



TETHERED LOGGING IN SOUTHWEST OREGON



RESEARCH PERSPECTIVE

WOODAM CHUNG & BRENNAN GARRELTS

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STUDY SITE & OBJECTIVES

STUDY SITES



LONE ROCK
RESOURCES

Study site

35 acres

Clear cut (200 trees per acre)

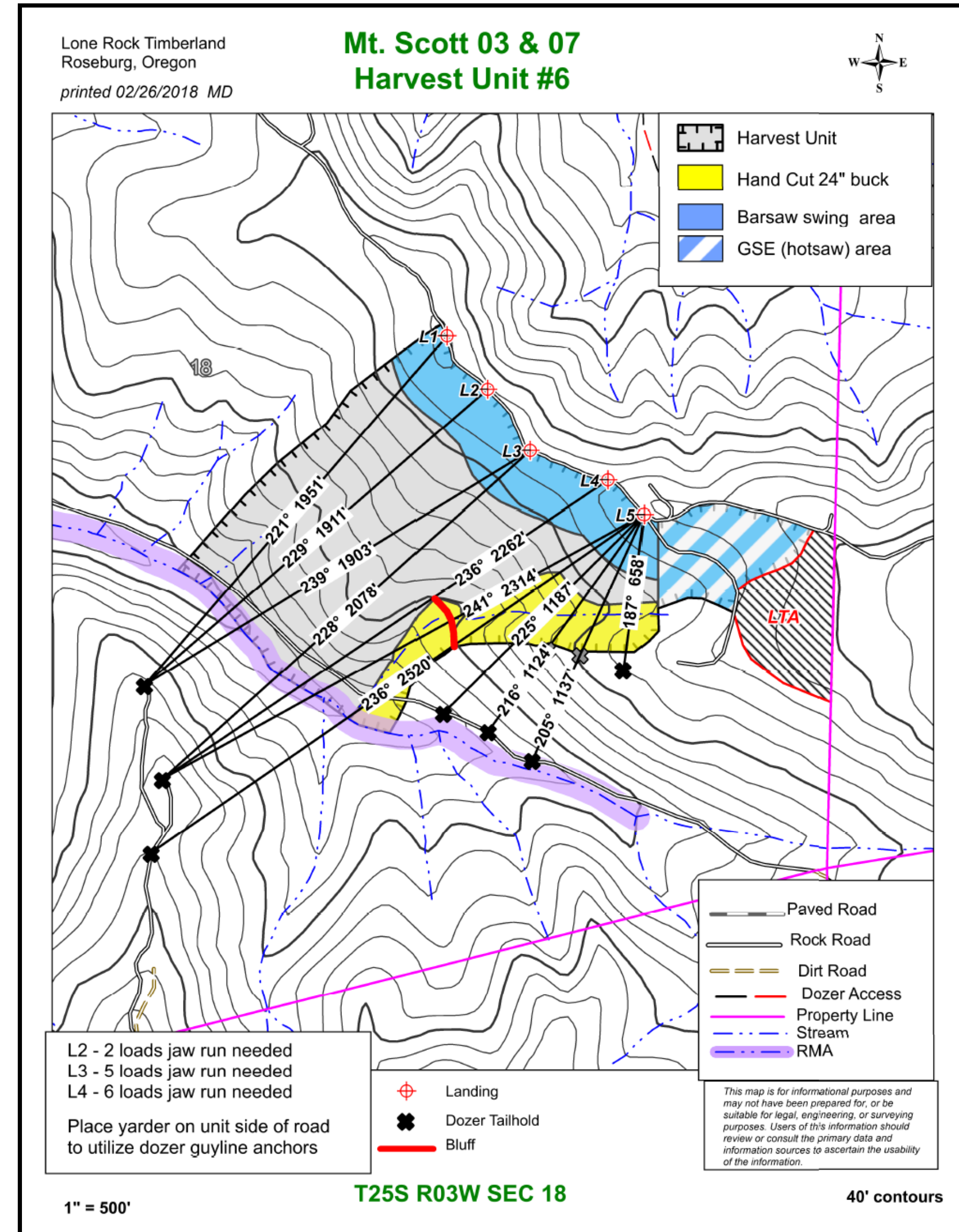
Avg. tree size: 220 bf

Tethered feller-buncher

Comparison between mechanized
and manual timber falling

Wet season

March – April 2018



A logging site near Sutherlin, OR



LONE ROCK RESOURCES

- ▶ Study site
 - 35 acres
 - Clear cut (200 trees per acre)
 - Avg. tree size: 220 bf
- ▶ Tethered feller-buncher
 - Comparison between mechanized and manual timber falling
- ▶ Wet season
 - March – April 2018



A yellow tracked harvester is shown working in a forest on a hillside. The machine is positioned among several thin, vertical trees. To the left, there is a large pile of cut logs. The ground is covered with green ferns and other vegetation. The background shows a steep, forested slope.

OBJECTIVES

Economics

#1: Estimate **CUTTING** productivity and cost (machine vs. hand)

#2: Examine the effects of machine cutting on **YARDING** productivity and cost

Hypothesis #1: Machine cutting has higher productivity and costs than hand cutting

Hypothesis #2: The ability of the machine to swing and pile trees near skyline corridors improve yarding efficiency



OBJECTIVES

Soil Impacts and Sediment Transport

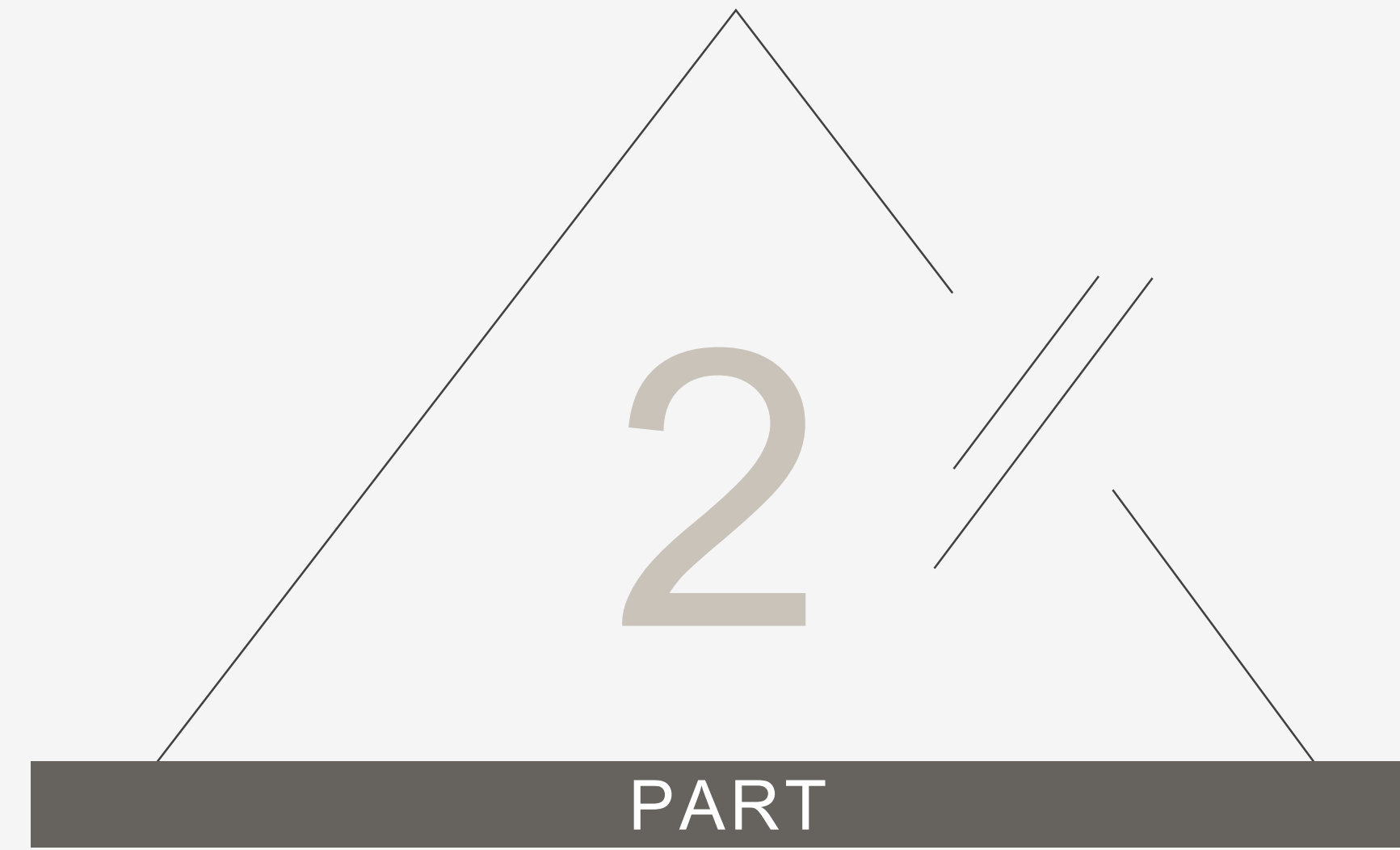
#1: Characterize and quantify soil **IMPACTS**

#2: Evaluate soil **EROSION** and **SEDIMENT** transport potential

MACHINE – SOIL – WATER

Hypothesis #1: Machine tracks creates a “tillage effect” on the surface soil – loosening surface soils while mixing organic matters with mineral soil materials; increasing moisture holding capacity

Hypothesis #2: Soil disturbance along machine corridors causes an increase in erosion and sediment transport potential



METHODS

Detailed Time Study

Cycle time data collection

GoPro video footage

Timber cruise data

Mill tickets

Delay-free cycle time regression models

- Hand cutting
- Machine cutting
- Machine swinging
- Yarding after hand-cut
- Yarding after machine-cut

Hourly production rates

Machine Rates

Hourly machine costs

System costs

Page 1 of 5

Timer K

Manual Felling Data Sheet

Date: 3/19/2018 March 19 20, 2018 Cutter: Brooke
 Corridor: Hand cut (330'x60') Weather: 40~60° clear
 Recorders: BAM Woody
 Notes: Start at 7:35:55 AM Stump dressing

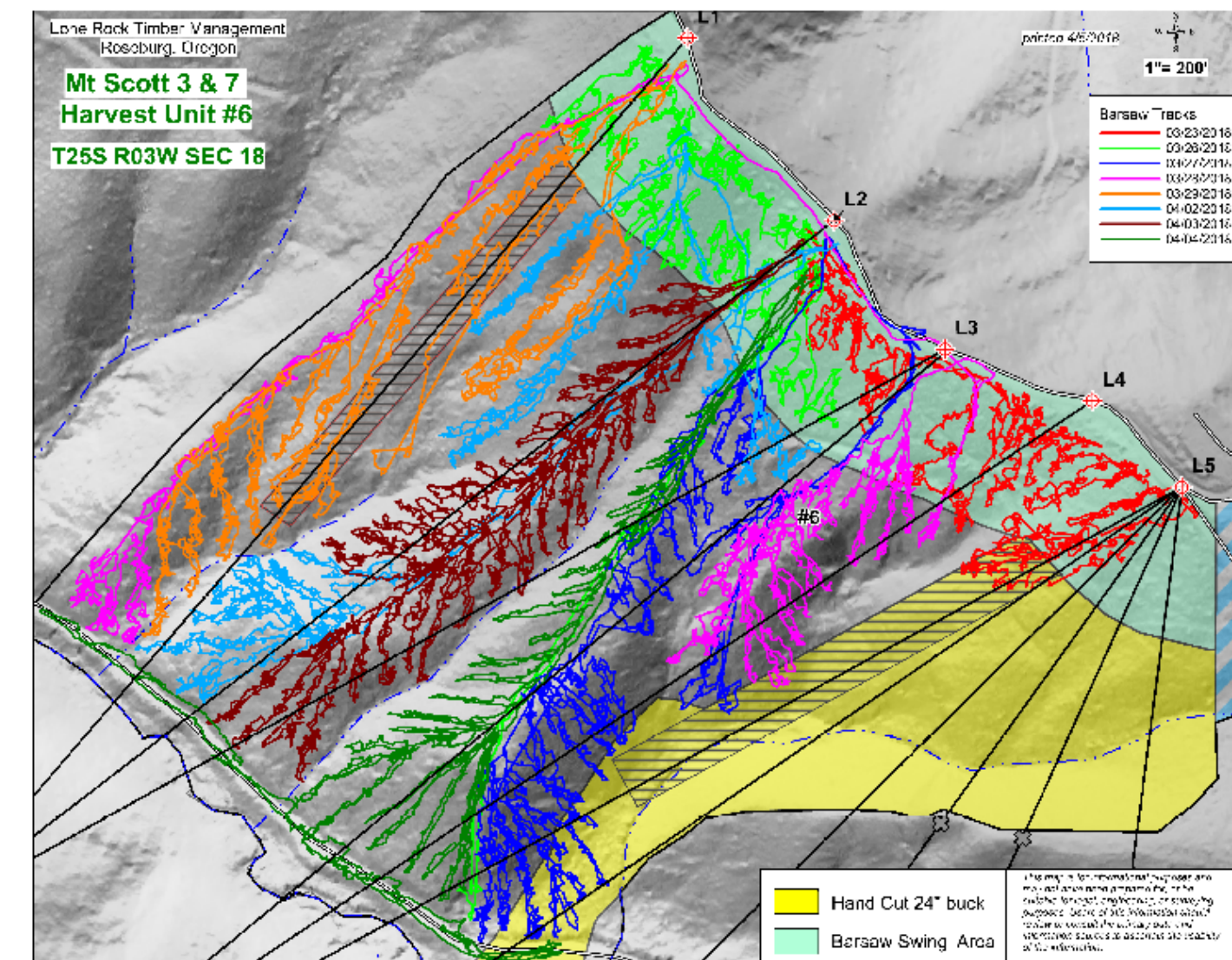
7:34
 #3 Engine
 7:35:55 Start
 Notes on back? _____

Ending times

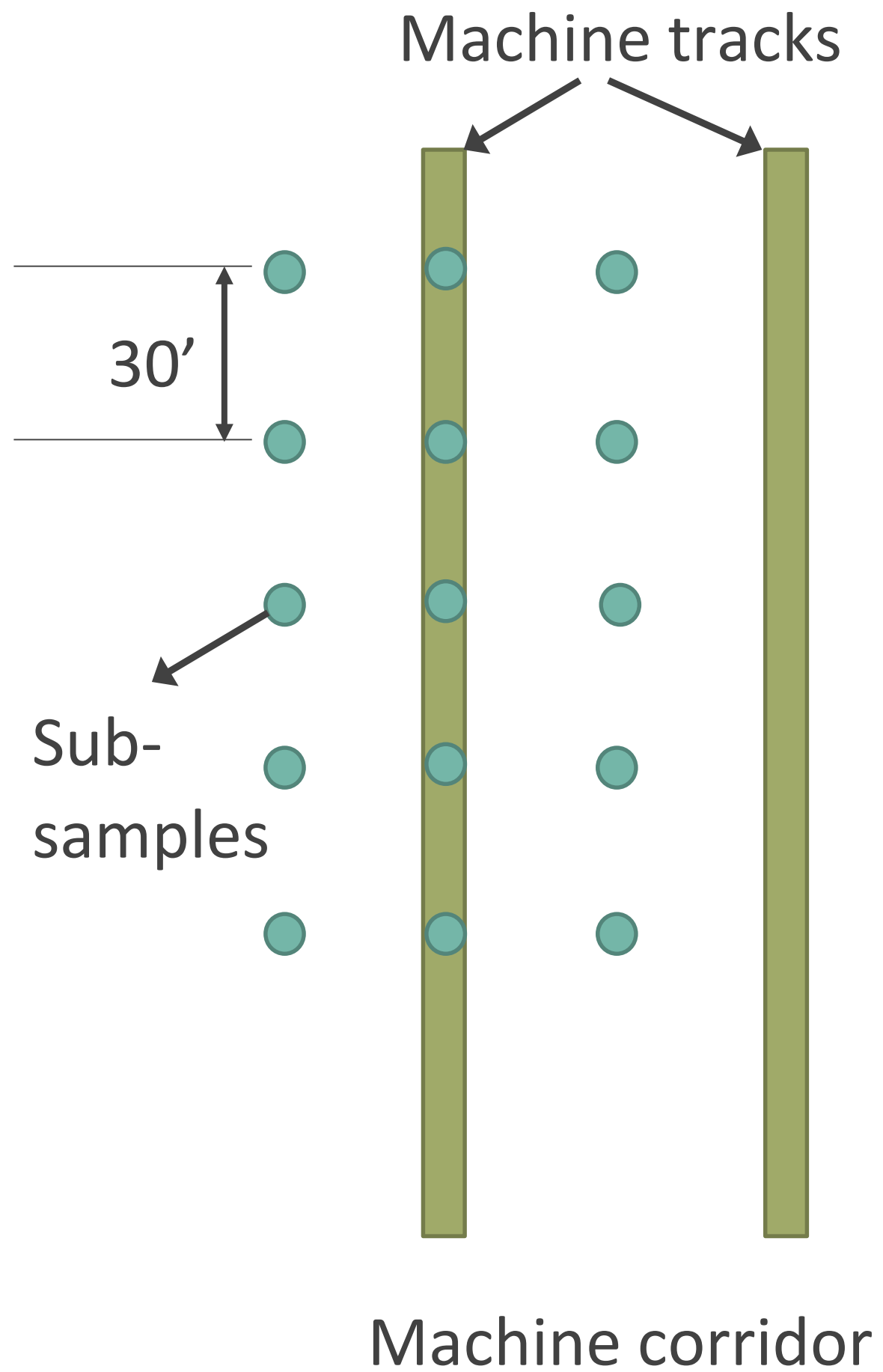
Cycle #	Walk Time	Dist. Bw Trees	Acquire Time	Fell Time	# Wedges	Tree Color (Size)	Delay Type	Delay Time	Cycle Time	Comments
1				7:36:19	0	B	Dressing			
2	36:45	5 steps		37:00	0	D				Delay time from ~ to
3	37:20	3		38:09	0	P				
4	38:30	8				B				
5				7:39:08			Cutting			
6		28 (0)	39:25	40:07	0	P				
7		3 (0)		41:10	1	P				
8		0				O				
9						O				
10						O				
11						B				
12				7:44:59						
13	7:45:26	19 (+)		46:19		B		45:10		
14	45:28	2 (0)		46:50		O		46:25		
15	47:05	5 (0)		47:26		O		46:57		
16	47:38	5 (0)		48:18		B		47:30		
17	48:31	5 (0)		48:58		B		48:24		
18	49:38	0 (0)		49:49		O				
19	49:46	3 (0)		50:01		O				
20	50:06	7 (0)		50:40		B		50:46		
21	50:55	13		51:33		P		51:49		
22	51:57	6 (0)		52:40		P		52:56		
23	53:03	7		53:50		D		54:06		54:06 ~ 54:28
24	54:33	7		55:25						
25	56:01	9		57:08						
26	57:21	12		57:46						
27	58:00	12		58:26						
28	58:45	5		59:04						
29	59:10	5		59:24						
30	59:27	2		8:00:40	1					
31	00:53	10								
32	03:00	Resume		04:58	1					
33	05:35	2		06:16						
34	06:40	10		07:10						
35	07:22	4		07:08						
36	08:20	11		08:55						
37	09:16	12		09:44						

* ALL time records are ending times

Practice to figure out how to do.



Pre- and post-harvesting



*Between machine tracks,
in the tracks, and
outside tracks*

Soil physical properties

- Bulk density
- Soil penetration resistance
- Rut depth
- Infiltration rates
- Soil moisture contents

Erosion and sediment potential

- Soil moisture changes over time
- Shallow subsurface runoff
- Sediment production rates
- Rainfall precipitation



SOIL
COMPACTION



MOISTURE
CONTENT



SILT FENCES



LONE ROCK
RESOURCES



METHODS – SOILS

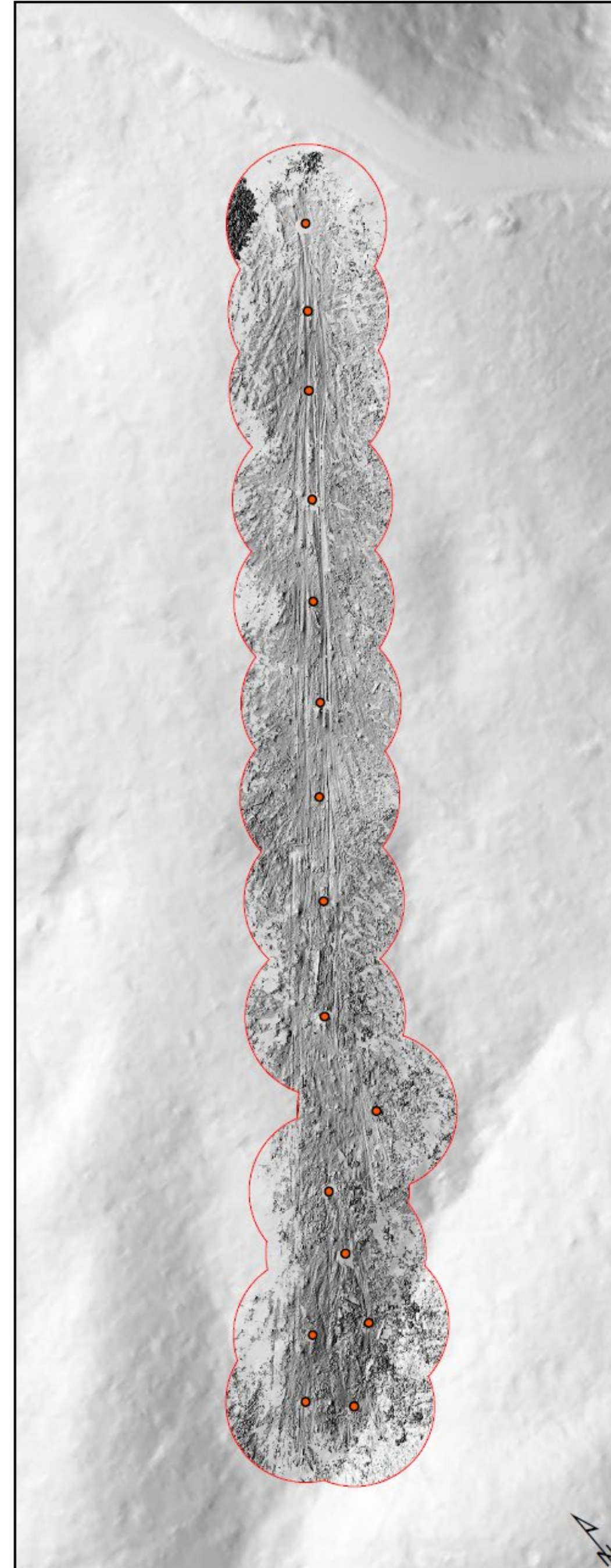


Machine cut areas – high intensity of disturbance

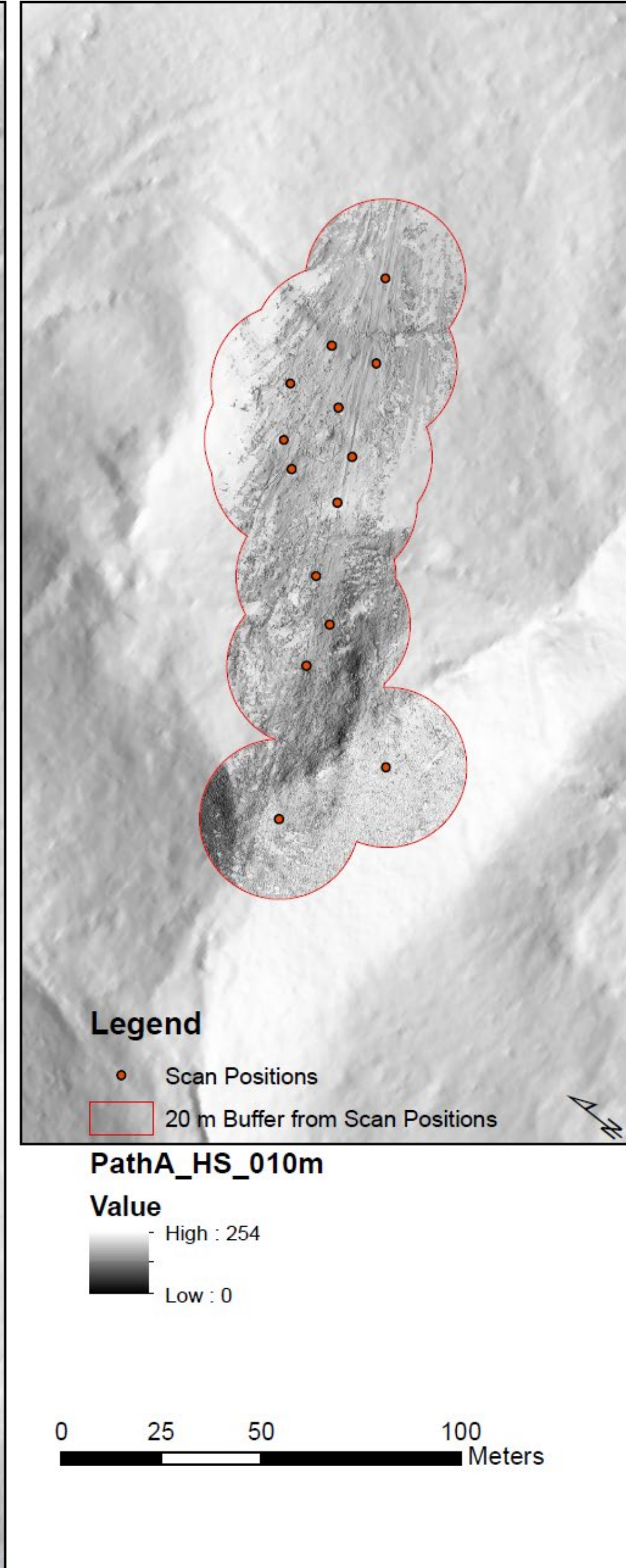
METHODS – SOILS



Equipment Cut



Hand Cut





LONE ROCK
RESOURCES





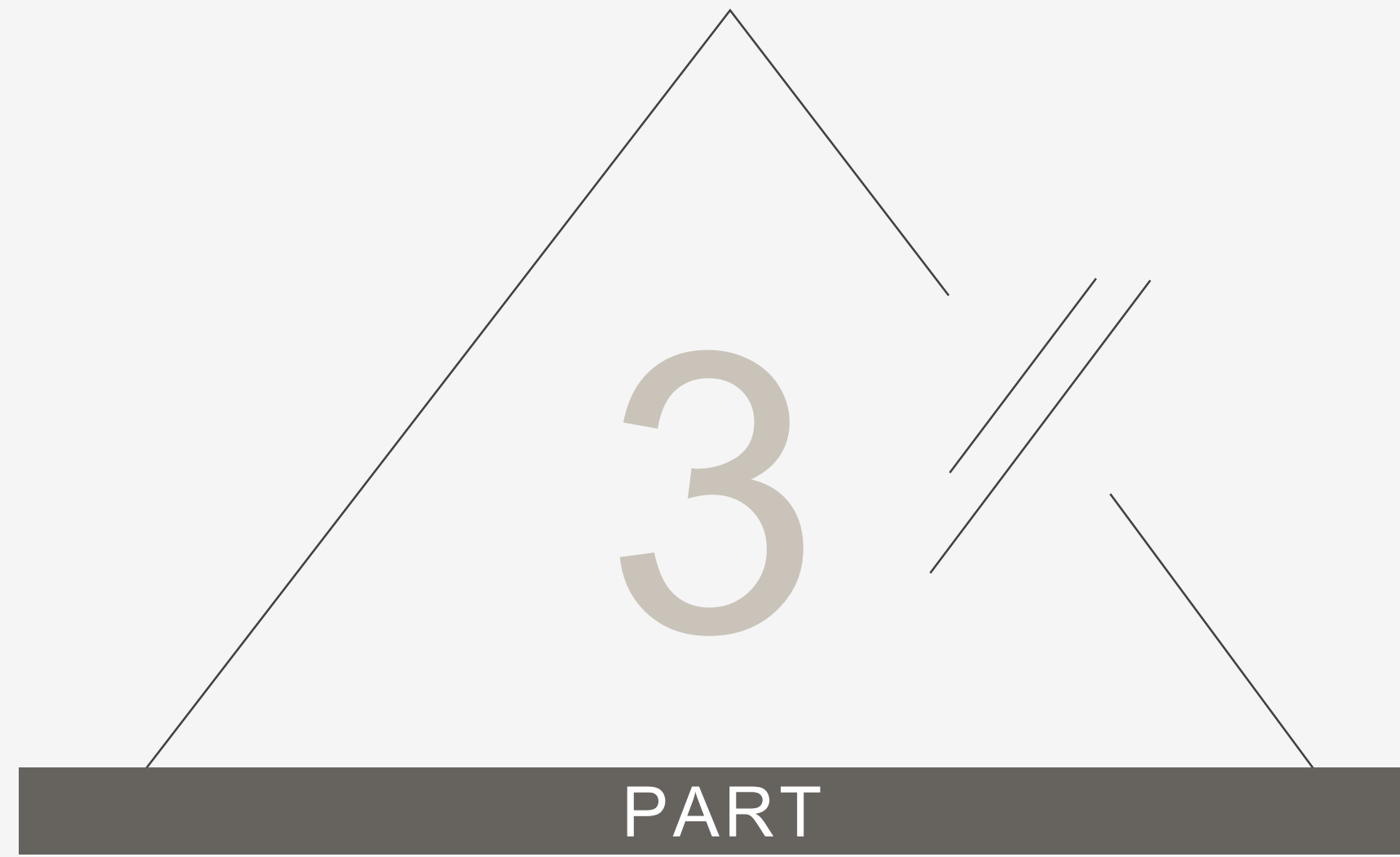
LONE ROCK
RESOURCES





LONE ROCK
RESOURCES





PRE. RESULTS

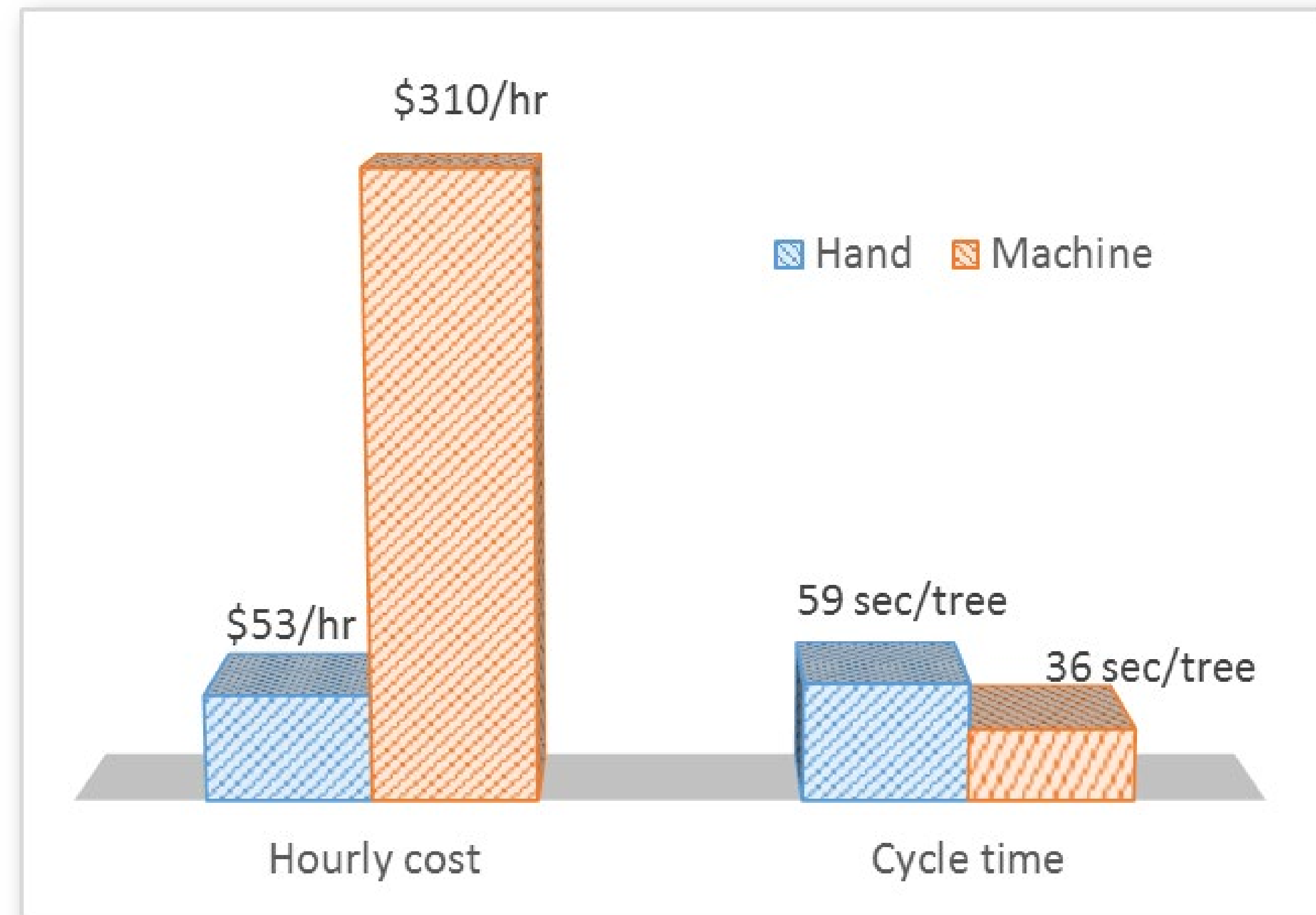
Machine costs

- Hand cutting: \$53/hour
- Machine cutting: \$310/hour
- Yarding: \$390/hour

Productivity

- Hand cutting (delay-free): 59 sec/tree
- Machine cutting (delay-free): 27 sec/tree
- Machine swing: Approx. 30% of total machine hours
- Yarding (hand cut): 4.8 min/turn, 610 bf/turn
- Yarding (machine cut): 3.5 min/turn, 970 bf/turn
- 27% faster, 60% more volume -> 120% higher productivity

Cutting



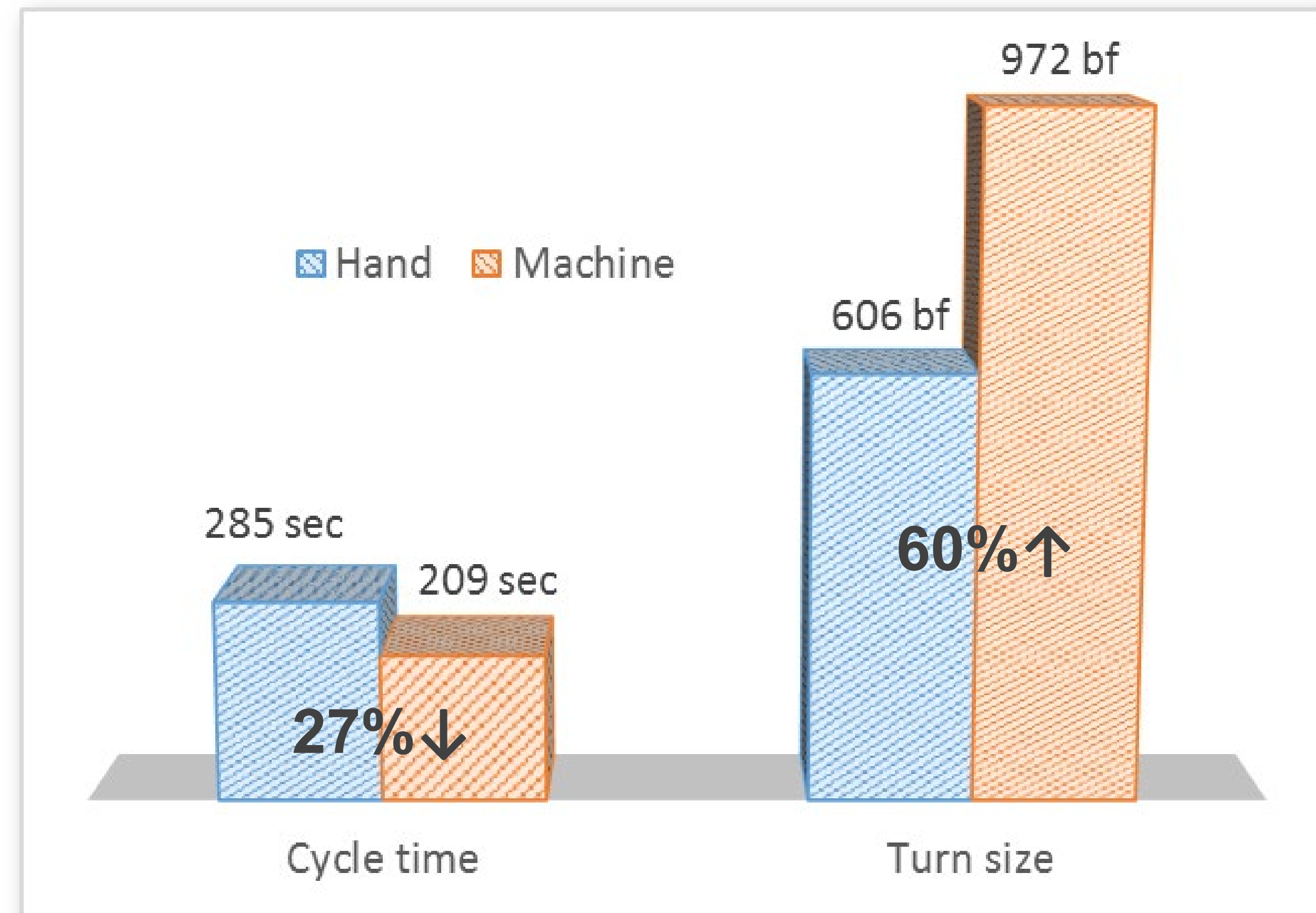
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Yarding



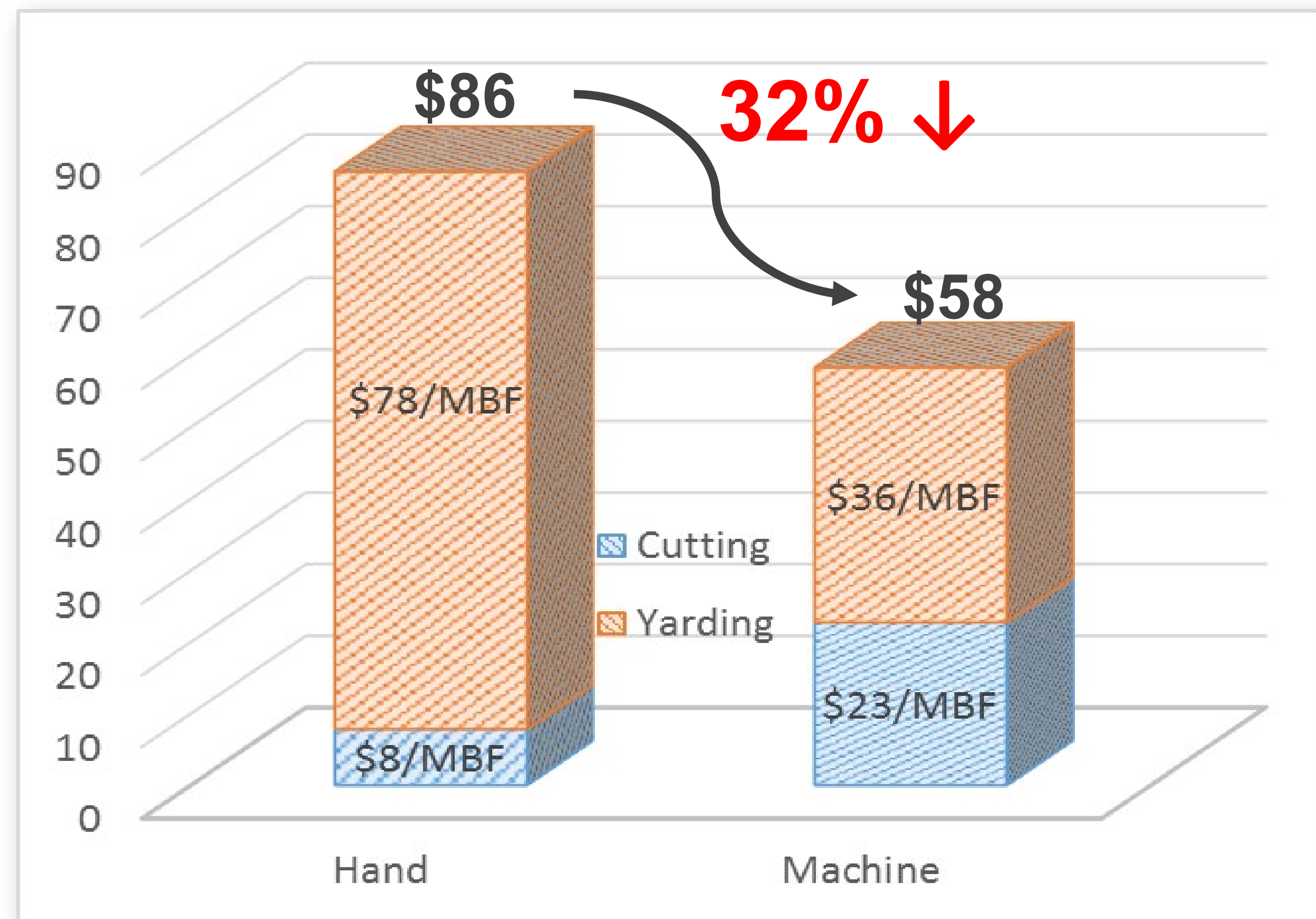
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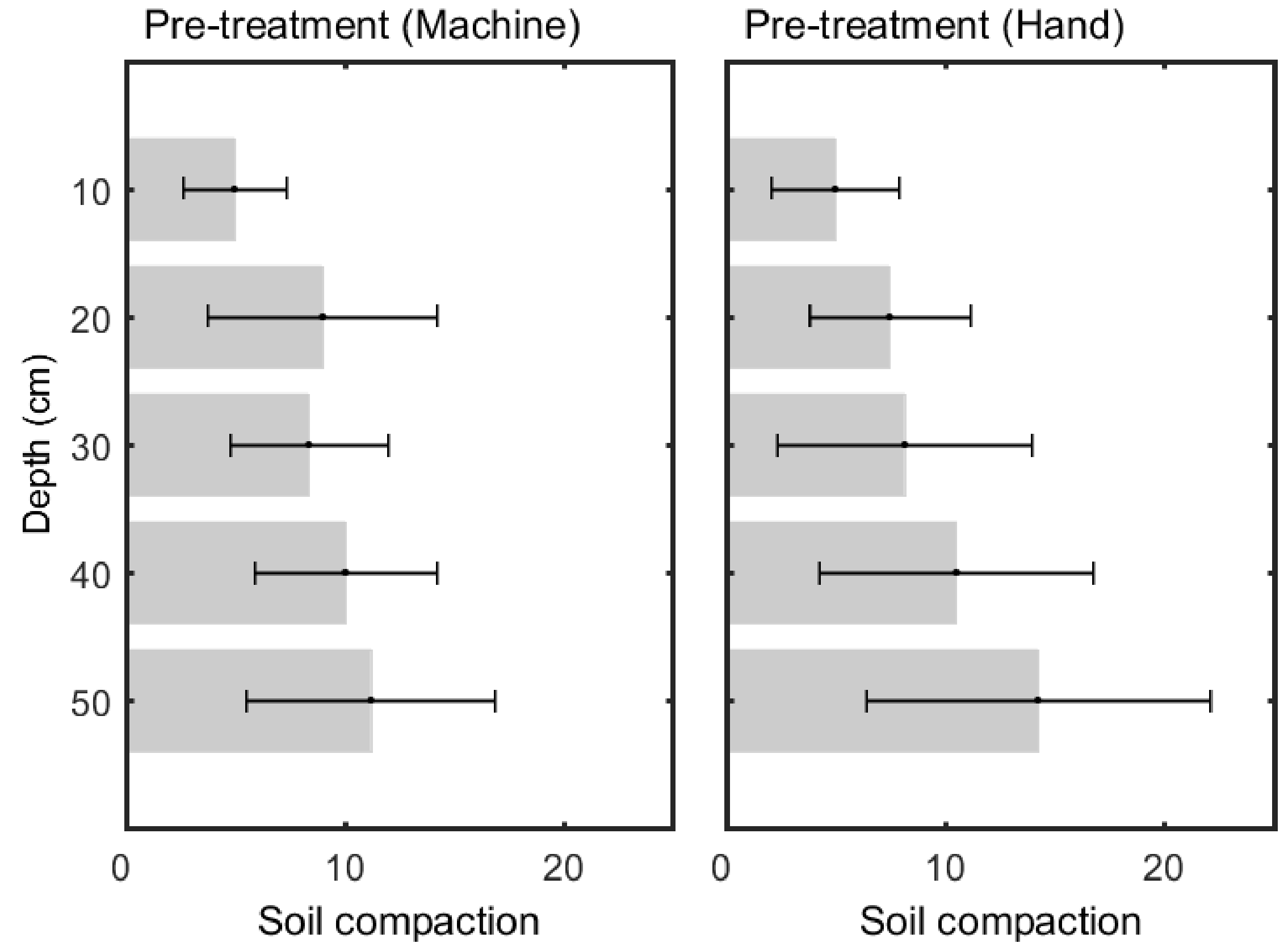
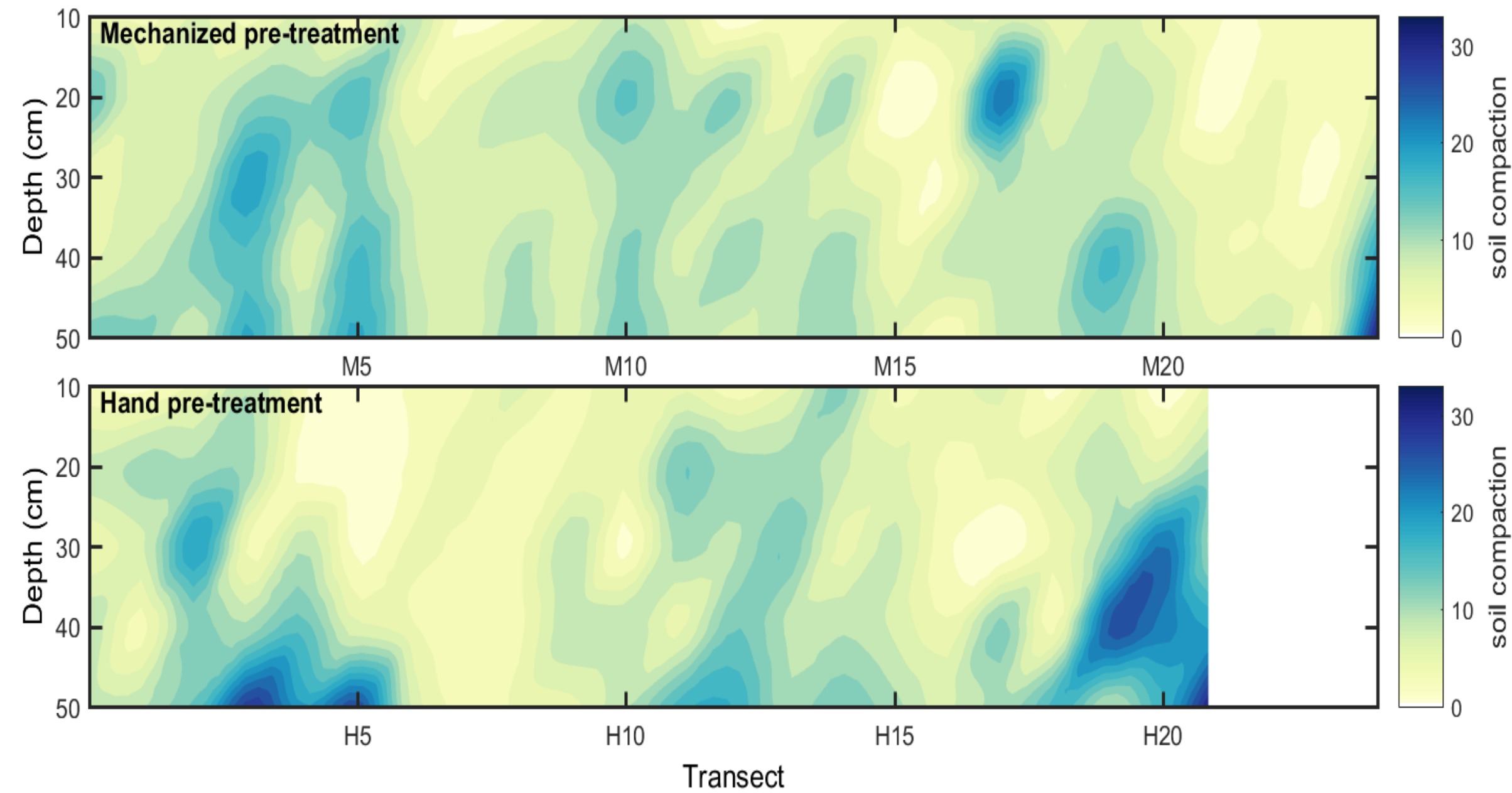
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Unit production costs

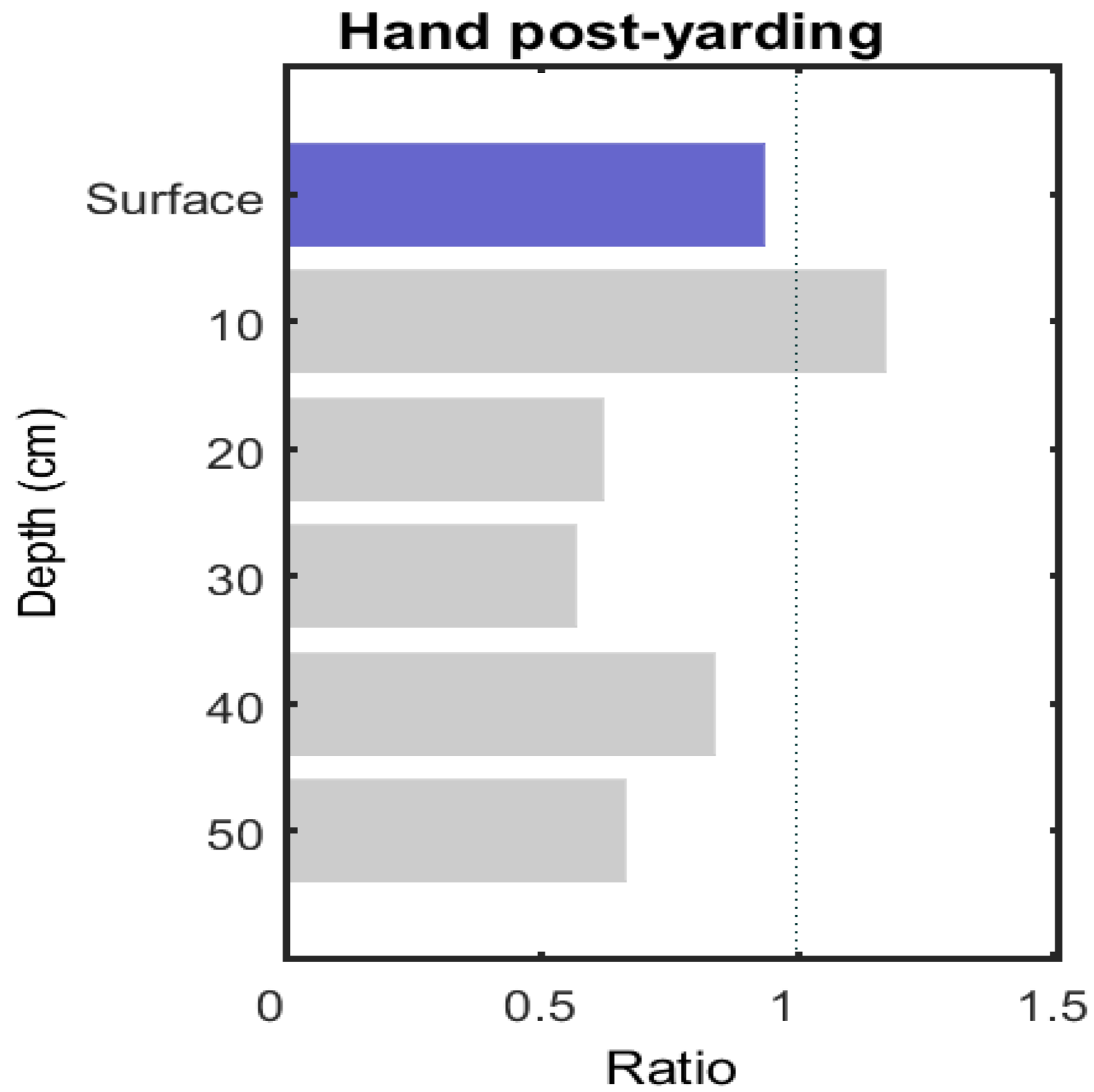




Pre-harvesting soil conditions

- A total of 22 sample stations located in each of machine and hand cut corridors
- No difference in the average soil penetrometer measurements between machine and hand cut areas prior to harvesting

Post-yarding



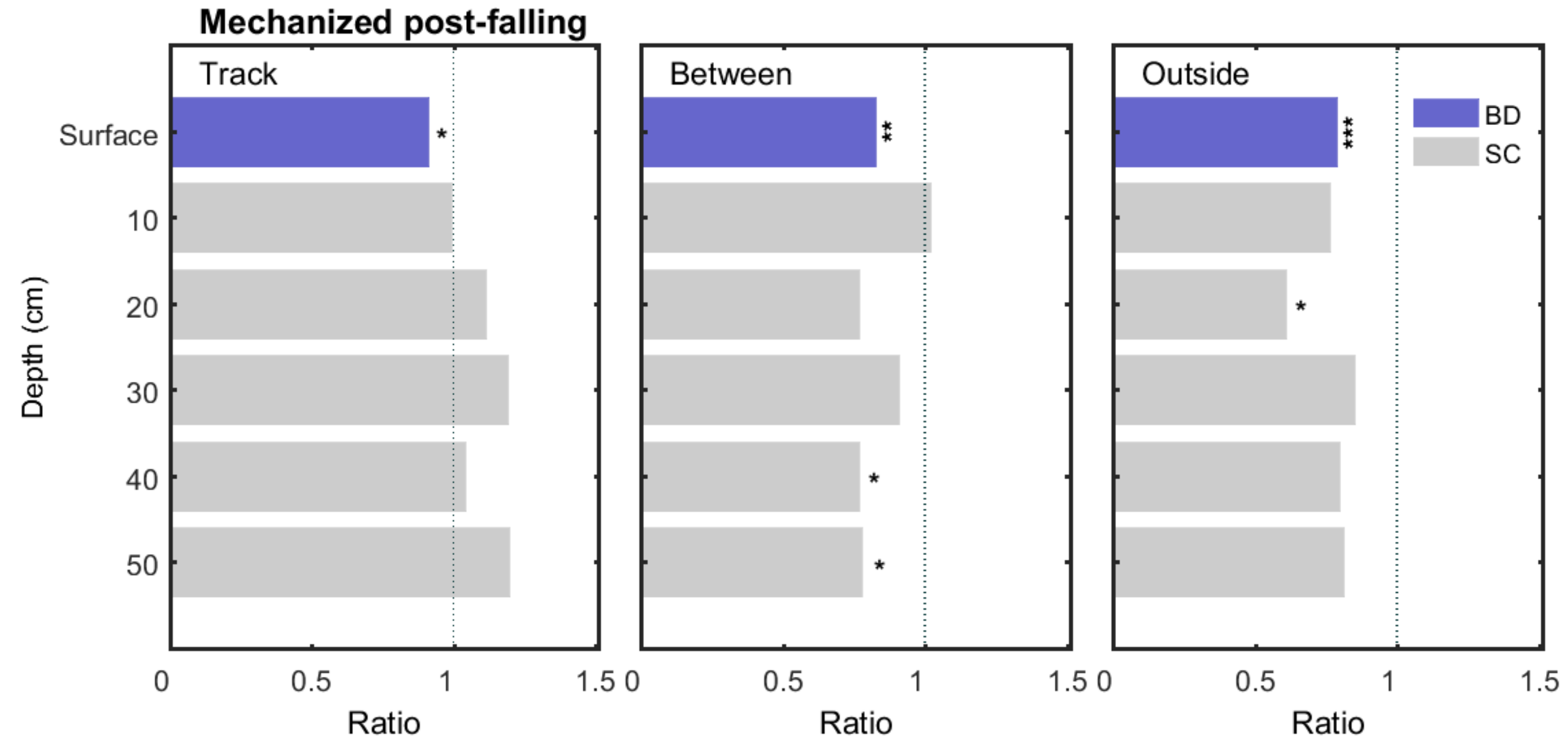
- Ratio > 1; Compacted soil
- Ratio = 1; No change
- Ratio < 1; Loosened-up soil

* significant at $p < 0.05$; ** significant at $p < 0.005$; *** significant at $p < 0.001$

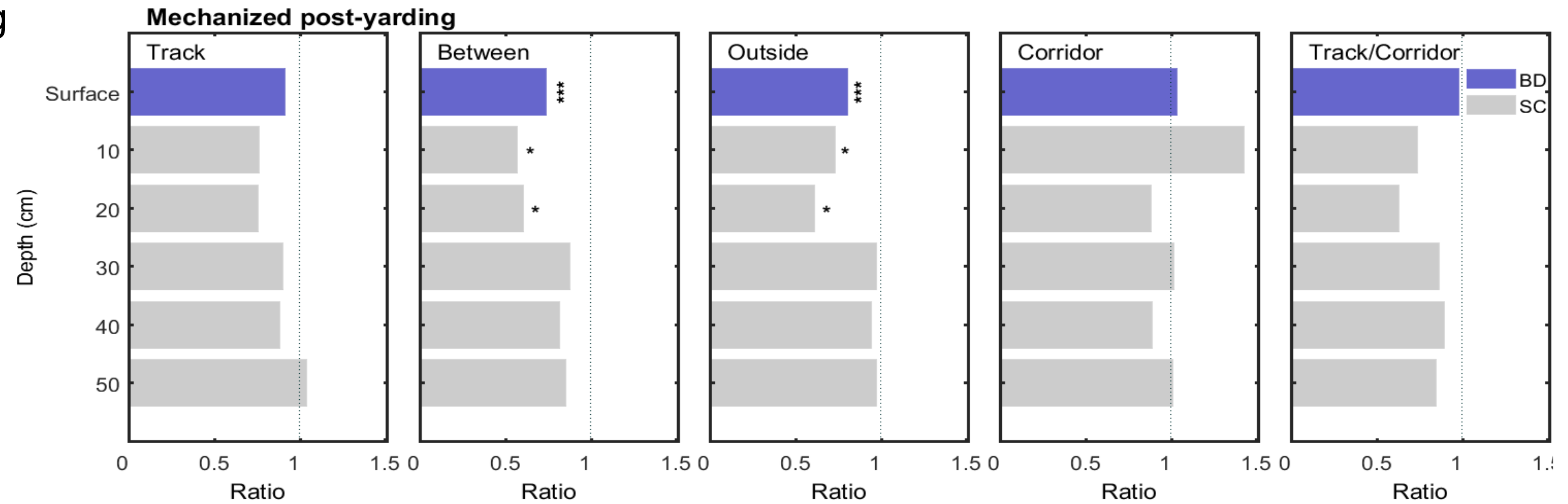
ENVIRONMENT

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Machine post-falling

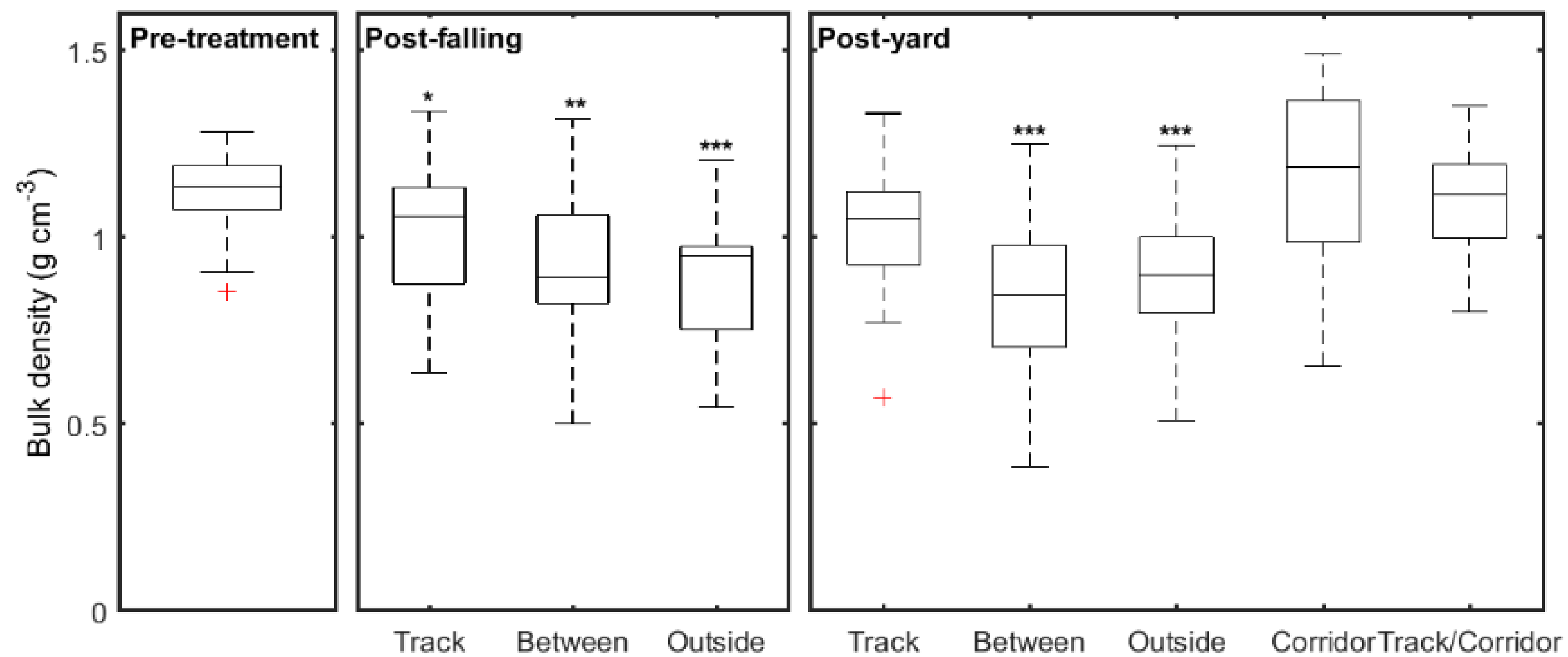


Machine post-yarding

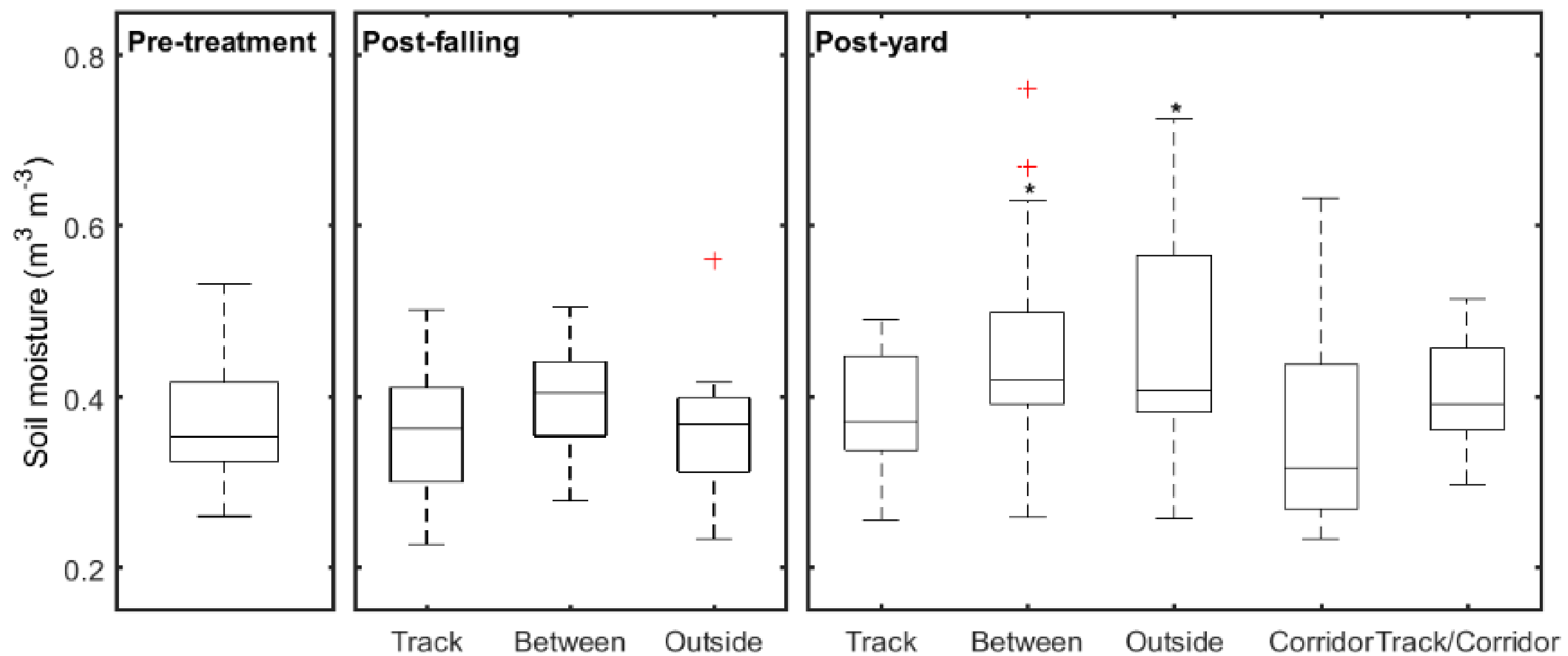


ENVIRONMENT

▲ Bulk density



▲ Soil Moisture Contents



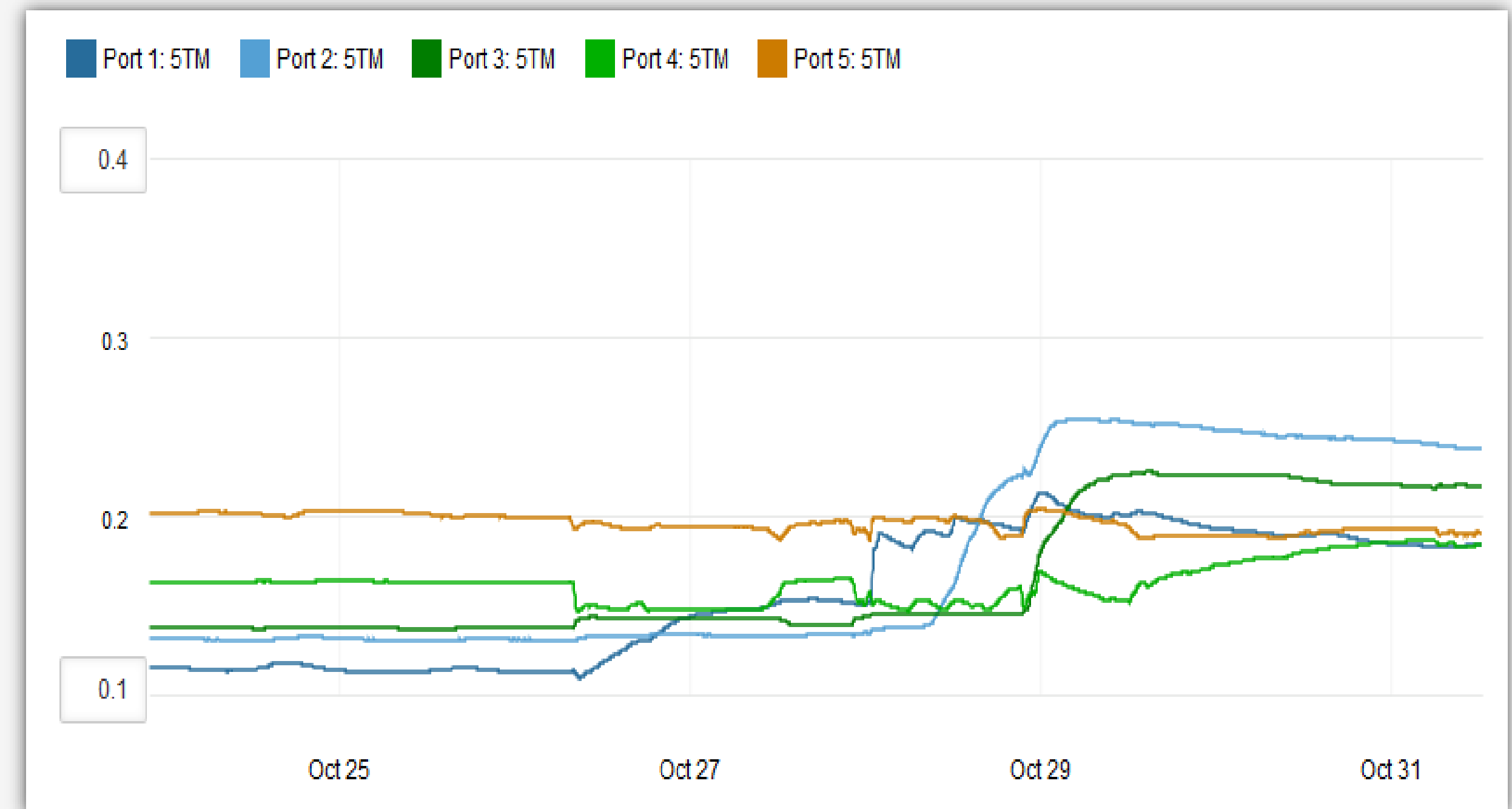
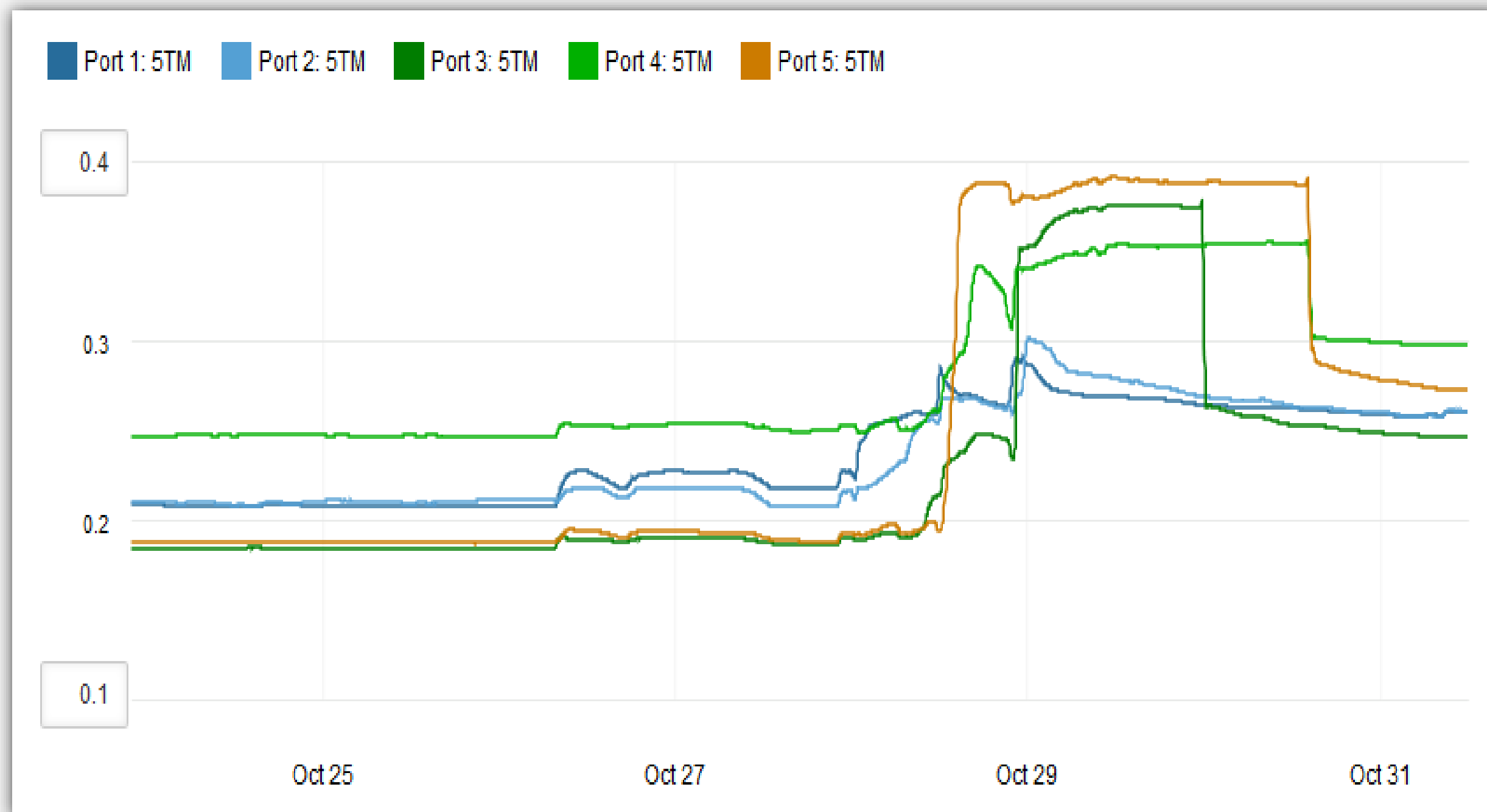
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ENVIRONMENT



Machine Track

Non-track

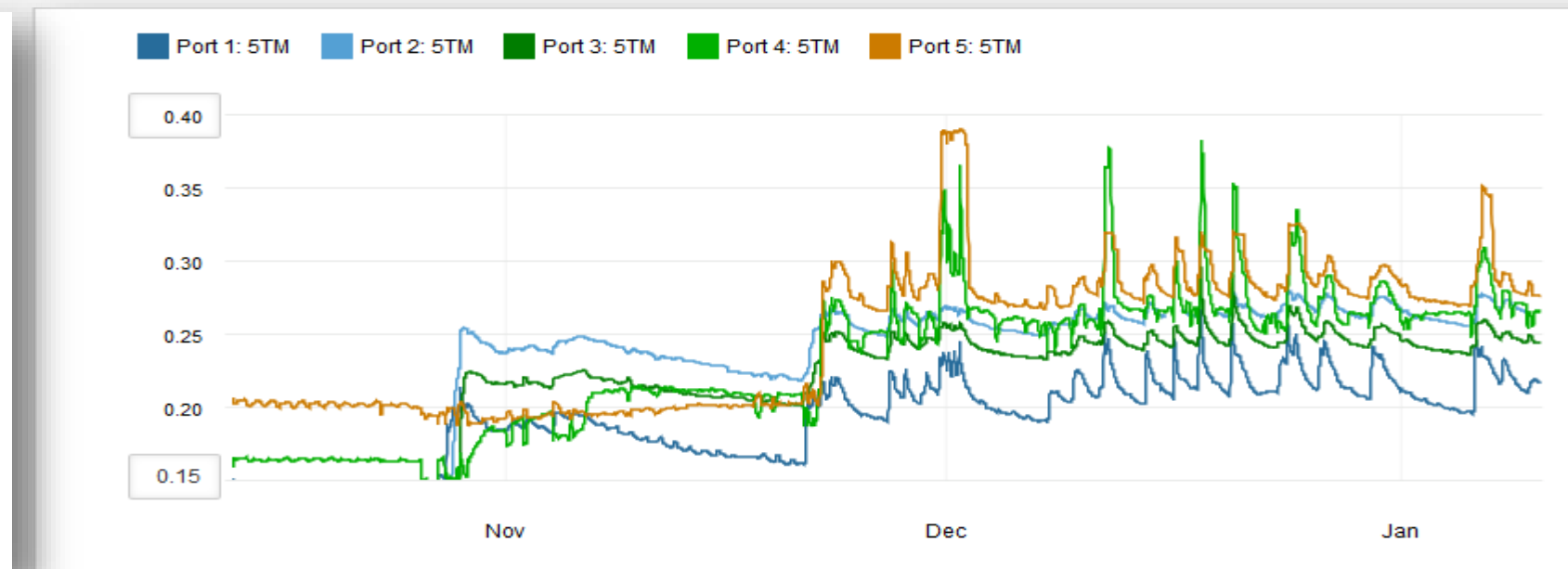
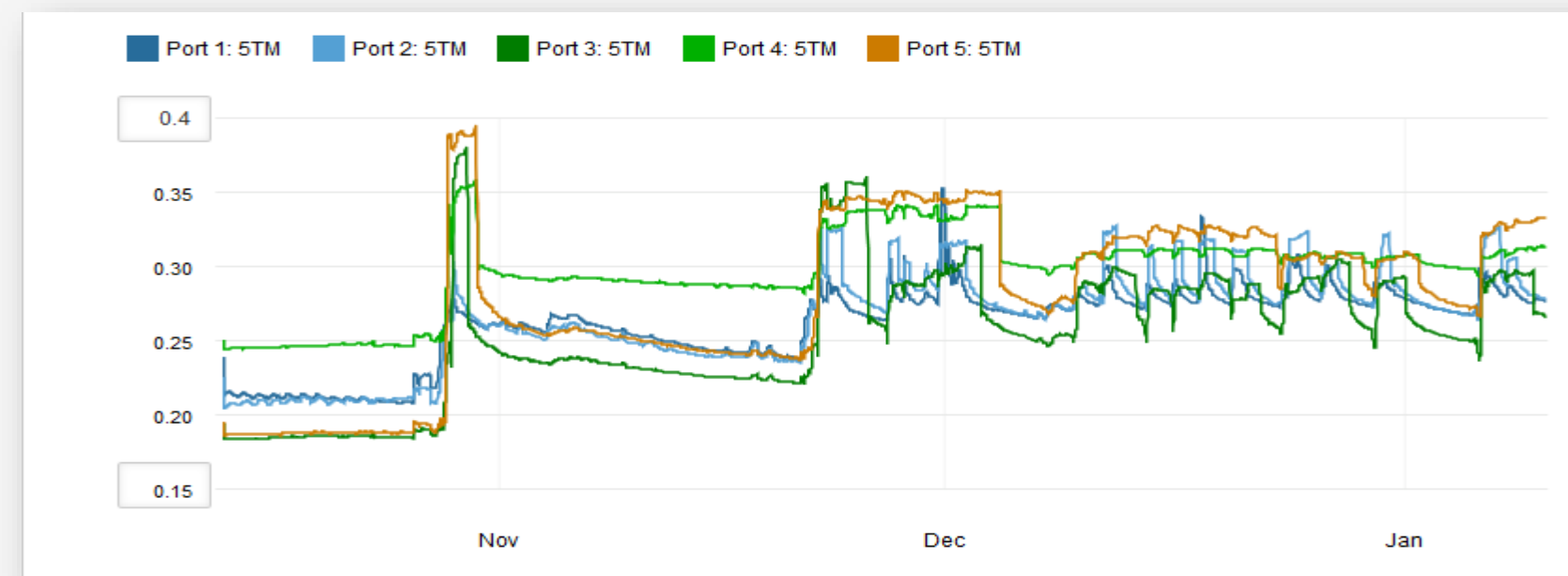


ENVIRONMENT

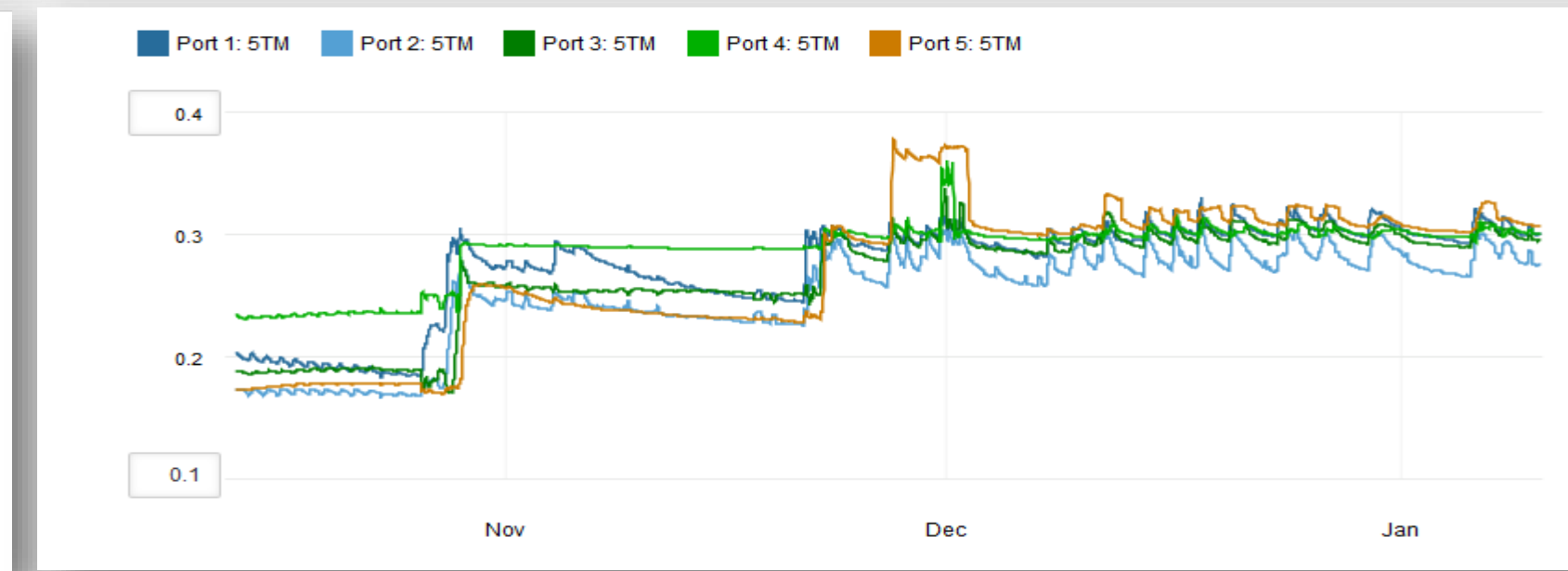
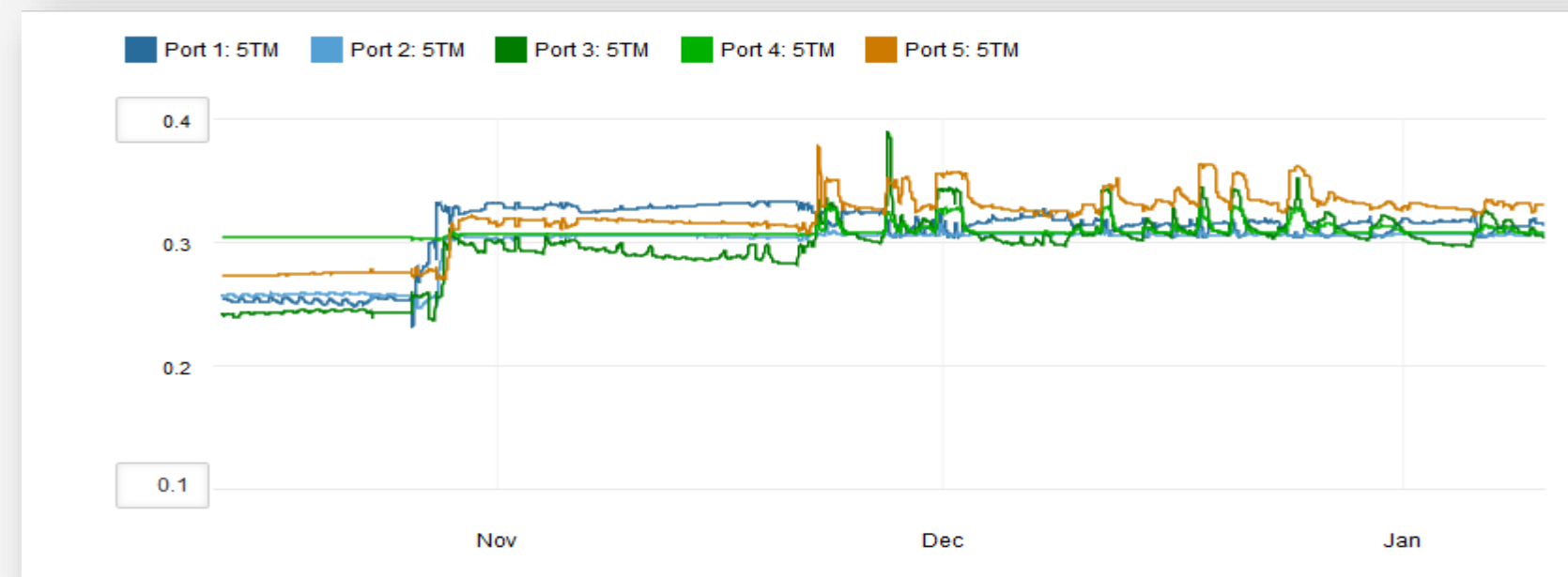
Machine Track

Non-track

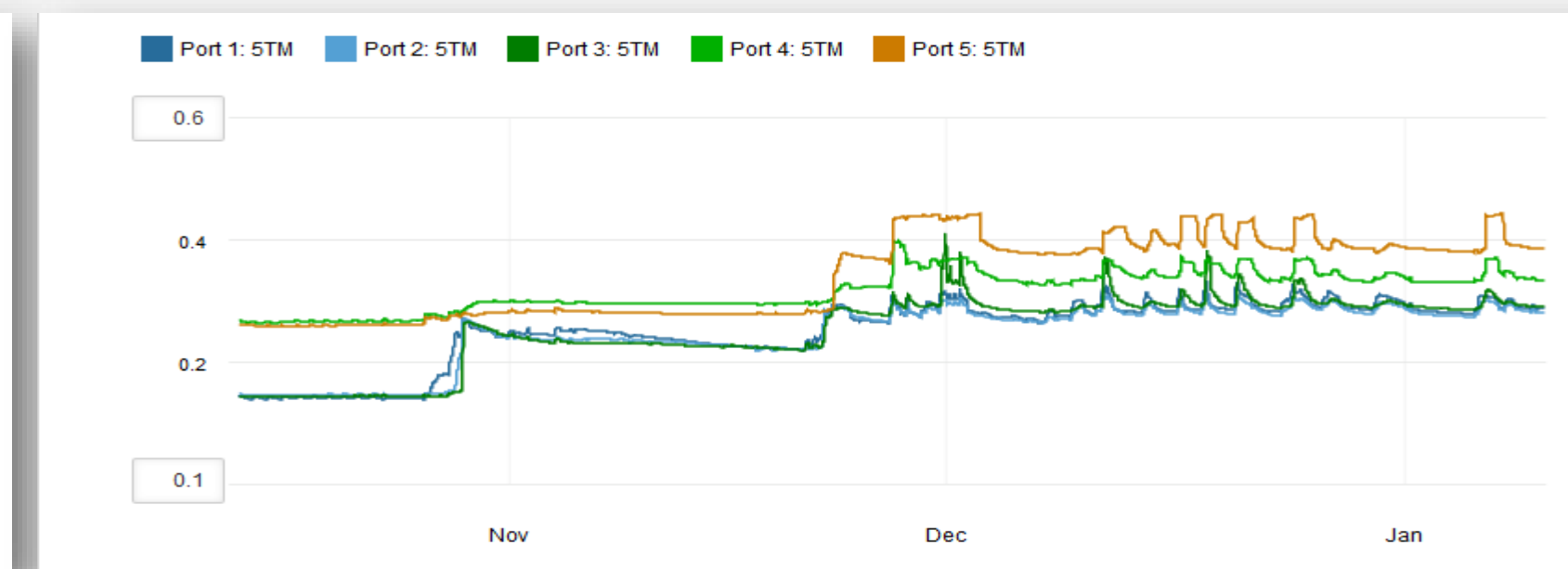
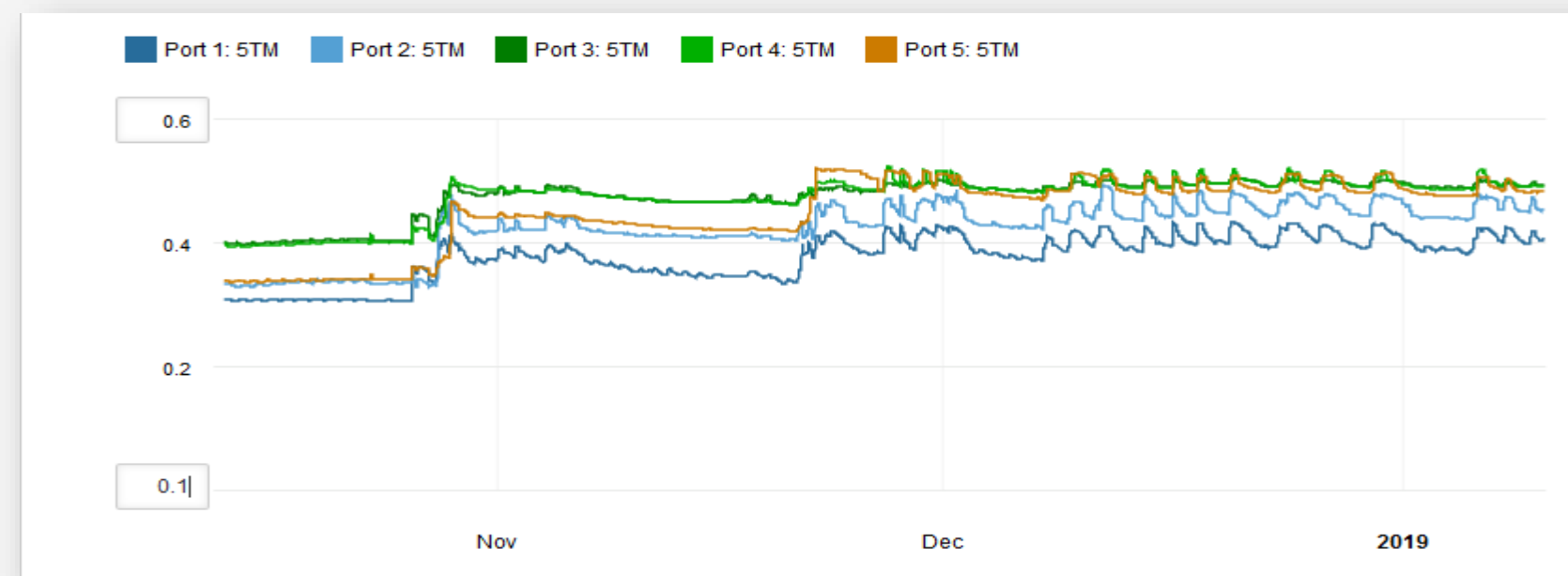
Location #1



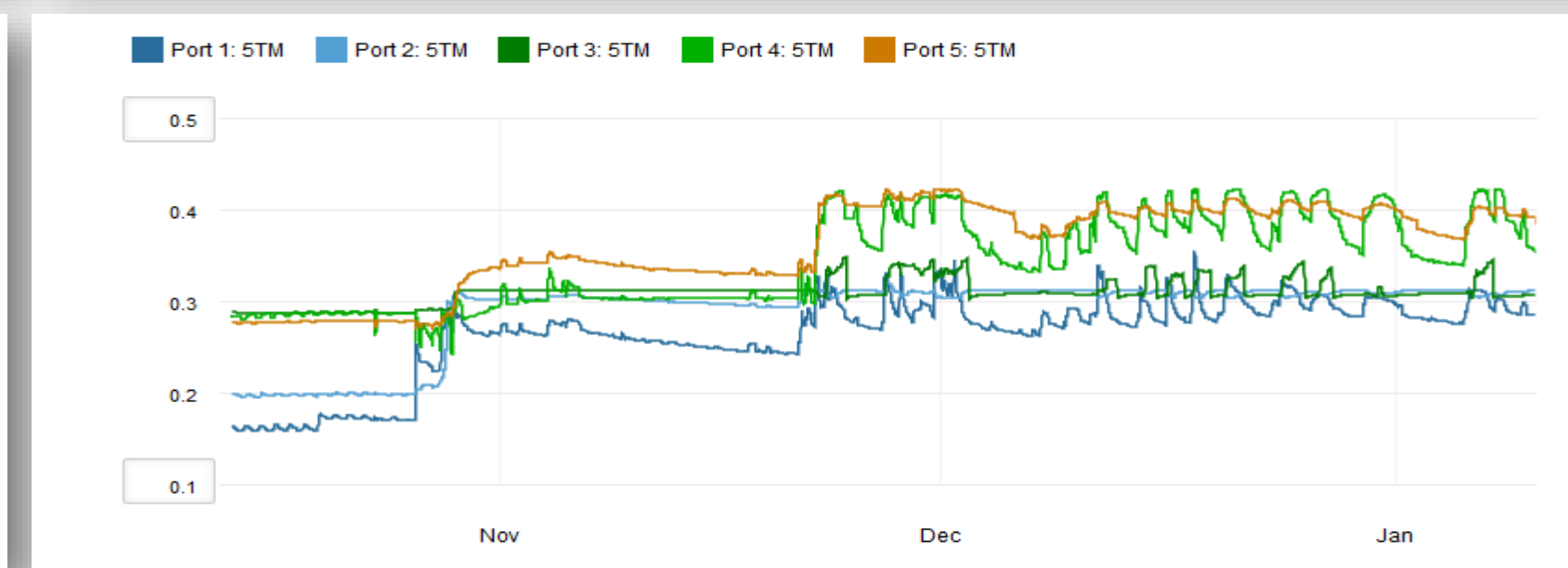
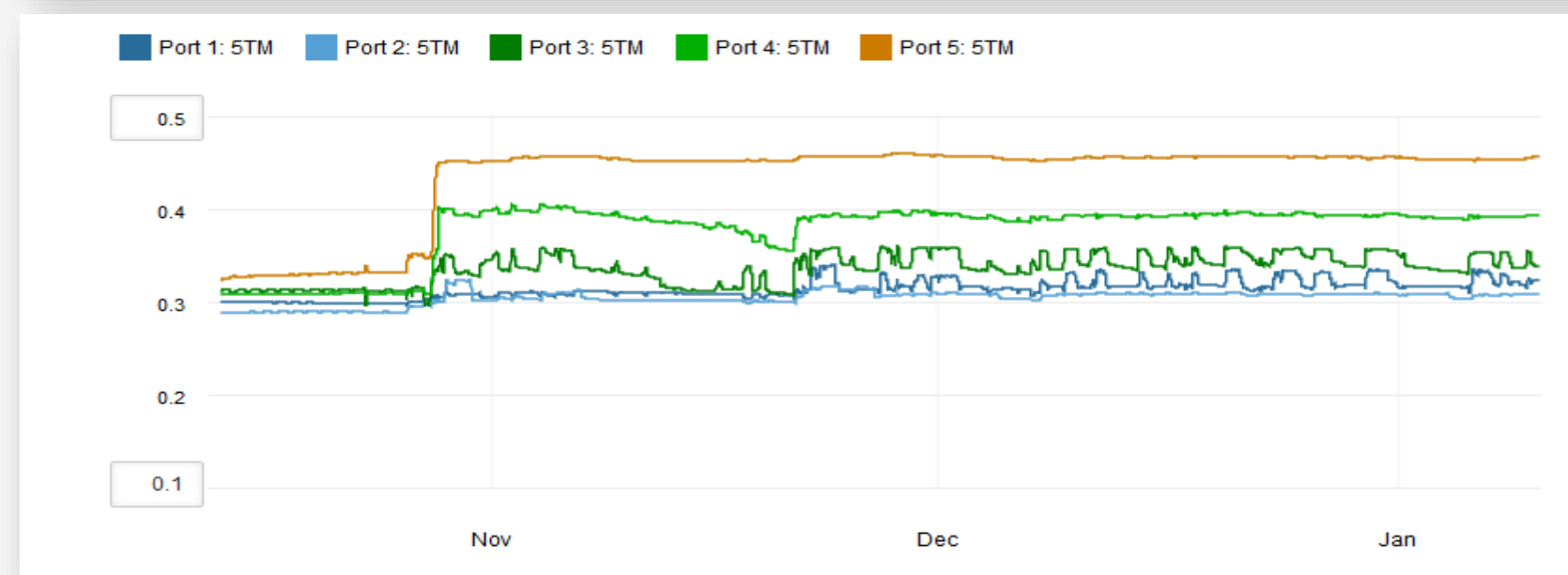
Location #2



Location #3



Location #4







REMARKS

RESEARCH OUTCOMES

Economic and Environmental Impacts of Tethered Logging

- Understand costs and benefits of cable-assisted steep slope harvesting
 - Productivity and cost
 - Positive and negative impacts
- Understand machine-soil-water interactions
 - Soil disturbance
 - Soil erosion
 - Sediment transport potential



ACKNOWLEDGMENT



Oregon State
University



LONE ROCK
RESOURCES





THANKS



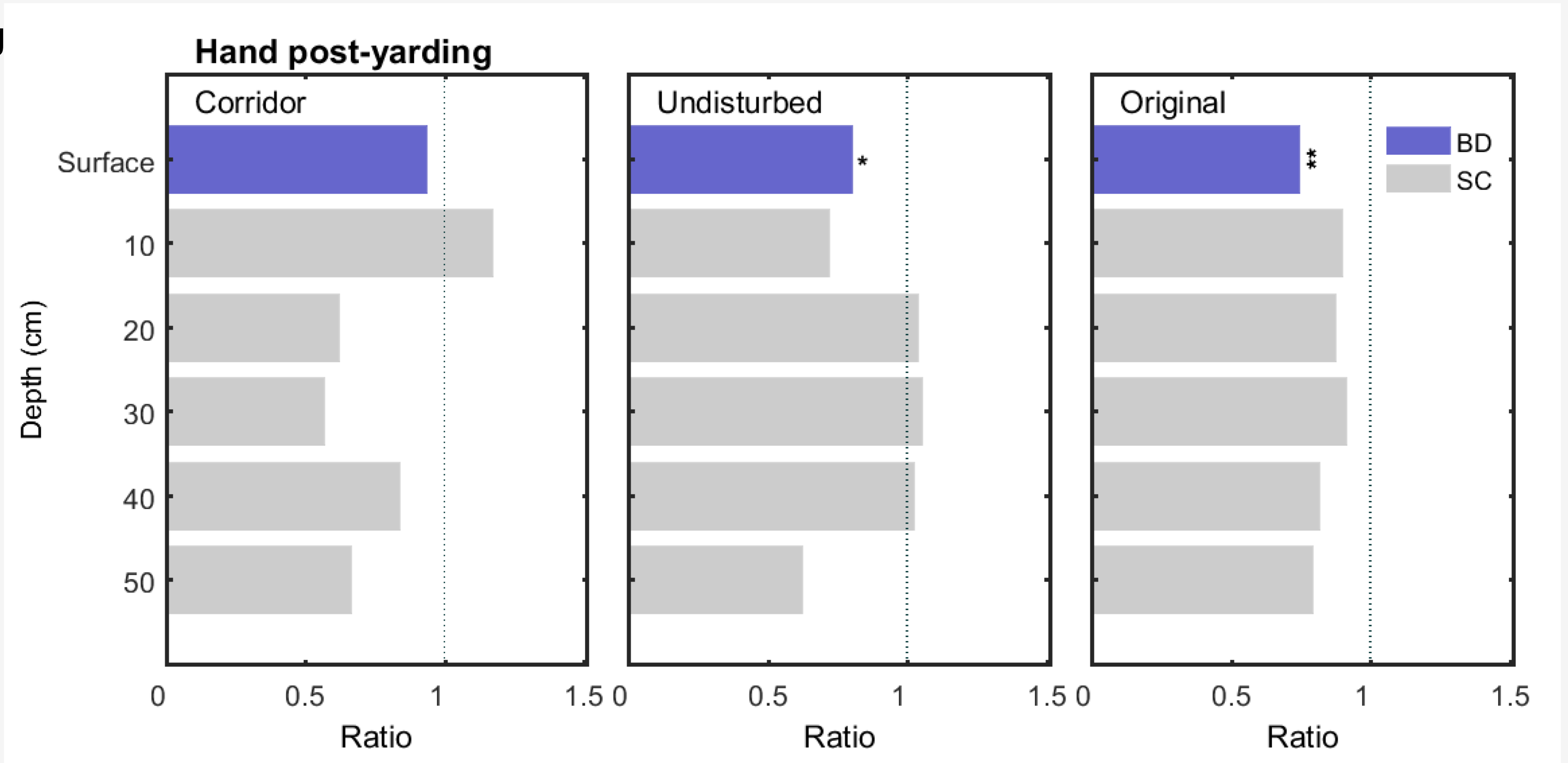
WOODY CHUNG

woodam.chung@oregonstate.edu



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Hand post-yarding



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