Abundance and range size of Panama's trees

Status of rare and common

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- Forest Ecology Group, Panama
- May 2018

The mission: plot abundance and geographic ranges

Data

Sparse specimen data

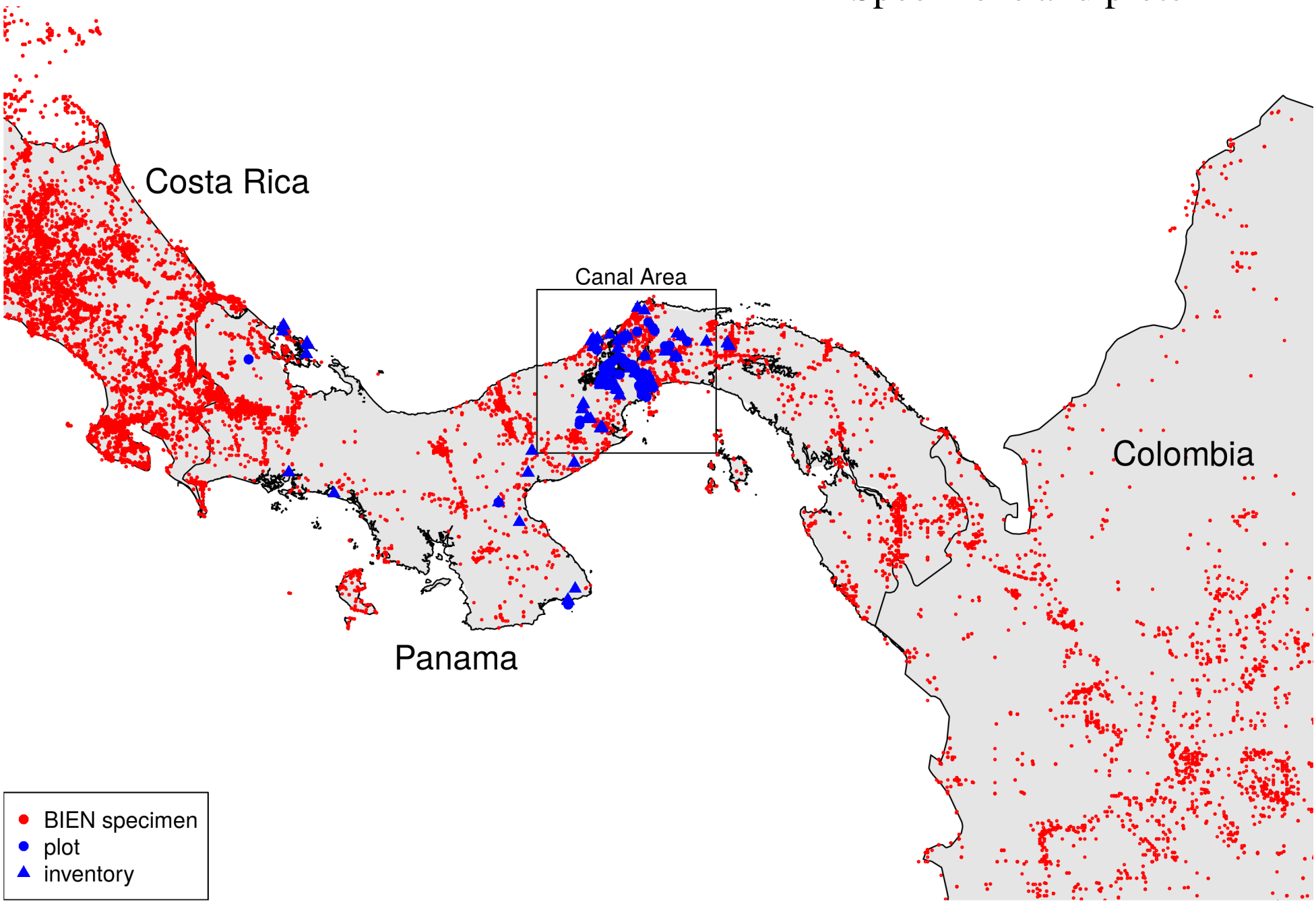
Sparse plots

Species checklists

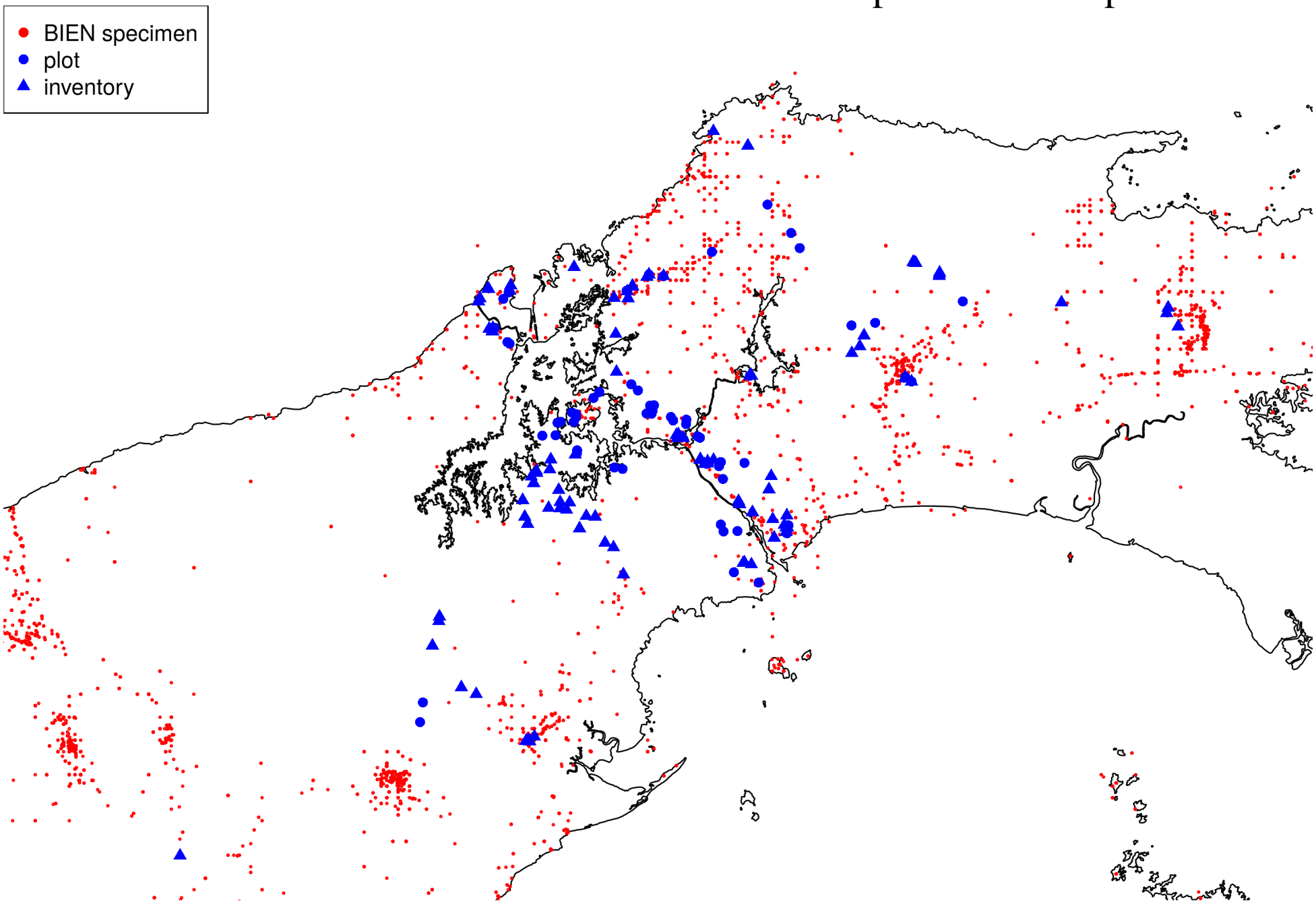
Caveats

Scales do not match

Plots capture few species


Specimens and plots
Costa Rica
Canal Area
Panama
Colombia
BIEN specimen
plot
inventory

Specimens and plots



The tree?

Including species

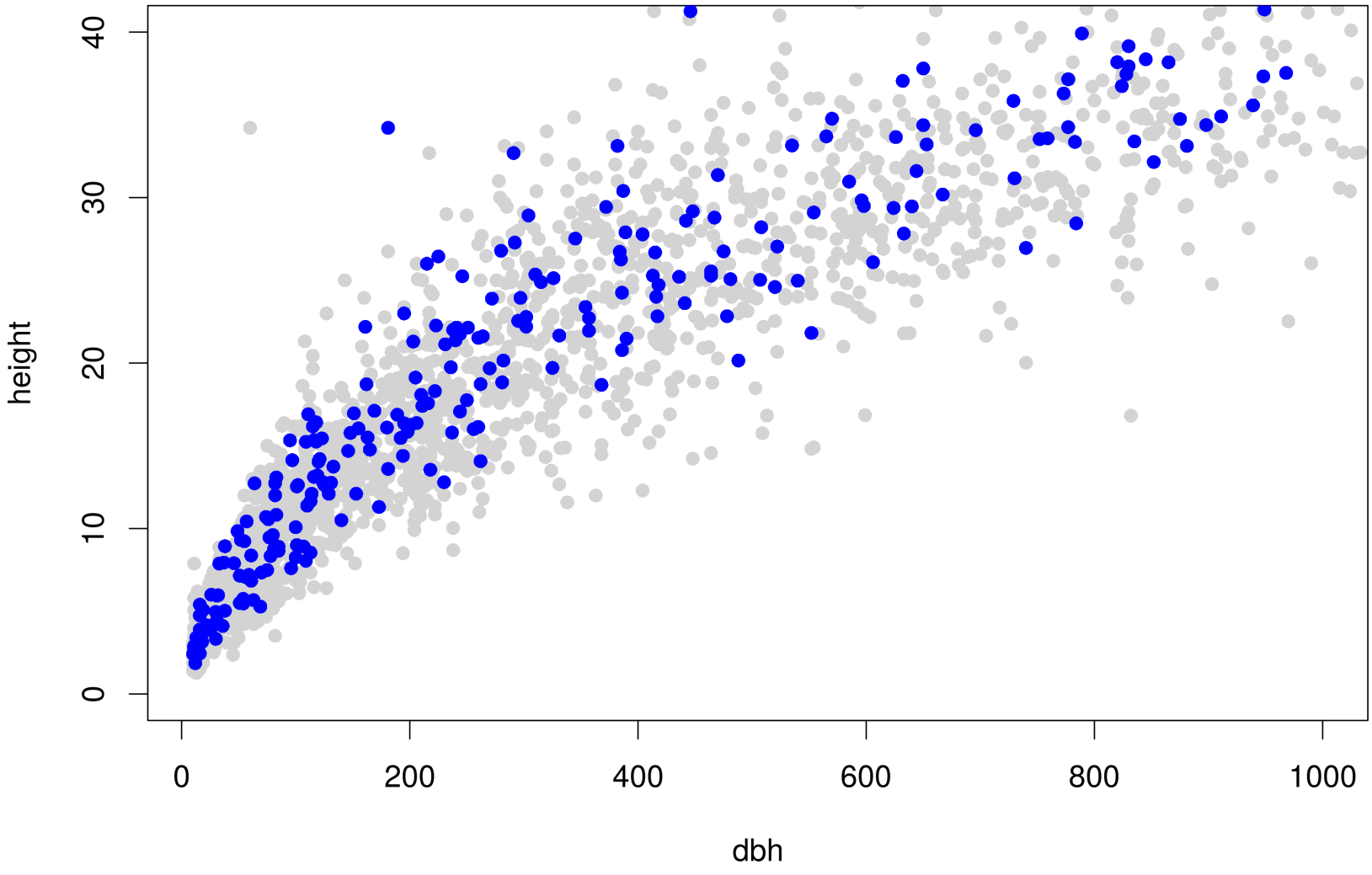
- sometimes reaching 10 m tall (as trees)
- sometimes reaching $\sim$ 4 m tall or 1 cm dbh (as treelets)
- usually free-standing as reproductive (stranglers included)
- any number of stems (ie clonal or not)

Excluding species

- usually reproducing as lianas
- usually epiphytes
- shrubs $<\sim$ 4 m tall

· All beg for precise records of many individuals
· But data either do not exist or are difficult to compile

Height of smallest species in plots



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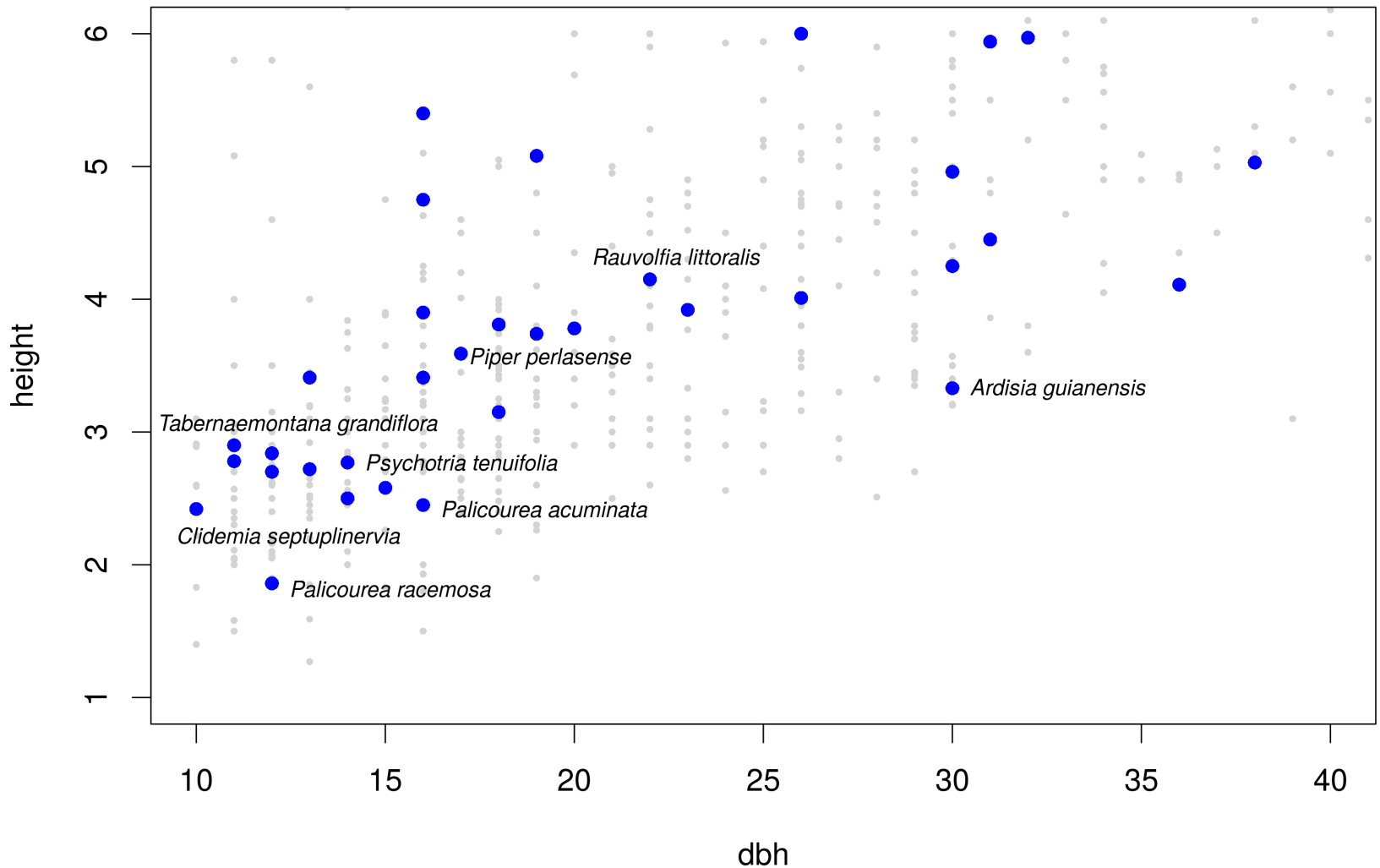


Maximum heights from Flora Mesoamericana

Rubiaceae and Melastomataceae are published

Psychotria/Palicourea*: most have max = 3 m

Clidemia**: 50 species in Panama (61 in Mesoamerica)

- 12 species max $\geq$ 4 m
- 24 species max $\leq$ 2.5 m (one epiphyte)
- 4 species max = 3 or 3.5 m

* Lorence & Taylor (2009)

** Almeda (2009)

Tree Species of Panama

A complete list

2653 species in checklist

- 129 families
- 1643 trees and 875 shrubs
- 1076 of the species are in our plots (40.6%)

W. D'Arcy (1987)

M. Correa et al. (2004)

Robin Foster

Rolando Pérez

Tree Species of Panama

A complete list

2653 species in checklist

They need thorough vetting since last update 2004

I started consulting recent monographs last year

- 42 families finished, 1238 species
- 212 species added, 115 eliminated

W. D'Arcy (1987)

M. Correa et al. (2004)

Robin Foster

Rolando Pérez

Updating tree species

Family	1987	2004	2018
Anacardiaceae	12	12	14
Annonaceae	62	78	91
Lauraceae	78	107	115
Meliaceae	31	27	31
Moraceae	69	74	72
Myristicaceae	16	18	19
Myrtaceae	51	59	83
Sapotaceae	45	57	54

- Paul Maas colleagues and students active on Annonaceae
- F. Barrie huge monograph Myrtaceae in 2005
- Pennington (Sapotaceae, Meliaceae) and Berg (Moraceae)

Narrow-range tree species

1238 species with taxonomy vetted

- 99 endemic to Panama (8.0%)
- 145 in one other country (11.7%)
  (usually Costa Rica, some Colombia and other oddities)
- 142 have range < 20,000 km^2 (15.4%)

Proportion endemic to Panama varies among families...

Family	Endemic	Not endemic	% endemic
Annonaceae	17	74	18.7
Araliaceae	10	29	25.6
Capparaceae	4	17	19.0
Cordiaceae	3	21	12.5
Fabaceae	9	228	3.8
Lauraceae	15	100	13.0
Meliaceae	3	31	8.8
Moraceae	0	72	0.0
Myristicaceae	1	18	5.3
Myrtaceae	22	61	26.5
Sapotaceae	1	53	1.9
Urticaceae	0	25	0.0
Minor*	10	143	6.5
Guttiferae**	4	32	11.1

* 29 small families including Anacardiaceae, Celastraceae, Combretaceae, Fagaceae, Lamiaceae, Rhamnaceae, Symplocaceae

** Calophyllaceae, Clusiaceae, Hypericaceae

... likewise proportion with narrow ranges < 20,000 km^2

Family	Narrow	Wide	% narrow
Annonaceae	29	56	34.1
Araliaceae	14	21	40.0
Capparaceae	3	17	15.0
Cordiaceae	0	19	0.0
Fabaceae	18	204	8.1
Lauraceae	24	85	22.0
Meliaceae	3	30	9.1
Moraceae	2	69	2.8
Myristicaceae	2	16	11.1
Myrtaceae	22	35	38.6
Sapotaceae	0	51	0.0
Urticaceae	1	24	4.0
Minor*	19	121	13.6
Guttiferae**	5	30	14.3

* 29 small families including Anacardiaceae, Celastraceae, Combretaceae, Fagaceae, Lamiaceae, Rhamnaceae, Symplocaceae

** Calophyllaceae, Clusiaceae, Hypericaceae

Species found in plots

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

Range (countries)	Found in plots	Not found	% found
1	20	79	20.2
2	32	113	22.1
>2	316	443	41.6

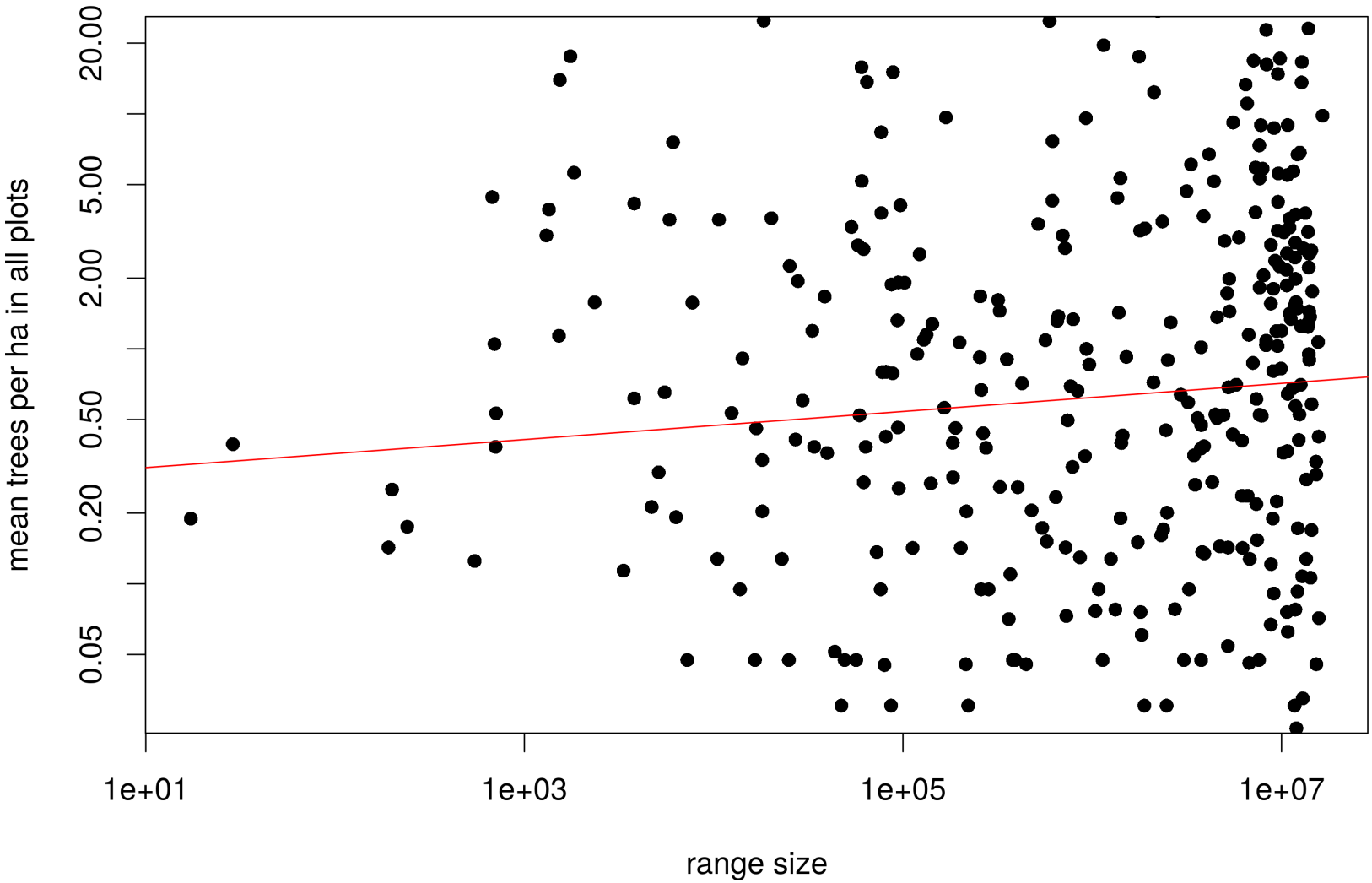
Species found in plots

...by range size

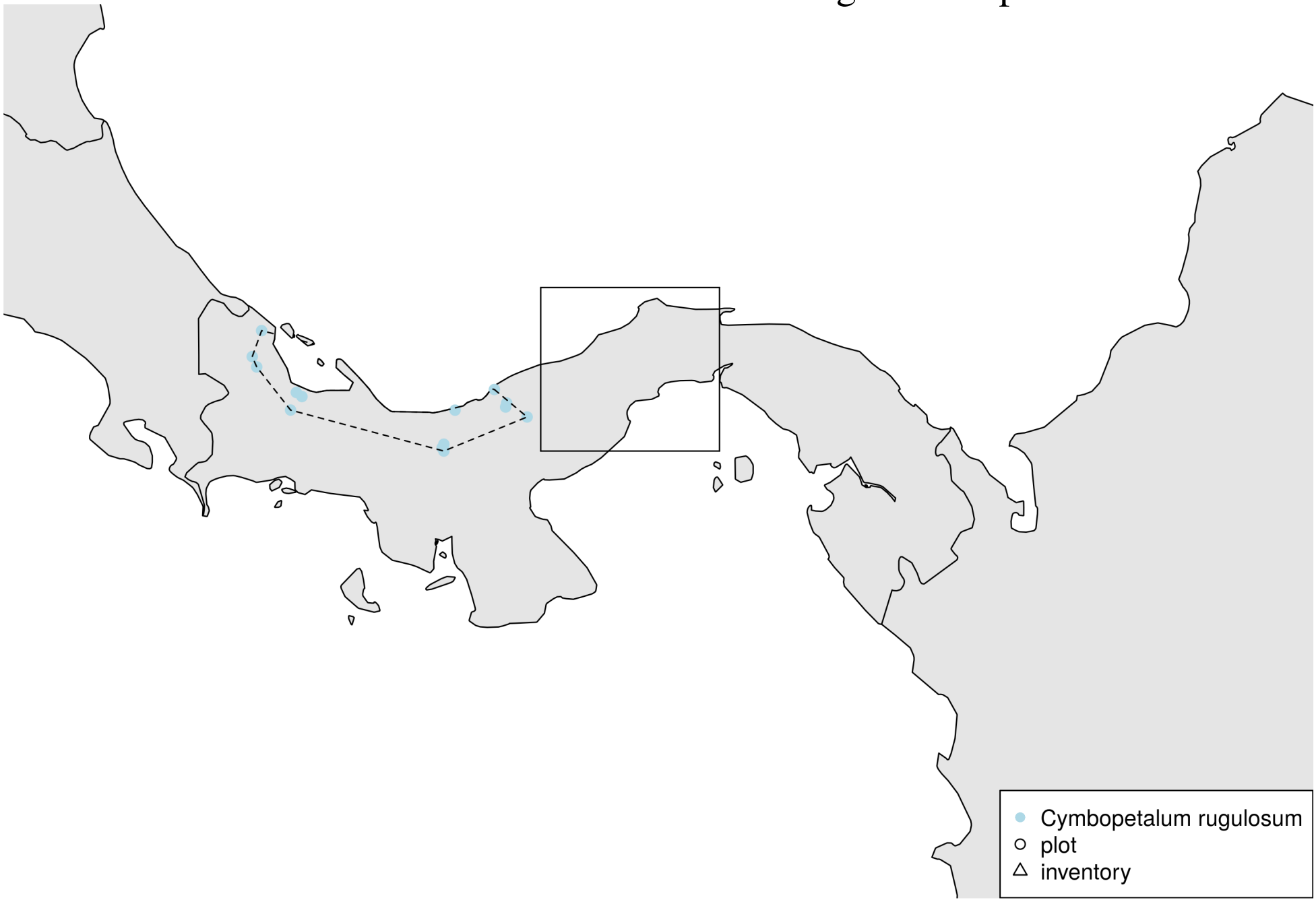
Range (km^2)	Found in plots	Not found	% found
<1e4	30	70	30.0
1e4-1e5	57	123	31.7
1e5-1e6	68	134	33.7
>1e6	208	230	47.5

All plot abundance vs. range

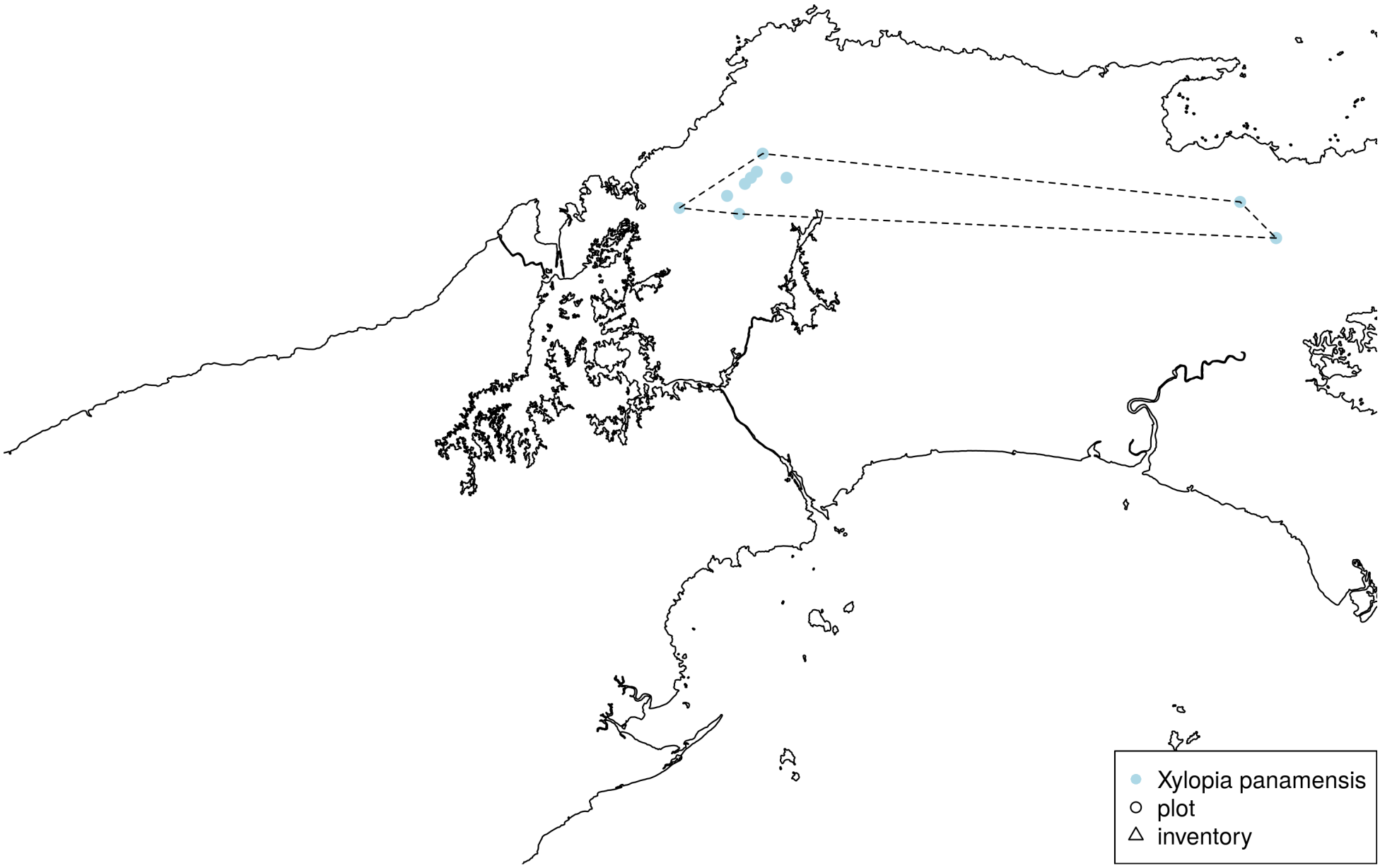
Among 920 in 42 carefully-vetted families



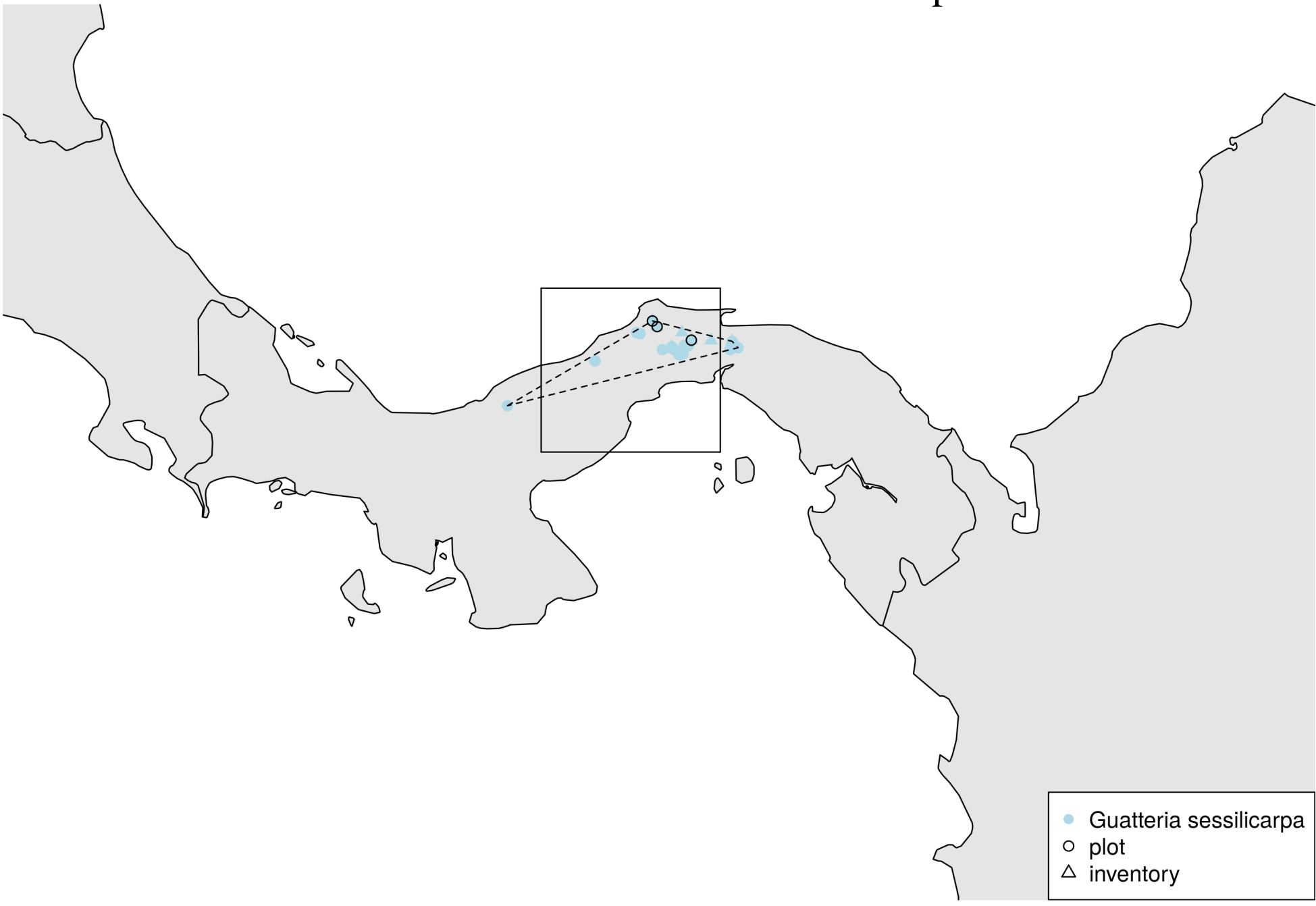
Endemic Annonaceae: range avoids plots



Endemic Annonaceae: not found in plots



Endemic Annonaceae: found in plots



Endemic Annonaceae: found in plots

Guatteria sessilicarpa
plot
inventory

Endemic Annonaceae: found in plots

Mosannona garwoodii
plot
inventory

Annonaceae most vulnerable

24 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, $\rho = 4.4$

  Core range 70 $\text{km}^2 \sim$ 30,000 individuals

Annonaceae most vulnerable

24 Annonaceae endemic to Panama
6 appear in plots allow estimate of density ρ per ha ≥ 1 cm dbh:

- *Guatteria sessilicarpa*

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

  Abundance over 13,000 $\text{km}^2 \sim 794{,}000$ individuals

Annonaceae most vulnerable

24 Annonaceae endemic to Panama
6 appear in plots allow estimate of density ρ per ha ≥ 1 cm dbh:

- *Guatteria alata*

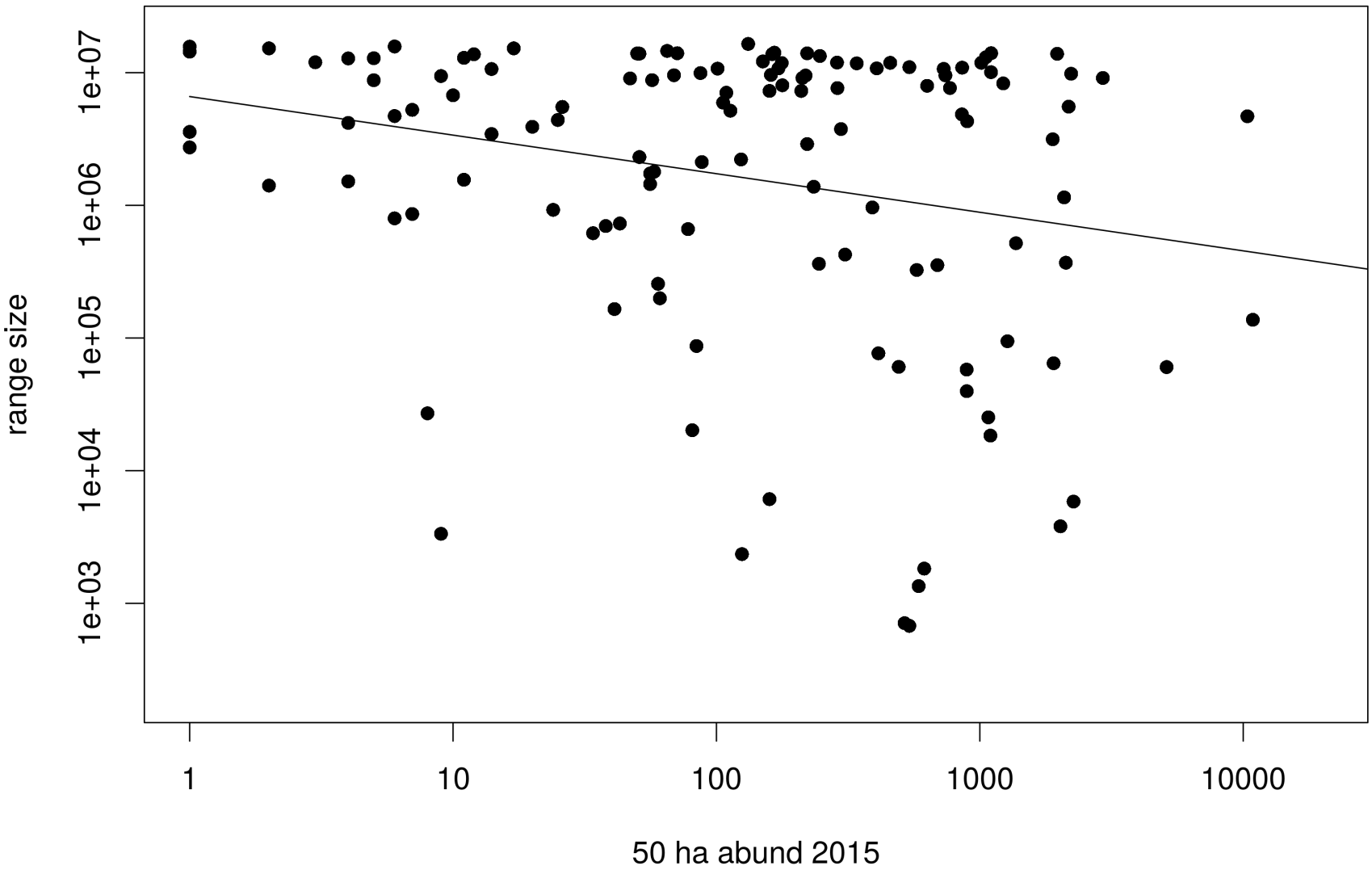
  Appears in 1 plot in wet Caribbean forest, $\rho = 0.047$

  Abundance over 19,000 $\text{km}^2 \sim 88{,}700$ individuals


Astronium graveolens
plot
inventory

Abundance vs. range

Among 133 species in 42 carefully-vetted families



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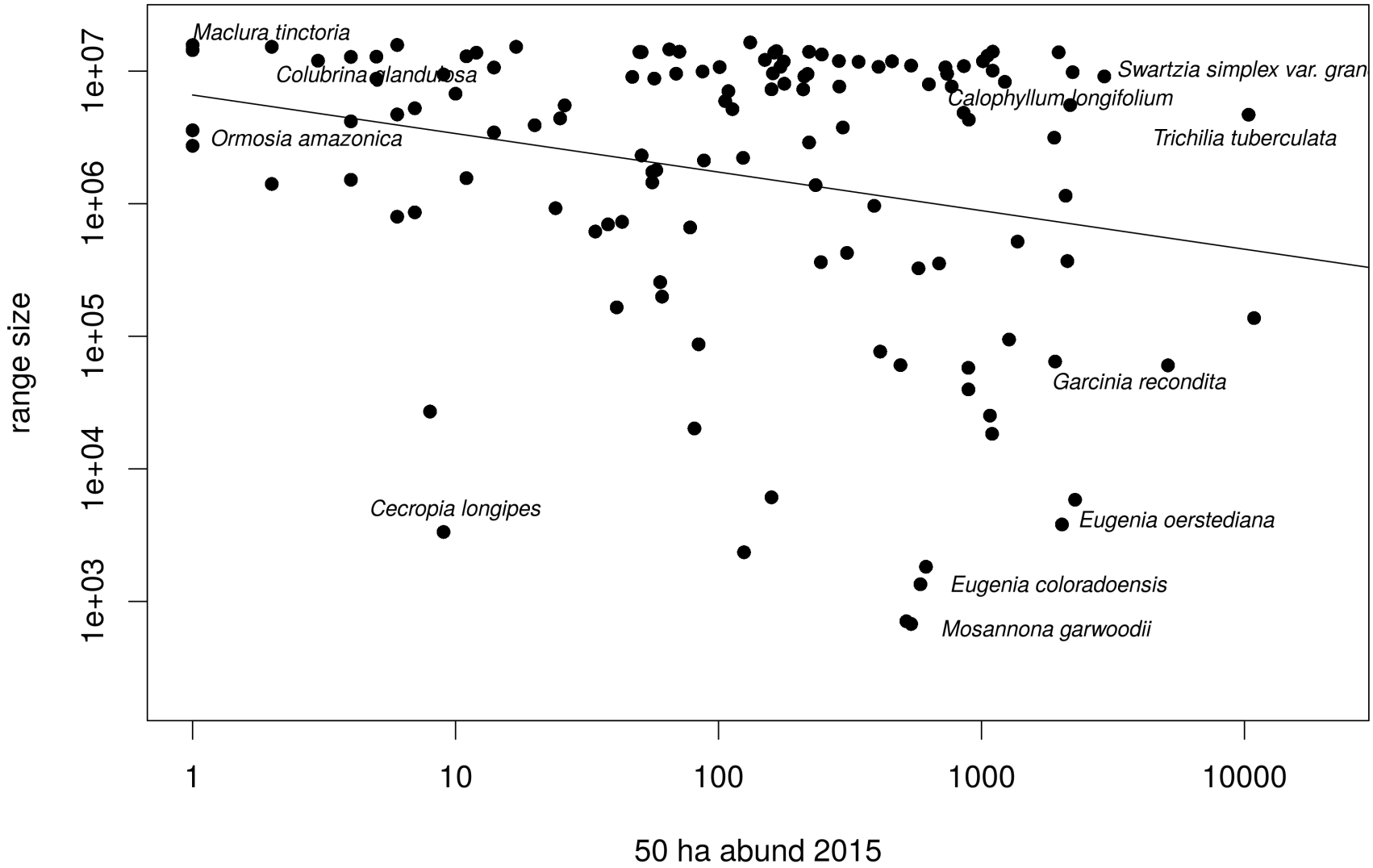
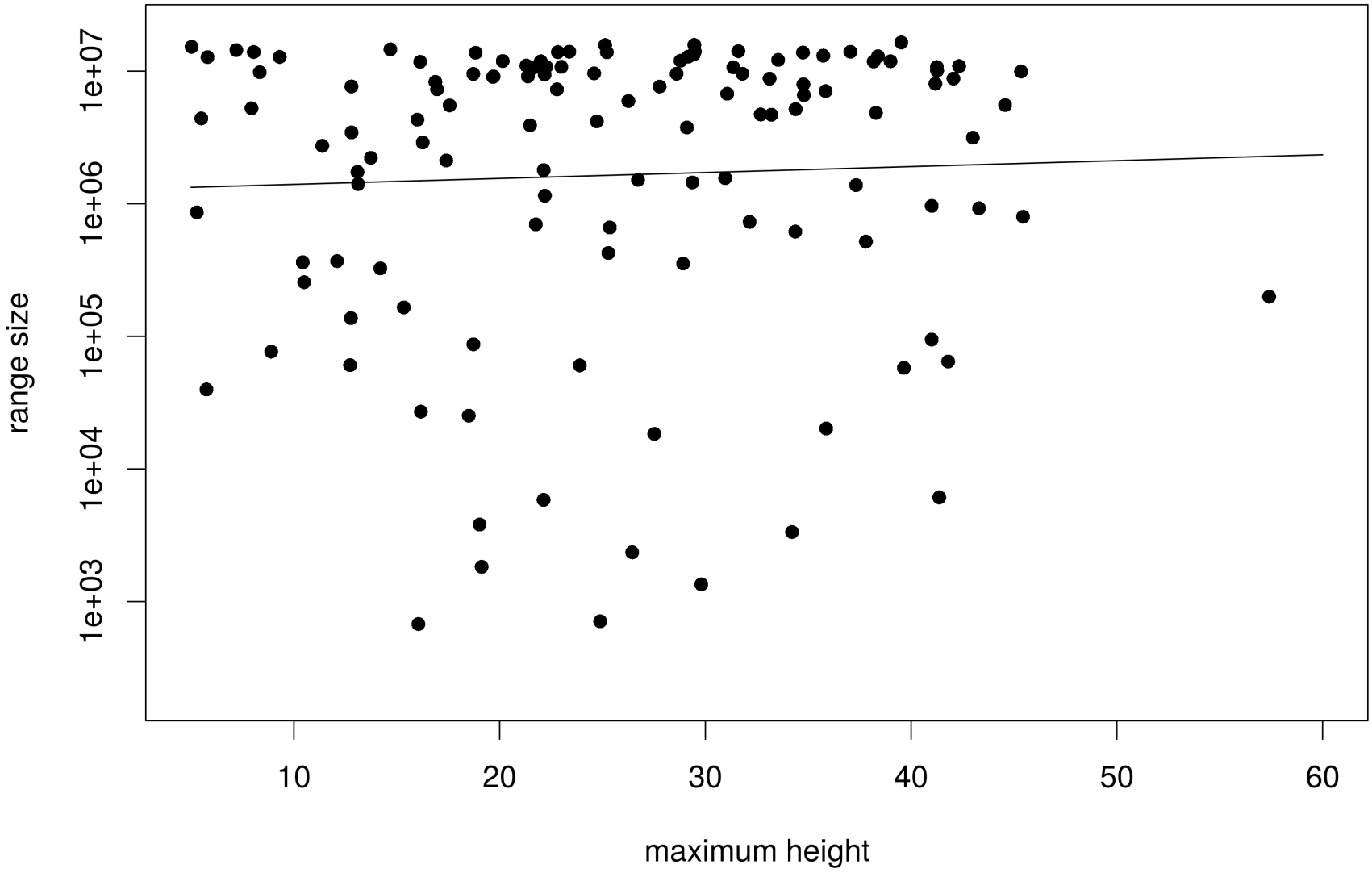


Species height vs. range

Among 124 species in 42 carefully-vetted families



Conclusions and hypotheses for future work

- Checklist and occurrence
  - Problems maintaining an updated taxonomy
  - Many taxonomists involved in revisions
  - All ($\pm$) species examined
- Plots and the checklist
  - In Panama, 40% 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 $\sim$ 0.4 per ha
  - Widespread species abundance $\sim$ 1.1 per ha
  - No correlation 50-ha abundance and range
  - But abundances vary orders of magnitude
    so predictions for unknown species are poor

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