

August 18, 2015, 6<sup>th</sup> International Barcode of Life Conference  
Barcodes to Biomes

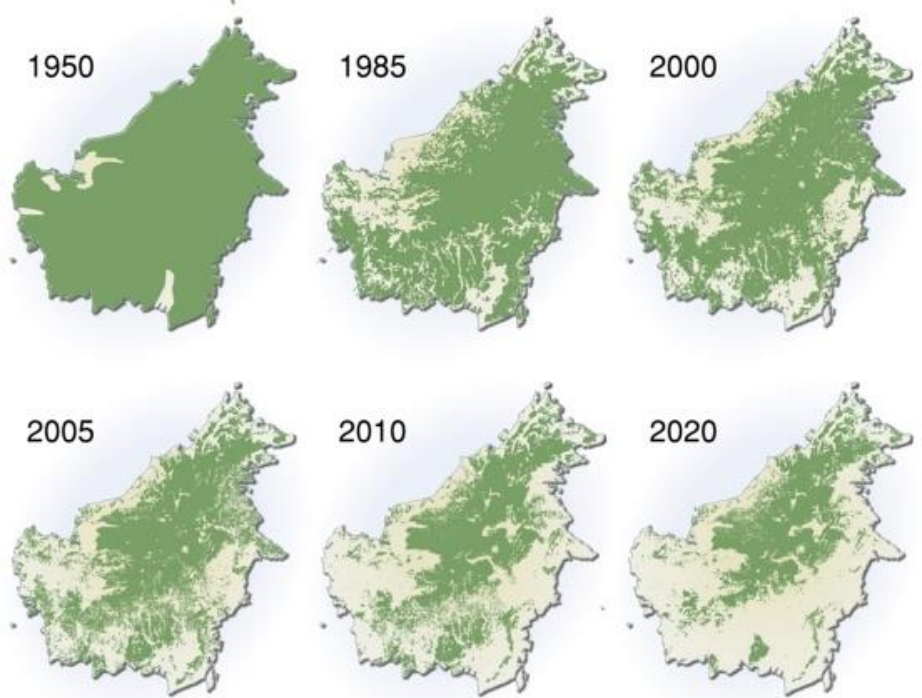
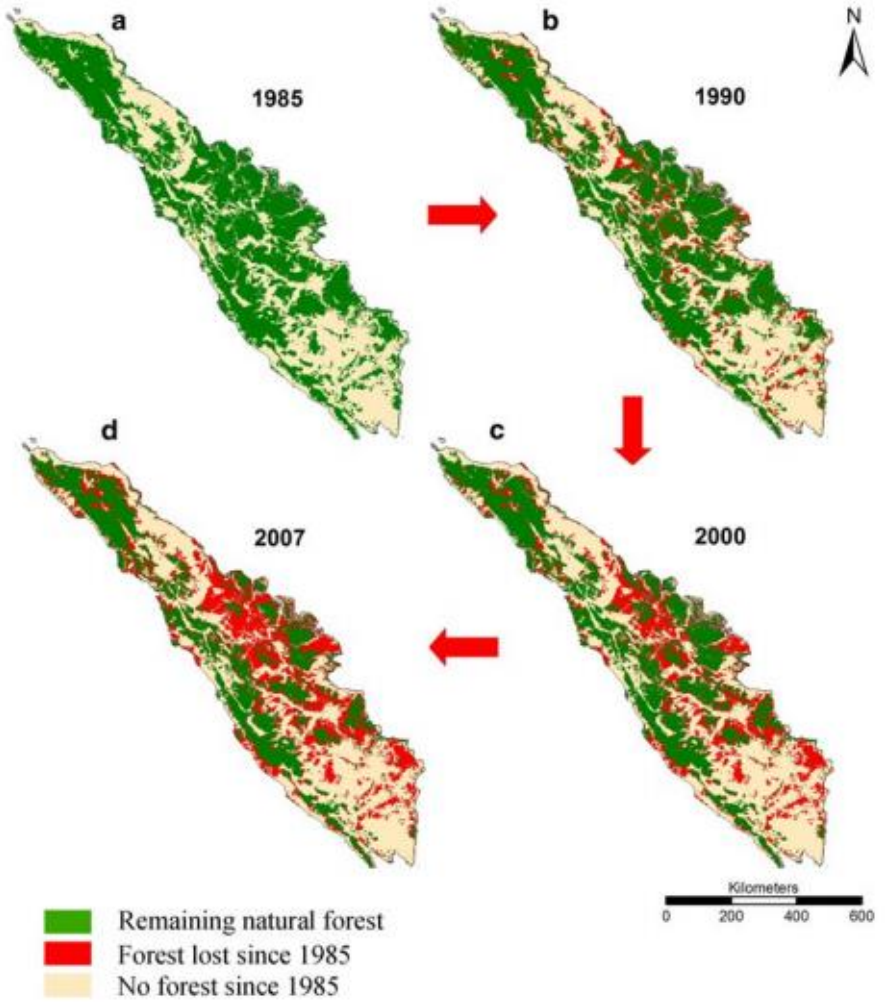
# Plant Diversity Assessments in tropical forest of SE Asia

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# Goal: assessing plant species loss under the rapid deforestation in SE Asia



Laumonier et al. (2010)

# Outline

- Assessing **trends** of species richness, PD and community structure in 32 permanent plots of 50m x 50m in Cambodia
- Recording **status** of all the vascular plant species in 100m x 5m plots placed in Vietnam, Cambodia, Thailand, Malaysia and Indonesia
- Assessing **extinction risks** in some representative groups: case studies in *Bauhinia* and *Dalbergia* (Fabaceae)

# Deforestation in Cambodia

Sep. 2010



Jan. 2011



Recently, tropical lowland forest of Cambodia is rapidly disappearing; assessments are urgently needed.





# Unknown taxonomy of plot trees

Top et al. (2009); 88 spp (36%) of 243 spp. remain unidentified.

## Appendix 1

See Table 2.

**Table 2** List of species (DBH  $\geq$  10 cm), number of individual, basal area, and important value index (IVI) of each species recorded in 60 inventoried clusters, Kampong Thom Province

Local name	Scientific name	Family	No. of individual	Basal area (m <sup>2</sup> )	IVI by DBH classes (%) (cm)		
					10-30	$\geq$ 30	$\geq$ 10
Ambeng Chan	UN	UN	7	0.2	0.2	0.0	0.1
Ambeng Preah	UN	UN	9	0.2	0.2	0.0	0.1
Achsath	<i>Brownlowia emarginata</i>	Tiliaceae	6	0.2	0.1	0.0	0.1
Angkear Seal	<i>Ochna harmandii</i>	Ochnaceae	6	0.1	0.1	0.0	0.1
Ambeng Bek	<i>Cardiospermum halicacabum</i>	Sapindaceae	38	0.7	0.7	0.0	0.4
Ambeng Ches	<i>Aglaia cochinchinensis</i>	Meliaceae	9	0.1	0.2	0.0	0.1
Ambeng Khnheer	UN	UN	1	0.0	0.0	0.0	0.0
Angkot Khmao	<i>Diospyros bejardii</i>	Ebenaceae	33	0.4	0.5	0.0	0.3
Angkot Thmat/Chang Au Thmat	<i>Stereospermum chelonoides</i>	Bignoniaceae	146	2.3	1.9	0.0	1.0
Anlong	UN	UN	10	1.9	0.0	0.2	0.1
Ansong Trokuot	UN	UN	7	0.7	0.1	0.1	0.1
Ataing/Rotaing	<i>Homalium annamensis</i>	Samydaceae	2	0.1	0.0	0.0	0.0
Atith/Neang Hg	<i>Haasia cuneata</i>	Lauraceae	117	8.1	1.6	0.9	1.2
Banla Pork	UN	UN	1	0.1	0.0	0.0	0.0
Bay Am	UN	UN	43	5.9	0.4	0.6	0.5
Beleuy	<i>Litsea vang</i>	Lauraceae	53	4.4	0.6	0.7	0.7
Bakdorng	<i>Gardenia philastreii</i>	Rubiaceae	3	0.0	0.1	0.0	0.0
Bampong Prohok	UN	UN	1	0.0	0.0	0.0	0.0
Bangkong Kenkang	UN	UN	18	0.3	0.3	0.0	0.2
Bangkao/Dangkao	<i>Aglaia gigantea</i>	Meliaceae	61	2.0	0.9	0.2	0.6

726

Biodivers Conserv (2009) 18:717–738

Top et al. (2009); many species are mis-identified.

# Use of DNA barcodes/phylogenetic tree

32 Permanent plots in Kg. Thom

347 species

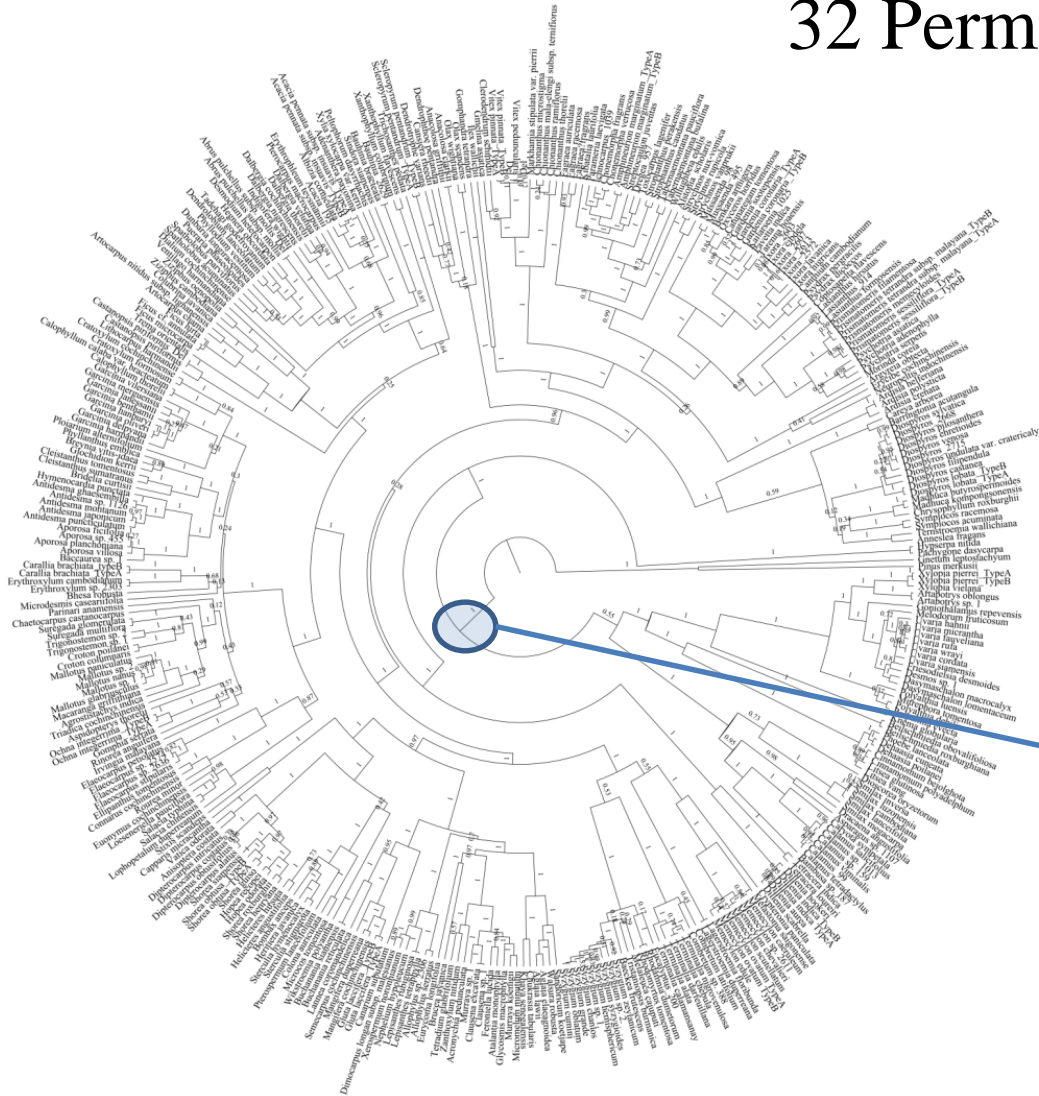
Bayesian method

14 calibration points

Estimated common ancestor of Angiosperms

159 Ma

141-199 Ma (Bell et al. 2010)





Scientific name: ????

Local name: Kro Ob

Specimen No.: 2002

rbcL

*Ixonanthes chinensis* (544/545)

*Ixonanthes reticulata* (556/558)

*Cyrtolopsis paraensis* (550/563)



Power point slides are prepared for all the plot tree species



Scientific name: Ixonanthaceae *Ixonanthes reticulata* Jack

Bokor 240m

Local name: Tromoung Sek Phnom

No. 4238

# Syn. = *Ixonanthes cochinchinensis* Pierrei

matK

*Ixonanthes chinensis* (747/754) Gaps= 0/754

*Ixonanthes reticulata* (746/754) Gaps= 0/754

*Cyrillopsis paraensis* (710/754) Gaps= 0/754"





4238



Specimen image from Kew Herbarium Catalogue

<http://apps.kew.org/herbcat/gotoHomePage.do>

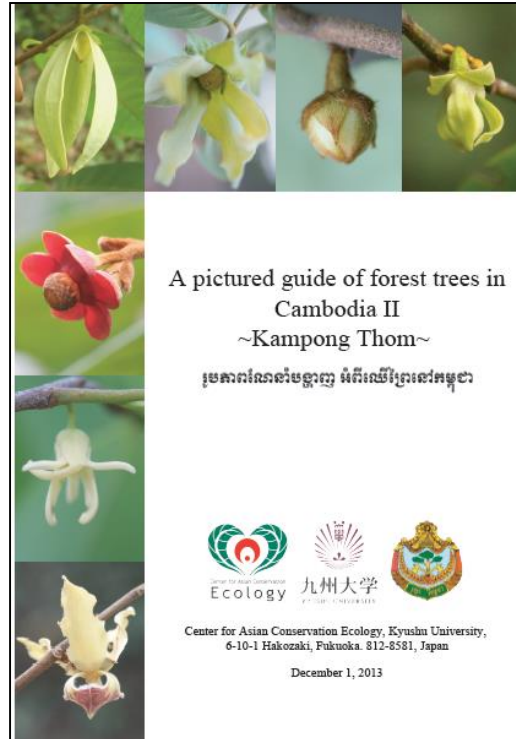


# Taxonomic papers & Picture Guides

Scientific name: Dipterocarpaceae *Dipterocarpus obtusifolius* Teijsm. ex Miq.  
Common name: Tbeing (Tbeng)  
No. 218



Toyama et al. (2013) Inventory of woody flora in permanent plots of Kampong Thom and Kampong Chhnang Provinces, Cambodia. *Acta Phytotaxonomica & Geobotanica* 64(2), 45-105.



Dipterocarpaceae *Dipterocarpus obtusifolius* Teijsm. ex Miq.  
Kmer name: បើប៊ីង្សា [Tbeng (Tbeing)]



Distribution: Cambodia, Laos, Myanmar, Thailand, Vietnam.  
Observation: **Deciduous tree** 8-14m tall and a dominant element of deciduous (dry dipterocarp) forests. Similar to *D. intricatus*, but this species has more hairy leaves with more distinct lateral veins and undulate margins.  
Specimen No. 180. 218



# Monitoring plot trees: 1998-2010

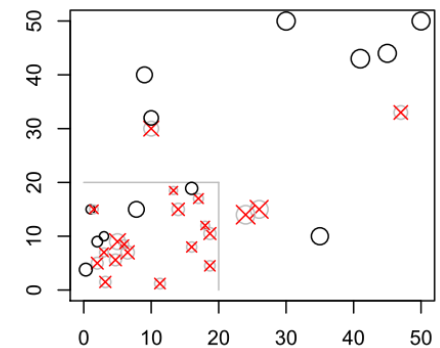
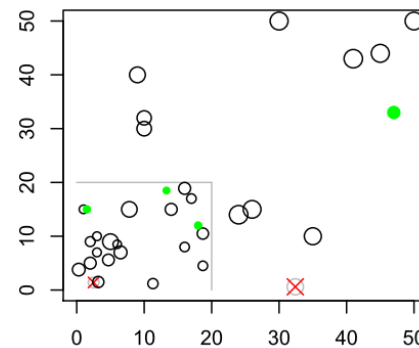
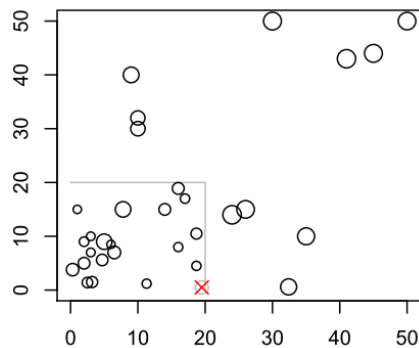
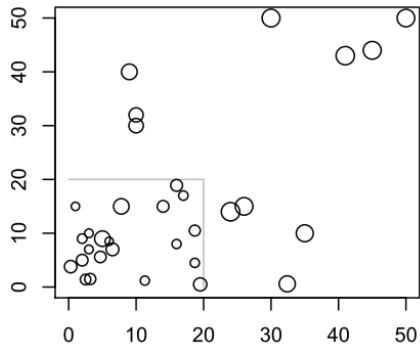
## Plot KT05 as an example

1998 (32 trees)

2000 (31 trees)

2004 (34 trees)

2010 (13 trees)



1 died

2 died, 4 recruited

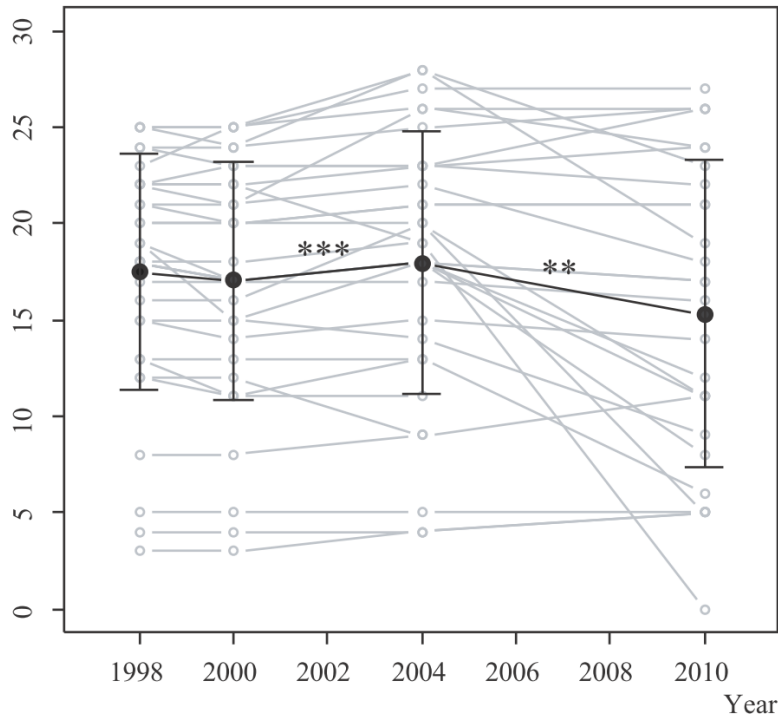
8 died, 13 cut



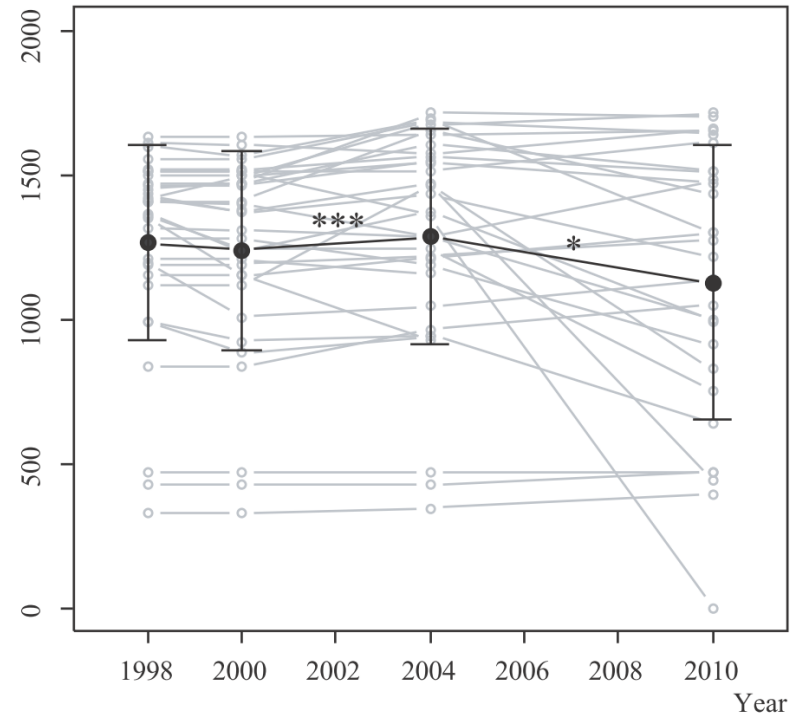


# Trends in species richness and phylogenetic diversity

## Species richness (SR)



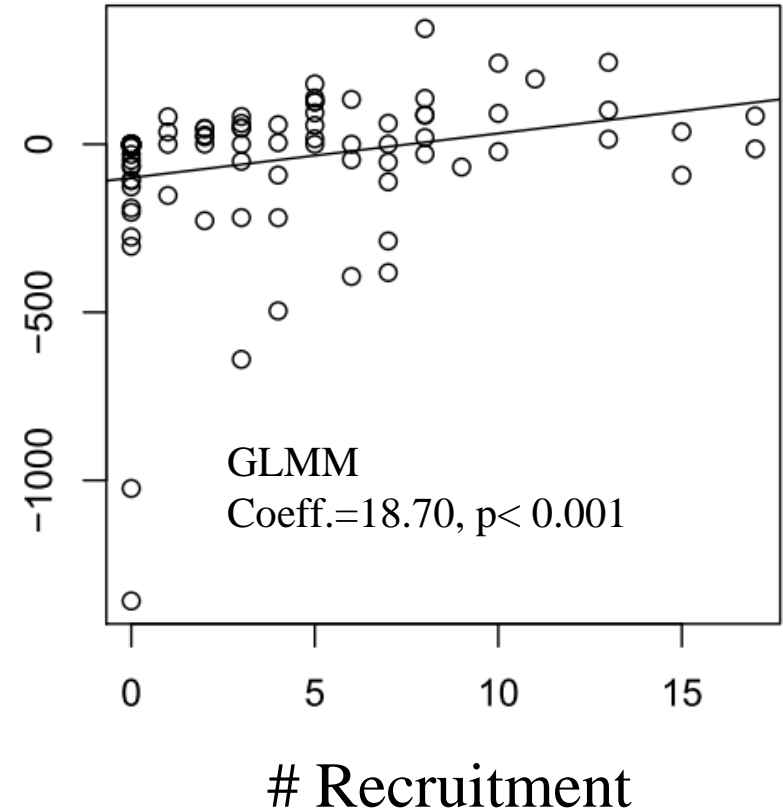
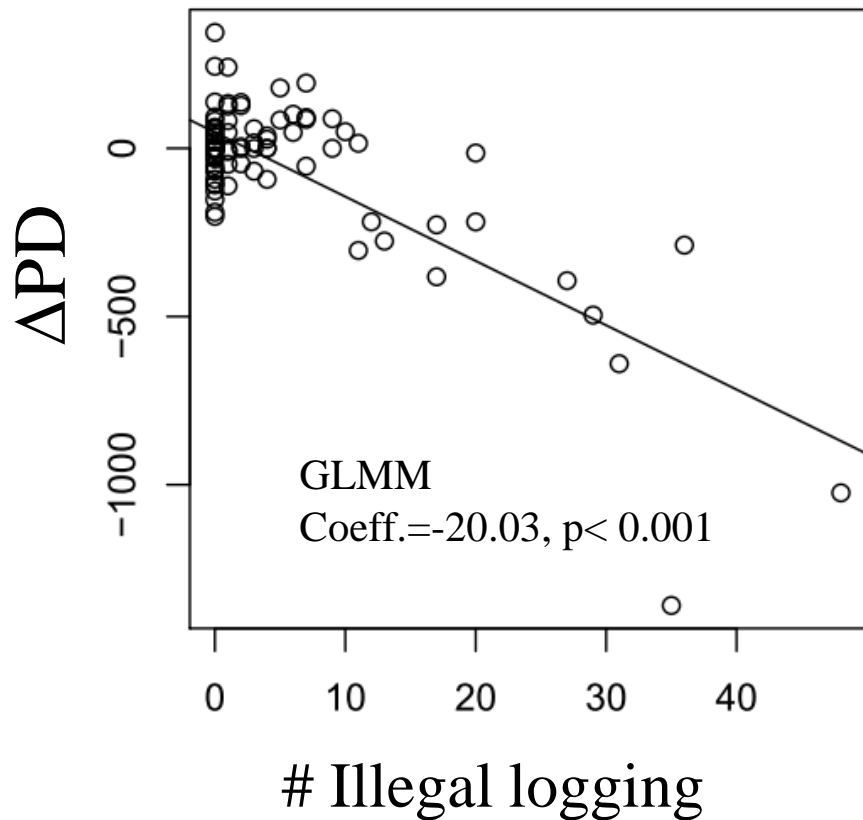
## Phylogenetic diversity (PD)



Both SR and PD largely decreased from 2004 to 2010 in some plots due to illegal logging.

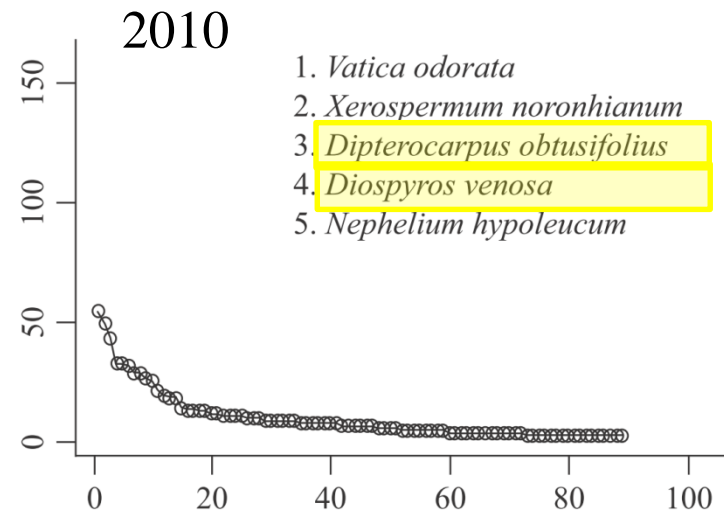
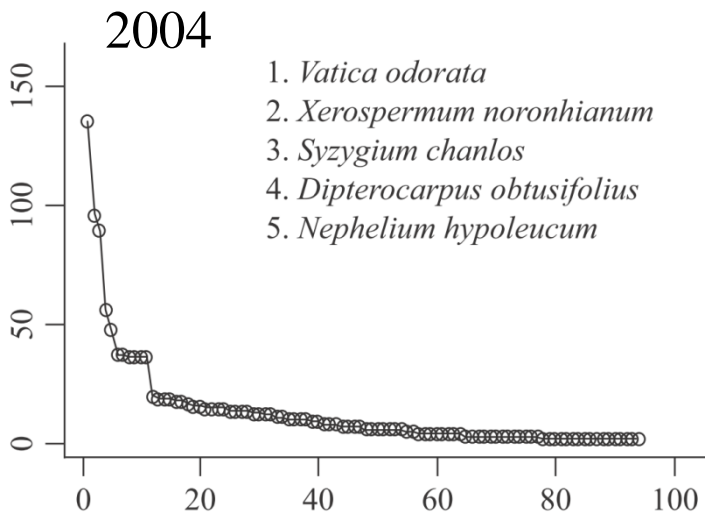
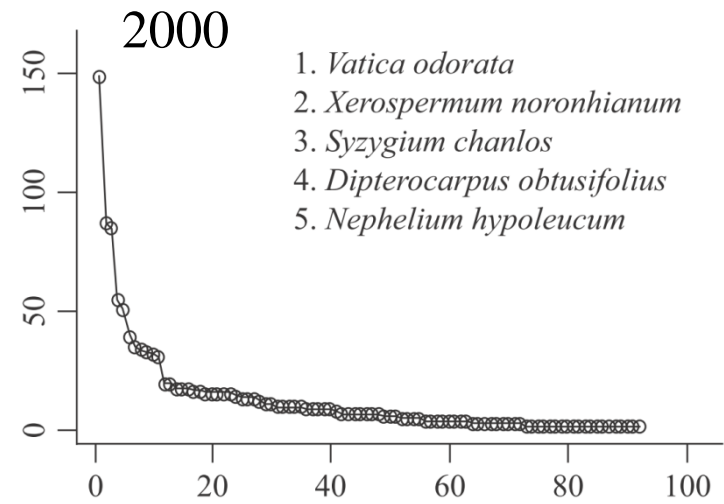
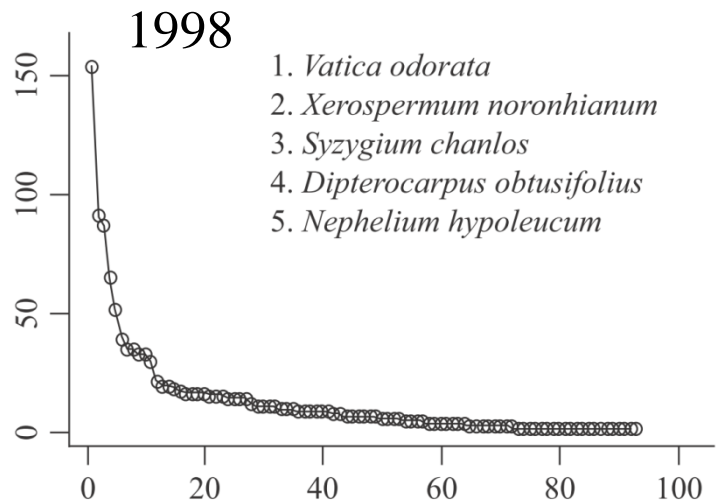
# Change of PD vs Illegal logging/recruitment

$\Delta$ PD = difference between two successive surveys





# Changes in rank-abundance relationship

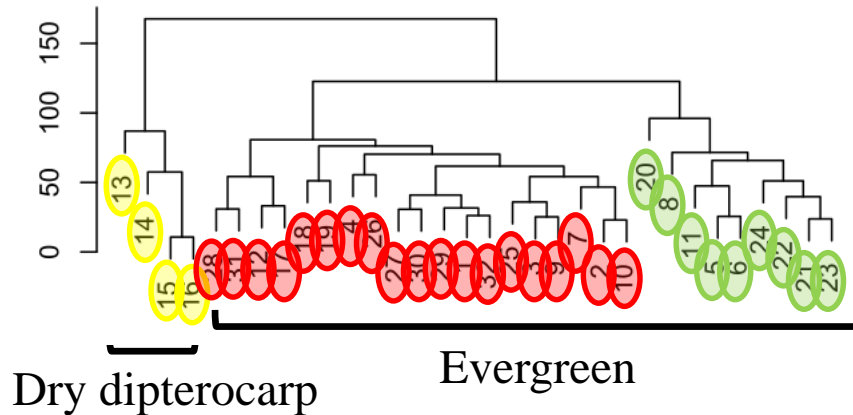


A drastic change was observed from 2004 to 2010.

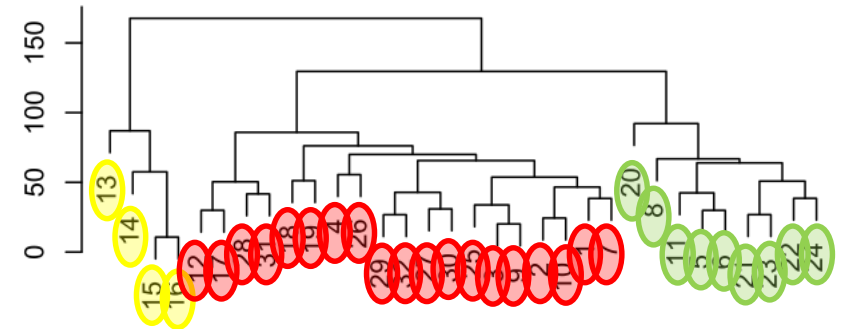
# Changes in phylogenetic relatedness among plots

Mean pairwise phylogenetic distance (MPD) among plots

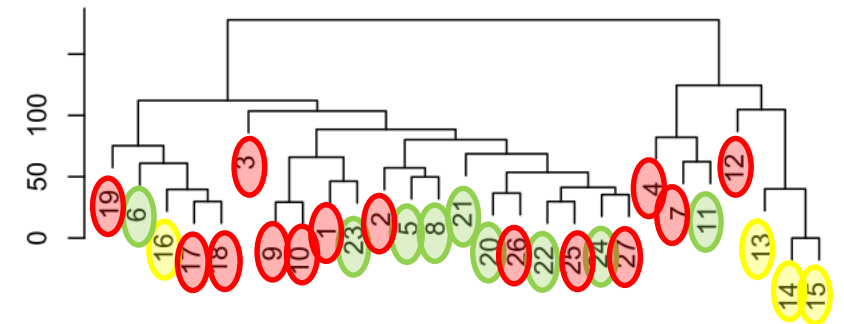
1998



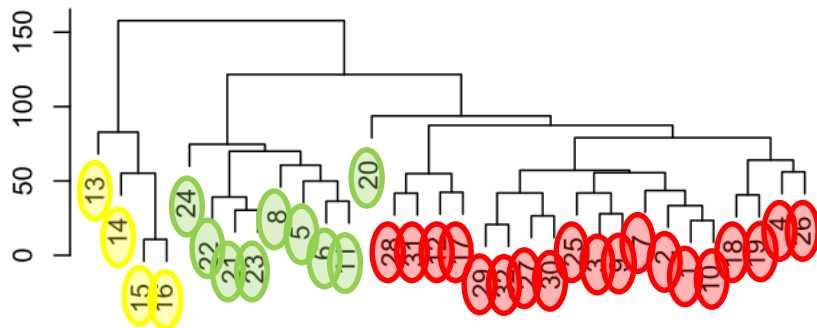
2000



2010



2004



Some evergreen plots became phylogenetically similar to dry Dip. plots.

# Outline

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- Assessing **extinction risks** in some representative groups: case studies in *Bauhinia* and *Dalbergia* (Fabaceae)



# Conserved Areas in West Borneo/Kalimantan



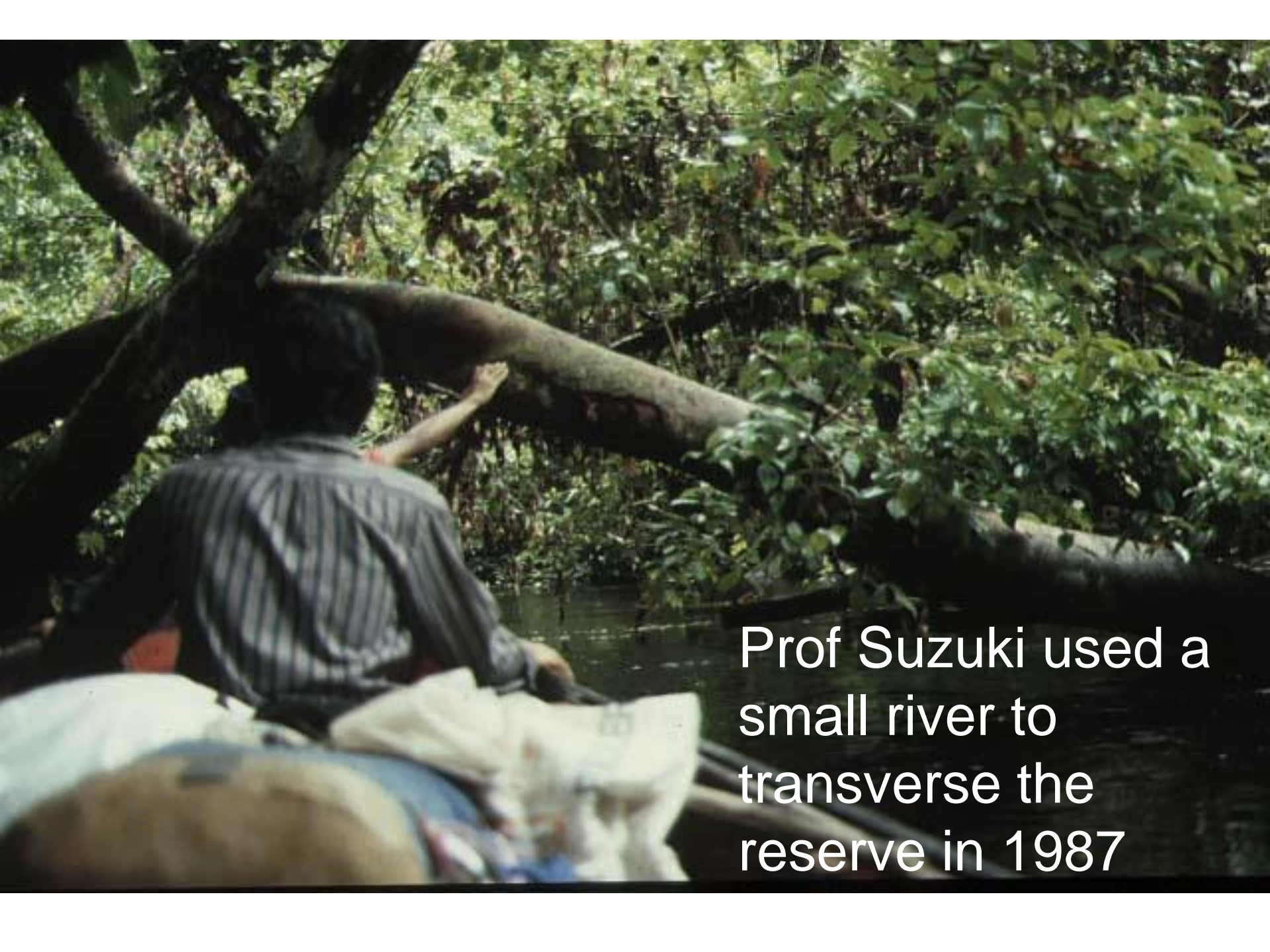




Mandor in 1987

Photo taken by E Suzuki





Prof Suzuki used a  
small river to  
transverse the  
reserve in 1987



But in 2012, we could move by motor cycles



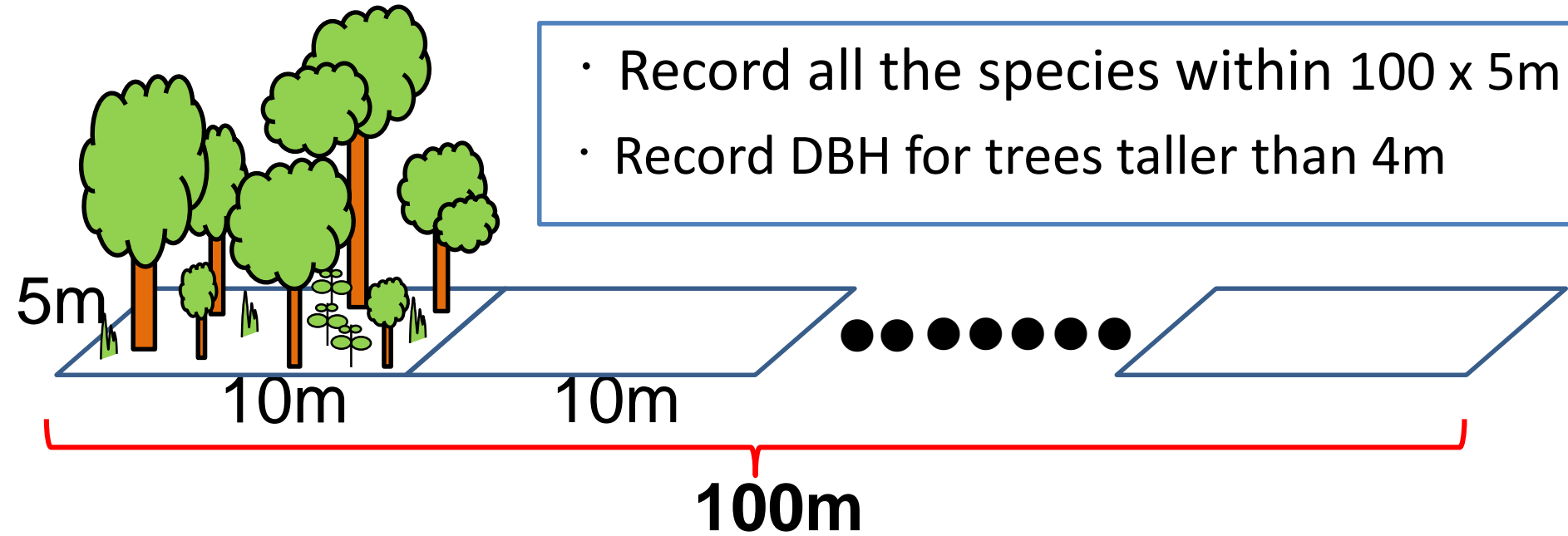




**Sand gold mining in Mandor Nature  
Reserve, W Kalimantan  
September 14, 2012**

# Standardized belt transect survey

- Record all the species within 100 x 5m
- Record DBH for trees taller than 4m



Collecting specimens and taking pictures



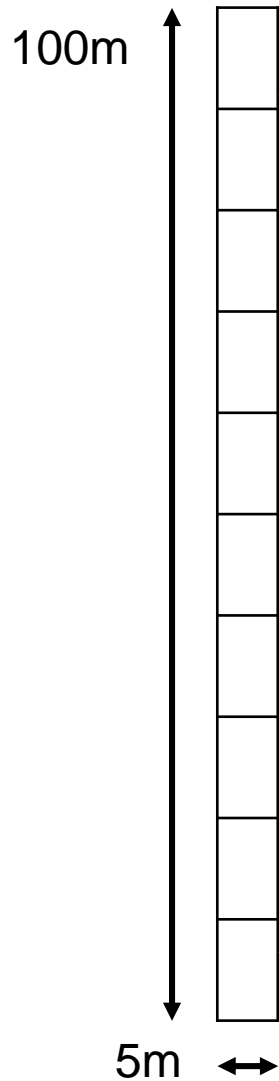
Identification using herbarium specimens





# Recording all species in 100m x 5m

An example of transect record: data from Mandor Nature Reserve, W Kalimantan



No	Specimen	Date	Subplot	Family	Name
1	1	14-Sep	1	Dipterocarpaceae	Shorea stenoptera
2	2	14-Sep	out	Rubiaceae	Mussaenda
3	3	14-Sep	1	Thymeleaceae	Goniostylis
4	4	14-Sep	1	Connaraceae	Ellipanthus
5	5	14-Sep	1	Sapindaceae	Nephelium
				.	
				.	
				.	
328	328	16-Sep	10	Fabaceae	
329	329	16-Sep	10	Celastraceae	Lophopetalum エダミドリ
287	0	16-Sep	10	Burseraceae	Santria 287
330	330	16-Sep	10	Dichapetalaceae	Dichapetalum?
5	0	16-Sep	10	Sapindaceae	Nephelium 小葉4枚
36	0	16-Sep	10	Gnetaceae	Gnetum 1
331	331	16-Sep	10		
332	332	16-Sep	10	Burseraceae	Dacriodes
333	333	16-Sep	10	Sapindaceae	Nephelium
334	334	16-Sep	10	Thymeleaceae	Goniostylis

Scientific name: Dipterocarpaceae *Shorea stenoptera* Burck

No. 1

# 1<sup>st</sup> record



Scientific name: Fabaceae *Bauhinia menispermacea* Gagnep.

No. 112

# Flora Malesiana describes this species with “petals yellow with a dark red centre, narrowly obovate”, but flower color may vary between Kuchin and Mandor.



Scientific name: Rubiaceae *Lasianthus* aff. *angustifolius*

No. 32

#



Scientific name: Thymelaeaceae *Gonystylus*

No. 334

#

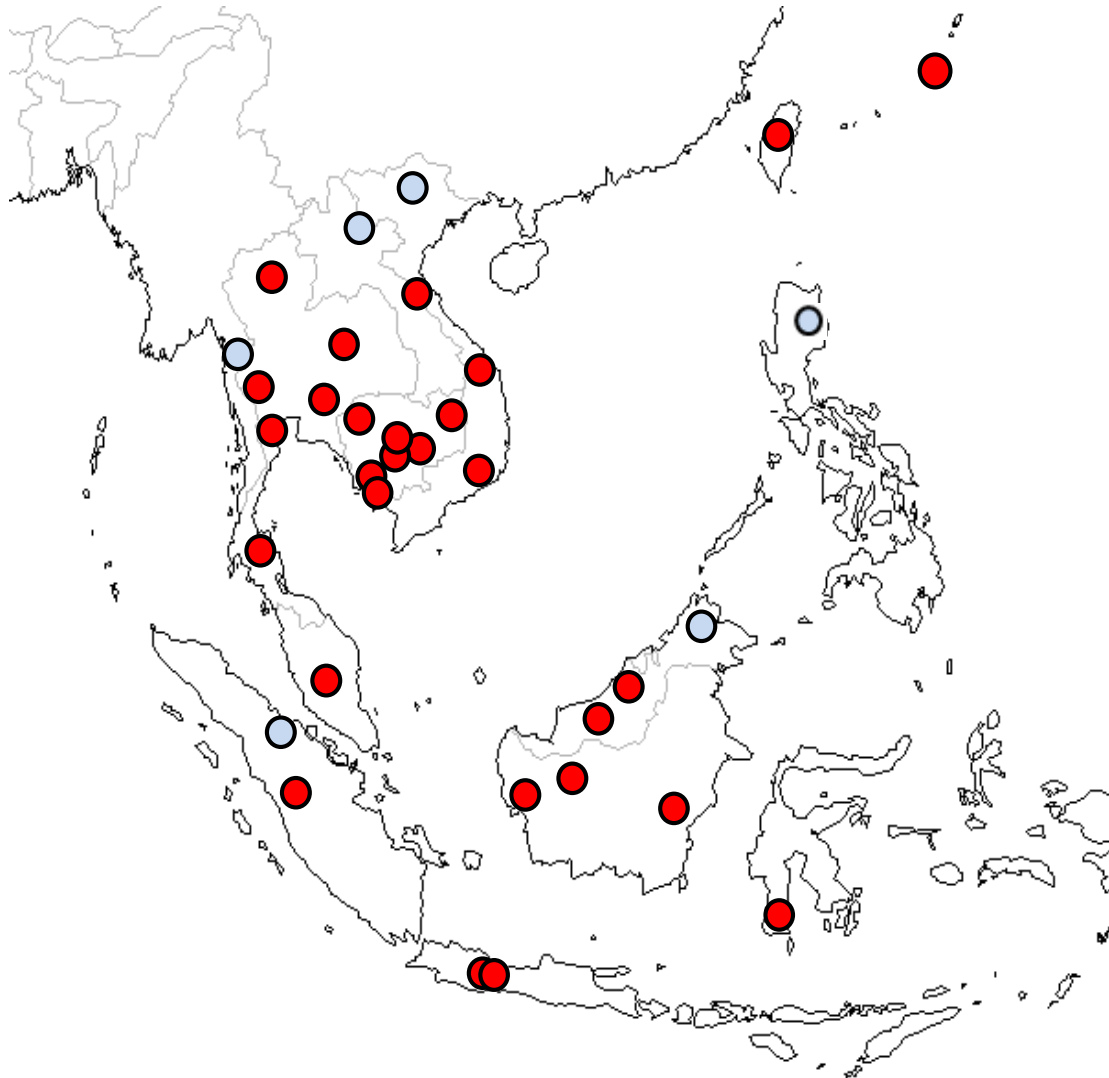
Last record



Mandor

# Collaborative plot surveys in tropical Asia

● 2011-15    ○ In preparation



## Indonesia (LIPI, Andalas Univ., Hasanudin Univ.)

Gn. Gede Pangrango NP  
Gn. Halimun NP  
Bantimulung Bulusarung NP  
Gn. Gadut (Sumatra)  
Mandor, Serimbu (W. Kalimantan)

## Cambodia (FA)

Cardamon, Kampong Chhnang,  
Kampong Thom, Koh Kong,  
Kratie, Ratanakiri, Bokor NP,  
Siem Reap

## Malaysia (FRIM)

Fraser's Hill Protected Area

## Thailand (BKF, KU)

Doi Inthanon NP  
Kaeng Krachan NP  
Maeklong, Kao Soi Dao

## Vietnam (ITB, Dalat Univ)

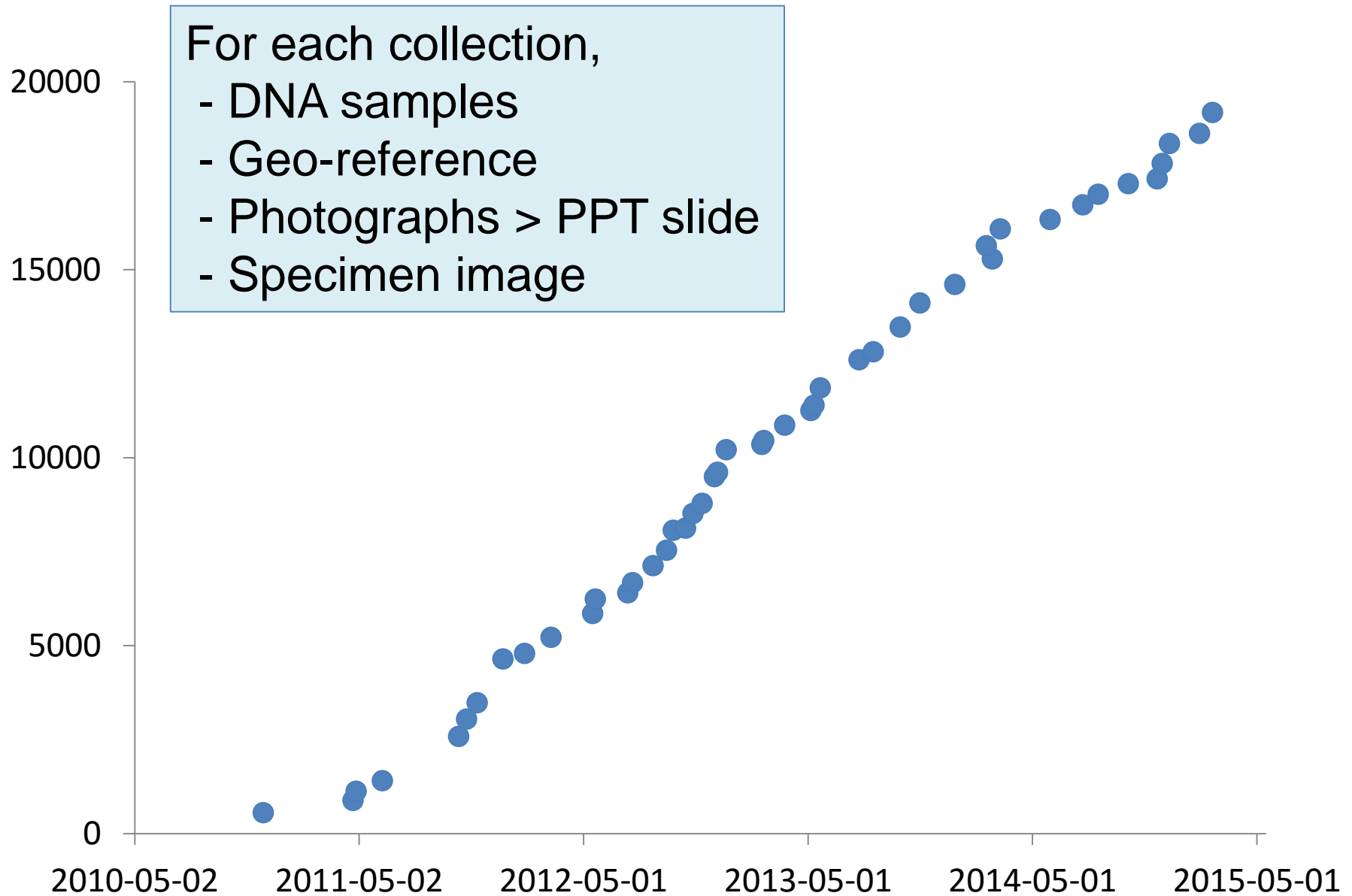
Honba NR, Bach Ma NP,  
Vu Quang NP

## China-Taipei (台灣林業試驗場)

蓮華池

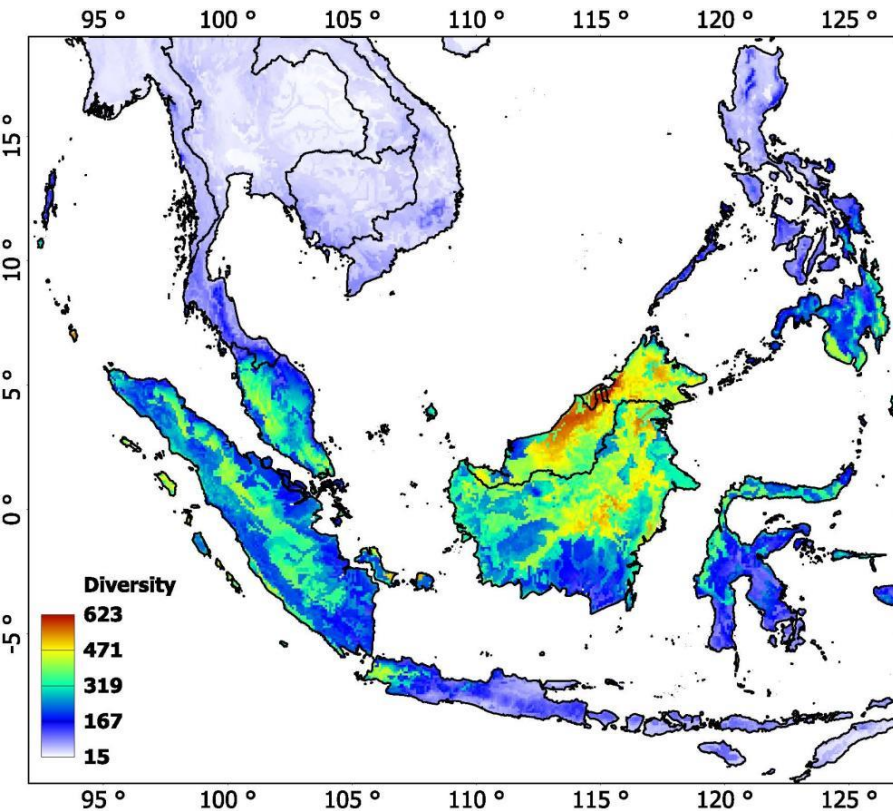


# 20,000 DNA samples have been accumulated

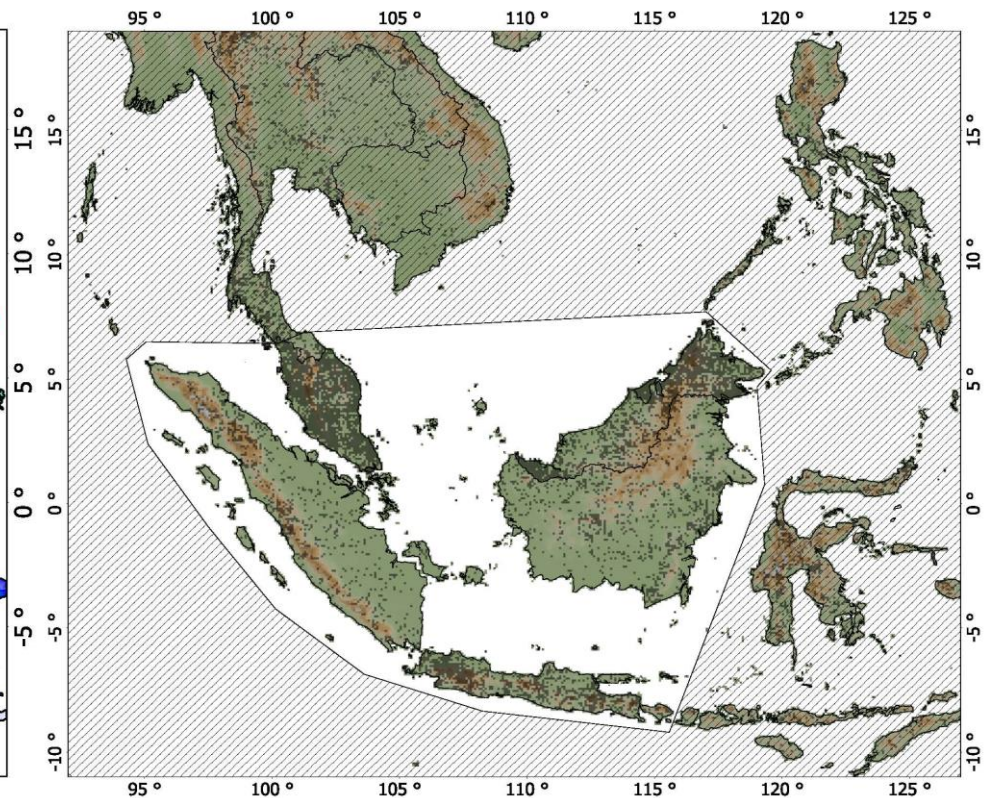


# Assessments with herbarium records

Raes, Saw, van Welzen & Yahara (2013) estimated species richness of 7 tree families with herbarium records and species distribution models.

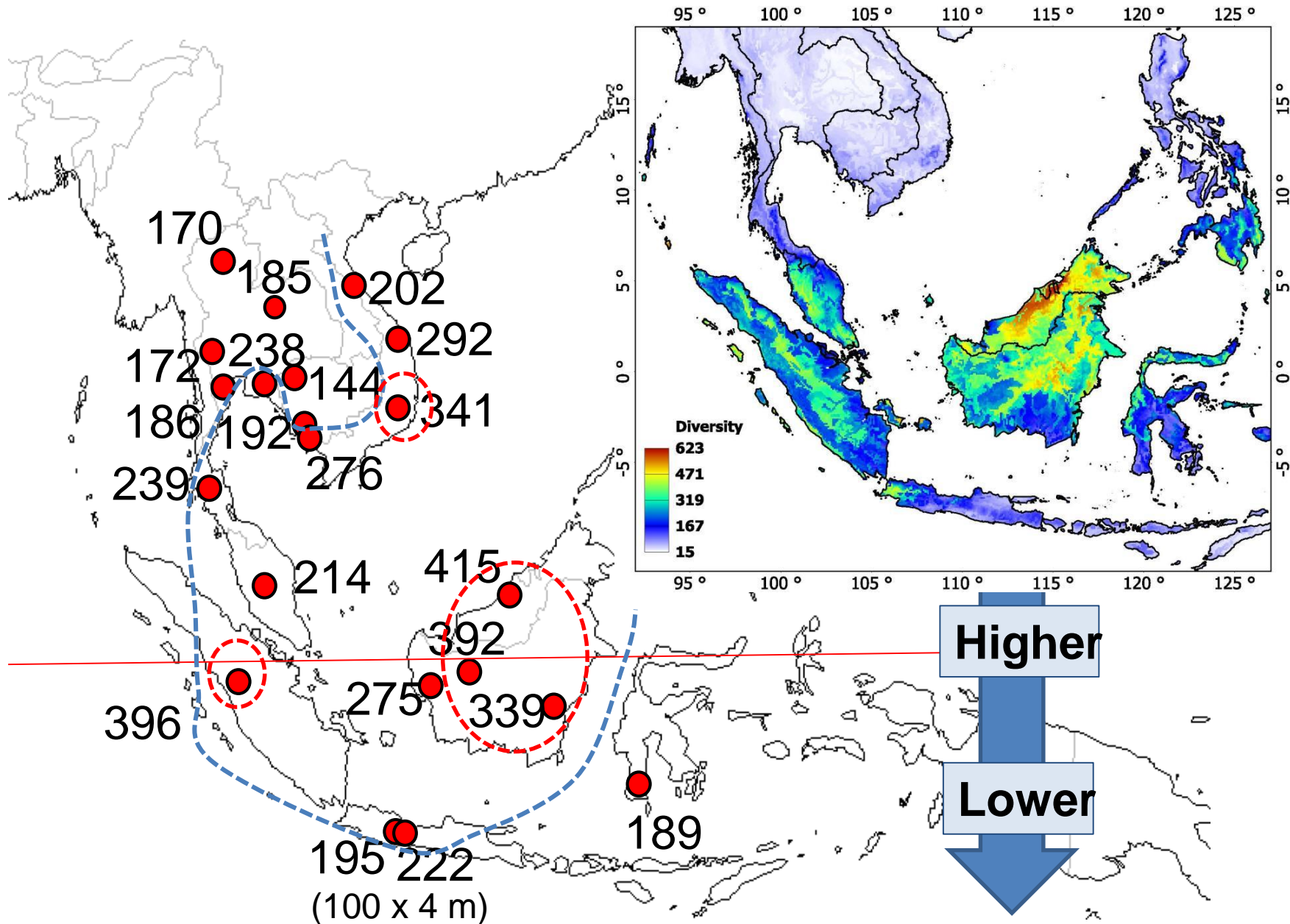


Tree species diversity estimated in Sarawak is the highest in SE Asia.



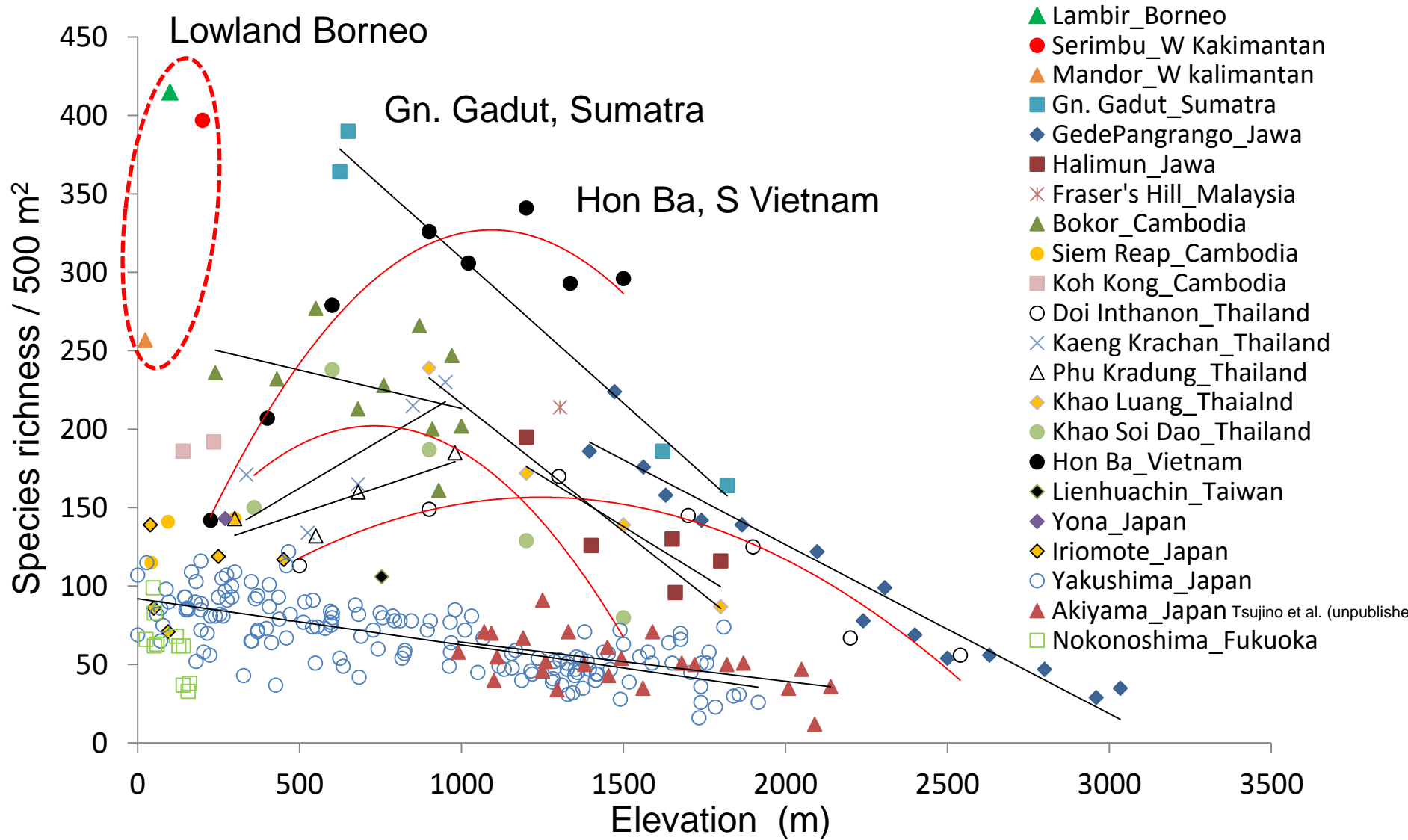
However, specimen density distribution is highly biased.

# Vascular Plant Species Richness / Transect (500 m<sup>2</sup>)





# Plant Species Richness/500m<sup>2</sup> vs Altitude



# Many more new species: a case of Lauraceae



Genus	Cambodia Bokor		Vietnam Hon Ba		Malaysia Fraser's Hill		Indonesia Sn. Gadut (Sumatra)		Total	
	Known	Unknown	Known	Unknown	Known*	Unknown	Known	Unknown	Known	Unknown
<i>Actinodaphne</i>	1	0	1	6	5	0	3	0	10	6
<i>Alseodaphne</i>	0	0	1	0	0	0	0	0	1	0
<i>Beilschmiedia</i>	4	0	4	5	1	0	2	3	11	8
<i>Cinnamomum</i>	5 (2)	0	2	6	2	1	2	4	6	11
<i>Cryptocarya</i>	3	1	2	1	1	0	4	2	10	4
<i>Dehaasia</i>	2	1	0	0	0	0	1	0	3	1
<i>Endiandra</i>	0	0	1	0	1	0	2	1	4	1
<i>Lindera</i>	1 (1)	0	0	0	2	0	1	0	3	0
<i>Litsea</i>	6	0	7	3	6	0	8	5	27	8
<i>Machilus</i>	1	2	0	5	0	0	0	0	1	7
<i>Neolitsea</i>	3	2	2	2	2	3	1	2	8	9
<i>Nothaphoebe</i>	0	0	0	0	0	0	0	0	0	0
<i>Phoebe</i>	2	0	1	0	1	0	0	0	4	0
<b>Total</b>	28	6	21	28	21	4	24	17	94	55
	0.82	0.18	0.43	0.57	0.84	0.16	0.59	0.41	0.63	0.37

\*Including known but undescribed spp.

(Yahara unpublished)



# *Neolitsea* (Lauraceae) in Tree Flora of Malaya vol. 4

Six species are recorded.

1 Leaves spirally arranged or alternate-----2

1 Leaves in pseudowhorls or opposite or subopposite-----4

2 Reticulations distinct on the upper surface leaf -----6. ***N. sp.'1'*** .

2 Reticulations indistinct-----3

3 Leaves thickly leathery; petiole to 13 mm long; confined to mountain forests -----1. ***N. coccinea***.

3 Leaves thinly leathery, petiole 1-3 cm long; widely distributed from coasts to

mountain forests ----- 5. ***N. zeylanica***.

4 Petiole more than 1 cm long; leaves distinctly glaucous below ----- 4.

***N. villosa***.

4 Petiole less than 1 cm long; leaves not glaucous below-----5

5 Secondary nerves 3-4 , sunken above ----- 3. ***N. mollissima*** .

5 Secondary nerves 5-6, not sunken above ----- 2. ***N. kedahense***.

# *Neolitsea* (Lauraceae) in Fraser's Hill, Malay Peninsula

Scientific name: Lauraceae *Neolitsea* sp. nov. 1

No. M178

#羽状脉

Fraser's Hill; Near Line 1





# *Neolitsea* (Lauraceae) in Fraser's Hill, Malay Peninsula

Scientific name: Lauraceae *Neolitsea*

No. M48

# ややアツバ

Fraser's Hill Line 1



Scientific name: Lauraceae *Neolitsea*

No. M257

# ややアツバもどき

Fraser's Hill Line 1

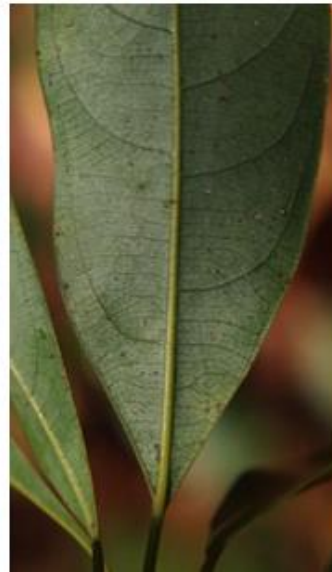


Scientific name: Lauraceae cf. *Neolitsea villosa* (Blume) Merr.

No. M251

# 羽状脈ホンバ

Fraser's Hill Line 1



Scientific name: Lauraceae *Neolitsea* sp. nov. 2

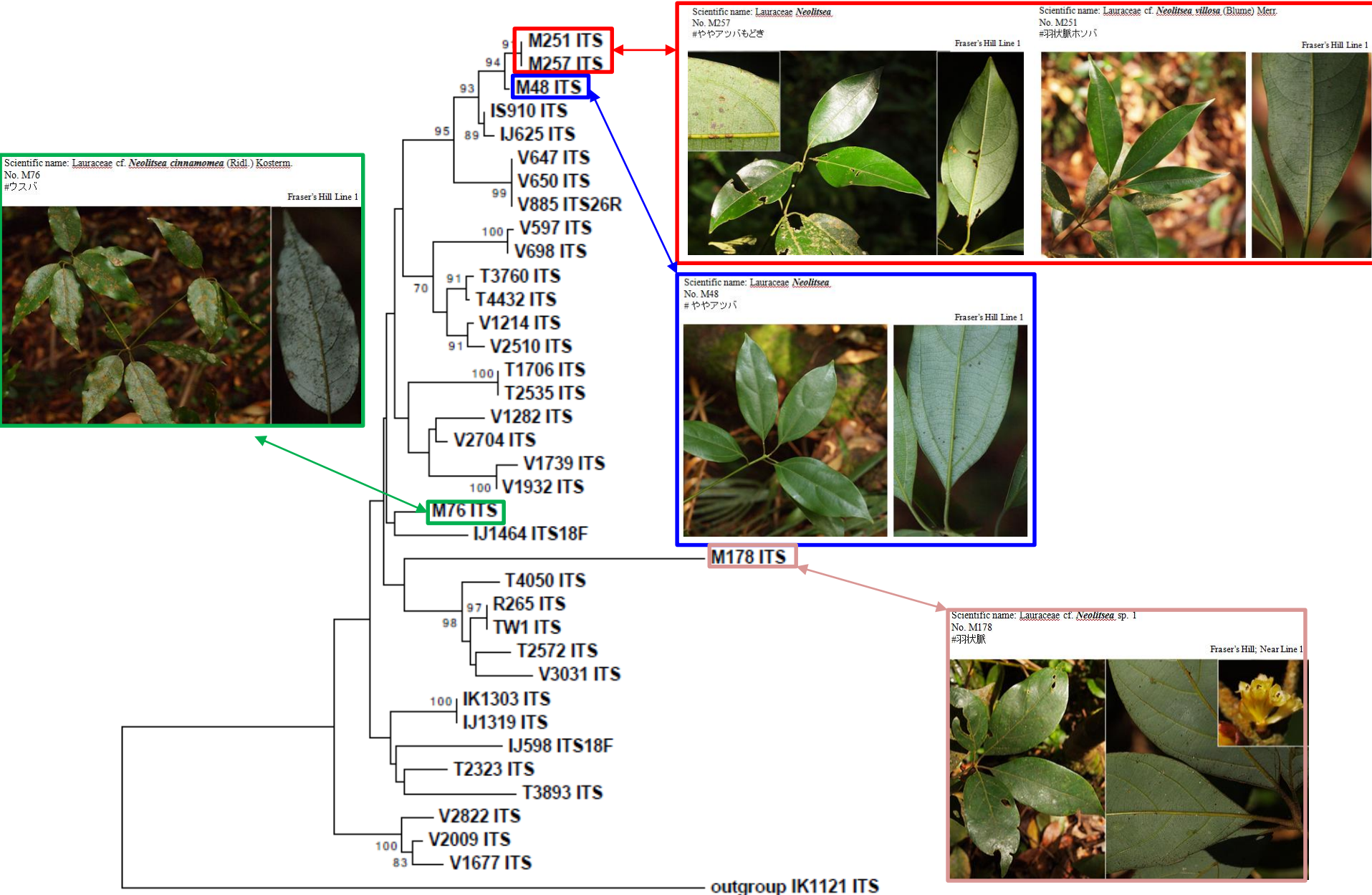
No. M76

# ウスバ

Fraser's Hill Line 1



# Neolitsea (Lauraceae) in Fraser's Hill, Malay Peninsula





# Neolitsea (Lauraceae) in Hon Ba Nature Reserve, Vietnam

Scientific name: Lauraceae Neolitsea polycarpa H. Liu

Local name:

No. V1739

#

HonBa near top (alt. 1521 m)



Scientific name: Lauraceae Neolitsea polycarpa H. Liu ?

Local name:

No. V647

#

HonBa 2



Scientific name: Lauraceae Neolitsea polycarpa H. Liu ?

Local name:

No. V885

#

V885=V647=V650; Seedling of Neolitsea polycarpa?

HonBa\_3 (alt.900 m)



Scientific name: Lauraceae Neolitsea polycarpa H. Liu

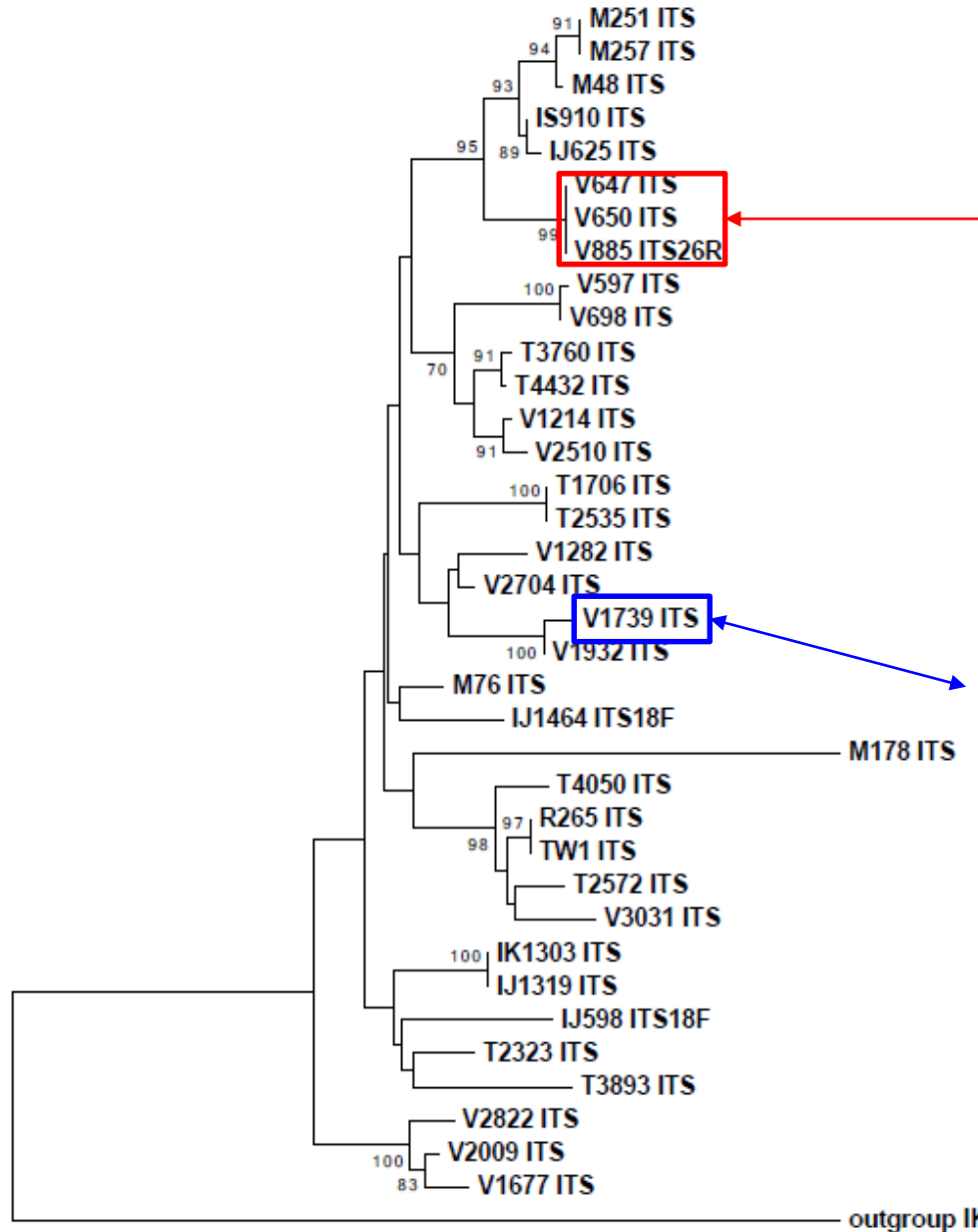
Local name:

No. V647 vs. V650

# Same???



# Neolitsea (Lauraceae) in Hon Ba Nature Reserve, Vietnam



Scientific name: Lauraceae *Neolitsea polycarpa* H. Liu ?

Local name:

V885=V647=V650; Seedling of *Neolitsea polycarpa*?

#

HonBa\_3 (alt.900 m)



Scientific name: Lauraceae *Neolitsea polycarpa* H. Liu

Local name:

No. V1739

#

HonBa\_near top (alt. 1521 m)



0.01

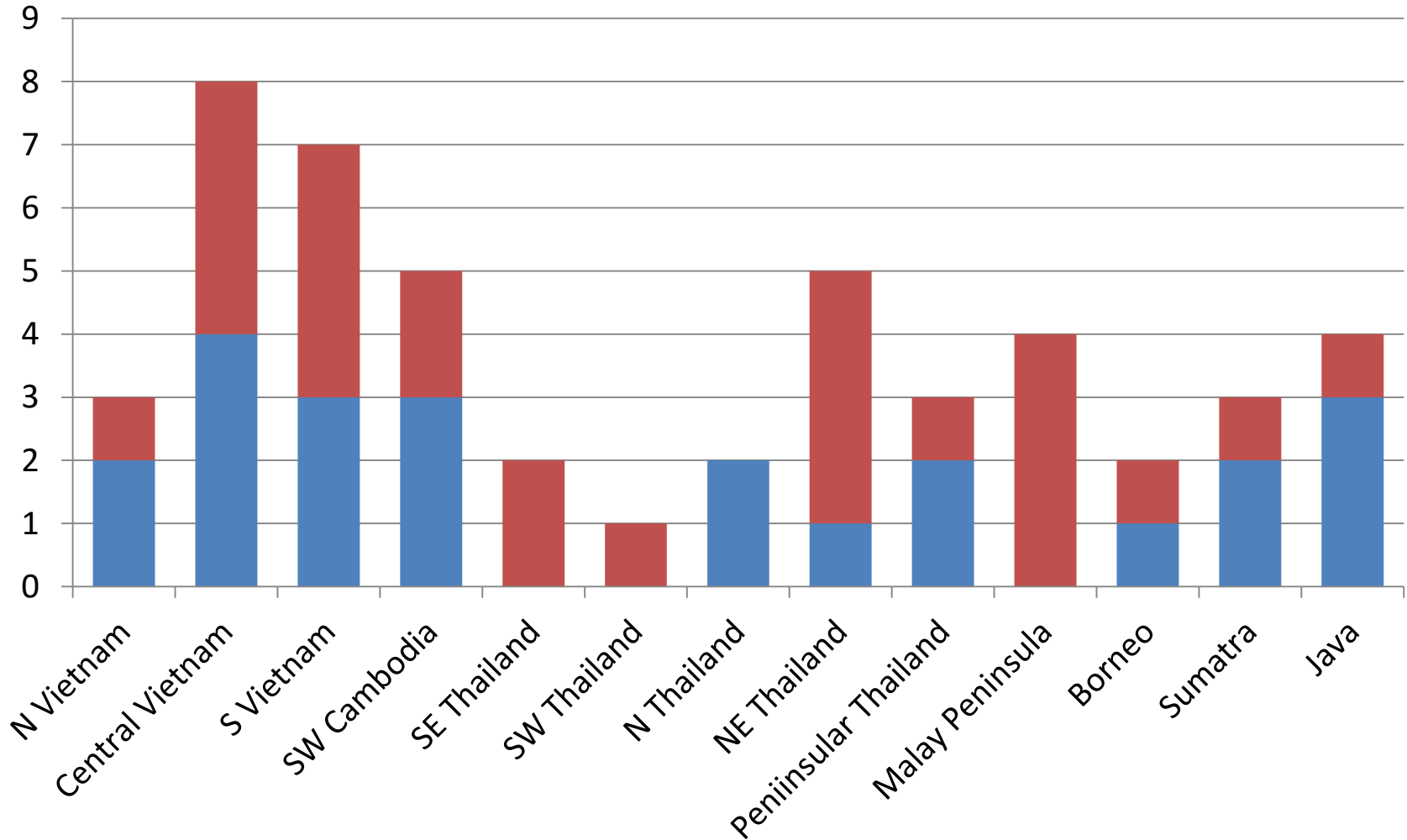
outgroup Ik



# *Neolitsea* (Lauraceae) : Proportion of new species

19 spp : 25 spp

■ Known sp ■ New sp



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# Global Legume Diversity Assessments

bioGENESIS meeting; July 19-20, 2010; Bali, Indonesia.

International workshop on the global legume diversity assessment; August 19-22, 2011; Fukuoka, Japan



**TAXON** 62 (2) • April 2013: 249–266

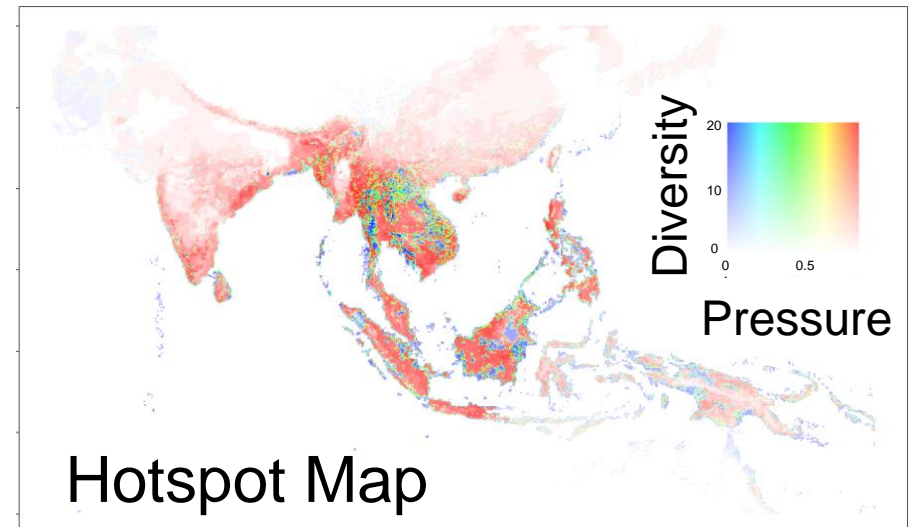
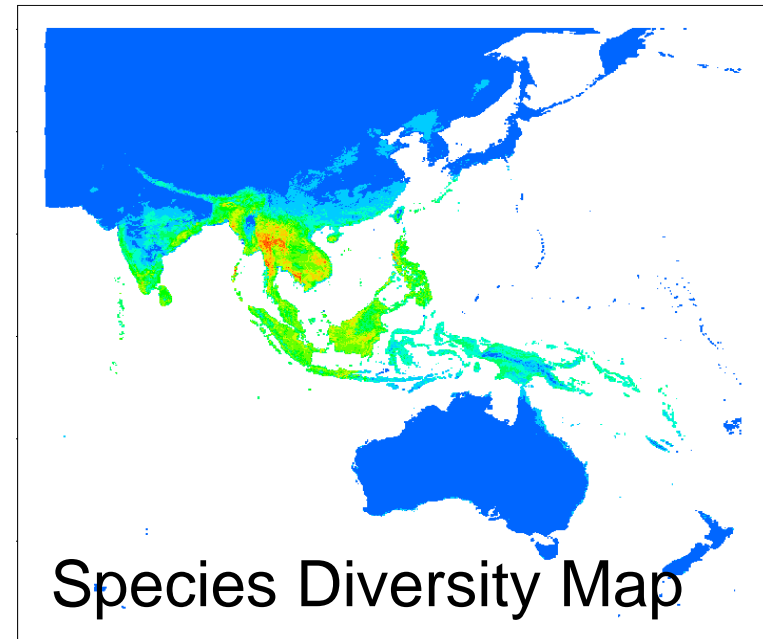
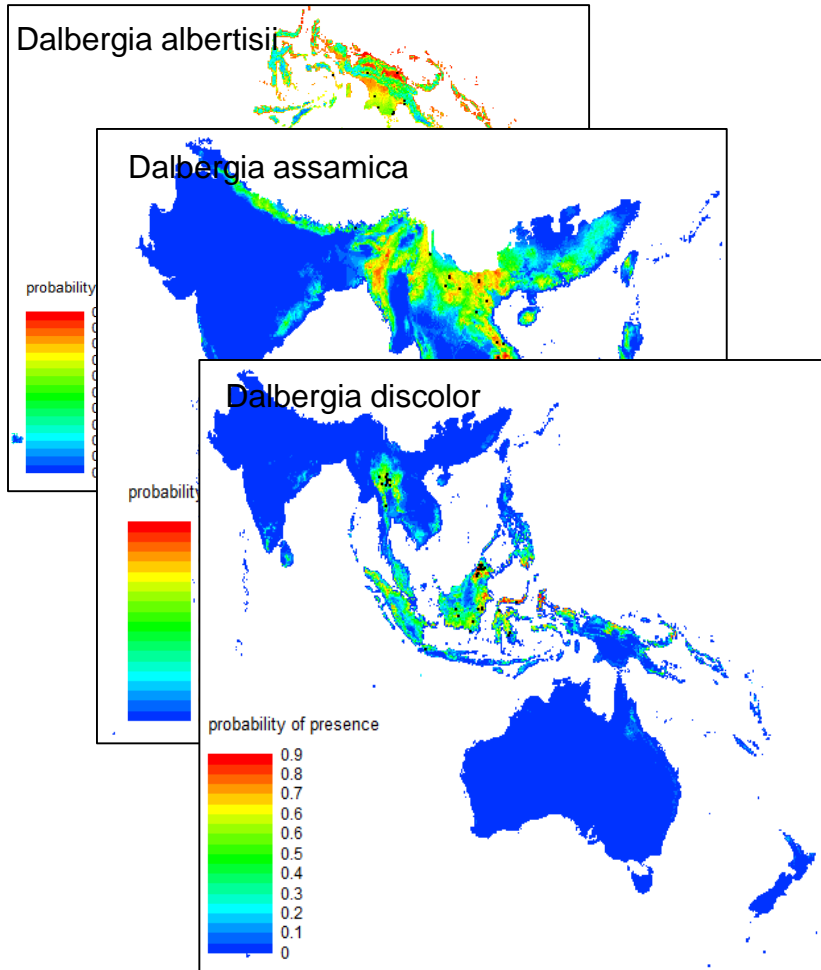
*Mucuna* sp.  
Sulawesi



Yahara & al. • Global legume diversity assessment

## Global legume diversity assessment: Concepts, key indicators, and strategies

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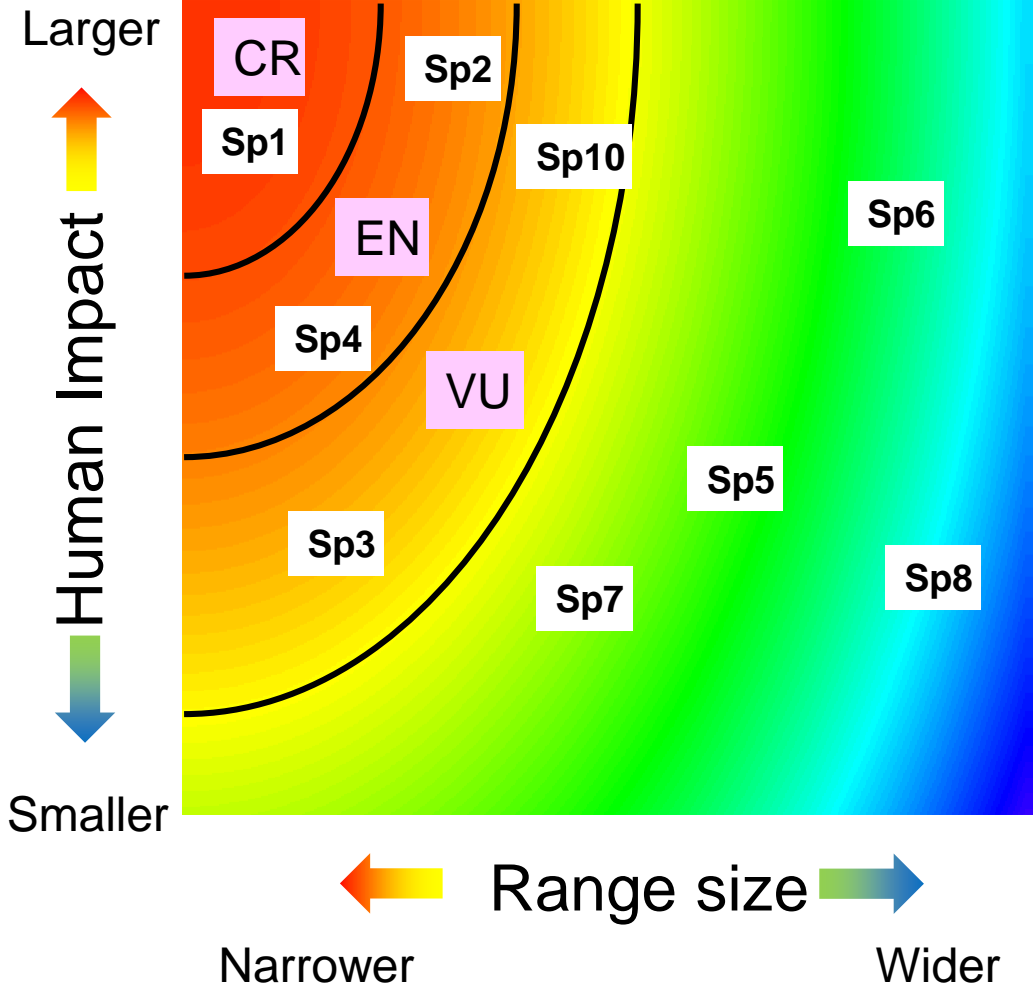


Species Distribution Modeling  
based on specimen records



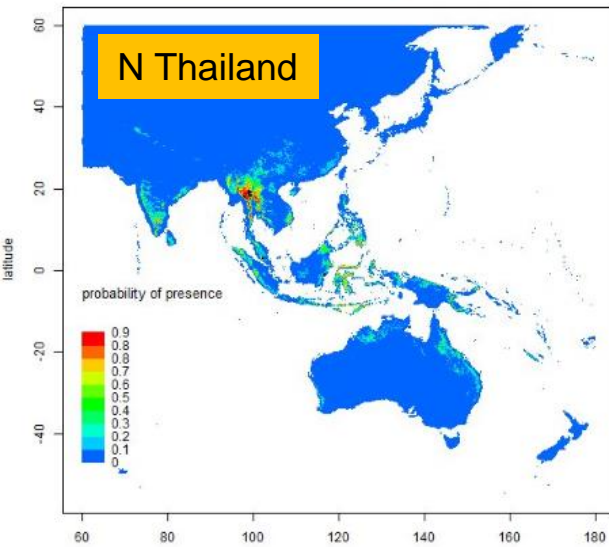
# Extinction Risk Assessment

Extinction risk is considered to be higher in species having narrower ranges under higher human impact

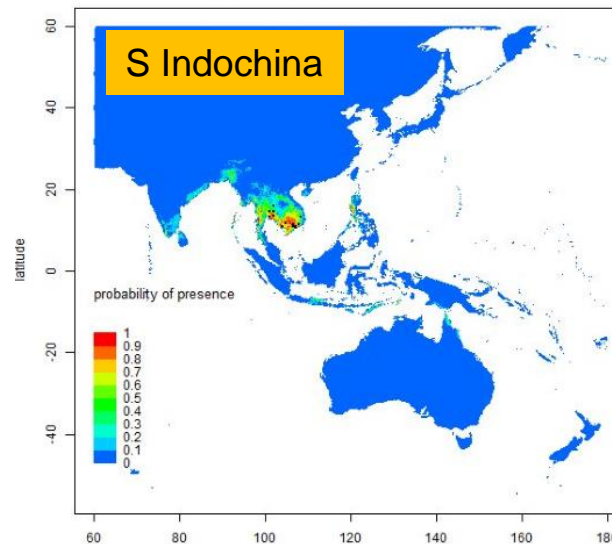


# Distribution of rare species : Dalbergia

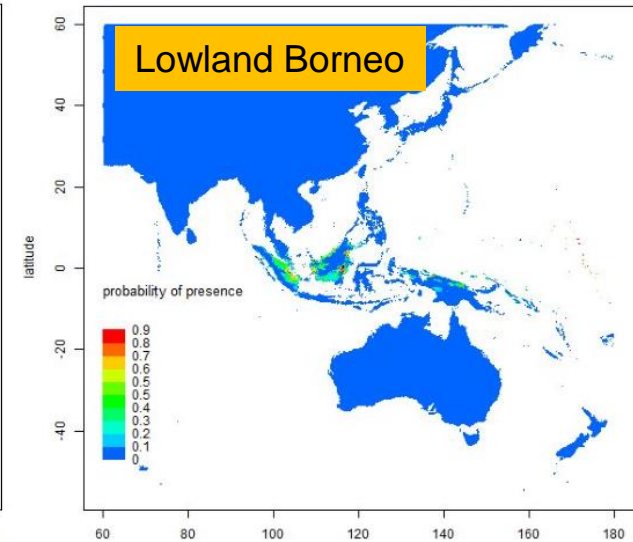
*Dalbergia abbreviata* (training AUC =0.98)



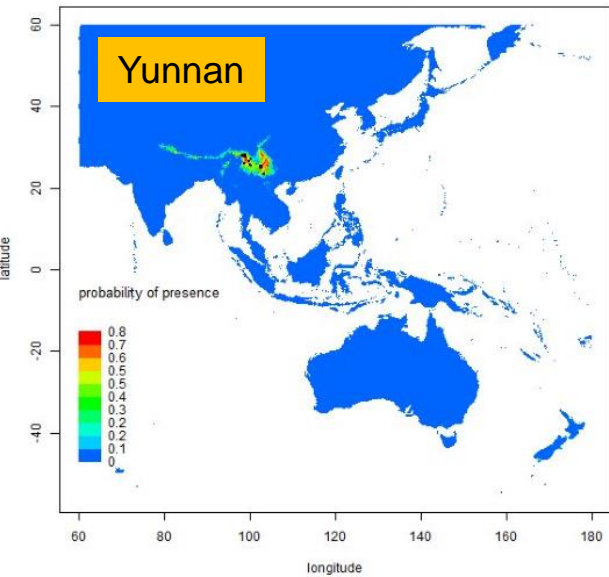
*Dalbergia cochinchinensis* (training AUC =0.99)



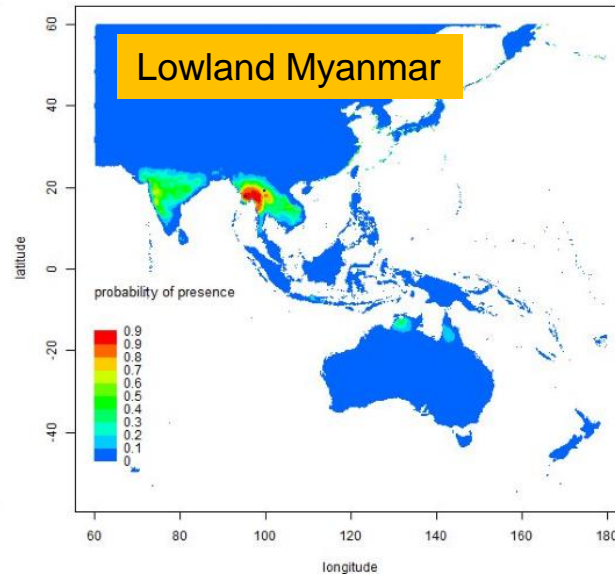
*Dalbergia falcata* (training AUC =1)



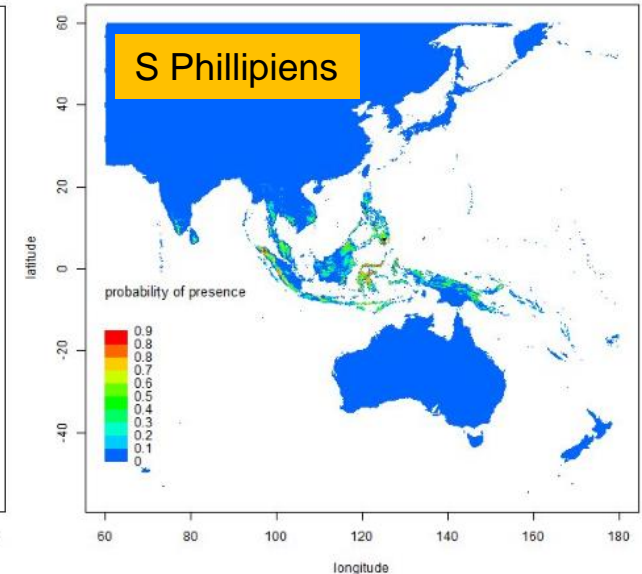
*Dalbergia mimosoides* (training AUC =1)



*Dalbergia lacei* (training AUC =0.99)



*Dalbergia mimosella* (training AUC =0.99)





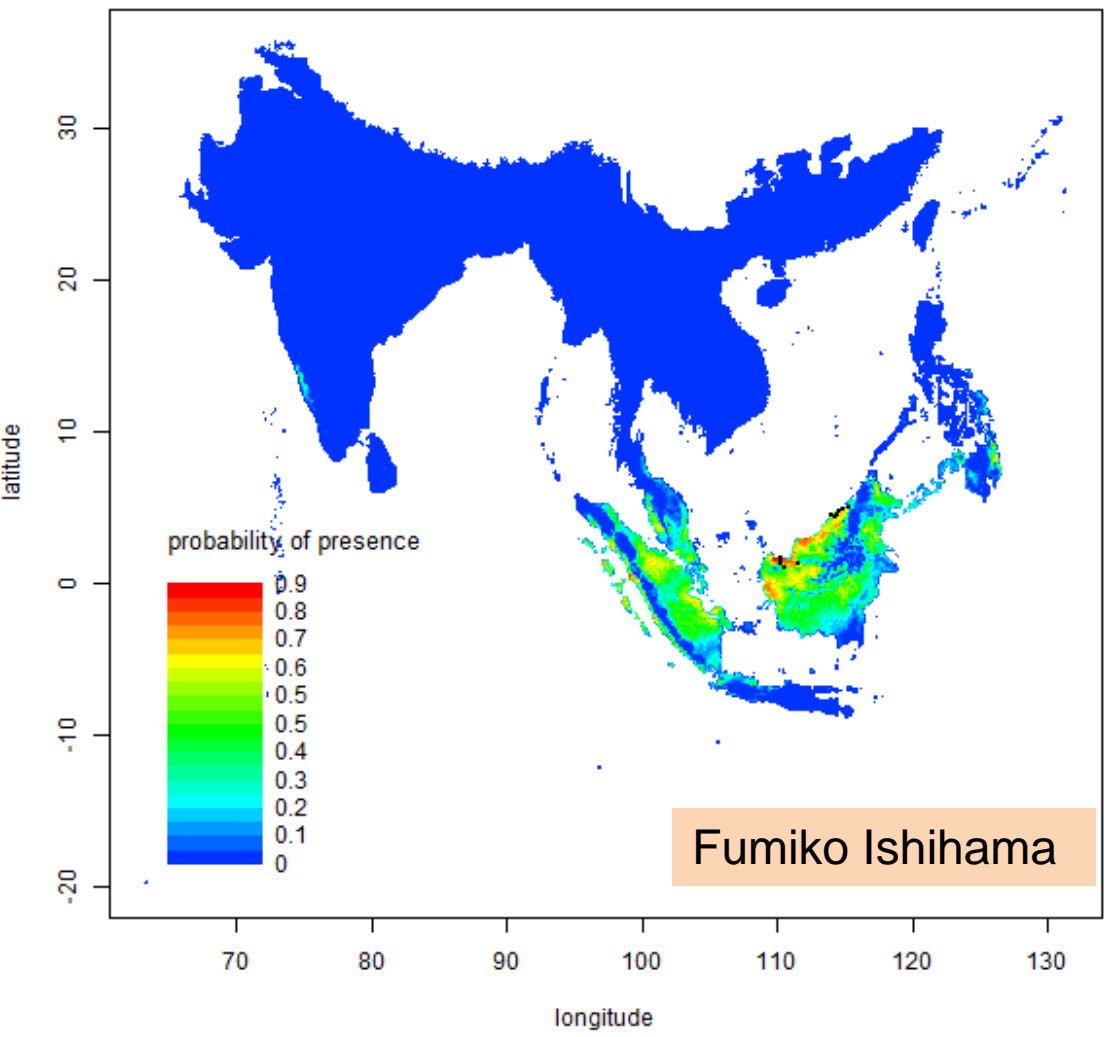
Scientific name: Fabaceae *Bauhinia wrayi* Prain var. *cardiophylla* (Merr.) K. &

S.S. Larsen

No. 418

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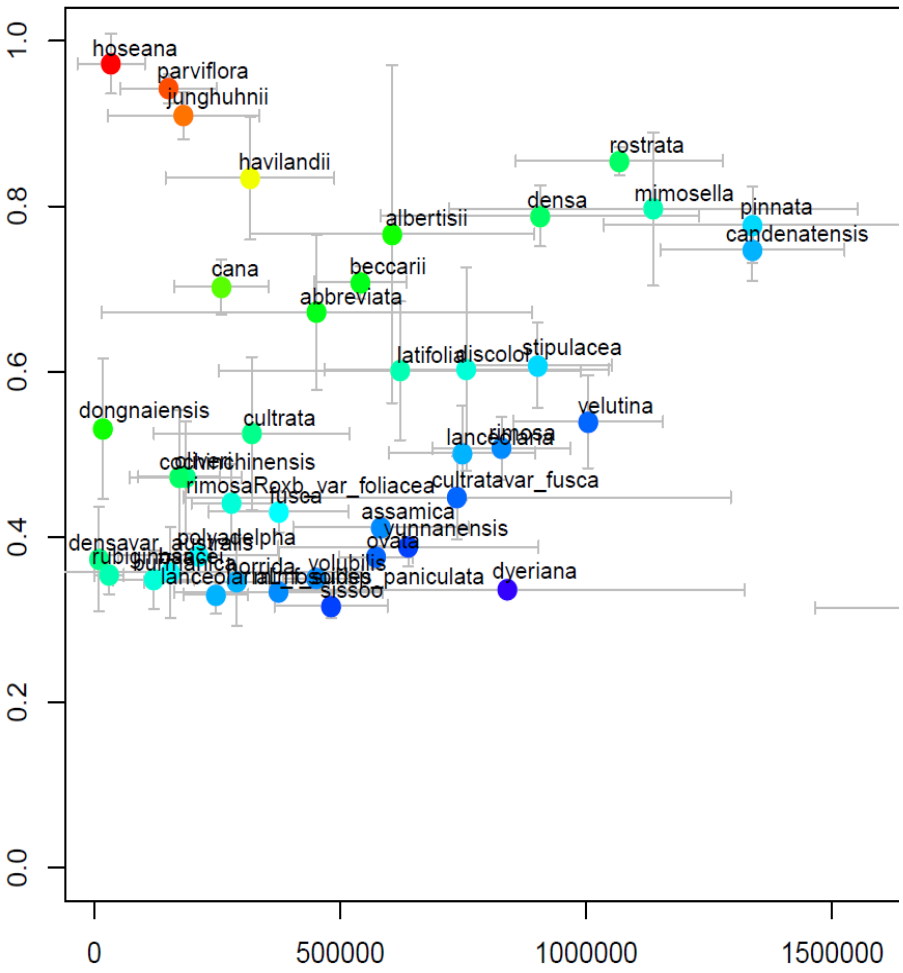
*Bauhinia wrayi*\_var\_*cardiophylla*, N =11 , test AUC=0.996



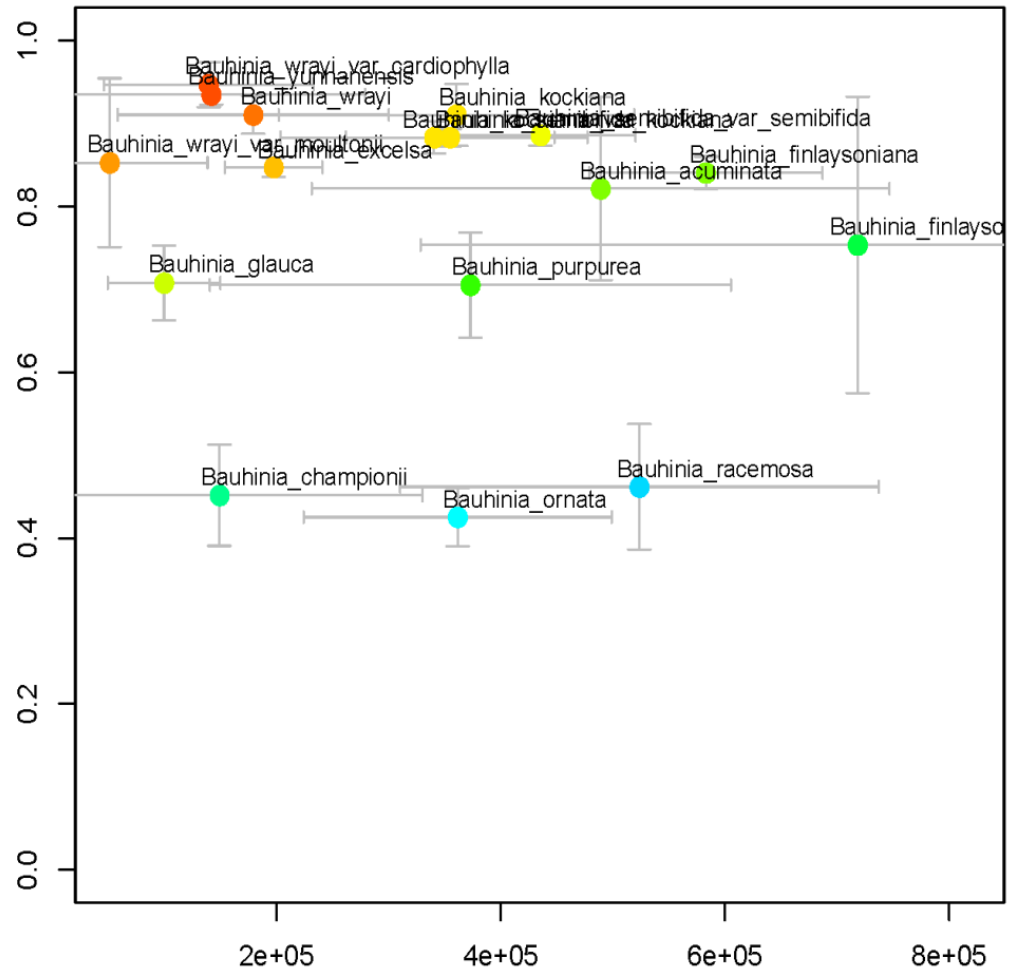
# Extinction Risk Assessment

Fumiko Ishihama

Dalbergia

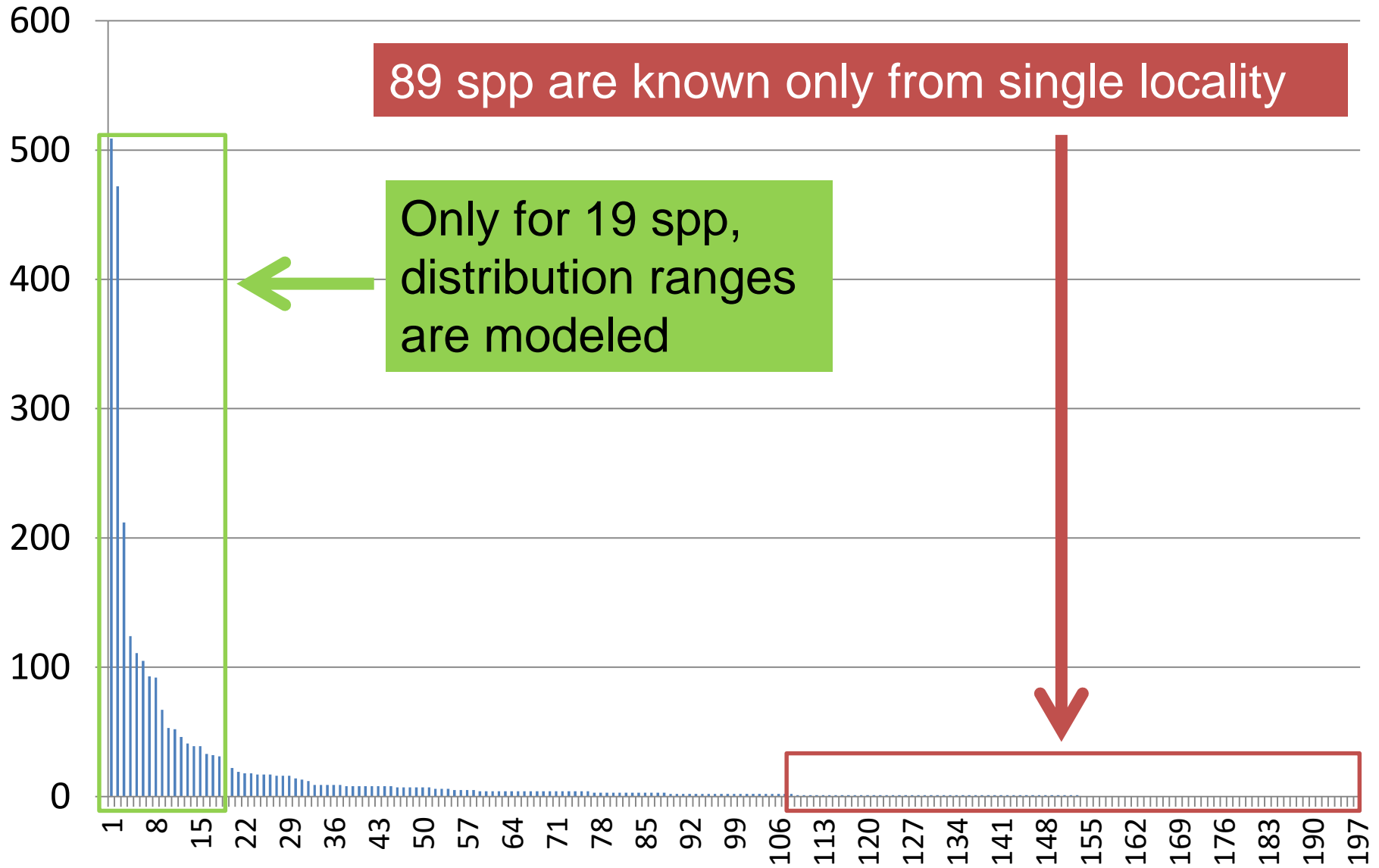


Bauhinia





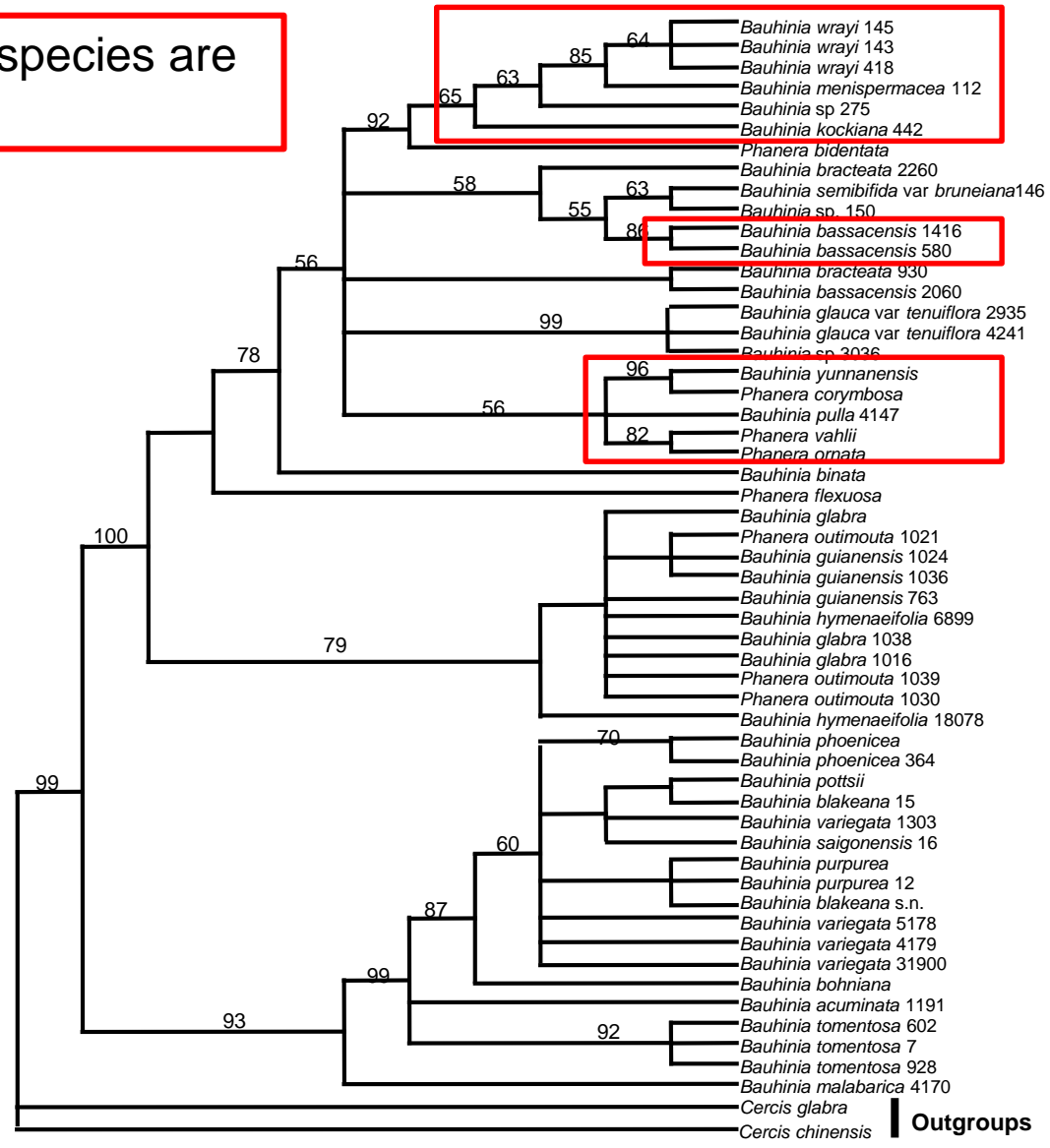
# Many more rare species: Bauhinia



# Phylogenetic diversity: Bauhinia

To assess PD loss, more rare species should be included

Threatened species are clustered.



Asia

America

Asia

Outgroups



# Plant diversity assessments in SE Asia

- Achievements
  - Ca. 20,000 records of distribution for all life forms of vascular plant species based on a standardized transect method
  - Distribution models for 1113 species of 7 tree families (Raes, Guan, Welzen & Yahara 2013), but mostly for non-threatened species
  - Extinction risk assessment for *Bauhinia* and *Dalbergia*
- Challenges
  - Taxonomy of many plant groups remain to be revised in tropical Asia; many species remain to be described
  - Larger parts of species are rare; known only from few localities; more efforts are needed for assessing extinction risks and PD loss
  - DNA barcoding of ca. 20,000 samples (by using NGS)

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