

# 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

# The mission: plot abundance and geographic ranges

## Data

Sparse specimen data

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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

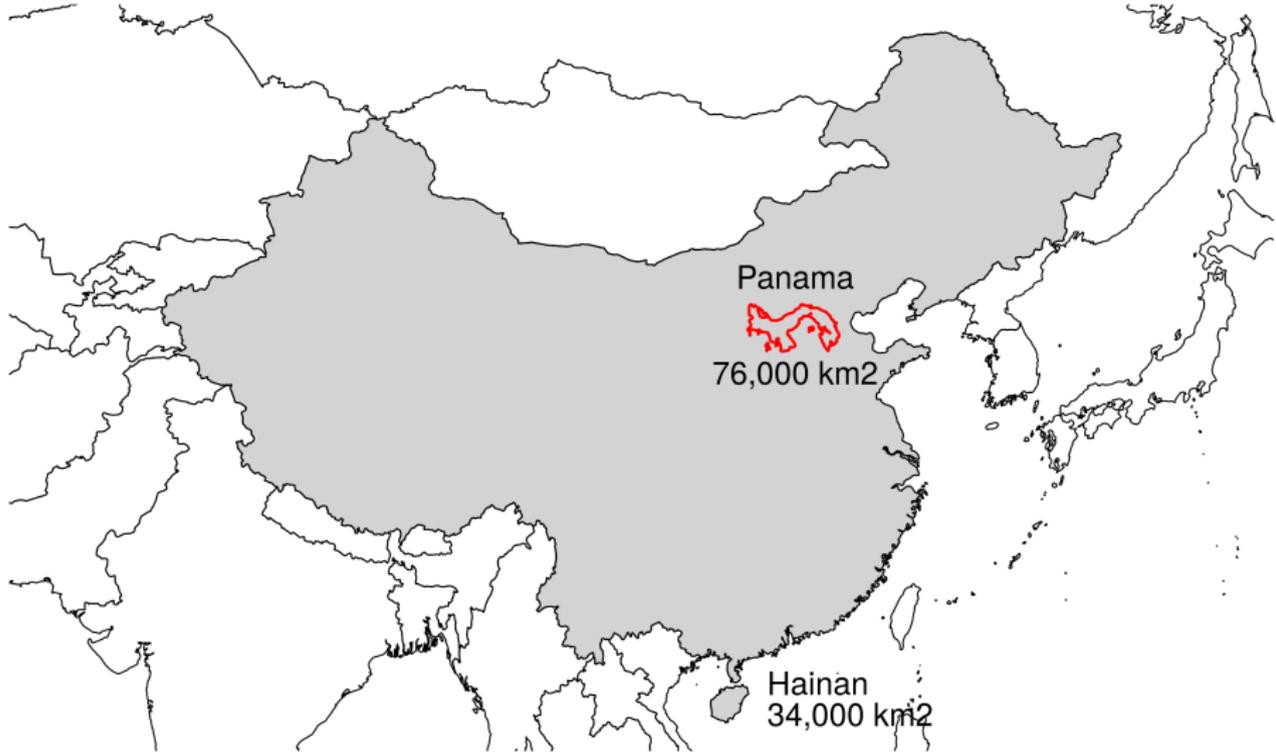
- Density · range

- Caveat: narrow endemics seldom in plots







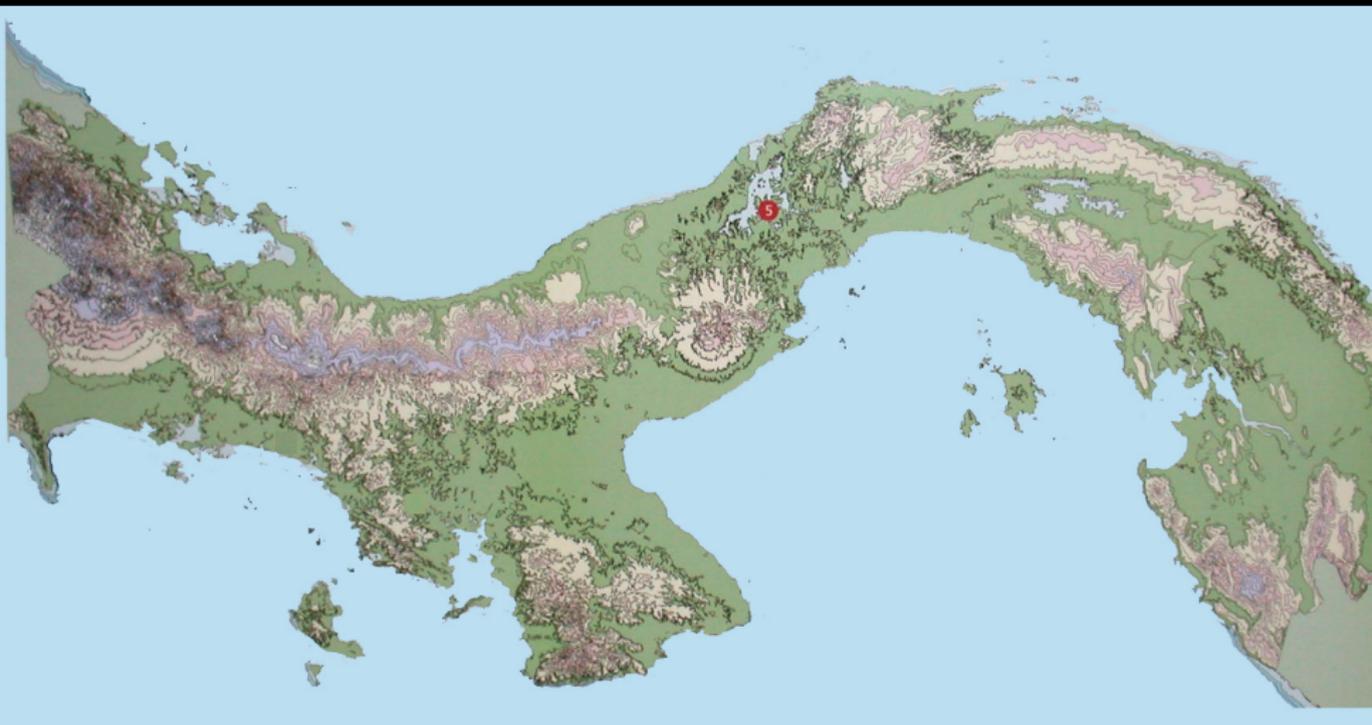


Panama

76,000 km<sup>2</sup>

Hainan

34,000 km<sup>2</sup>



# 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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M. Correa et al. (2004)

Robin Foster

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- ▶ 243 (39%) appear in our plots
- ▶ 82 (13%) of 624 endemic to Panama
- ▶ 44 (7%) have ranges  $< 10^4$  km<sup>2</sup>  
(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 (Tropicos<sup>1</sup>)
2. Botanical Information Network (R access<sup>2</sup>) (BIEN)

<sup>1</sup> <http://www.tropicos.org>

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

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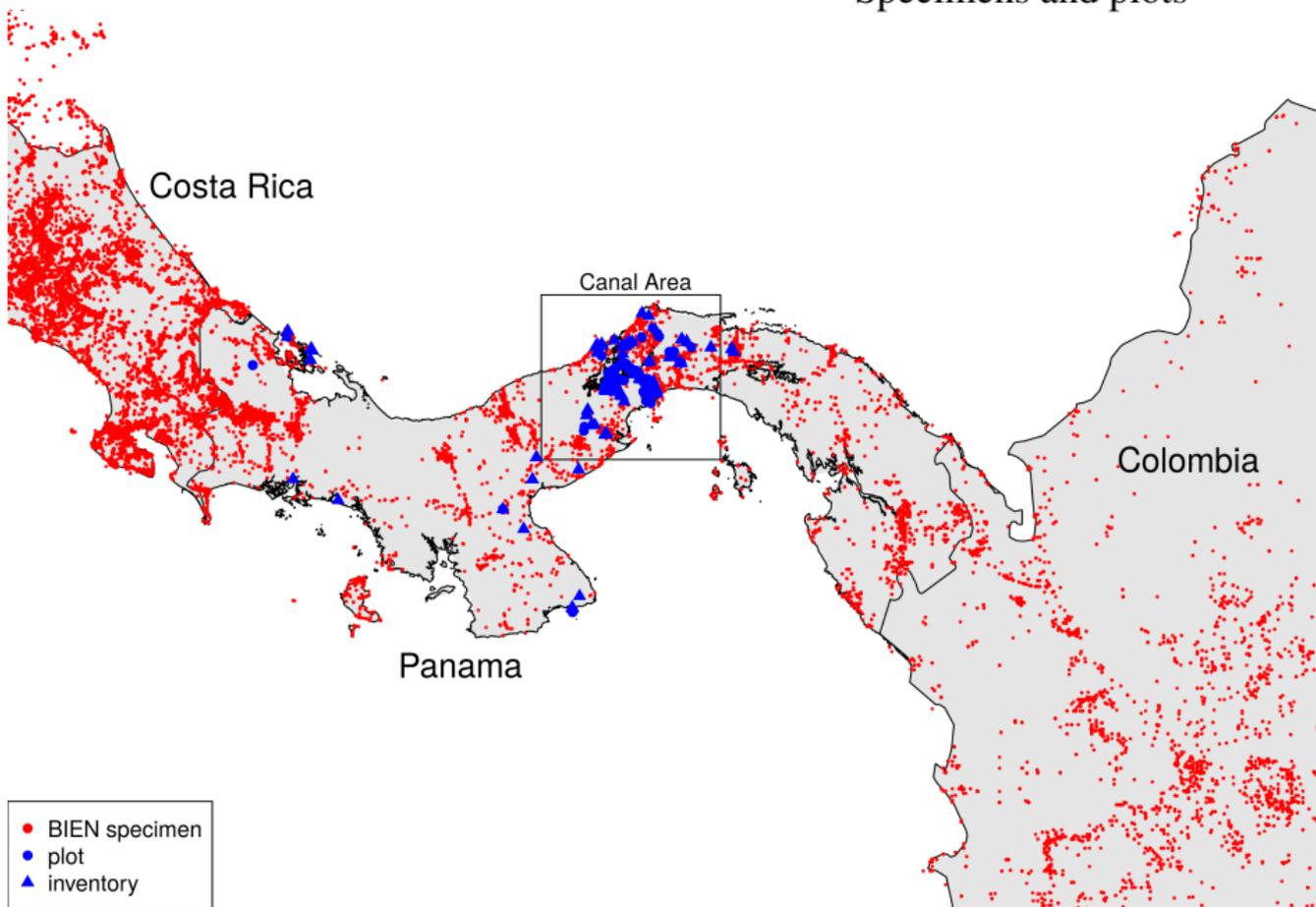
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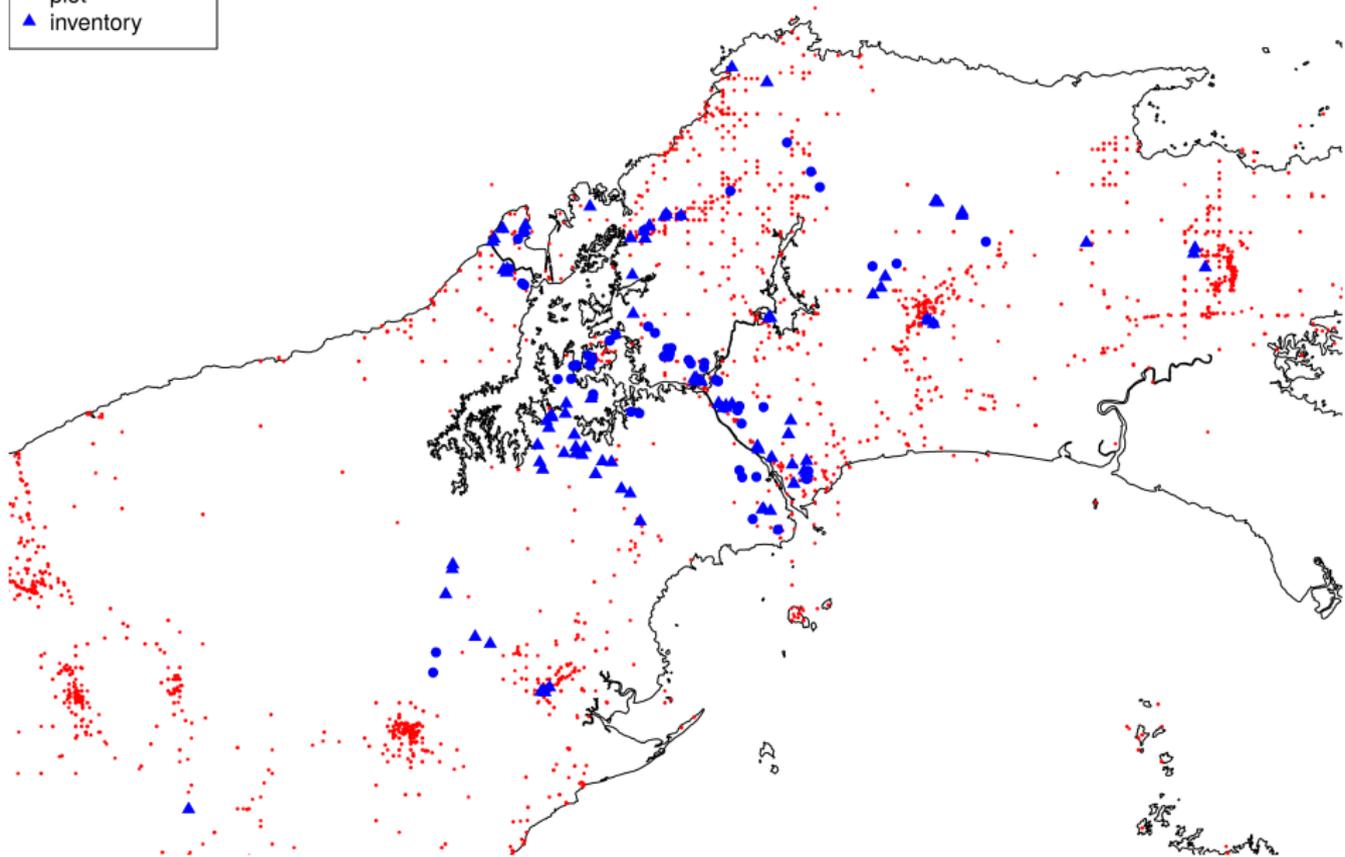
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(known with confidence due to active taxonomy)
- ▶ 16 described since 2005
- ▶ 36 (38%) appear in our plots
- ▶ 22 (23%) are endemic to Panama
- ▶ 14 (15%) have ranges  $< 10^4$  km<sup>2</sup> (13 endemic, 1 crosses into Colombia)

# Specimens and plots

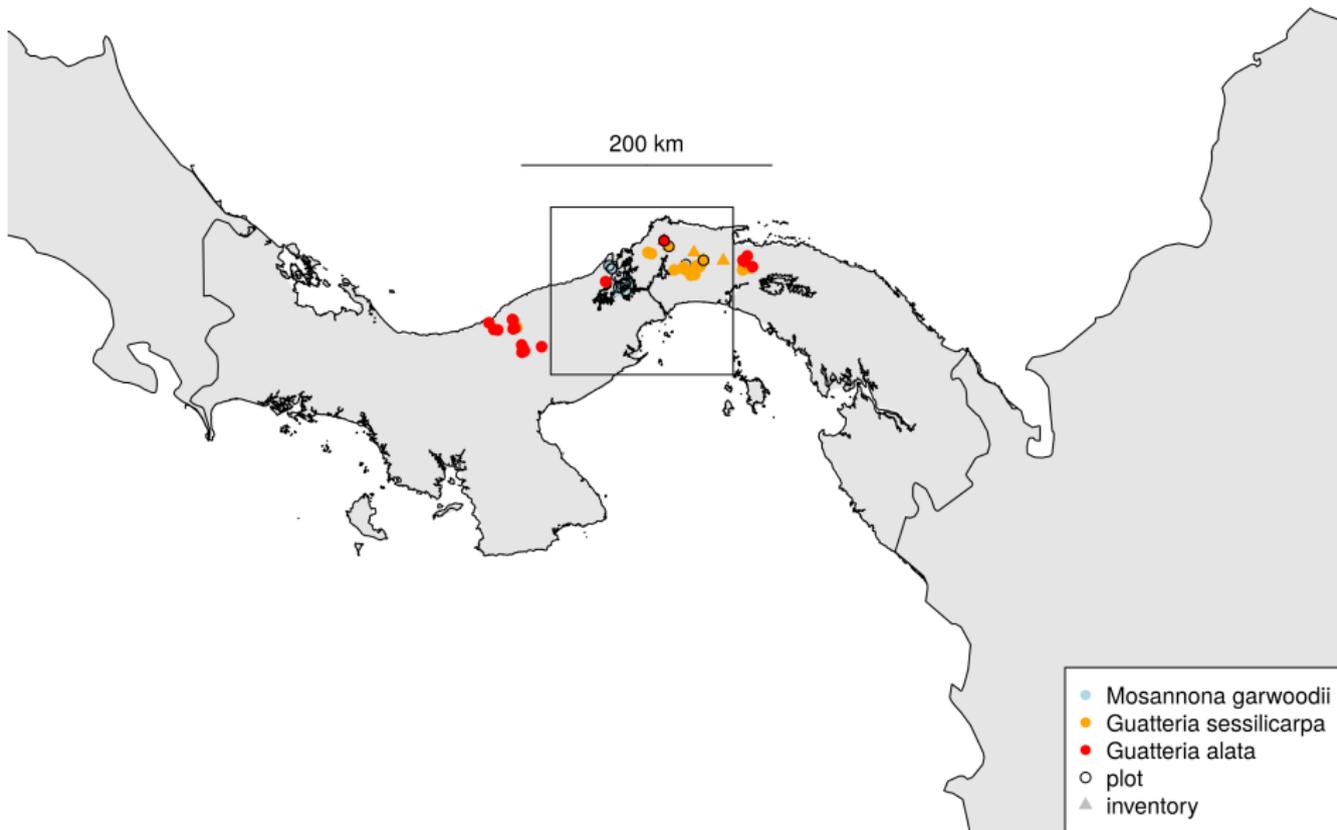


# Specimens and plots

- BIEN specimen
- plot
- ▲ inventory



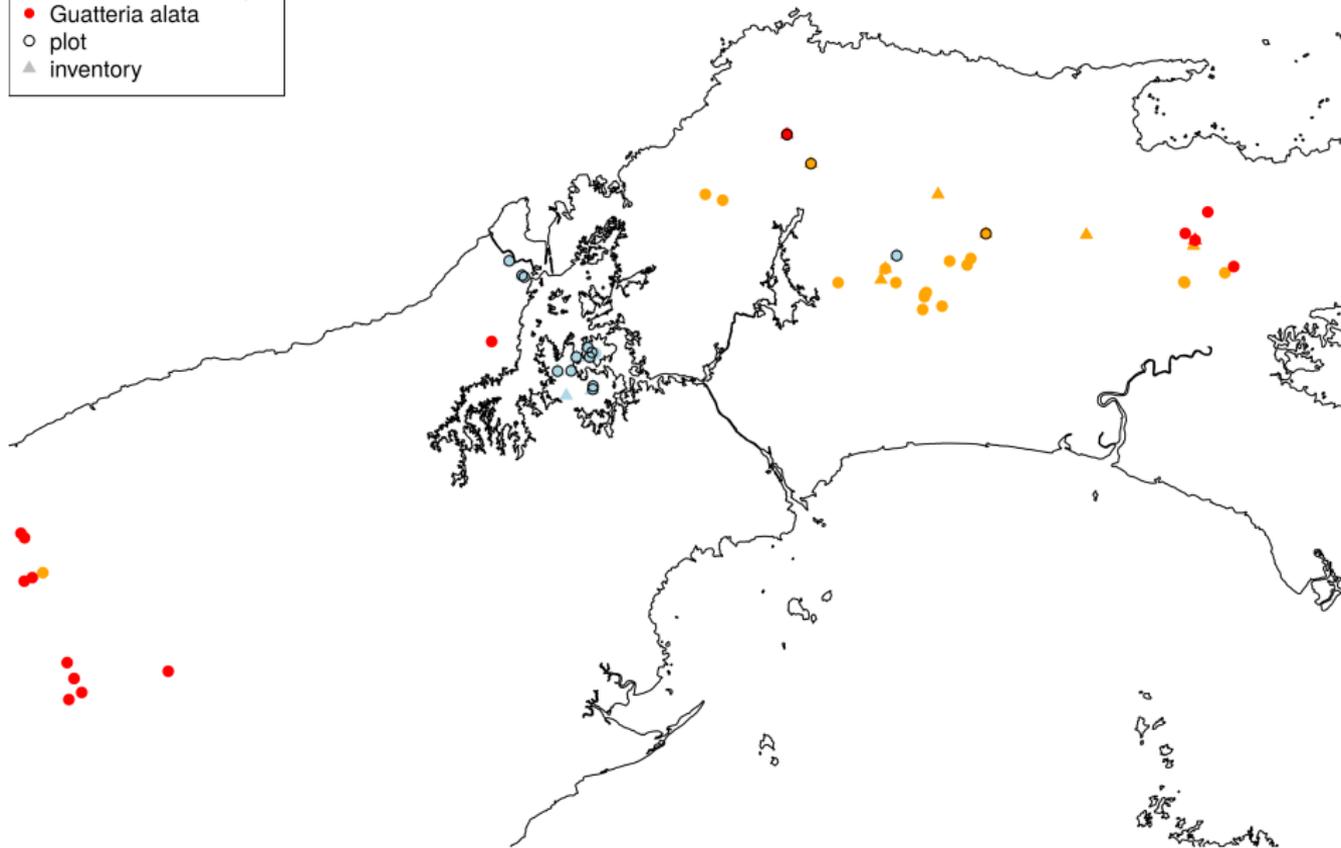
### 3 endemic Annonaceae in plots



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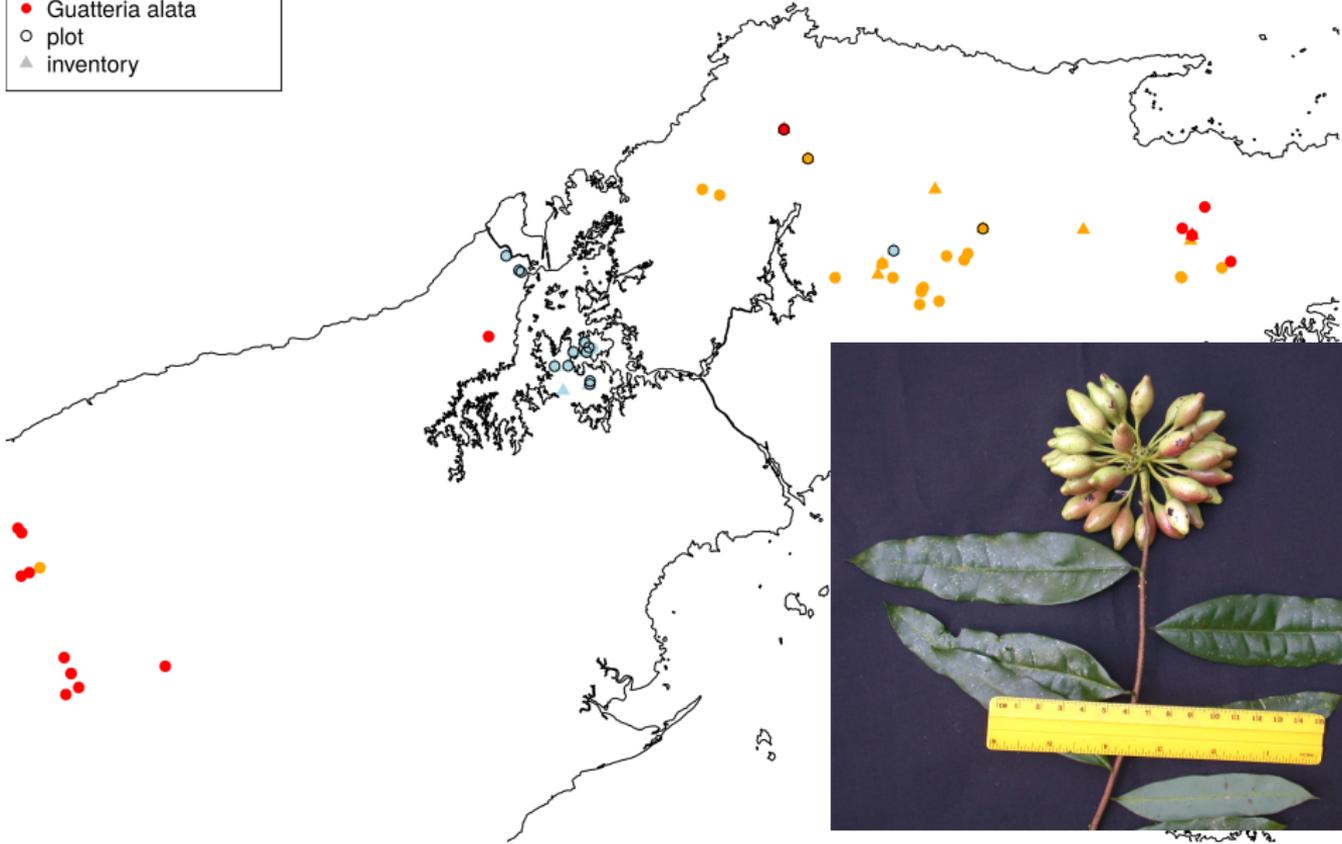
50 km

- *Mosannona garwoodii*
- *Guatteria sessilicarpa*
- *Guatteria alata*
- plot
- ▲ inventory



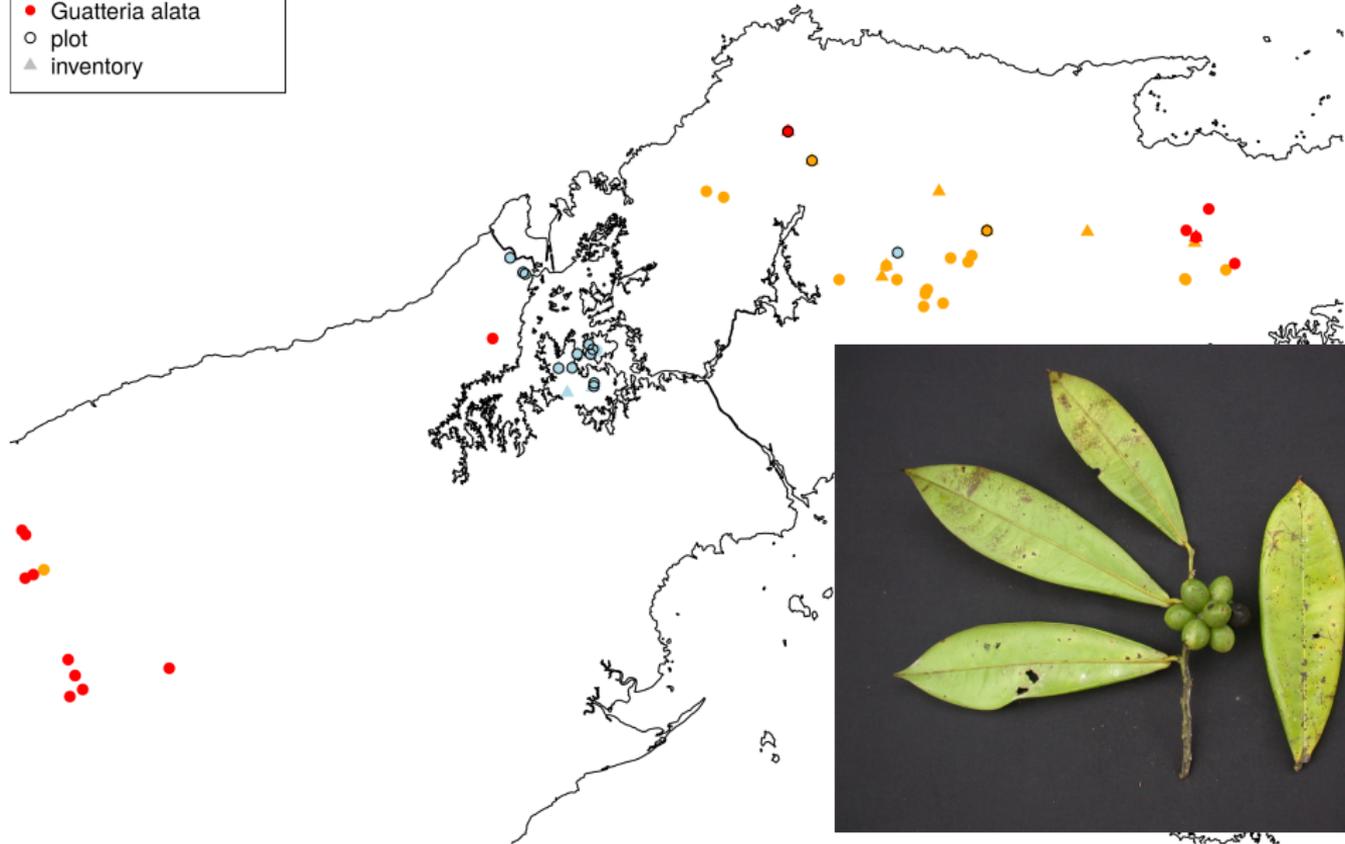
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## Annonaceae most vulnerable

23 Annonaceae endemic to Panama

6 appear in plots allow estimate of density  $\rho$  per ha  $\geq 1$  cm dbh:

- ▶ *Mosannona garwoodii* described (1997) from 50-ha plot  
Numerous in many plots near the Canal in Panama,  $\rho = 4.4$   
Abundance over 1350 km<sup>2</sup>  $\sim$  597,500 individuals

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- ▶ *Guatteria sessilicarpa*

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

Abundance over 13,000 km<sup>2</sup>  $\sim 794,000$  individuals

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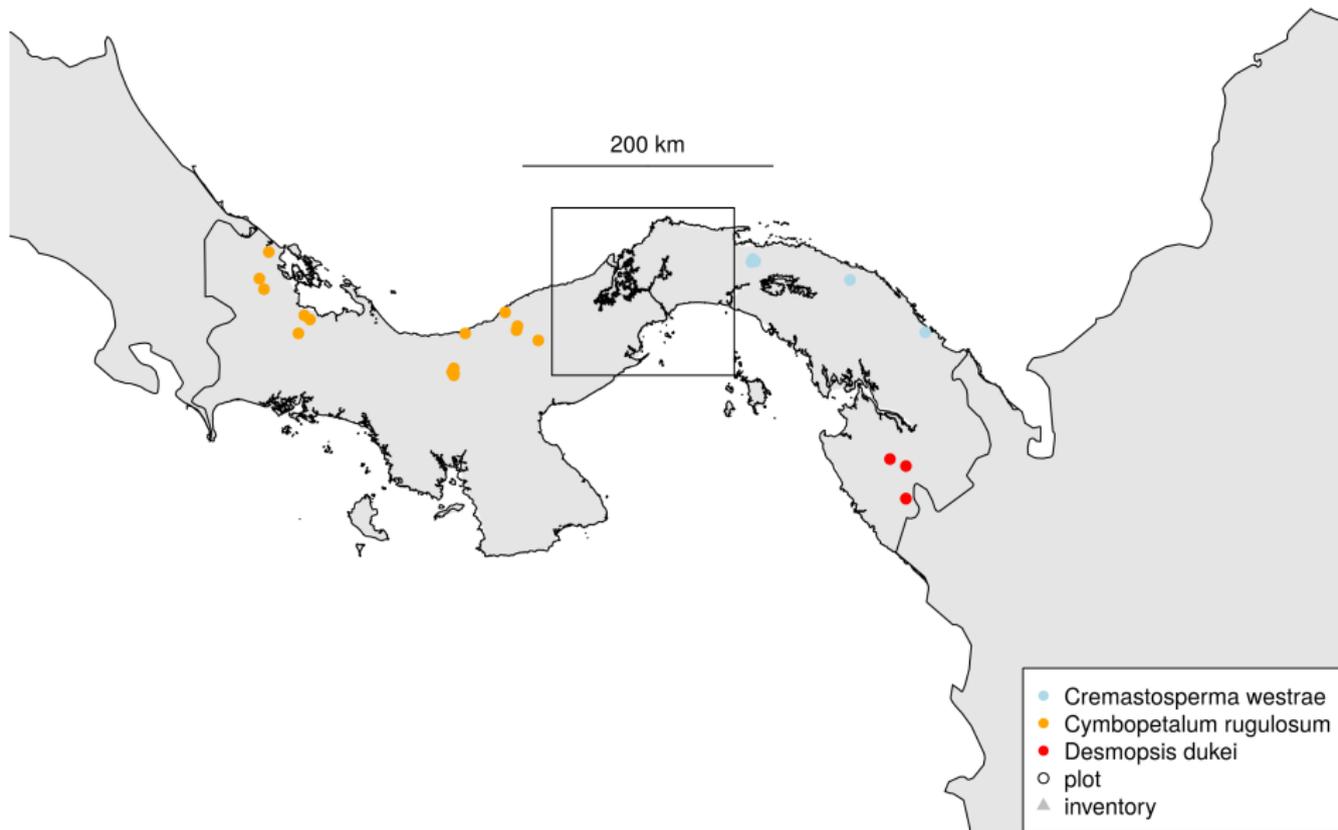
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- ▶ *Guatteria alata*

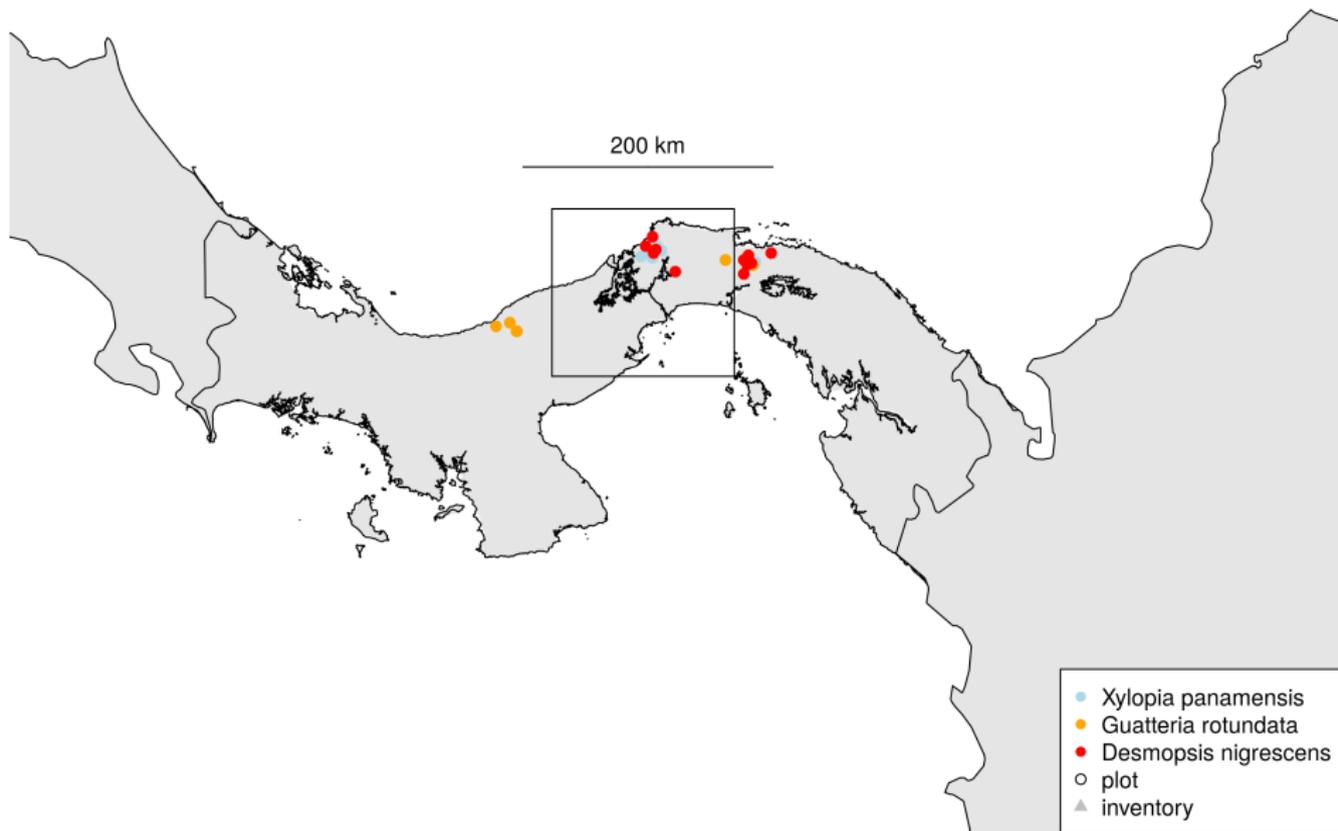
Appears in 1 plot in wet Caribbean forest,  $\rho = 0.047$

Abundance over 19,000 km<sup>2</sup>  $\sim$  88,700 individuals

### 3 endemic Annonaceae far from plots



### 3 endemic Annonaceae missing plots



## Endemic abundance

Species	plots	<sup>1</sup> density	<sup>2</sup> range	<sup>3</sup> population
<i>Crematosperma 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>Mosannonna garwoodii</i>	13	4.43	1.4	0.598

<sup>1</sup> Density ha<sup>-1</sup> averaged over all plots

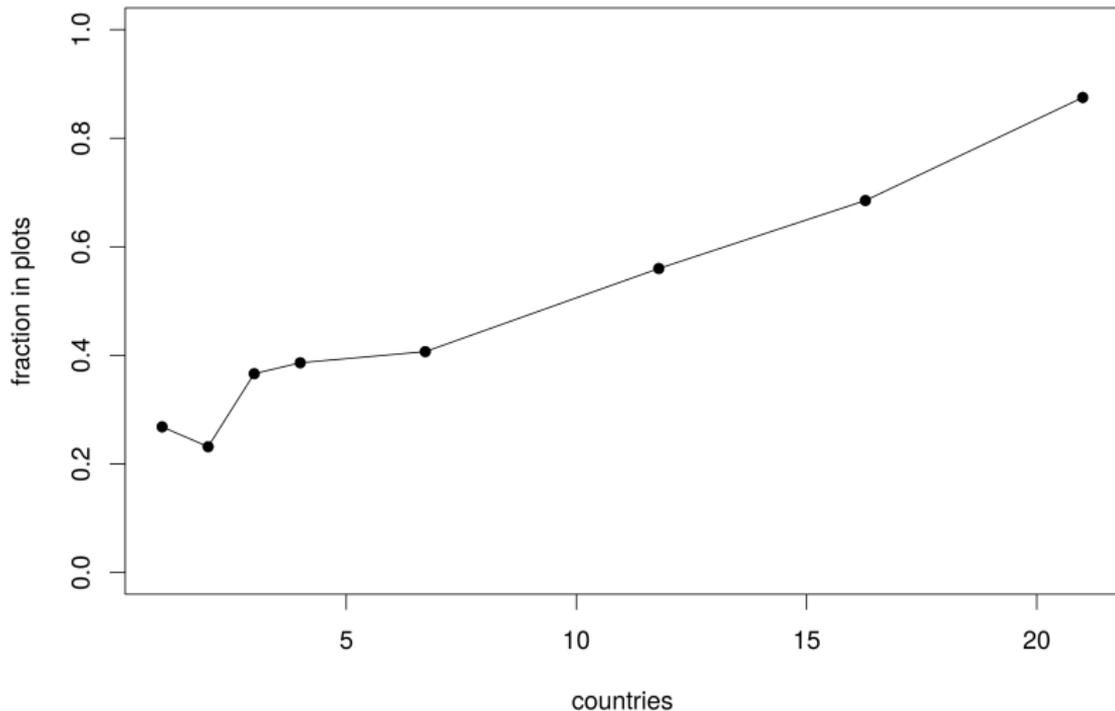
<sup>2</sup> Thousands of km<sup>2</sup>

<sup>3</sup> Millions of trees  $\geq 1$  cm dbh over entire range

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

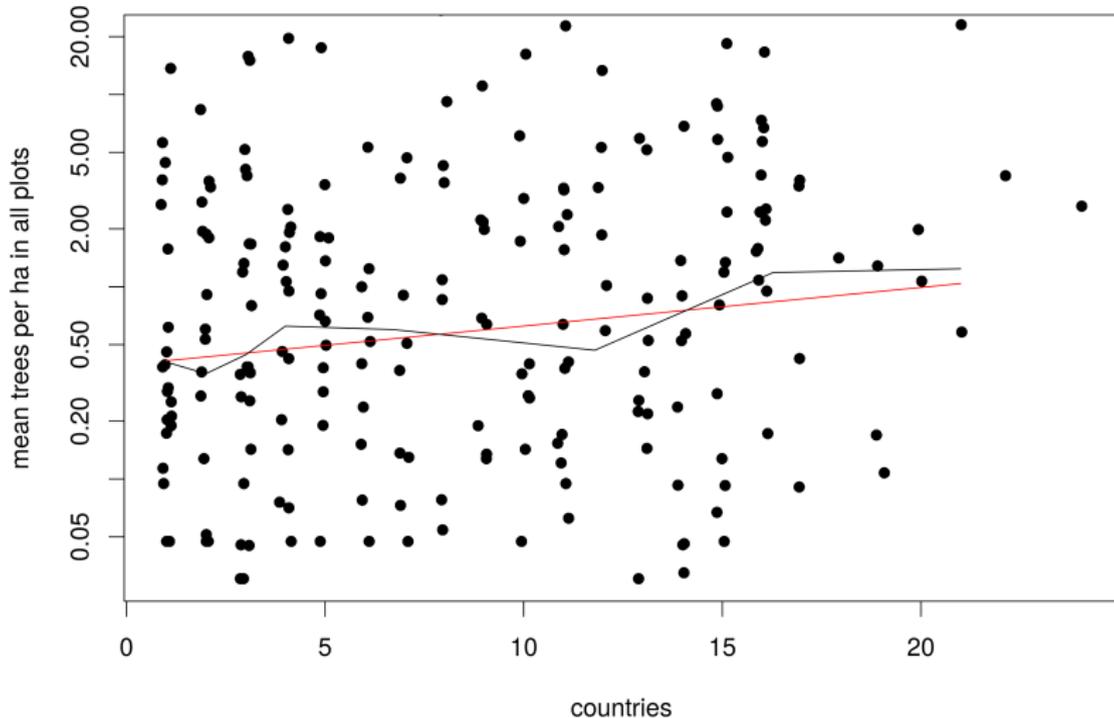
# Plot occurrence vs. range

Among 624 carefully-vetted species



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  - Endemic species abundance  $\sim 0.4$  per ha
  - Widespread species abundance  $\sim 1.1$  per ha
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