Introduction

Cacapon Institute (CI) has prepared this report to inform future planning and tree purchases with the goal of increasing species diversity and providing greater short-term and long-term benefits of trees planted through WV Project CommuniTree. A summary of accomplishments 2012-2015 is displayed in the table below. Records for each column are in bold.

<table>
<thead>
<tr>
<th>Planting Season</th>
<th>Planting Events</th>
<th>Trees Planted</th>
<th>Acres Trees (100/acre)</th>
<th>Volunteers Engaged</th>
<th>Volunteer Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2012</td>
<td>10</td>
<td>444</td>
<td>4.4</td>
<td>570</td>
<td>1,286</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>11</td>
<td>282</td>
<td>2.8</td>
<td>759</td>
<td>1,116</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>16</td>
<td>710</td>
<td>7.1</td>
<td>1,319</td>
<td>1,877</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>10</td>
<td>204</td>
<td>2.0</td>
<td>429</td>
<td>848</td>
</tr>
<tr>
<td>Spring 2014</td>
<td>19</td>
<td>528</td>
<td>5.3</td>
<td>1,554</td>
<td>3,141</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>10</td>
<td>370</td>
<td>3.7</td>
<td>504</td>
<td>1,233</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>18</td>
<td>596</td>
<td>6.0</td>
<td>1,408</td>
<td>2,687</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>13</td>
<td>292</td>
<td>2.9</td>
<td>959</td>
<td>1,191</td>
</tr>
<tr>
<td>Total 2012-2015</td>
<td>107</td>
<td>3,426</td>
<td>34.3</td>
<td>7,502</td>
<td>13,379</td>
</tr>
</tbody>
</table>

1 WV Project CommuniTree began in 2008 under the direction of WV Conservation Agency. Between 2008 and 2011, CTree had 9 planting events and planted 1,722 trees. In 2012, CTree was renewed under a broader partnership with WV Division of Forestry, WV DEP, and Cacapon Institute joining WV Conservation Agency.
Species Diversity (Charts on page 4-6)

The top three species planted through the WV Project CommuniTree program in 2012-2015 are Eastern Redbud (434, 15%), Serviceberry (292, 10%), and Flowering Dogwood (220, 8%). Although these trees are beautiful and are frequently requested by CTree applicants, planting larger, shade trees (i.e., long-lived and large growing species) will have a greater benefit for reducing stormwater runoff pollution, increasing tree canopy, improving public health, reducing particulate and air pollution, and making communities more resilient to climate change.

Where flowering trees (i.e., shorter growing species) are required, such as under power lines, a greater diversity is necessary to provide greater benefits as described above. Despite the restraints that have limited purchase of larger or more diverse trees in the past, including low availability, high cost, or incompatible stock sizes, a wider range of species needs to be considered. The “cost benefit” of trees should weigh diversity and greater, long-term, ecological benefits and look beyond individual trees’ purchase price.

Based on the “10-20-30 Rule” (page 5) the CTree program exceeded the species rule on two counts, slightly exceeded the genus rule on one, but met the family rule. Eastern Redbud (15%) was planted at half again the 10% recommended species limit. Serviceberry (10.3%) narrowly exceeded the species rule. Quercus (20.6%) narrowly exceeded the 20% genus rule. Of the 3,426 trees planted, all groupings of trees by family were well below the 30% family rule (Fagaceae (20.6%) was planted most frequently).

Tree Cost by Species (Table on page 7)

Given that greater diversity is necessary, it is useful to review previous purchases’ cost per individual tree. Making more cost effective purchases may make it possible to purchase a wider range of species. Trees are a commodity so there is no certainty that costs will remain constant. This analysis did not factor in stock size. None the less, looking strictly at cost per species per tree is a beginning look at market costs while seeking a wider range of species in future purchases. Additional analysis of species cost is recommended including:

- cost per tree given survival rates,
- cost per tree that includes stock size information,
- cost per tree in relation to short term ecological benefits, and
- cost per tree in relation to long term ecological benefits.
i-Tree Streets can be used to assign quantitative values to the amount of pollution trees mitigate, remove, and/or store. i-Tree then assigns a dollar value to those benefits. Trees must be classified based on species, size, health, and other inputs in order for i-Tree to assign a value. More inputs will provide more informative i-Tree outputs. In the short-term model, all 3,426 trees that were planted through WV Project CommuniTree (2012-2015) are assumed to fall into the smallest i-Tree DBH class classification (1-3” DBH). Based on this “stock size” (i.e., size when planted), eastern redbuds, serviceberry, and flowering dogwoods provide the most benefit. This is due, in large part, to the larger percentage planted. In the 20-year growth analysis we assume shade and evergreen trees reach the DBH class of 6-9”, flowering trees reach the DBH class 3-6”, and shrubs remain in the DBH class 1-3”. In the long-term model, pin oaks, white oaks, and red maples will provide the greatest benefits after a 20-year grow-out period. Over time, the benefits of flowering trees (that dominate early) is surpassed by the shade trees that have a higher per-tree benefit due to greater canopy cover, carbon sequestration, and mitigation of air pollution.

Recommendation

More investigation is needed but, in order to increase diversity and foster greater benefits (both short-term and long-term), two recommendations can be made.

1. Expand the planting of “shade trees” (i.e., large growing, long-lived species). While “flowering trees” (smaller species often used as ornamentals) are popular, an effort should be made to improve the public understanding of, and desire for, species that produce the greatest long-term benefit. Sycamores, for example, appear to be popular (112 have been planted), their cost is unexceptional, and their ecological benefit expands greatly over time.

2. Continue applying the “10-10-30% rule.” Over-planted species and genus (eastern redbud, serviceberry, and Quercus (oaks) particularly) should be brought into balance. This can be achieved by limiting their planting number and/or by increasing the relative number of other types of trees planted. Educating the public on the benefits of “shade trees” such as Liquidambar and Tilia, species with a reasonable cost, good long-term benefits, and that are also highly sought after for their landscape value, may increase applicants’ request for them.

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Benefits by Species, i-Tree Analysis of Current and 20-year Growth (Chart on page 8)

Cacapon Institute recognizes that trees have intrinsic value beyond our ability to quantitatively measure. In addition, fixing a monetary value creates a somewhat arbitrary dollar value (markets vary and the value of energy saving, for example, will fluctuate). The USDA Forest Service i-Tree Streets tool, used for this report, is not specifically intended for the purpose of evaluating trees planted across time and projects but, broadly speaking, use of i-Tree Streets presents not unlikely, potential, short-term and long-term benefits for the trees.
CTree 2012-2015 - Species Planted

The top 3 species, (946 trees, 33% of total) are flowering trees which will generally not increase tree canopy, reduce stormwater runoff pollution, or provide other benefits to the same degree as larger shade trees. Tree selection in 2016 and beyond should focus on larger shade trees when possible.
The “10-20-30” rule of biodiversity states that a tree population should be comprised of no more than 10% of any species, 20% of any genera, or 30% of any family. In Urban Forestry, following this rule will help ensure that the tree population is biodiverse and therefore less susceptible to major decline in tree canopy from exotic pests or diseases.

For WV Project CommuniTree 2012-2015, only 2 tree species exceeded the 10% rule (Cercis canadensis and Amelanchier canadensis), 1 genera of trees exceeded the 20% rule (Quercus), and no families of trees exceeded the 30% rule.

More about the “10-20-30” rule can be found in this publication – “Trees for Urban Planting – Diversity, Uniformity, and Common Sense”.

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The table below shows the tree statistics for WV Project CommuniTree 2012-2015:

### CTree 2012-2015 - "10-20-30" Rule

<table>
<thead>
<tr>
<th>Family (19)(30% MAX)</th>
<th>Count</th>
<th>%</th>
<th>Genus (25)(20% MAX)</th>
<th>Count</th>
<th>%</th>
<th>Species (41)(10% MAX)</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fagaceae</td>
<td>583</td>
<td>20.6%</td>
<td>Quercus</td>
<td>583</td>
<td>20.6%</td>
<td>Cercis canadensis</td>
<td>434</td>
<td>15.4%</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>434</td>
<td>15.4%</td>
<td>Cercis</td>
<td>434</td>
<td>15.4%</td>
<td>Amelanchier canadensis</td>
<td>292</td>
<td>10.3%</td>
</tr>
<tr>
<td>Rosaceae</td>
<td>408</td>
<td>14.4%</td>
<td>Cercis</td>
<td>434</td>
<td>15.4%</td>
<td>Pinus strobis</td>
<td>220</td>
<td>7.8%</td>
</tr>
<tr>
<td>Pinaceae</td>
<td>275</td>
<td>9.7%</td>
<td>Pinus</td>
<td>265</td>
<td>9.4%</td>
<td>Cornus florida</td>
<td>220</td>
<td>7.8%</td>
</tr>
<tr>
<td>Cornaceae</td>
<td>247</td>
<td>8.7%</td>
<td>Cornus</td>
<td>245</td>
<td>8.7%</td>
<td>Quercus palustris</td>
<td>183</td>
<td>6.5%</td>
</tr>
<tr>
<td>Sapindaceae</td>
<td>215</td>
<td>7.6%</td>
<td>Acer</td>
<td>215</td>
<td>7.6%</td>
<td>Quercus alba</td>
<td>159</td>
<td>5.6%</td>
</tr>
<tr>
<td>Altingiaceae</td>
<td>127</td>
<td>4.5%</td>
<td>Liriodendron</td>
<td>127</td>
<td>4.5%</td>
<td>Acer rubrum</td>
<td>142</td>
<td>5.0%</td>
</tr>
<tr>
<td>Magnoliaceae</td>
<td>122</td>
<td>4.3%</td>
<td>Liquidambar</td>
<td>122</td>
<td>4.3%</td>
<td>Quercus rubra</td>
<td>134</td>
<td>4.7%</td>
</tr>
<tr>
<td>Betulaceae</td>
<td>122</td>
<td>4.3%</td>
<td>Platanus</td>
<td>112</td>
<td>4.0%</td>
<td>Liriodendron tulipifera</td>
<td>127</td>
<td>4.5%</td>
</tr>
<tr>
<td>Platanaceae</td>
<td>112</td>
<td>4.0%</td>
<td>Juniperus</td>
<td>56</td>
<td>2.0%</td>
<td>Liquidambar styraciflua</td>
<td>122</td>
<td>4.3%</td>
</tr>
<tr>
<td>Cypress</td>
<td>56</td>
<td>2.0%</td>
<td>Betula</td>
<td>56</td>
<td>2.0%</td>
<td>Platanus occidentalis</td>
<td>112</td>
<td>4.0%</td>
</tr>
<tr>
<td>Lauraceae</td>
<td>31</td>
<td>1.1%</td>
<td>Lindera</td>
<td>31</td>
<td>1.1%</td>
<td>Amelanchier laevis</td>
<td>98</td>
<td>3.5%</td>
</tr>
<tr>
<td>Rubiaceae</td>
<td>20</td>
<td>0.7%</td>
<td>Sambucus</td>
<td>29</td>
<td>1.0%</td>
<td>Acer saccharum</td>
<td>68</td>
<td>2.4%</td>
</tr>
<tr>
<td>Cannabaceae</td>
<td>20</td>
<td>0.7%</td>
<td>Viburnum</td>
<td>26</td>
<td>0.9%</td>
<td>Juniperus virginiana</td>
<td>56</td>
<td>2.0%</td>
</tr>
<tr>
<td>Caprifoliaceae</td>
<td>17</td>
<td>0.6%</td>
<td>Corylus</td>
<td>21</td>
<td>0.7%</td>
<td>Betula nigra</td>
<td>56</td>
<td>2.0%</td>
</tr>
<tr>
<td>Tiliaceae</td>
<td>15</td>
<td>0.5%</td>
<td>Cephalanthus</td>
<td>20</td>
<td>0.7%</td>
<td>Quercus bicolor</td>
<td>56</td>
<td>2.0%</td>
</tr>
<tr>
<td>Caprifoliaceae</td>
<td>9</td>
<td>0.3%</td>
<td>Celtis</td>
<td>20</td>
<td>0.7%</td>
<td>Pinus rigida</td>
<td>37</td>
<td>1.3%</td>
</tr>
<tr>
<td>Betulaceae</td>
<td>7</td>
<td>0.2%</td>
<td>Prunus</td>
<td>18</td>
<td>0.6%</td>
<td>Lindera benzoin</td>
<td>31</td>
<td>1.1%</td>
</tr>
<tr>
<td>Rosaceae</td>
<td>5</td>
<td>0.2%</td>
<td>Tilia</td>
<td>15</td>
<td>0.5%</td>
<td>Sambucus canadensis</td>
<td>29</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Total: 2825 100%
In 2012-2015, CTree paid $3,669.80 for 220 Eastern White Pines for an average cost of $16.68/tree, lower than the average cost/tree.

Alternately, CTree paid $347.80 for 4 Kousa dogwoods for an average cost of $86.95/tree, over 4 times higher than the average cost/tree.

Additional analysis of species cost is recommended including cost per tree given survival rates and cost per tree that includes stock size information (i.e., the size of the tree at planting time). A consideration of tree survival based on stock size is also necessary to inform future purchases.