

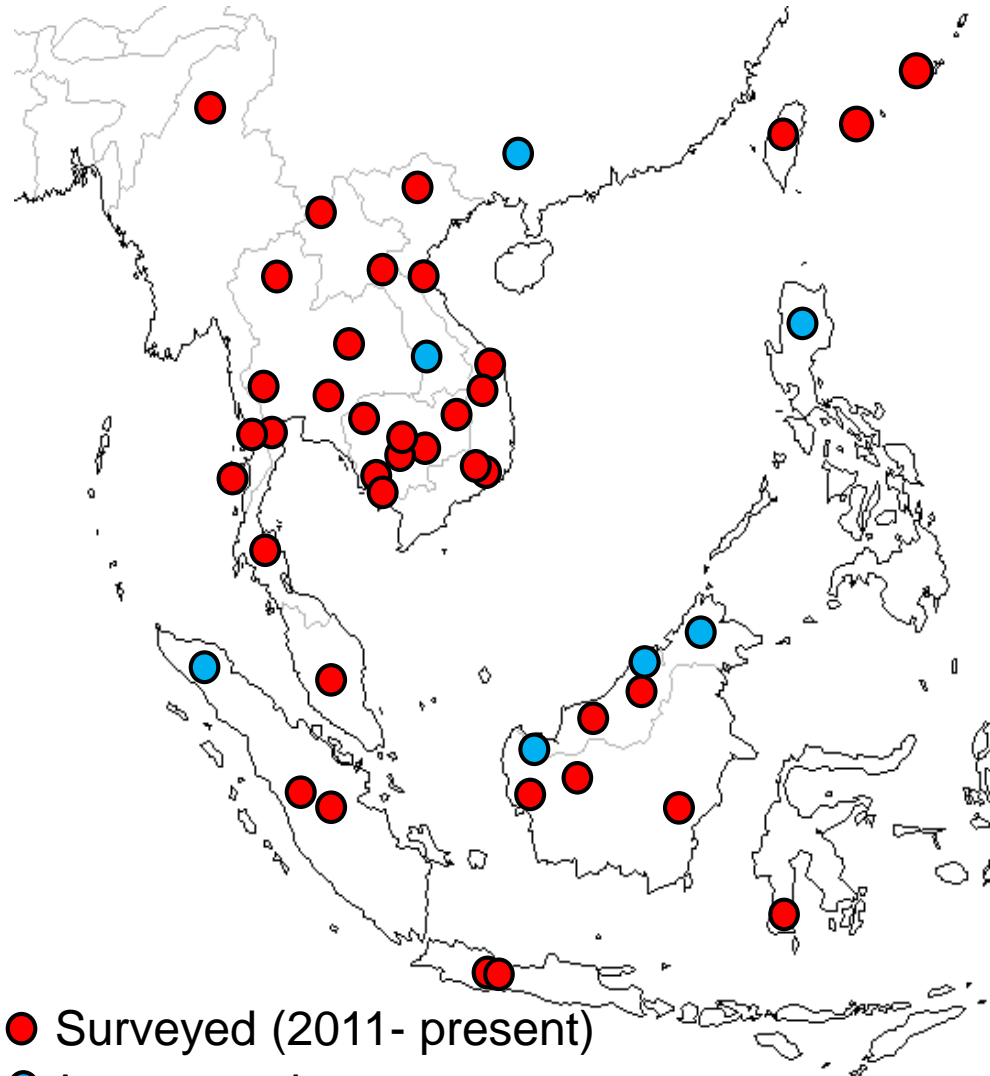
19 September 2017, Hanoi  
10<sup>th</sup> GEOSS AP symposium

# SE Asian Plant Diversity Assessment Network

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Kyushu University, Japan

# Botanical inventories from 2011-present

- 135 sites in 35 locations



## Cambodia (FA)

Koh Kong, Bokor NP, Seima Protected Forest  
Siem Reap, Kampong Thom, Kampong Chhnang

## Vietnam (TBI, Dalat Univ.)

Hon Ba NR, Bach Ma NP, Vu Quang NP,  
Hoan Lien NP, Bidoup Nui Ba NP, Ngoc Linh NR

## Laos (NUL)

Nam Khading NP, Nam Ha PA

## Thailand (BKF, KU)

Doi Inthanon NP, Kaeng Krachan NP, Phu  
Kradueng NP, Maeklong, Khao Soi Dao Wildlife  
Sanctuary, Khao Luang NP

## Myanmar (FRI)

Tanintharyi NR, Indawgyi NP

## Malaysia (FRIM, FDS)

Lambir Hills NP, Fraser's Hill, Bintulu

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

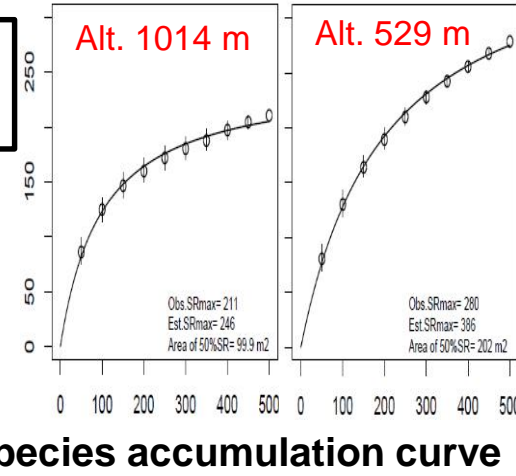
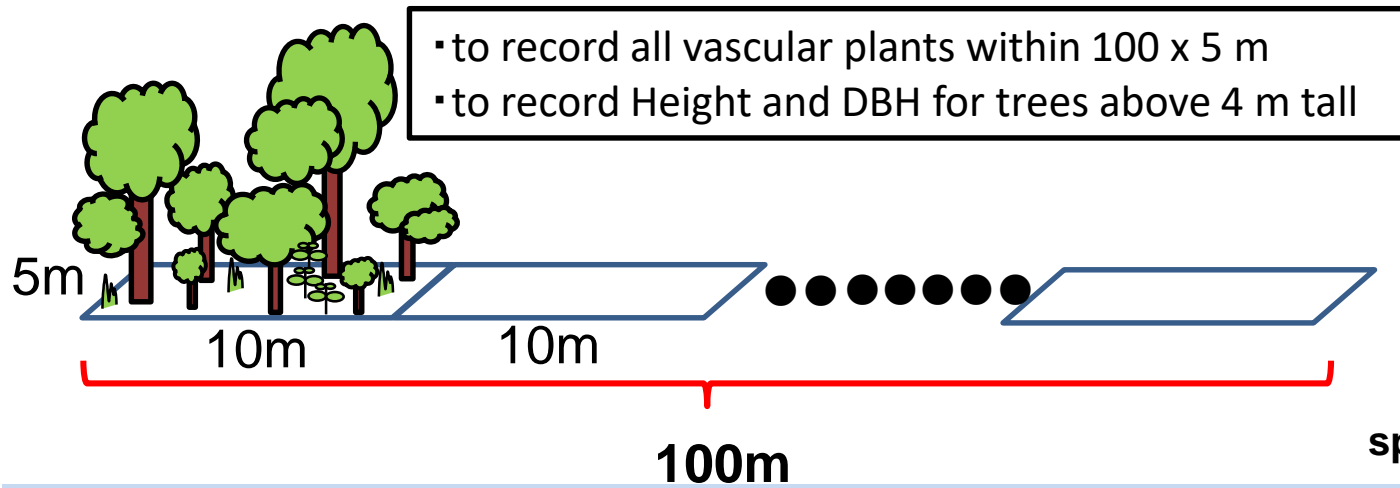
Gn. Gede Pangrango NP (Java), Gn. Halimun NP  
(Java), Bantimulung Bulusarung NP (Sulawesi)  
Gn. Gadut (Sumatra), Pekanbaru (Sumatra)  
Mandor, Serimbu (W. Kalimantan),  
Bukit Bangkirai (E. Kalimantan)

## Taiwan (Taiwan Forest Research Institute)

Lienhuachi



# A standardized belt-transect method



(1) Collect plants and record data, (2) Taking photos, (3) Collect leaf pieces for DNA analysis and (4) Make voucher specimens.



(5) Identify the plant species based on herbarium specimens, literature and DNA barcoding

(6) Study on taxonomy, ecology, phylogeny and biogeography; Picture guide, Database, etc.



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

#

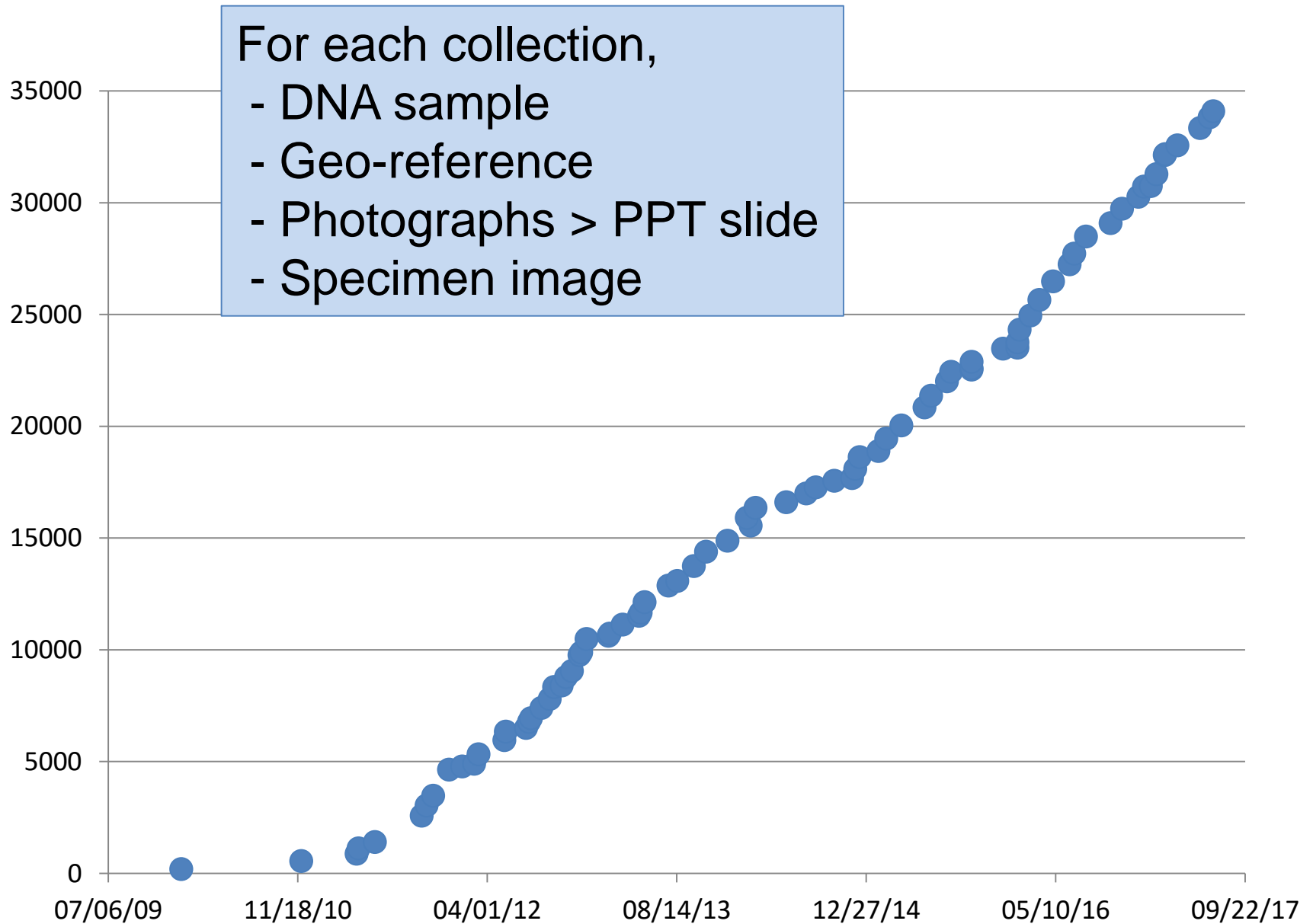
Last record

Mandor



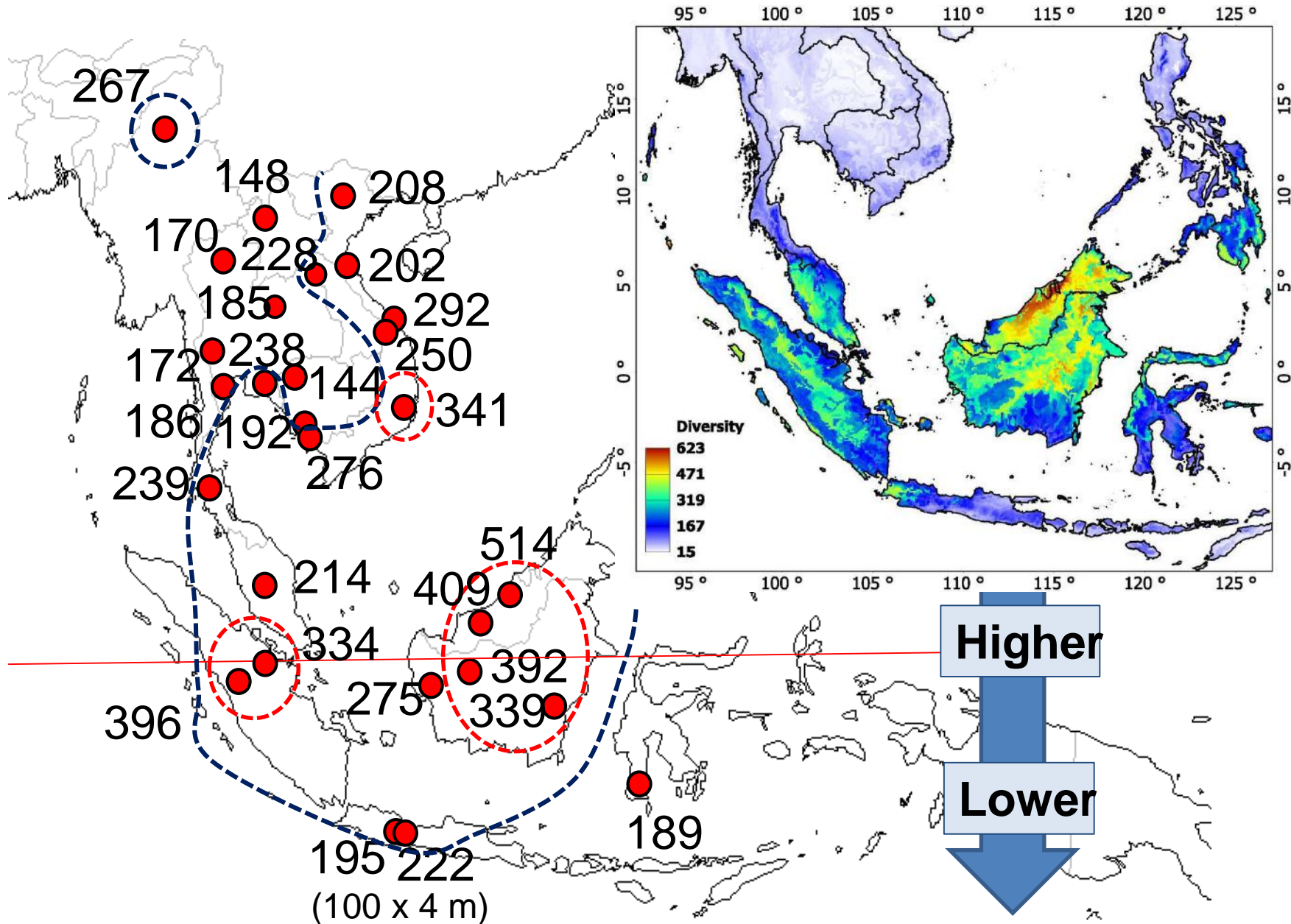
Power point slides are available for all the species recorded

# 34,099 collections have been accumulated





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



# Use of DNA barcodes/phylogenetic tree

32 Permanent plots in Kg. Thom,  
Cambodia

347 species

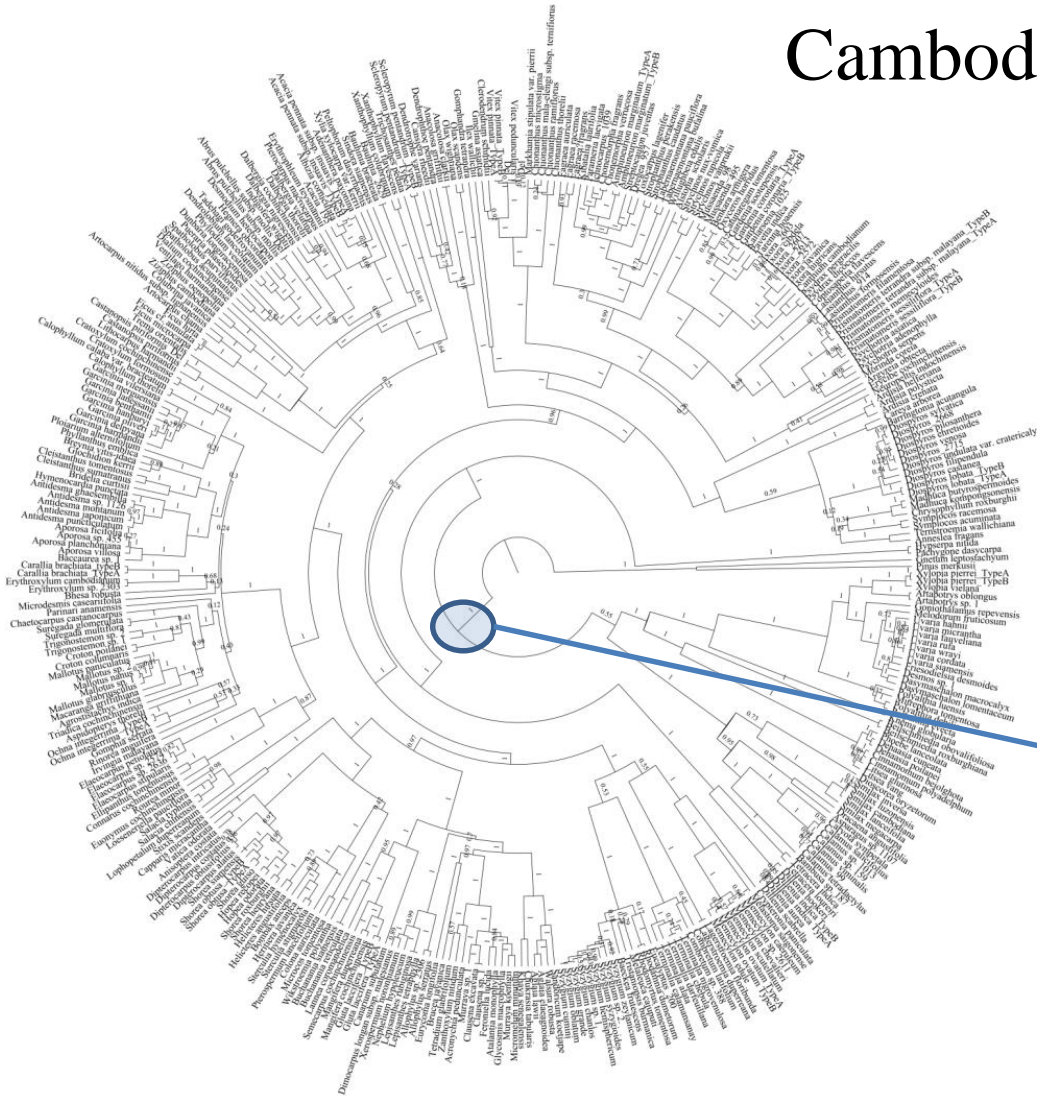
Bayesian method

14 calibration points

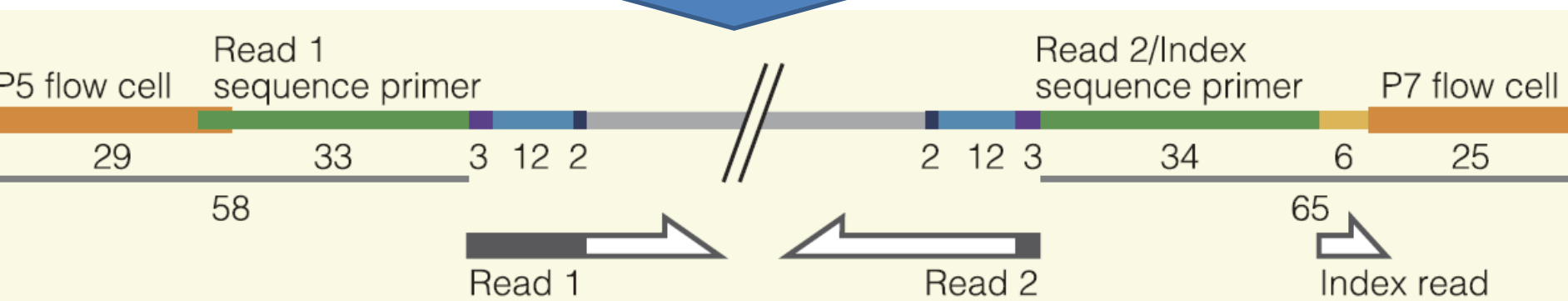
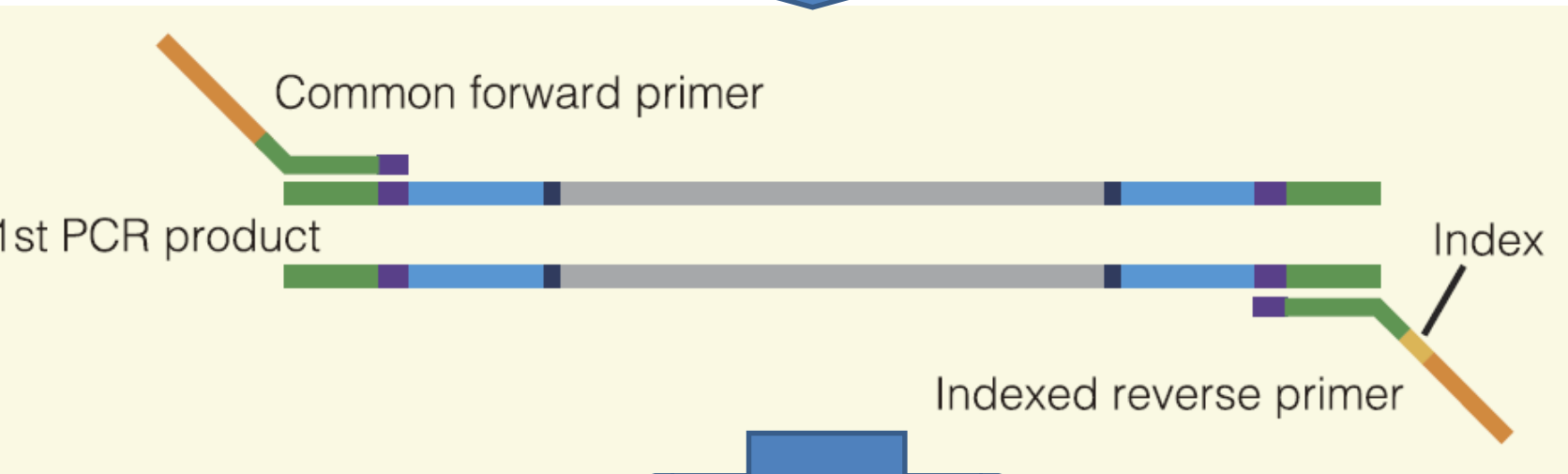
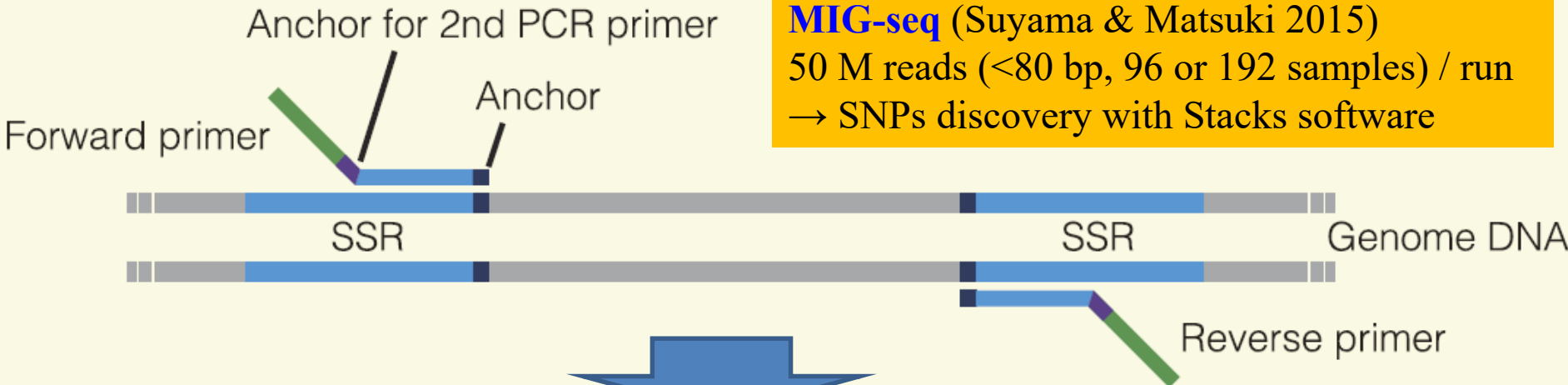
Estimated common  
ancestor of Angiosperms

159 Ma

141-199 Ma (Bell et al. 2010)

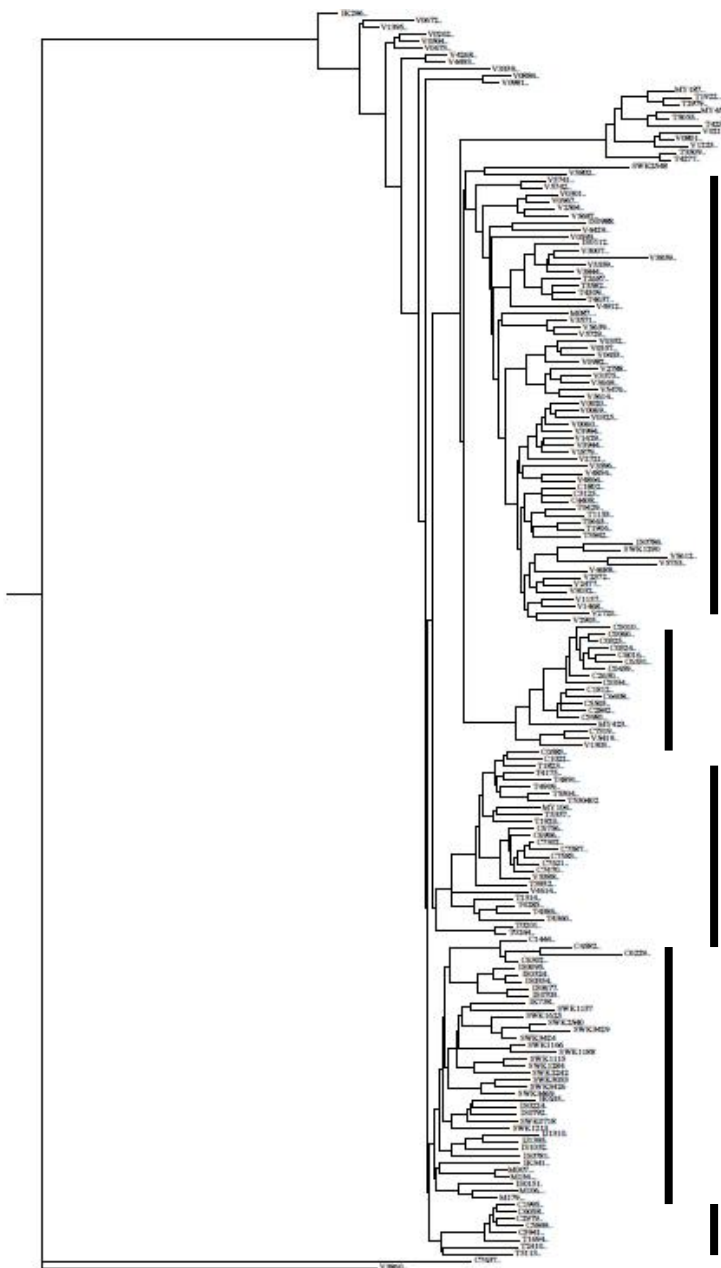


**MIG-seq** (Suyama & Matsuki 2015)  
50 M reads (<80 bp, 96 or 192 samples) / run  
→ SNPs discovery with Stacks software





# MIGseq tree of *Cinnamomum* (Ma, Mitsuyuki, Suyama, Yahara)



Pinnate clade

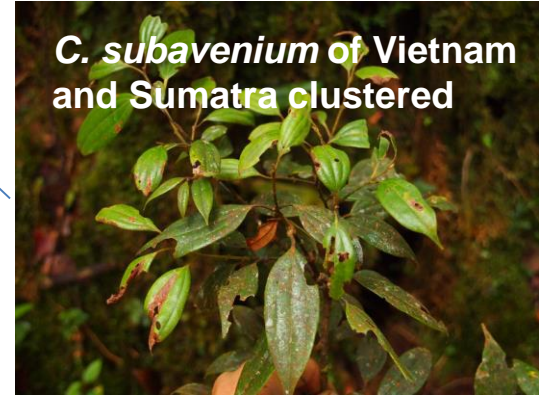
Clade 1

Clade 2

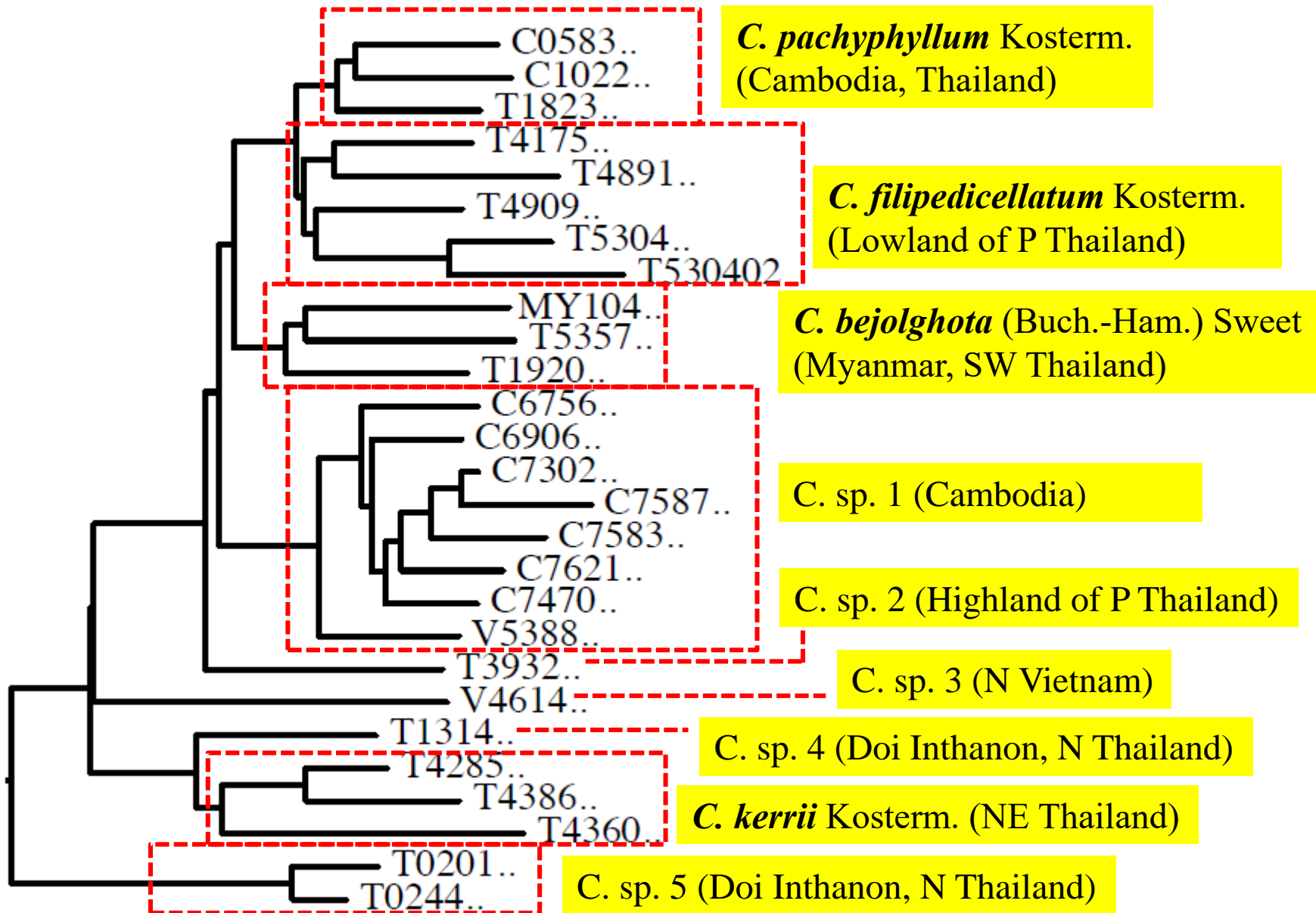
Clade 3

Clade 4

Clade 5



# MIGseq tree of *Cinnamomum bejorghota* / *iners* complex



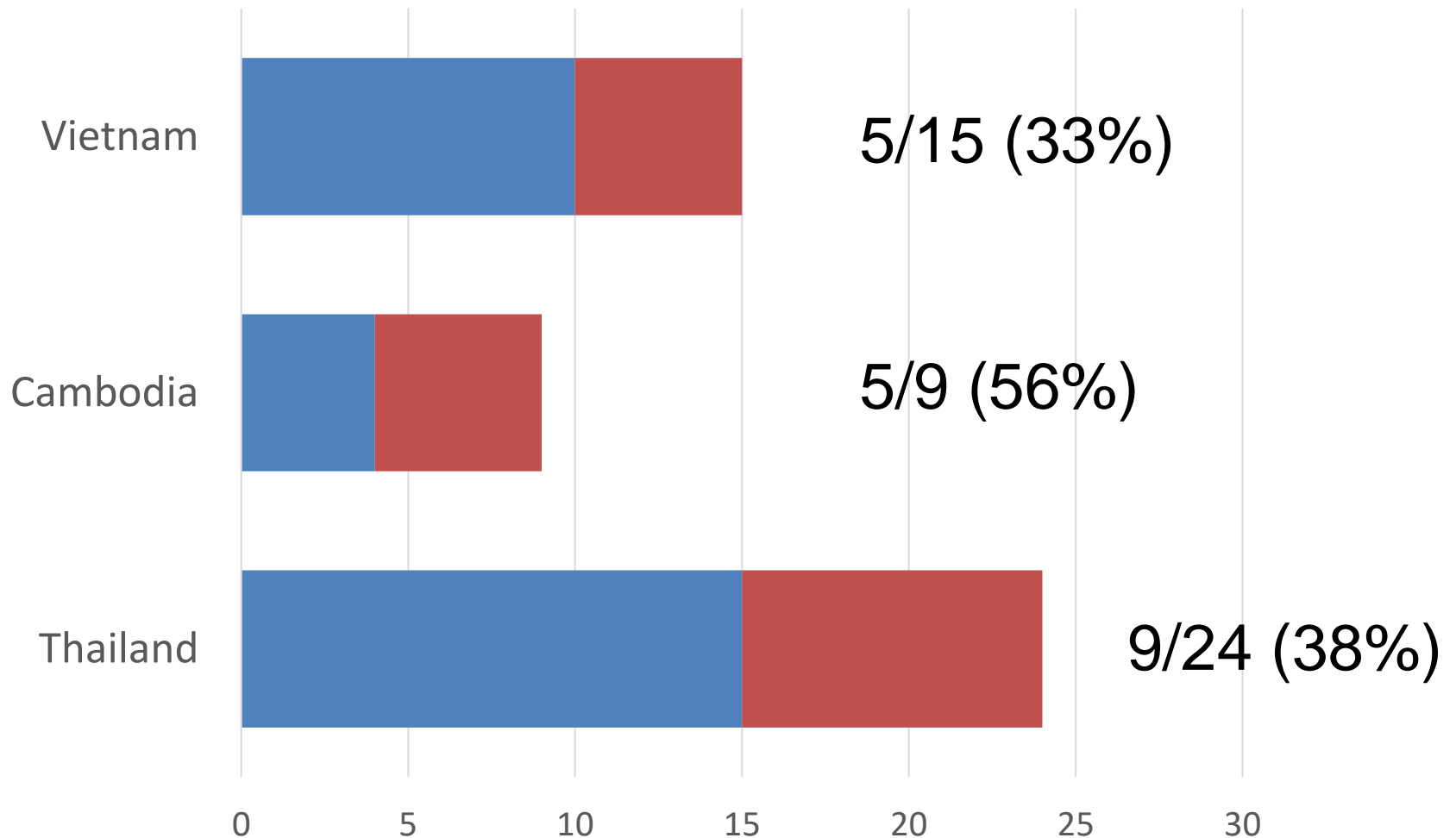


# MIGseq tree of *Cinnamomum bejorghota* / *iners* complex



# *Cinnamomum* of Vietnam, Cambodia and Thailand

**Proportion of new species: 19/48 (40%)**

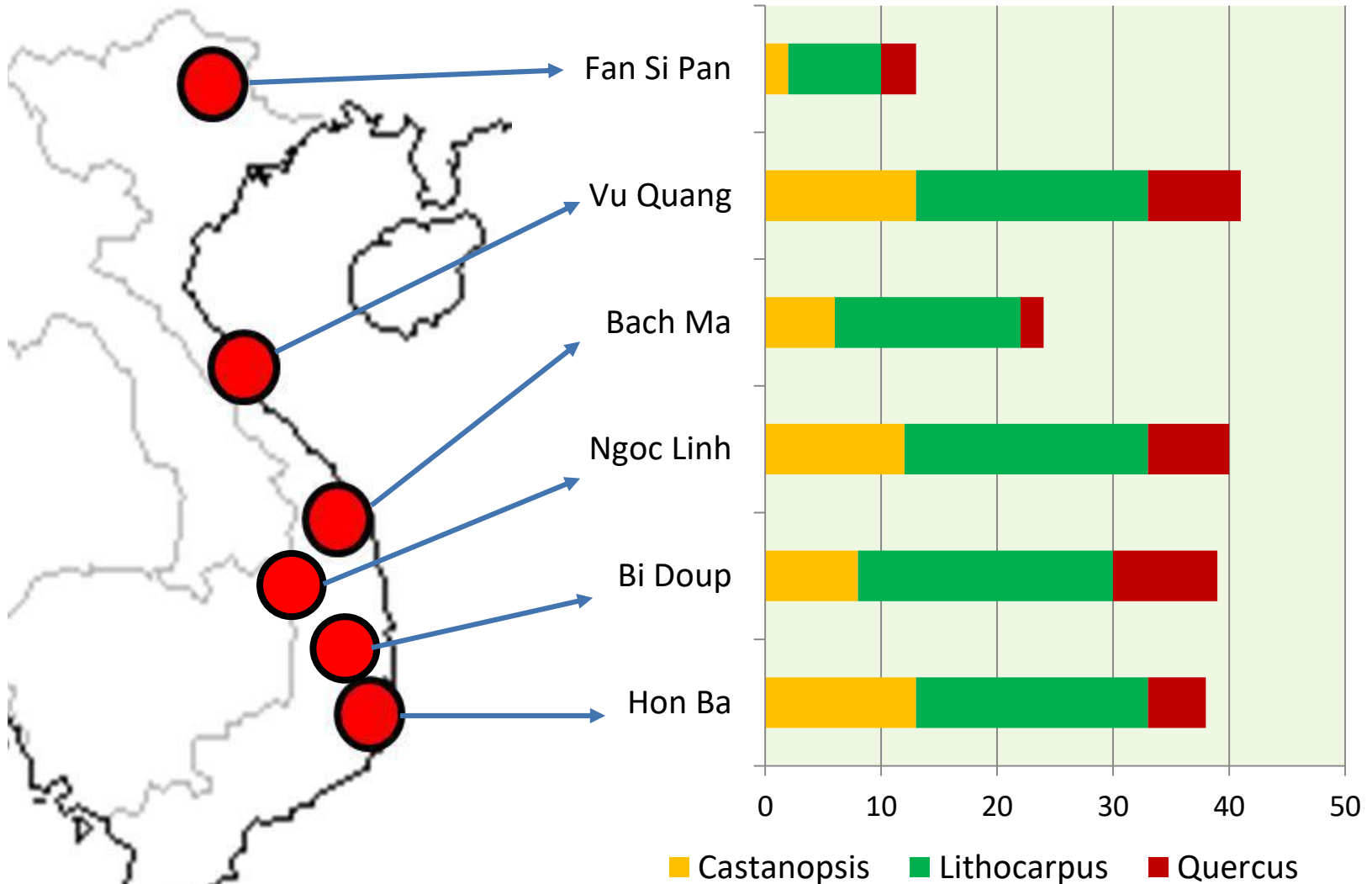




# Fagaceae of Vietnam

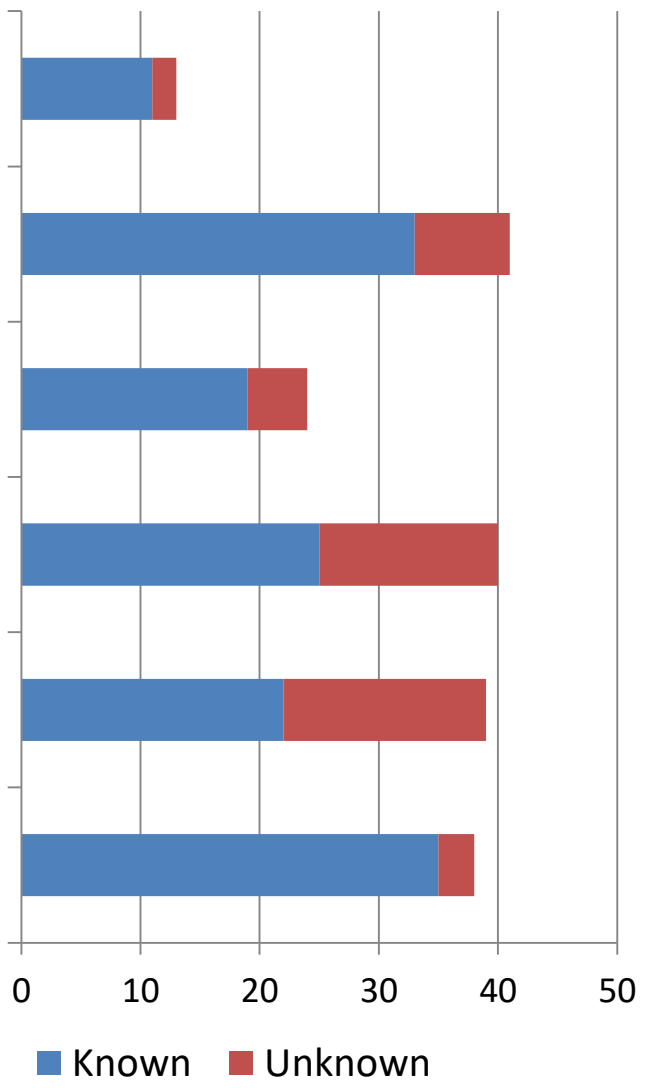
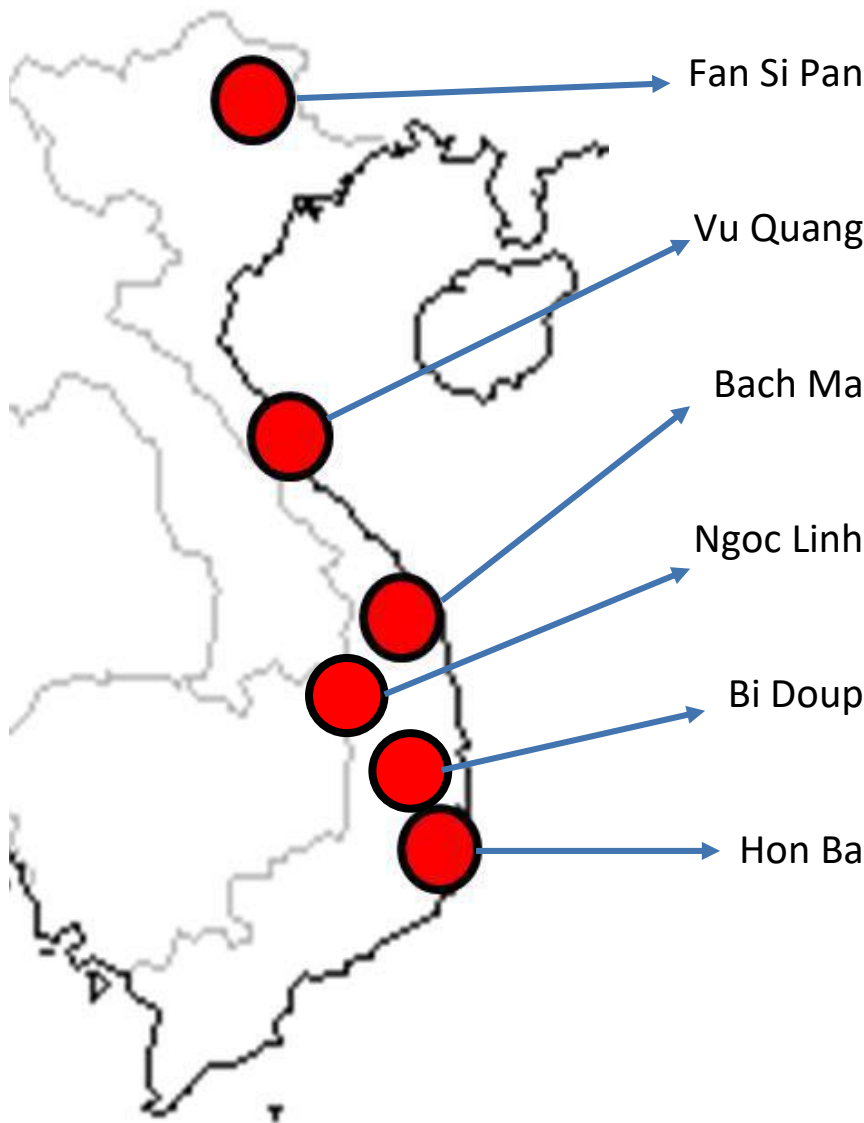


# Species richness of Fagaceae in Vietnam





# New species of Fagaceae in Vietnam



50 new species (24%)

# Picture Guides of Forest Trees in Cambodia



Picture guide of forest trees cambodia

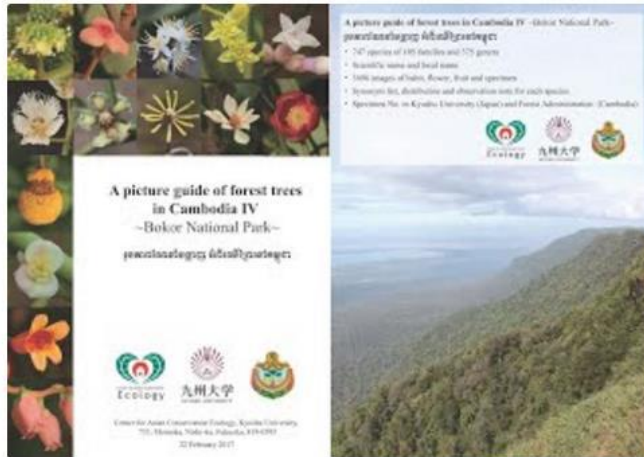


## Bokor National Park

### A Picture guide of forest trees in Cambodia IV -Bokor National Park- (610MB)

[Update history](#)

[Future updates](#)



[-< Click to download!!](#)

Annonaceae

*Artabotrys* sp. 2

■ **Distribution:** -

■ **Observation:** Scandent tree to climber, locally common in semi-evergreen forest and its vicinity in lowland. This species is characterized by large thorns on stems (up to 3 cm long), shining leathery leaves, and finely reticulated tertiary veins prominent on both surfaces.

■ **Khmer name:** វិទ្យុន់ [Vor Chektum]

■ **Specimens:** 95 m (5523 [fl. & fr]), 19 m (4120 [fl. & fr]).



Fig. 18. *Artabotrys* sp. 2 (A–F *Tague et al.* 4120, 20 July 2012). A) Fruiting branch, B) lower leaf surface, C) flower, D) fruits, E) thorns on stem, F) specimen (bar = 10 cm), G) flower.

25

- 747 species of 105 families and 375 genera
- Scientific name and local name
- 3696 images of habit, flower, fruit and specimen
- Synonym list, distribution and observation note for each species
- Specimen No. in Kyushu University (Japan) and Forestry Administration (Cambodia)

**24 new species published**

**More than 40 species to be described**

**$(24+40)/747 = 9\%$**

# New species of Rubiaceae in Bokor, Cambodia

4 new species published

*Lasianthus bokorensis*, *L. giganteus*, *L. oblanceolatus*, *L. stephanocalycinus* (Naiki et al. 2015)

14 more new species of Rubiaceae from Bokor, Cambodia **(4+14)/62=29%**

**Rubiaceae**  
*Brachyotum* sp.

- Distribution:** -
- Observation:** Shrub, 1.3 m tall. One found only one individual in primary moist evergreen forest on the plateau. This species is similar to *B. zosterocaulis* King & Gable, (previously recorded in Vietnam to Sidaie Province), but differs in glabrous twigs and leaves.
- Khmer name:** អ្នក ក្រូច (0517)
- Specimens:** 789 no (0517)




Fig. 393. *Brachyotum* (A-F) Thoma et al. 2022. A body branch, B lower leaf surface, C stipule, D specimen (herb = 10 cm), E lower leaf surface.

393

**Rubiaceae**  
*Cantium* sp. 1

- Distribution:** -
- Observation:** Small tree, 5m. One found only one individual in evergreen forest beside a stream. The species is similar to *C. cambodianum*, but differs in long petioles and flowers leaves.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 264 no (1302)



Fig. 479. *Cantium* (A-F) Thoma et al. 2022. A body branch, B lower leaf surface, C stipule, D specimen (herb = 10 cm), E lower leaf surface.

394

**Rubiaceae**  
*Cantium* sp. 2

- Distribution:** -
- Observation:** Small tree, 5m. This species is similar to *C. cambodianum*, but differs in long petioles and flowers leaves.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 264 no (1302)

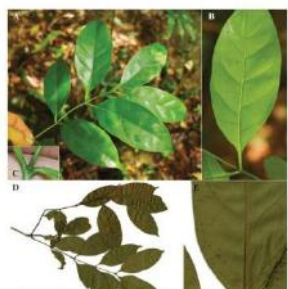


Fig. 480. *Cantium* (A-F) Thoma et al. 2022. A body branch, B lower leaf surface, C stipule, D specimen (herb = 10 cm), E lower leaf surface.

395

**Rubiaceae**  
*Diplogera* sp.

- Distribution:** -
- Observation:** Small tree, occasional in evergreen forest in higher elevation.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 302 no (2102), 303 no (1707), 444 no (2873) (80)




Fig. 481. *Diplogera* (A-F) Thoma et al. 2022. A body branch, B lower leaf surface, C stipule, D specimen (herb = 10 cm).

396

**Rubiaceae**  
*Lasianthus* sp. 1

- Distribution:** -
- Observation:** Shrub, 1 m tall. One. This species is similar to *L. bokorensis*, but differs in having smaller leaves and pubescent rachis only near base (1.2-1.4) on upper surface of leaves.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 762 no (1512), 763 no (1304)



Fig. 431. *Lasianthus* (A-F) Thoma et al. 2022. A body branch, B lower leaf surface, C stipule, D specimen (herb = 10 cm), E lower leaf surface.

397

**Rubiaceae**  
*Lasianthus* sp. 2

- Distribution:** -
- Observation:** Shrub, 1 m tall. This species is similar to *L. bokorensis*, but is distinguished by dense hairs on twigs and dorsal leaf veins.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 758 no (1777) (816)




Fig. 432. *Lasianthus* (A-F) Thoma et al. 2022. A body branch with dense hairs, B lower leaf surface, C dorsal vein of specimen (herb = 10 cm), D lower leaf surface.

398

**Rubiaceae**  
*Lasianthus* sp. 3

- Distribution:** -
- Observation:** Shrub, 1 m tall, occasional in higher elevation. The leaves are similar to *L. bokorensis* (herb), but rather in dark venation.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 770 no (4346), 903 no (1110), 941 no (2319) (81), 808 no (1074, 3972)




Fig. 433. *Lasianthus* (A-F) Thoma et al. 2022. A body branch with dense hairs, B lower leaf surface, C dorsal vein of specimen (herb = 10 cm), D lower leaf surface.

399

**Rubiaceae**  
*Metadina* sp.

- Distribution:** -
- Observation:** Tree, 5m in evergreen forest in middle elevation. One collection would be *M. polyantha* (Sidaie), but further specimens are needed for identification.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 137 no (1728, 2013)




Fig. 434. *Metadina* (A-F) Thoma et al. 2022. A body branch, B lower leaf surface, C stipule, D specimen (herb = 10 cm), E lower leaf surface.

400

**Rubiaceae**  
*Neonauclea* sp.

- Distribution:** -
- Observation:** Small tree 10 m tall, rarely found along stream in evergreen forest. Inflorescences are terminal and solitary. It is difficult to identify at the species level because of flowers were dropped.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 872 no (1089) (8)



Fig. 435. *Neonauclea* (A-F) Thoma et al. 2022. A flowering branch, B lower leaf surface, C inflorescence, D specimen (herb = 10 cm), E retained fruit, F lower leaf surface.

401

**Rubiaceae**  
*Neonauclea* sp. 1

- Distribution:** -
- Observation:** Shrub, 5m in moist evergreen forest in higher elevation. This species is similar to *P. spicata* (Sidaie) in having long hairs on both surfaces and 8-9 pairs of secondary veins. However, detailed specimens are needed for identification.
- Khmer name:** ក្រូច ក្រុង (264)
- Specimens:** 803 no (3073), 771 no (201)




Fig. 436. *Neonauclea* (A-F) Thoma et al. 2022. A body branch, B lower leaf surface, C stipule, D specimen (herb = 10 cm).

402

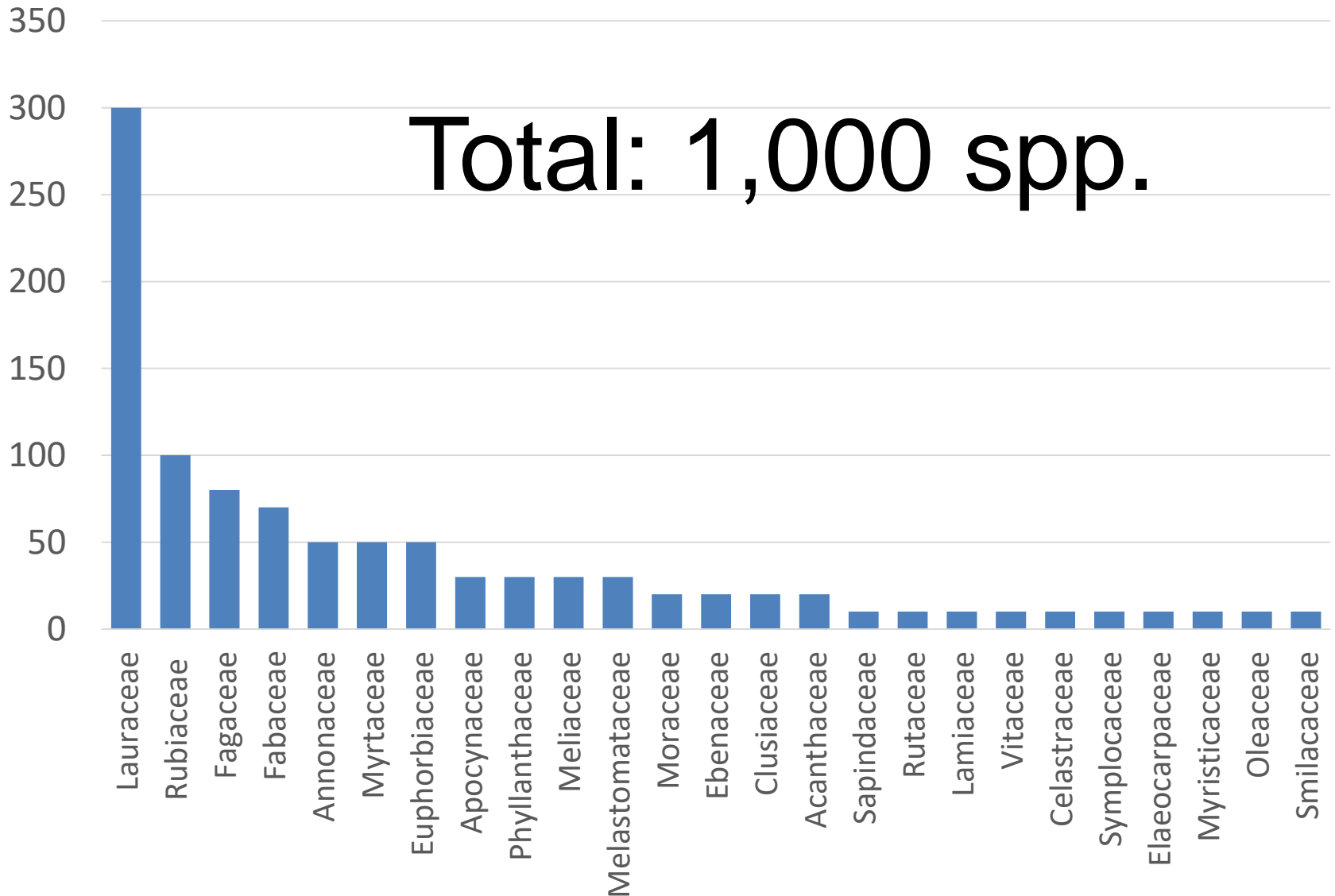


# Specimens per family (2011-2017)

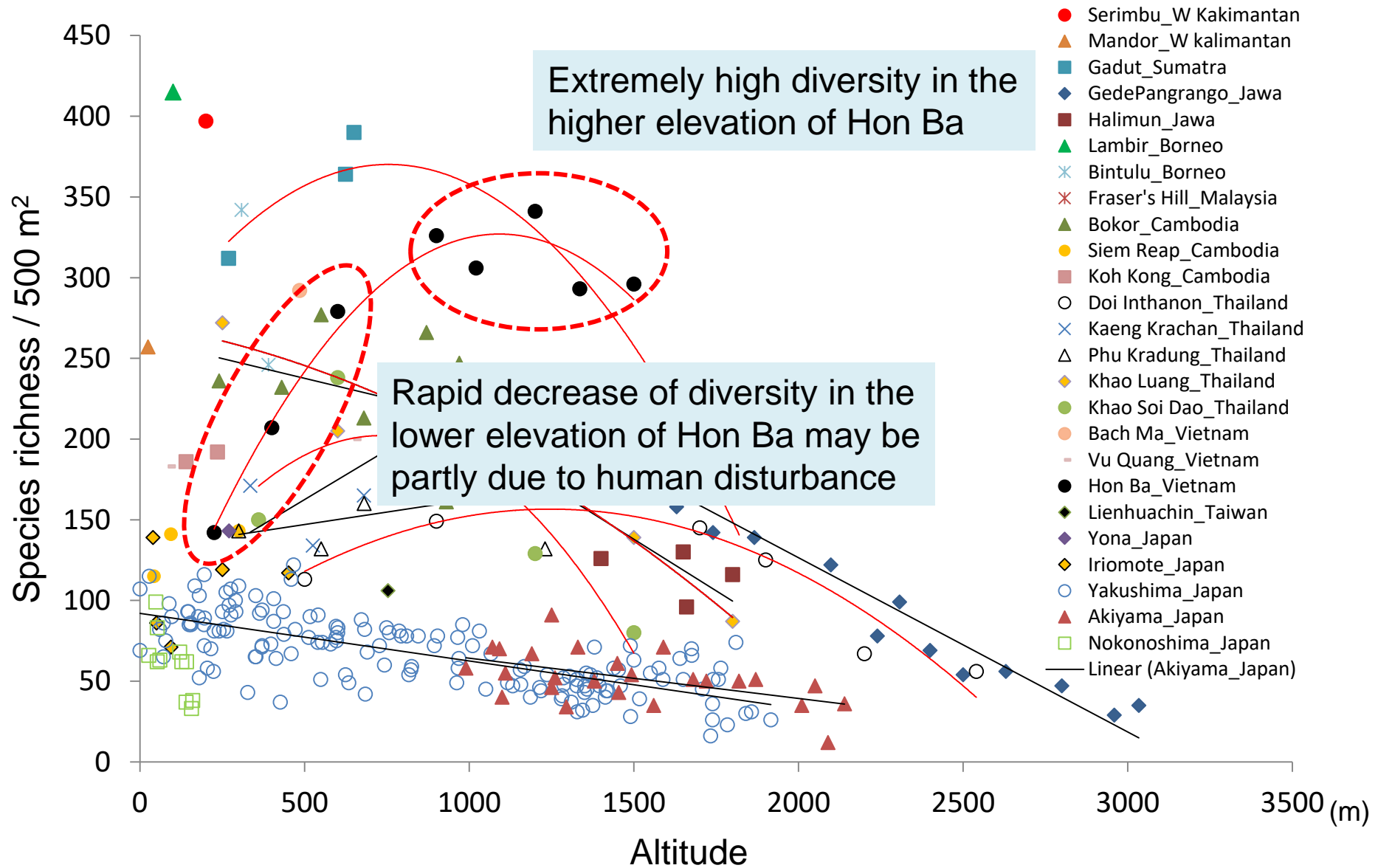
<b>Rubiaceae</b>	<b>2163</b>	Zingiberaceae	355	Sapotaceae	191
<b>Lauraceae</b>	<b>1759</b>	<b>Sapindaceae</b>	<b>328</b>	Pentaphragaceae	183
<b>Fagaceae</b>	<b>915</b>	<b>Lamiaceae</b>	<b>326</b>	Polygalaceae	182
<b>Fabaceae</b>	<b>873</b>	<b>Rutaceae</b>	<b>303</b>	Poaceae	178
<b>Annonaceae</b>	<b>849</b>	<b>Symplocaceae</b>	<b>302</b>	<b>Acanthaceae</b>	<b>176</b>
<b>Myrtaceae</b>	<b>767</b>	<b>Vitaceae</b>	<b>302</b>	Convolvulaceae	176
<b>Phyllanthaceae</b>	<b>767</b>	<b>Myristicaceae</b>	<b>297</b>	Aquifoliaceae	163
<b>Euphorbiaceae</b>	<b>619</b>	Araceae	287	Dryopteridaceae	160
<b>Moraceae</b>	<b>619</b>	<b>Elaeocarpaceae</b>	<b>282</b>	Calophyllaceae	154
Primulaceae	525	<b>Celastraceae</b>	<b>281</b>	Pteridaceae	153
<b>Clusiaceae</b>	<b>509</b>	<b>Smilacaceae</b>	<b>265</b>	Athyriaceae	149
Malvaceae	503	Polypodiaceae	242	Ericaceae	144
Orchidaceae	499	Anacardiaceae	232	Theaceae	144
<b>Meliaceae</b>	<b>477</b>	Burseraceae	216	Combretaceae	140
<b>Melastomataceae</b>	<b>449</b>	Rosaceae	213	Asparagaceae	137
<b>Apocynaceae</b>	<b>447</b>	<b>Oleaceae</b>	<b>211</b>	Urticaceae	125
Dipterocarpaceae	447	Cyperaceae	209	Salicaceae	121
Arecaceae	410	Araliaceae	197	Dioscoreaceae	119
<b>Ebenaceae</b>	<b>385</b>	Piperaceae	194	Gesneriaceae	118

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# Expectation of new species for top 25 families

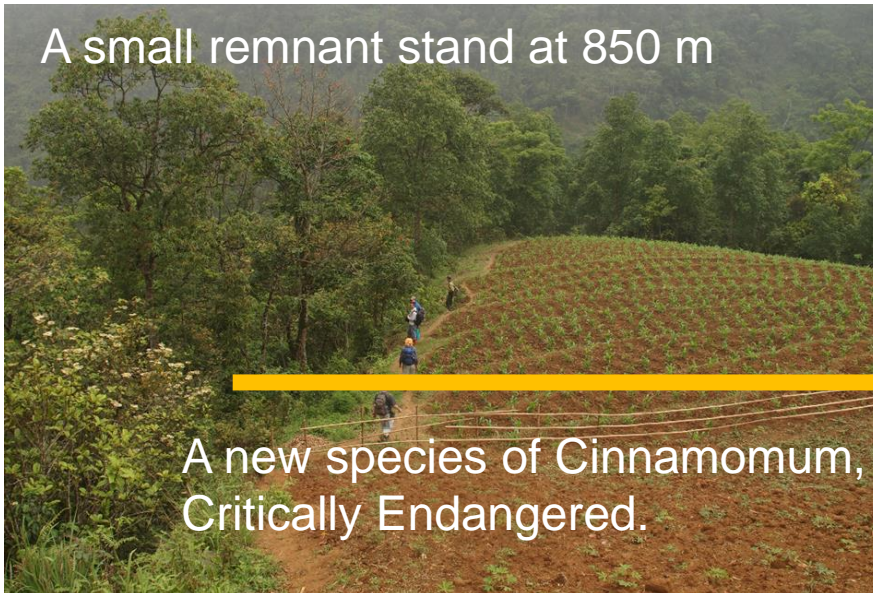


# Species richness vs altitude





# An example of threats: Fan Si Pan, Vietnam



# Further steps

- Supporting management of national parks and protected areas
  - Picture guide for each park and protected area
  - Assessing threats; providing Red Lists
- Publication of more than 1,000 new species
  - Taxonomic papers
  - Picture guides for Lauraceae, Fagaceae, Rubiaceae etc
- Contribution to ecosystem studies
  - Developing trait database
  - Constructing phylogenetic trees
- Linking small transects, large plots and supersites
  - Trade-off of site number and observation variables
  - Developing plots in Laos and Vietnam where no plot at now
- Collaboration with remote sensing

# SE Asian Plant Diversity Assessment Network

- **Cambodia:** Sokh Heng, Chhang Phourin, Ma Vuthy, Samreth Vanna (Forest Administration)
- **Vietnam:** Son Van Dang (ITB), Nguyen Van Ngoc, Hoang Thi Binh (Dalat University)
- **Laos:** Phetlasy Souladeth (National University of Laos)
- **Thailand:** Somran Suddee, Sukid Rueangruea, Dokrak Ma (Forest Herbarium)
- **Myanmar:** Mu Mu Aung (Forest Research Institution)
- **Malaysia:** Saw Leng Guan, Lim Chung Lu (FRIM), staffs of BRC and FRC Sarawak, staffs of Zedtee SDN.
- **Indonesia:** Dedy Darnaedi, Marlina Ardiyani (LIPI), Anes Syamsuardi (Andalas University), Ibrahim Dberjadin (Hasanudin University)
- **Japanese fieldwork members:** Shuichiro Tagane, Hironori Toyama (Kyushu University), Hidetoshi Nagamasu, Mamoru Kanzaki (Kyoto University), Eiji Suzuki (Kagoshima University), Akiyo Naiki (Ryukyu University), Shinji Fujii (University of Human Environments)
- **Lab works:** Keiko Mase, Etsuko Moritsuka (Kyushu University), Chika Mitsuyuki, Yoshihisa Suyama (Tohoku University)