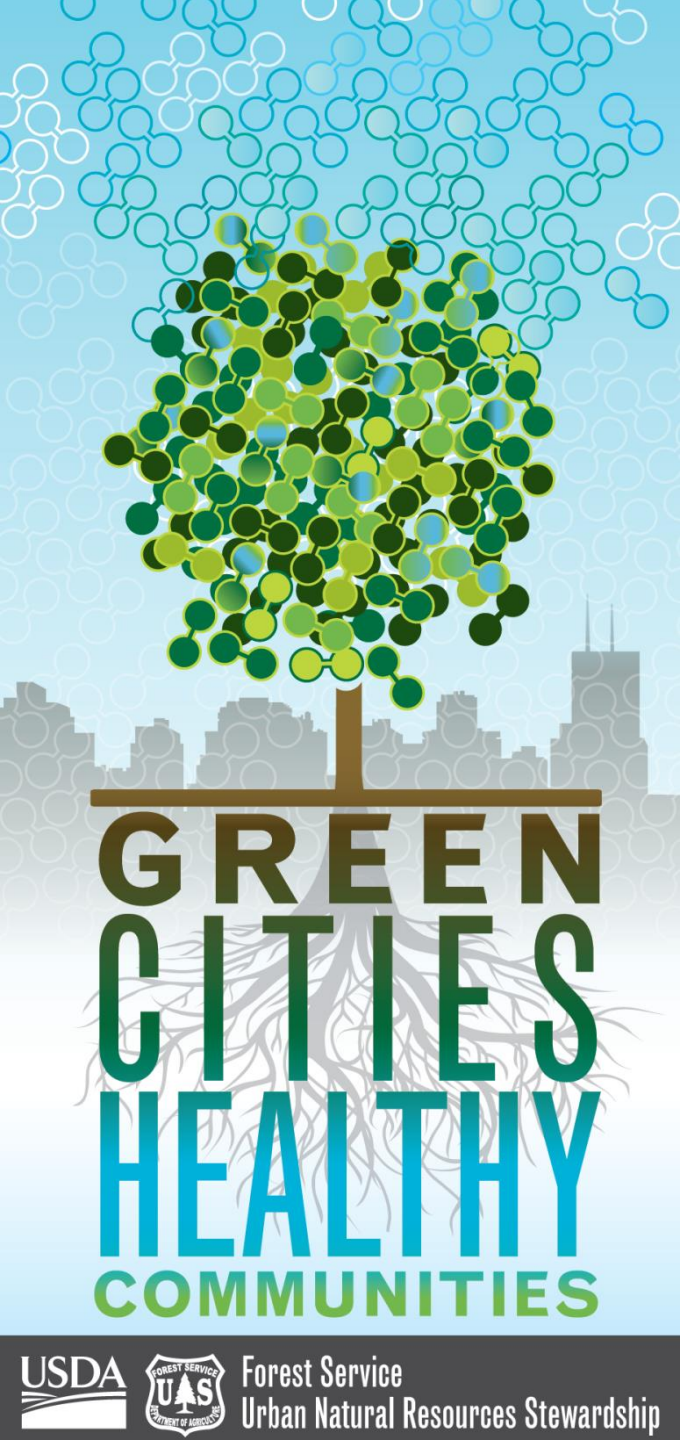

USDA Forest Service

URBAN FOREST CONNECTIONS

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www.fs.fed.us/research/urban-webinars

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Tree Risk Assessments: Cutting edge science meets practical applications

Gregory Dahle

Assistant Professor

West Virginia University

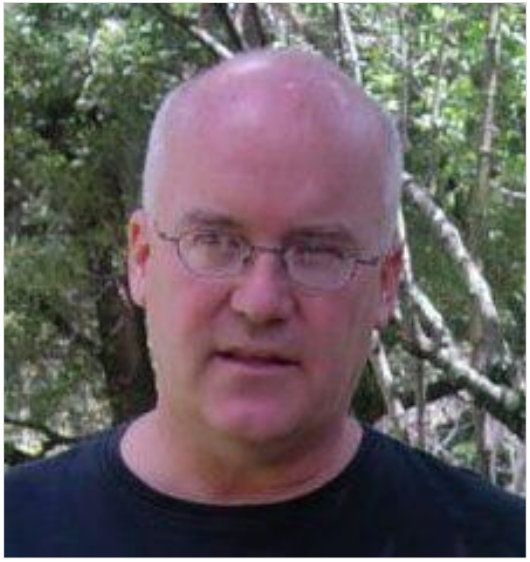
gregory.dahle@mail.wvu.edu

Andrew Koeser

Assistant Professor

University of Florida Gulf Coast Research & Education Center

akoeser@ufl.edu



Mark Duntemann

Owner & Urban Forestry Consultant

Natural Path Urban Forestry

naturalpathforestry@gmail.com

Tree Risk Assessment – Perceptions, Reality, and Reliability

http://www.louisdallaraphotography.com

Andrew Koeser, BCMA, Ph.D.
University of Florida IFAS – Gulf Coast REC

Tree Risk Assessment

Tree risk is ultimately governed by:

- The likelihood a target will be impacted

www.sptimes.com

www.rockymtnrefl.com

Tree Risk Assessment

Tree risk is ultimately governed by:

- The likelihood a target will be impacted
- The potential of a tree or tree part to fail

news.gardentoolbox.co.uk

autonopedia.org

Tree Risk Assessment

Tree risk is ultimately governed by:

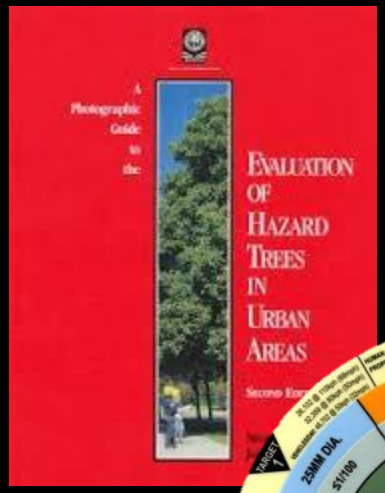
- The likelihood a target will be impacted
- The potential of a tree or tree part to fail
- The consequences should a tree/tree part strike the target

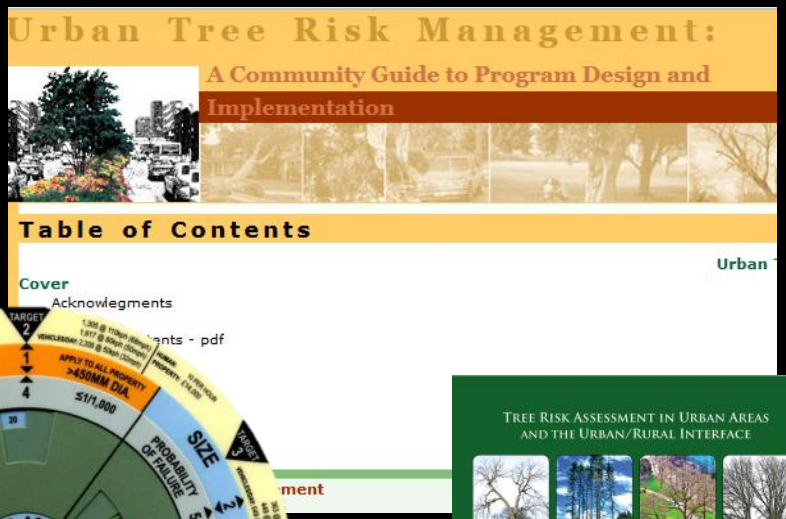
http://www.komonews.com

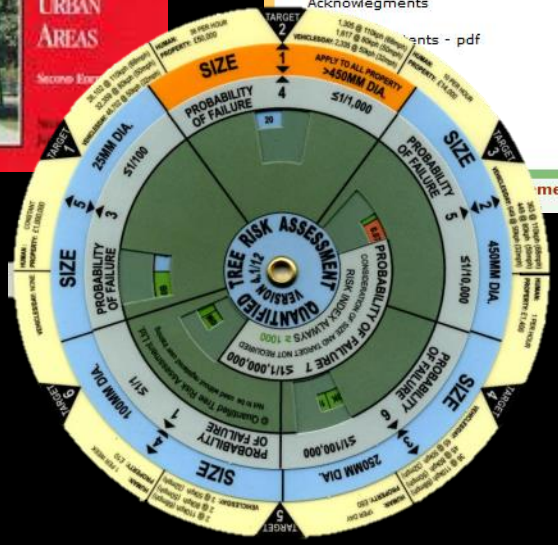
www.dailymail.co.uk

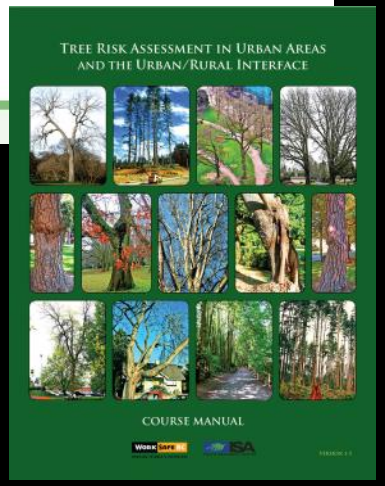
Tree Risk Assessment

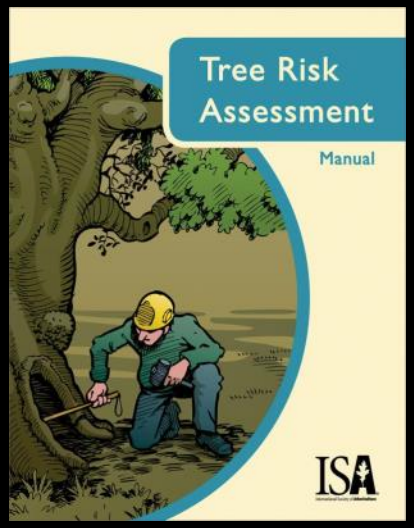
3 inputs (target – likelihood of failure – consequences) are shared by all common assessment methods



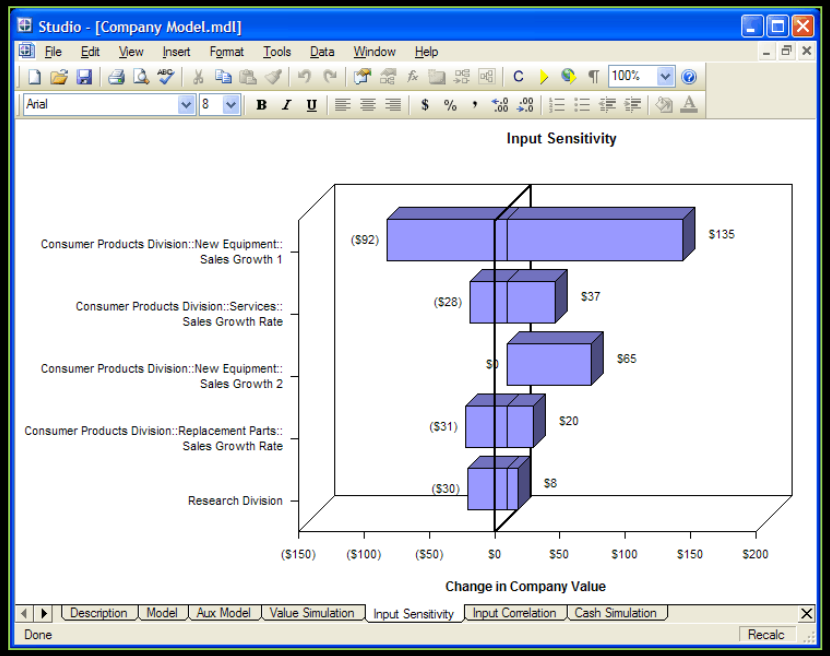


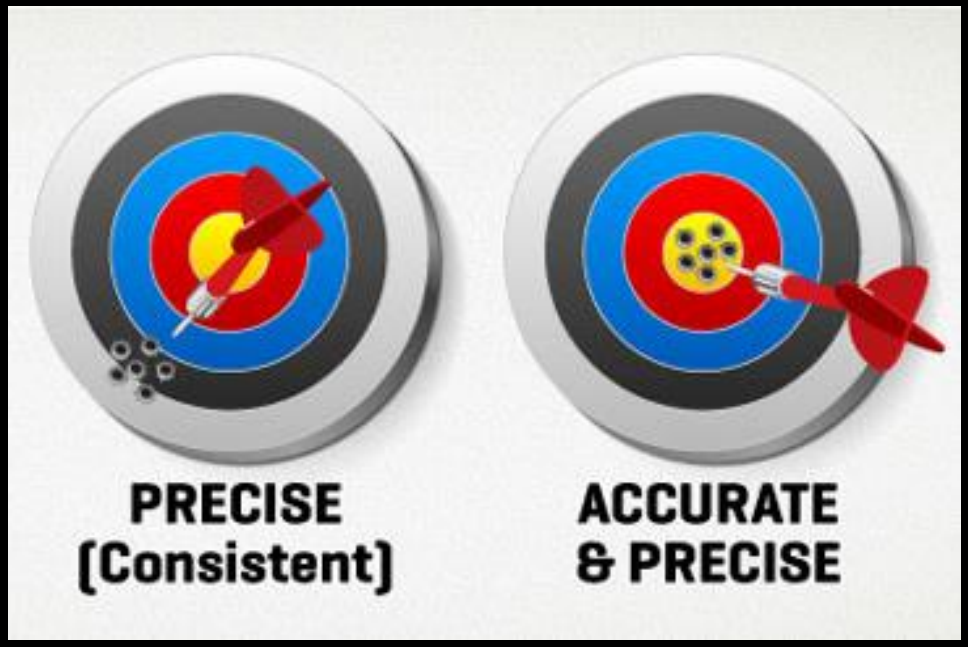






All currently accepted methods of risk assessment share a common concern…





How do we limit the impact of assessor bias and risk perception to make risk assessments more robust and repeatable?

Impact of Arborist on Risk Assessments

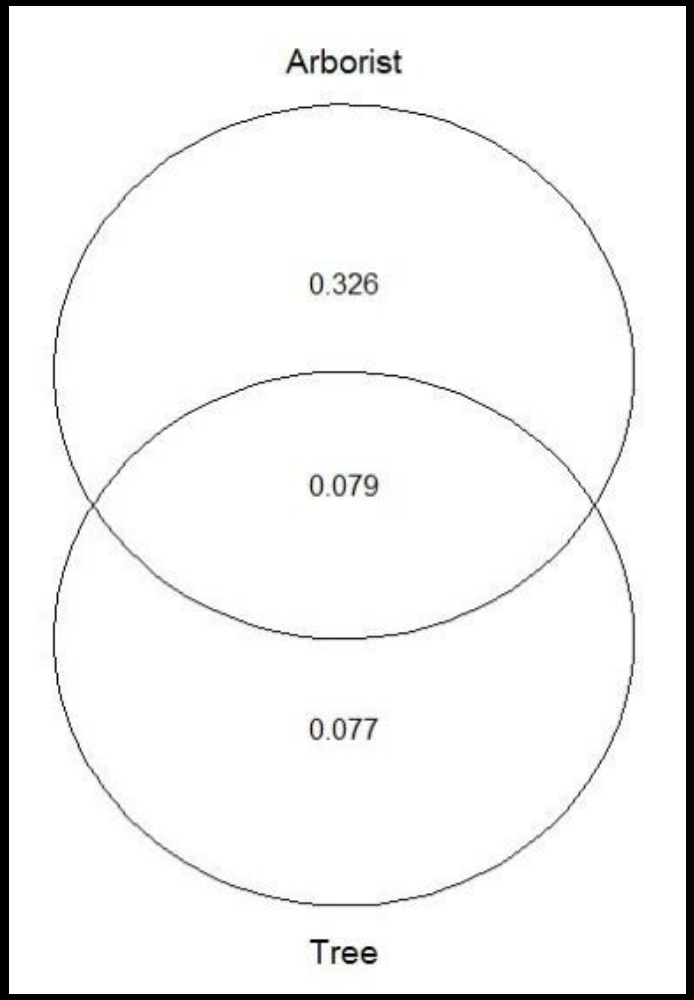
296 Arborists assessed three trees each.

Compared sources of variation among ratings/inputs

Impact of Assessor on Tree Risk Assessment Ratings and Prescribed Mitigation Measures

Andrew K. Koeser[1†] and E. Thomas Smiley[2]

[1]Assistant Professor, Department of Environmental Horticulture, CLCE, IFAS, University of Florida – Gulf Coast Research and Education Center, 14625 County Road 672, Wimauma, FL 33598, United States



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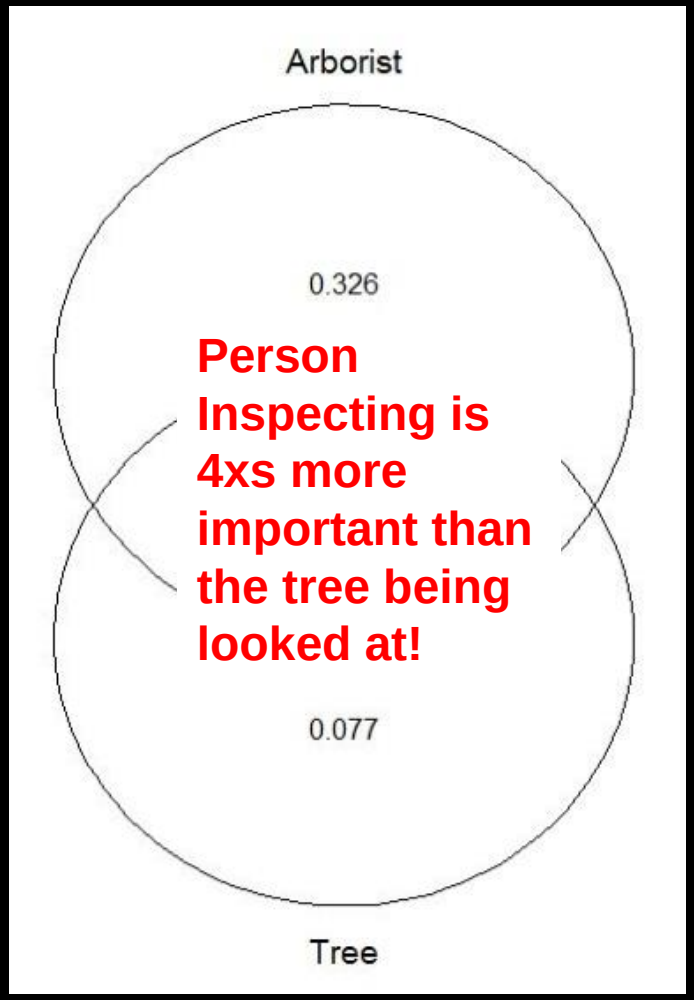

Why are things so variable?

Failure Potential

Journal of Arboriculture 31(2): March 2005

Previous

QUANTIFIED TREE RISK ASSESSMENT USED IN THE MANAGEMENT OF AMENITY TREES

By Michael J. Ellison

"Accurately assessing the probability that a tree or branch will fail is highly dependent on the skill and experience of the assessor."

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journal homepage: www.elsevier.com/locate/ufug

Factors driving professional and public urban tree risk perception

Andrew K. Koeser[a,*], Ryan W. Klein[b], Gitta Hasing[a], Robert J. Northrop[c]

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So, we focus on failure potential…

Next logical question: How well can we assess it?

Detecting Decay With Visual Indicators

Arboriculture & Urban Forestry 42(4): July 2016 217

Arboriculture & Urban Forestry 2016. 42(4): 217–226

Frequency, Severity, and Detectability of Internal Trunk Decay of Street Tree *Quercus* spp. in Tampa, Florida, U.S.

Andrew K. Koeser, Drew C. McLean, Gitta Hasing, and R. Bruce Allison

153 *Quercus virginiana* (Southern live oak)

86 *Quercus laurifolia* (laurel oak)

Table 3. Comparison of laurel oak (*Quercus laurifolia*) street trees in Tampa, Florida, U.S., with visual decay indicators and internal stem decay (n = 86). Trees were assessed visually prior to advanced assessment with a resistance-recording drill.

Decay severity	Trees with positive/potential decay indicators	Actual number of trees with decay at this level[z]	Percent identified correctly with visual assessment
0%	10	28	64.3%[y]
1%–10%	14	22	63.6%
11%–20%	5	9	55.6%
21%–30%	3	7	42.8%
31%–40%	5	6	83.3%
41%–50%	4	4	100%
51%–60%	2	3	66%
61%–70%	5	5	100%
71%–80%	0	0	n/a
81%–90%	2	2	100%

[z] Based on resistance-recording drill measurement data.

[y] To calculate this percentage, researchers compared the number of trees without positive/potential decay indicators (18) to the actually number of trees without decay (28).

Table 4. Comparison of live oak (*Quercus virginiana*) street trees in Tampa, Florida, U.S., with visual decay indicators and internal stem decay (n = 153). Trees were assessed visually prior to advanced assessment with a resistance-recording drill.

Decay severity[z]	Trees with positive/potential decay indicators	Actual number of trees with decay at this level[z]	Percent identified correctly with visual assessment
0%	7	108	93.5%[y]
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21%–30%	1	3	33.3%
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61%–70%	0	1	0.0%
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[y] To calculate this percentage, researchers compared the number of trees without positive/potential decay indicators (101) to the actually number of trees without decay (108).

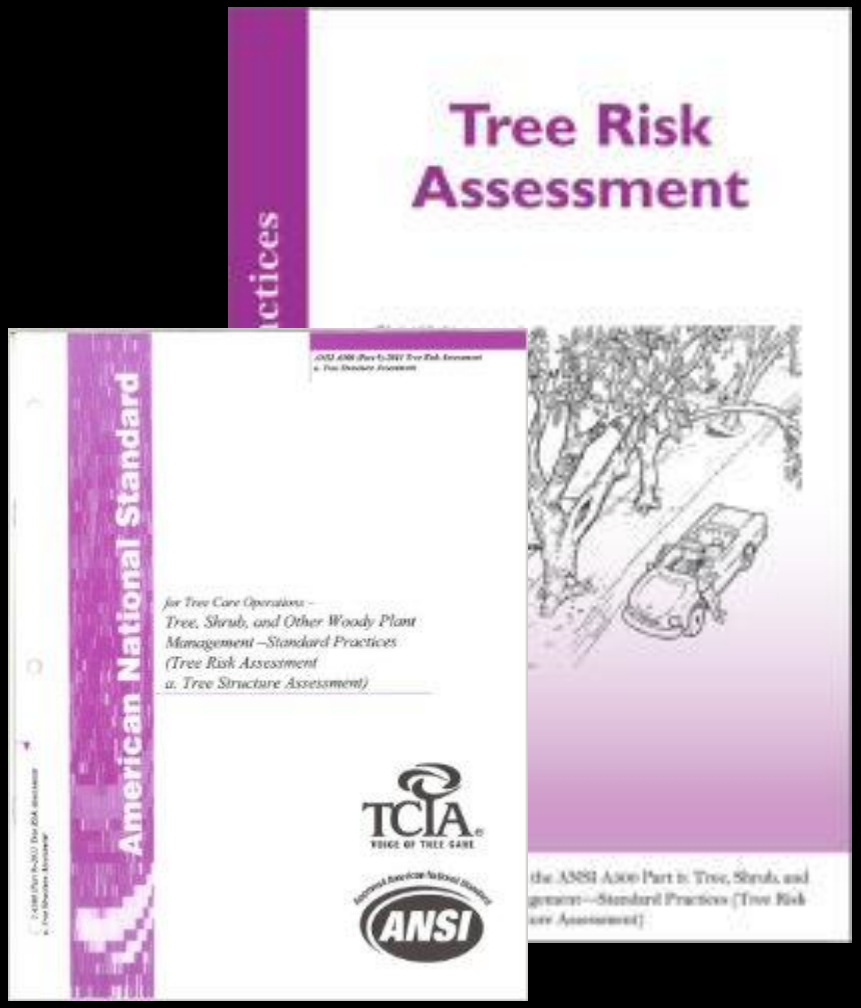
Next Logical Questions…

- How much more does advanced assessment add?
- Was this just one arborist getting lucky? What happens when multiple arborist perform a similar experiment?

Assessment of Likelihood of Failure Using Limited Visual, Basic, and Advanced Assessment Techniques

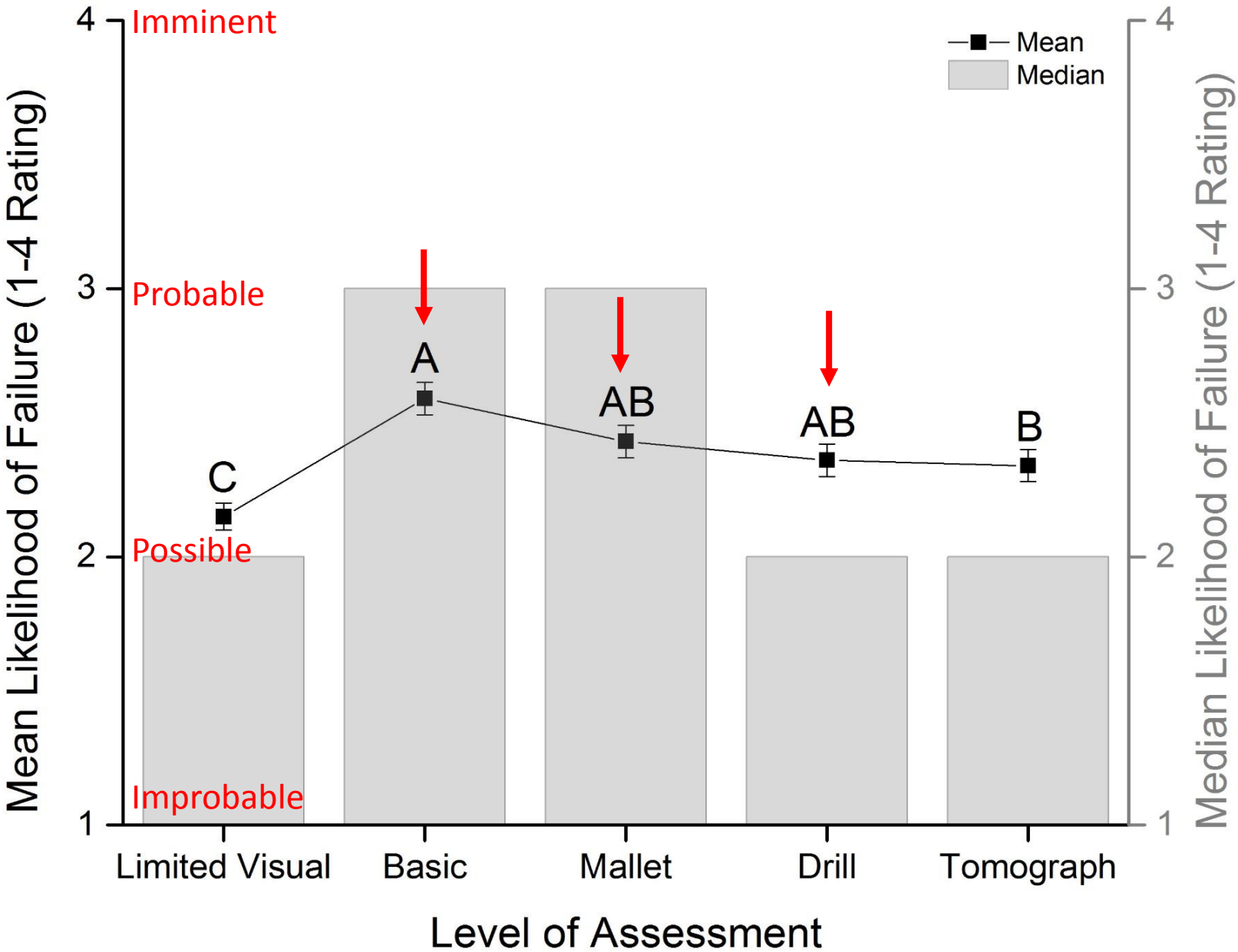
Three Levels of Risk Assessment

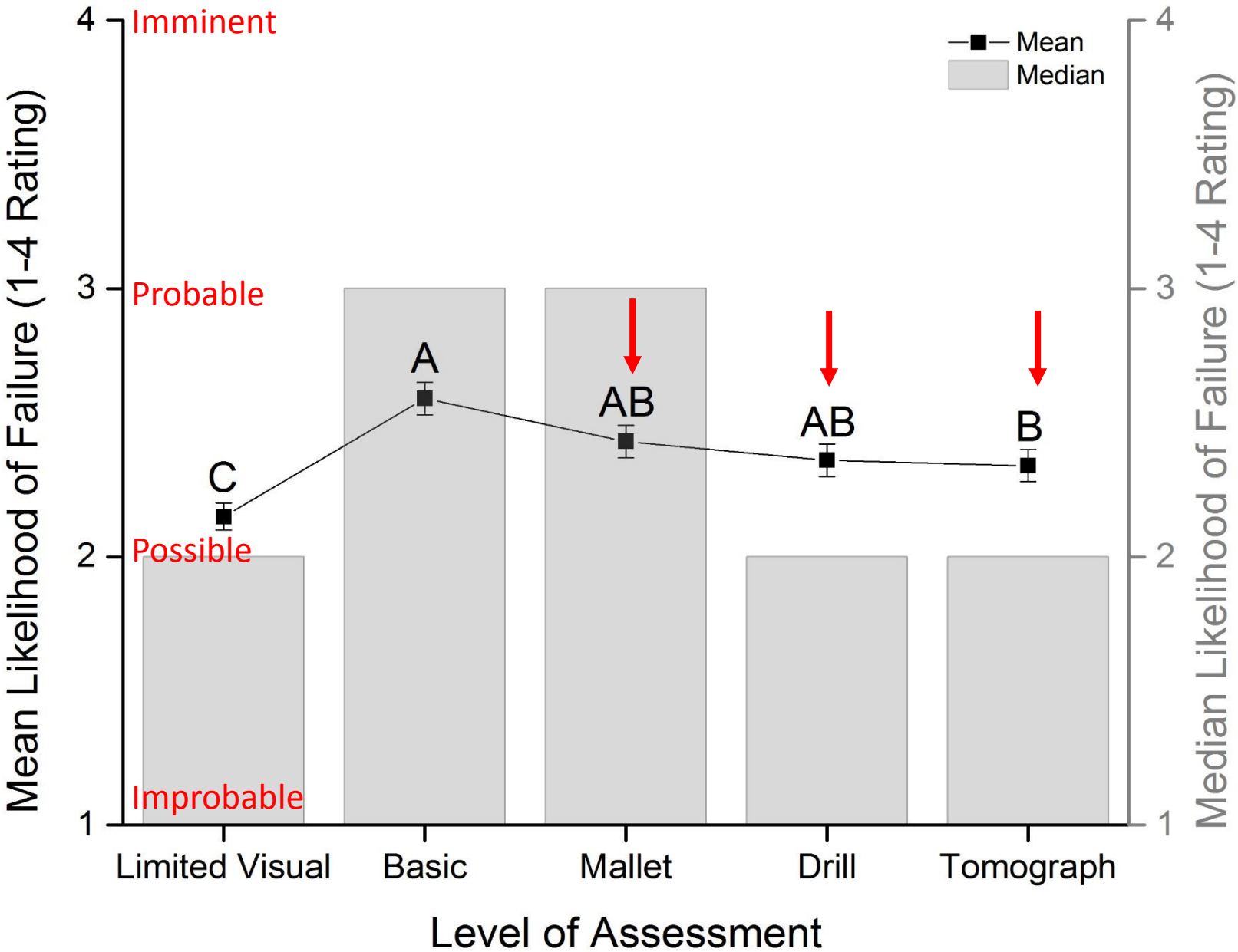
- Level 1 – Limited Visual (Walk- or Drive-by)
- Level 2 – Basic Assessment
- Level 3 – Advanced Assessment

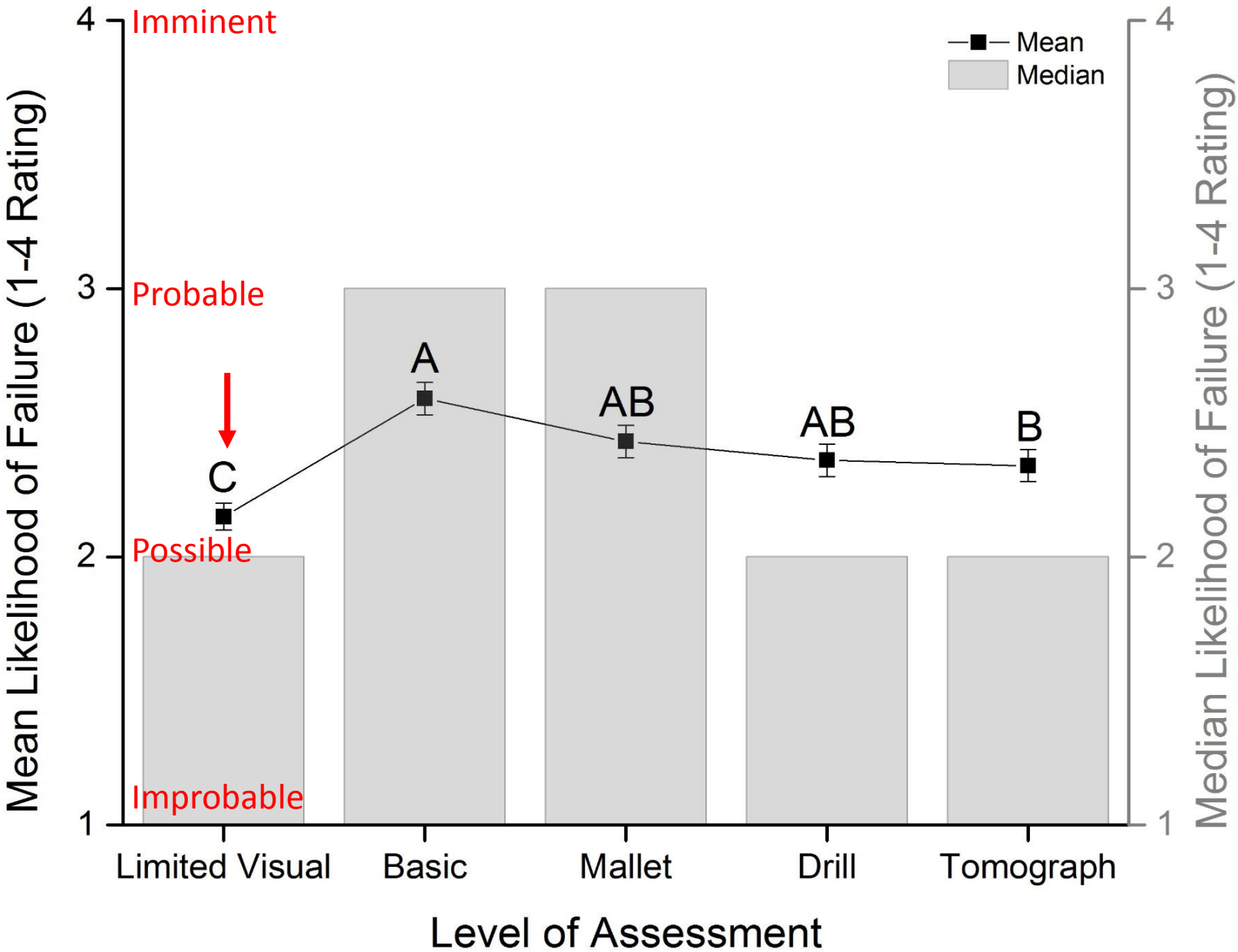


Impact of Level of Assessment on Failure Potential Rating

- 70 Arborists assessed 5 trees going from LV to AA


Imminent
Probable
Possible
Improbable
Mean
Median
A
AB
AB
B
C
Mean Likelihood of Failure (1-4 Rating)
Median Likelihood of Failure (1-4 Rating)
Limited Visual
Basic
Mallet
Drill
Tomograph
Level of Assessment


Mean Likelihood of Failure (1-4 Rating)
Median Likelihood of Failure (1-4 Rating)
Imminent
Probable
Possible
Improbable
4
3
2
1
Mean
Median
C
A
AB
AB
B
Limited Visual
Basic
Mallet
Drill
Tomograph
Level of Assessment


Mean Likelihood of Failure (1-4 Rating)
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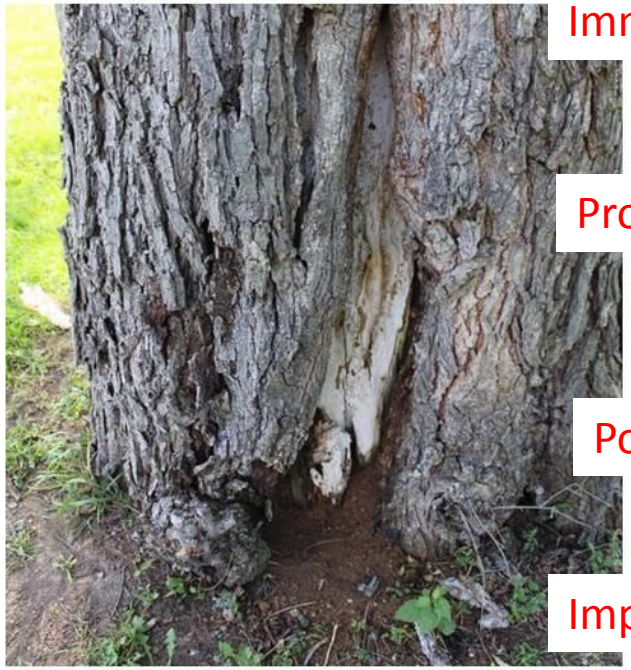
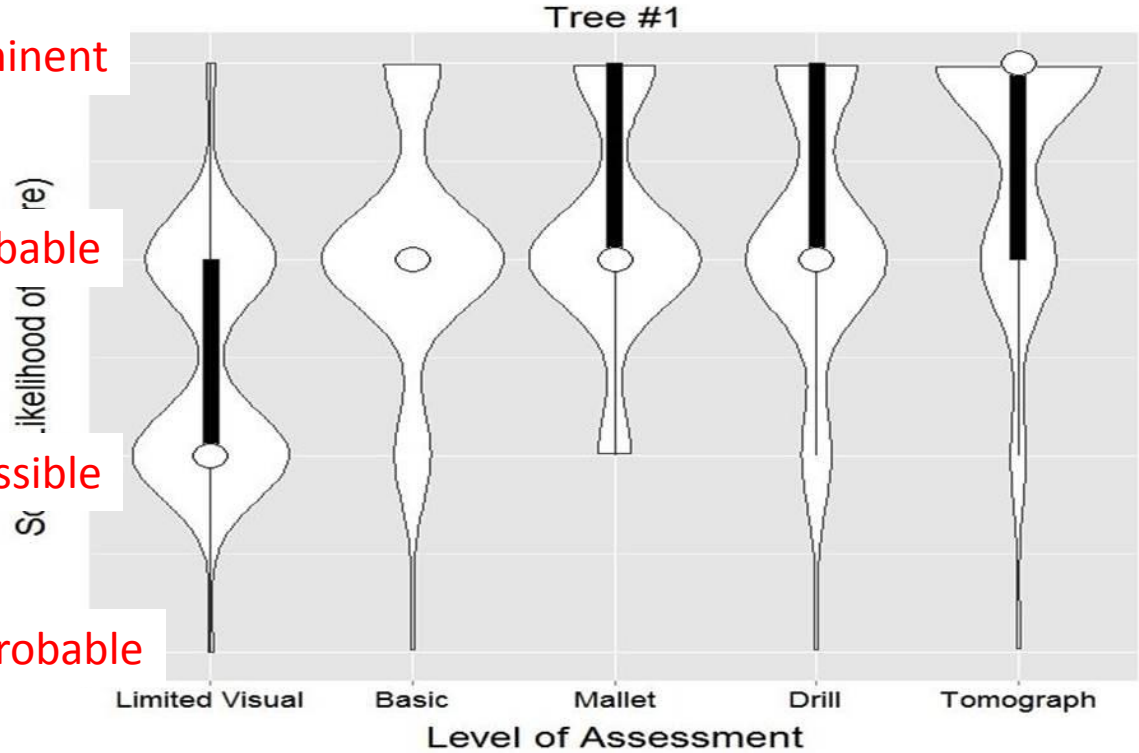
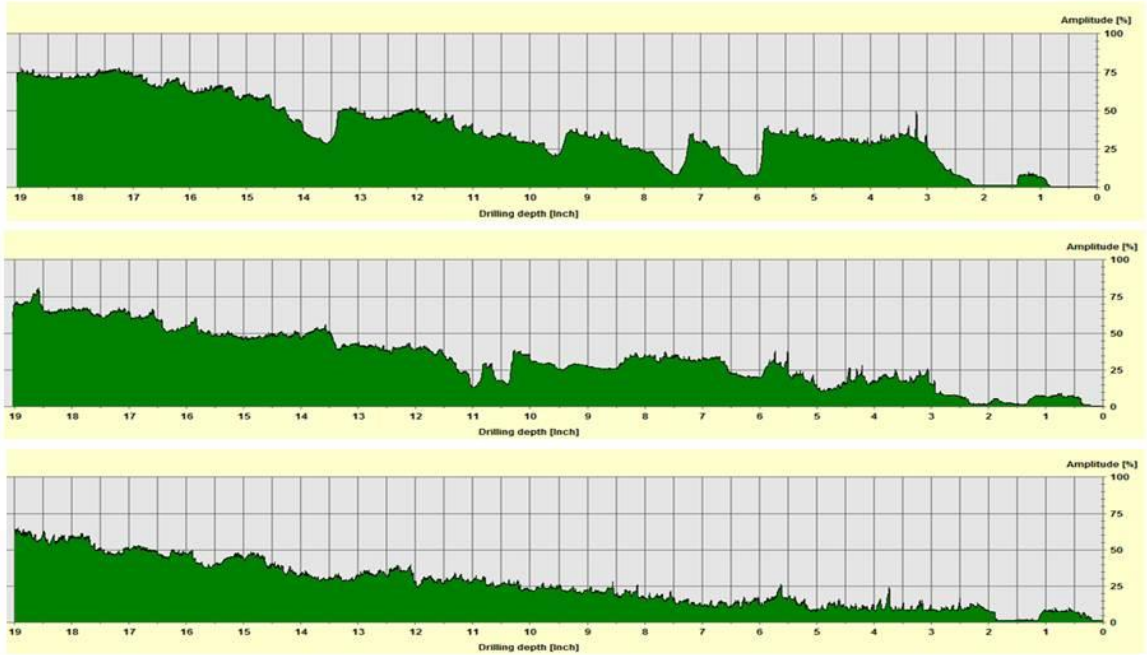
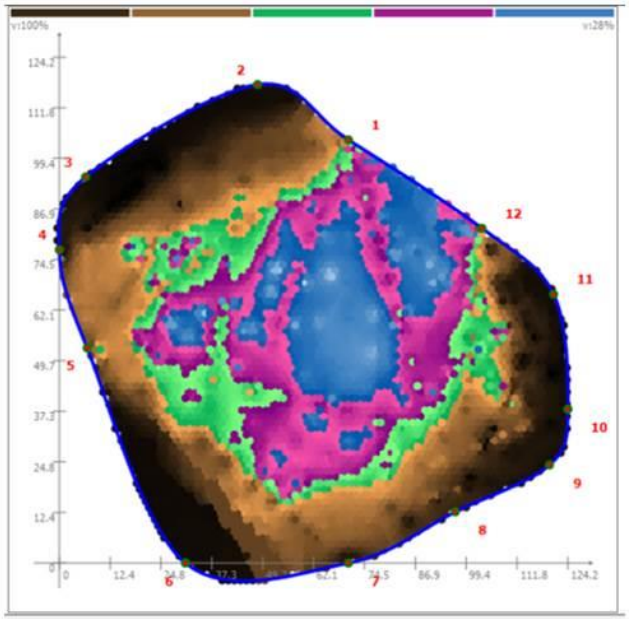
Imminent
Probable
Possible
Improbable
Mean
Median
C
A
AB
AB
B
Limited Visual
Basic
Mallet
Drill
Tomograph
Level of Assessment

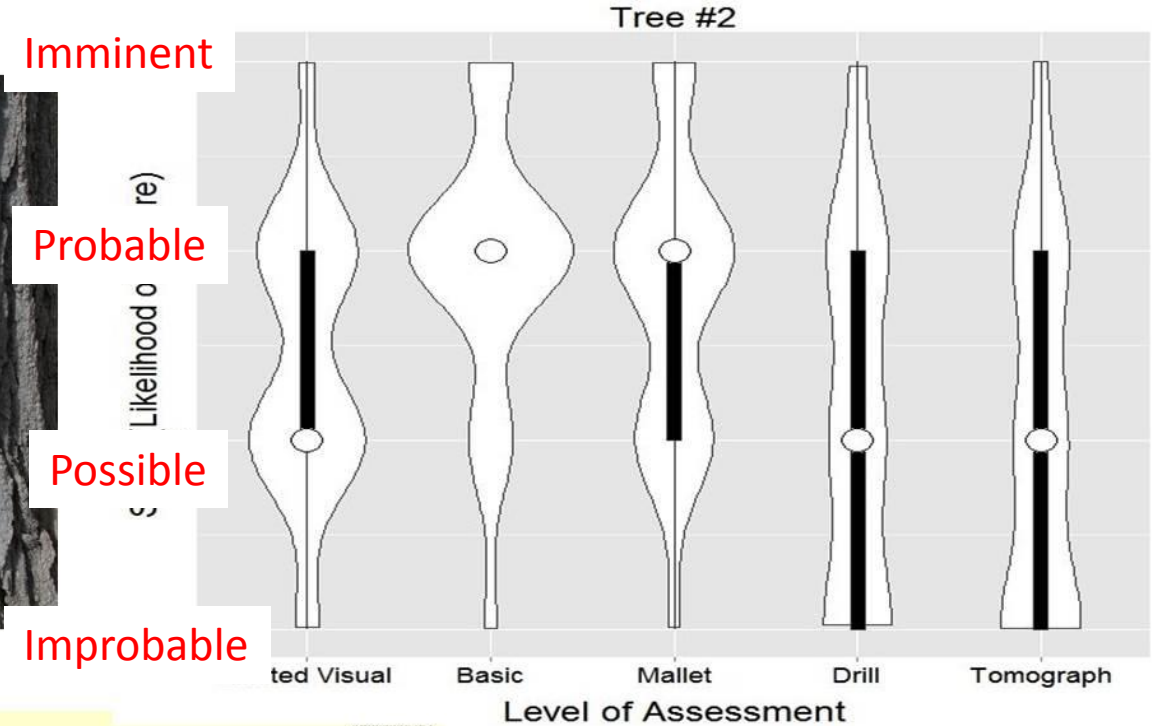
What about reproducibility?

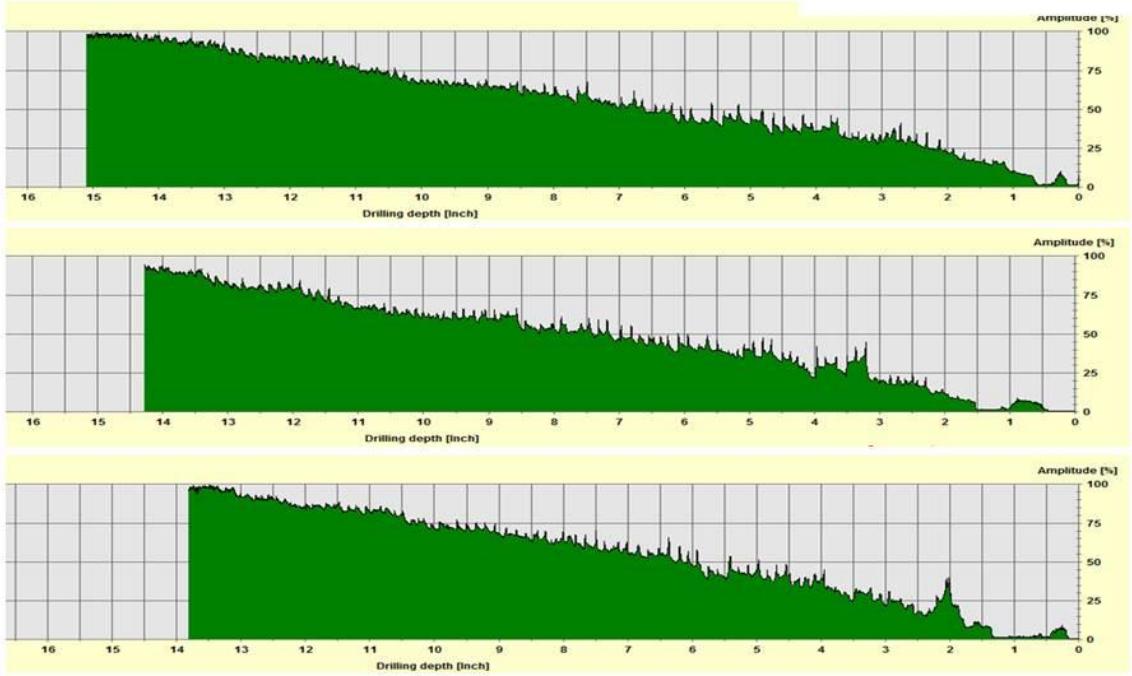


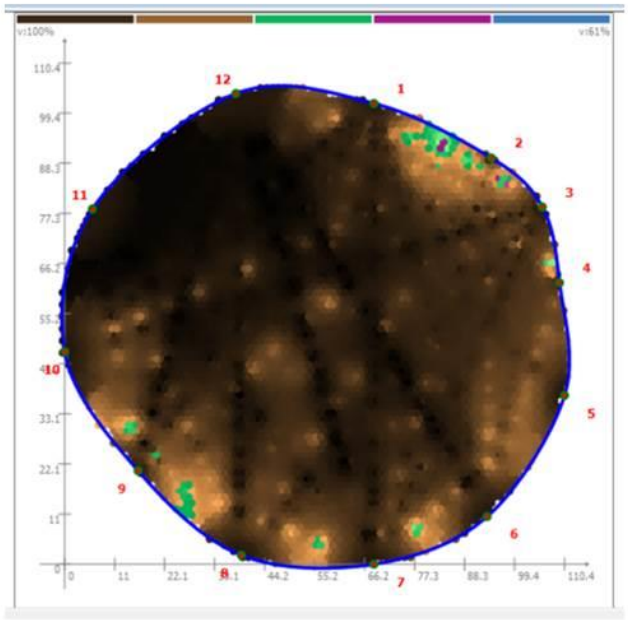

Tree #1
Imminent
Probable
Possible
Improbable
Limited Visual
Basic
Mallet
Drill
Tomograph
Level of Assessment


Amplitude [%]
Drilling depth [inch]




Tree #2
Imminent
Probable
Possible
Improbable
Likelihood o
re)
ted Visual
Basic
Mallet
Drill
Tomograph
Level of Assessment


Amplitude [%]
Drilling depth [inch]



Remember this study? The plot thickens…

296 Arborists assessed three trees each.

Compared sources of variation among ratings/inputs

Impact of Assessor on Tree Risk Assessment Ratings and Prescribed Mitigation Measures

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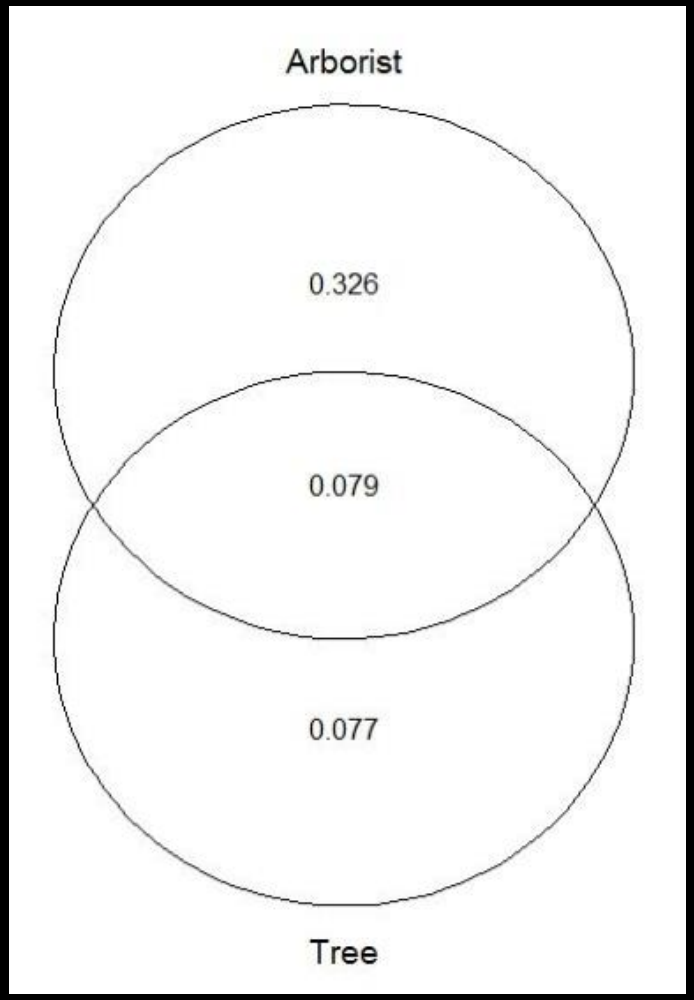


Table 3. Instances where the risk assessment inputs (i.e., likelihood of impact, likelihood of failure, and consequence of failure) were the most variable (only looking at cases where tests of equal variance were significant).

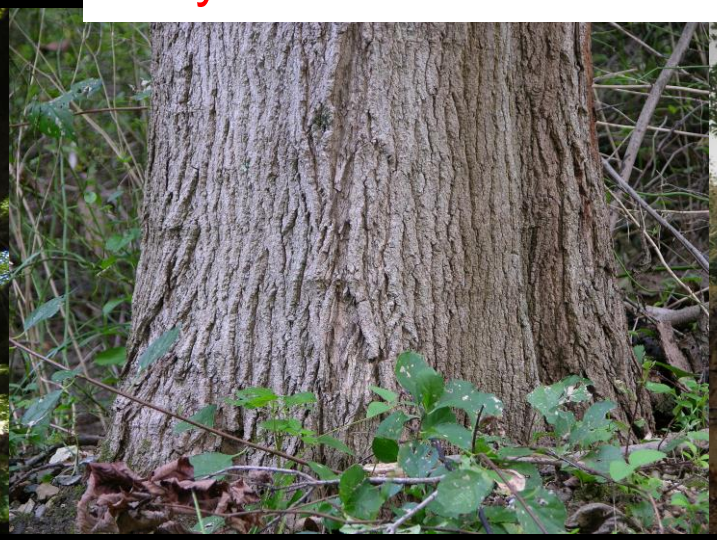
	Statistical Test of Equal Variance		
	Significant Bartlett's Test (n = 46)	Significant Levene's Test (n = 32)	Significant Fligner-Killeen Test Outcomes (n = 30)
Likelihood of Impact	28	21	19
Likelihood of Failure	2	2	2
Consequence of Failure	16	9	9
Significance (*P*-value)	<0.0001	<0.0001	<0.0001

Table 3. Instances where the risk assessment inputs (i.e., likelihood of impact, likelihood of failure, and consequence of failure) were the most variable (only looking at cases where tests of equal variance were significant).

	Statistical Test of Equal Variance
	Significant Bartlett's Test (n = 46)
Likelihood of Impact	28
Likelihood of Failure	2
Consequence of Failure	16
Significance (*P*-value)	<0.0001

Over half of the 90 assessments had cases were variance among the inputs was unequal.

Look at which two inputs were the most likely to be the most varied…



An Explanation…

The risk ratings from this study were gut-level.

Proper risk assessment forces us to think beyond our comfort zone (tree defects).

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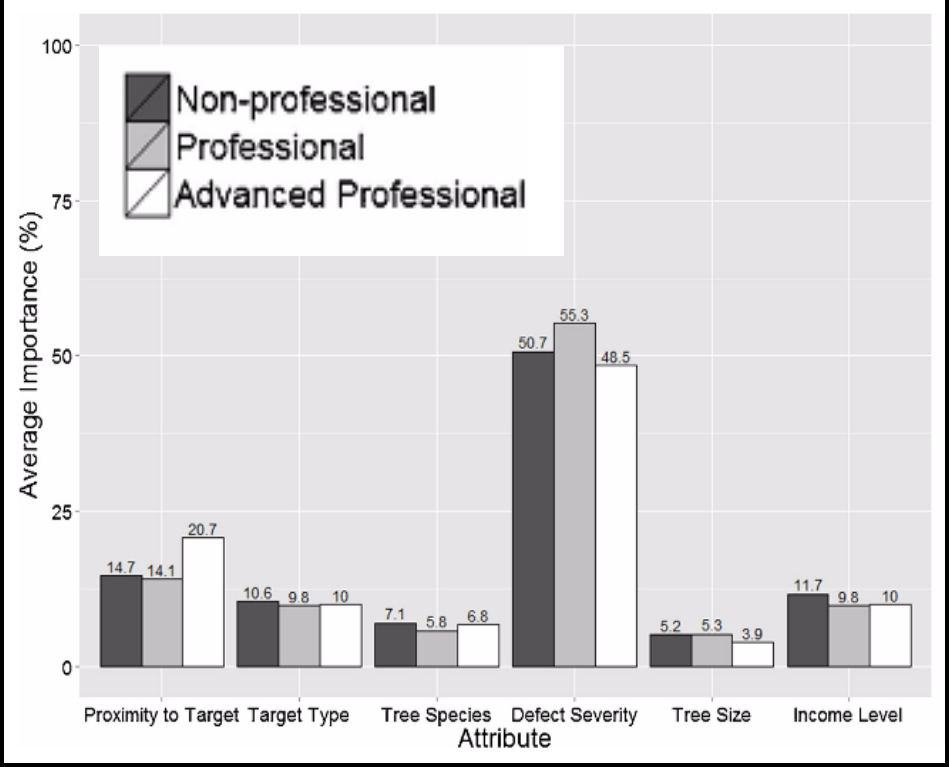


Target Occupancy

Journal of Arboriculture 31(2): March 2005

Previous

QUANTIFIED TREE RISK ASSESSMENT USED IN THE MANAGEMENT OF AMENITY TREES

By Michael J. Ellison

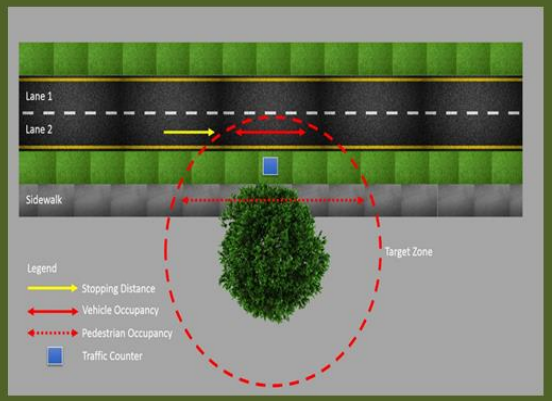
- "…target value is the most significant and most easily quantified element of the [risk] assessment"
- Echoed by in ISA TRAQ Training…now multiple targets can be listed

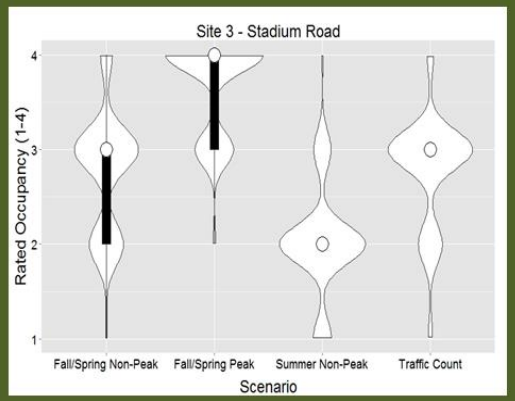
Perceived vs Real Target Occupancy

Urban Forestry & Urban Greening
Volume 19, 1 September 2016, Pages 194–201

Relationship between perceived and actual occupancy rates in urban settings

Ryan W. Klein[a], Andrew K. Koeser[b], Richard J. Hauer[c], Gail Hansen[d], Francisco J. Escobedo[e]





Actual vs real target occupancy

4 sites shown 3 times each

Video clips varied by:

- Time Filmed (peak hours vs off hours)
- Time of year (classes in/out of session)

4 video stills with traffic data shown after clips

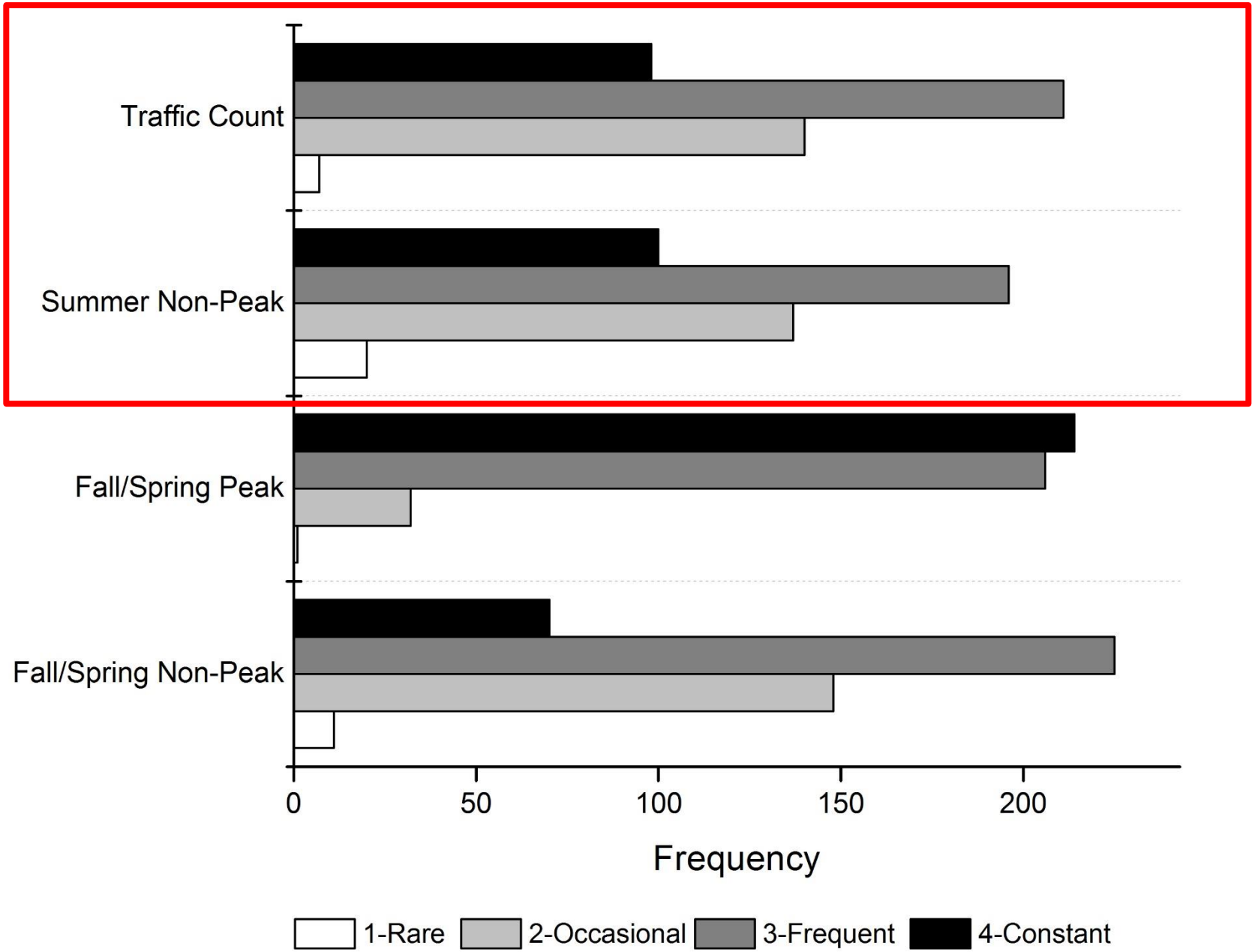
Table 1. Regression model for predicting visual target occupancy ratings given time of assessment (i.e. time of day and season of year), actual occupancy (i.e., daily average with traffic count data), rating index (i.e., median value of all ratings from an individual), and factors related to professional experience.

Factor	Coefficient	Standard error	*P*-value	95% CI lower	95% CI upper
Intercept	2.17	0.08	<0.001	2.01	2.32
Season – Fall/Spring[a]	-0.05	0.04	0.127	-0.12	0.02
Time of Day - Peak[b]	0.63	0.05	<0.001	0.54	0.72
Actual Occupancy	0.07	<0.00	<0.001	0.06	0.08
Certified – Yes[c]	-0.09	0.05	0.058	-0.18	0.00
Risk Experience – Yes	0.02	0.04	0.587	-0.06	0.10
				Adjusted R^2	0.23

[a] Compared to base level "Summer".

[b] Compared to base level "Non-peak".

[c] International Society of Arboriculture Certified Arborist.


Traffic Count
Summer Non-Peak
Fall/Spring Peak
Fall/Spring Non-Peak
0
50
100
150
200
Frequency
1-Rare
2-Occasional
3-Frequent
4-Constant

Conclusions

North American arborists have long focused solely on tree defects. This played out in several studies.

We should take heart in knowing our basic assessments can be quite consistent with regard to failure potential.

Conclusions

- Advanced equipment can give precise estimates of decay and occupancy

- However, without defendable thresholds or decision rules, risk assessments will remain variable (if not more variable).

Conclusions

For ISA TRAQ, LoI and CoF are low-hanging fruit which, if addressed, could greatly increase reproducibility.

Scientifically sound and unbiased research will improve risk assessment.