The Cost of NOT Maintaining Trees

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University of Wisconsin – Stevens Point

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Eugene, OR – October 6 – 9, 2019

What is your favorite tree?

Victory Memorial Parkway, Minneapolis

What is the Value of Urban Trees?

Photo from Mark Stennes, Victory Memorial Parkway, Minneapolis, MN USA

Depends: size, location, condition, species

What is the Value of Urban Trees?

Relatively easy way to quantify urban forest values

If there were no humans, would trees have value?

i-Tree Results

A Benefit – Cost Summary

Stevens Point UWSP Campus Urban Forest

Total Annual Benefits, Net Benefits, and Costs for Public Trees

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Shade</td>
<td>22,530 (97%)</td>
<td>2,932 (62%)</td>
<td>16,600 (83%)</td>
<td>4,902 (12%)</td>
</tr>
<tr>
<td>Environmental</td>
<td>1,020 (44%)</td>
<td>0 (0%)</td>
<td>1,020 (44%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Aesthetic</td>
<td>1,000 (43%)</td>
<td>0 (0%)</td>
<td>1,000 (43%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>24,550 (100%)</td>
<td>2,932 (62%)</td>
<td>18,600 (76%)</td>
<td>4,902 (20%)</td>
</tr>
</tbody>
</table>

Annual B’s & C’s and B/C … per capita and per tree
Just What is the Value of a Tree?

Many Ways to Measure

What is the Value of Urban Trees?

Just ask the NYC Central Park Users

Hypothesis: Can Donald Trump Buy Central Park?

Value of Donald Trump

Forbes gave Donald Trump's net worth a $5.5 billion haircut
Published: Sept 30, 2015 9:56 a.m. ET

I am worth 10 billion USD

Hypothesis: Can Donald Trump Buy Central Park?

Land Value Manhattan

Priciest NYC Neighborhood by Square Foot? It's Central Park South

What is he worth & what is Central Park worth?
Conclusion: No Trump Can Not Afford Central Park

Estimated Central Park Value ($ USD total)

Urban Tree Value … Can be Negative

What is the Value of Urban Trees?

Just ask the bike owner

An Urban Forest … Response to

Emerald Ash Borer

Urban Tree Value … Can be Negative

Depends: age, location, condition, species

Effect of EAB on Municipal Budgets

EAB Management Works, Like it or not EAB will costs $
The Urban Forest Ledger Sheet

• **Benefits** (Social, Ecological, Economic)

• Urban Trees **Appreciate in Value Over Time**

• **Liabilities** (Litter, Blocked View, Maintenance)

\[ \text{Benefits} - \text{Liabilities} = \text{Net Benefits} \]

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Just What is the Value of a Tree?

Hedonic Pricing

Contingent Valuation

Willingness to Pay

Real Estate Value

Ecosystem Services

**Benefits**

**Costs**

Money Value Time

Many Ways to Measure

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Literature Review: Benefit and Cost of Trees

• Collected and read ~400 articles

• ~150 within arboriculture/urban forestry deemed “useful” and “relevant” (incl. utility management literature)

• 95 discussed economic costs
  – 65 of these actually calculated costs (others inferred)

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Benefits of Trees ... Benefit of Time

• **Years before benefits = costs of tree planting?**

  – Public housing sites 9 years
  – Yard/street trees 13-14 years
  – Parks & highways 15 years

• All sites Chicago region (McPherson 1993, GTR NE-186)

Tree payback ... break even time in different locations
Net Tree Value = Tree Value (CTLA) – Management Costs

Liability of not planting trees

Costs of No Site Evaluation

The Life of a Tree Depends on …

Selecting Trees: **Design for Final Size**

Restricted Planting Sites, Try Small Stature Trees

Selecting Trees: **Design for Decline**

Trees planted ~ 1988 and look similar in 1998

De-energized in 2010 Still Energized in 2010

De-energized in 2016 Still Energized in 2016

Selecting Trees: **Design for Decline**

In this corner … Pit versus Bed Green versus Grey
Selecting Trees: *Design for Decline*

Trees planted ~ 1975 and relatively healthy in 2018

Non Apparent Norway Maple Decline Initial Decline

Abiotic stress often leads to biotic failure

Soil Chemical Properties

A Tree Litmus Test, Foliar Chlorosis

Moderate Norway Maple Decline Advanced

Abiotic stress often leads to biotic failure

Planting a Tree

Nothing to it, Right?

The Root of the Cause: Stem Girdling Roots (SGR’s)

Sugar maple with 100% SGR’s with decline evident
How Soon Can SGR’s Form?

Little leaf linden 1 year after planting 10 inches deep.

Freeman maple 4 years after planting 6 inches deep.

Plant Part Grafting Commonly Occurs in Nature

Root and stem tissue do not graft!

73% of Little leaf linden’s

18% of all tree failures

30% of all tree failures outside of storm center’s

50% of trees in 6 to 10” DBH with SGR’s

Trees Planted to Deep and SGR’s

A Practitioner’s Guide to Stem Girdling Roots of Trees

Stems and general anatomy of trees

Interpreting signs and symptoms of girdling

Stem and tree failures

Impact on trees, symptoms, and prevention

Storms of 1998 and Tree Failures

18% of all failures

30% of all failures outside of storm center’s

50% of trees in 6 to 10” DBH with SGR’s
Stem Girdling Roots and Tree Loss
- Tree decline and death 82% of time
- Sudden failure of tree 18% of time

What practitioners said in 1997 Survey

Economic Impact of Deep Root Systems and SGR’s

- 125,000 $\times$ 18% = 22,250 trees lost
- 22,500 $\times$ $500 = $11 Million Preventable Loss Tree Value Only

and estimated 125,000 lost: the Storms of 1998 in MN

Bumper Guard Needed? (Uppsala, Sweden)

Modern Tree Selection Bumper Guard (Uppsala, Sweden)

Moving the Tree into the Street

Trees + People = Urban Forest (Horb, Germany)

Trees + People = Urban Forest (Melbourne, Australia)

Moving the Tree into the Street
Moving the Tree into the Street

Trees + People = Urban Forest (Melbourne, Australia)

Moving the Tree into the Street 2.0

Bumper Tree Guard (Melbourne, Australia)

Establishment: Don’t set it and forget it

I am a chicken I am a tree

Silva Cells

Soil volume
H2O storage
Drivable final surface possible

Suitable Tree Growth Site is Value Added

Importance of Water

Explains 80 to 90% of Plant Growth
Transplant Shock … Establishment Indicators

Establishment: Water Deficits, Sunscald and Borers

What came first the chicken or the sunscald?

Establishment: Water & Economics 101 (Gilman J. Arbor 2001)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of Trees</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Plastic container</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Plastic container with SpinOut</td>
<td>14</td>
<td>8</td>
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<tr>
<td>Air root-pruning (ARP)</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>Low-profile ARP container</td>
<td>14</td>
<td>10</td>
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<tr>
<td>Root-pruned, field-grown B&amp;B</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Non-root-pruned, field-grown B&amp;B</td>
<td>14</td>
<td>4</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cost per live tree</th>
<th>Irrigation</th>
<th>No Irrigation</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic container</td>
<td>445</td>
<td>585</td>
<td>143</td>
<td></td>
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<tr>
<td>Plastic container with SpinOut</td>
<td>445</td>
<td>784</td>
<td>339</td>
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<tr>
<td>Air root-pruning (ARP)</td>
<td>445</td>
<td>672</td>
<td>227</td>
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<tr>
<td>Low-profile ARP container</td>
<td>445</td>
<td>1,176</td>
<td>731</td>
<td></td>
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<tr>
<td>Root-pruned, field-grown B&amp;B</td>
<td>383</td>
<td>274</td>
<td>-109</td>
<td></td>
</tr>
<tr>
<td>Non-root-pruned, field-grown B&amp;B</td>
<td>383</td>
<td>383</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Establishment: Weed whips, killing trees since 1972

Inventor George Ballas envisioned no damage to tree bark

Establishment: Mulching Dosage and Spread

Proper watering, better growth

The more is not always the merrier
Establishment: Mulching

Pruning Trees

Is it Really Needed?

Formative Pruning ... Structural Pruning ... Training

Pruning a necessary part of tree structure and health

Maturing: Now which limb to remove?

Included Bark

What will the tree look like, how will it respond?

Maturing: Where to Prune

Hackberry and decay from included bark

Costs of Formative Pruning

- Ryder and Moore 2013
- $2.79 (AUD) Formative pruning new tree
- $44.59 (AUD) Structural prune mature tree
- ~15 times less costly to structural prune

Pruning a necessary part of tree structure and health
**Miller & Sylvester (1981)** – "An economic evaluation of the pruning cycle"

- Municipal trees in Milwaukee, WI
- More years since last pruning → lower condition class rating

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**Costs of Pruning**

- Pruning a necessary part of tree structure and health

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**Utility line pruning**

Costs of not pruning = political and legal costs, lost service billing time, repair costs, more pruning later

- Defer $1 of routine maintenance, more than $1 must be spent later to make up.

**Table 3.** Projected impact of deferred maintenance on the average cost of pruning trees for line clearance.

<table>
<thead>
<tr>
<th></th>
<th>1 Pr.</th>
<th>2 Pr.</th>
<th>3 Pr.</th>
<th>4 Pr.</th>
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</thead>
<tbody>
<tr>
<td>1 Yr</td>
<td>$1.25</td>
<td>$1.43</td>
<td>$1.99</td>
<td>$1.99</td>
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<tr>
<td>2 Yr</td>
<td>$1.21</td>
<td>$1.39</td>
<td>$1.95</td>
<td>$1.95</td>
</tr>
<tr>
<td>3 Yr</td>
<td>$1.17</td>
<td>$1.35</td>
<td>$1.91</td>
<td>$1.91</td>
</tr>
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**Trees Need a Buddy (Ginkgo)**

- Trees often grow near a neighbor (Washington D.C.)

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**Trees Need a Buddy (London Plane Tree)**

- Trees often grow near a neighbor (Melbourne, Australia)

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**Local Citizen Advocacy Tree Protection**

- Chiang Mai, Thailand
Trees, Construction & Infrastructure

Must Be an Act of … August 1978

Just Simple Physics, Root Pruning Gone Bad

Meet the “Tree Cop” Jim Kringer

Did a Tree Preservation Program Pay Dividends?

Percent Tree Condition 1979, 1989, 2005, 2018

Did a Tree Preservation Program Pay Dividends?

Percent Tree Survival Since 1989

Did a Tree Preservation Program Pay Dividends?

Odds of Tree Survival: Preexisting Condition

Compared to a Base Level 50% Condition Tree
Odds of Tree Survival: Terrace Width

Compared to a Base Level 60 cm (24 in) Tree Lawn

Costs of a Major Disease:

The Dutch Elm Disease Case Study

Pays for Itself & Much More

American Elm (*Ulmus americana*): The Tolerant One

Alberta, Canada Still DED Free

English Elm (*Ulmus procera*): The Tolerant One

Australia Still DED Free
A Lost Generation ~ 40 to 50 years to recover

Whether You Like it or Not, DED Will Cost You Money

How much will it cost? A DED Example circa 1970’s

Ecosystem Service Types: Actual vs. “Best”

And wait if you act now…
Whether You Like it or Not, DED Will Cost You Money

Modeled Outcomes for Milwaukee WI

NPV and B/C of DED Management (i-Tree Eco)

EAB Management Costs

EAB Management: Net Benefit

Costs of a Major Insect:
The Emerald Ash Borer Case Study

Trees & Wood Products
Repurposing