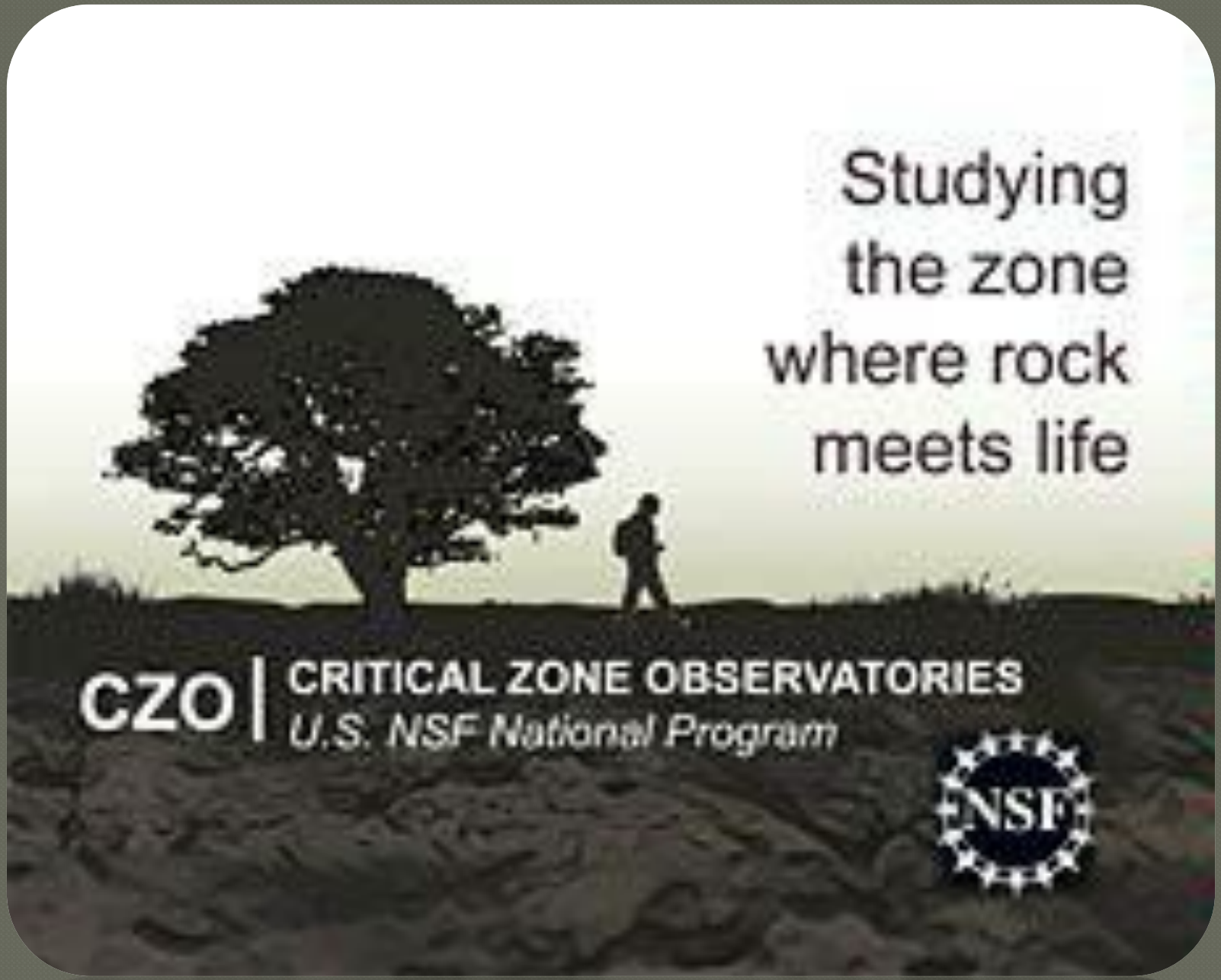


http://www.usu.edu/today/images/large/Mission_NSFCZOLogo_ust.jpg

Density of Root Intersections in relation to Lithology

Siobhan Donnelly[1], Maggie Ruppel[2], Tom Adams[3] and Dr. Dave Eissenstat[3]

[1]CZO RET, Centre Learning Community Charter School
[2]REU, Wittenberg University
[3]Penn State University

http://wildeherb.com/2006/06/09/box-huckleberry-and-mountain-laurel/

Overview:

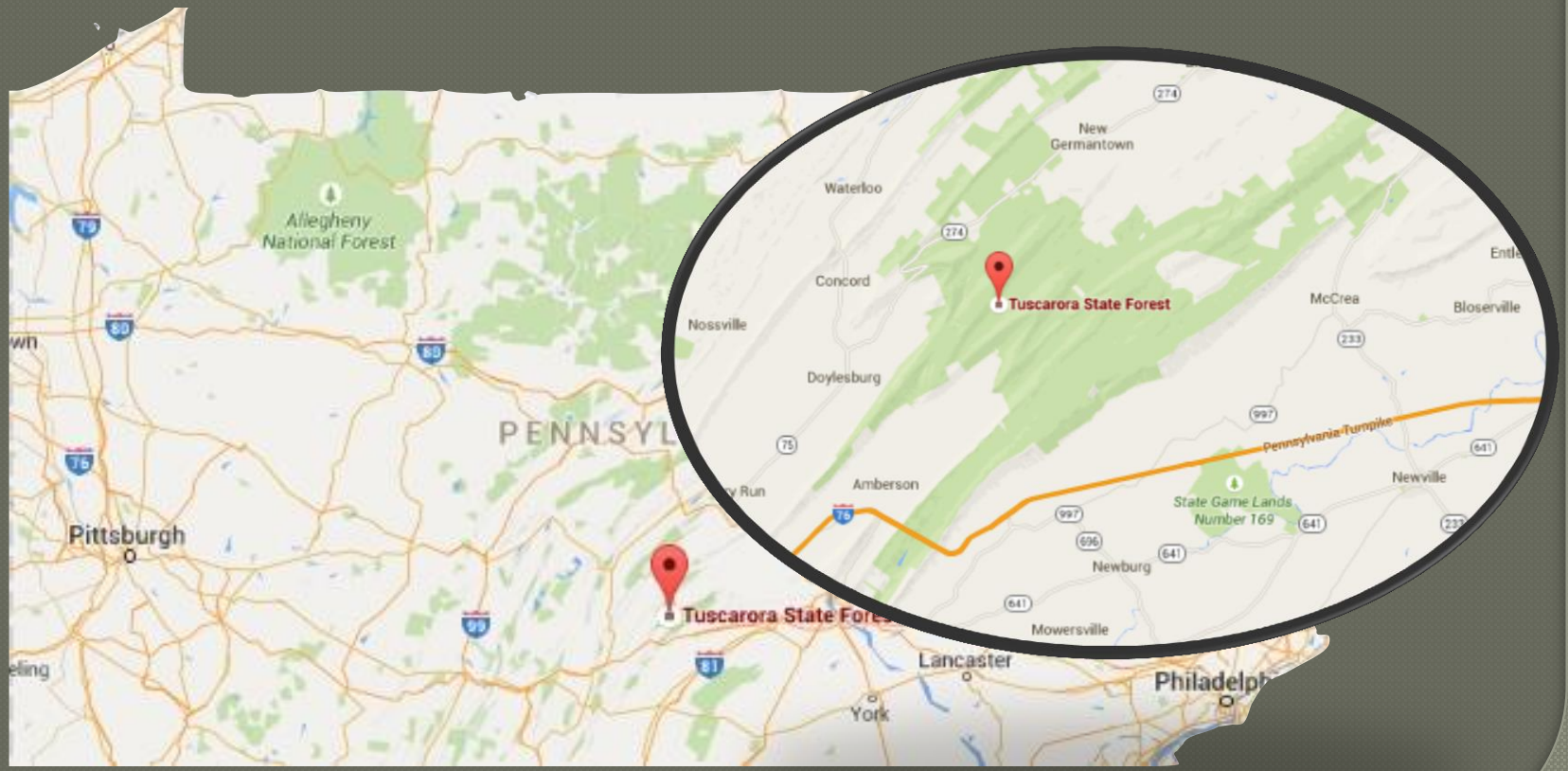
- Field Work
- Lab Work
- Results

What Affects Root Density?

- Lithology
- Soil Depth

Field Work Location

- Tuscarora State Forest
- Blaine, PA



https://www.google.com/maps/place/Tuscarora+State+Forest/@40.8082143,-78.8559502,7.5z/data=!4m2!3m1!1s0x0:0x6d89606028ab4cdb

Our Focus

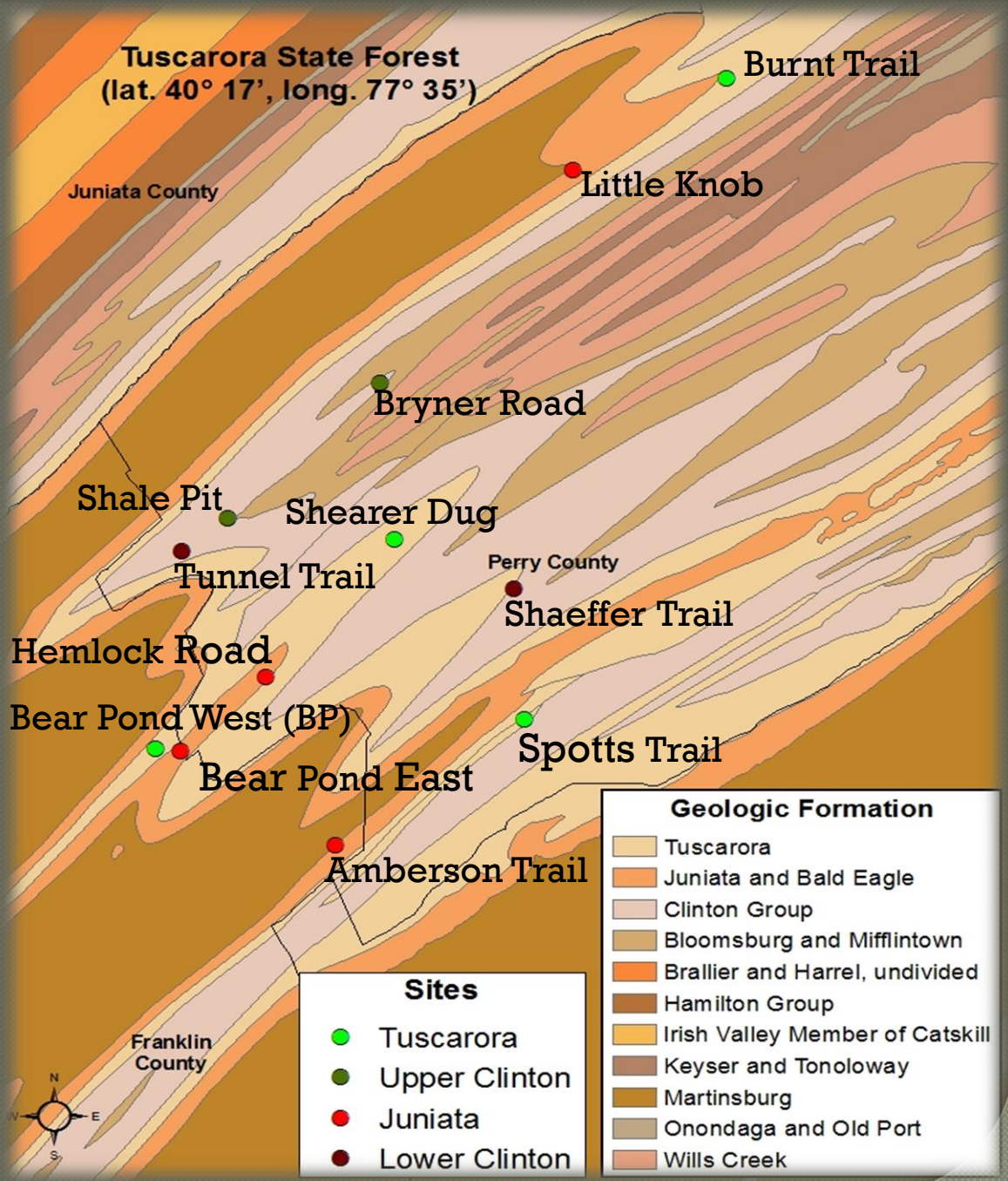
- 12 soil pits total
  - 4 Clinton Group: Shale
  - 4 Tuscarora: Sandstone
  - 4 Juniata: Shale and Siltstone

Note:

Similar lithology to that in the Shale Hills CZO

(Clinton and Tuscarora)

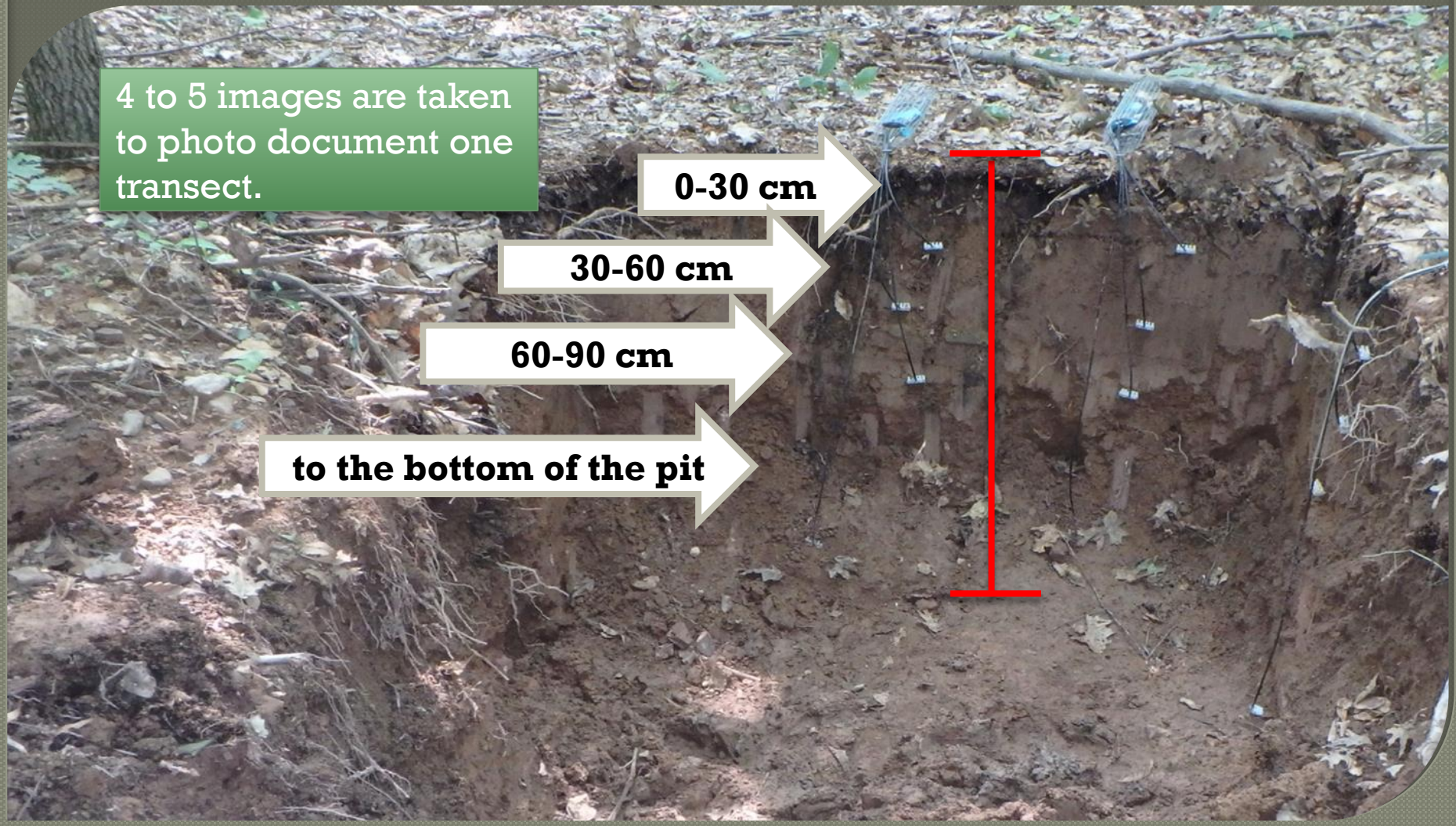
Soil Pit Locations



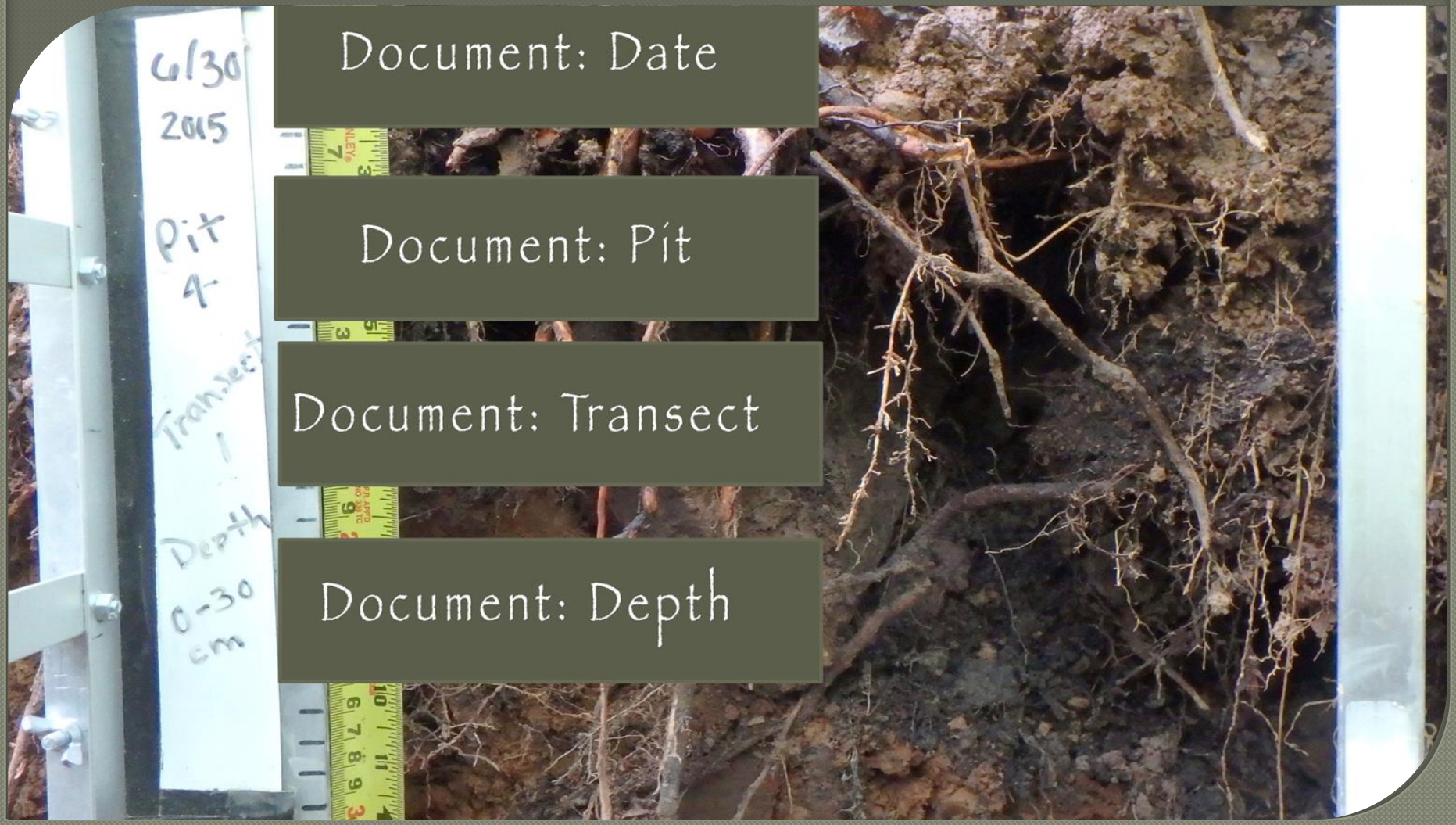
Long, Robert. (2015, June 3). Electronic communication.

Task: Root Pictures

Photo Documenting Soil Pit Transects (in cm)



Provide Labels



Document: Date

Document: Pit

Document: Transect

Document: Depth

Back at the PSU Lab Work

http://www.psiee.psu.edu/news/2007_news/jan_2007/forestry_leeds.asp

Question:

- Does root density vary with lithology?

Adams, Tom. (2015, July). Personal interview.

Hypothesis:

- The roots will grow more deeply into the shale than the sandstone due to nutrient availability for the trees.

Eissenstat, Dave. (2015, July 24). Personal interview.

Background Knowledge:

- Finer textures of soil hold more moisture and nutrients than coarse textures.

Eissenstat, Dave. (2015, August 5 and 7). Personal interview.
White, Tim. (2015, June). Orientation Lecture.
Long, Robert. (2015, June 3). Electronic communication.
Sandstone. (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Sandstone.
Shale. (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Shale
Juniata Formation . (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Juniata_Formation
Schenk, H. J. and Jackson, R. B. (2002), Rooting depths, lateral root spreads and below-ground/above-ground allometries of plants in water-limited ecosystems. Journal of Ecology, 90: 480–494. doi: 10.1046/j.1365-2745.2002.00682.x

Background Knowledge:

- Soil above shale is less course in texture than that of sandstone.

Eissenstat, Dave. (2015, August 5 and 7). Personal interview.
White, Tim. (2015, June). Orientation Lecture.
Long, Robert. (2015, June 3). Electronic communication.
Sandstone. (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Sandstone.
Shale. (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Shale
Juniata Formation . (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Juniata_Formation
Schenk, H. J. and Jackson, R. B. (2002), Rooting depths, lateral root spreads and below-ground/above-ground allometries of plants in water-limited ecosystems. Journal of Ecology, 90: 480–494. doi: 10.1046/j.1365-2745.2002.00682.x

Background Knowledge:

- Sandstone is very porous and allows moisture to pass through it more easily than shale.

Eissenstat, Dave. (2015, August 5 and 7). Personal interview.
White, Tim. (2015, June). Orientation Lecture.
Long, Robert. (2015, June 3). Electronic communication.
Sandstone. (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Sandstone.
Shale. (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Shale
Juniata Formation . (2015, August 7). Retrieved https://en.wikipedia.org/wiki/Juniata_Formation
Schenk, H. J. and Jackson, R. B. (2002), Rooting depths, lateral root spreads and below-ground/above-ground allometries of plants in water-limited ecosystems. Journal of Ecology, 90: 480–494. doi: 10.1046/j.1365-2745.2002.00682.x

Hypothesis:

- The roots will grow more deeply into the shale than the sandstone due to nutrient availability for the trees.

Eissenstat, Dave. (2015, July 24). Personal interview.

Method: Root Counts for Tuscarora

EDIT IMAGE (ADD GRID)

MARK ROOT INTERSECTIONS

Calculate Root Density (RD)

- Count root intersections in 1 section of the grid
- Find the area of the section of the grid that has been counted
- Divide the total number of root intersections by the area in squared centimeters
- Count and average 2 sections of grid for each depth

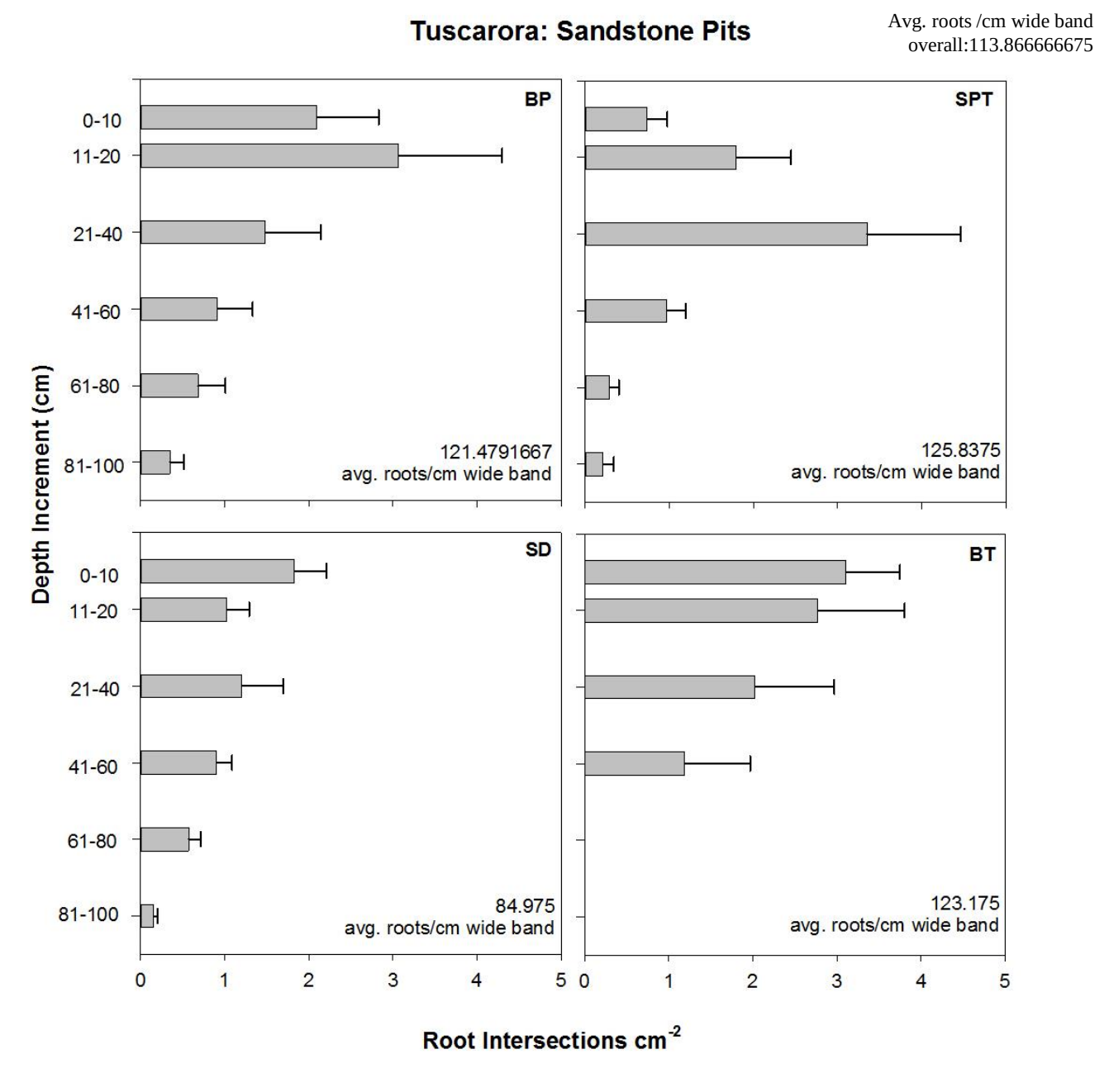
Example:

Root Intersections =138

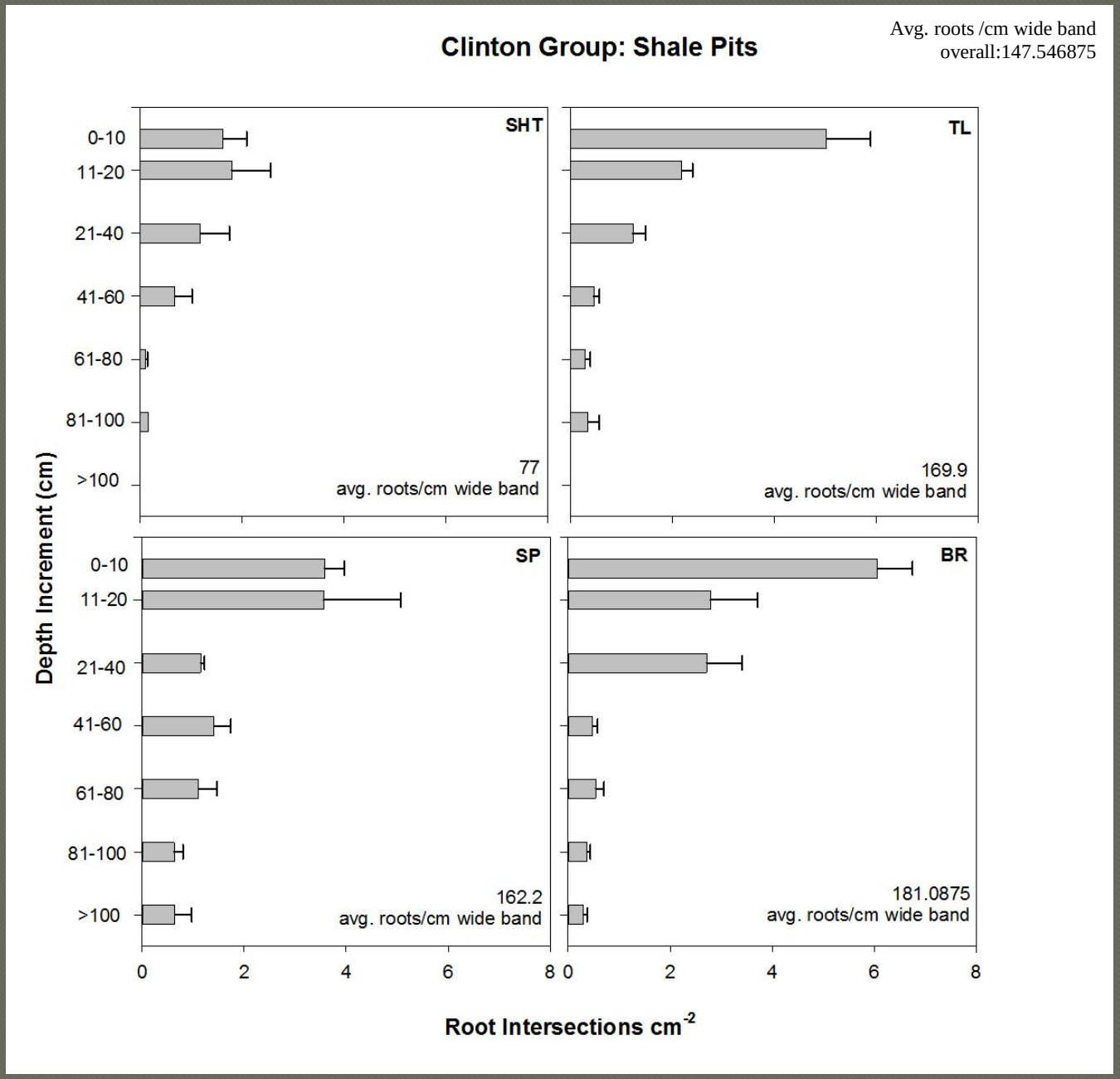
Area = 40 cm

RD = 138/40 = 3.45 Root intersections/cm^2

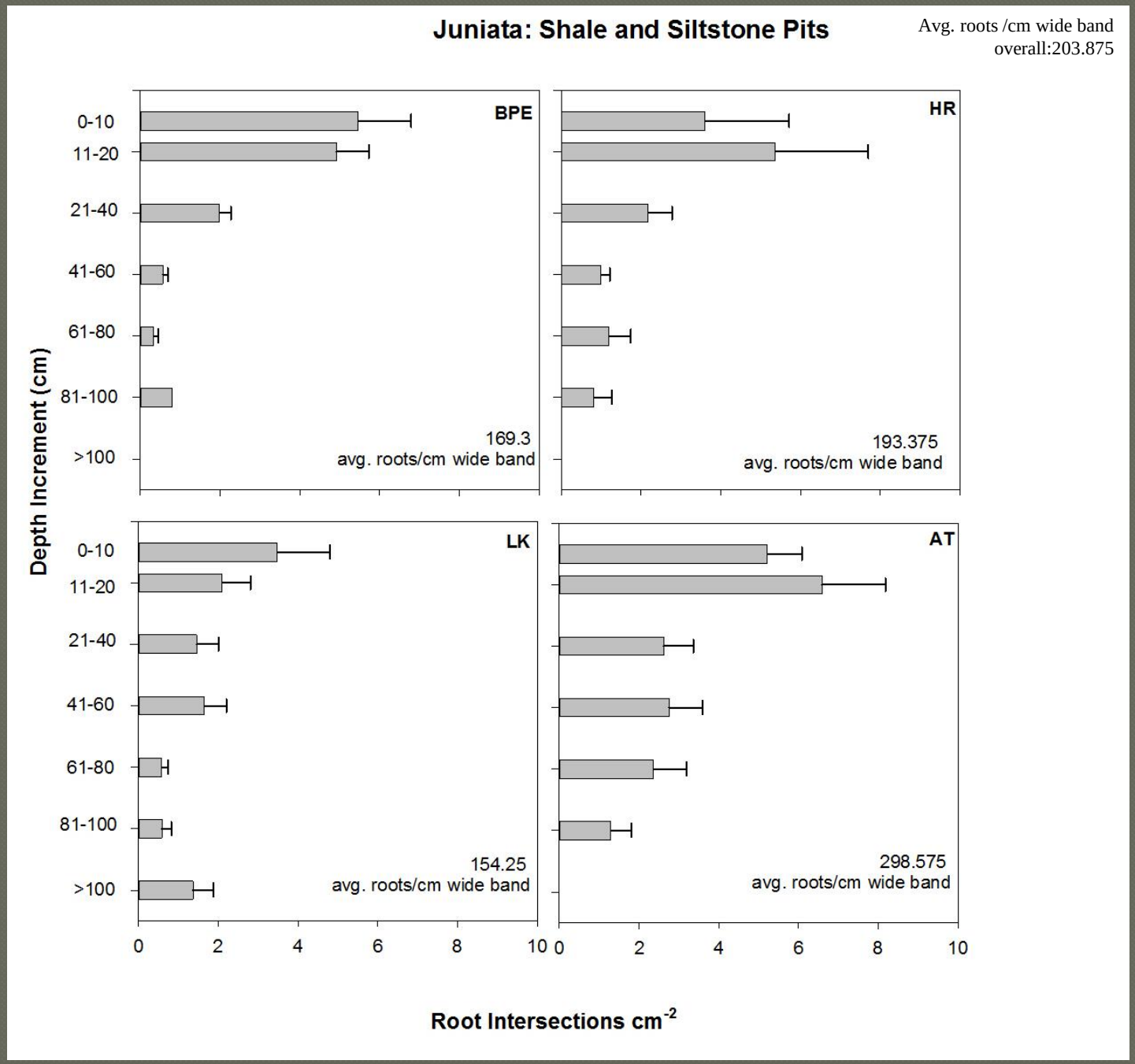
Results:


Tuscarora: Sandstone Pits
Avg. roots /cm wide band
overall:113.866666675
BP
121.4791667
avg. roots/cm wide band
SPT
125.8375
avg. roots/cm wide band
SD
84.975
avg. roots/cm wide band
BT
123.175
avg. roots/cm wide band
Depth Increment (cm)
0-10
11-20
21-40
41-60
61-80
81-100
0
1
2
3
4
5
Root Intersections cm-2

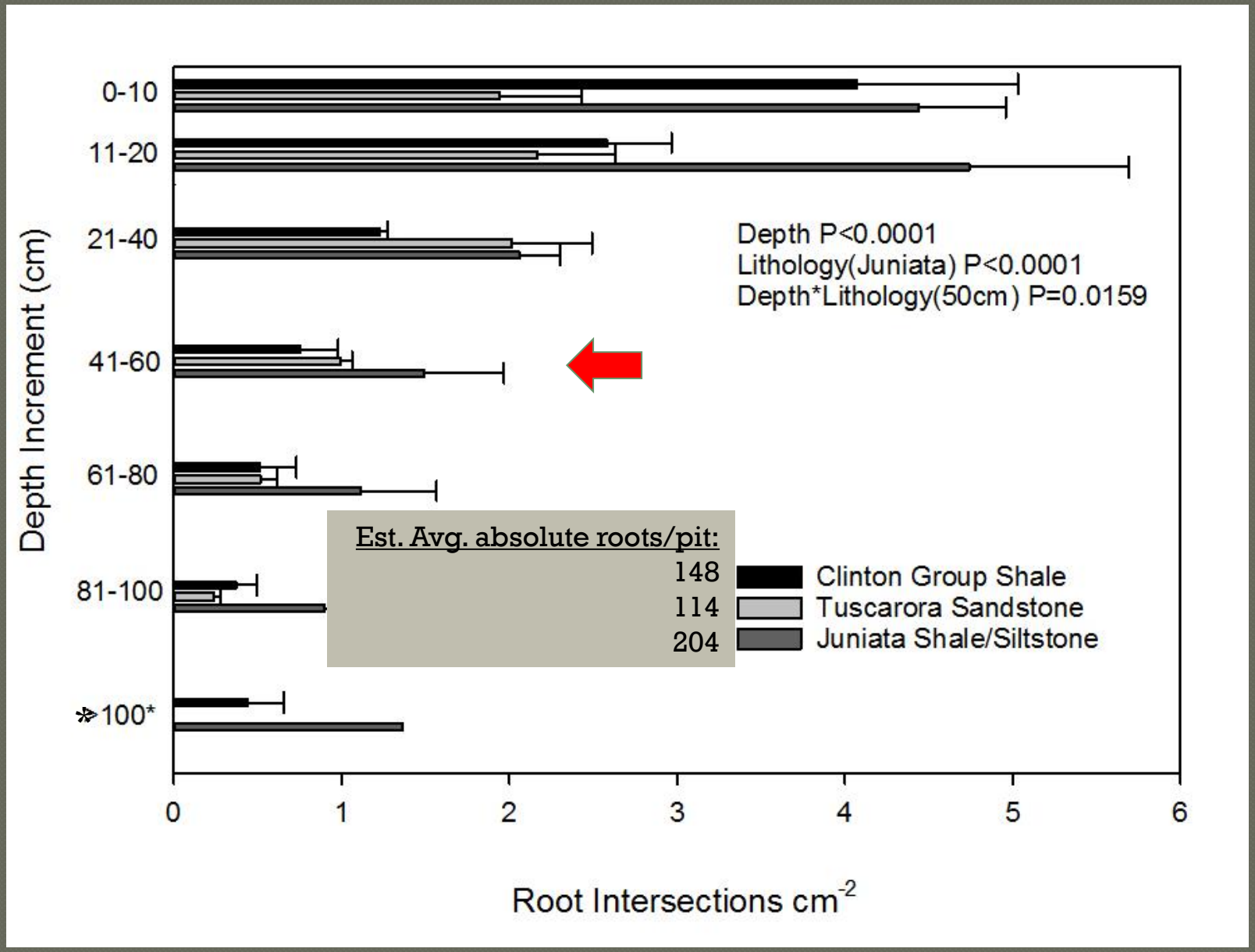
Results:


Clinton Group: Shale Pits
Avg. roots /cm wide band
overall:147.546875
SHT
77
avg. roots/cm wide band
TL
169.9
avg. roots/cm wide band
SP
162.2
avg. roots/cm wide band
BR
181.0875
avg. roots/cm wide band
Depth Increment (cm)
0-10
11-20
21-40
41-60
61-80
81-100
>100
0
2
4
6
8
Root Intersections cm-2

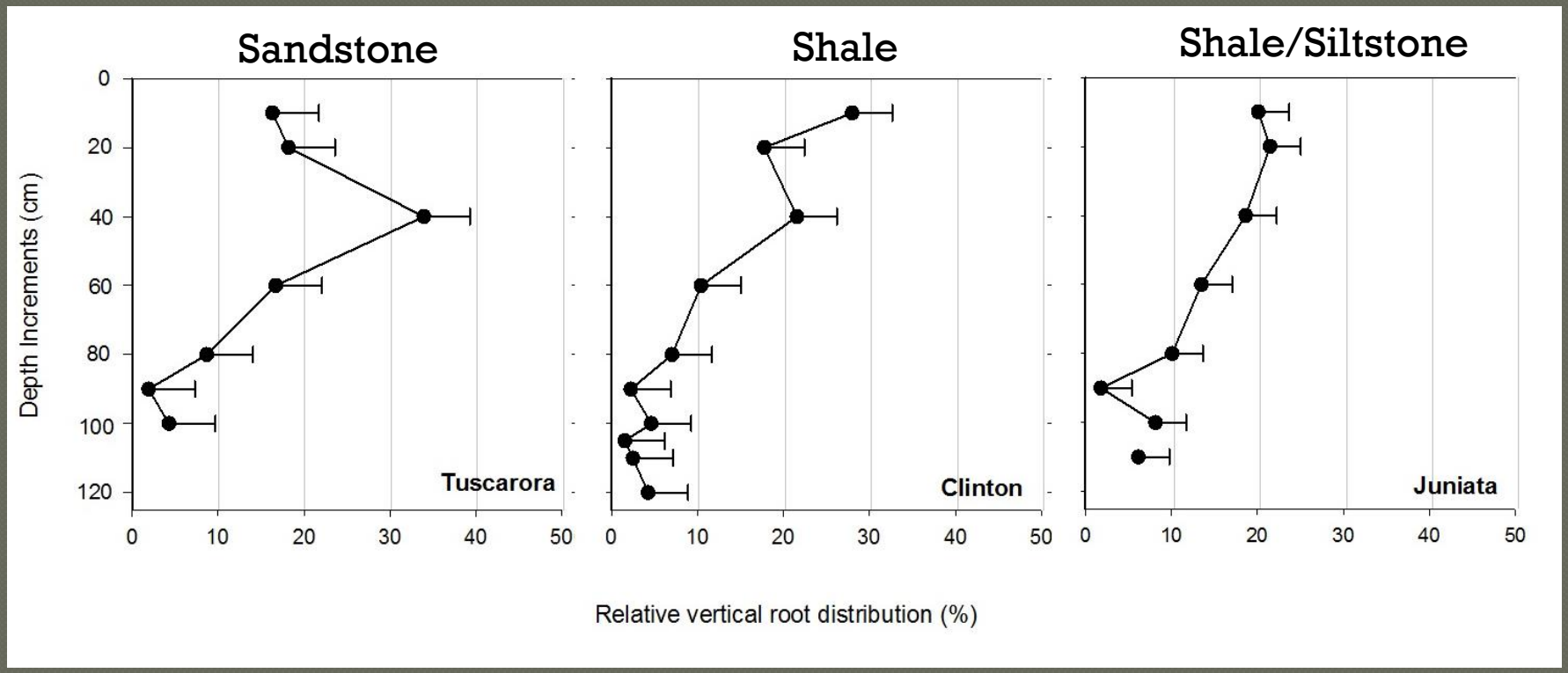
Results:


Juniata: Shale and Siltstone Pits
Avg. roots /cm wide band
overall:203.875
BPE
HR
LK
AT
0-10
11-20
21-40
41-60
61-80
81-100
>100
Depth Increment (cm)
169.3
avg. roots/cm wide band
193.375
avg. roots/cm wide band
154.25
avg. roots/cm wide band
298.575
avg. roots/cm wide band
0
2
4
6
8
10
Root Intersections cm-2

Results:


0-10
11-20
21-40
41-60
61-80
81-100
≥100*
Depth Increment (cm)
Depth P<0.0001
Lithology(Juniata) P<0.0001
Depth*Lithology(50cm) P=0.0159
Est. Avg. absolute roots/pit:
148
114
204
Clinton Group Shale
Tuscarora Sandstone
Juniata Shale/Siltstone
0
1
2
3
4
5
6
Root Intersections cm-2

Relative Percentiles



Question:

- Does root density vary with lithology?

Conclusion:

- We found a significant difference in root density based on the depth and lithology.
- Lithology of the Juniata at a depth of 50 cm is statistically significant.

Hypothesis:

- The roots will grow more deeply into the shale than the sandstone due to nutrient availability for the trees.

Hypothesis:

- The roots do grow more deeply into the shale than the sandstone based on the pits that we studied, but not significantly.

- There is NOT a significant difference in rooting depth. <u>The findings did not support my hypothesis.</u>

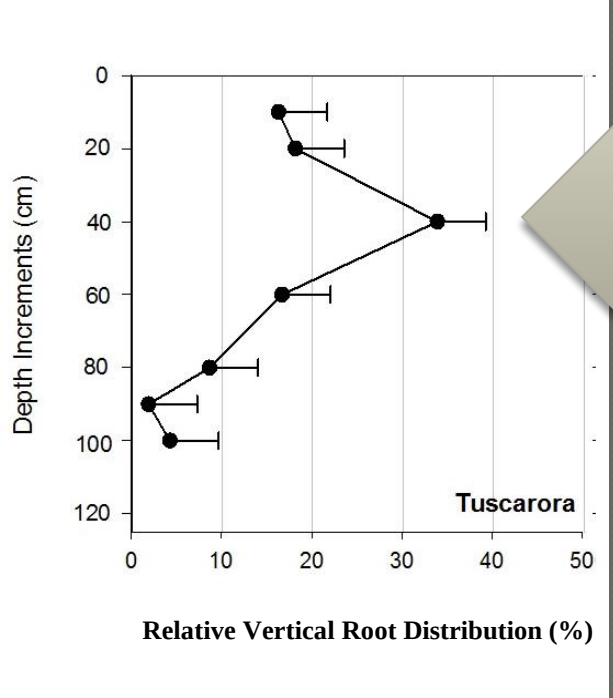
Future Questions/Future Work:

The difference in the way the roots behave over sandstone leads us to ask:

- Why are there more roots present at the depth of 50 cm below the surface over sandstone?

New Hypothesis

- The organic layer is deeper over sandstone than shale.



Question:
Why are there more roots present at the depth of 50 cm below the surface over sandstone?

CZO Connection:

- Knowing the lithology of Shale Hills CZO allowed this root study to be conducted.
- The study of root behavior over similar lithology to that of Shale Hills will allow PSU replicate the same study multiple time in order to create research with greater validity.

Support for this project was provided by:

- Dr. Dave Eissenstat
- Tom Adams
- Jessie Ward
- Liza Brazil
- Alexandra "Lexi" Orr
- All the members of Dave Eissenstat's lab
- Tim White
- Sarah Sharkey
- CZO REUs & RET