

The rarest species of Amazonia: Local abundance and range sizes

Conservation of the most vulnerable



¹ SIGEO & Center for Tropical Forest Science

Tendencias en investigaciones en los bosques amazónicas:
manejo y monitoreo como herramientas de toma de decisiones
September 2011

Tropical forest renowned for rarity

Habitat heterogeneity relates to beta-diversity and range limits

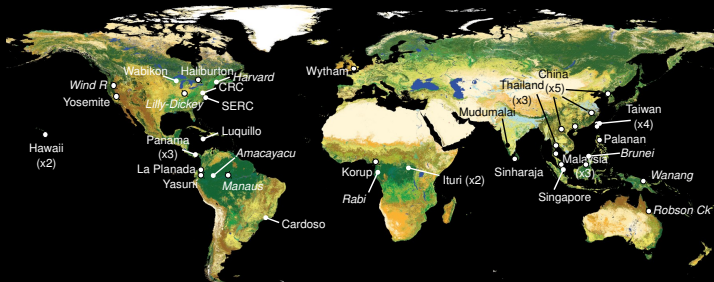
Tropical forest renowned for rarity

Habitat heterogeneity relates to beta-diversity and range limits

- Does lowland Amazonia have very rare species?
- Is Amazonia homogeneous so that most species are widespread?
- Are there 'hot spots' where very rare species are concentrated?

Center for Tropical Forest Science: Smithsonian & Harvard

SIGEO-CTFS: A network of forest censuses following common methods



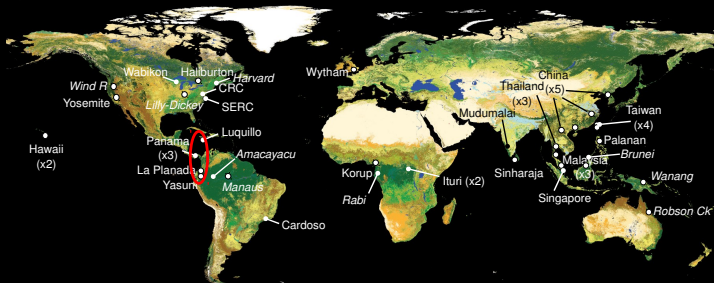
33 completed plots have data in a common database format on one of 4 servers

-- 3,802,654 trees (ie 3.80×10^6)

-- 9,073,531 measurements (ie 9.07×10^6) in 89 plot censuses

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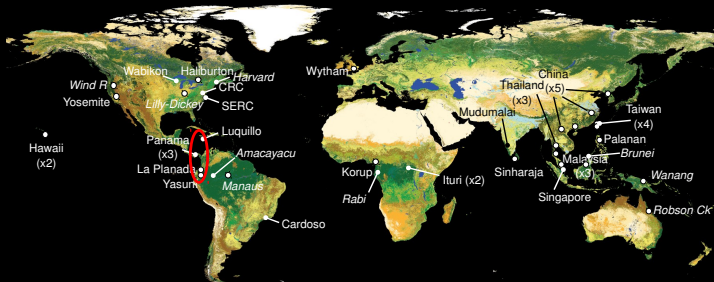
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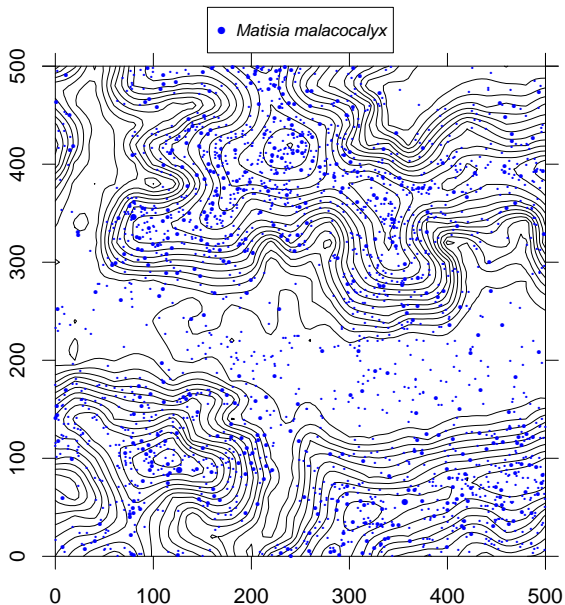


Yasuni: Renato Valencia et al.
Luquillo: Jess Zimmerman et al.
La Planada: Cristian Samper et al.
BCI: Hubbell & Foster et al.

CTFS Amazon census plots

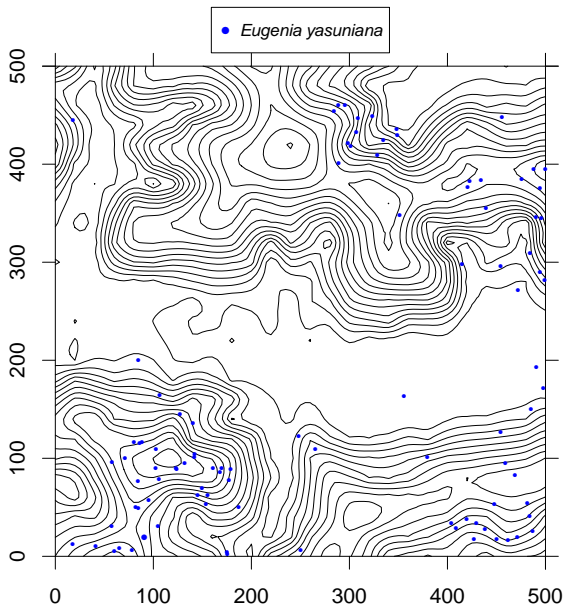


Yasuní, Amazonian CTFS census plot



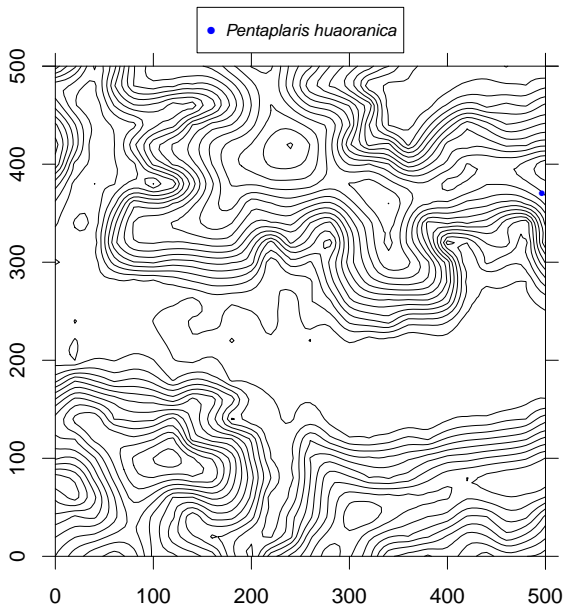
- Yasuni plot
- 1997-2010
- R. Valencia
C. Hernández
R. Condit
R. Foster

Yasuní, Amazonian CTFS census plot



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Abundance of all 1073 species in Yasuní plot, Amazonian Ecuador

Family	Species	Population
Malvaceae	<i>Matisia oblongifolia</i>	4625
Violaceae	<i>Rinorea lindeniana</i>	3213
Malvaceae	<i>Matisia malacocalyx</i>	2311
Arecaceae	<i>Iriartea deltoidea</i>	2227
:	:	:
Myrtaceae	<i>Eugenia yasuniana</i>	99
:	:	:
Clusiaceae	<i>Garcinia brasiliensis</i>	81
:	:	:
Malvaceae	<i>Pentaplaris huaoranica</i>	1
Theaceae	<i>Gordonia fruticosa</i>	1
	48 more species	1

BIEN: Botanical Information for Ecology Network

BIEN is a group of botanists interested in broad-scales in ecology and seeking ecoinformatic solutions



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BIEN is a group of botanists interested in broad-scales in ecology and seeking ecoinformatic solutions

- seeking very large collections of plot and specimen data publicly available
- harmonizing the format and the taxonomy in order to maximize the records available
- offering convenient access



- B. Enquist (Arizona)
- P. Jørgensen (Missouri)
- B. Boyle (Arizona)
- S. Dolins (Bradley)
- R. Condit (STRI)
- M. Schildauer (NCEAS)
- R. Peet (N. Carolina)
- ... and more



- ① CTFS plot network
 - Complete local censuses
 - Many rare species
- ② BIEN Working Group
- ③ Range statistics from 9 million specimens
 - Species in the Americas
 - Amazonian species
 - Species with very localized records
 - Abundance and range size
- ④ Conclusions
 - Range of Amazonian species
 - Hot spots

- 12 million occurrences in a single table



Faramea occidentalis

- 12 million occurrences in a single table
 - Abundances for a single taxon from a single plot
 - Herbarium specimens with locations (e.g. Missouri)



Faramea occidentalis

- 12 million occurrences in a single table
- 11.3 million occurrences in the Americas



Faramea occidentalis

- 11.3 million occurrences in the Americas
- 10.3 million have a verified province name
- 6.6 million have precise coordinates
- The taxonomy challenge
 - 9.5 million have a verified, harmonized, complete Latin binomial
 - 5.6 million have coordinates and a verified Latin name



Faramea occidentalis

Taxonomic Name Resolution Service

<http://tnrs.iplantcollaborative.org/TNRSapp.html>

a product of the BIEN group which will check 1000s of names and report misspellings and synonymy

- 315,488 distinct taxa names in 12 million records
 - Many incorrect, or are spelling 'variants'
 - Many are not complete binomials
 - Some are ferns, algae, mosses
- 180,283 names can be matched to an authoritative list (Missouri)
- 129,998 species of higher plants in the Americas



Symphonia globulifera
(plant photos Rolando Pérez)

129,998 valid names in the Americas:



Palicourea guianensis

129,998 valid names in the Americas:

- 11,999 have no records with coordinates nor with province name
 - 7,197 with just one record
 - 11,177 occur in only one country



Palicourea guianensis

129,998 valid names in the Americas:

- 11,999 have no records with coordinates nor with province name
- 117,999 have at least one province name
- 85,889 have at least one record with coordinates



Palicourea guianensis

129,998 valid names in the Americas:

- 22,841 have exactly one record, period (singletons)



Palicourea guianensis

25,281 valid names in Amazonia:



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- 1,190 have only one record (singletons)



Palicourea guianensis

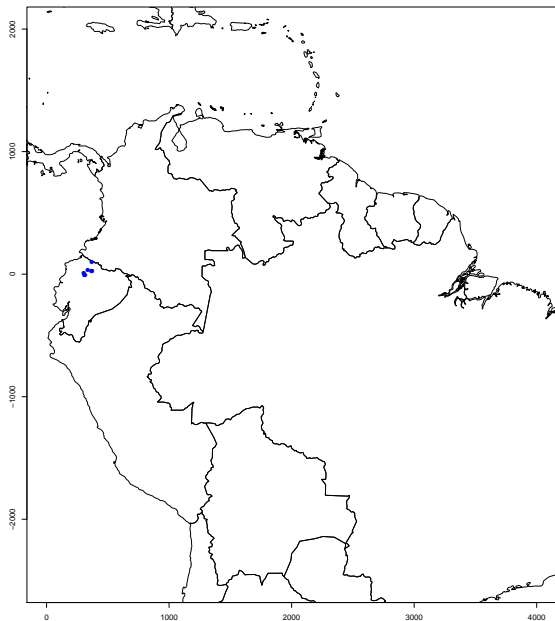
25,281 valid names in Amazonia:

- 22,413 have at least one record with coordinates
- 387 have exactly one record, and it has coordinates
- 1,190 have only one record (singletons)
- 2,960 endemic to Amazon



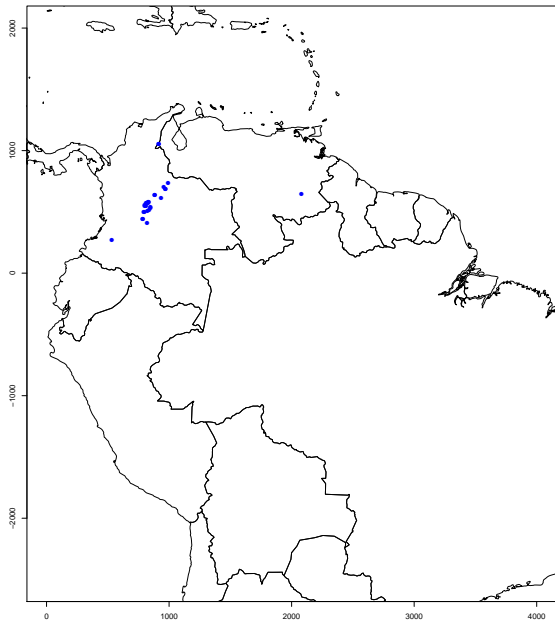
Palicourea guianensis

Range sizes in Amazonia



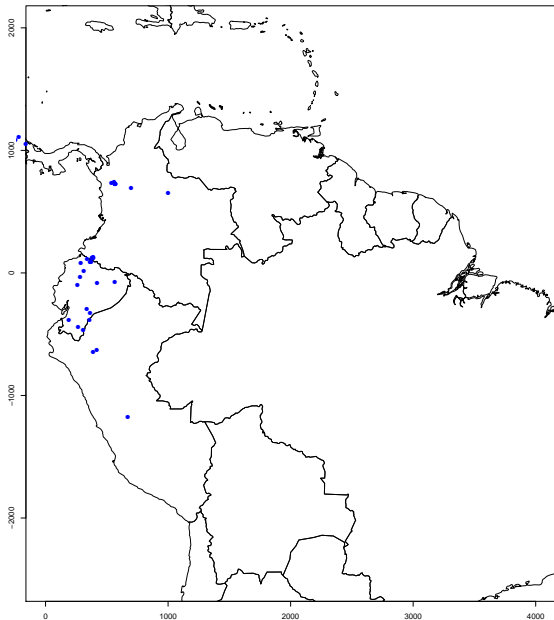
Axinaea sodiroi
 $1.5 \cdot 10^4 \text{ km}^2$

Range sizes in Amazonia



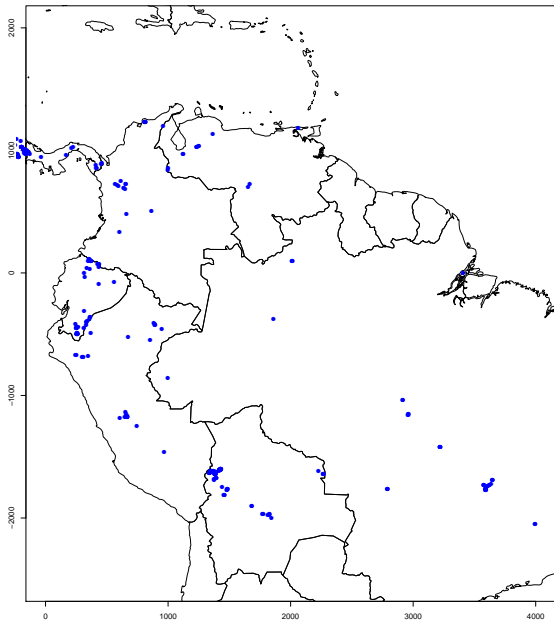
Weinmannia tomentosa
 $1.4 \cdot 10^6 \text{ km}^2$

Range sizes in Amazonia



Hillia macrophylla
 $2.2 \cdot 10^6 \text{ km}^2$

Range sizes in Amazonia



Gordonia fruticosa
 $15.8 \cdot 10^6 \text{ km}^2$

Range size and singletons

Amazonian range sizes compared to all America

Range	Number of species (%)		
	American	Amazonian	Yasuni
singleton	22841 (17.7)	1190 (4.7)	6* (0.8)
narrow	6463 (5.0)	562 (2.2)	5 (0.7)
wide	44458 (34.4)	17458 (69.1)	690 (95.0)
total	129255	25281	726
median range (km ²)	0.12	1.60	6.47

Singleton: one specimen only (many lack coordinates)

Narrow: > 1 specimen, but only known at one location

Wide: > 10⁵ km²

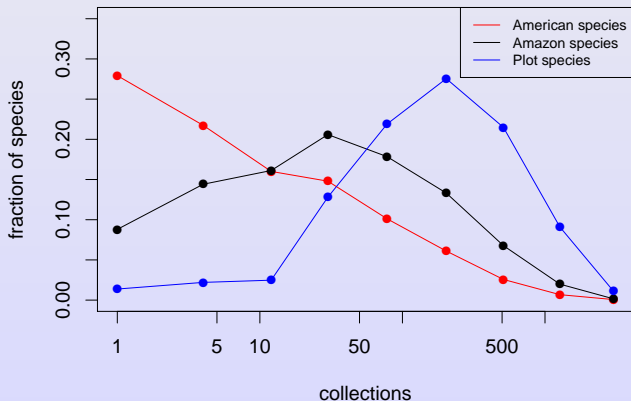
* including *Eugenia yasuniana* and *Garcinia brasiliensis*

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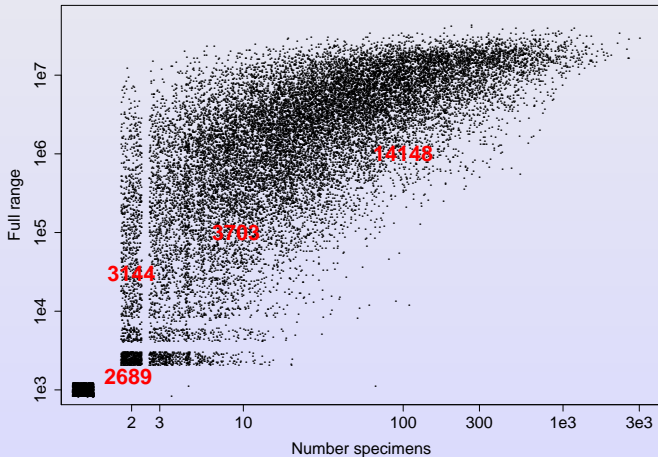
Histogram of collections per species in BIEN database (9 million total)

- Across Americas: high proportion have one specimen only
- Amazonian species and plot species: many collections



Range size vs. specimen number

Amazonian species



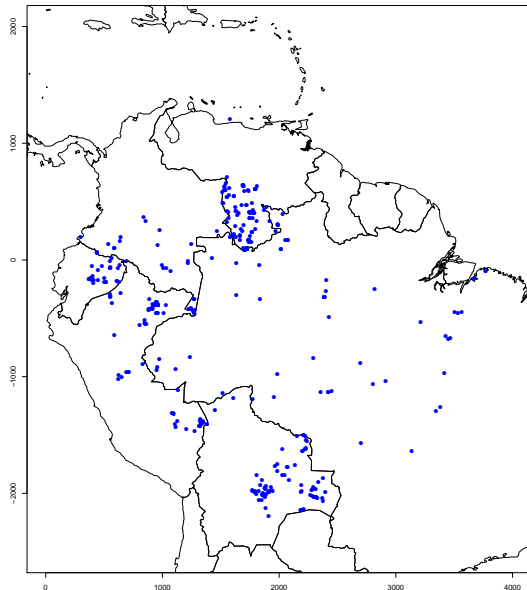
22,413 species:

14K have ≤ 10 records
spanning $> 10^5$ km²

3,700 have ≤ 10 records
spanning $> 10^4$ km²

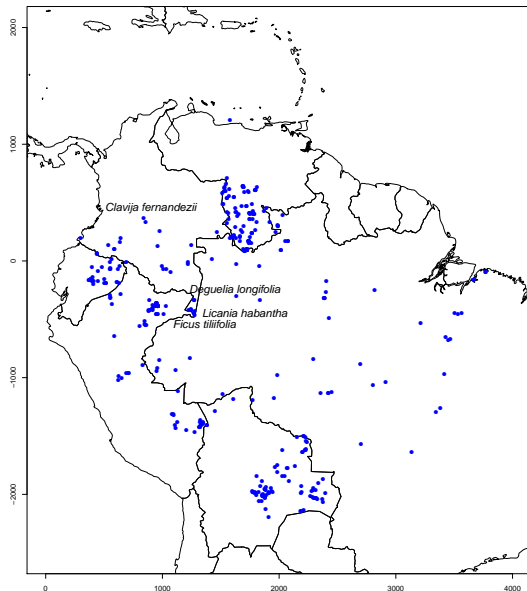
2,689 have ≤ 10 records
spanning < 2.5 km³

387 singleton species of Amazonia



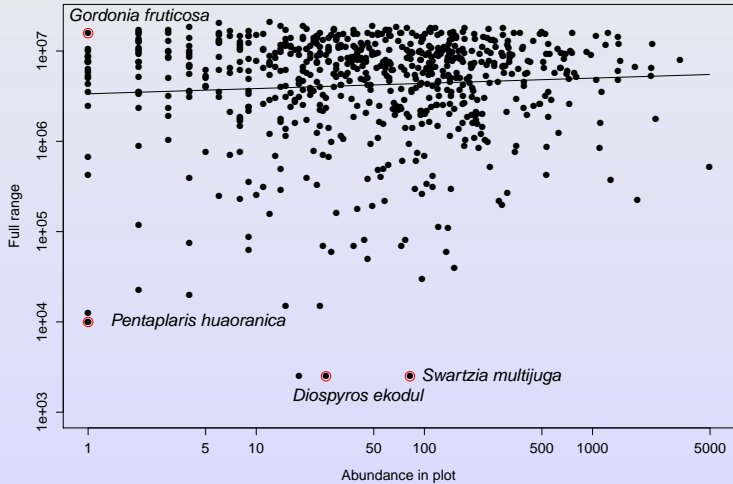
Hot spots?

387 singleton species of Amazonia



Hot spots?

Yasuní abundance and range size



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- How many more collections to be digitized, will they add many more?
- 3,000 species with very few collections are an invitation for more study

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- Are they real or ghosts?

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