23 December 2021,
10th APBON seminar

# Leafing, flowering, and fruiting phenology of in East and Southeast Asia

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## Today’s talk

# BACKGROUND

MATERIAL & METHODS

RESULTS

DISCUSSION

NEXT STEP

**Phenology**

Temporal patterns of biological activities in response to annual and multi-year fluctuations of environmental factors.
(e.g. Leafing, flowering, fruiting, leaf coloring, leaf fall, ...)

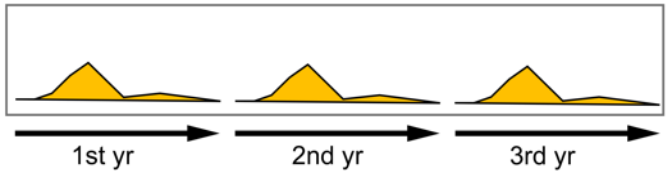
# Various phenological patterns in East and Southeast Asia

**Temperate forest** (e.g. Edwards et al. 2017; Nagahama & Yahara 2019)

The annual pattern responds to four seasons

**Tropical seasonal forest** (e.g. Kato et al. 2008; Williams et al. 2008)

The annual pattern responds to wet/dry seasons

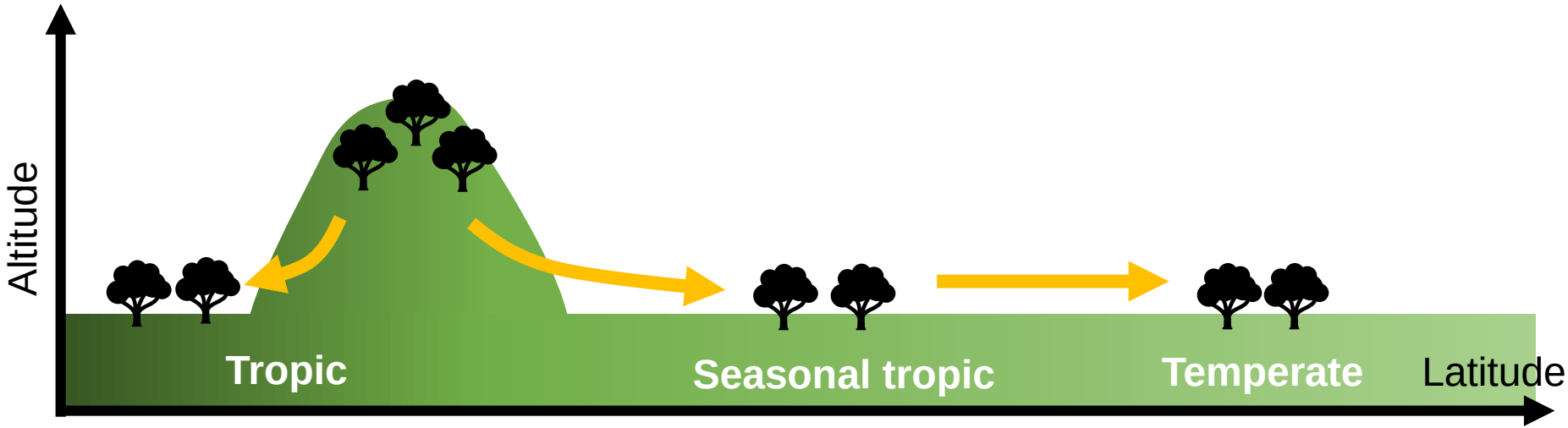



**Tropical rain forest** (e.g. Sakai et al. 1999; Ushio et al. 2019)

Non-seasonal pattern (e.g. general flowering)

## Based on the hypothesis…

- Plant phenology might have diversified from tropical montane forests to tropical lowland and temperate forests.



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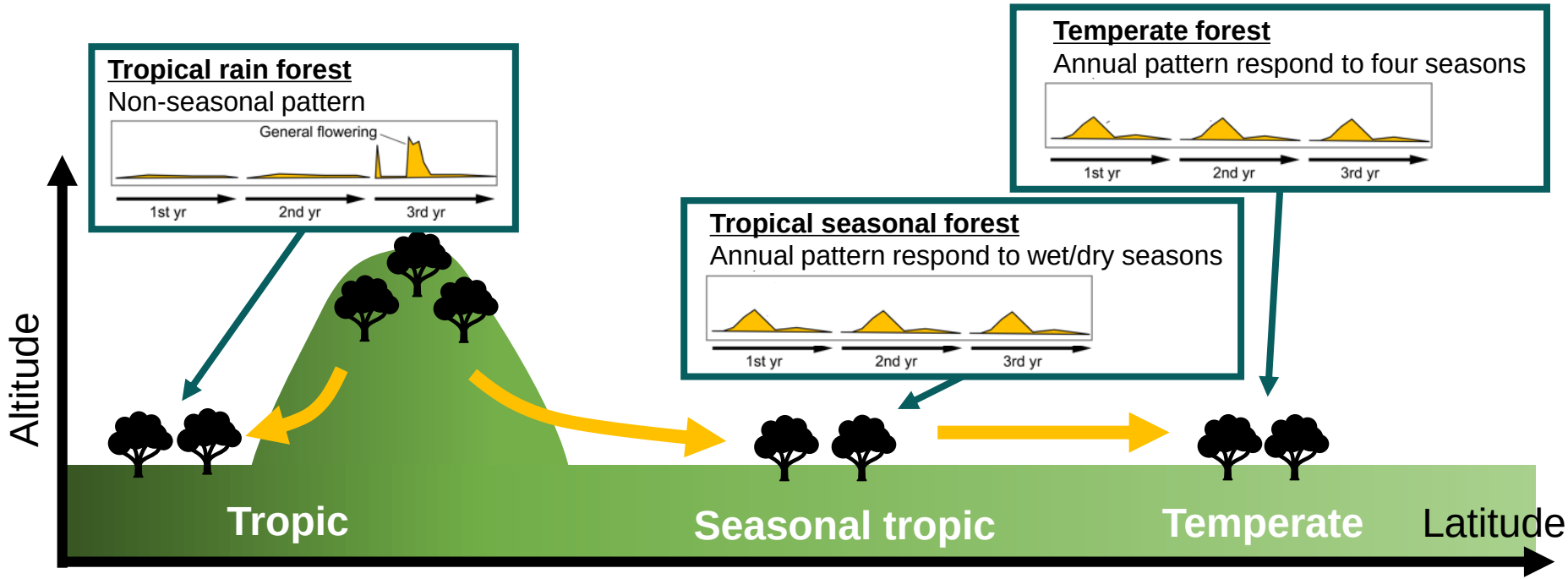

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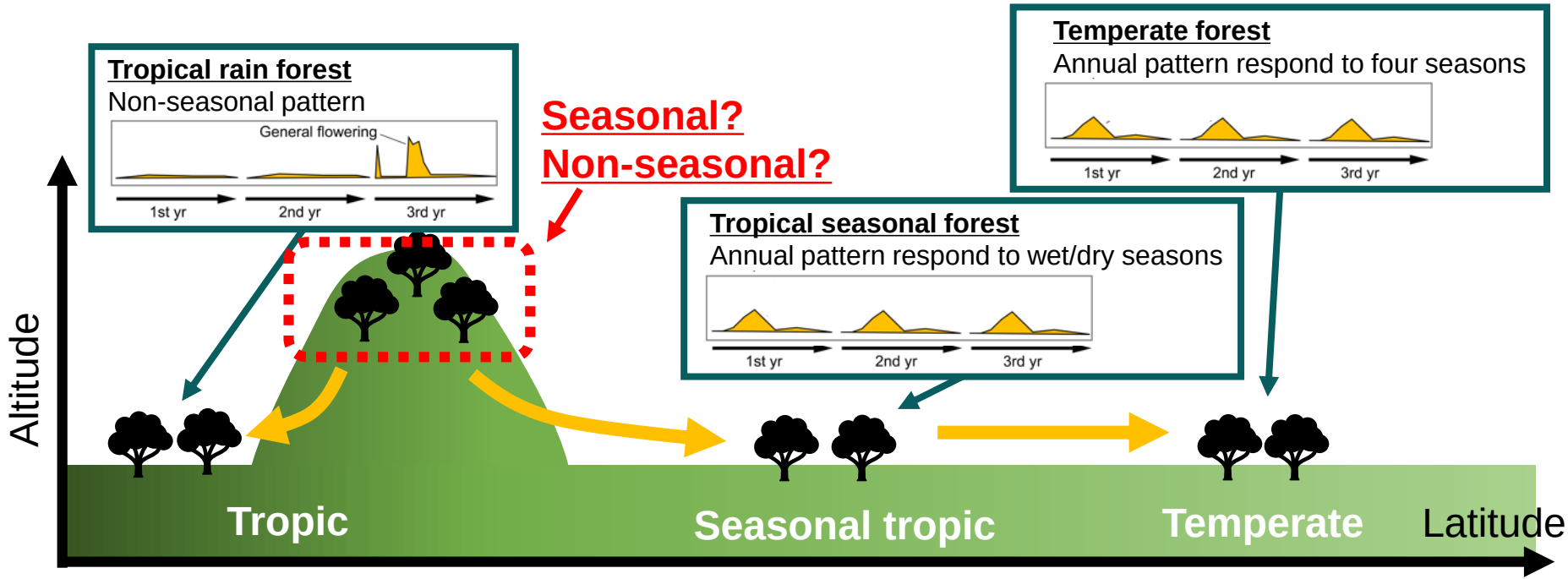
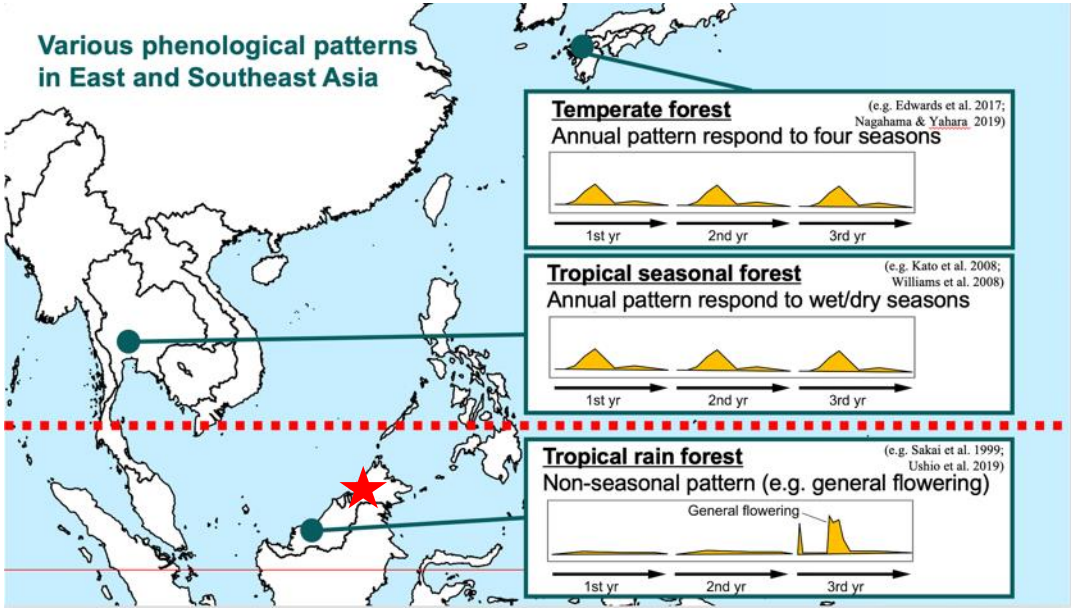


# Previous studies in the tropical montane forests of Southeast Asia

- The relationship between phenology and meteorological factors has been studied only in Mt. Kinabalu, Malaysia. (Nomura *et al.* 2003 for leafing; Kimura *et al.* 2009 for flowering and fruiting)



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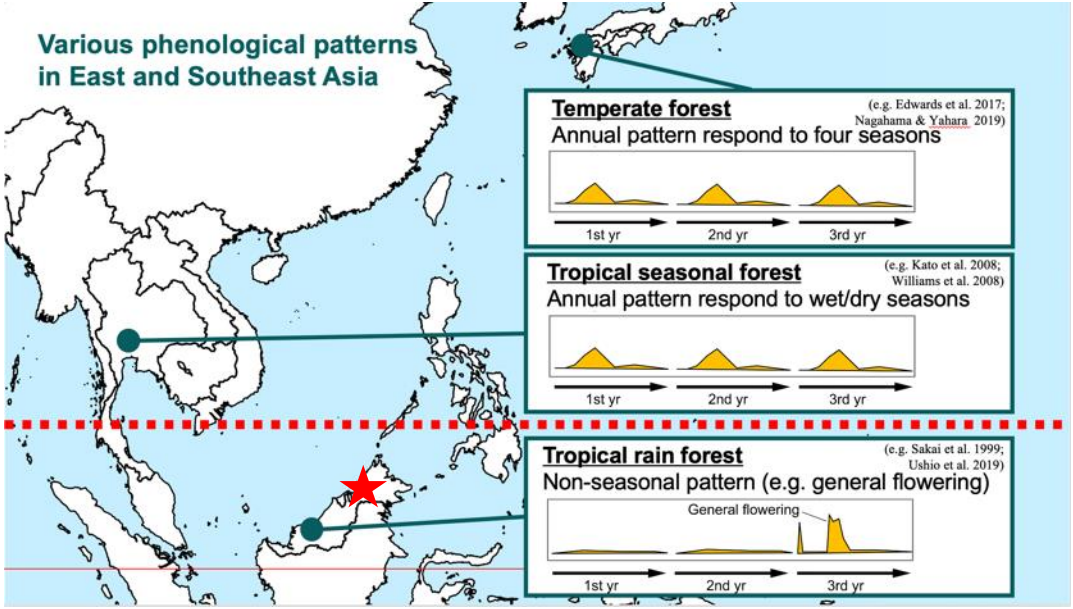
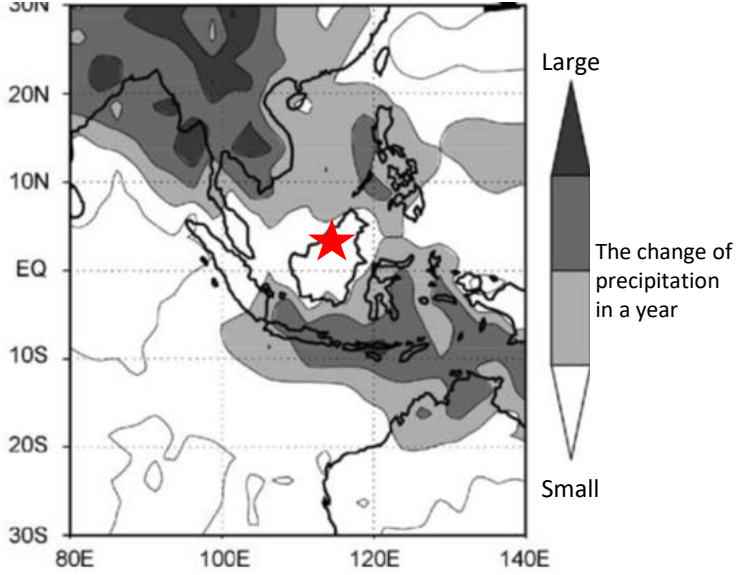
- The relationship in the tropical montane forests of Mainland Southeast Asia is expected to be different from that of Mt. Kinabalu because the climate conditions are not uniform throughout Southeast Asia.




The difference of precipitation (Kumagai et al. 2005)

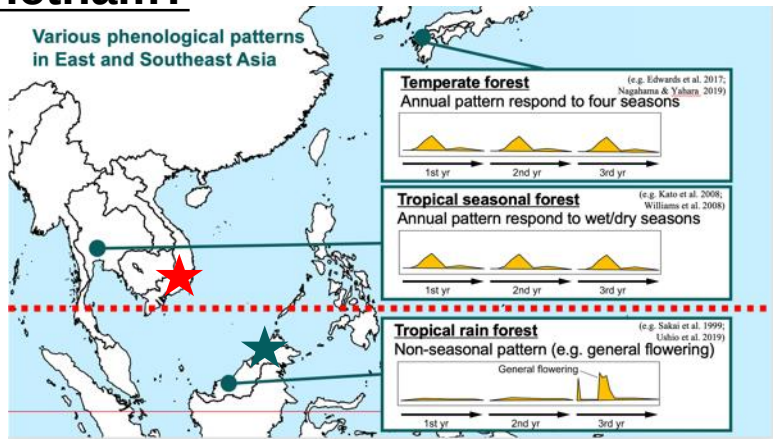


# In this study…

We observed leafing, flowering, and fruiting phenology in Bidoup-Nui Ba National Park, Vietnam, in Mainland Southeast Asia.

**(1) <u>What kind of leafing, flowering, and fruiting patterns are observed in tropical montane forests in Vietnam?</u>**

**(2) <u>Which meteorological factors correlate with leafing, flowering and fruiting patterns in tropical montane forests in Vietnam?</u>**



# Today's talk

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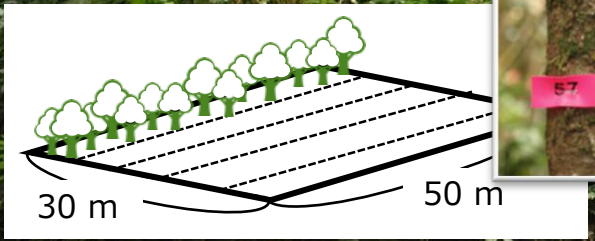
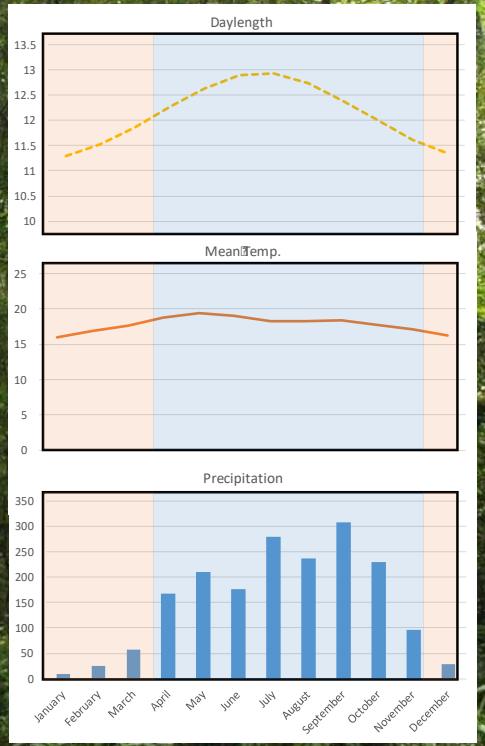
# Study site & observation

- Bidoup-Nui Ba National Park, Vietnam.
- Wet season: April–November, dry season: December–March.

- Leafing, flowering, and fruiting phenology were observed every three months in five plots located between elevation 1460m and 1920 m.
- 91 species (five individuals/species)
- June 2018–January 2020
- Meteolorogical data were obtained from the weather database WorldClim





# Collecting plants…

# Making specimens in the field

# Data analysis

- **Relationship between phenology and meteorological factors**

  Generalized Linear Models (GLMs) with logit link function and binomial distribution of errors were used.

- **Categorizing phenological patterns**

  Phenological similarity between species was calculated by squared Euclidean and constructed dendrograms using UPGMA method.

- **Comparison of phenological patterns among forests in E and SE Asia**

  The variances of the number of leafing, flowering, and fruiting species at the locations were calculated and a maximum parsimony tree was constructed to examine the similarity of phenological patterns between locations.

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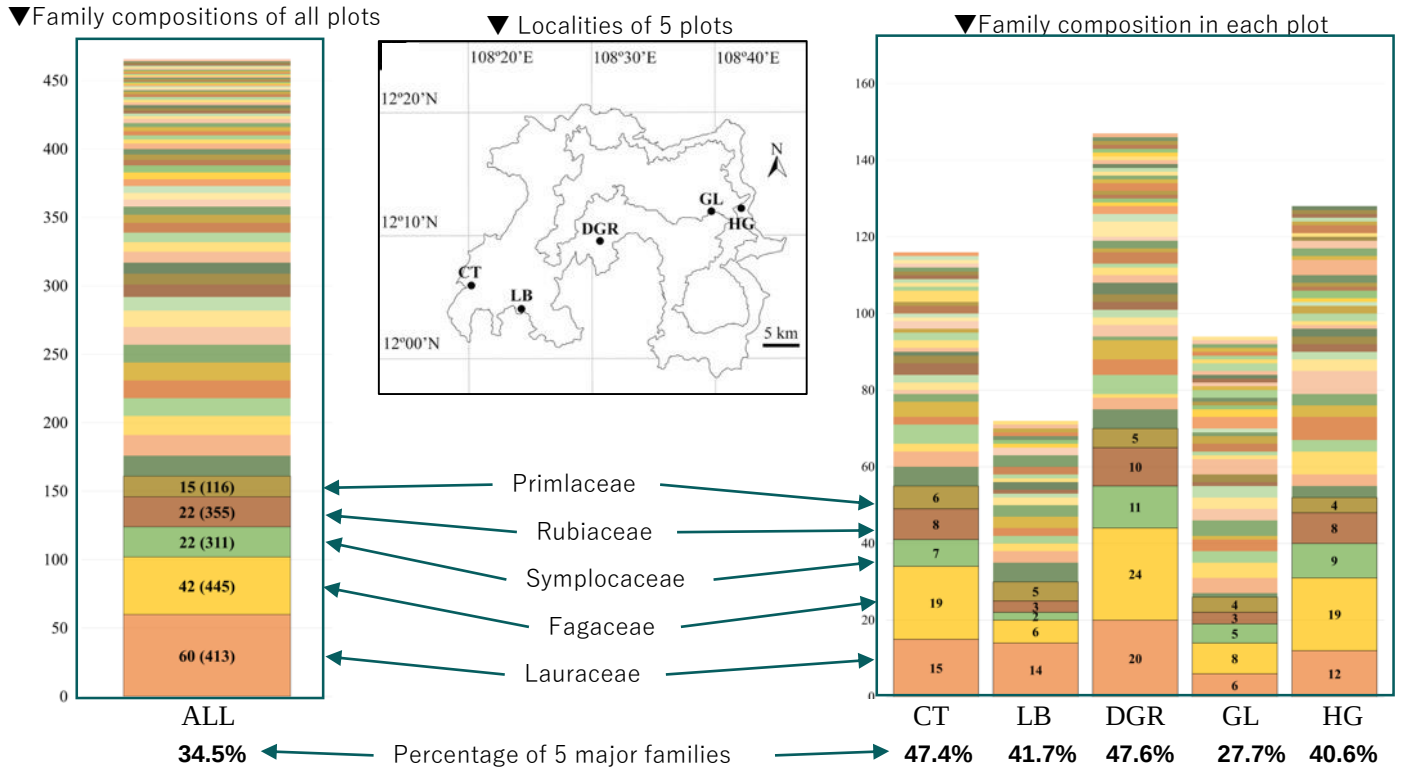
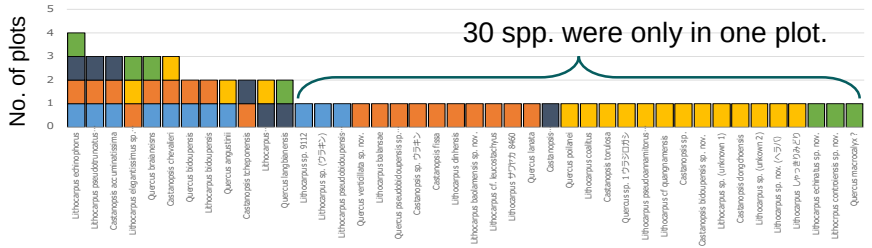
# Species composition of survey plots

5 major families in Bidoup-Nui Ba are also common in temperate forest.

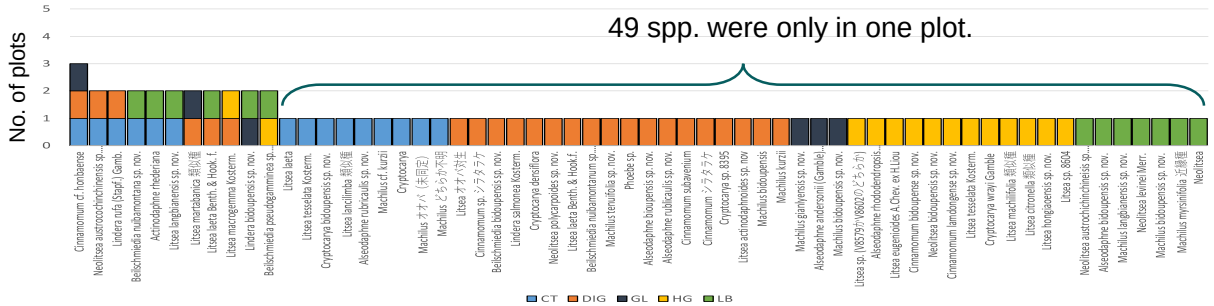


# Species diversity of Bidoup-Nui Ba

Fagaceae 42spp.
（vs. 22spp. in Japan）




Lauraceae 60spp.
（vs. 31spp. in Japan）

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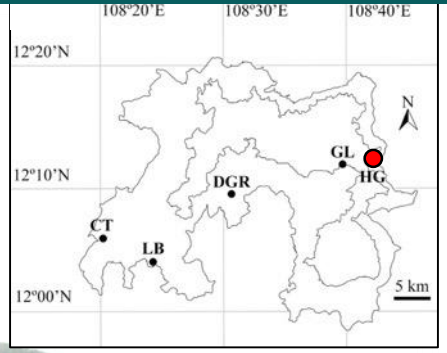

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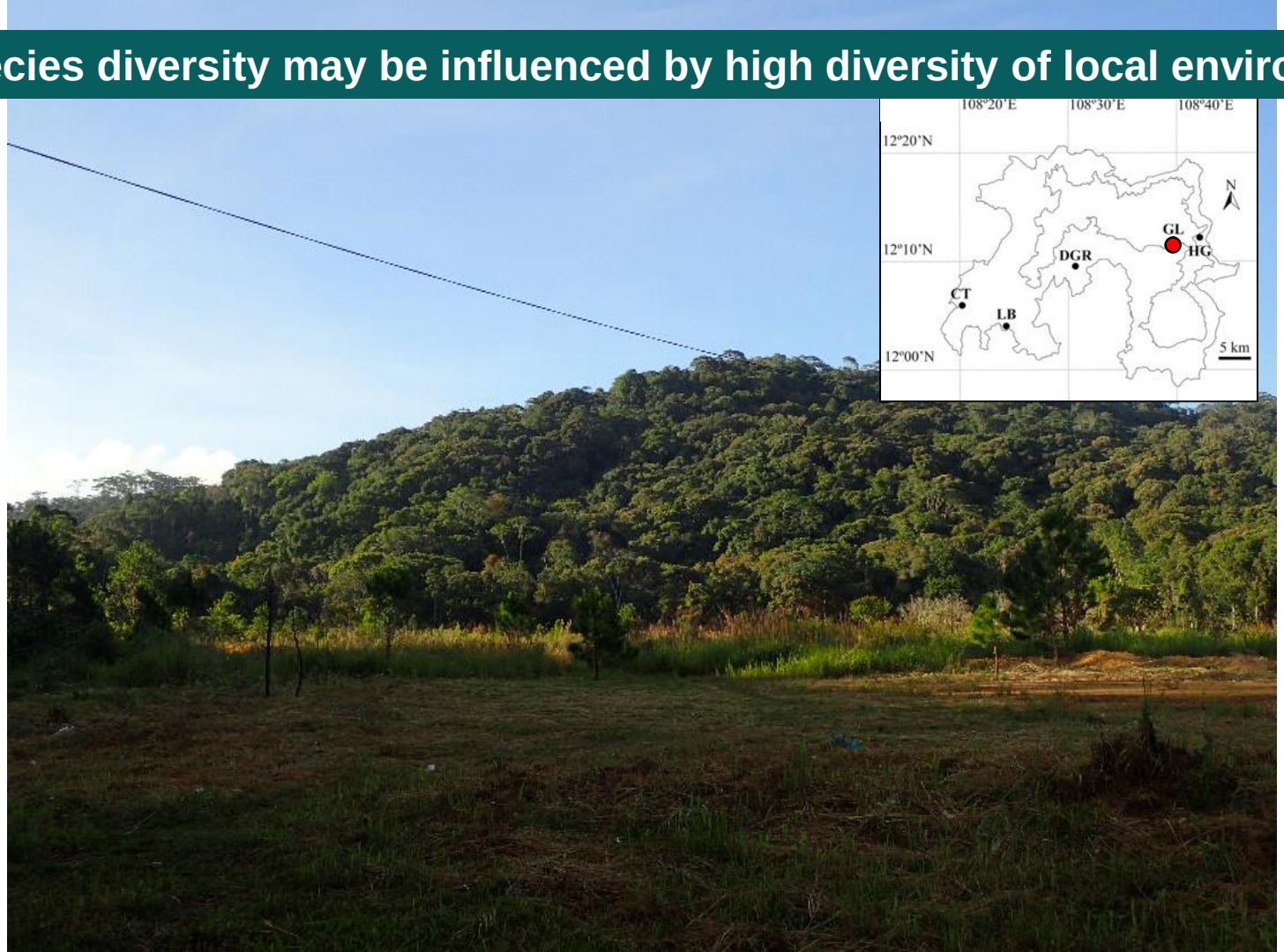

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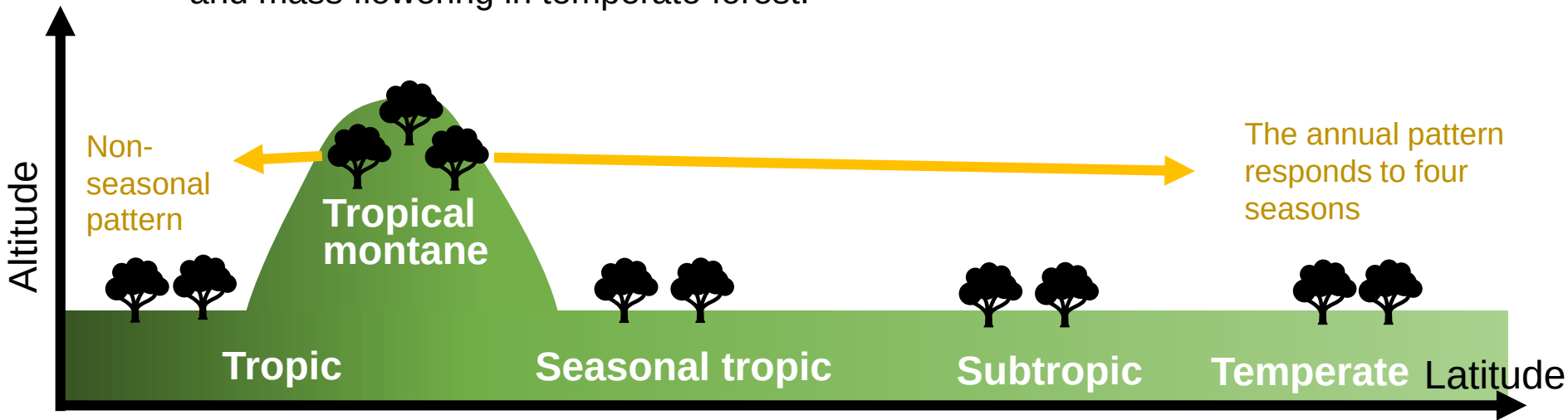
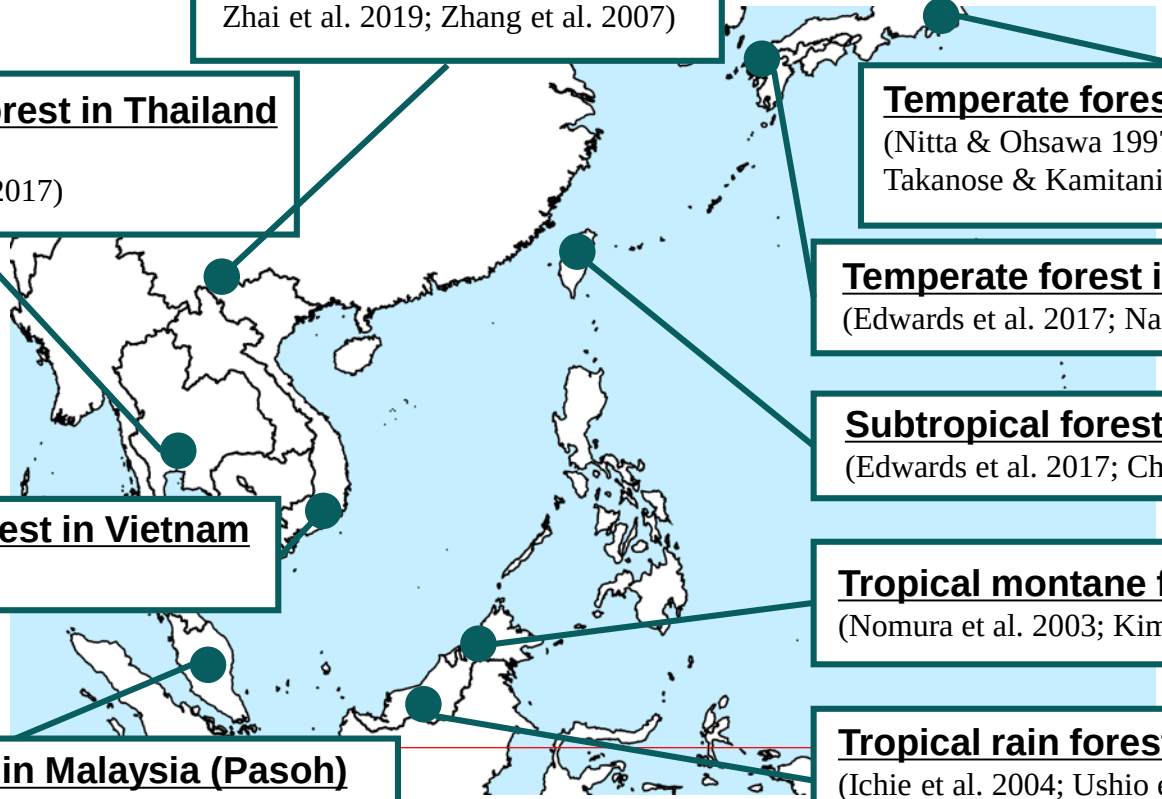
# Phenological patterns in tropical montane forest in Bidoup-Nui Ba

- **Leafing phenology peaked in April.**
  - ➡ Similar to temperate forest.
- **Some species showed non-seasonal leafing patterns.**
  - ➡ Similar to tropical rain forest.
- **Some species showed supra-annual flowering and fruiting.**
  - ➡ Similar to general flowering in tropical rain forest, and mass flowering in temperate forest.



# Comparison of phenological patterns between forests in East and Southeast Asia



**Subtropical forest in China**
(Mohandass et al. 2018;
Zhai et al. 2019; Zhang et al. 2007)

**Tropical seasonal forest in Thailand**
(Williams et al. 2008;
Mountgsrimuangdee et al. 2017)

**Temperate forest in Japan (Kanto)**
(Nitta & Ohsawa 1997;
Takanose & Kamitani 2003)

**Temperate forest in Japan (Kyushu)**
(Edwards et al. 2017; Nagahama & Yahara 2019)

**Subtropical forest in Taiwan**
(Edwards et al. 2017; Chang-Yang et al. 2013)

**Tropical montane forest in Vietnam**
(This study)

**Tropical montane forest in Malaysia**
(Nomura et al. 2003; Kimura et al. 2009)

**Tropical rain forest in Malaysia**
(Ichie et al. 2004; Ushio et al. 2020;
Sakai et al. 1999)

**Tropical rain forest in Malaysia (Pasoh)**
(Intachat et al. 2001)