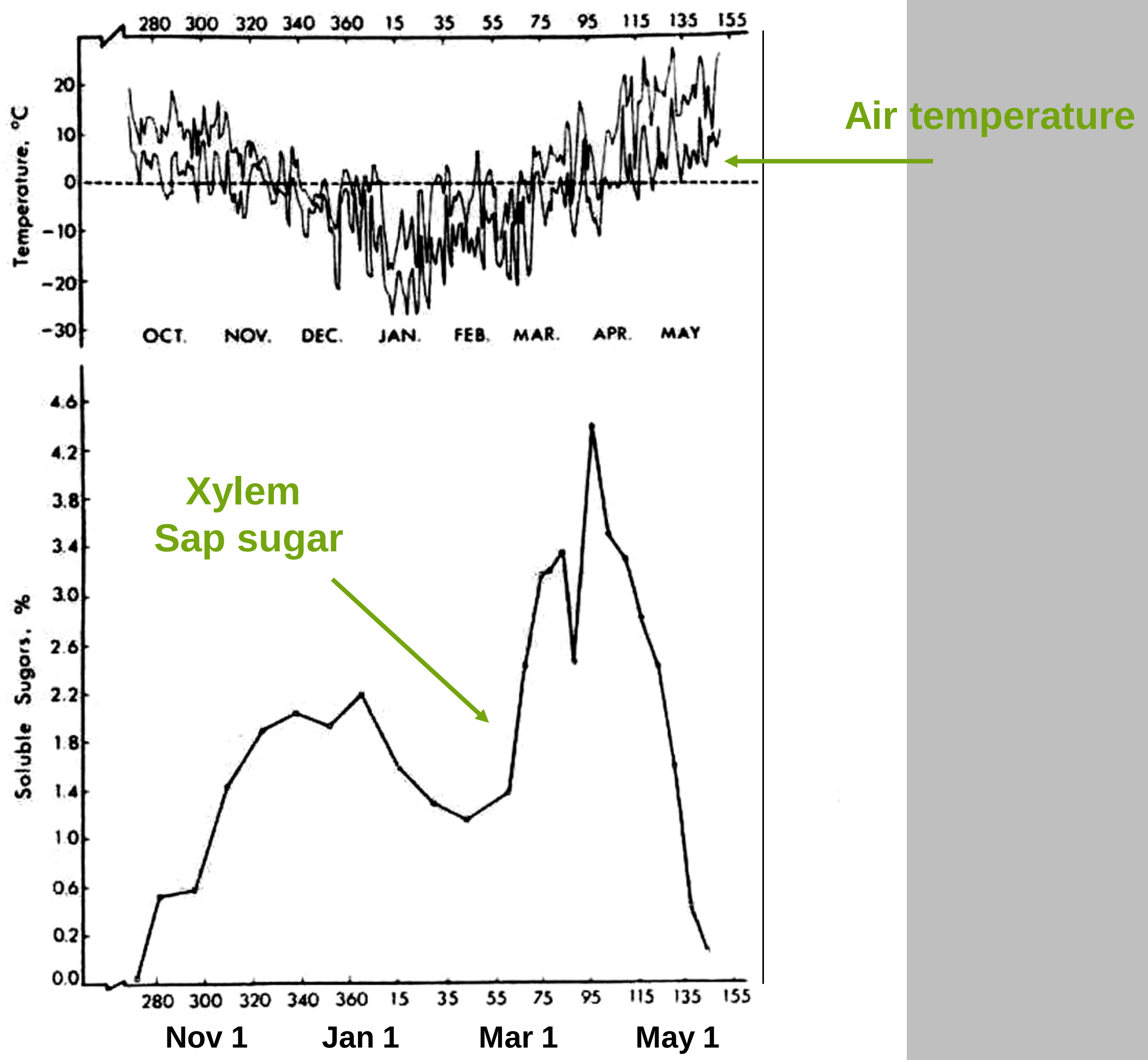
Questions of sustainability:

Greater wounding (more nonconductive wood)?

Longer open wound – increased risk of infection and decay?

Carbohydrate removal during critical period for tree (winter respiration, freeze tolerance, survival)




Air temperature
Temperature, °C
20
10
0
−10
−20
−30
280 300 320 340 360 15 35 55 75 95 115 135 155
OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY
Xylem
Sap sugar
Soluble Sugars, %
4.6
4.2
3.8
3.4
3.0
2.6
2.2
1.8
1.4
1.0
0.6
0.2
0.0
280 300 320 340 360 15 35 55 75 95 115 135 155
Nov 1
Jan 1
Mar 1
May 1

Early Tapping and Taphole Longevity Study - Objective

Determine if early tapping practices result in increased yields and overall net benefit relative to standard spring tapping

($, nonconductive wood and long-term yields and $)

North American Maple Syrup Council Research Fund
USDA Acer Access
Lapierre Equipment Sponsor

Perkins, T.D. and van den Berg, A.K. Outreach to improve yields and profits for maple producers.
USDA AMS Acer Access and Development Program Grant AM170100XXXXG167

Early Tapping and Taphole Longevity - Methods

Repeated 3 years

7 different early tapping/freshening treatments (plus control)

10 trees per treatment (avg. dbh 12.9")

Each tree tubed into separate 30-gal sap collection chamber

Vacuum ~28" Hg

Sap volume/Sugar content measured 5-7X per season

Average total yield for each treatment

Treatments

Year 1

2017-18

Description	Spout	Depth	Date First Tapped	On 2/19/2018:
Fall Control	5/16"	1.5"	11/10/2017	-
Fall Deeper	5/16"	1.5"	11/10/2017	Redrilled Deeper (2.5")
Fall Ream+Deep	1/4"	1.5"	11/10/2017	Reamed to 5/16" and Deeper (2.5")
Fall 2nd Hole	5/16"	1.5"	11/10/2017	Drilled 2nd hole 2" Higher (1.5")
Winter Control	5/16"	1.5"	1/18/2018	-
Winter Deeper	5/16"	1.5"	1/18/2018	Redrilled Deeper (2.5")
Winter Ream+Deep	1/4"	1.5"	1/18/2018	Reamed to 5/16" and Deeper (2.5")
Spring Control	5/16"	1.5"	2/19/2018	(First tapped)

Treatments

Year 1

2017-18				
Description	Spout	Depth	Date First Tapped	On 2/19/2018:
Fall Control	5/16"	1.5"	11/10/2017	-
Fall Deeper	5/16"	1.5"	11/10/2017	Redrilled Deeper (2.5")
Fall Ream+Deep	1/4"	1.5"	11/10/2017	Reamed to 5/16" and Deeper (2.5")
Fall 2nd Hole	5/16"	1.5"	11/10/2017	Drilled 2nd hole 2" Higher (1.5")
Winter Control	5/16"	1.5"	1/18/2018	-
Winter Deeper	5/16"	1.5"	1/18/2018	Redrilled Deeper (2.5")
Winter Ream+Deep	1/4"	1.5"	1/18/2018	Reamed to 5/16" and Deeper (2.5")
Spring Control	5/16"	1.5"	2/19/2018	(First tapped)

Year 2

2018-19				
Description	Spout	Depth	Date First Tapped	On 2/13/2019:
Fall Control	5/16"	2"	10/24/2018	-
Fall Deeper	5/16"	2"	10/24/2018	Redrilled Deeper (2.5")
Fall Ream+Deep	1/4"	2"	10/24/2018	Reamed to 5/16" and Deeper (2.5")
Fall 2nd Hole	5/16"	2"	10/24/2018	Drilled 2nd hole 2" Higher (2")
Winter Control	5/16"	2"	1/3/2019	-
Winter Deeper	5/16"	2"	1/3/2019	Redrilled Deeper (2.5")
Winter Ream+Deep	1/4"	2"	1/3/2019	Reamed to 5/16" and Deeper (2.5")
Spring Control	5/16"	2"	2/13/2019	(First tapped)

Treatments

Year 3

2019-20				
Description	**Spout**	**Depth**	**Date First Tapped**	**On 2/13/2019:**
Fall Control	5/16"	2"	10/31/2019	-
Fall Deeper	5/16"	2"	10/31/2019	Redrilled Deeper (2.5")
Fall Ream+Deep	1/4"	2"	10/31/2019	Reamed to 5/16" and Deeper (2.5")
~~Fall 2nd Hole~~	------		----------	------------------
Winter Control	5/16"	2"	12/17/2019	-
Winter Deeper	5/16"	2"	12/17/2019	Redrilled Deeper (2.5")
Winter Ream+Deep	1/4"	2"	12/17/2019	Reamed to 5/16" and Deeper (2.5")
Spring Control	5/16"	2"	2/12/2020	(First tapped)
				On 3/30/2020:
Ream Late-Season	5/16"	2"	2/12/2020	Redrilled Deeper (2.5")

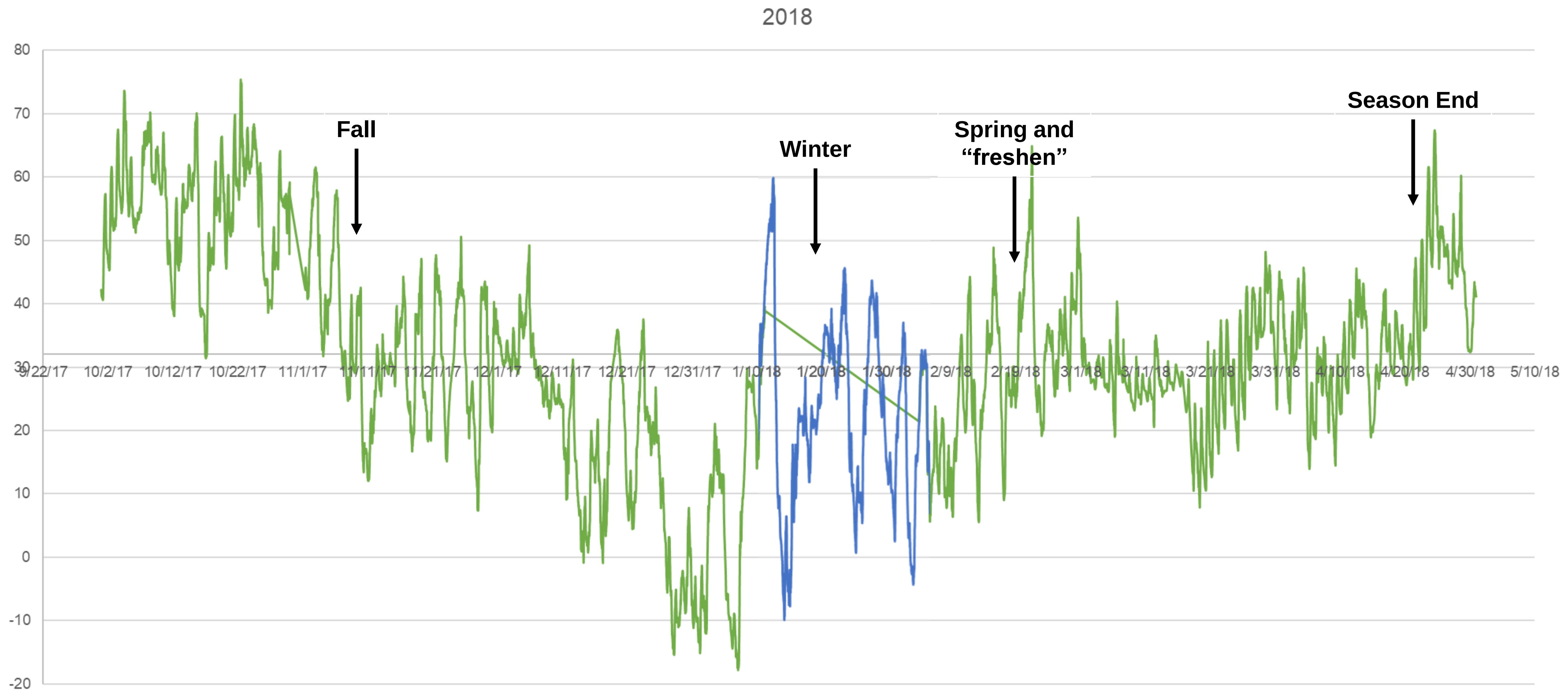
Fall	Winter	Spring	Season End
11/10/2017	1/18/2018	2/19/2018	4/23/2018
10/24/2018	1/3/2019	2/13/2019	4/18/2019
10/31/2019	12/17/2019	2/12/2020	4/8/2020


DEWALT


FIRE
4K HD
KIMTECH

Fall	Winter	Spring	Season End
11/10/2017	1/18/2018	2/19/2018	4/23/2018
10/24/2018	1/3/2019	2/13/2019	4/18/2019
10/31/2019	12/17/2019	2/12/2020	4/8/2020

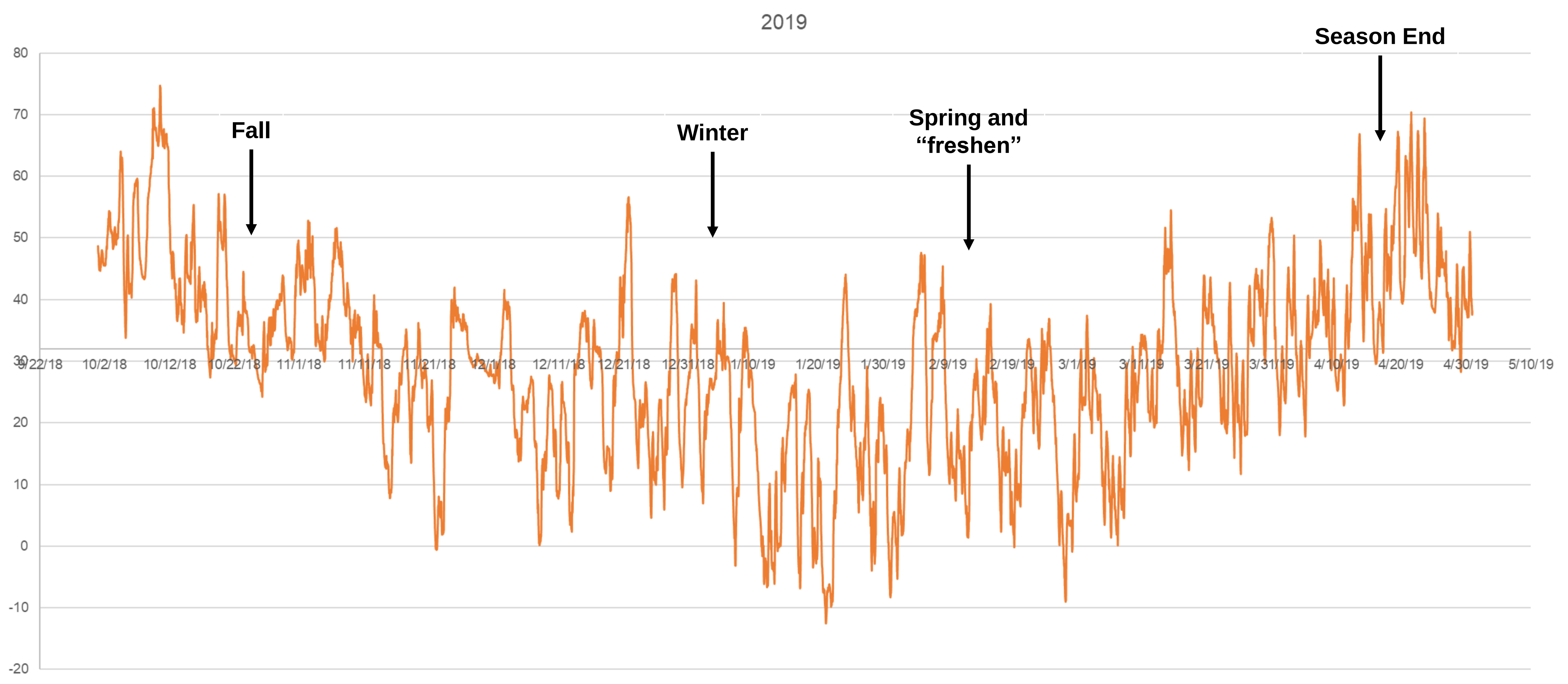
2018



Duncan J., and C. Waite. Raw Forest Canopy Meteorological Tower Data. University of Vermont. FEMC. Can be found at: https://www.uvm.edu/femc/data/archive/project/forest-environmental-monitoring-canopy-tower/dataset/raw-forest-canopy-meteorological-tower-data

Fall	Winter	Spring	Season End
11/10/2017	1/18/2018	2/19/2018	4/23/2018
10/24/2018	1/3/2019	2/13/2019	4/18/2019
10/31/2019	12/17/2019	2/12/2020	4/8/2020

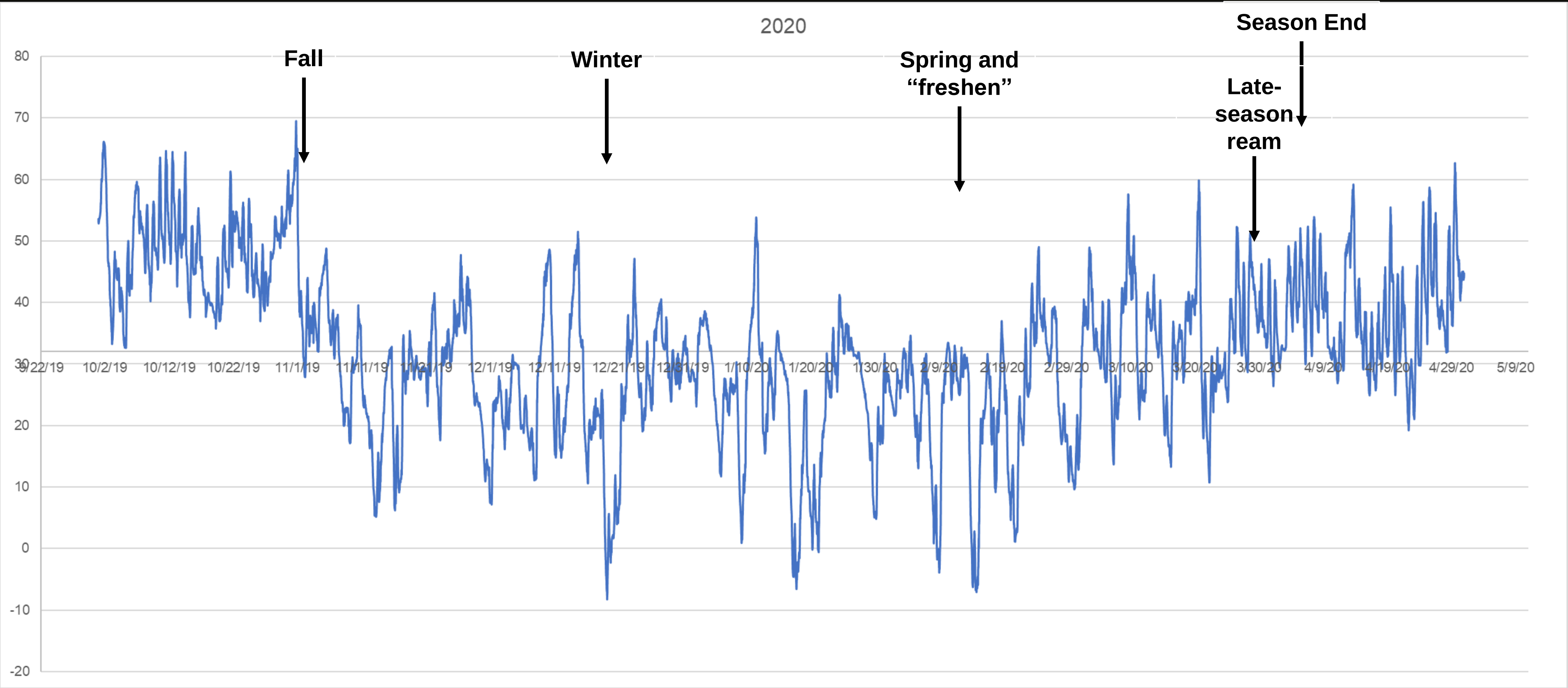
2019



Duncan J., and C. Waite. Raw Forest Canopy Meteorological Tower Data. University of Vermont. FEMC. Can be found at: https://www.uvm.edu/femc/data/archive/project/forest-environmental-monitoring-canopy-tower/dataset/raw-forest-canopy-meteorological-tower-data

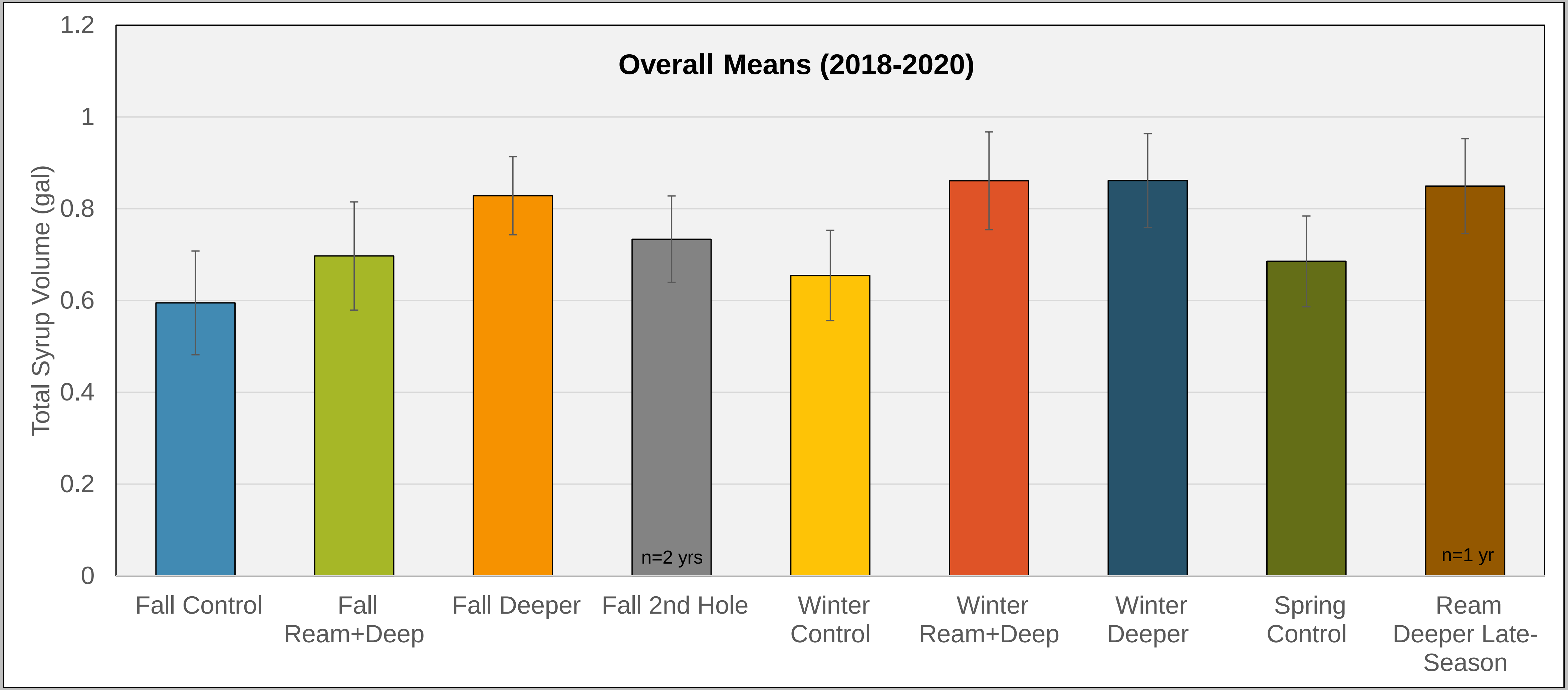
Fall	Winter	Spring	Season End
11/10/2017	1/18/2018	2/19/2018	4/23/2018
10/24/2018	1/3/2019	2/13/2019	4/18/2019
10/31/2019	12/17/2019	2/12/2020	4/8/2020

2020



Duncan J., and C. Waite. Raw Forest Canopy Meteorological Tower Data. University of Vermont. FEMC. Can be found at: https://www.uvm.edu/femc/data/archive/project/forest-environmental-monitoring-canopy-tower/dataset/raw-forest-canopy-meteorological-tower-data

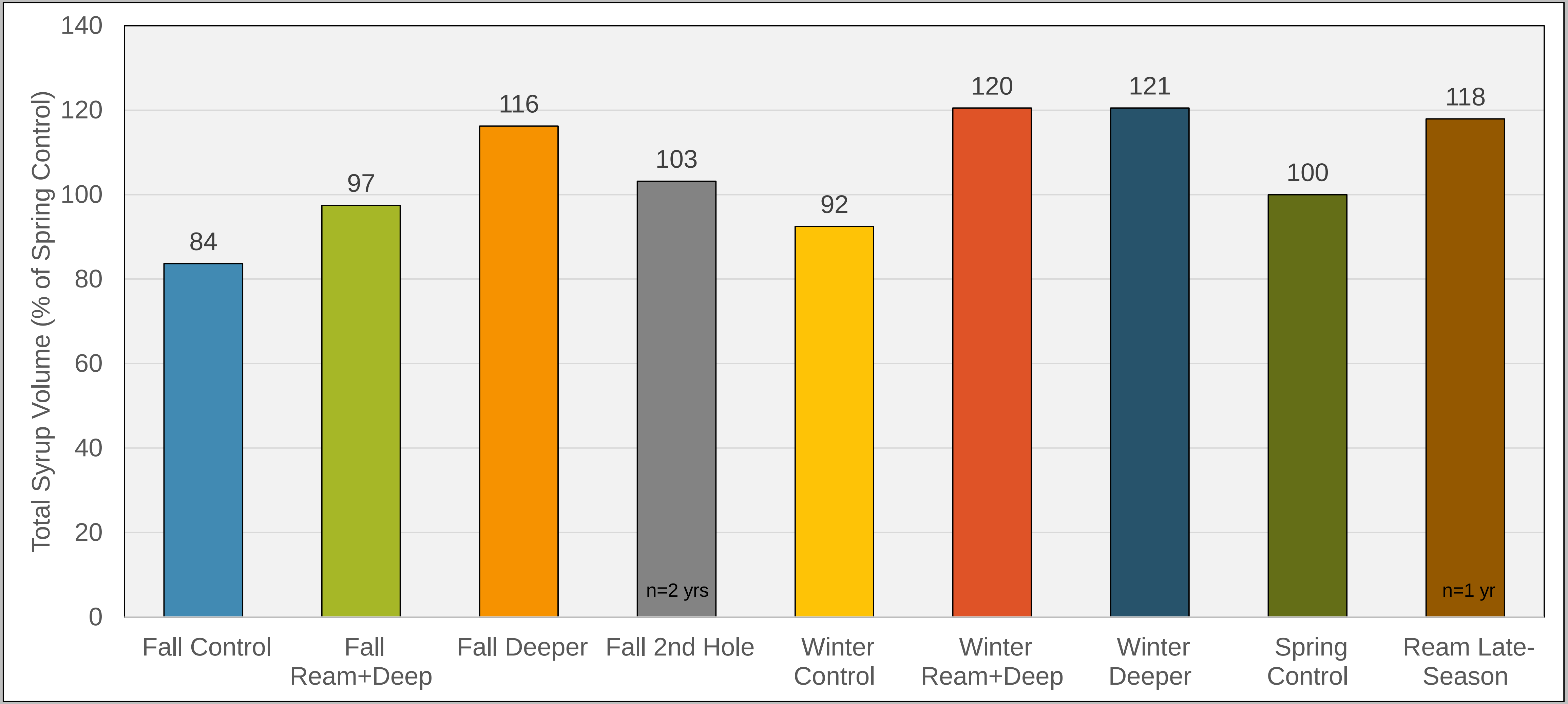
Results: Overall Averages (3 Years)



No significant differences

Total Syrup Yield (gallons of syrup per tree) 2018-2020

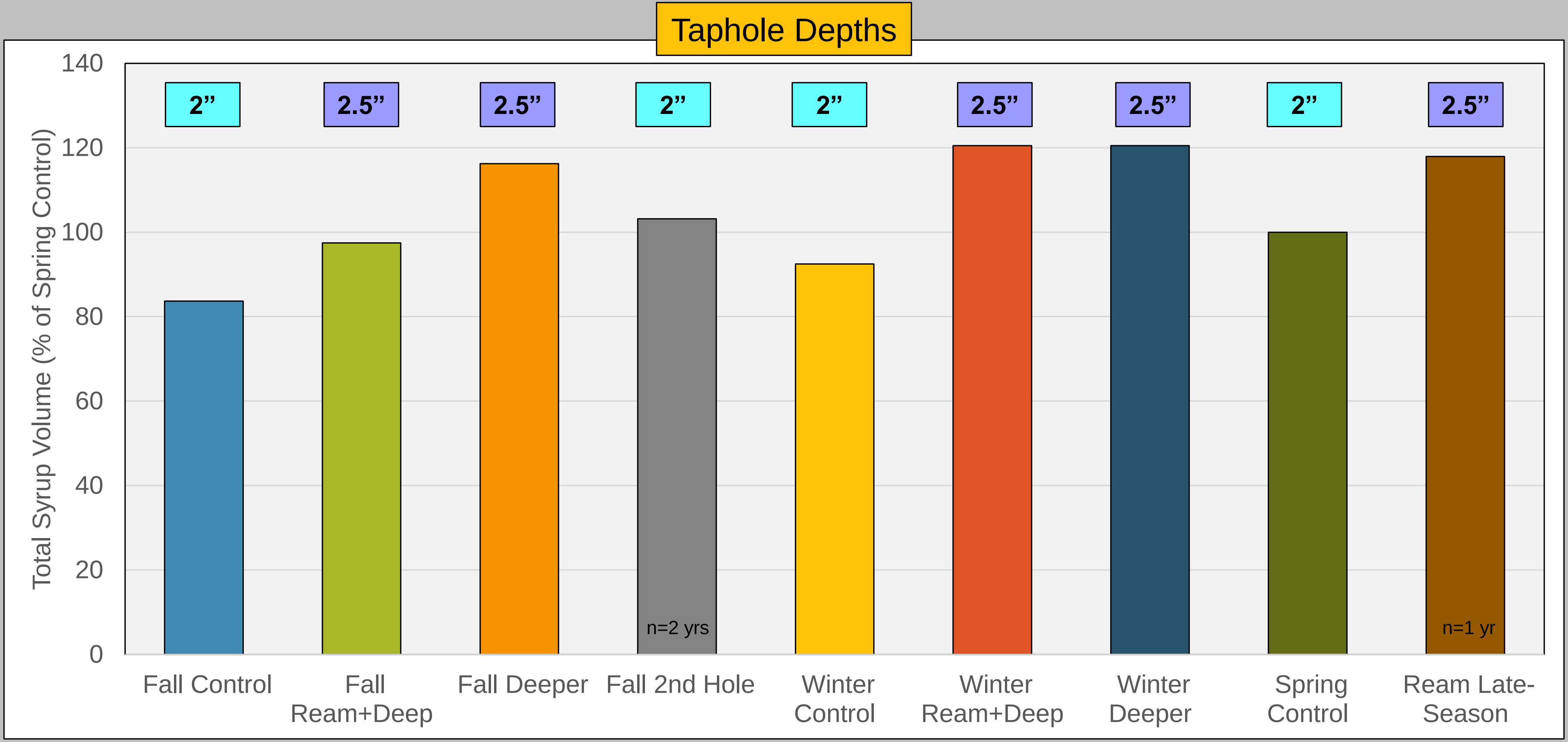
Results: Overall Averages (3 Years)



Total Syrup Yield - % of Spring Control 2018-2020

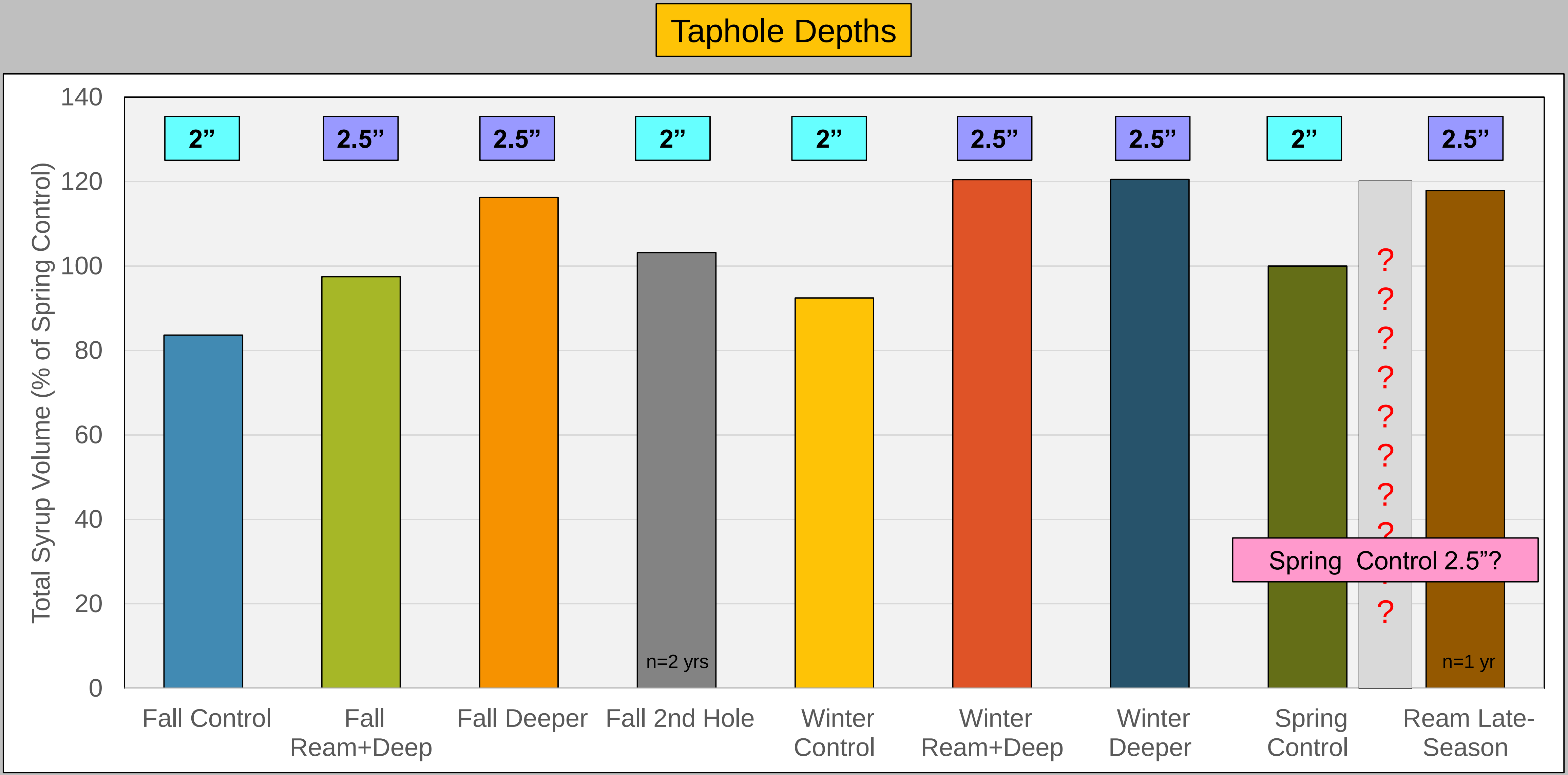
No significant differences

Results: Overall Averages (3 Years)

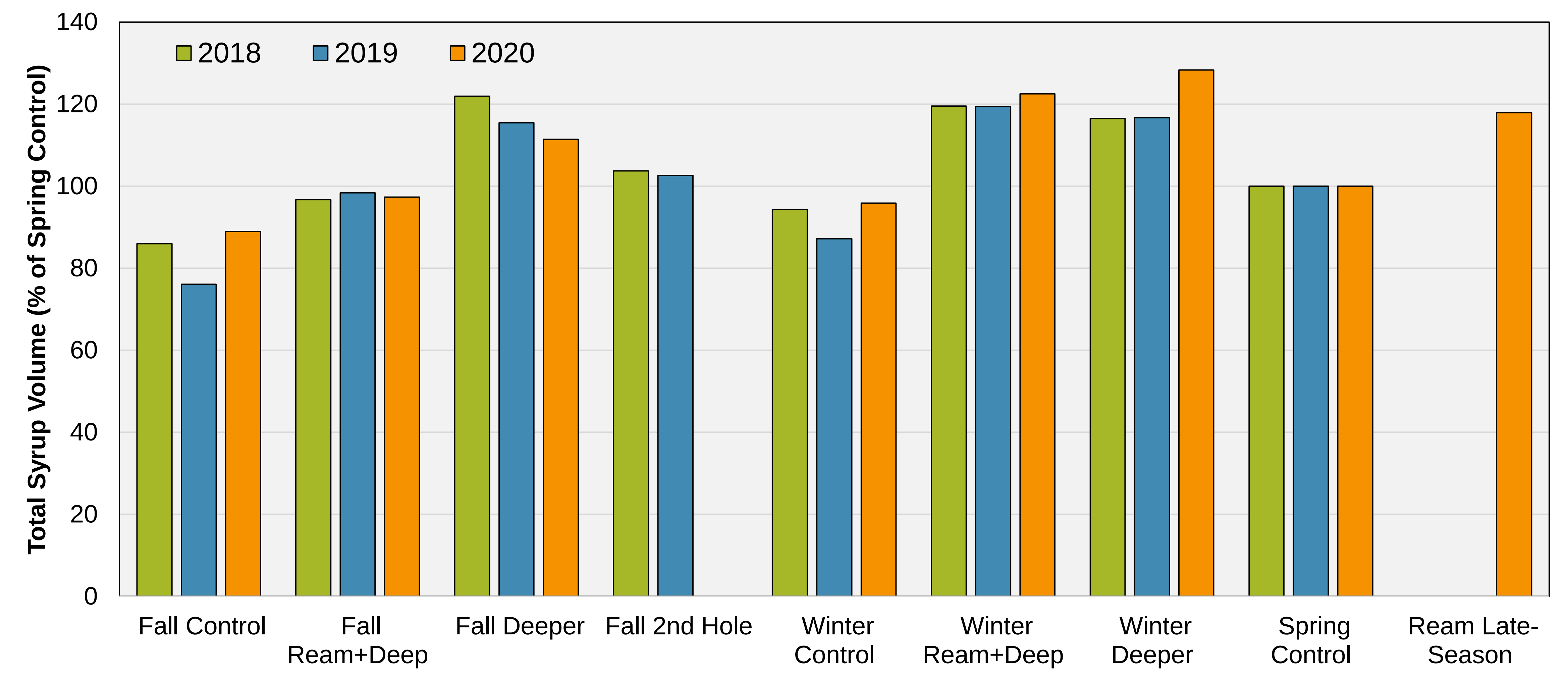


Total Syrup Yield - % of Spring Control 2018-2020

Results: Overall Averages (3 Years)

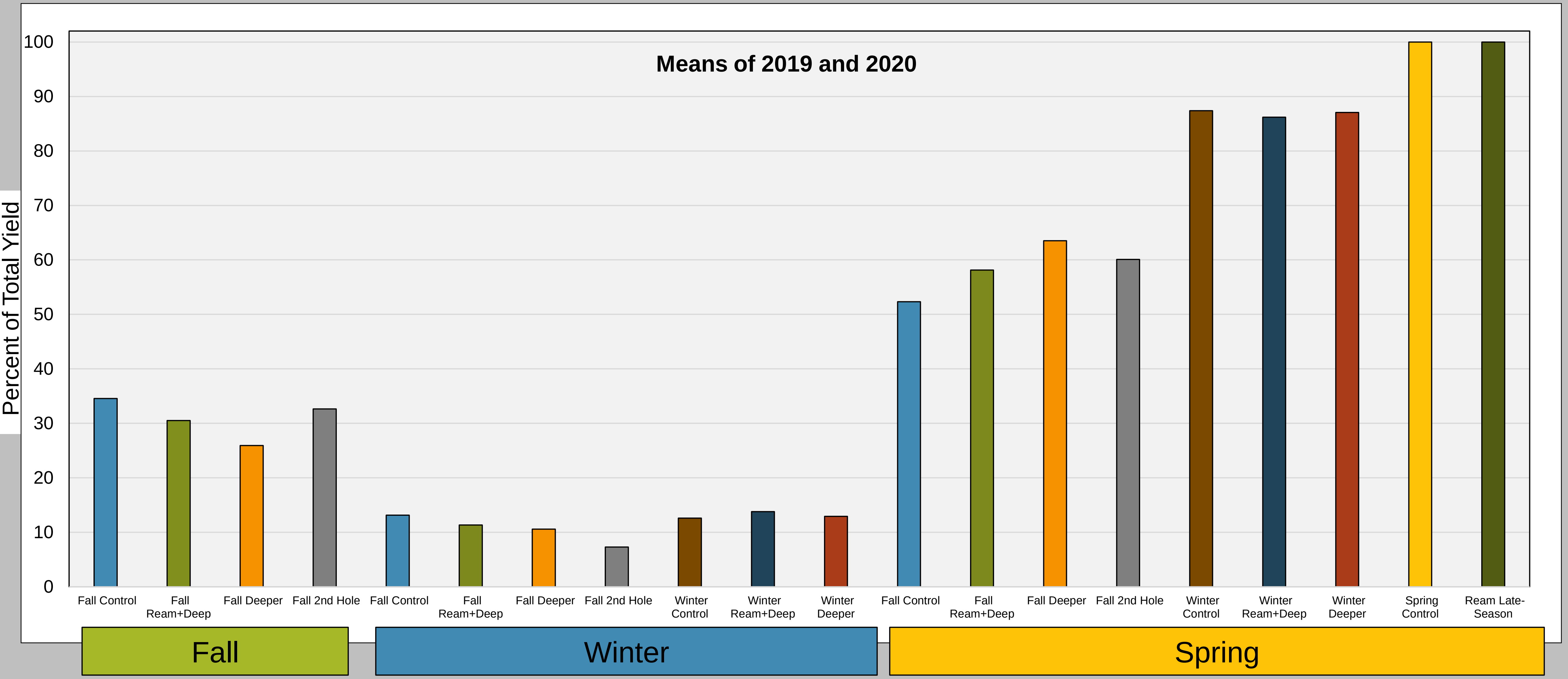


Results - Individual Years



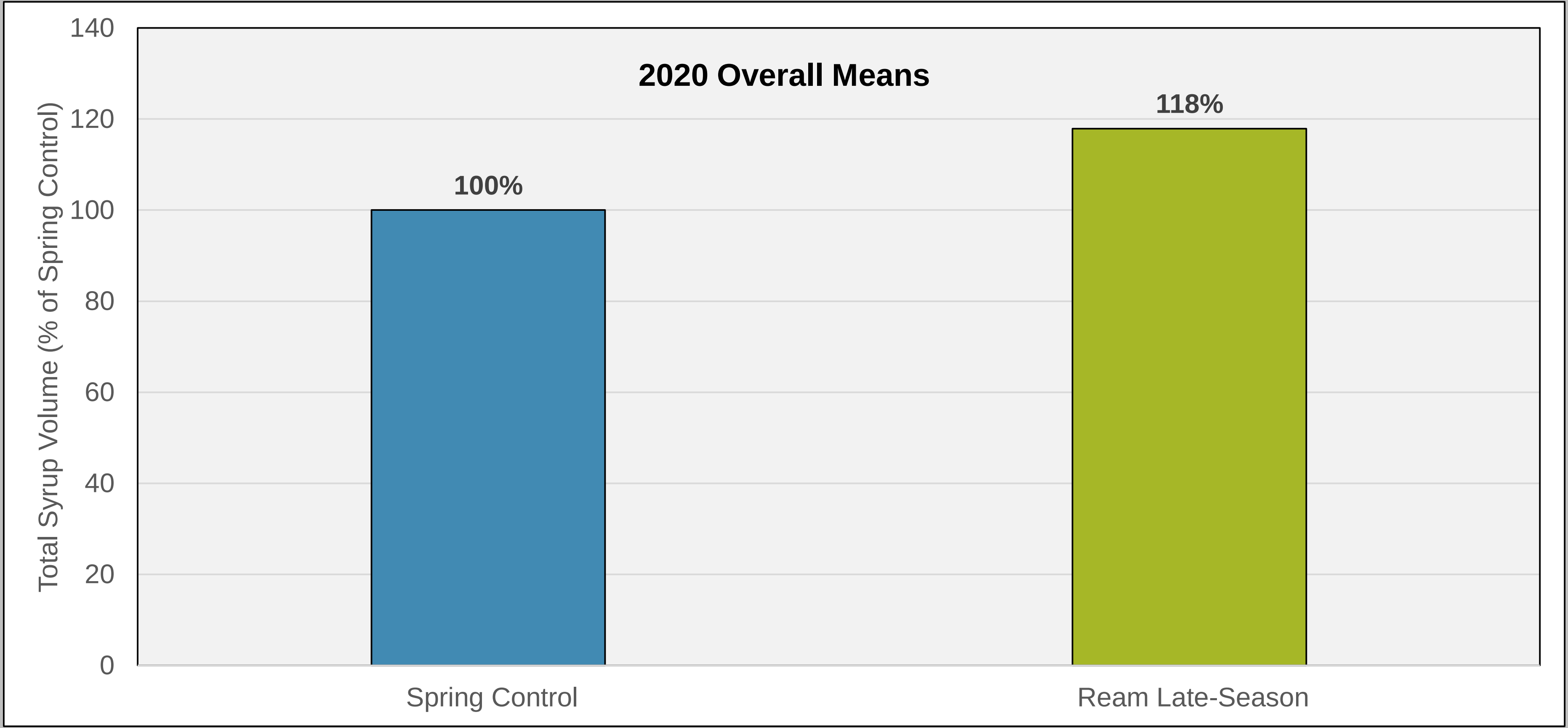
Total Syrup Yield - % of Spring Control (n= 10 trees per treatment)

Percent of Total Yield by Time Period



Late-season Reaming

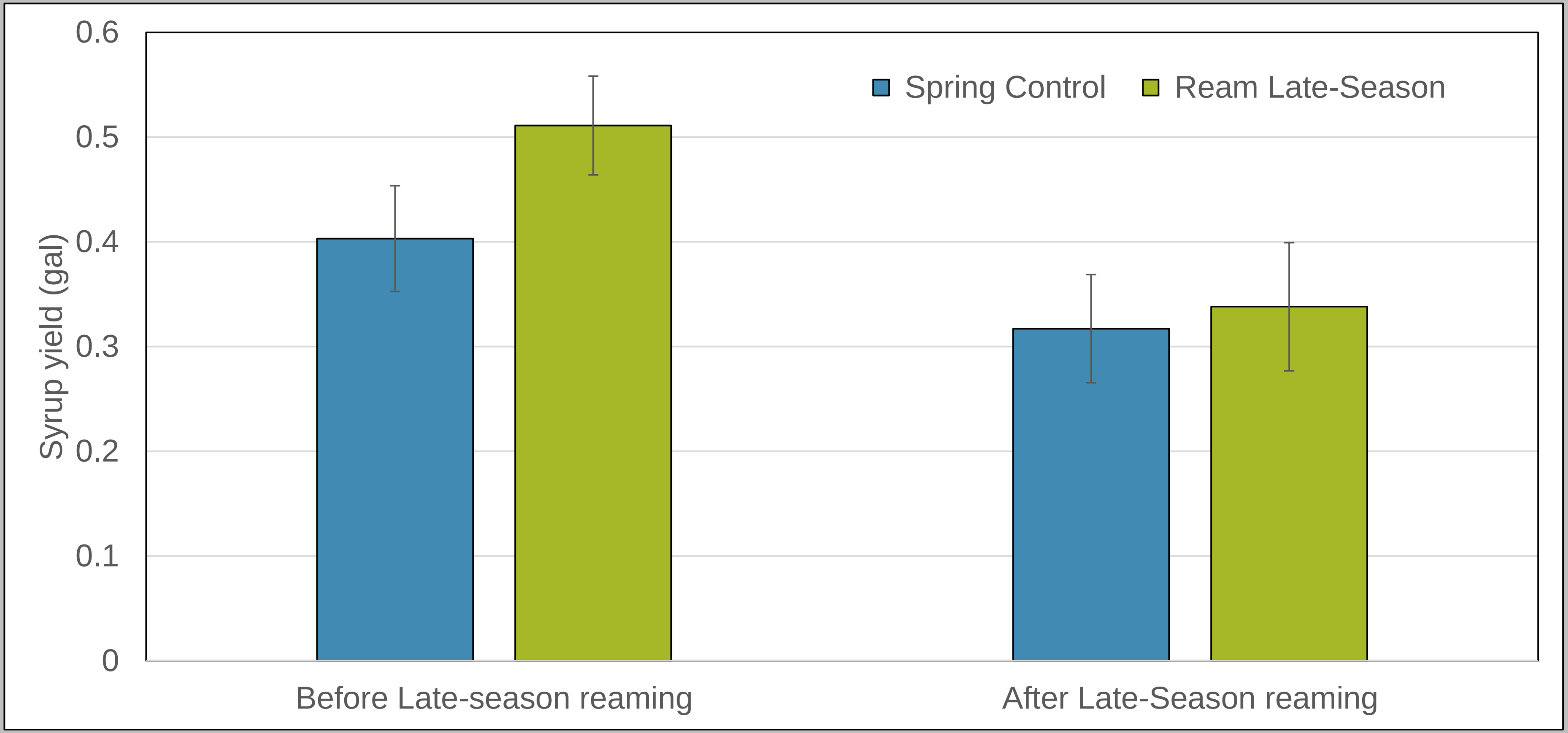
Fall	Winter	Spring	Late-season Ream	Season End
10/31/2019	12/17/2019	2/12/2020	3/30/2020	4/8/2020



Total Syrup Yield - % of Spring Control (n= 10 trees per treatment)

Late-season Reaming

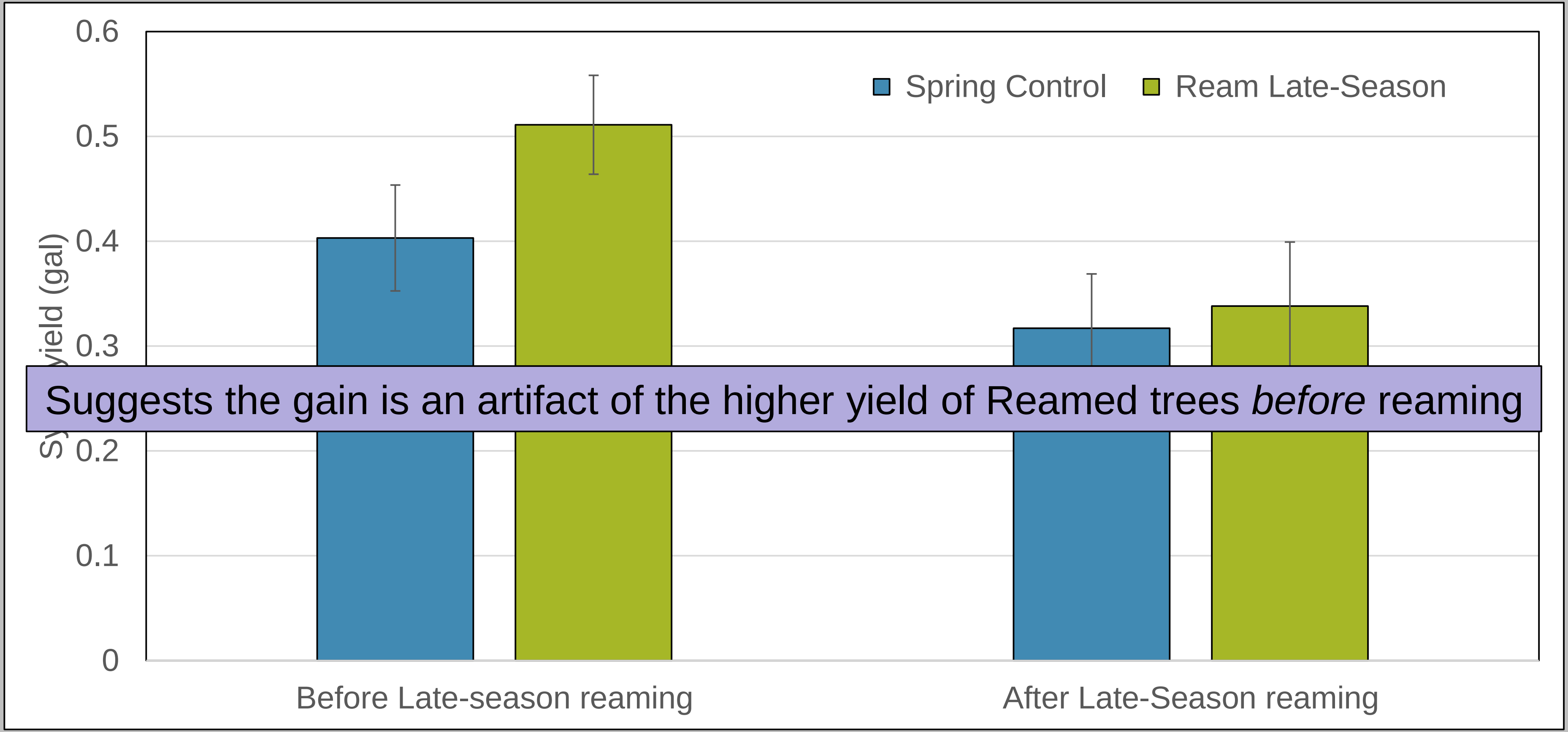
Fall	Winter	Spring	Late-season Ream	Season End
10/31/2019	12/17/2019	2/12/2020	3/30/2020	4/8/2020



Yield Before and After Reaming

Late-season Reaming

Fall	Winter	Spring	Late-season Ream	Season End
10/31/2019	12/17/2019	2/12/2020	3/30/2020	4/8/2020



Suggests the gain is an artifact of the higher yield of Reamed trees *before* reaming

Yield Before and After Reaming

Sustainability questions – What about nonconductive wood?

Mark Isselhardt, UVM Extension

Early Tapping and Taphole Longevity Strategies

Questions of sustainability:

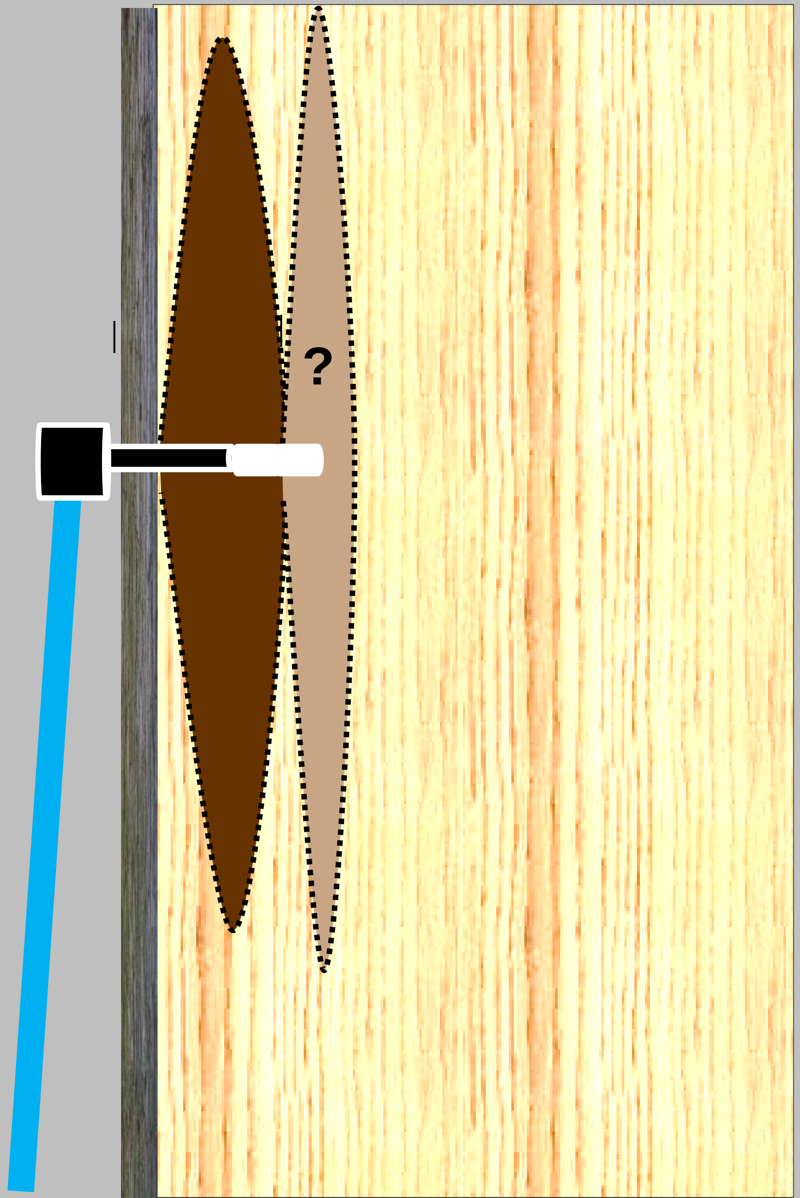
Greater wounding (more nonconductive wood)

How *much* more?

Weigh benefits versus this cost

Longer open wound – increased risk of infection?

Carbohydrate removal during critical period for tree (winter respiration, freeze tolerance, survival)



What is the trade-off in nonconductive wood?

Experiment to determine the volume of nonconductive wood (NCW) generated by 2 “freshening”/longevity treatments relative to Control tapholes

20 Trees

Each tree received 2 or 3 Tapholes:
1 Control (spring taphole) and
1 or both of 2 treatments:

Treatment	Fall	Spring
Control	-----	5/16", 1.5" deep
Fall Ream+Deep	1/4", 1.5" deep	Reamed to 5/16" and 2.5" Deep
Fall 2nd Hole	5/16", 1.5" deep	Drilled 2nd hole, 5/16", 1.5" deep, 2" higher than first

Each tree felled the following fall

Slabs with each taphole stain column removed

Each slab cut in 2”-wide sections, beginning through center of the taphole

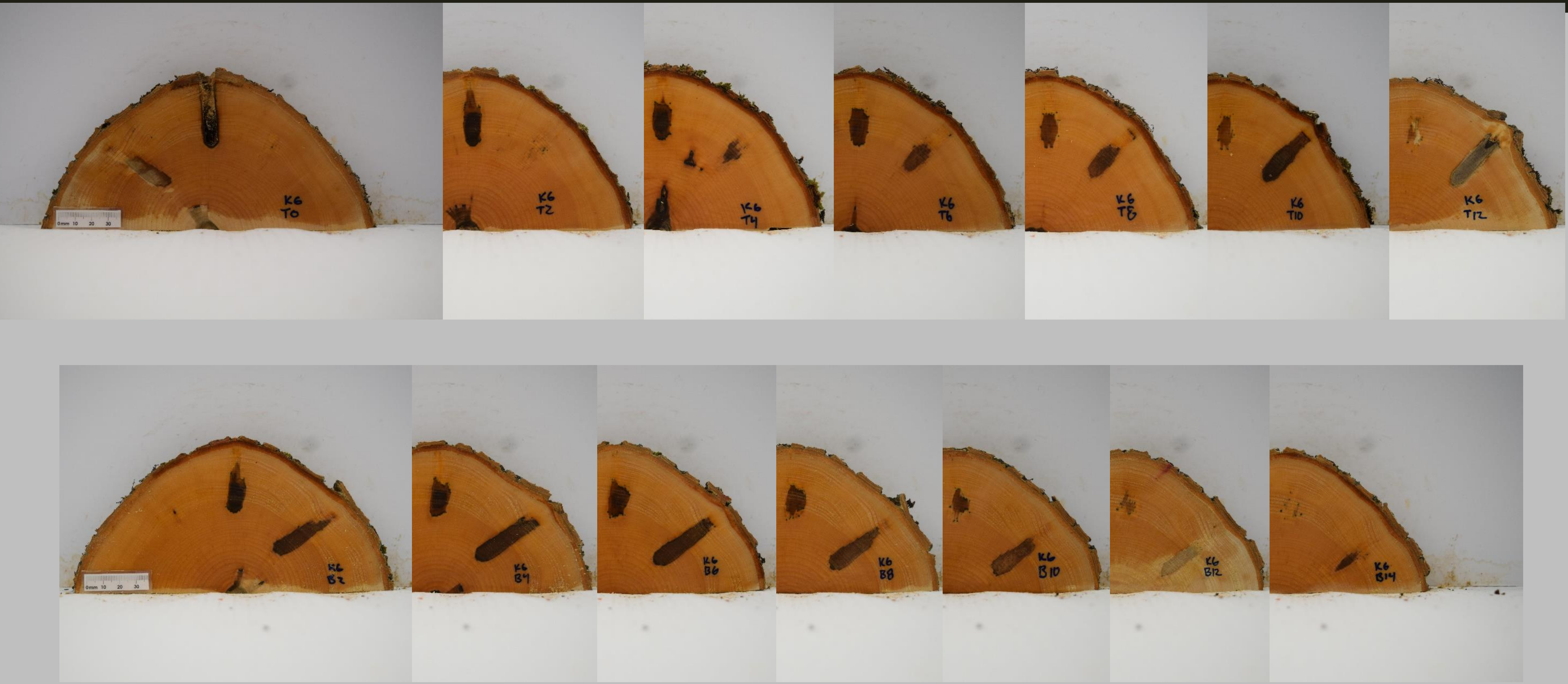
Each tree felled the following fall

Slabs with each taphole stain column removed

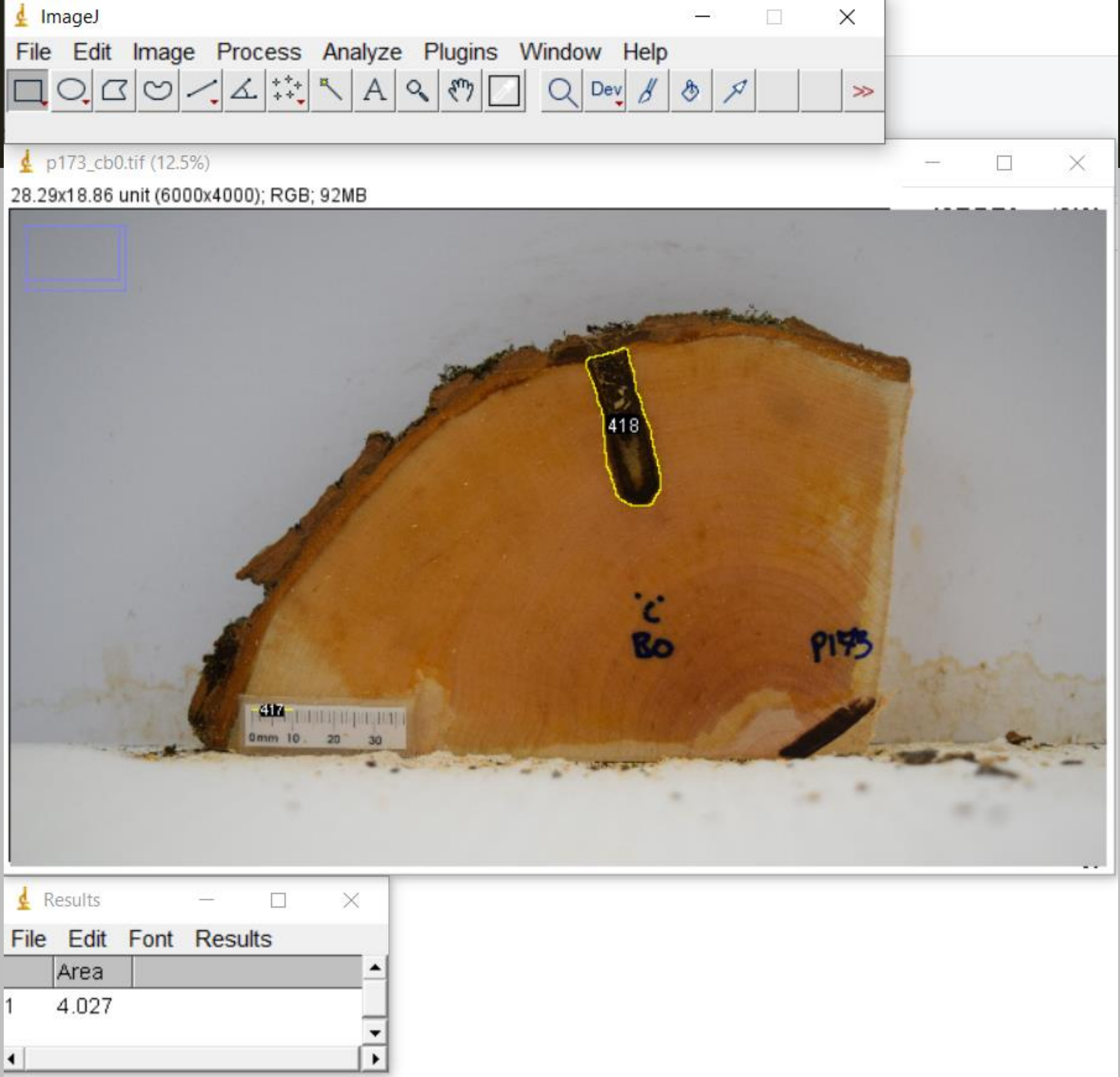
Each slab cut in 2”-wide sections, beginning through center of the taphole

Each cookie photographed with a scale

Each cookie photographed with a scale



0mm 10 20 30
K6 T0
K6 T2
K6 T4
K6 T6
K6 T8
K6 T10
K6 T12
0mm 10 20 30
K6 B2
K6 B4
K6 B6
K6 B8
K6 B10
K6 B12
K6 B14



Area of nonconductive wood (NCW) in each cookie measured with image analysis software

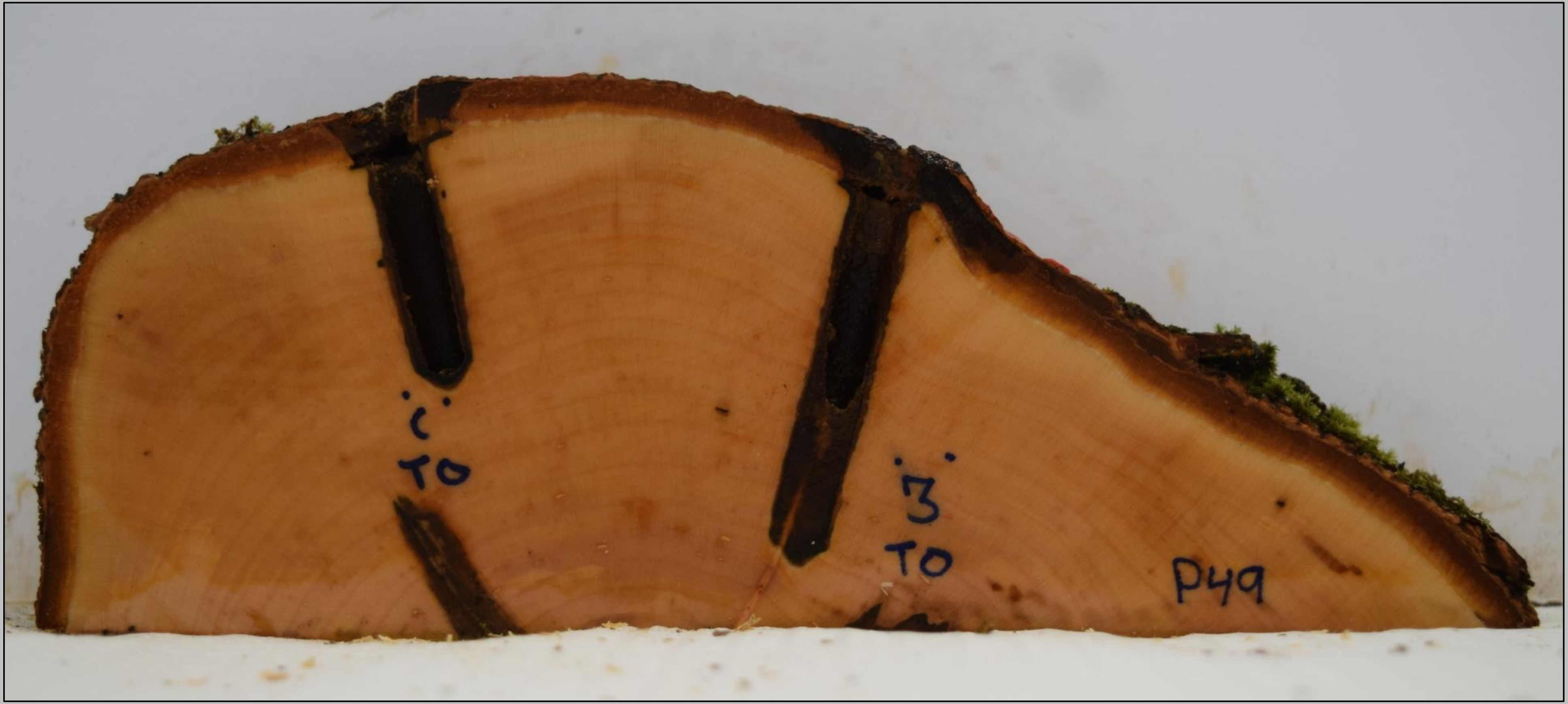
$$= \frac{(0.66+0.41)}{2} \times 2$$

Tree ID	Segment Top or Bottom	Segment Number (inches from taphole)	Stain Area (in^2)	Stain Volume (in^3)	Total Stain Volume (Top and Bottom)	Total Stain Volume (in^3)
27	T	0	0.66	1.07		
27	T	2	0.41	0.62		
27	T	4	0.20	0.27		
27	T	6	0.07	0.07	2.0	
27	B	0	0.70	1.12		
27	B	2	0.42	0.59		
27	B	4	0.17	0.20		
27	B	6	0.03	0.04		
27	B	8	0.01	0.01	2.0	4.0

Each cookie's stain data used to calculate total NCW volume:

Area of each segment averaged with next and multiplied by cookie width (2″) to calculate average stain volume

Summed for Total NCW Volume



Within the same tree:

Calculated % of “freshened” taphole NCW volume relative to the Control taphole volume

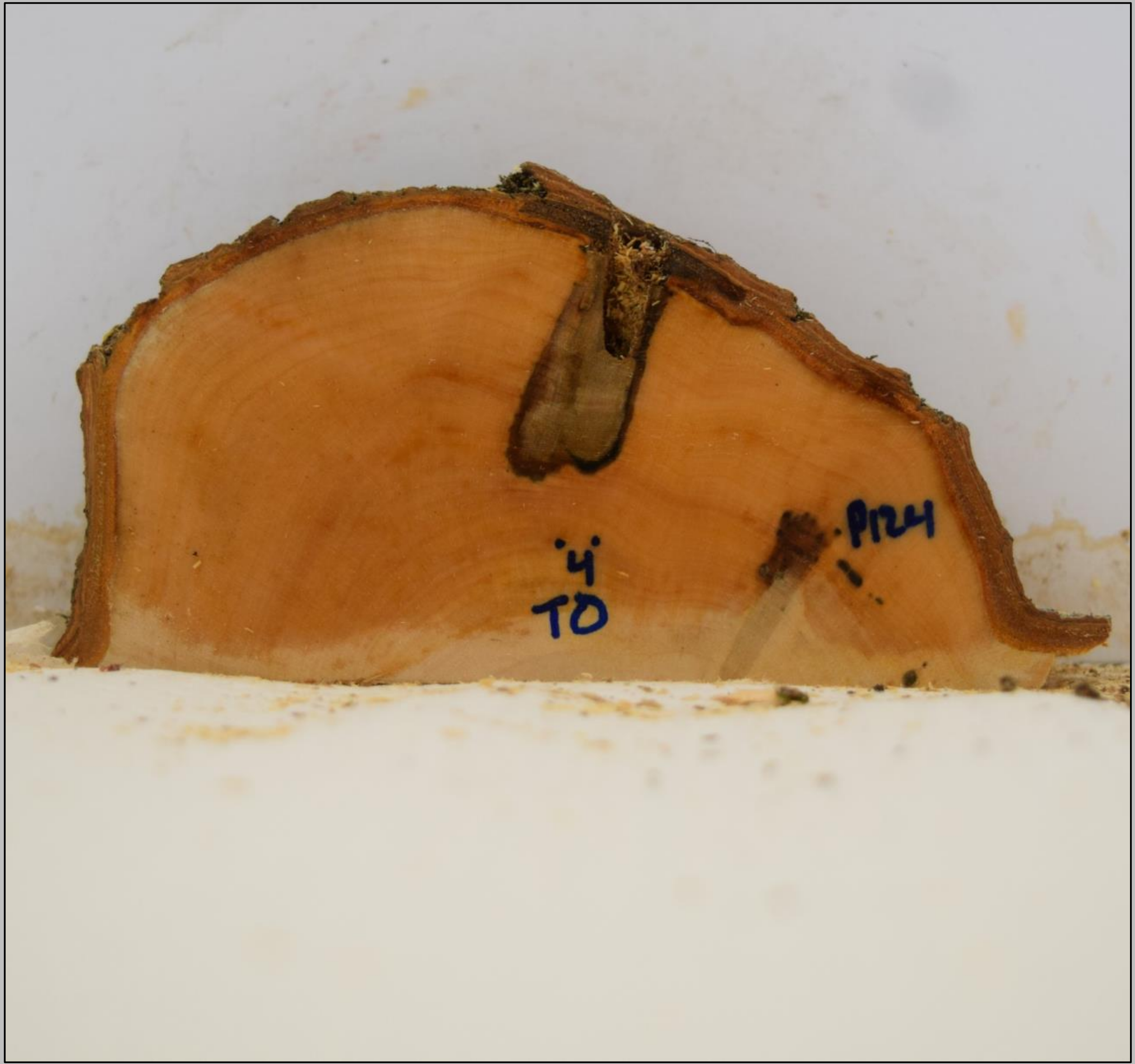
Results

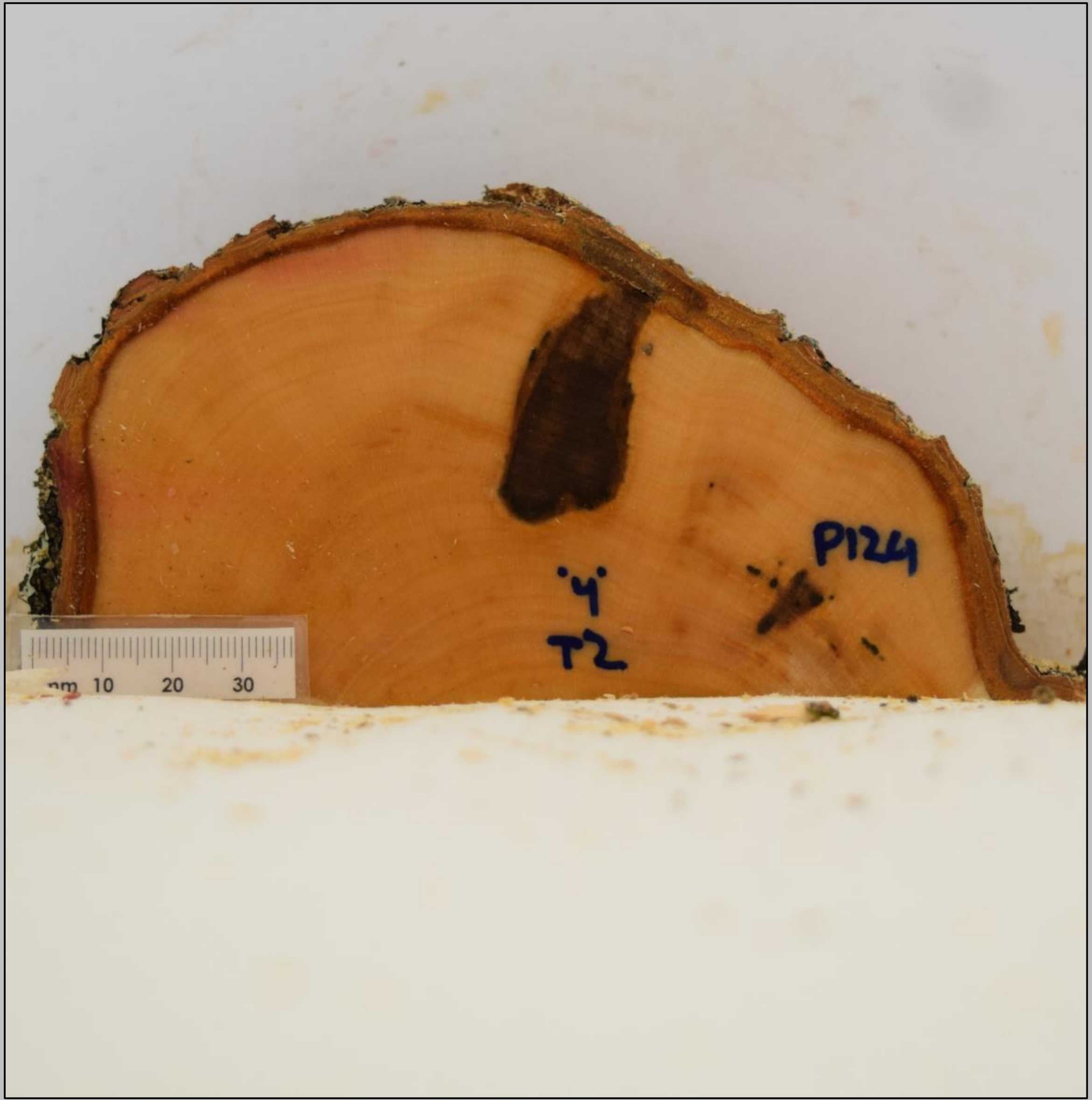
Second hole above the first: not the best idea…

Second hole above the first: not the best idea…

Second hole above the first: not the best idea…

Second hole above the first: not the best idea…





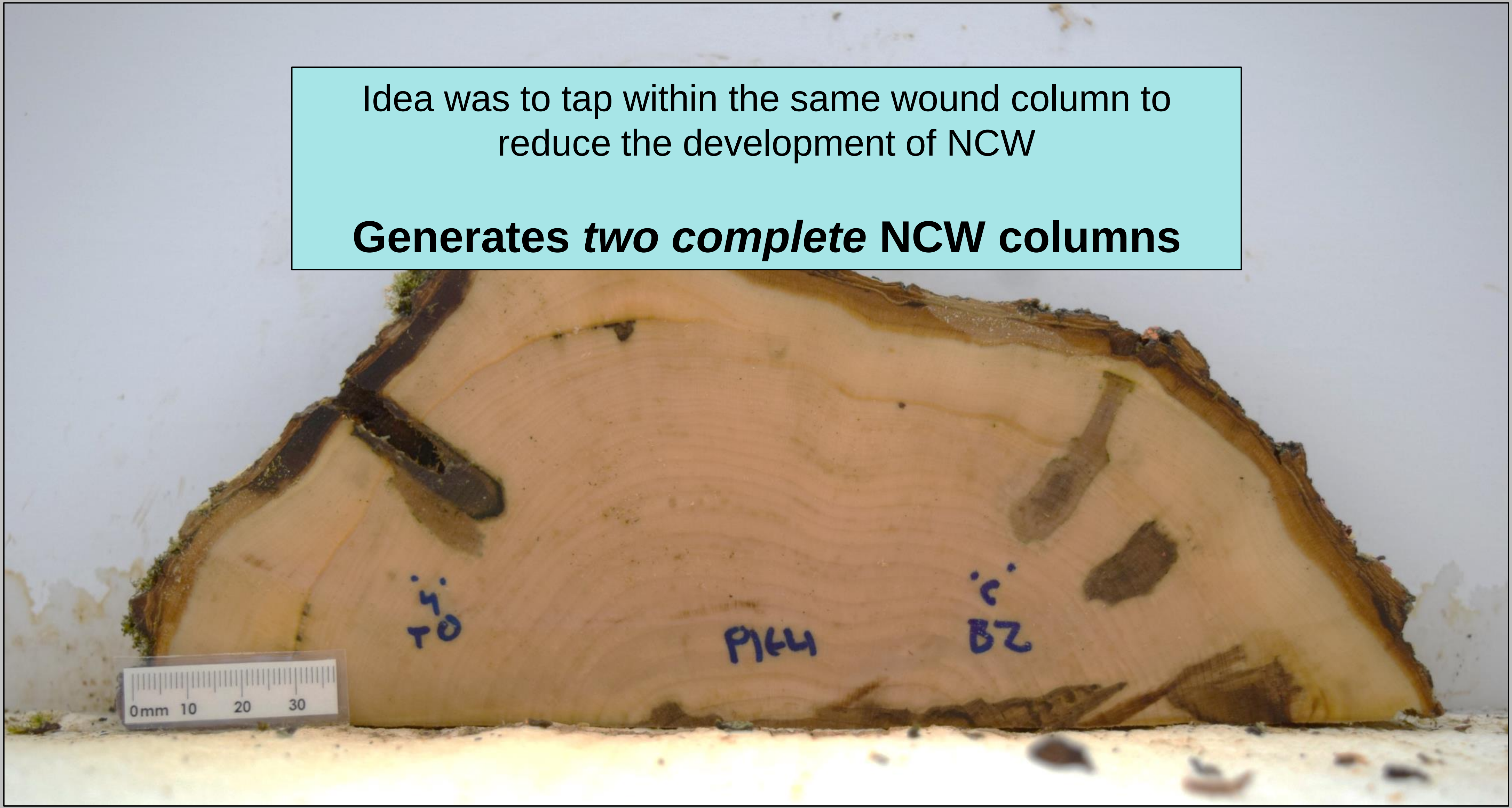

TO
P54
B1
T1
P54
TO
T2
P54
T1

Second hole above the first: not the best idea…

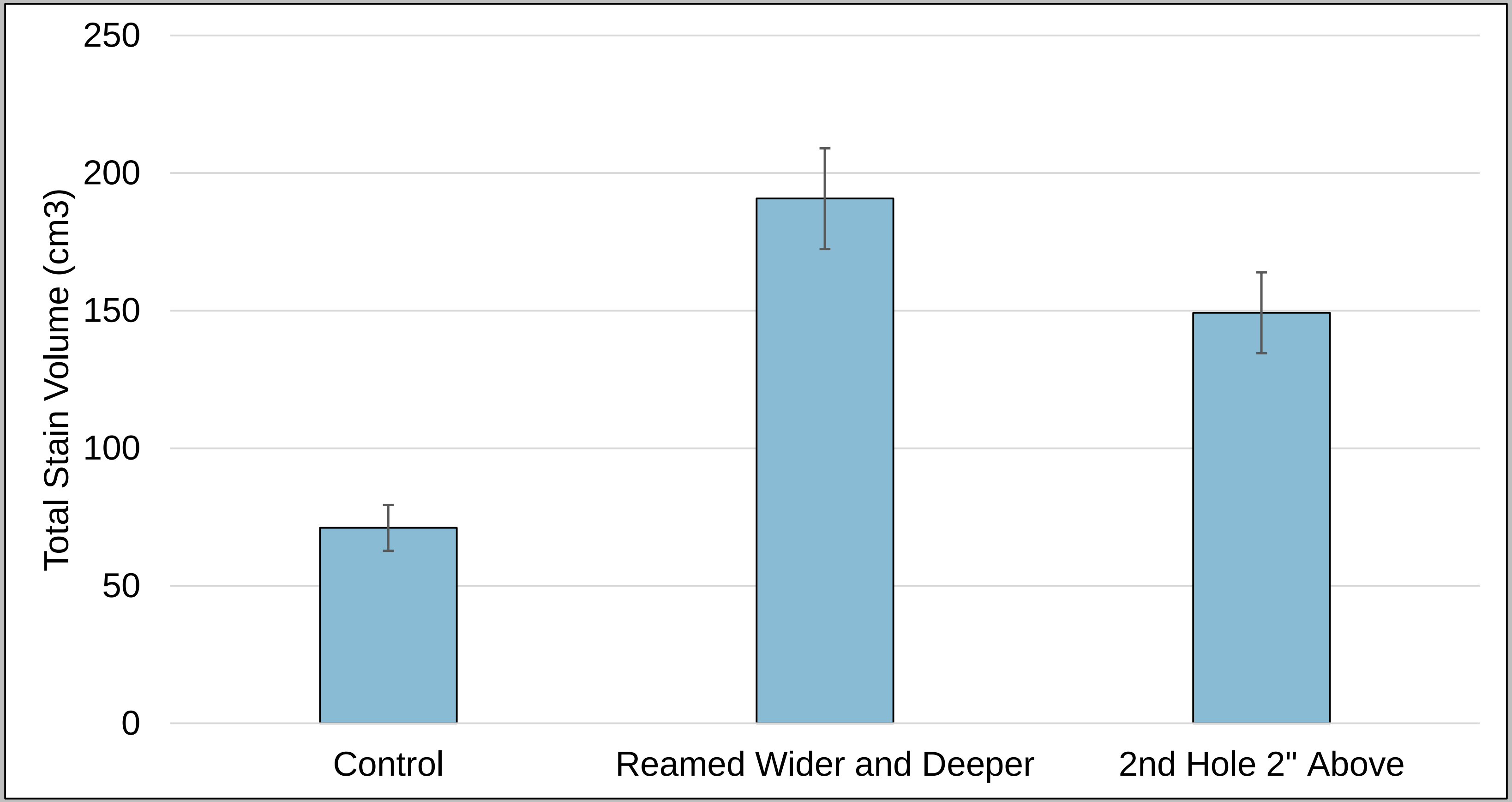
Second hole above the first: not the best idea…

Idea was to tap within the same wound column to reduce the development of NCW

Generates *two complete* NCW columns

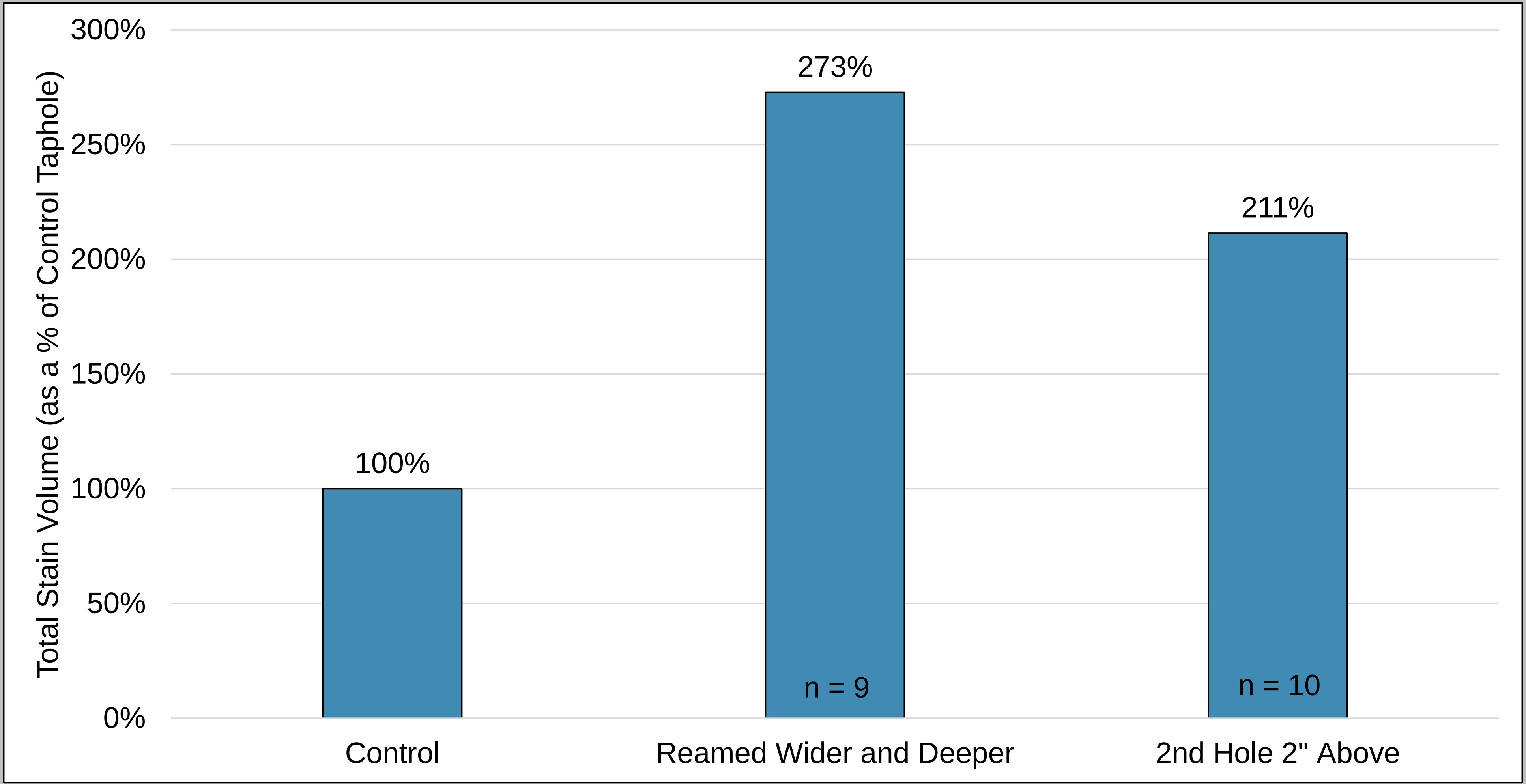


Results



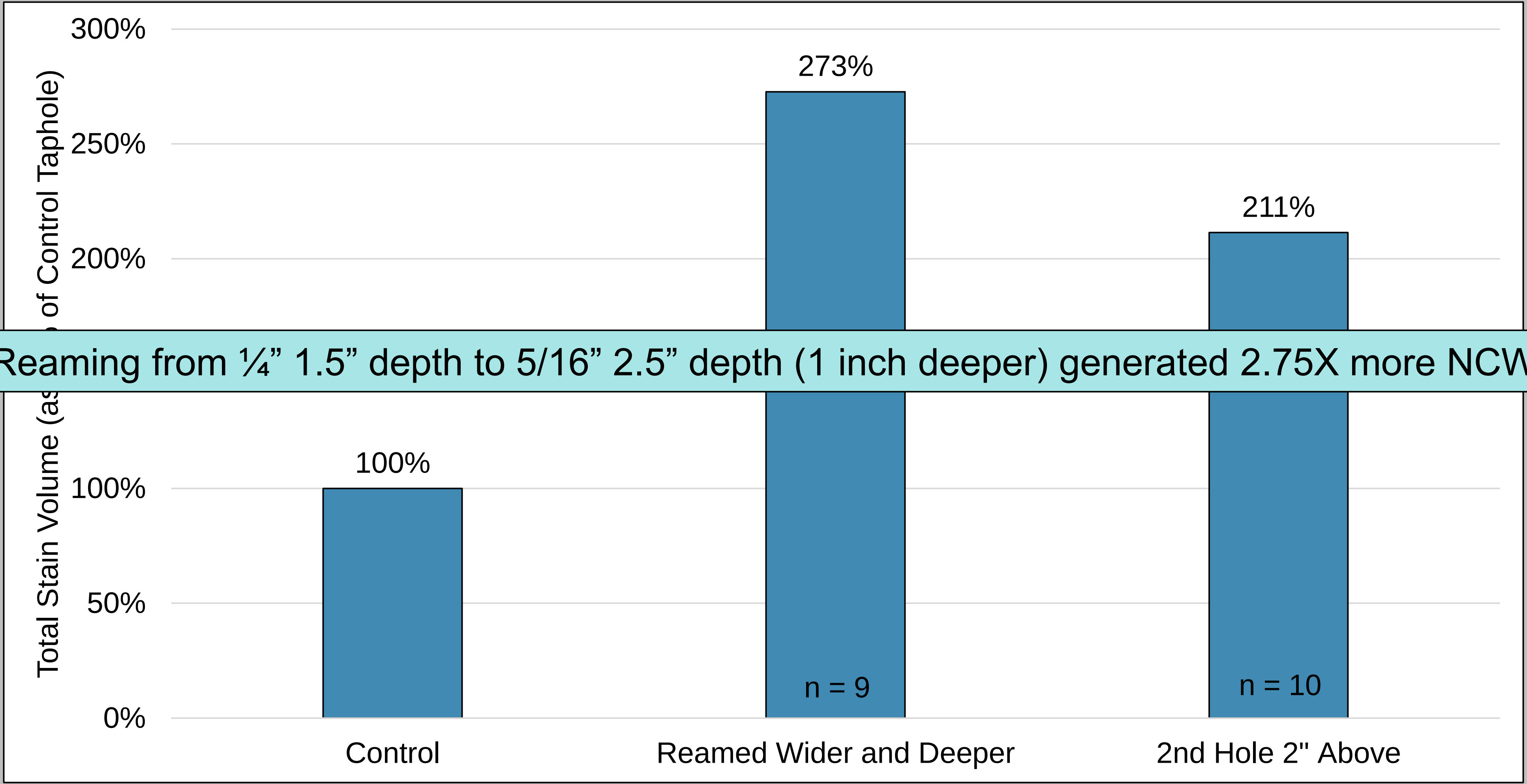
Average total nonconductive wood volume for each treatment (n = 15, 12, 11)

Results



Average NCW volume as a percent of Control Taphole (in the same tree)

Results



Reaming from ¼” 1.5” depth to 5/16” 2.5” depth (1 inch deeper) generated 2.75X more NCW

Average NCW volume as a percent of Control Taphole (in the same tree)

Conclusions

Fall and Early-Winter Tapping alone:

~80 and 90% of spring taphole yields

Fall tapping probably not optimal

(unless there are other compelling reasons to do it…)

Early-winter tapping not a large (or significant) reduction, but no compelling reason to do it to *increase* yields from capturing early sapflows

Treatment	**% of Spring Taphole**
Fall Control	84
Winter Control	92

Conclusions

Fall and Early-Winter Tapping with later “freshening”:

Fall ¼” reamed to 5/16” wide and 2.5” deep – similar yields to spring tapholes (XX)

Early-winter tapholes reamed from ¼” to 5/16” and to 2.5” deep, and Fall and Early-winter 5/16” tapholes re-drilled to 2.5” depth suggest gains over spring tapholes

but….

Significantly more NCW plus the labor for two rounds of tapping, cost of extra spouts (and bits ☺)

Treatment	% of Spring Taphole
Fall Control	84
Winter Control	92
Fall Ream+Deep	97
Fall Deeper	116
Winter Ream+Deep	121
Winter Deeper	120

Do not underestimate the unique challenges of *fall* tapping and syrup production (later snowfall, deep and lasting freeze)

Deeper tapholes…

Greater chances of intercepting existing NCW

Consequences of more Nonconductive wood…

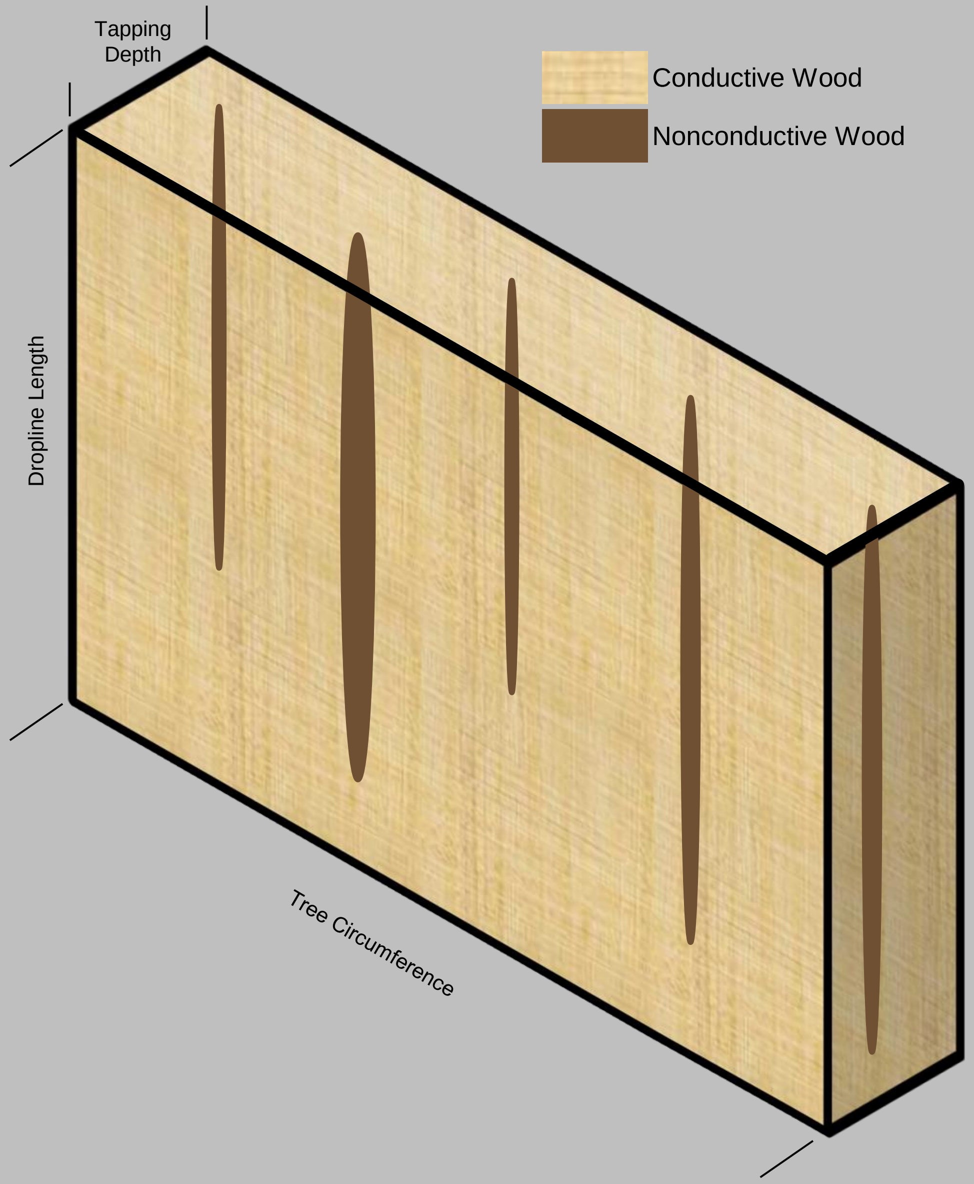
Greater chances of hitting it when tapping

Proportion of the Tapping Zone that is NCW = Chance of hitting NCW when tapping

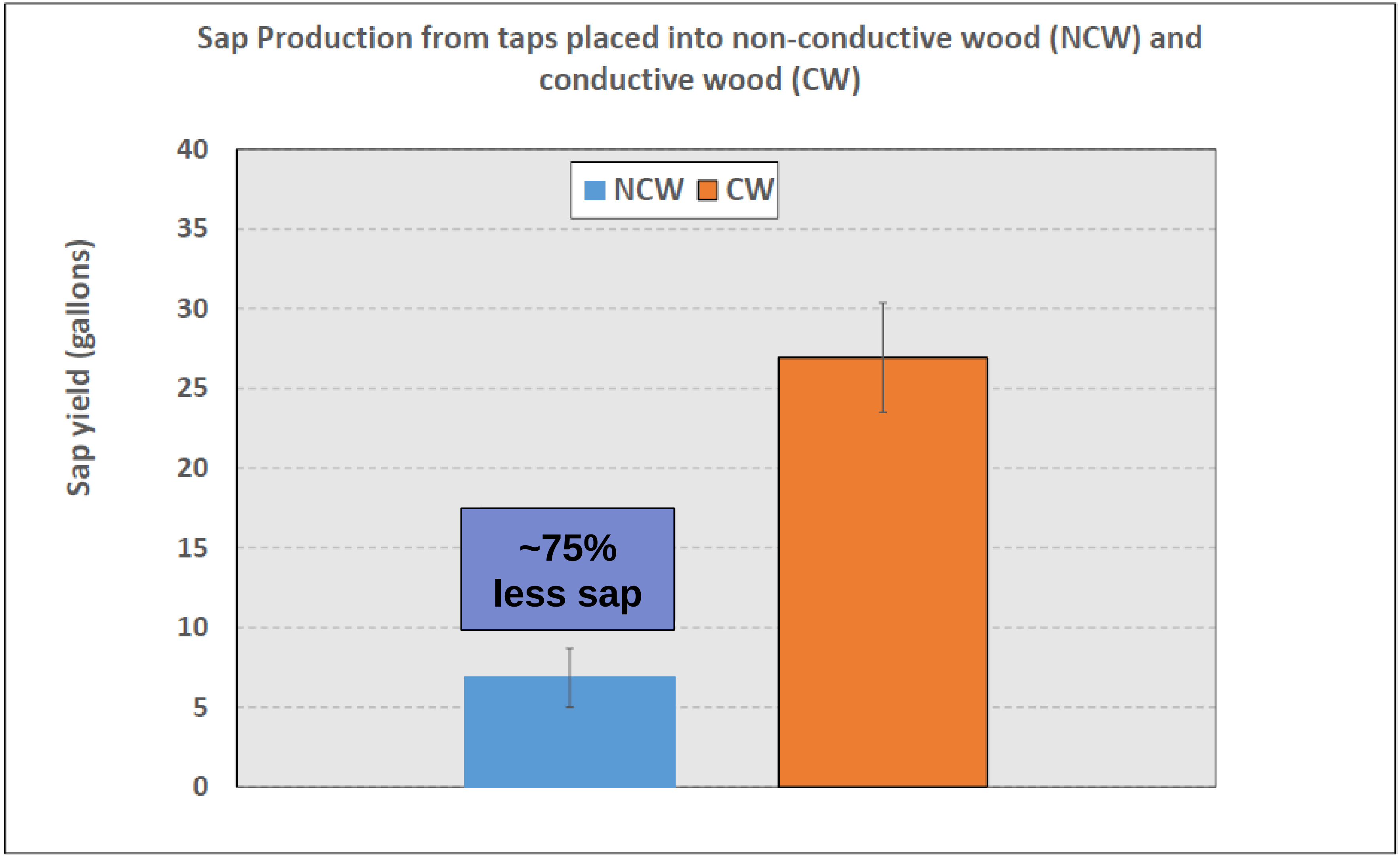
20% of the Tapping Zone is NCW = 20% chance of hitting NCW

60% of the Tapping Zone is NCW = 60% chance of hitting NCW

Chances increase as NCW increases



Consequences of more Nonconductive wood…



Yields are **significantly** lower from tapholes drilled into NCW

Greater the chances of hitting NCW, greater the chances of reductions in yield

Data from Mark Isselhardt, UVM Extension

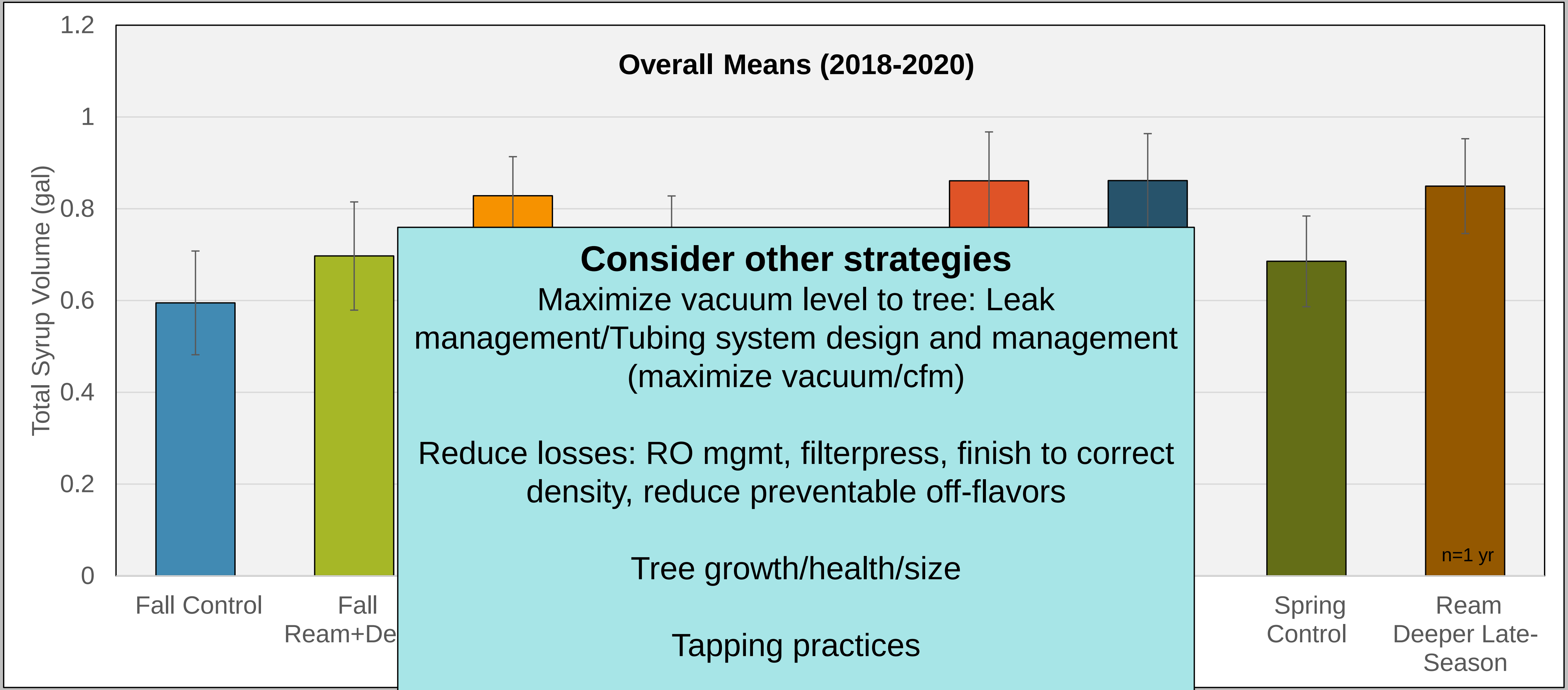
Consequences of more Nonconductive wood…

Increasing NCW amount to get a small increase in yield from “freshening” can end up reducing yields in the future

Increased amount of NCW, increased chances of tapping into it and obtaining reduced yields in the future

Tapping practices must optimize current yields and addition of NCW, as this will determine ***future*** yields

Want better yields?



Consider other strategies

Maximize vacuum level to tree: Leak management/Tubing system design and management (maximize vacuum/cfm)

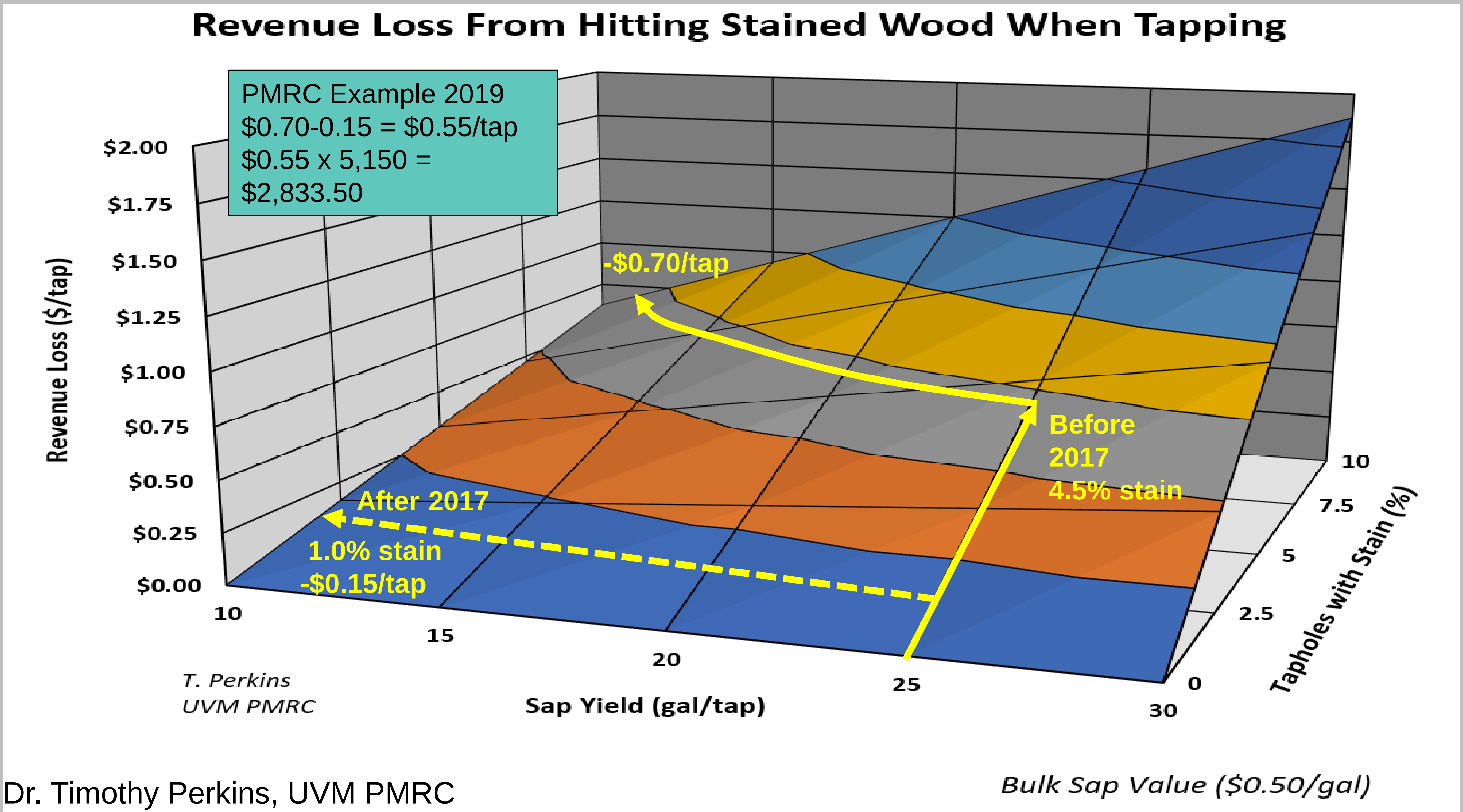
Reduce losses: RO mgmt, filterpress, finish to correct density, reduce preventable off-flavors

Tree growth/health/size

Tapping practices

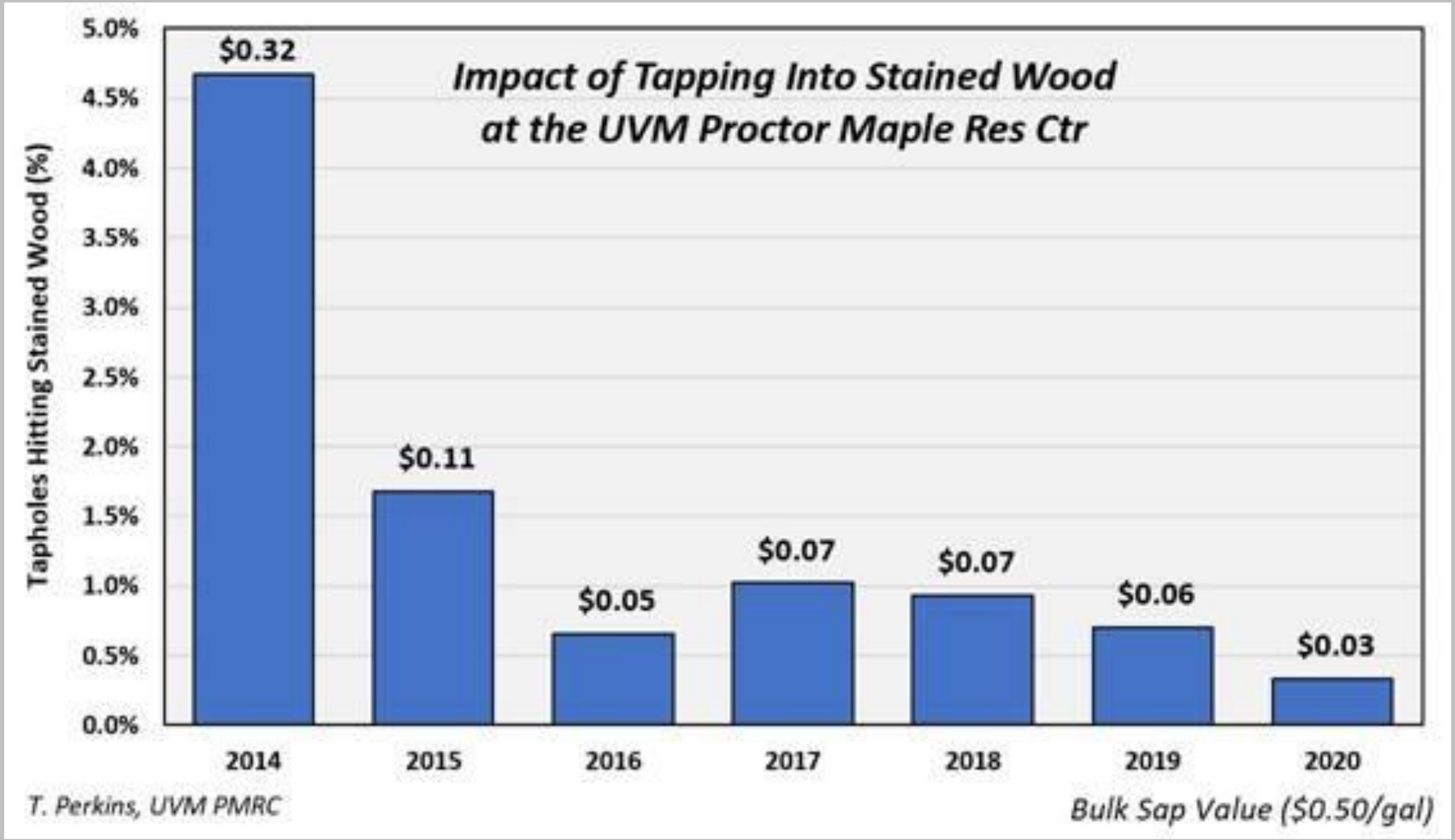
(Separate presentation…interested?)

Tapping into NCW Impacts Profitability



Dr. Timothy Perkins, UVM PMRC

Consequences of more Nonconductive wood…



UVM Proctor Maple Research Center

Thank you!

North American Maple Syrup Council,
Carl Lapierre and Les équipements Lapierre,
USDA-AMS

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Questions?

Funding for this project was made possible by the U.S. Department of Agriculture's (USDA) Agricultural Marketing Service through grant AM170100XXXXG167. This presentation's contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA.