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Seasonal changes in vertical stratification of moth diversity in tropical rainforests of Thailand

Presenter:

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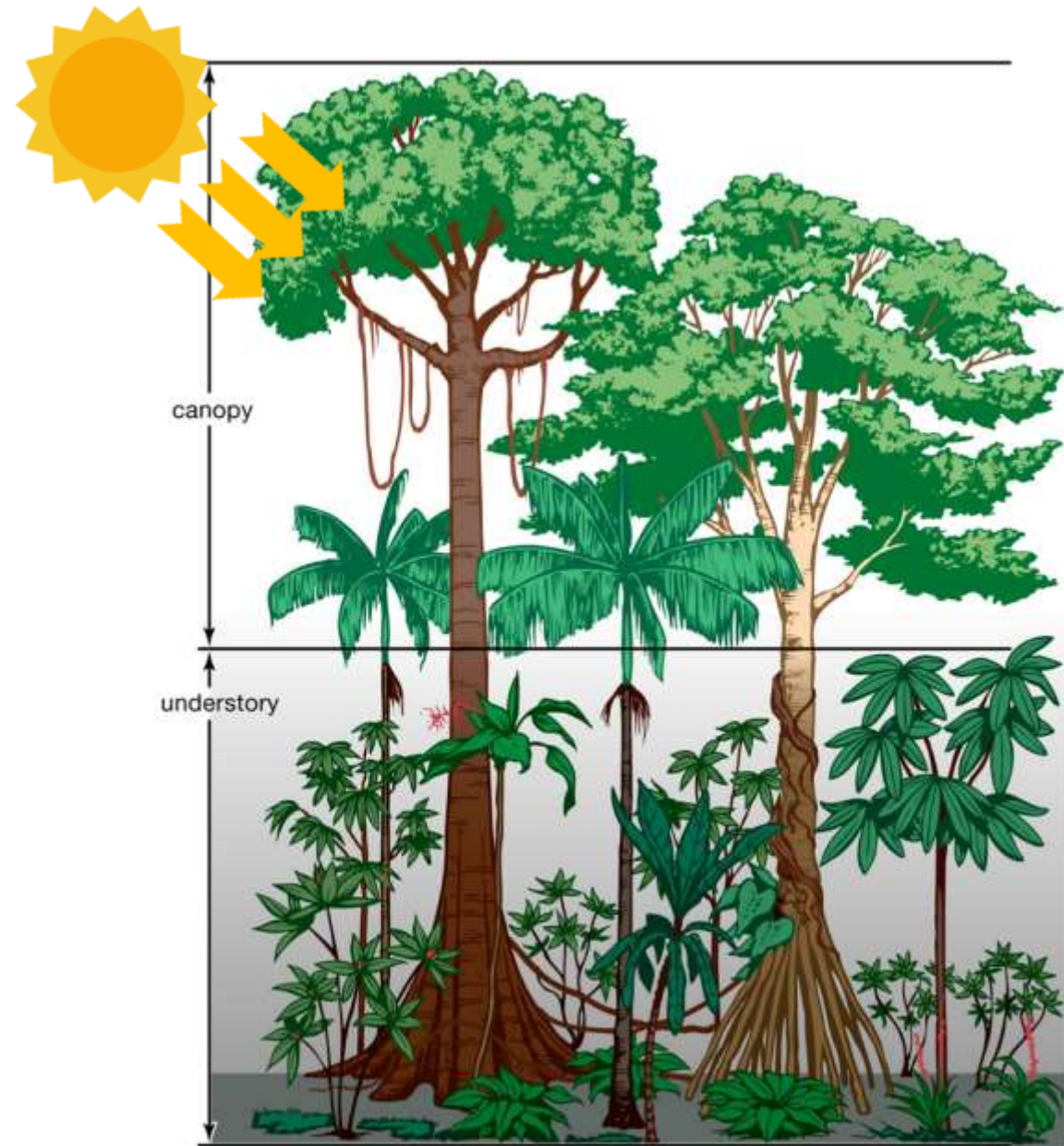
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Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Science

Introduction



Introduction



Pollinator

Herbivore

Scavenger

Ecological model: moth



- High abundance and diversity
- Host plant relations
- Well-known taxonomic group
- Effective light traps sampling

- Moth vertical stratification were recognized.
- Lacks of **seasonal variation**



Ashton et al., 2016



Dry season



Wet season

Wet season plant

Heterogeneity



Abundance



Fresh leave & nectar



Objective

1. To investigate how moth communities changes along vertical dimension
2. To observed how seasonal changes effected to vertical stratification of moth

Materials and Methods: Field sampling

Study areas

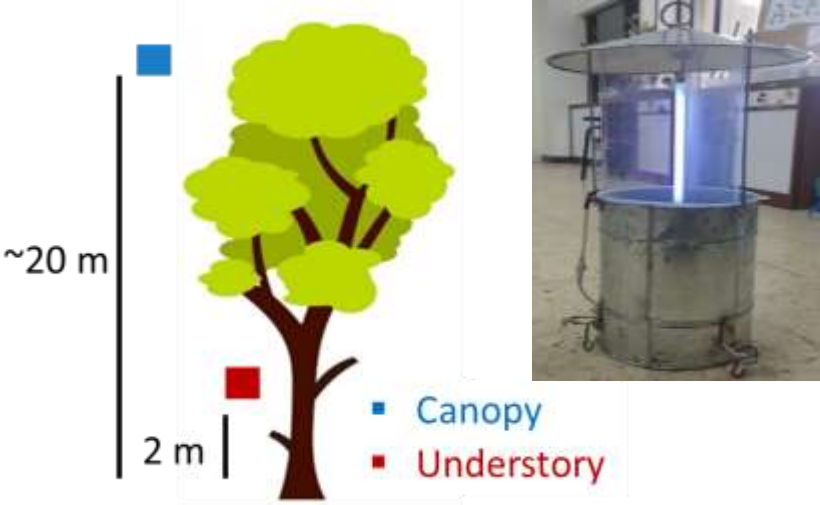
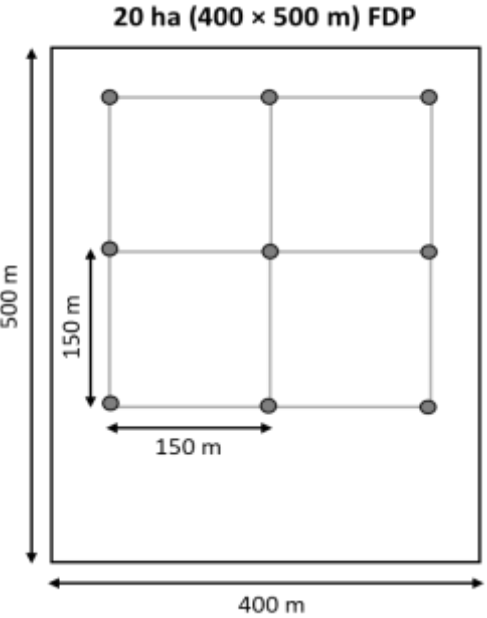


Sampling periods



MS: June 2019 (Wet)
KN: Sep 2020 (Wet)

Dec 2019 (Dry)
Mar 2020 (Dry)



Materials and Methods: Sample processing and Analysis



> 2 cm

Dry specimen

Family dataset

- 1 Do moth communities changes along vertical layers and seasons?

Accumulation curve

PERMANOVA

- 2 How moth communities changes along vertical layers and seasons?

NMDs

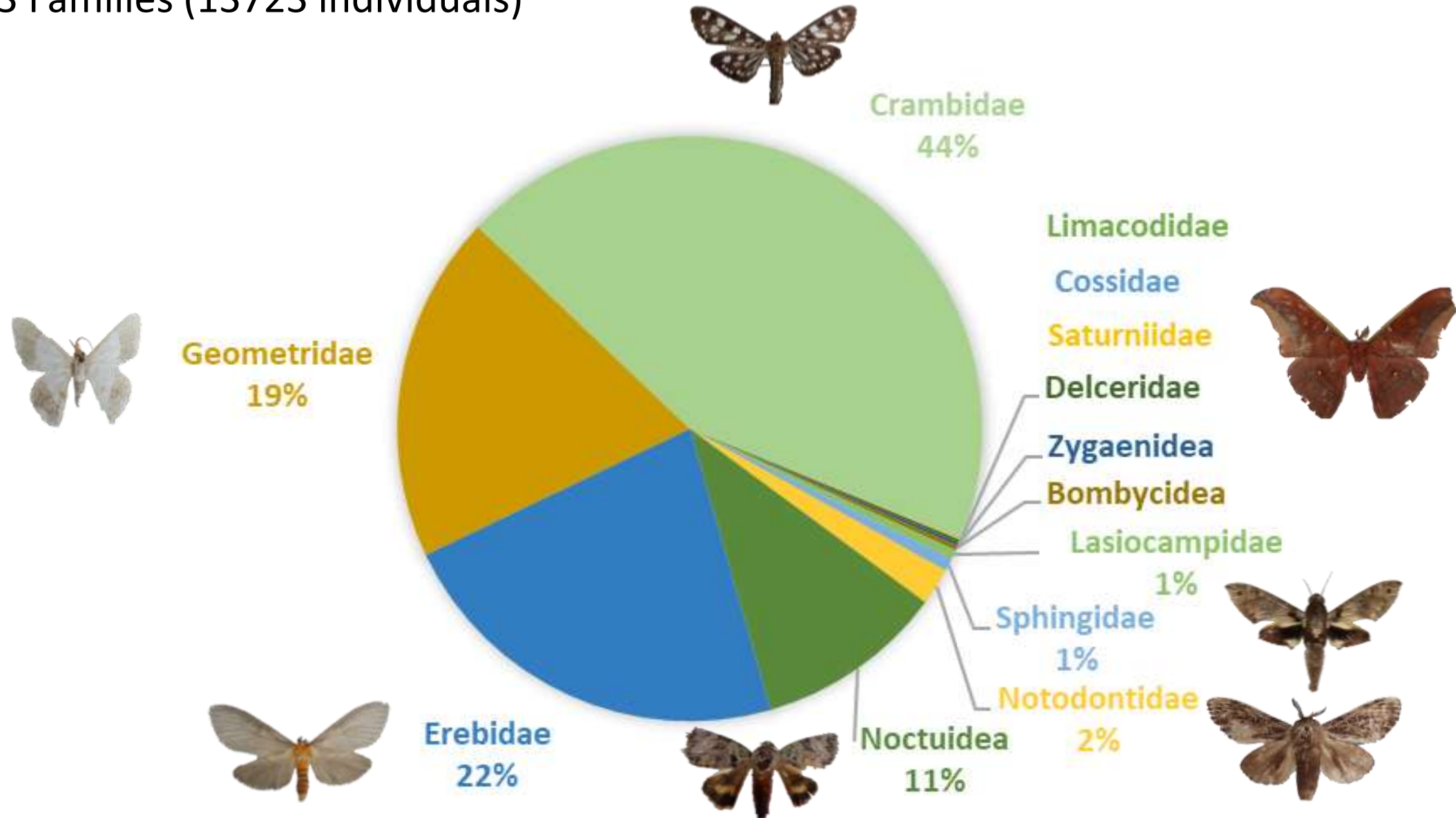
Similarity Percentage

- 3 How much factors effect to moth communities?

Variation partitioning

Results

13 Families (13723 individuals)



Results

1

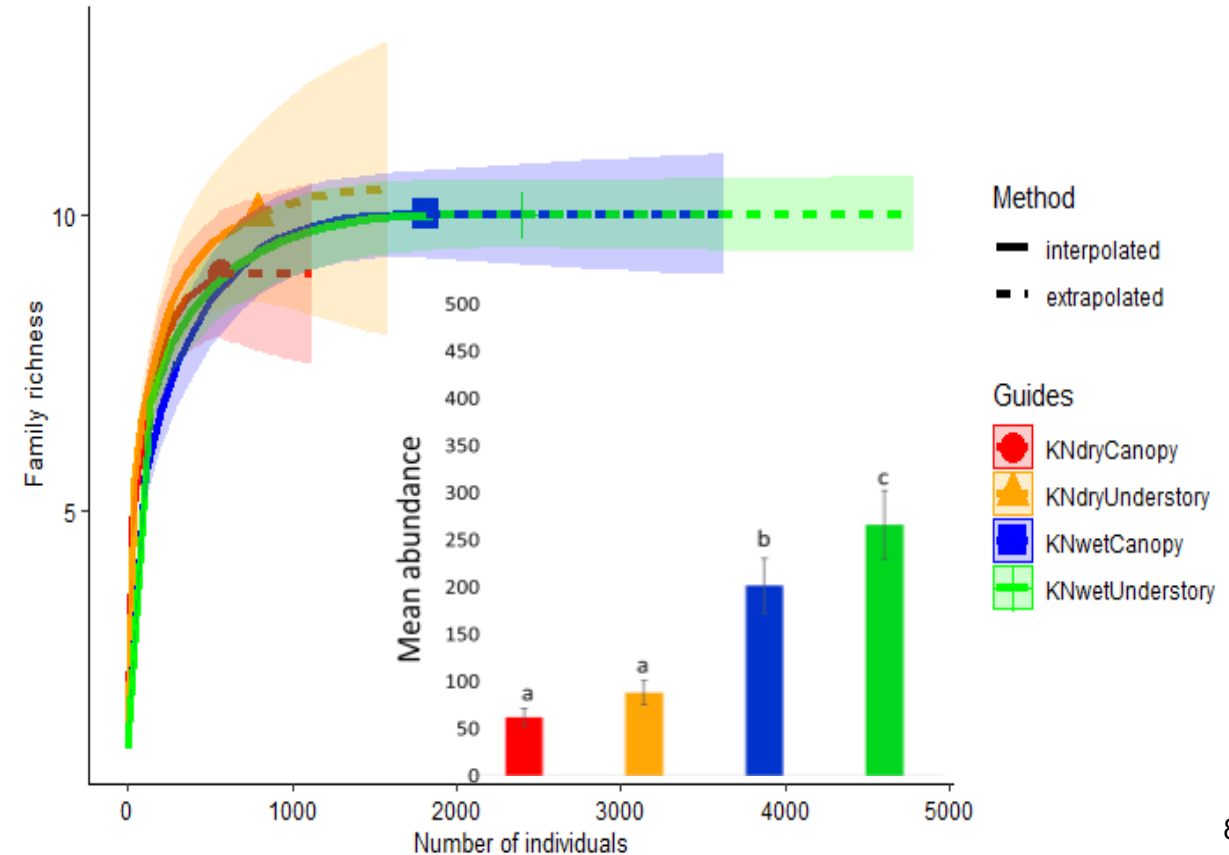
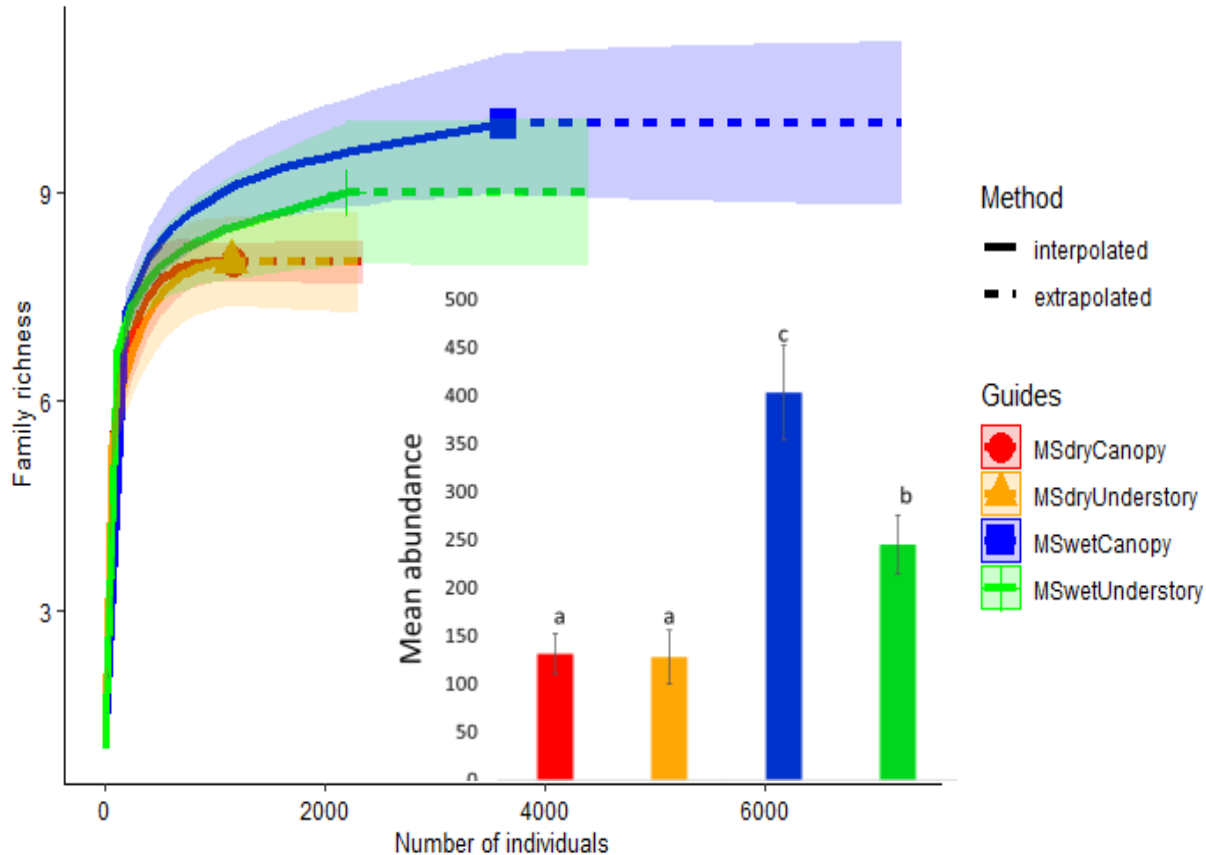
Do moth communities changes along vertical layers and seasons?

Family richness and abundance

Accumulation curve – *iNEXT*

Mo Singto plot

Klong Naka plot



Results

1

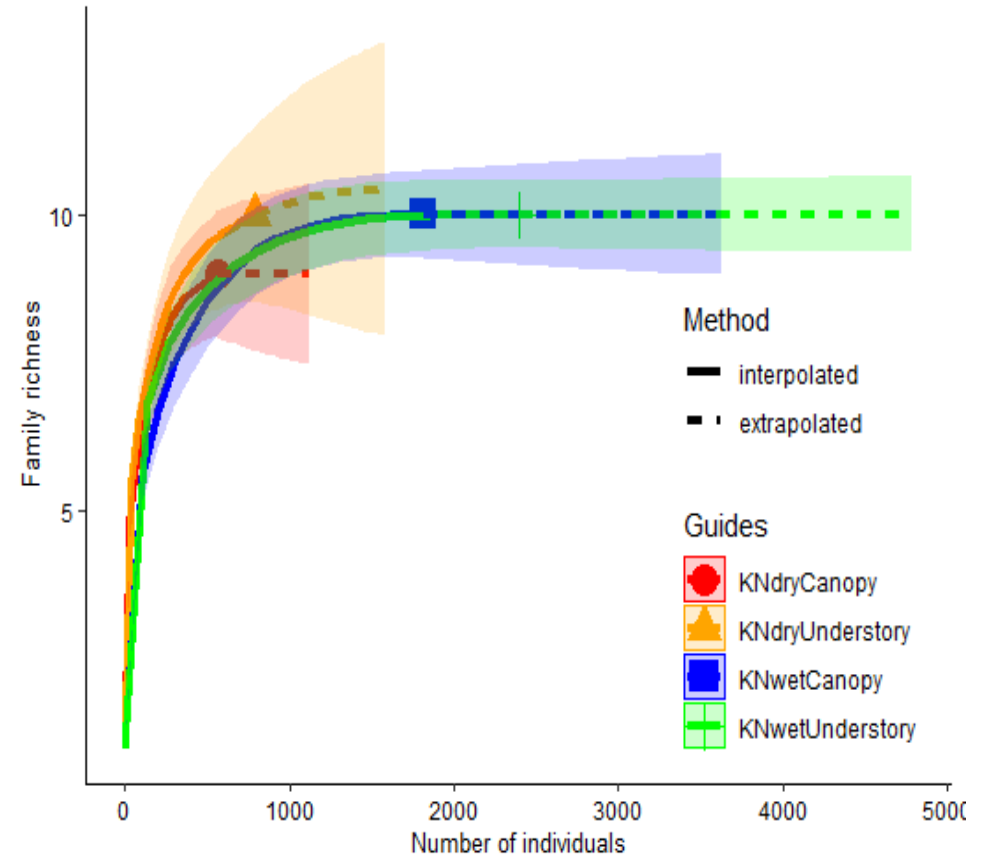
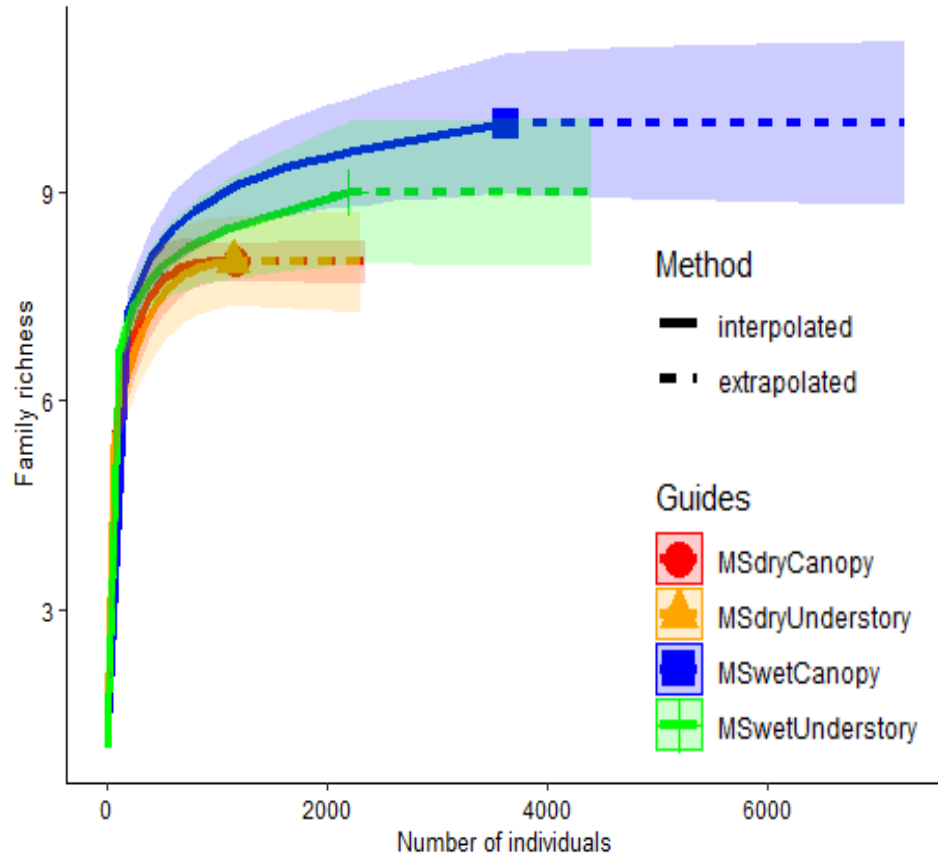
Do moth communities changes along vertical layers and seasons?

Family richness and abundance

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Results

Influence of main factors on moth diversity

PERMANOVA - Horn dissimilarity index

Factor	Df	Sum of Sqs	R2	F	Pr(>F)	Sig
Vertical	1	0.099	0.142	18.360	0.001	***
Location	1	0.089	0.127	16.467	0.002	**
Season	1	0.123	0.176	22.834	0.001	***
Vertical: Location	1	-0.030	-0.043	-5.584	1	
Vertical: Season	1	0.028	0.040	5.194	0.065	.
Vertical: Location: Season	1	0.039	0.055	7.150	0.018	*
Residual	65	0.352	0.502			
Total	71	0.701	1			

Canopy and understory comparison

Post hoc PERMANOVA

Locations and seasons	Df	Sums Of Sqs	F Model	R2	p.value	p.adjusted	Sig
MS Wet	1	0.038	8.934	0.358	0.028	0.028	.
MS Dry	1	0.002	0.321	0.020	0.544	0.544	
KN Wet	1	0.007	20.231	0.558	0.001	0.001	**
KN Dry	1	0.097	30.523	0.656	0.001	0.001	**

Significant. codes: '***' = $P > 0.001$; '**' = $P > 0.01$; '*' = $P > 0.05$; '.' = $P > 0.1$; ' ' = $P > 1$

Results

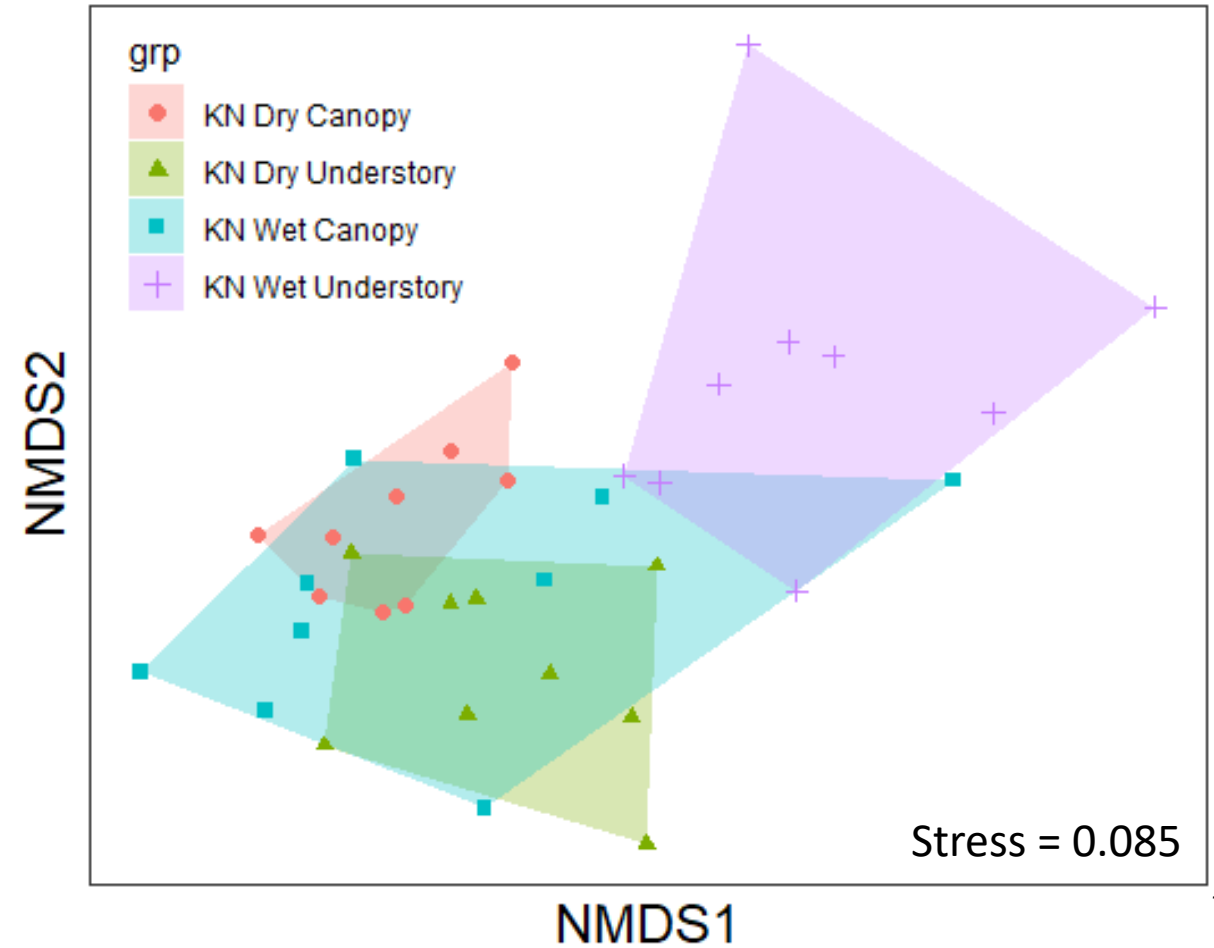
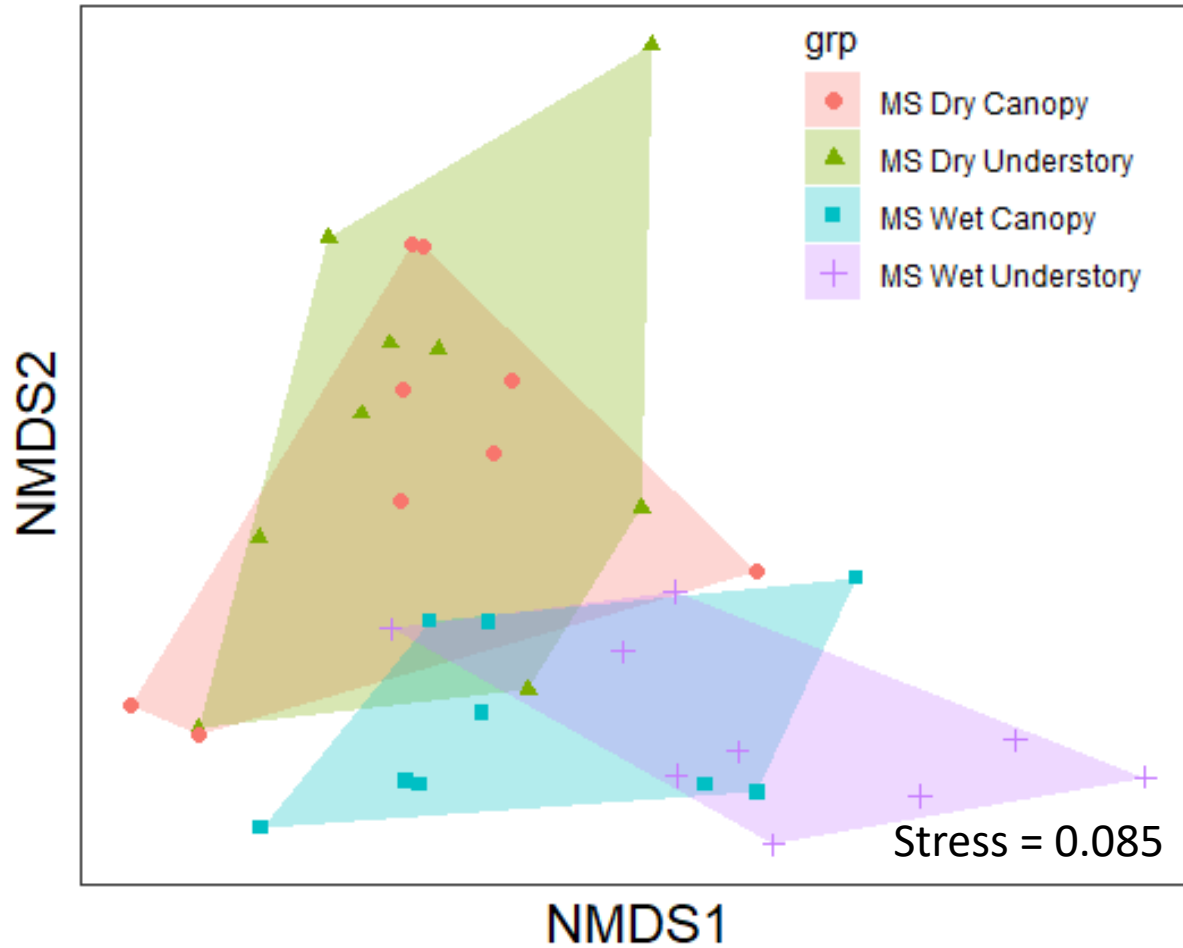
2 How moth communities changes along vertical layers and seasons?

Moth community similarity

NMDS ordination

Mo Singto

Klong Naka



Vertical stratification of moth families

Mo Singto

Wet season

	Canopy	Understory	P-value
Crambidae	172.56	75.89	0.001 ***
Geometridae	89.56	82.22	0.999
Noctuidea	59.56	27.67	0.03 *
Erebidae	64.44	44	0.055 .
Notodontidae	7.33	9	0.112
Sphingidae	5.44	3.67	0.57
Lasiocampidae	2.56	1.67	0.646
Bombycidea	1	0.56	0.843
Saturniidae	0.44	0.11	0.079 .
Cossidae	0.11	0	0.015 *

Dry season

	Canopy	Understory	P-value
Crambidae	54.33	49.56	0.84
Erebidae	39.56	42.67	0.945
Geometridae	16.78	16.78	0.931
Noctuidea	16.78	14.56	0.799
Notodontidae	2.33	3.22	0.39
Sphingidae	0.56	0.56	0.558
Lasiocampidae	0.44	0.44	0.641
Bombycidea	0.44	0	0.091 .
Zygaenidea	0	0.22	0.345

Signif. codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '.' 0.1 ' ' 1

Klong Naka

Wet season

	Canopy	Understory	P-value
Crambidae	110.89	144.78	0.221
Geometridae	19	45.33	0.005 **
Erebidae	56.44	51.78	1
Noctuidea	11.22	13.44	0.647
Notodontidae	1.67	5.33	0.006 **
Zygaenidea	0	2.67	0.001 ***
Lasiocampidae	0.56	1.44	0.043 *
Delceridae	0.44	0.56	0.116
Bombycidea	0.56	0.44	0.987
Saturniidae	0.44	0.33	0.974
Sphingidae	0.22	0	0.473

Dry season

	Canopy	Understory	P-value
Crambidae	32.44	30.44	0.994
Erebidae	13.78	28.44	0.003 **
Geometridae	5.22	18	0.008 **
Noctuidea	8.67	7	0.635
Notodontidae	0.33	2.11	0.009 **
Delceridae	0.78	0.67	0.263
Bombycidea	0.44	0.56	0.923
Lasiocampidae	0.44	0.44	0.922
Sphingidae	0.11	0.22	0.501
Limacodidae	0	0.11	0.106

Results

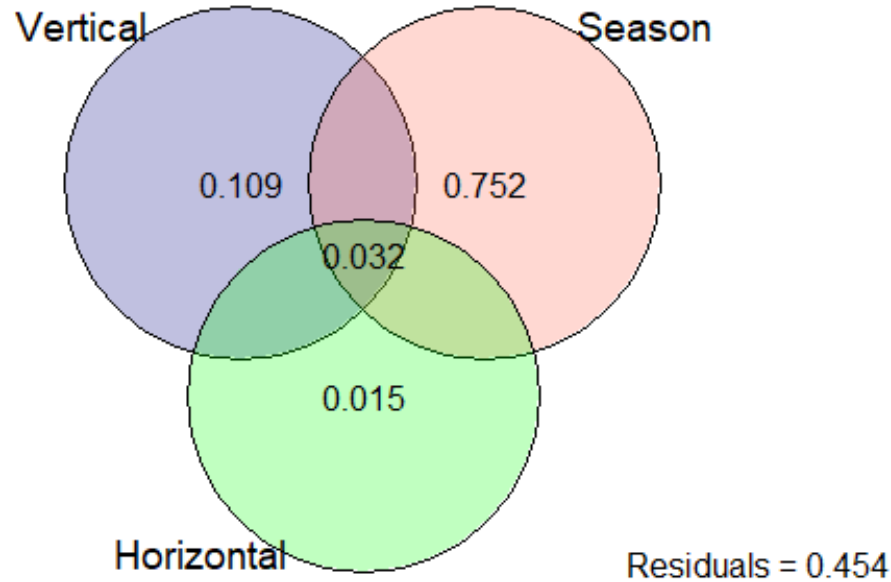
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How much factors effect to moth communities?

Explanatory variable

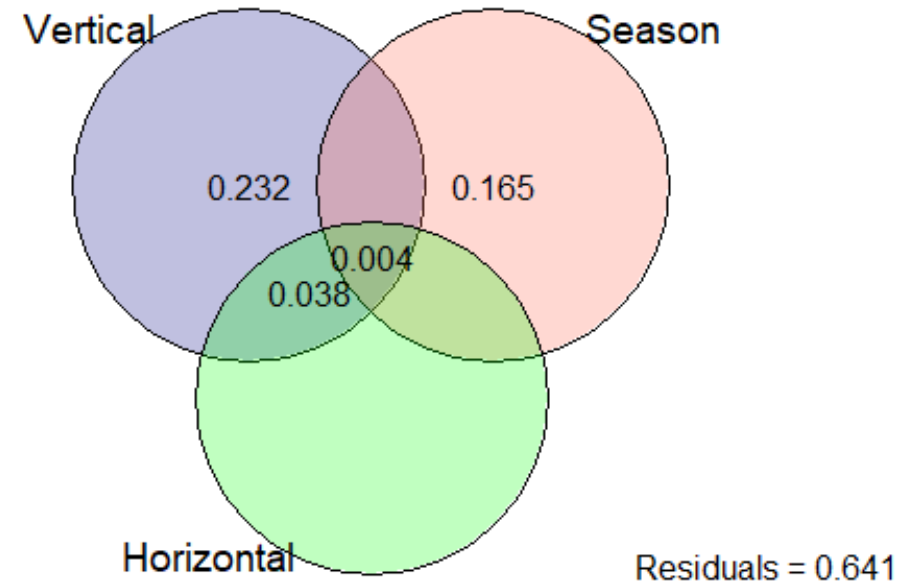
Variation partitioning - *varpart*

Mo Singto



Values <0 not shown

Klong Naka



Values <0 not shown

Discussion

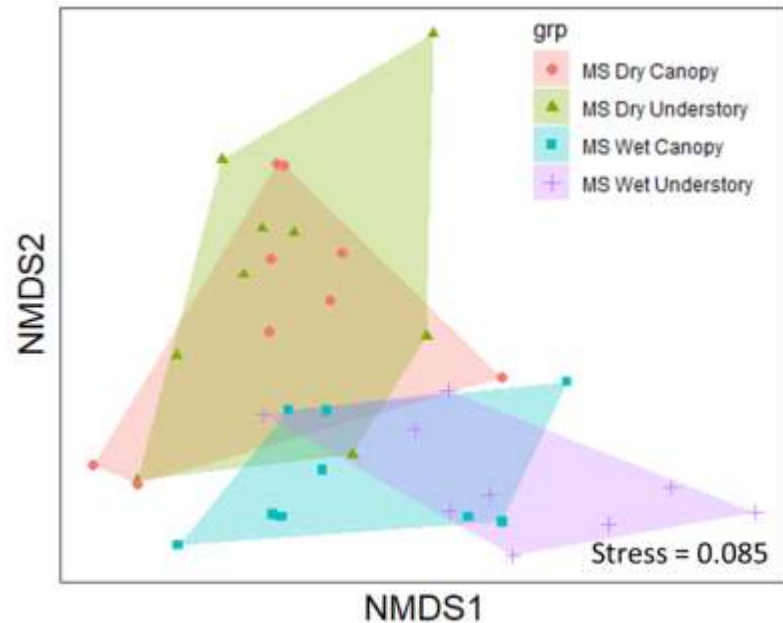
Moth communities changed along vertical dimension across seasons and locations

Factor	Df	Sum of Sqs	R2	F	Pr(>F)	Sig
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Discussion

1

Vertical Stratification



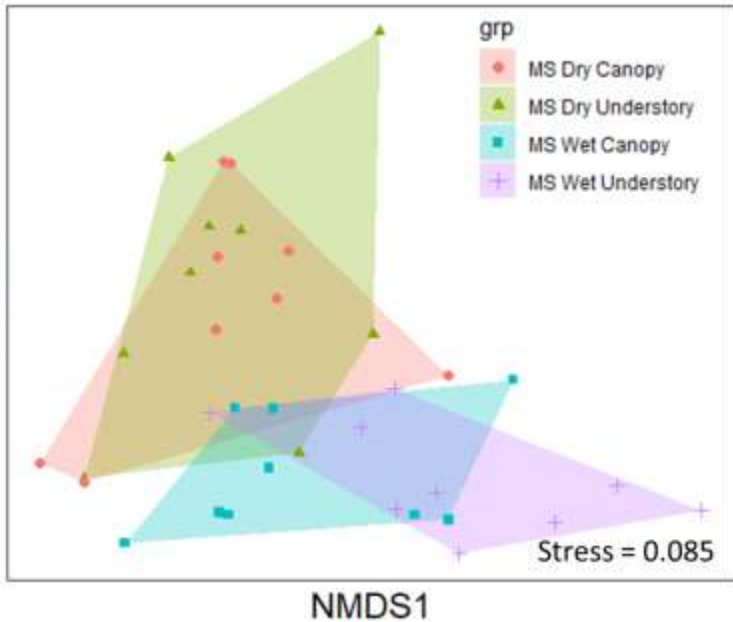
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Vertical stratification of moth

- Forest structure and openness (Delabye et al., 2021; Vlasanek et al., 2013).
- Vertical stratification of plant diversity (Aduse-Poku et al., 2012).

Discussion

2 Seasonal changes



Wet season

	Canopy	Understory	P-value
Crambidae	172.56	75.89	0.001 ***
Geometridae	89.56	82.22	0.999
Noctuidea	59.56	27.67	0.03 *
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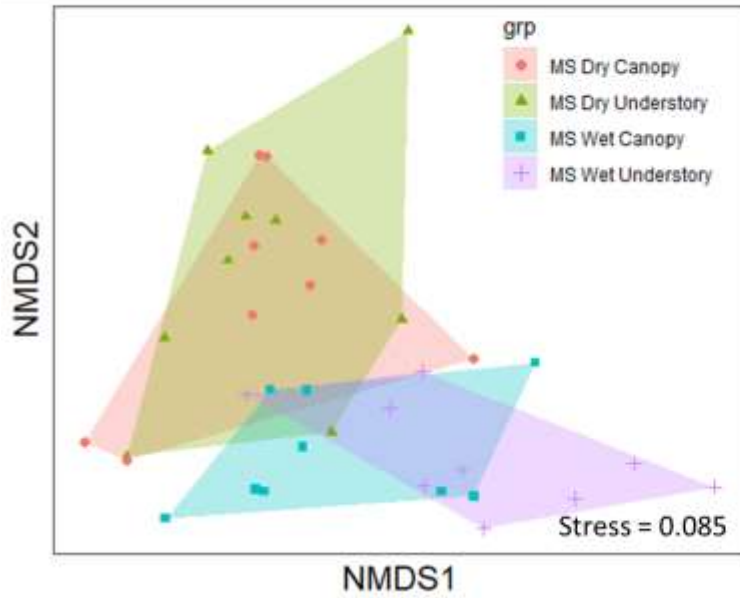
- Wet season increased the magnitude of vertical stratification.
- Seasonal changes are associated with weather conditions. (Grimbacher & Stork, 2009; Poulin et al., 1999).

Discussion

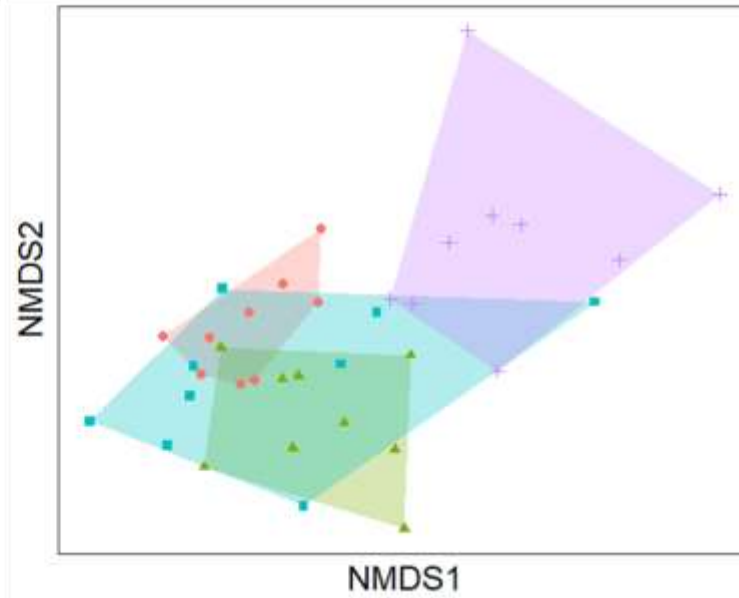
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Locations

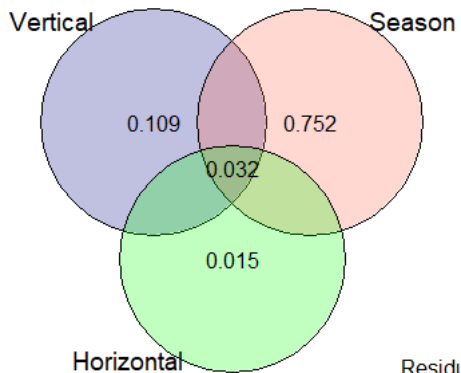
Mo Singto



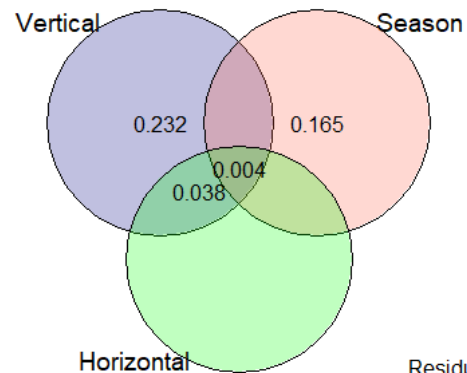
Klong Naka



KN had greater vertical stratification magnitude.
KN had lower seasonal change influence.



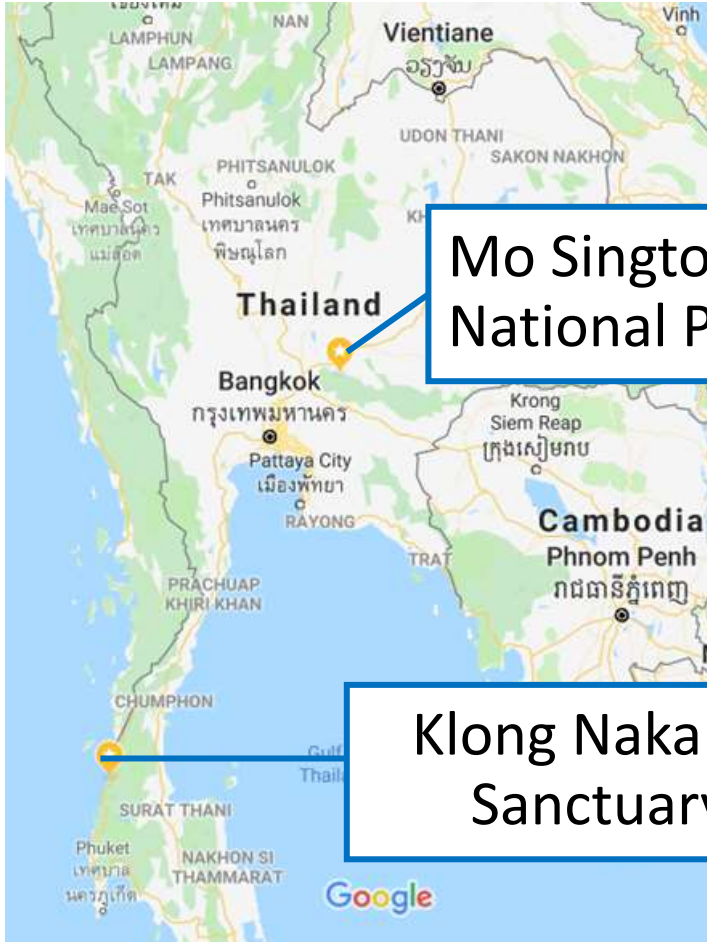
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Values <0 not shown

Discussion

3 Locations



Mo Singto, Khao Yai National Park (MS)

Klong Naka Wildlife Sanctuary (KN)



MS: Jun – Oct (Rainy)



Nov – Feb (Winter)

KN: May – Oct (Rainy)

Nov – Apr (Drought)

Vertical stratification increased by decreasing latitude. (Lieberman et al., 1996)

Conclusion

1

Moth community was highly influenced by vertical stratum and seasonal changes, but the magnitude of differences depend on the forest type and latitude.

2

This study represented the importance of seasonal variation and vertical stratification in tropical rainforests study.



Thank you for your kind attention

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GBIF

