Abundance and range size of Panama’s trees
Early results on assessing status

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· Morton Arboretum
· Center for Tree Science

January 2018
The mission: plot abundance and geographic ranges

<table>
<thead>
<tr>
<th>Data</th>
<th>Caveats</th>
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1. Risk assessment must include all species
2. Abundance comes only from plots at few locations
3. Ranges are extrapolated from occurrences at other locations
Specimens and plots

- BIEN specimen
- plot
- inventory
The tree?

Including species
- sometimes reaching 10 m tall (as trees)
- sometimes reaching \( \sim 3 \text{ m} \) tall or 1 cm dbh (as treelets)
- usually free-standing as reproductive (stranglers included)
- any number of stems (ie clonal or not)

Excluding species
- usually reproducing as lianas
- usually epiphytes
- shrubs \(< \sim 3 \text{ m} \) tall

· All beg for precise records of many individuals
· But data either do not exist or are buried on specimen labels
Tree Species of Panama
A complete list

2637 species in checklist

- 127 families
- 1644 trees and 879 shrubs
- 1076 of the species are in our plots (40.6%)

They need thorough vetting since last update 2004

- Working here since August, I have checked 723 species in monographs
- 150 species added, 63 eliminated during vetting

W. D’Arcy (1987)
M. Correa et al. (2004)
Robin Foster
Rolando Pérez
Narrow-range tree species

723 species with taxonomy vetted
  ▶ 95 endemic to Panama (13%)
  ▶ 94 in one other country (13%)
      (usually Costa Rica, some Colombia, one in Ecuador*)

* Tapirira rubrinervia:
  · Formerly endemic and on Ecuador’s red list
  · Now known in Panama and probably Peru
## Proportion of endemics

Proportion endemic to Panama varies among 12 families...

<table>
<thead>
<tr>
<th>Family</th>
<th>Endemic</th>
<th>Not endemic</th>
<th>% endemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anacardiaceae</td>
<td>1</td>
<td>13</td>
<td>7.1</td>
</tr>
<tr>
<td>Annonaceae</td>
<td>24</td>
<td>67</td>
<td>26.4</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>28</td>
<td>207</td>
<td>11.9</td>
</tr>
<tr>
<td>Moraceae</td>
<td>1</td>
<td>68</td>
<td>1.4</td>
</tr>
<tr>
<td>Minor*</td>
<td>1</td>
<td>25</td>
<td>3.8</td>
</tr>
<tr>
<td>Guttiferae**</td>
<td>5</td>
<td>31</td>
<td>13.9</td>
</tr>
</tbody>
</table>

* Adoxaceae, Alzateaceae, Cannabaceae, Combretaceae, Fagaceae  
** Calophyllaceae, Clusiaceae, Hypericaceae
### Proportion of narrow ranges

... likewise proportion with narrow ranges $< 20 \cdot 10^3 \text{ km}^2$

<table>
<thead>
<tr>
<th>Family</th>
<th>Narrow</th>
<th>Wide</th>
<th>% narrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anacardiaceae</td>
<td>0</td>
<td>13</td>
<td>0.0</td>
</tr>
<tr>
<td>Annonaceae</td>
<td>29</td>
<td>56</td>
<td>34.1</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>21</td>
<td>199</td>
<td>9.5</td>
</tr>
<tr>
<td>Moraceae</td>
<td>2</td>
<td>66</td>
<td>2.9</td>
</tr>
<tr>
<td>Minor*</td>
<td>2</td>
<td>23</td>
<td>8.0</td>
</tr>
<tr>
<td>Guttiferae**</td>
<td>5</td>
<td>30</td>
<td>14.3</td>
</tr>
</tbody>
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## Species found in plots

Proportion of all Panama tree species found in our plots...

<table>
<thead>
<tr>
<th>Range (countries)</th>
<th>Found in plots</th>
<th>Not found</th>
<th>% found</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27</td>
<td>67</td>
<td>28.7</td>
</tr>
<tr>
<td>2</td>
<td>26</td>
<td>69</td>
<td>27.4</td>
</tr>
<tr>
<td>&gt;2</td>
<td>223</td>
<td>271</td>
<td>45.1</td>
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Species found in plots

...by range size

<table>
<thead>
<tr>
<th>Range (km²)</th>
<th>Found in plots</th>
<th>Not found</th>
<th>% found</th>
</tr>
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<tr>
<td>&lt;1e4</td>
<td>14</td>
<td>27</td>
<td>34.1</td>
</tr>
<tr>
<td>1e4-1e5</td>
<td>32</td>
<td>57</td>
<td>36.0</td>
</tr>
<tr>
<td>1e5-1e6</td>
<td>37</td>
<td>54</td>
<td>40.7</td>
</tr>
<tr>
<td>&gt;1e6</td>
<td>114</td>
<td>111</td>
<td>50.7</td>
</tr>
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</table>
Plot occurrence vs. range
Among 492 in 12 carefully-vetted families
Endemic Annonaceae: range avoids plots
Endemic Annonaceae: not found in plots
Endemic Annonaceae: found in plots
Endemic Annonaceae: found in plots
Endemic Annonaceae: found in plots
Annonaceae most vulnerable

24 Annonaceae endemic to Panama
6 appear in plots allow estimate of density $\rho$ per ha $\geq 1$ cm dbh:

- *Mosannona garwoodii* described (1997) from 50-ha plot
  Numerous in many plots near the Canal in Panama, $\rho = 4.4$
  Core range $70$ km$^2$ $\sim 30,000$ individuals

- *Guatteria sessilicarpa* appears in 3 plots in wet Caribbean forest, $\rho = 0.62$
  Abundance over $13,000$ km$^2$ $\sim 794,000$ individuals

- *Guatteria alata* appears in 1 plot in wet Caribbean forest, $\rho = 0.047$
  Abundance over $19,000$ km$^2$ $\sim 88,700$ individuals
Annonaceae most vulnerable

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- **Mosannona garwoodii**
  - Described (1997) from 50-ha plot
  - Numerous in many plots near the Canal in Panama, $\rho = 4.4$
  - Core range 70 km$^2$ ~ 30,000 individuals

- **Guatteria sessilicarpa**
  - Appears in 3 plots in wet Caribbean forest, $\rho = 0.62$
  - Abundance over 13,000 km$^2$ ~ 794,000 individuals

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Among 492 in 12 carefully-vetted families
Conclusions and hypotheses for future work

- Checklist and occurrence
  - Problems maintaining an updated taxonomy
  - Many taxonomists involved in revisions
  - All (±) species examined

- Plots and the checklist
  - In Panama, one-third of known trees appear in plots
  - But only 25% of narrow endemics are in plots
  - Without thousands of plots, most species will be missed

- Range size plus abundance
  - Endemic species abundance ~ 0.4 per ha
  - Widespread species abundance ~ 1.1 per ha
  - But abundances vary orders of magnitude
    so predictions for unknown species are poor
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