The potential for quantitative wood anatomy of dryland riparian trees to improve understanding of historic water availability in the USA Southwest

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Dendrochronology is an established tool for understanding changes in plant water availability through time

- Extend hydrologic records
- Establish baseline for water availability at a site
- Understand and predict how woody species respond to changes in water availability
- Investigate mortality related to reduced/diverted flows

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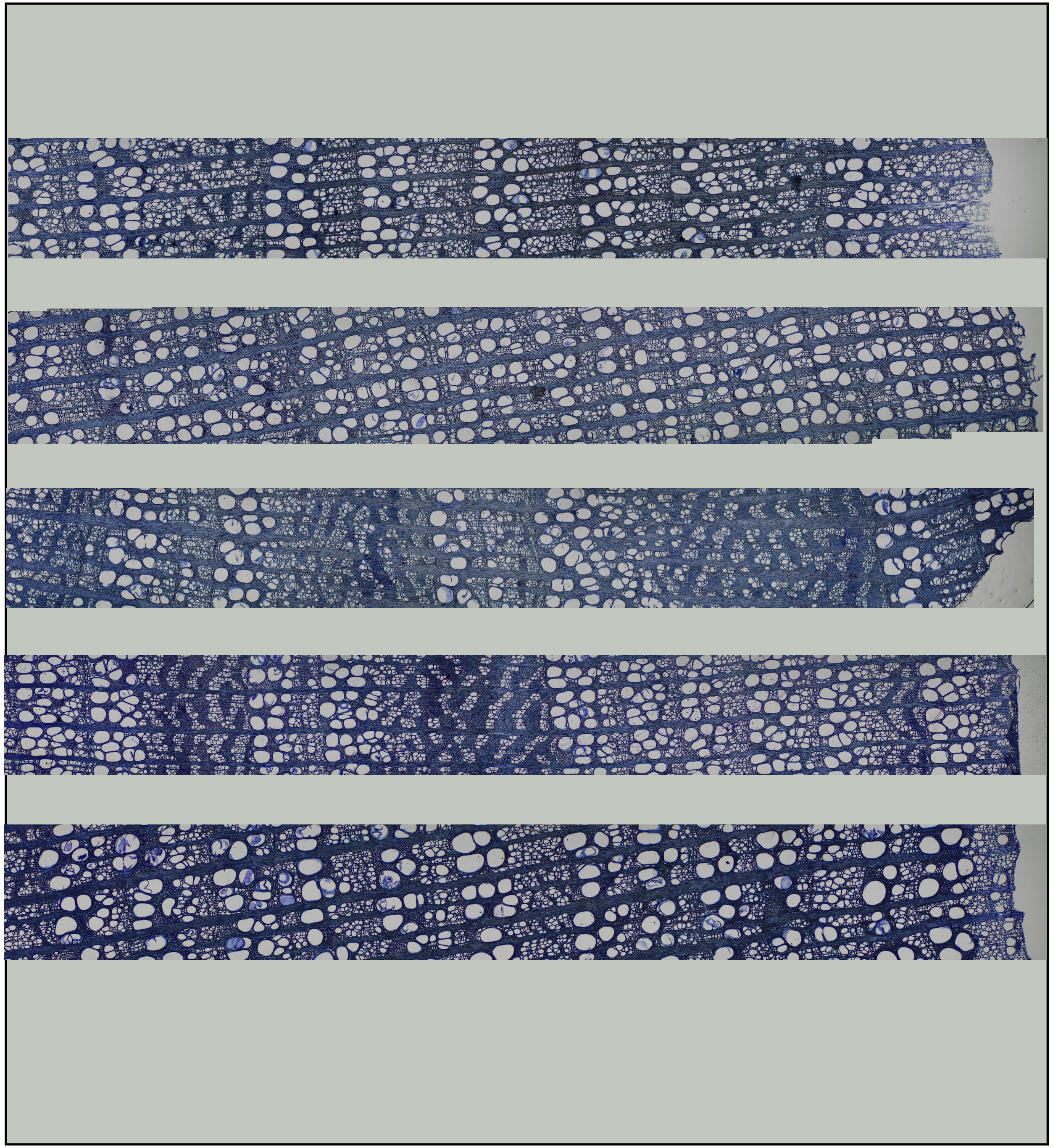
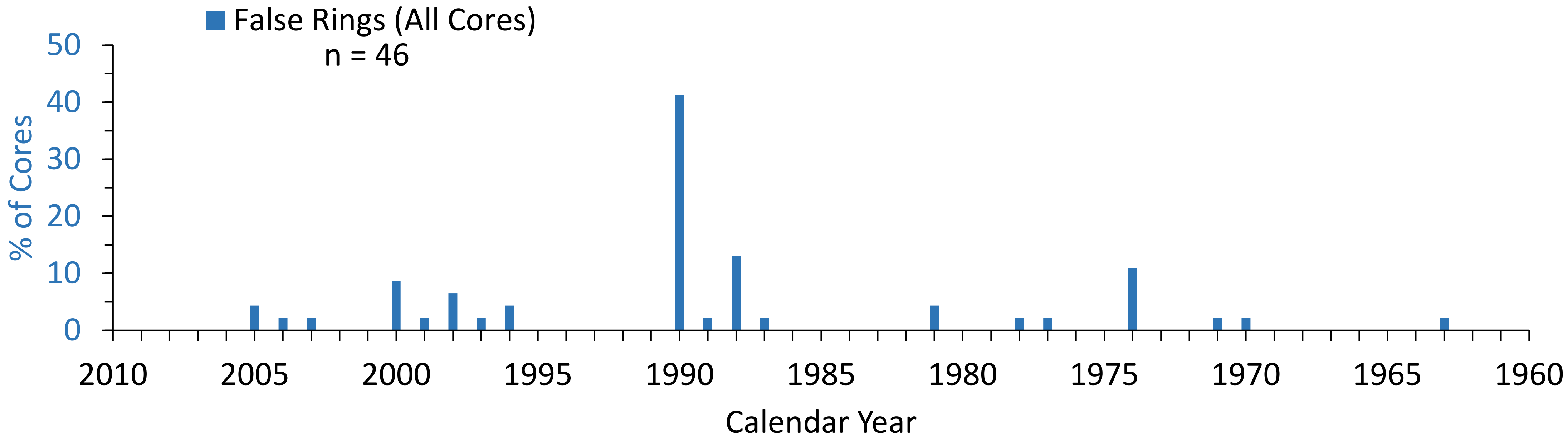
But we can do more!

Can quantitative wood anatomy (QWA) of woody species help us better understand variations in plant water availability at higher resolutions?

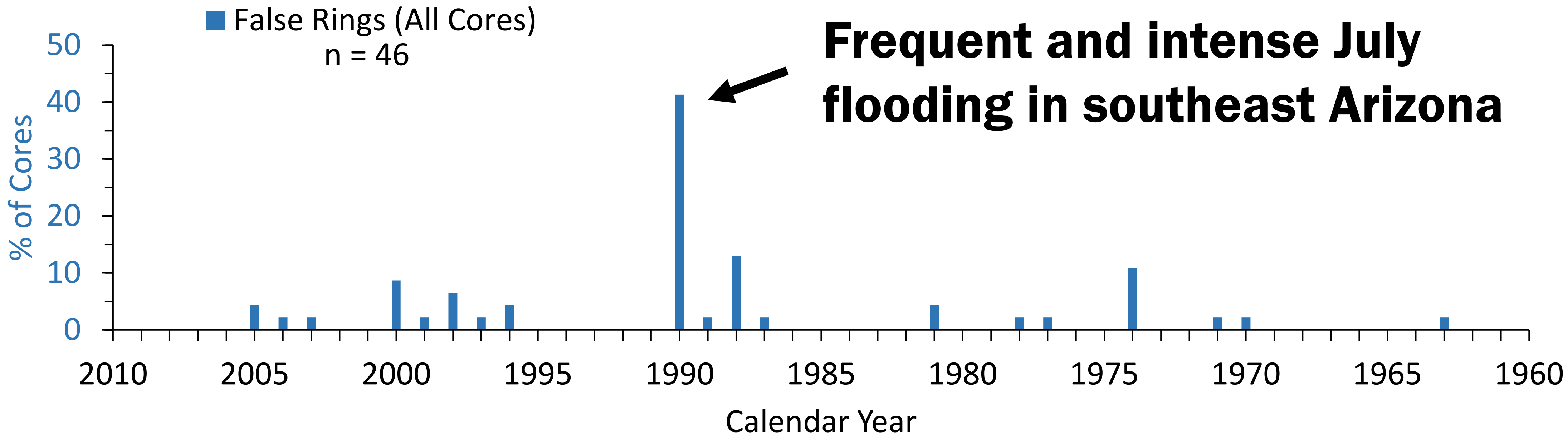
- QWA measures cellular characteristics in wood
- Allows us to probe growth at finer temporal resolutions
- Explore different cell types (vessels, fibers, etc.)

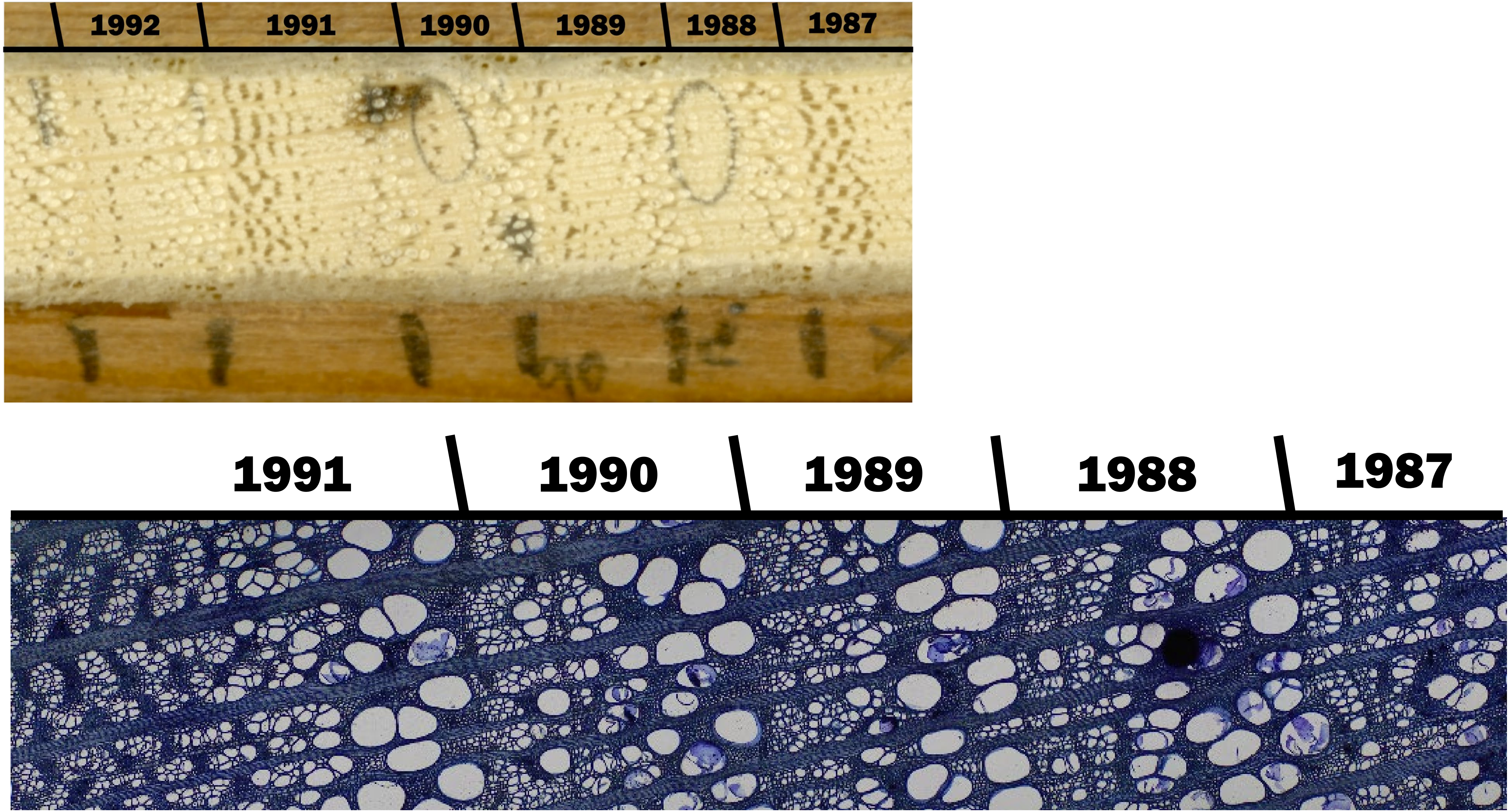


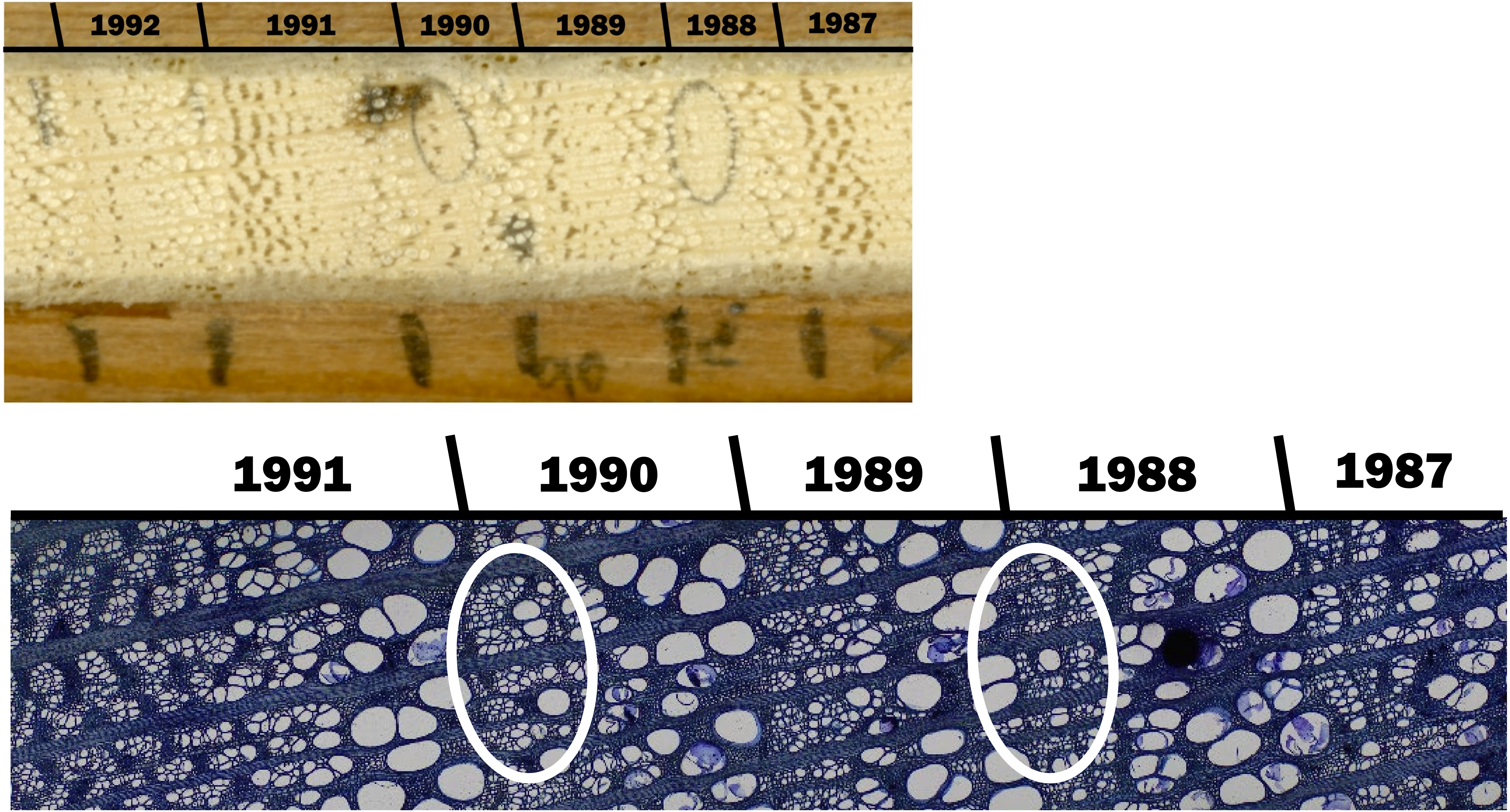

0.05 km
Sonoita Creek
N
SON20, SON23, SON25
SON03, SON06
AZ



False Rings (All Cores)
n = 46
% of Cores
50
40
30
20
10
0
2010
2005
2000
1995
1990
1985
1980
1975
1970
1965
1960
Calendar Year


False Rings (All Cores)
n = 46
Frequent and intense July flooding in southeast Arizona
% of Cores
50
40
30
20
10
0
2010
2005
2000
1995
1990
1985
1980
1975
1970
1965
1960
Calendar Year


1992
1991
1990
1989
1988
1987
1991
1990
1989
1988
1987


1992
1991
1990
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1988
1987
1991
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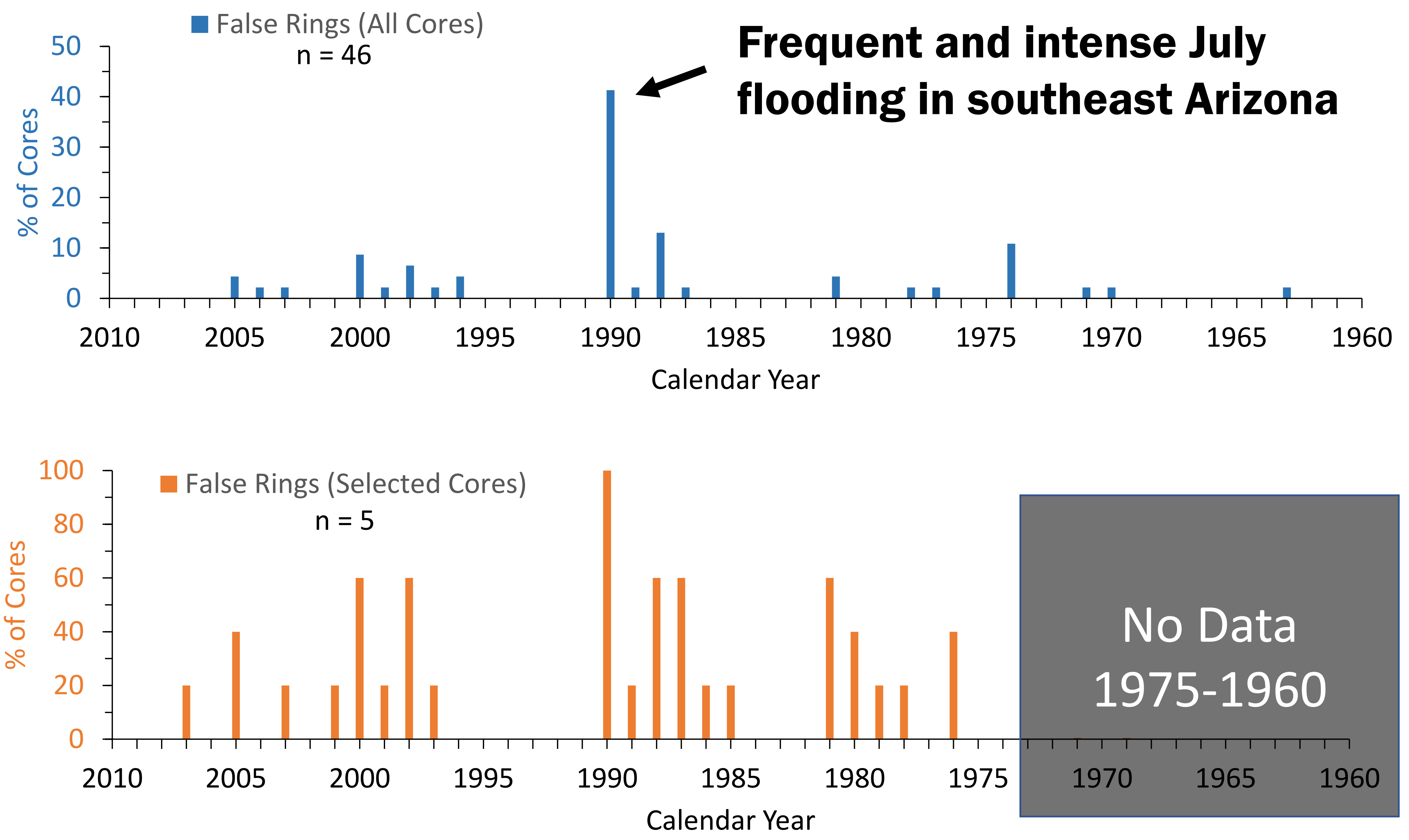
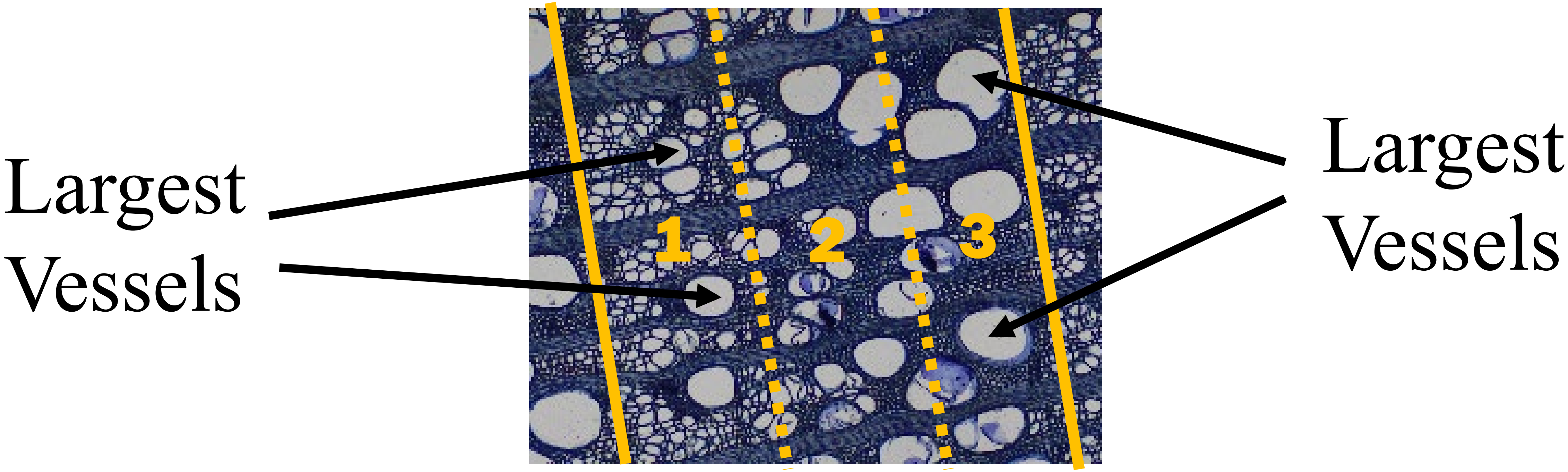
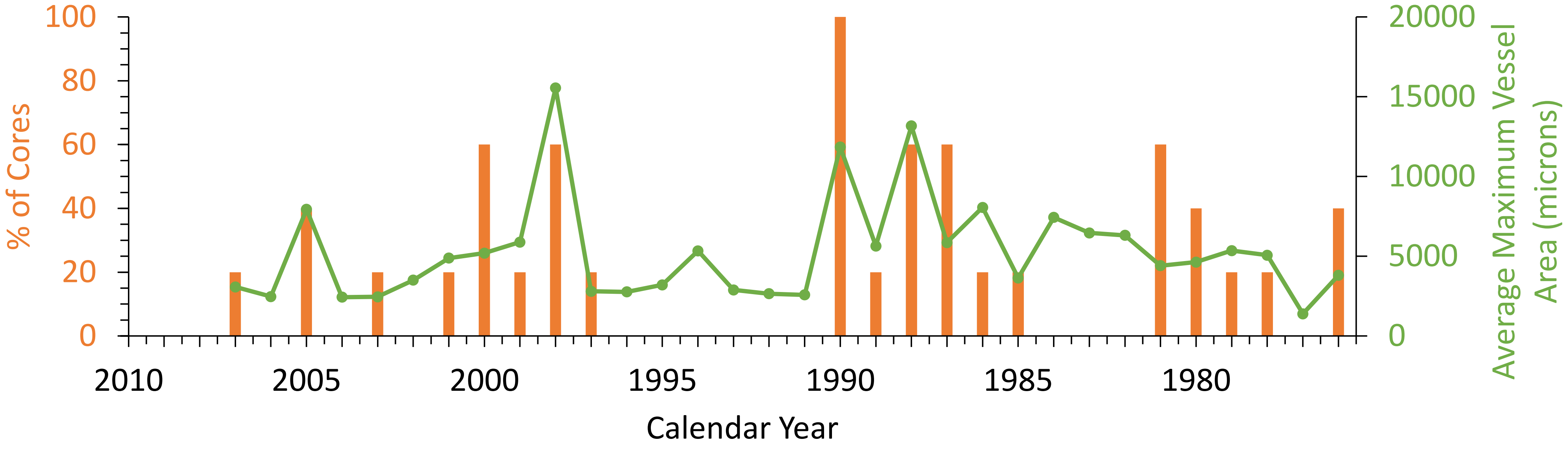
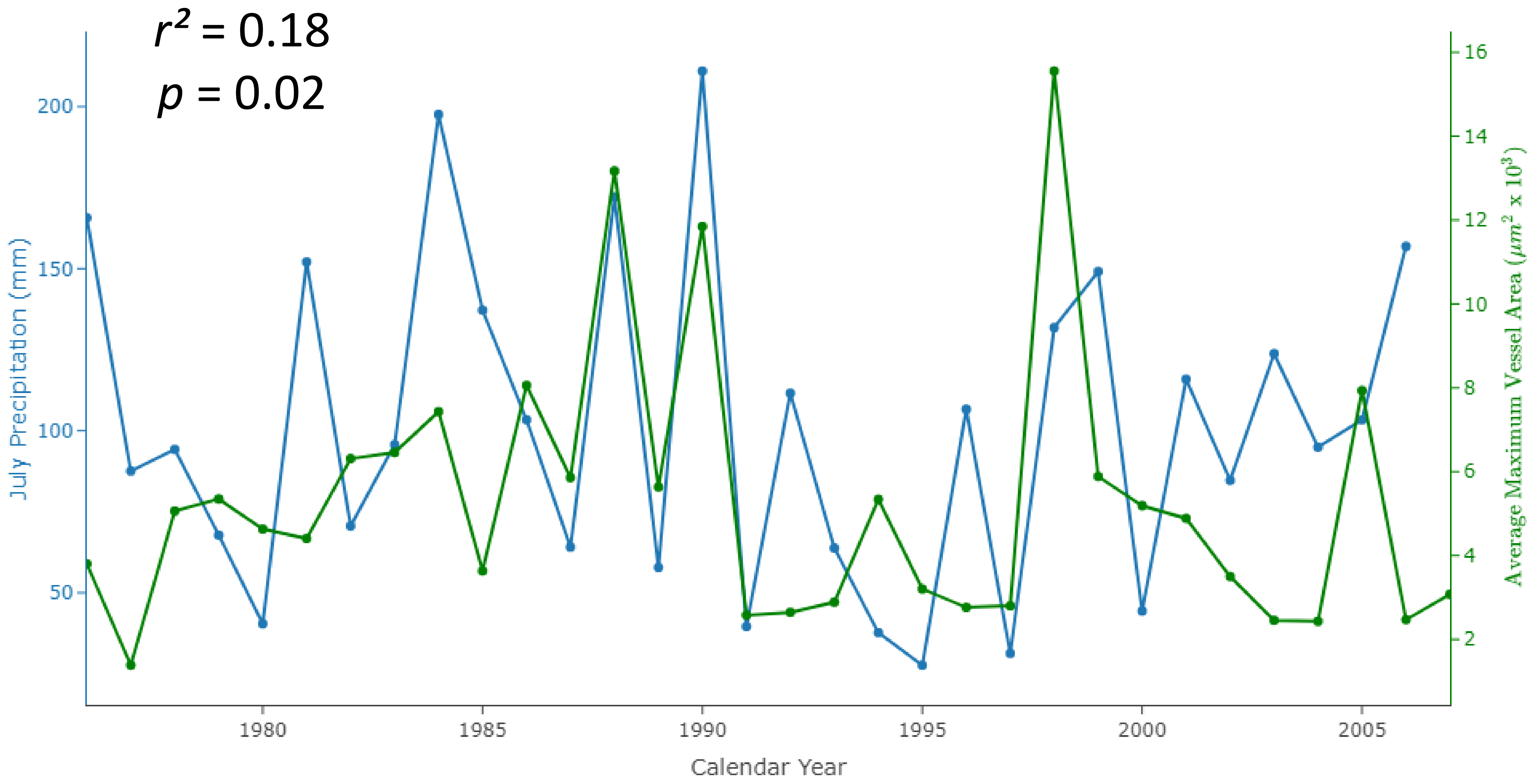
1988
1987



False Rings (All Cores)
n = 46
Frequent and intense July flooding in southeast Arizona
% of Cores
50
40
30
20
10
0
2010
2005
2000
1995
1990
1985
1980
1975
1970
1965
1960
Calendar Year
False Rings (Selected Cores)
n = 5
% of Cores
100
80
60
40
20
0
No Data
1975-1960
2010
2005
2000
1995
1990
1985
1980
1975
1970
1965
1960
Calendar Year


Largest Vessels
1
2
3
Largest Vessels


100
80
60
40
20
0
% of Cores
20000
15000
10000
5000
0
Average Maximum Vessel Area (microns)
2010
2005
2000
1995
1990
1985
1980
Calendar Year


$r^2 = 0.18$
$p = 0.02$
July Precipitation (mm)
200
150
100
50
Average Maximum Vessel Area (μm^2 x 10^3)
16
14
12
10
8
6
4
2
1980
1985
1990
1995
2000
2005
Calendar Year

Takeaways

- False rings are more prevalent and variable in hackberry than at first glance
- Size of the largest vessels following false rings appear related to years with high July precipitation

Future Directions

- Can we use these measurements to extend monthly discharge records on ungauged streams?
- Other cell parameters?

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References

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