

Tree species abundance and range size

Rigorous assessment of vulnerability to extinction

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The mission: plot abundance and geographic ranges

Data

Sparse specimen data

Sparse plots

Species checklists

Caveats

Scales do not match

Plots capture few species

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Species checklists

Caveats

Scales do not match

Plots capture few species

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

Outline

Checklist and occurrence data

Specimens and plots

A complete and updated checklist

The checklist of Panama trees

More doubt in species identity

But large sample for statistical power

Abundance-range relation

The Annonaceae as a model

Recent monographs

96 well-studied species

Range size and plot occurrence

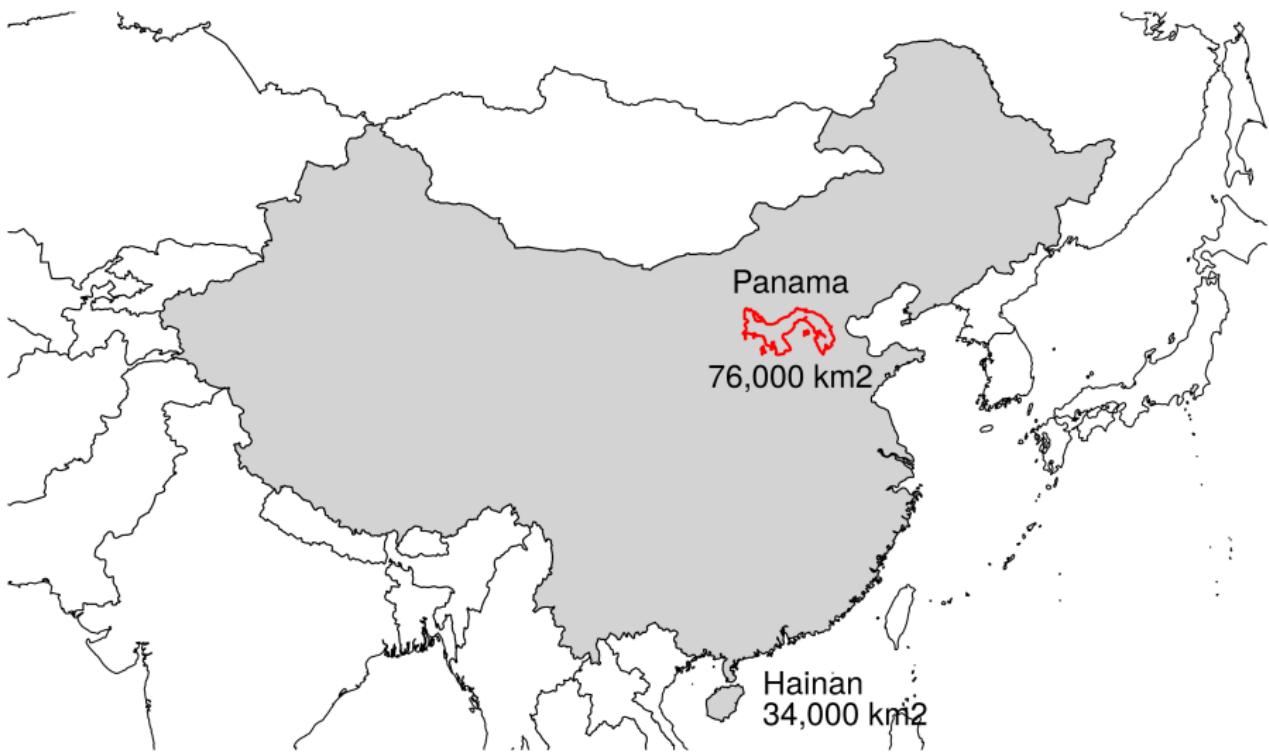
Density · range

Caveat: narrow endemics seldom in plots











Tree Species of Panama

A complete list

- ▶ 2639 species in checklist
(but they need thorough vetting and I have not finished them all)

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- ▶ 624 species checked in monographs:
- ▶ 243 (39%) appear in our plots
- ▶ 82 (13%) of 624 endemic to Panama
- ▶ 44 (7%) have ranges $< 10^4 \text{ km}^2$
(41 endemic, 3 cross into Colombia or Costa Rica)

Complete species lists

A well-known family: Annonaceae of Panama

- ▶ Monographs

1. Maas et al. 2015
Confronting a morphological nightmare: revision of the
Neotropical genus *Guatteria* (Annonaceae)
2. Schatz et al. In Prep.
Revision of the Neotropical genus *Desmopsis* (Annonaceae)
3. etc.

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- ▶ Collection databases

1. Missouri (Tropicos¹)
2. Botanical Information Network (R access²) (BIEN)

¹ <http://www.tropicos.org>

² <http://bien.nceas.ucsb.edu/bien/tools/rbien/>

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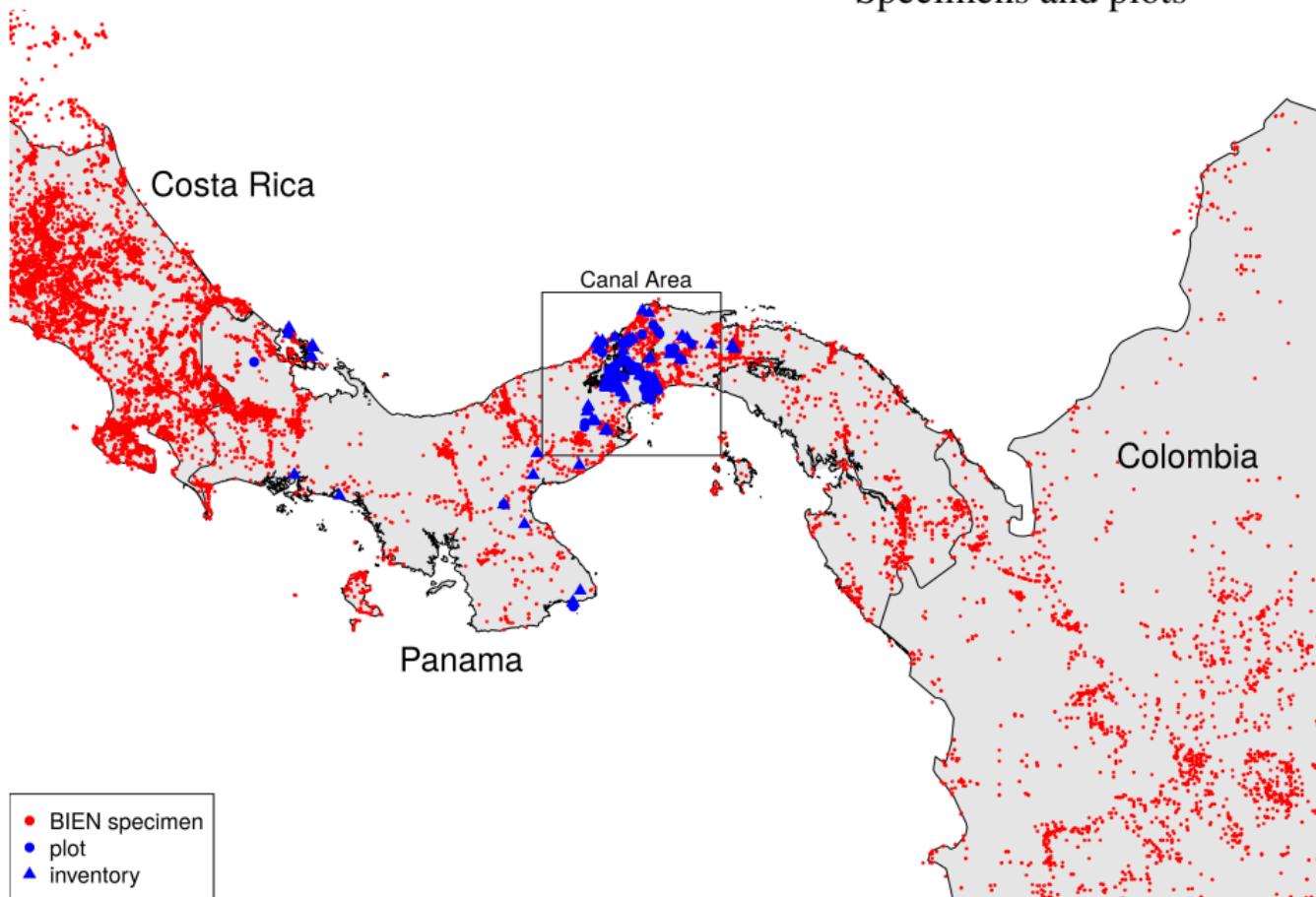
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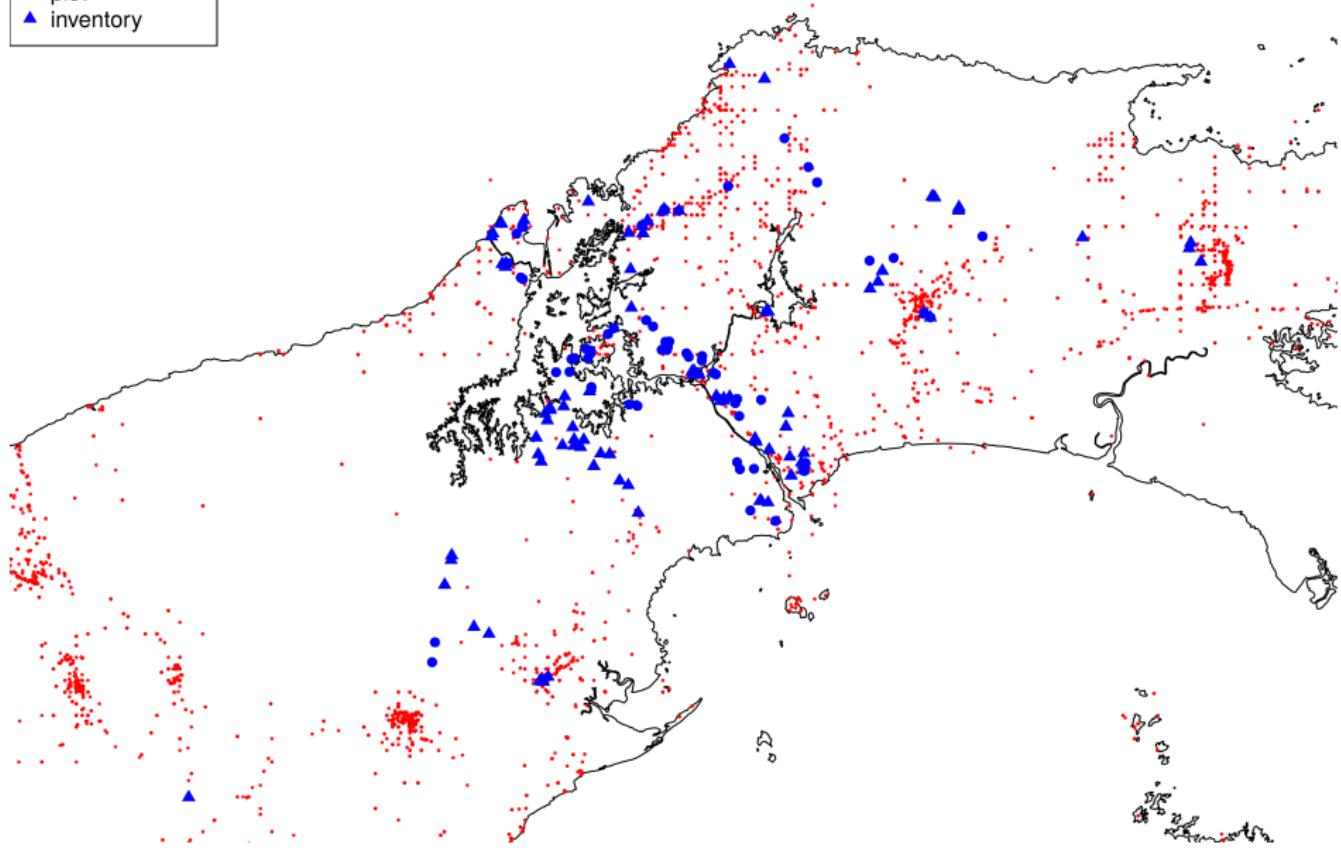
- ▶ 96 Annonaceae in Panama in 17 genera
(known with confidence due to active taxonomy)
- ▶ 16 described since 2005
- ▶ 36 (38%) appear in our plots
- ▶ 22 (23%) are endemic to Panama
- ▶ 14 (15%) have ranges < 10^4 km² (13 endemic, 1 crosses into Colombia)

Specimens and plots

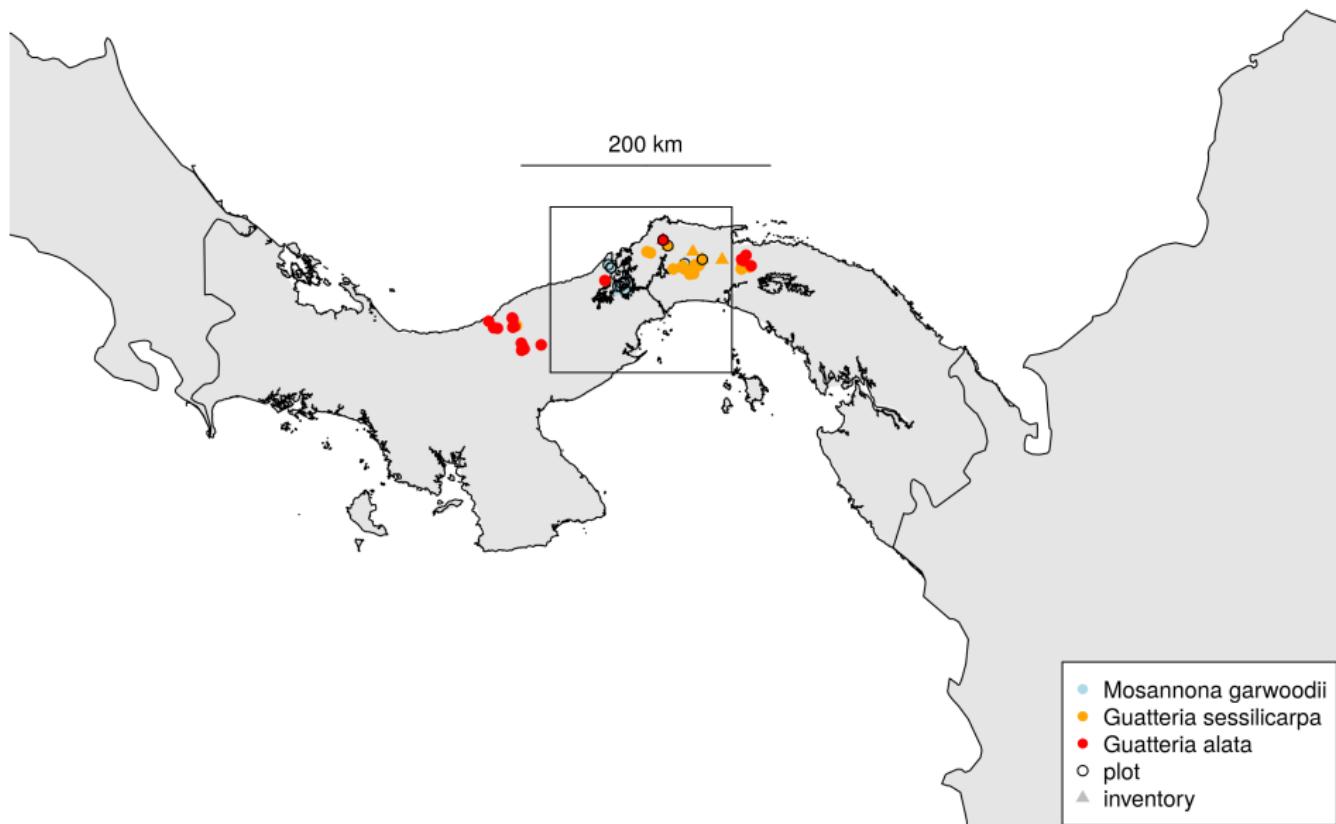


Specimens and plots

- BIEN specimen
- plot
- ▲ inventory



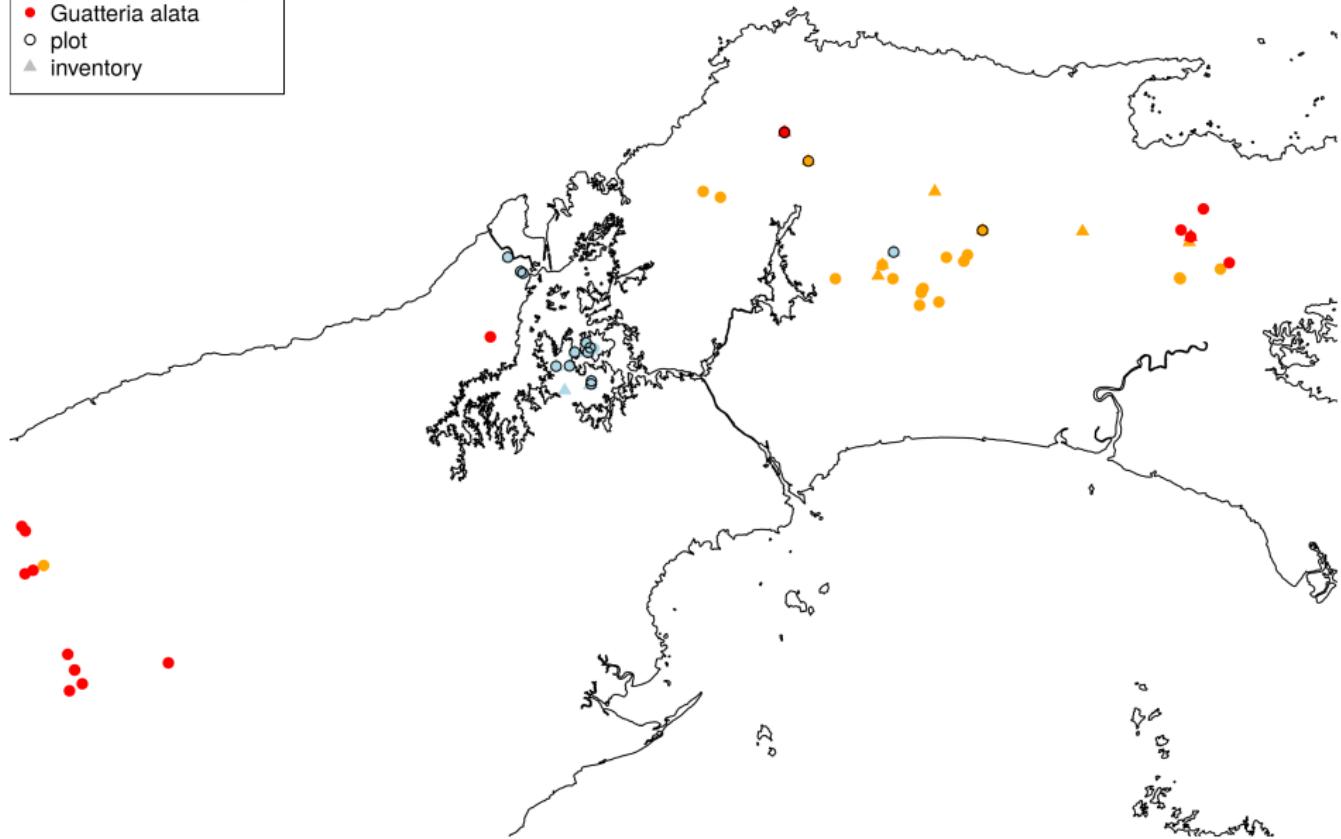
3 endemic Annonaceae in plots



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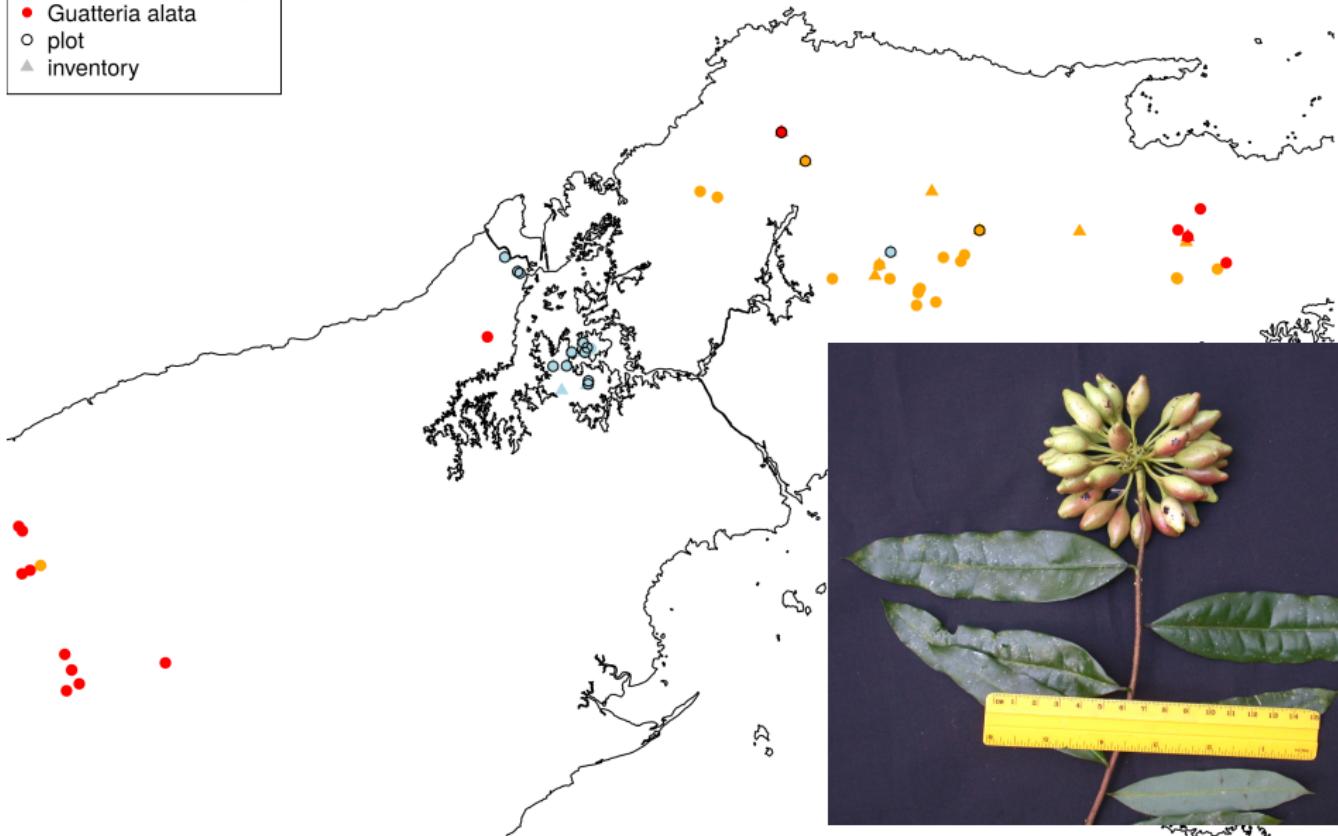
50 km

- Mosannonia garwoodii
- Guatteria sessilicarpa
- Guatteria alata
- plot
- △ inventory



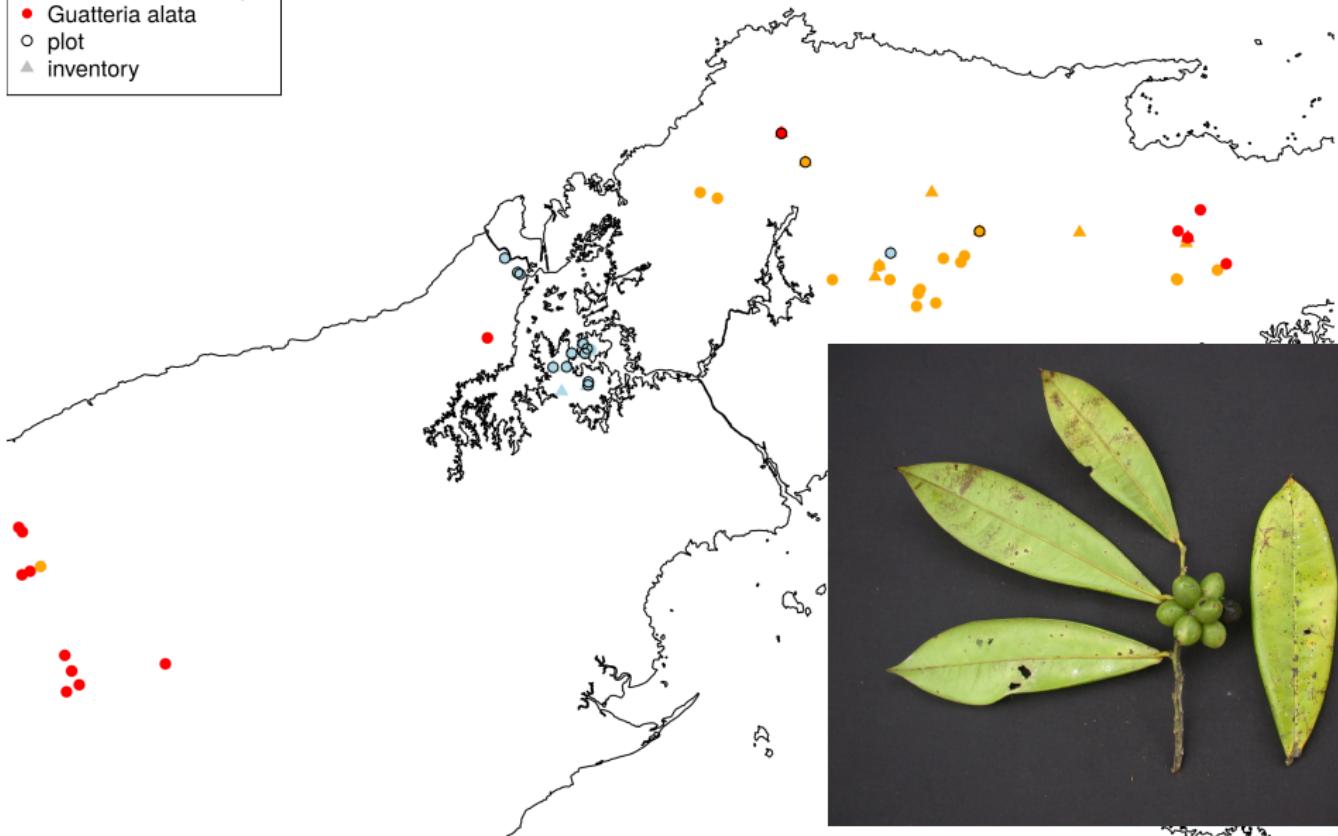
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Annonaceae most vulnerable

23 Annonaceae endemic to Panama

6 appear in plots allow estimate of density ρ per ha ≥ 1 cm dbh:

- ▶ *Mosannona garwoodii* described (1997) from 50-ha plot

Numerous in many plots near the Canal in Panama, $\rho = 4.4$

Abundance over 1350 km² $\sim 597,500$ individuals

Annonaceae most vulnerable

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- ▶ *Guatteria sessilicarpa*

Appears in 3 plots in wet Caribbean forest, $\rho = 0.62$

Abundance over 13,000 km² $\sim 794,000$ individuals

Annonaceae most vulnerable

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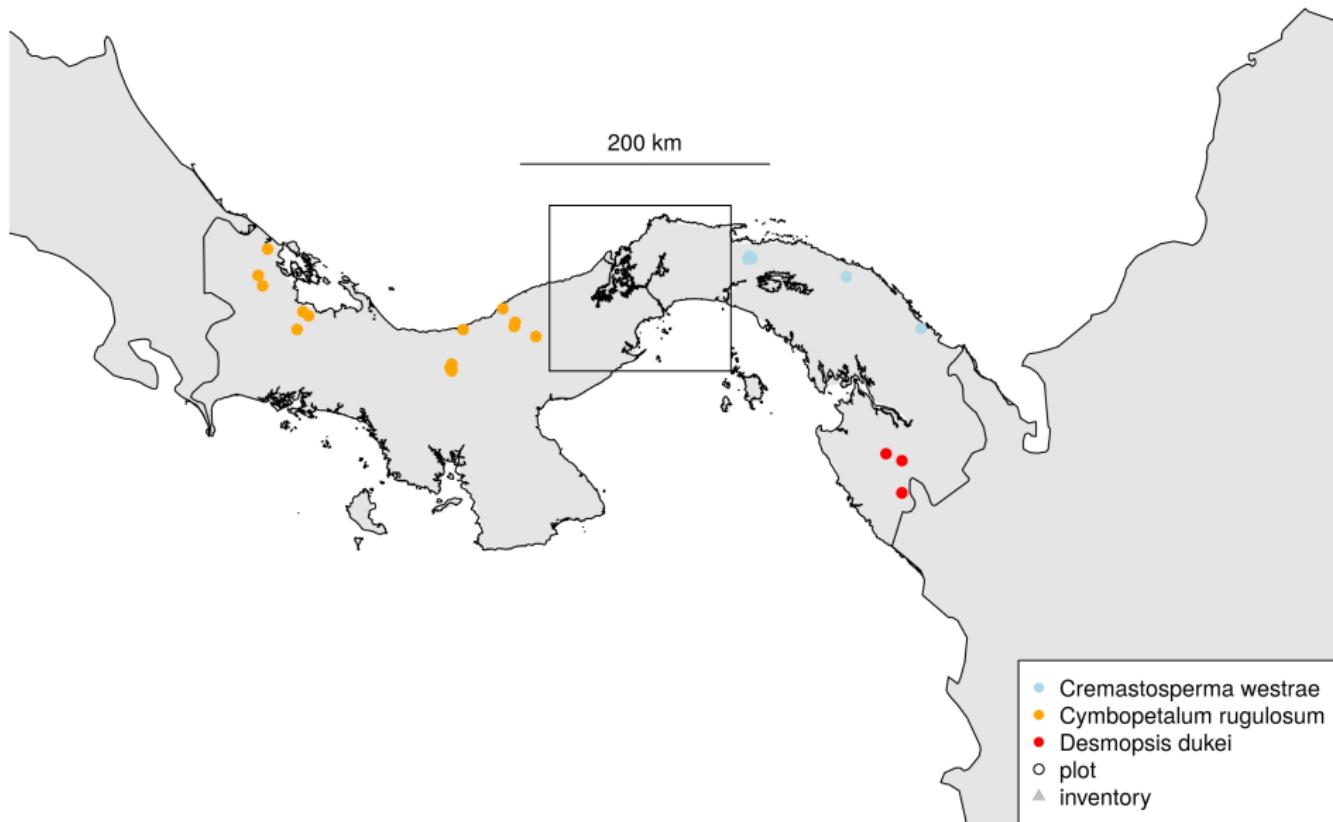
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- ▶ *Guatteria alata*

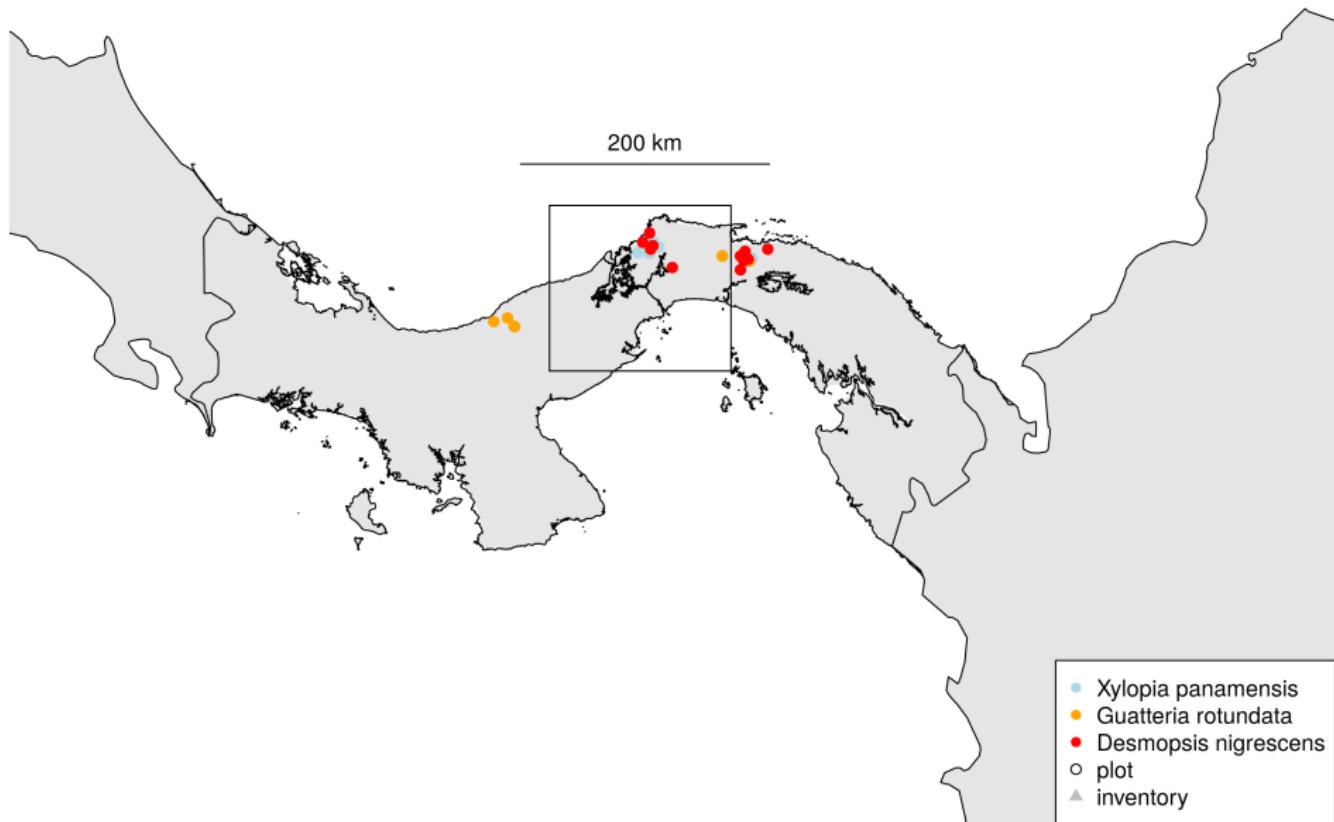
Appears in 1 plot in wet Caribbean forest, $\rho = 0.047$

Abundance over 19,000 km² $\sim 88,700$ individuals

3 endemic Annonaceae far from plots



3 endemic Annonaceae missing plots



Endemic abundance

Species	plots	¹ density	² range	³ population
<i>Cremastosperma panamense</i>	2	1.57	20.5	3.225
<i>Guatteria alata</i>	1	0.05	18.7	0.089
<i>Guatteria allenii</i>	2	0.09	51.2	0.485
<i>Guatteria sessilicarpa</i>	3	0.62	12.9	0.794
<i>Malmea dimera</i>	1	0.46	55.5	2.543
<i>Mosannonia garwoodii</i>	13	4.43	1.4	0.598

¹ Density ha⁻¹ averaged over all plots

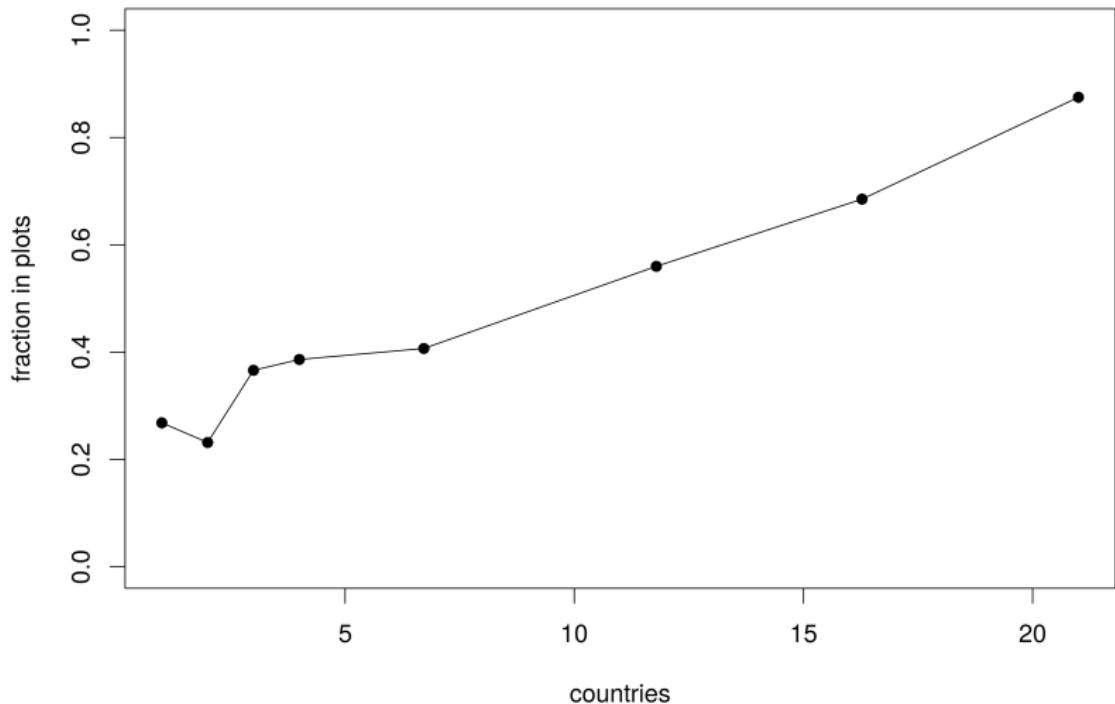
² Thousands of km²

³ Millions of trees ≥ 1 cm dbh over entire range

Deforestation not considered, but these species occur on well-forested Caribbean slope

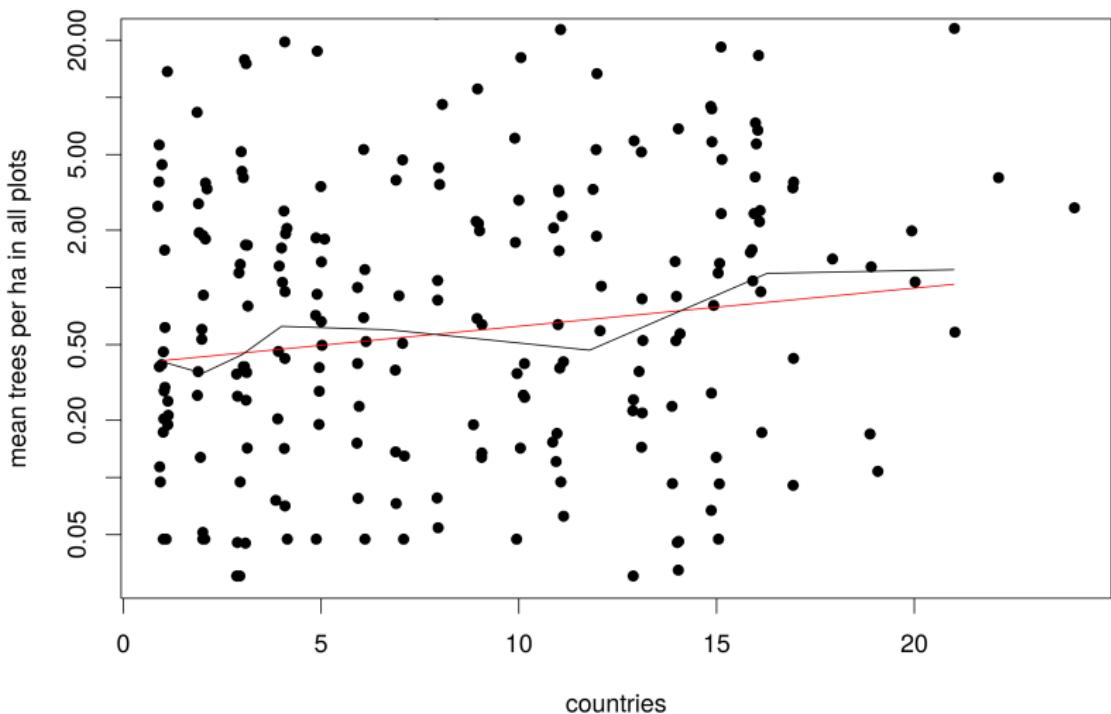
Plot occurrence vs. range

Among 624 carefully-vetted species



Abundance vs. range

Among 624 carefully-vetted species



Conclusions and hypotheses for future work

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 - All (\pm) species examined

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 - Widespread species abundance ~ 1.1 per ha
 - But abundances vary orders of magnitude
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