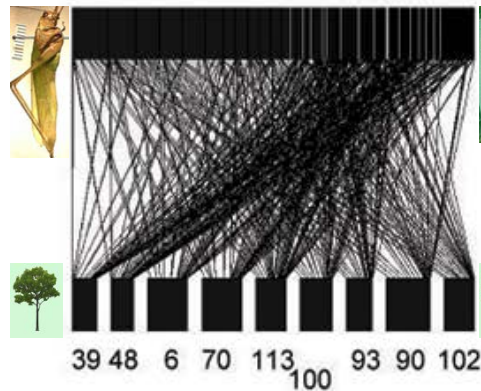
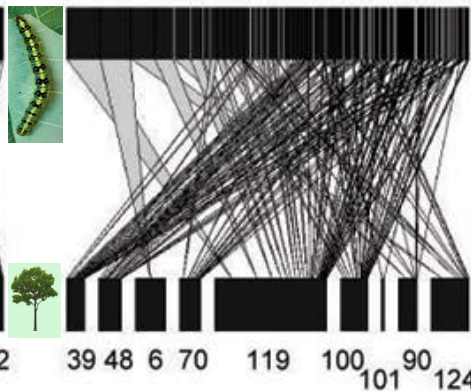
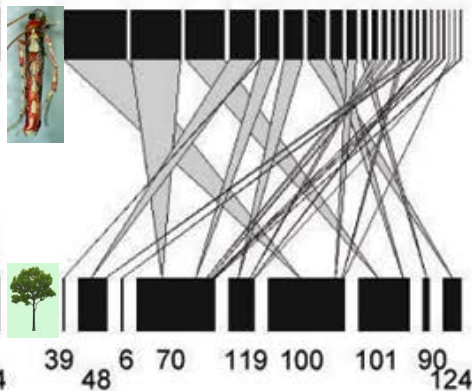
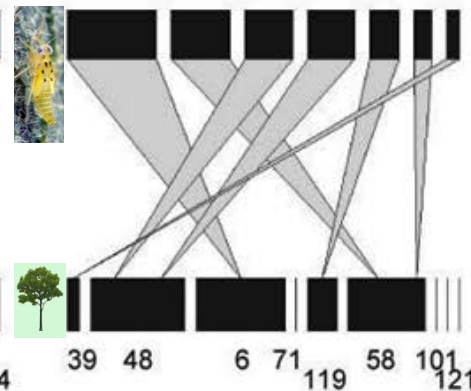
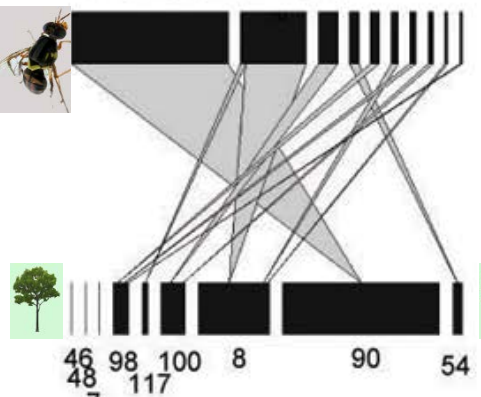
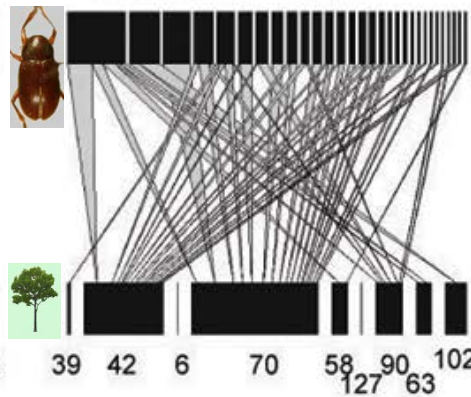
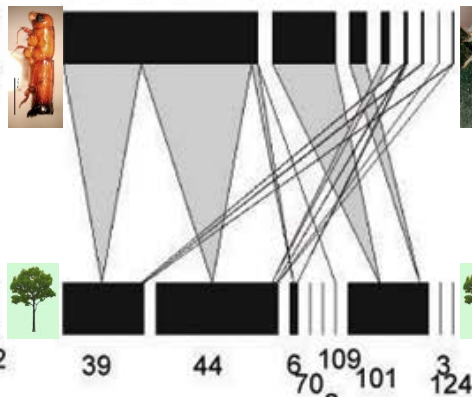
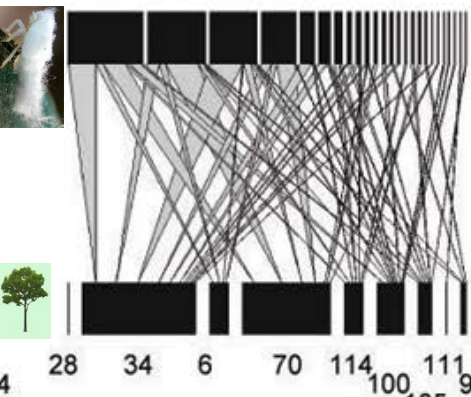
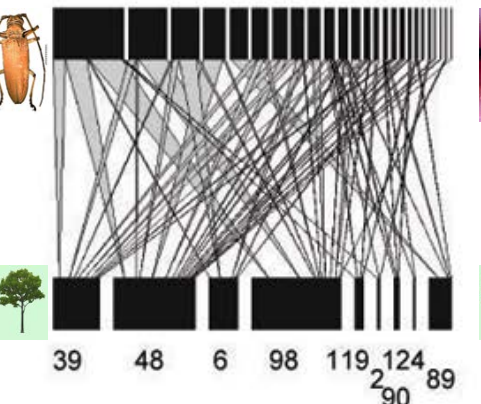
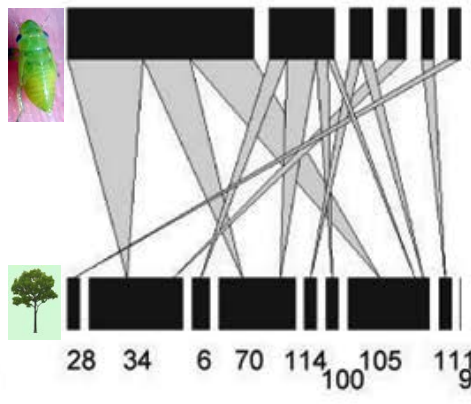
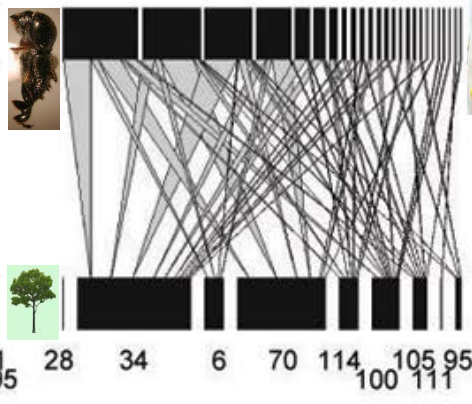
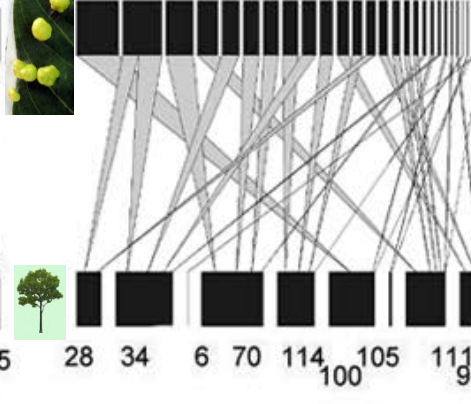


Diversity of insects and plant-insect interactions in rainforests

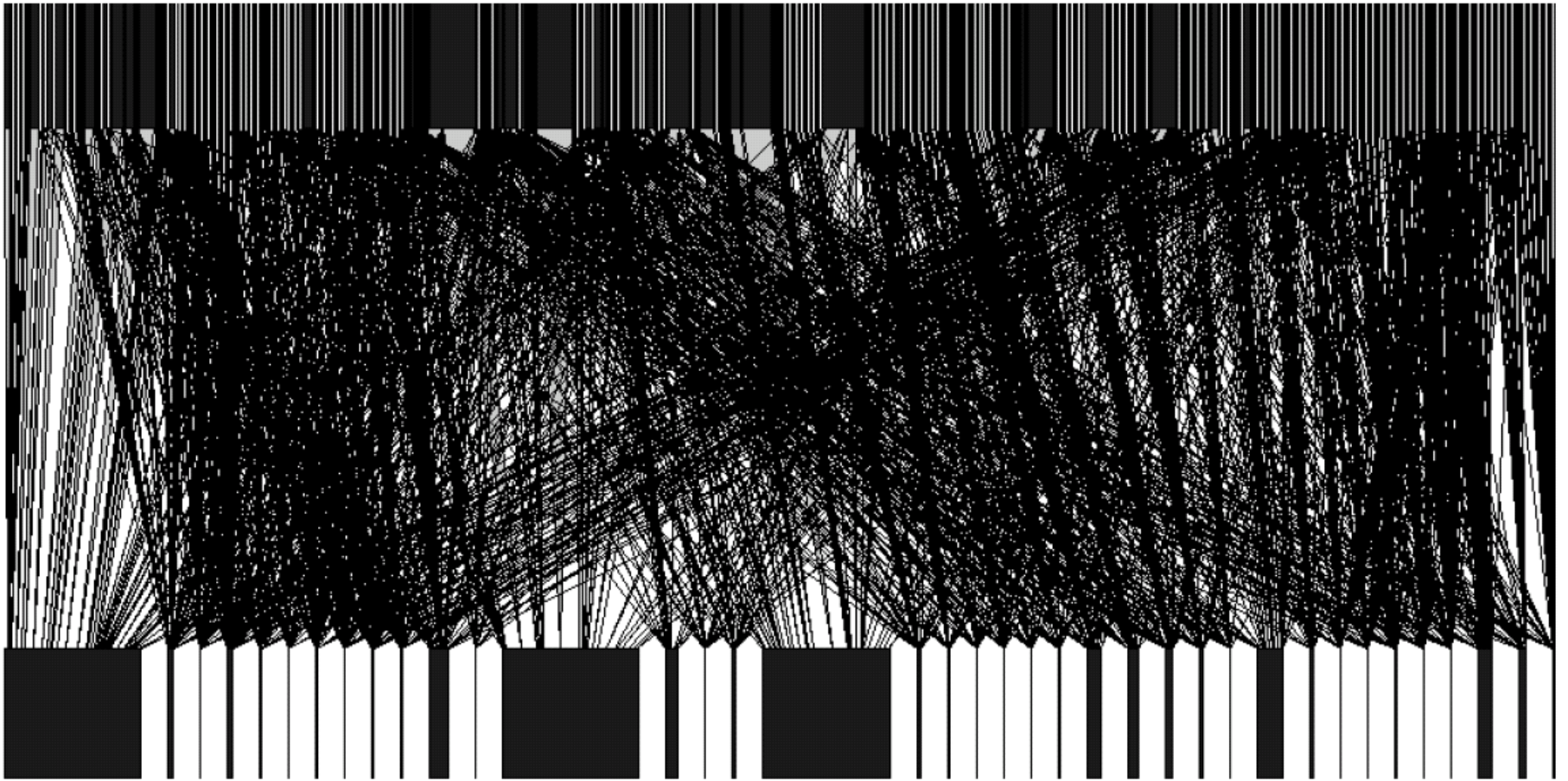
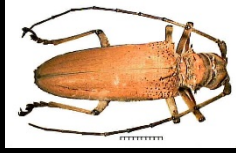


Documenting food webs for 12 herbivorous guilds:
60 person-years in a rainforest

Adult leaf-chewers**Larval leaf-chewers****Leaf miners****Leaf suckers****Fruit chewers****Root chewers****Phloem chewers****Phloem suckers****Xylem chewers****Xylem suckers****Fungal chewers****Gallers**

High resolution data on a tropical plant-insect food web

~200 tree species, ~9,600 insect species, ~50,000 trophic interactions



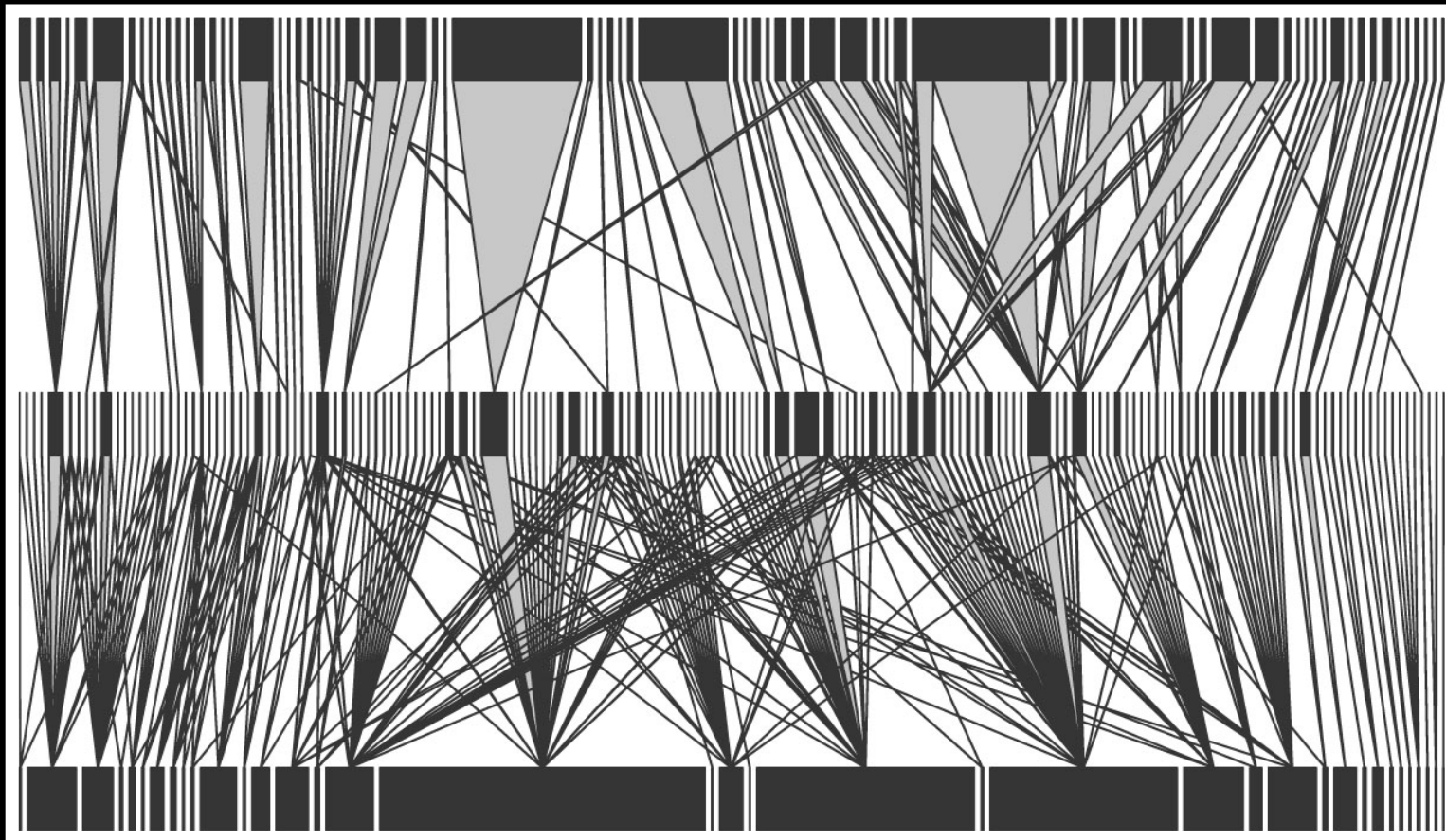
High resolution data on a rainforest food web: at least 100,000 trophic interactions locally

200 tree species:

~50,000 interactions with 9,600 herbivore species

~13,000 herbivore-parasitoid interactions

- Unknown no. of predator-prey interactions

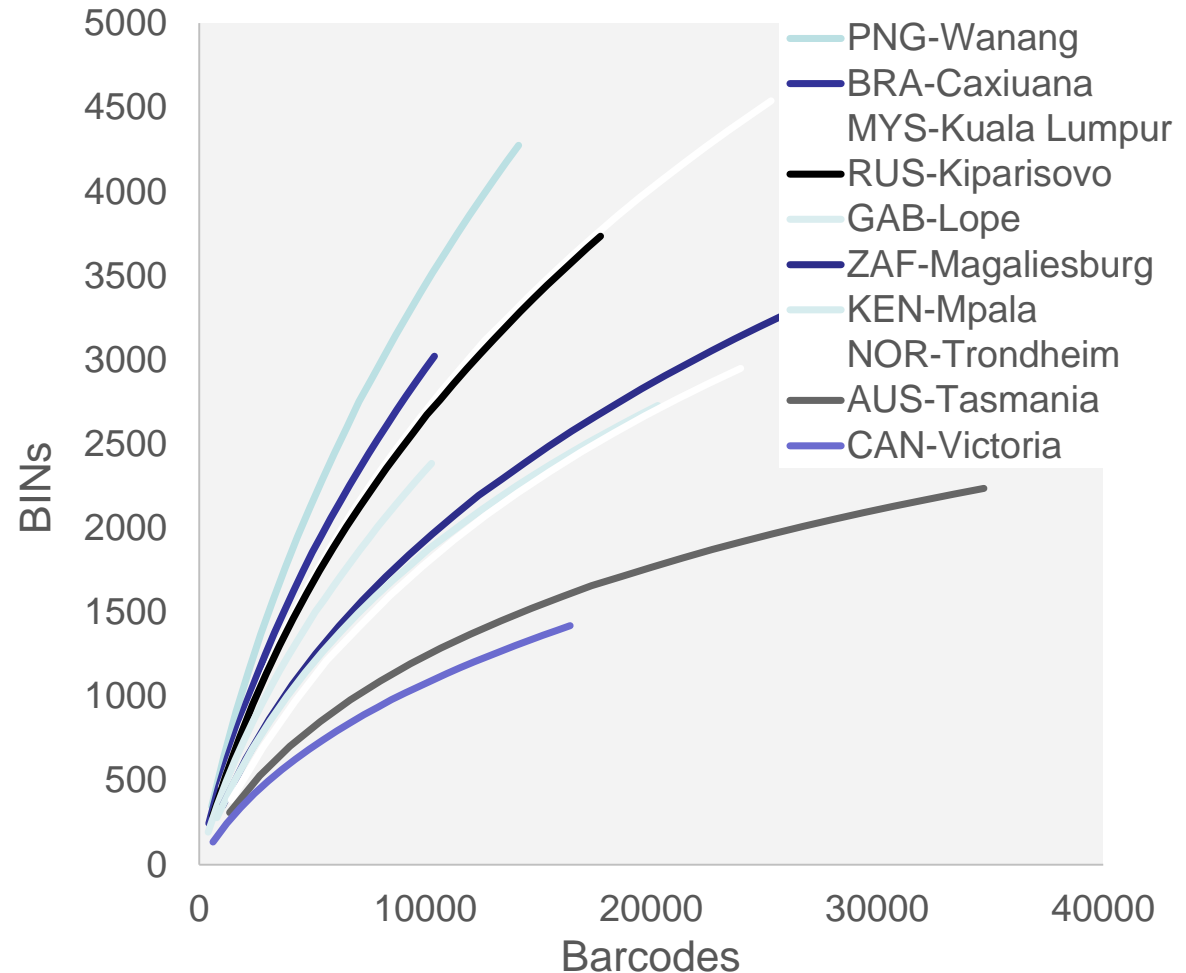




Global Malaise Program

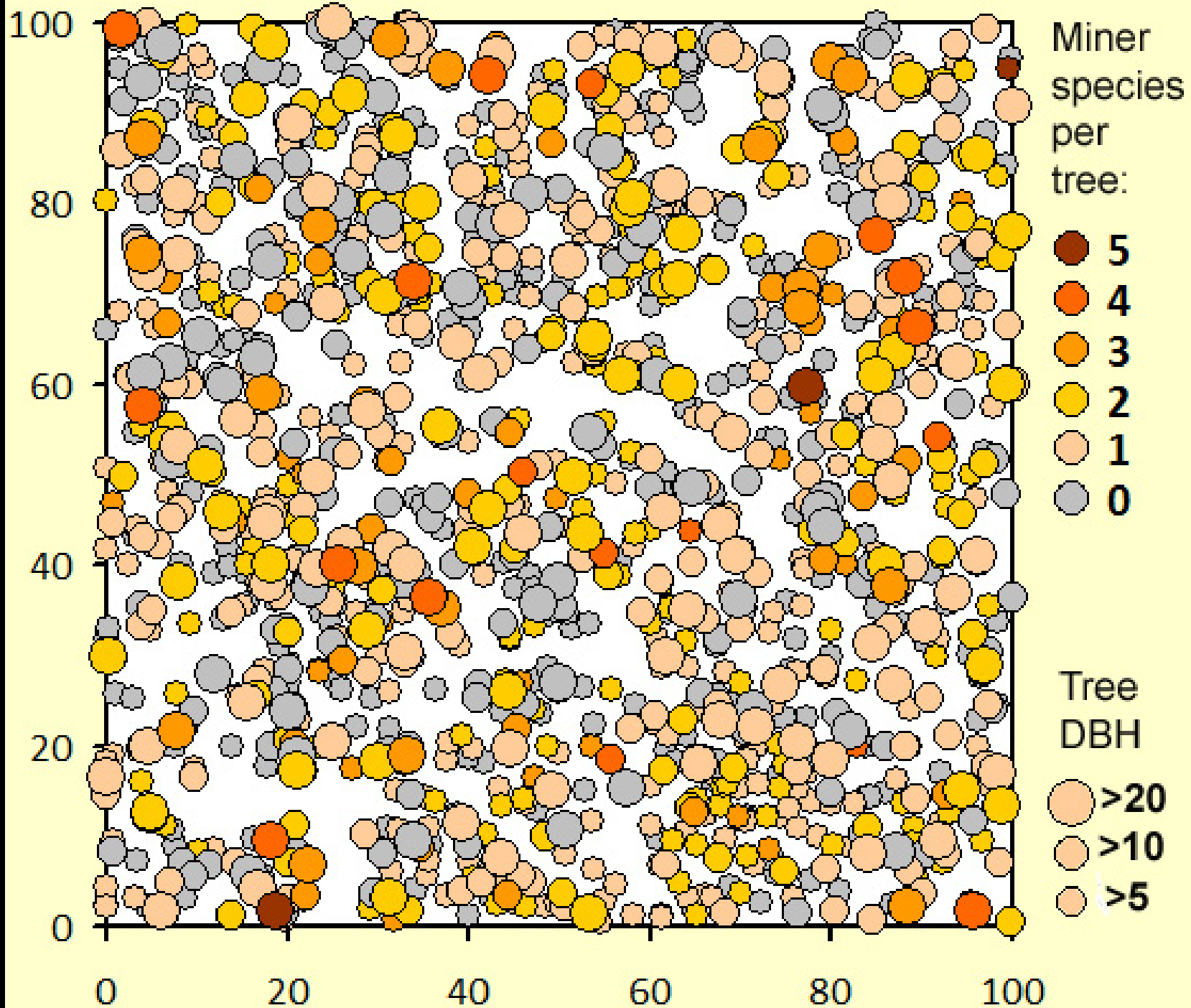
Papua New Guinea – Wanang Site

- 52 weekly Malaise trap samples collected
- 26 samples (every other week) analyzed
- 17,525 specimens
- 14,181 barcodes
- 4,310 BINs
- 98% of BINs unique to site

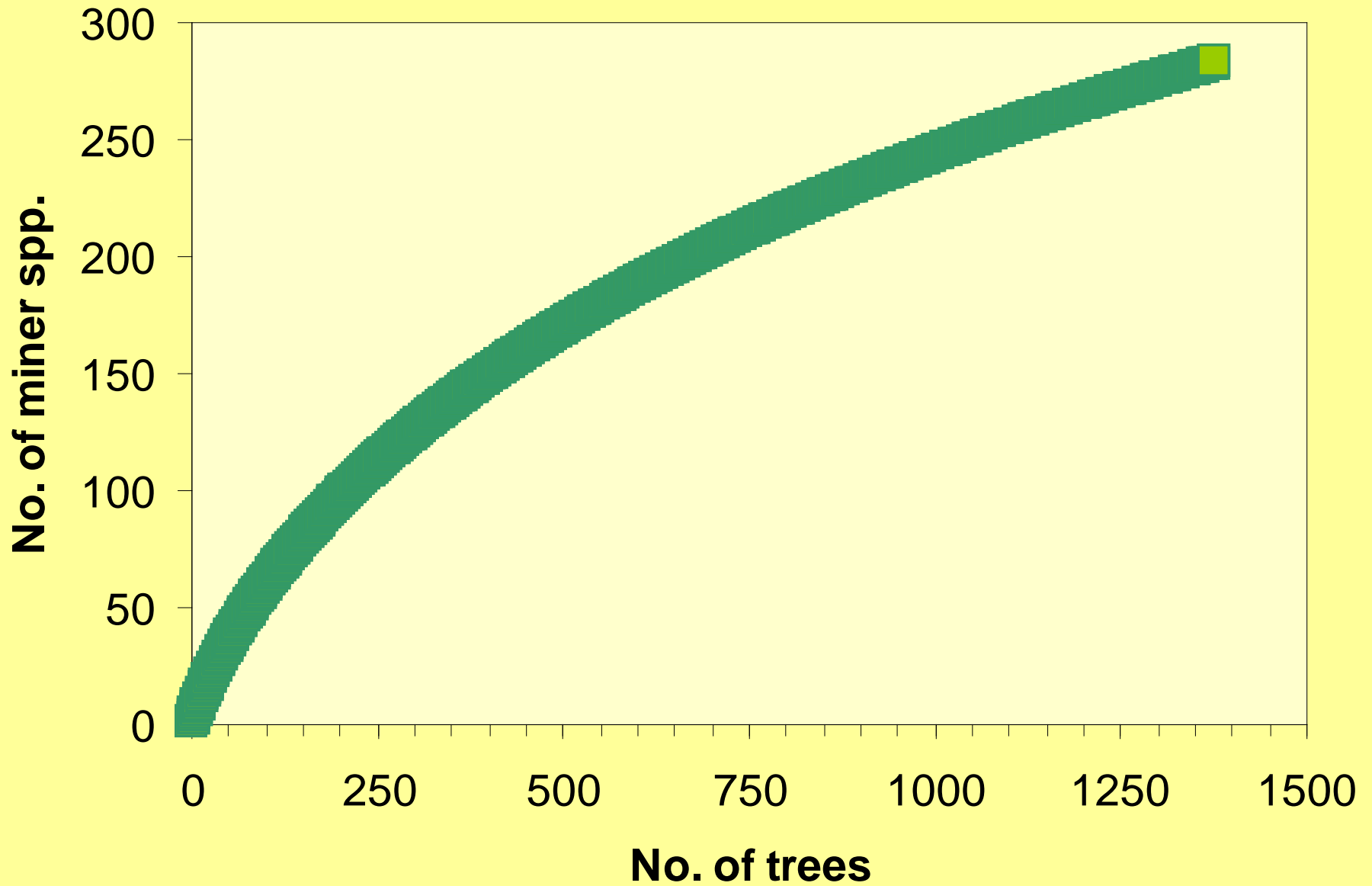








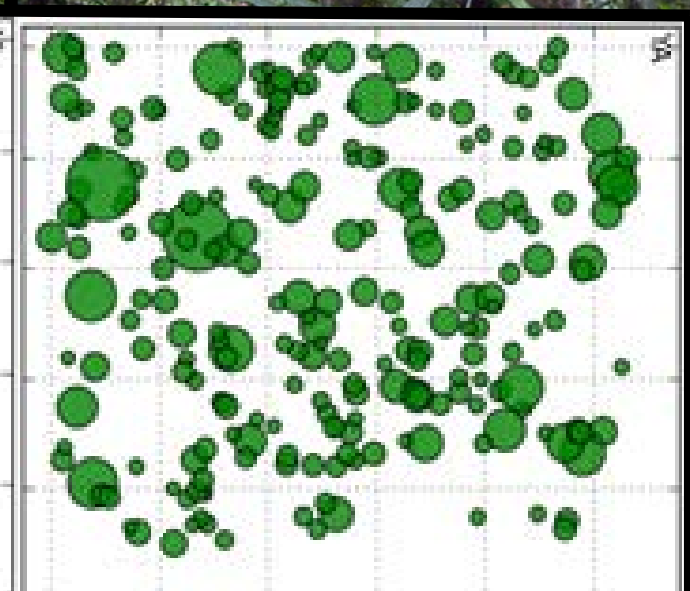
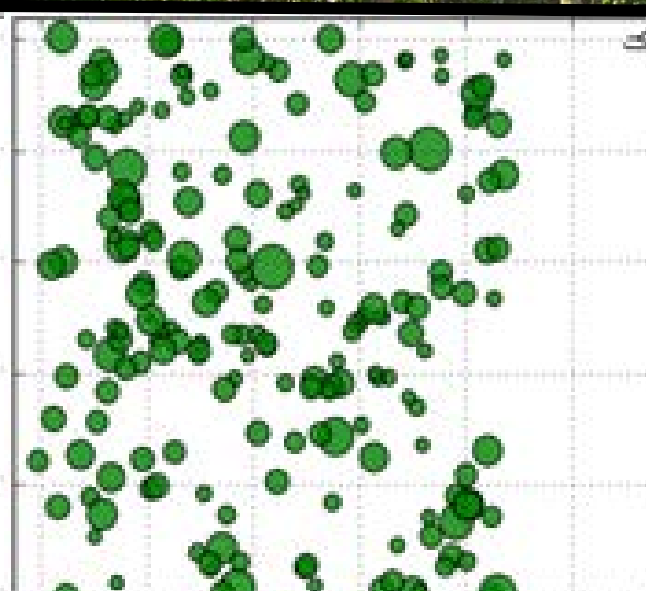
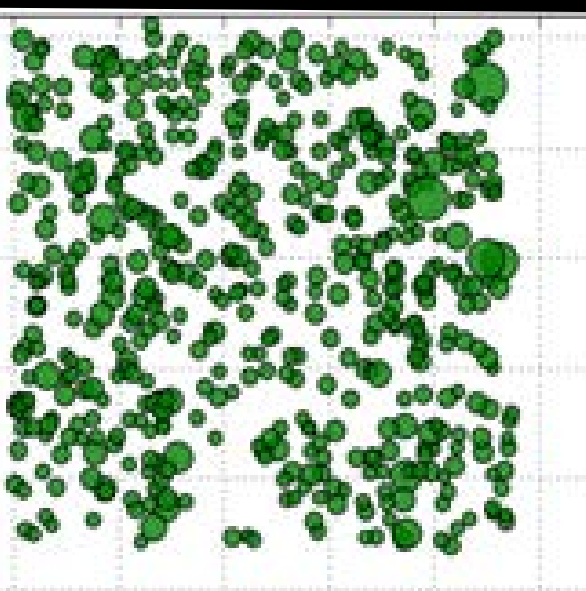
Miner species accumulation curve for 1 ha of tropical rainforest

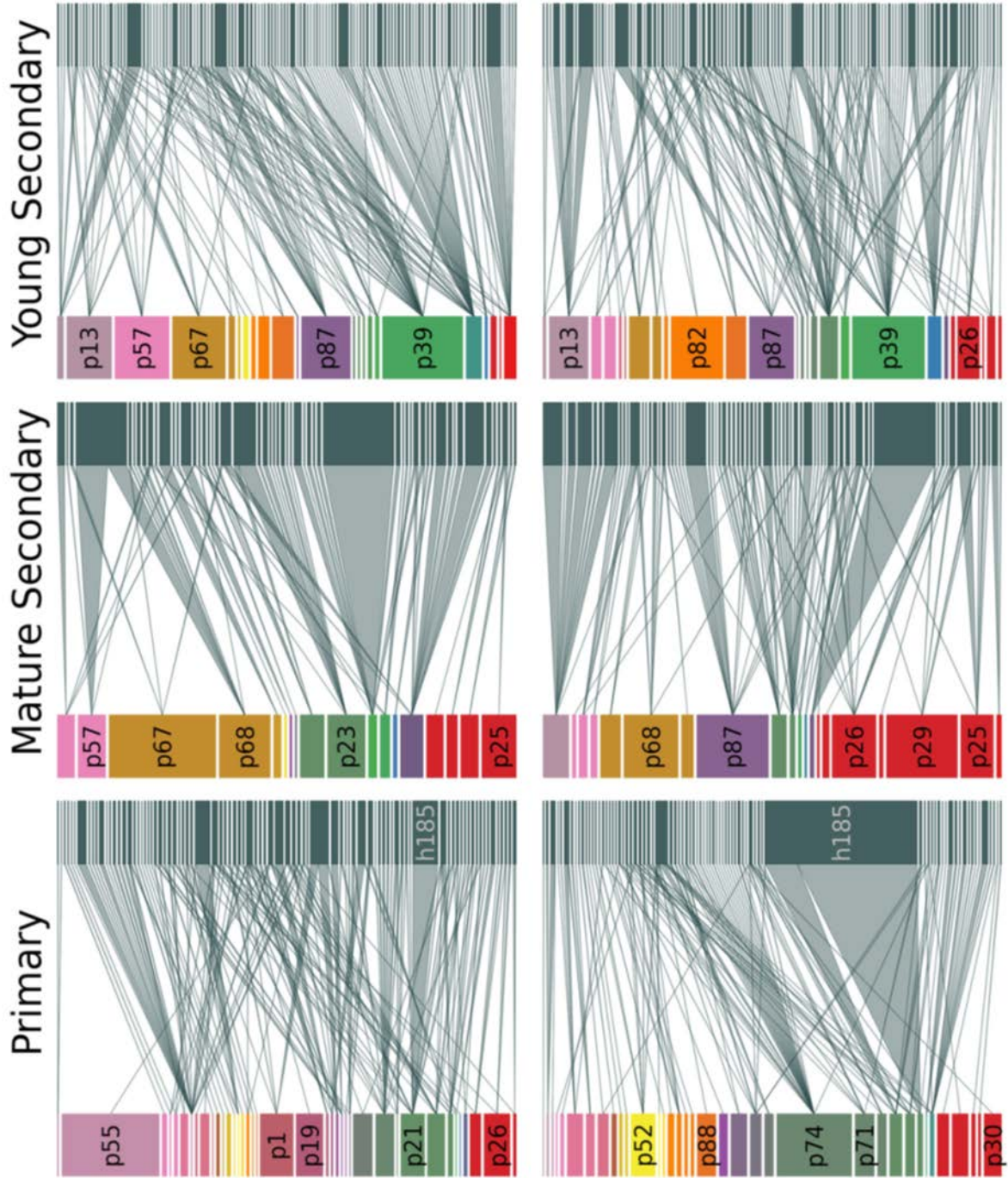




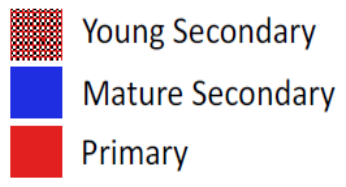
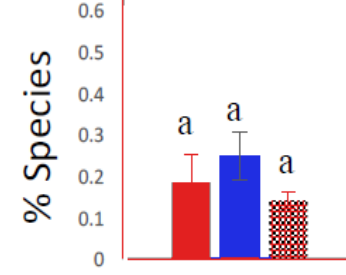
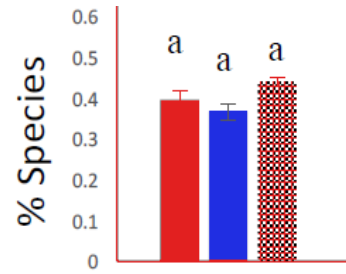
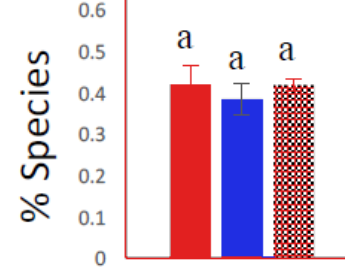








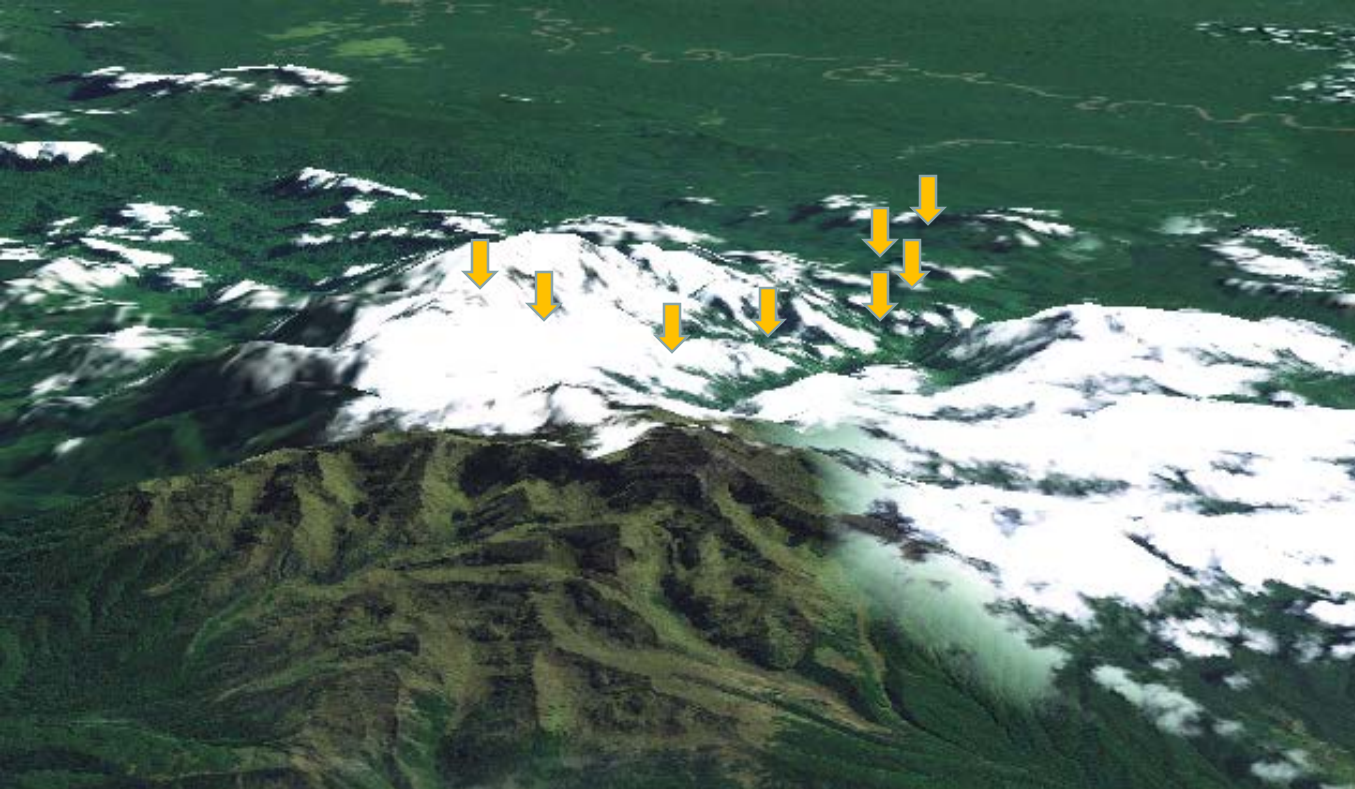
- Podocarpus
- Cyathea
- Dicksonia
- Pandanus
- Piper
- Steganthera
- Cryptocarya
- Myristica
- Helicia
- Meliosma
- Saurauia
- Cyphomandra
- Neuburgia
- Psychotria
- Mussaenda
- Nauclea
- Ichnocarpus
- Chionanthus
- Astronidium
- Syzygium
- Turpinia
- Toona
- Aglaia
- Dysoxylum
- Melicope
- Zanthoxylum
- Mischocarpus
- Guioa
- Trichospermum
- Sterculia
- Perrottetia
- Caldcluvia
- Sloanea
- Elaeocarpus
- Schuermansia
- Macaranga
- Homalanthus
- Corynocarpus
- Lithocarpus
- Prunus
- Alphitonia
- Gouania
- Nothocnide
- Pipturus
- Ficus
- Trema



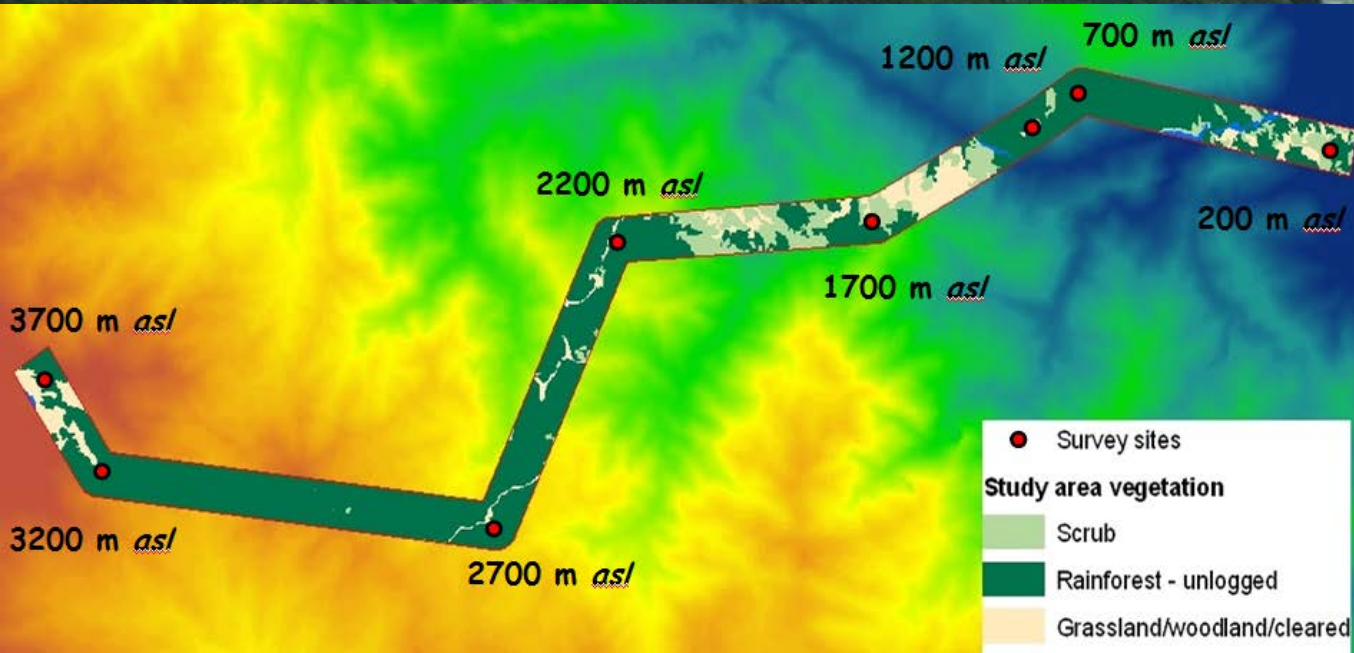
Redmond et al.
Ecography in rev.



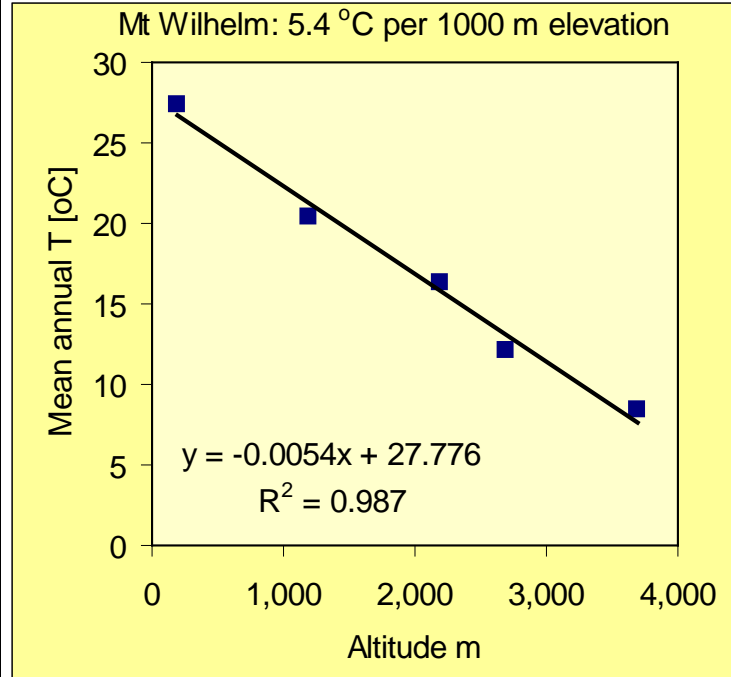
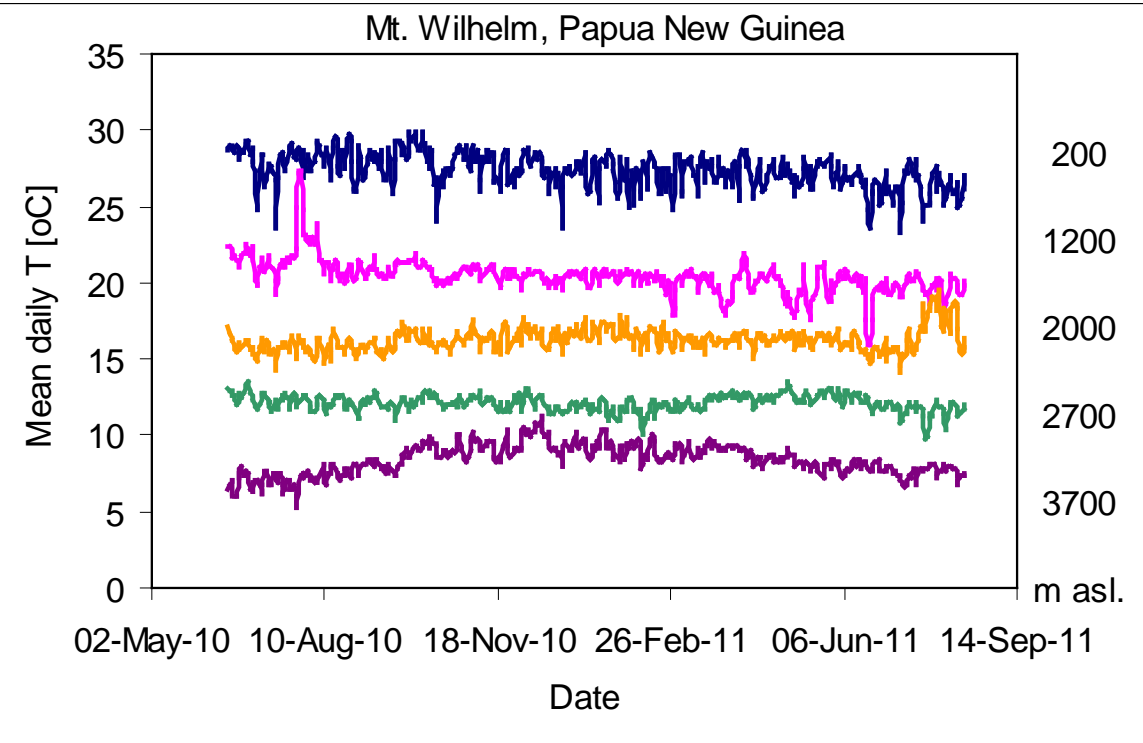
Diversity along altitudinal gradient at Mt Wilhelm



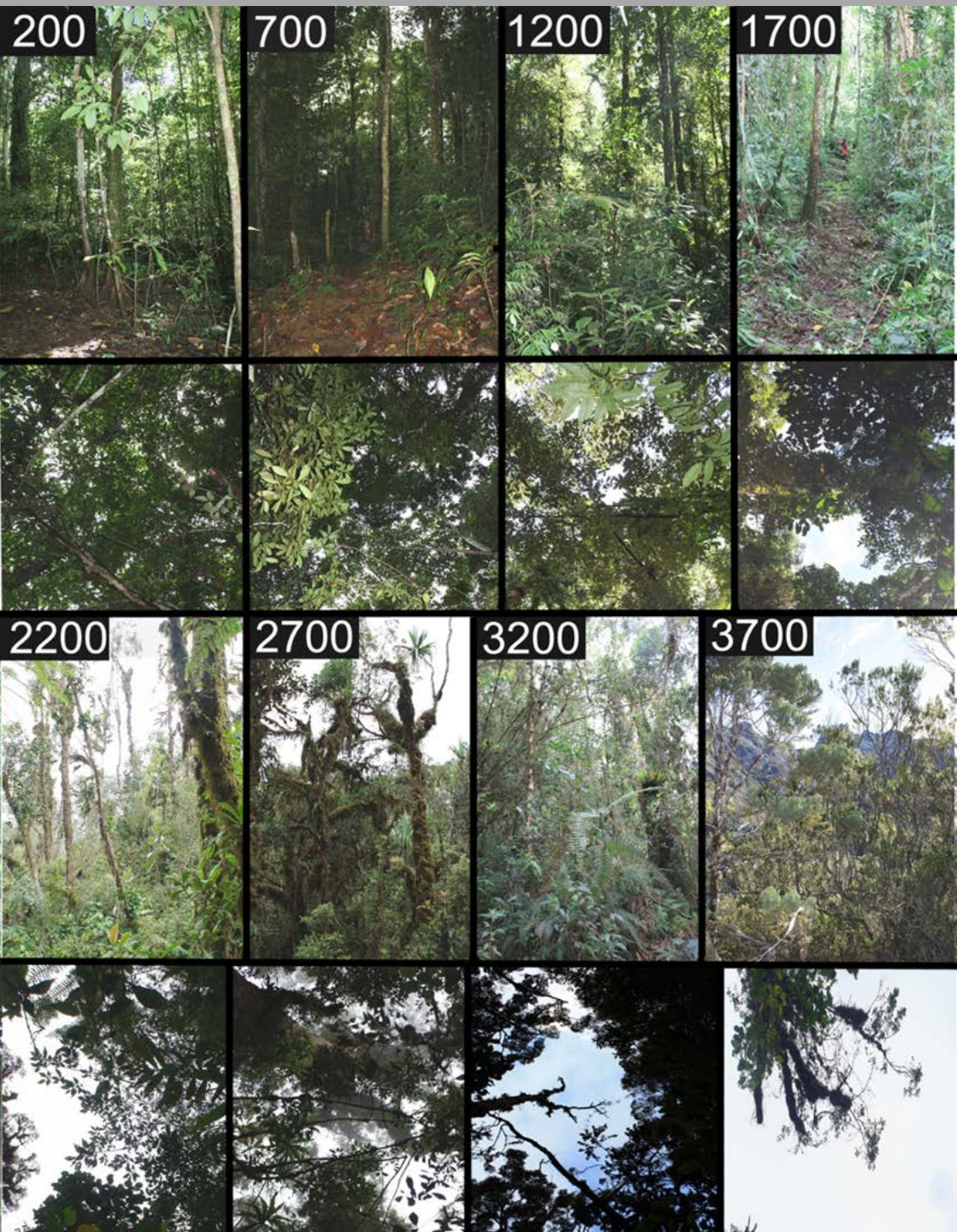
Complete
rainforest
altitudinal
gradient at Mt.
Wilhelm



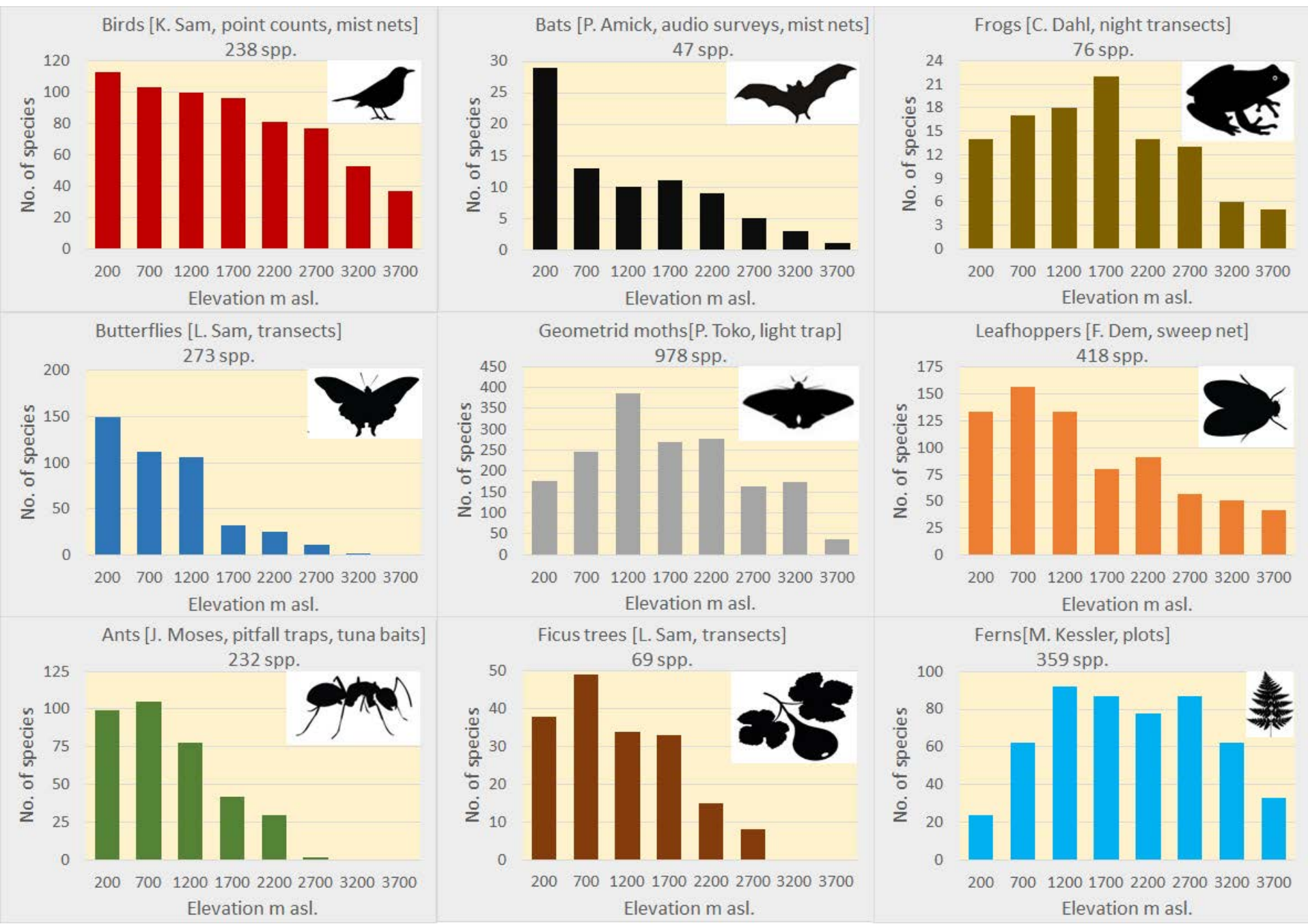
Decrease in temperature with altitude: 5-6°C per 1000 m

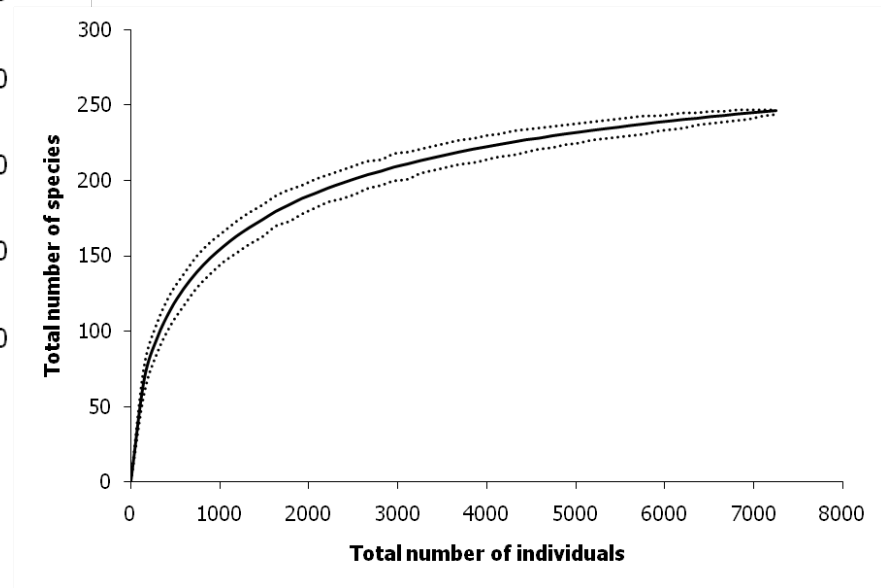
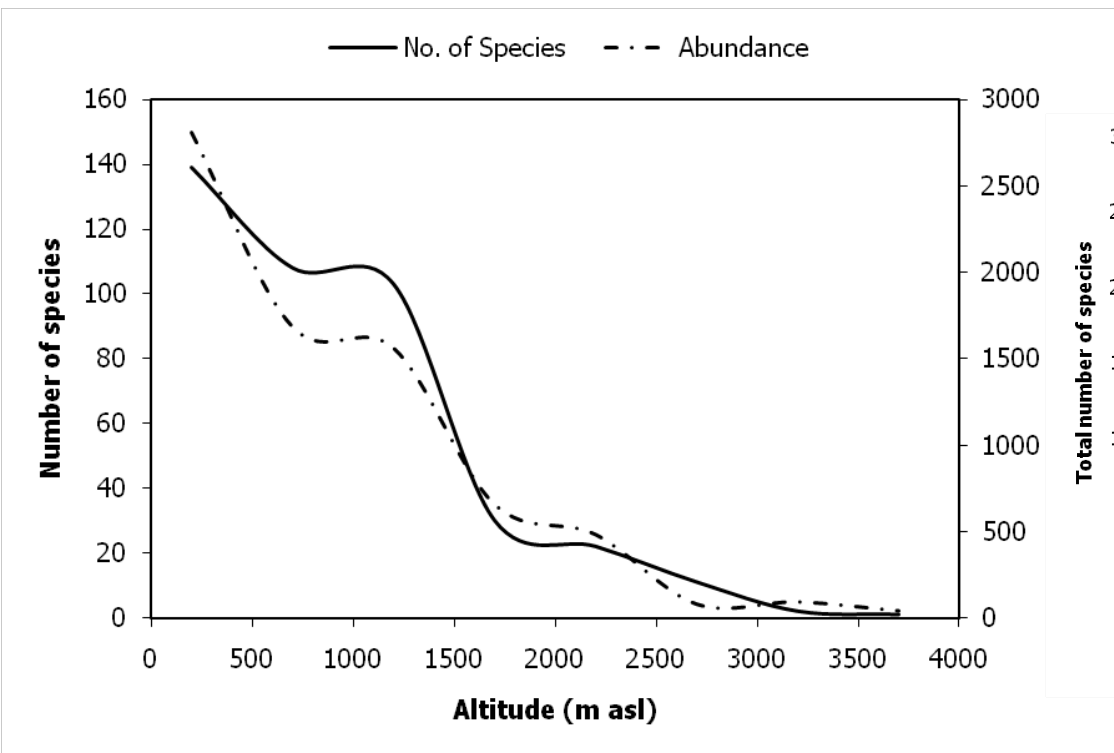


Mt Wilhelm complete rainforest elevation gradient



Altitudinal local gradients at Mt. Wilhelm, PNG





20 most common species along the transect

Species	Altitude (m asl)									Total
	200	700	1200	1700	2200	2700	3200	3700	Alt. Range	
<i>Mycalesis phidon</i>	272	146	63	0	0	0	0	0	0 - 1500	481
<i>Danis danis</i>	247	91	5	0	0	0	0	0	0 - 1000	343
<i>Mycalesis barbara</i>	0	33	174	90	3	0	0	0	600 - 2000	300
<i>Eurema puella</i>	68	93	72	14	0	0	0	0	0 - 1500	247
<i>Mycalesis discobolus</i>	0	0	0	178	62	0	0	0	800 - 2500	240
<i>Parthenos aspila</i>	100	125	8	0	0	0	0	0	0 - 800	233
<i>Taenaris myops</i>	64	66	88	0	0	0	0	0	0 - 1300	218
<i>Harsiesis hygaea</i>	0	100	104	0	0	0	0	0	0 - 1200	204
<i>Delias nais</i>	0	0	0	110	82	0	0	0	1000 - 2000	192
<i>Pantoporia venilia</i>	57	76	53	0	0	0	0	0	0 - 1600	186
<i>Papilio aegaeus</i>	131	13	25	1	0	0	0	0	0 - 1600	170
<i>Tellervo nedusia</i>	41	45	57	0	0	0	0	0	0 - 1000	143
<i>Pithecops dionisius</i>	67	64	6	0	0	0	0	0	0 - 1800	137
<i>Delias iltis</i>	0	0	0	0	122	11	0	0	1400 - 2740	133
<i>Terinos tethys</i>	125	1	3	0	0	0	0	0	0 - 200	129
<i>Delias gilliardi</i>	0	0	0	0	0	0	78	44	2600 - 3500	122
<i>Euploea wallacei</i>	8	9	105	0	0	0	0	0	0 - 1700	122
<i>Jamides celeno</i>	121	0	0	0	0	0	0	0	0 - 1000	121
<i>Delias meeki</i>	0	0	0	0	118	0	0	0	1500 - 2400	118
<i>Mycalesis elia</i>	62	25	22	0	0	0	0	0	0 - 1800	109

Species Diversity of Geometrid Moths

(Pagi Toko, in preparation)



Sampling Method: Light Trapping

Preliminary Results: 15000 individuals,
930 species

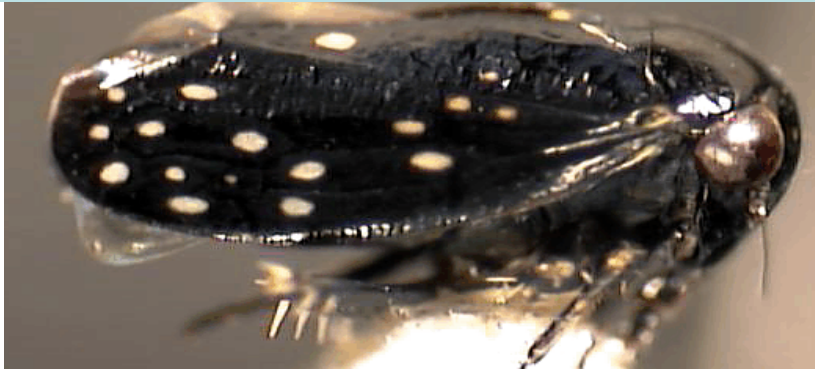
Species Diversity of Leaf Hoppers

(Hannelore & Dem. (2011). Dtsch Entomol. Z. 58 (2) + others in preparation

Sampling Method:

Sweep Nets & Light Trapping

Preliminary results: 3 new species described and published.



Species Diversity of Frogs

(Chris Dahl et al. 2012. *Herp Journal* 22:183-186) + others in preparation

Sampling Method: collection at night by tracking calls or searching in leaf litters

Preliminary Results: 3,812 frogs, 76 species of frogs from 4 native families



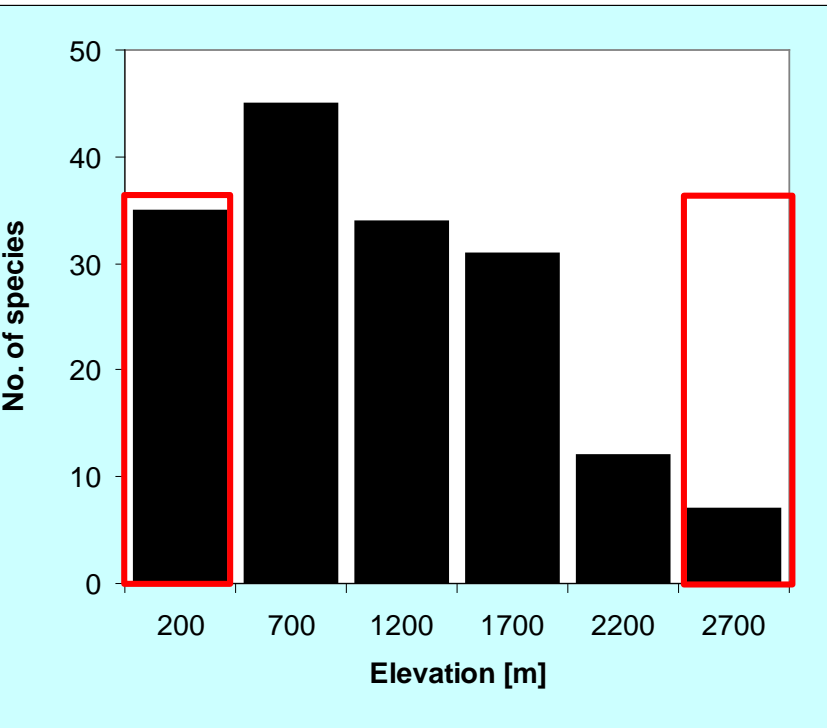
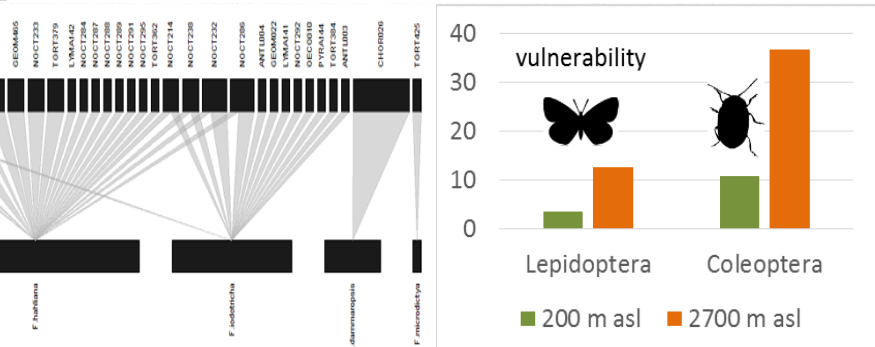
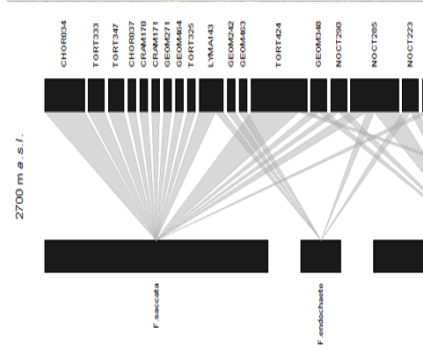
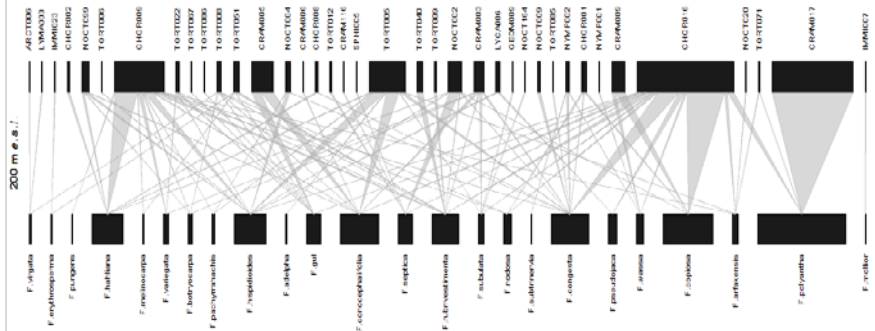
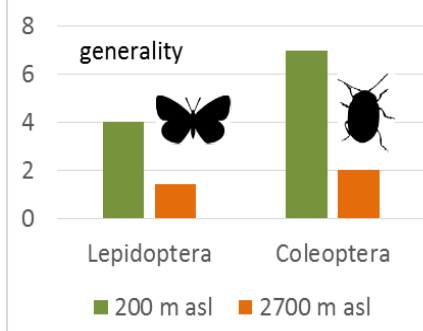
Species Diversity of Birds

(*Tvardikova et al (2012) J. Trop. Ecol. 28: 331-341*)



Sampling Method: Point Counts & Mist Netting & Random walks

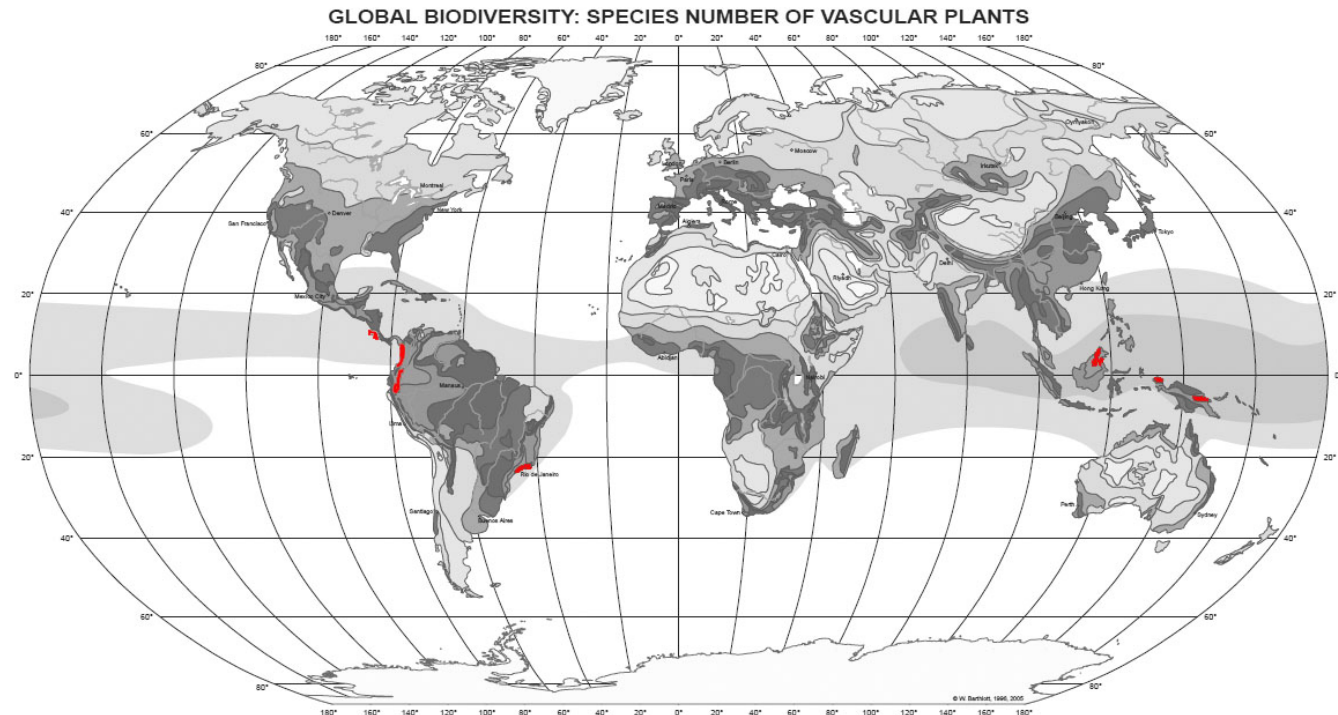
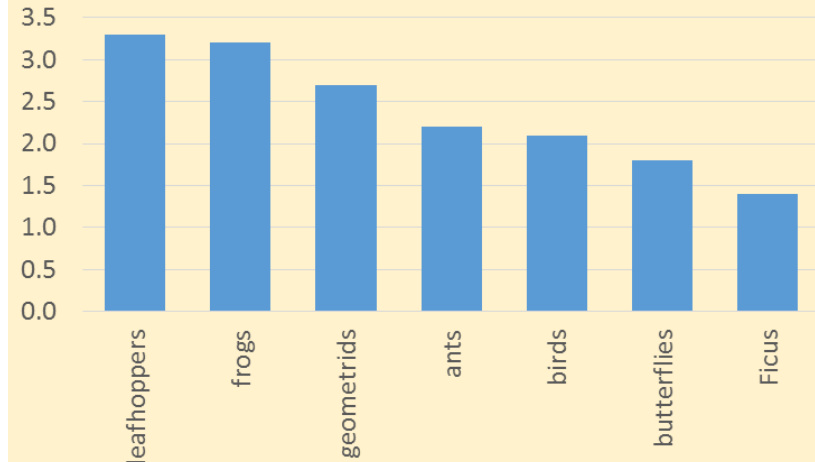
Species	200	700	1200	1700	2200	2700
<i>Ficus septica</i>	25					
<i>Ficus prunifolia</i>	2					
<i>Ficus robusta</i>	2					
<i>Ficus virgata</i>	15					
<i>Ficus archboldiana</i>	2	4				
<i>Ficus botryocarpa</i>	52	17				
<i>Ficus drupacea</i>	2	1				
<i>Ficus hispidoidea</i>	76	12				
<i>Ficus melaniocarpa</i>	24	1				
<i>Ficus pachyrrhachis</i>	10	25				
<i>Ficus polyantha</i>	20	15				
<i>Ficus pseudojaca</i>	13	14				
<i>Ficus virens</i>	1	2				
<i>Ficus congesta</i>	33	75	16			
<i>Ficus gul</i>	30	5	1			
<i>Ficus nodosa</i>	40	24	3			
<i>Ficus semivestita</i>	13	8	4			
<i>Ficus variegata</i>	48	16	5			
<i>Ficus mollior</i>	3		51	178		
<i>Ficus itoana</i>	4	4		214		
<i>Ficus arfakensis</i>	174	61	30	346		
<i>Ficus copiosa</i>	34	152	17	6		
<i>Ficus erythrosperma</i>	9	27	90	28		
<i>Ficus leptodictya</i>	2	1	63	13		
<i>Ficus pungens</i>	7	29	5	2		
<i>Ficus rubrivestimenta</i>	35	46	41	7		
<i>Ficus pungens</i>	14	59	15	3		
<i>Ficus subcuneata</i>	35	192	111	10		
<i>Ficus trichocerasa</i>	1	25	66	210		
<i>Ficus adelpha</i>	29	168	50	42		
<i>Ficus xylosyca</i>	1		9	2	12	
<i>Ficus hombroniana</i>	11	35	6	358	173	
<i>Ficus trachypison</i>	13	14	4	101	9	
<i>Ficus hahliana</i>	51	265	156	88	304	680
<i>Ficus wassa</i>	66	23	36	14	162	24
<i>Ficus arbuscula</i>		7				
<i>Ficus glaberrima</i>		1				
<i>Ficus phaesyce</i>		51				
<i>Ficus sanguma</i>		4				
<i>Ficus novoguineensis</i>		5	5			
<i>Ficus badiopurpurea</i>		113	41			
<i>Ficus disticha</i>		3	7			
<i>Ficus morobensis</i>		11	20			
<i>Ficus baeuerlenii</i>		4	13	21		
<i>Ficus bernaysii</i>		25	8	2		
<i>Ficus edelfeltii</i>		53	45	7		
<i>Ficus odoardii</i>		7	9	3		
<i>Ficus pandoniana</i>		1			6	
<i>Ficus dammaropsis</i>		4		135	86	1
<i>Ficus saccata</i>		147	79		213	159
<i>Ficus endochaete</i>		33	209		35	50
<i>Ficus hesperidiiformis</i>			2			
<i>Ficus heteromeka</i>			1			
<i>Ficus augusta</i>			6	16	2	
<i>Ficus red</i>				91		
<i>Ficus schumanniana</i>				1		
<i>Ficus scratchleyana</i>				15		
<i>Ficus wav</i>				192		
<i>Ficus beb</i>				369		
<i>Ficus calopilina</i>				333		
<i>Ficus complexa</i>				65		
<i>Ficus iodotricha</i>				44	188	199
<i>Ficus microdictya</i>					31	9



Long ecological gradients

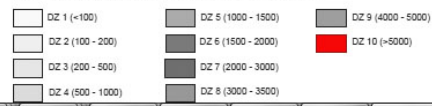
Mt Wilhelm:
total diversity
1.4 – 3.3x higher
than maximum
local diversity

Total spp along transect / local species maximum



Robinson Projection
Standard Lines 38°N and 38°S

Diversity Zones (DZ): Number of species per 10 000 km²

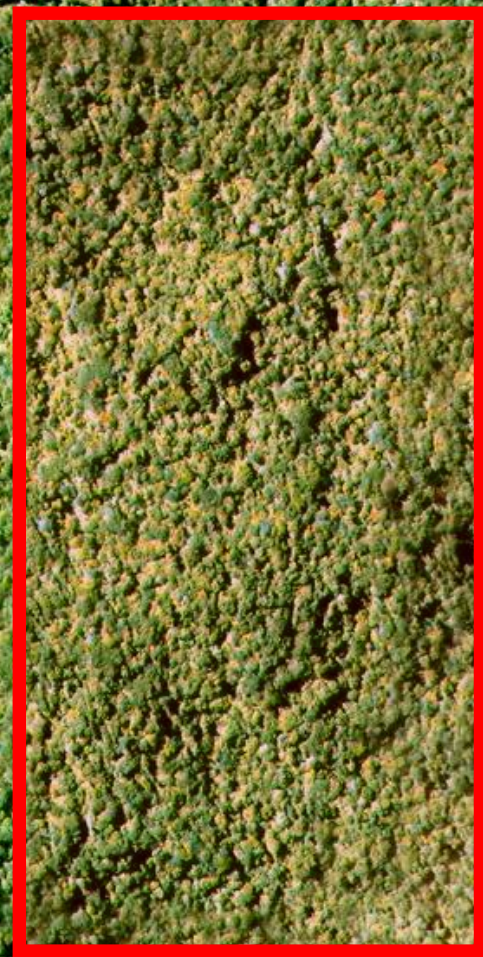


sea surface temperature



W. Barthlott, G. Jäger, H. Körtz, W. Kötter,
D. Rathgeber & J. Müller 2005
modified after
W. Barthlott, W. Lauer & A. Placke 1996
Nees Institute for Biodiversity of Plants
University of Bonn

Plant diversity in the 50 ha forest dynamics plot in Wanang



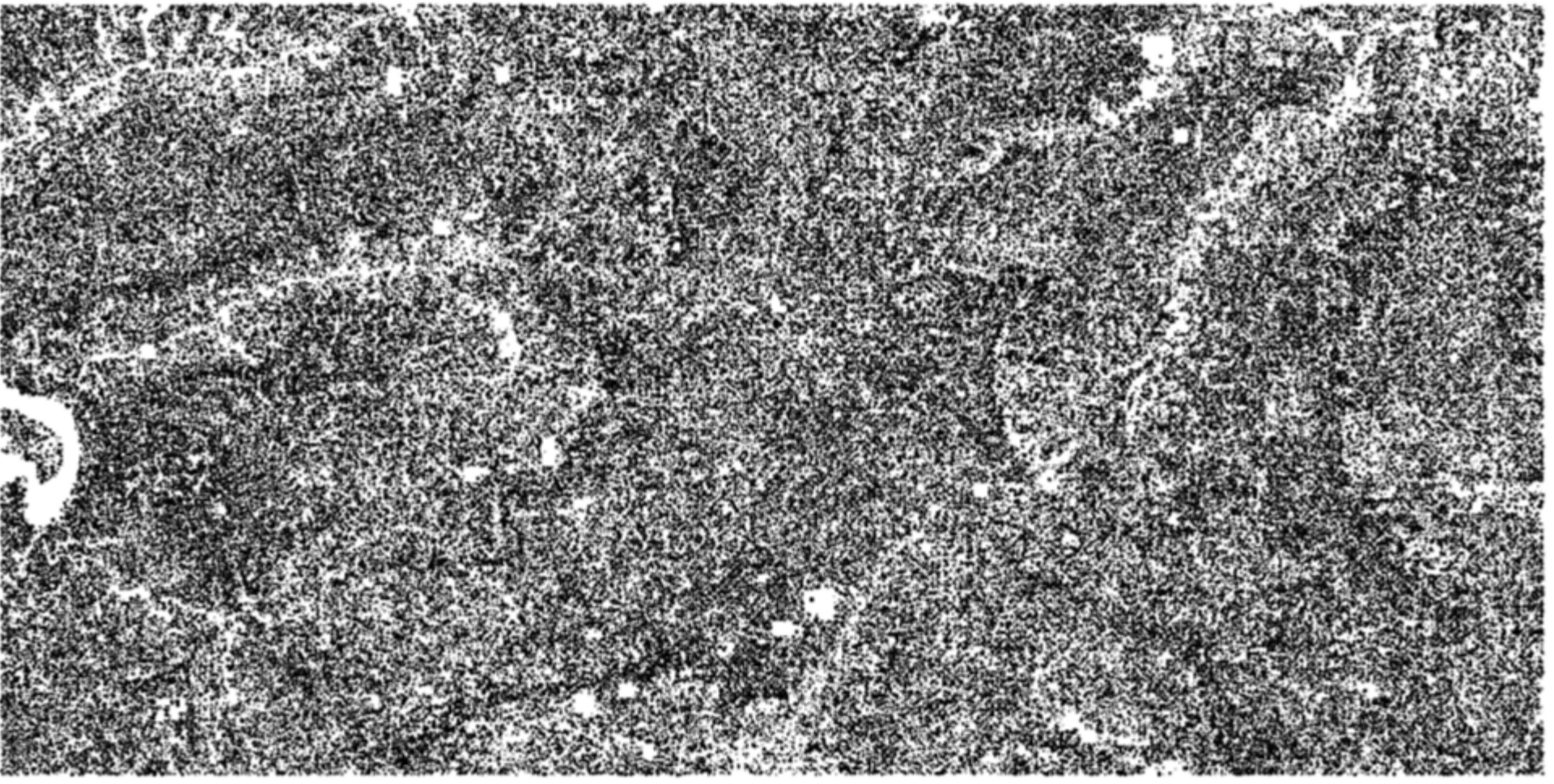
50 ha forest plot



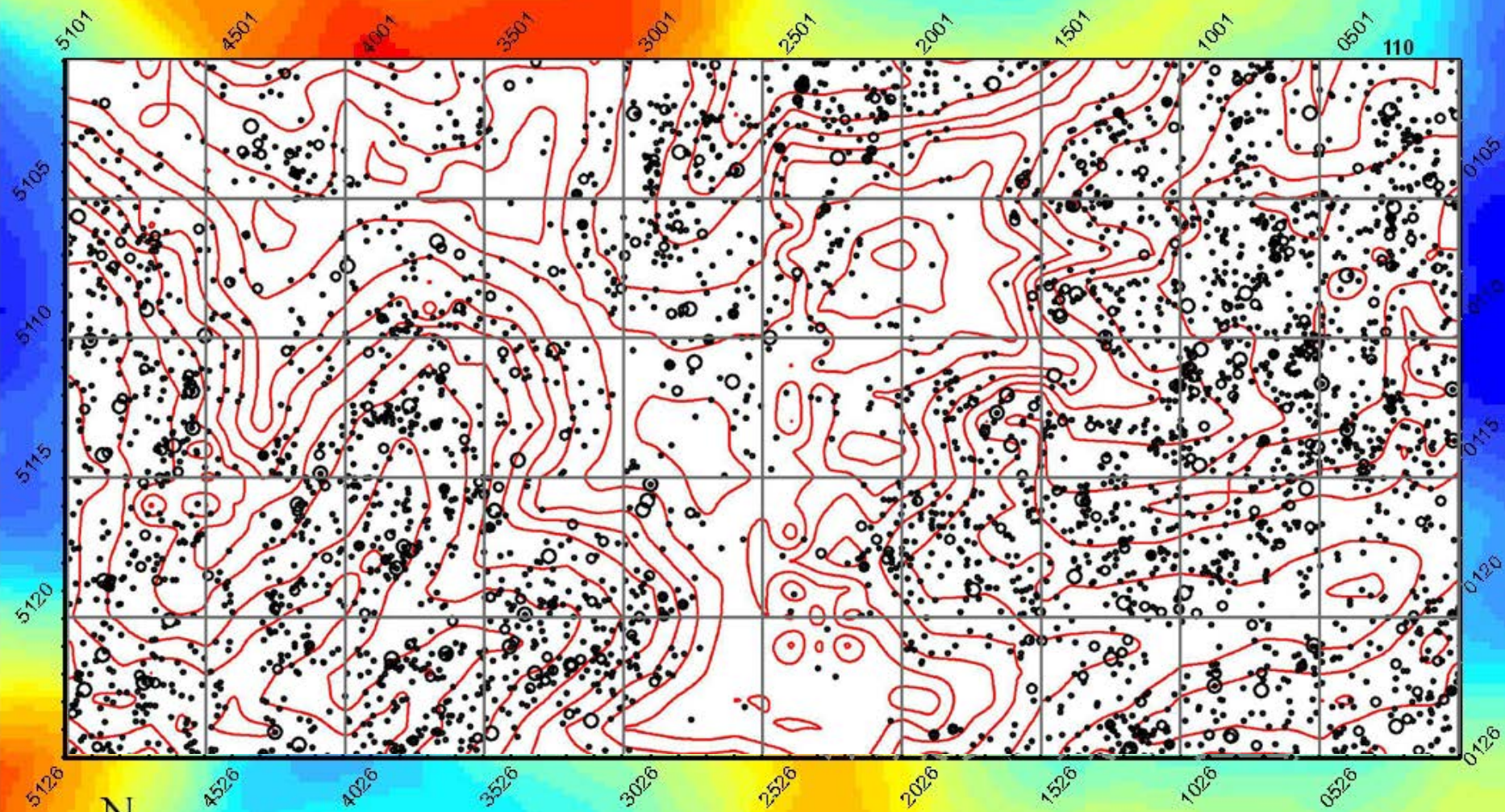
63 plots, 6 million trees, 10,000 species



Plant data: the beauty of plots

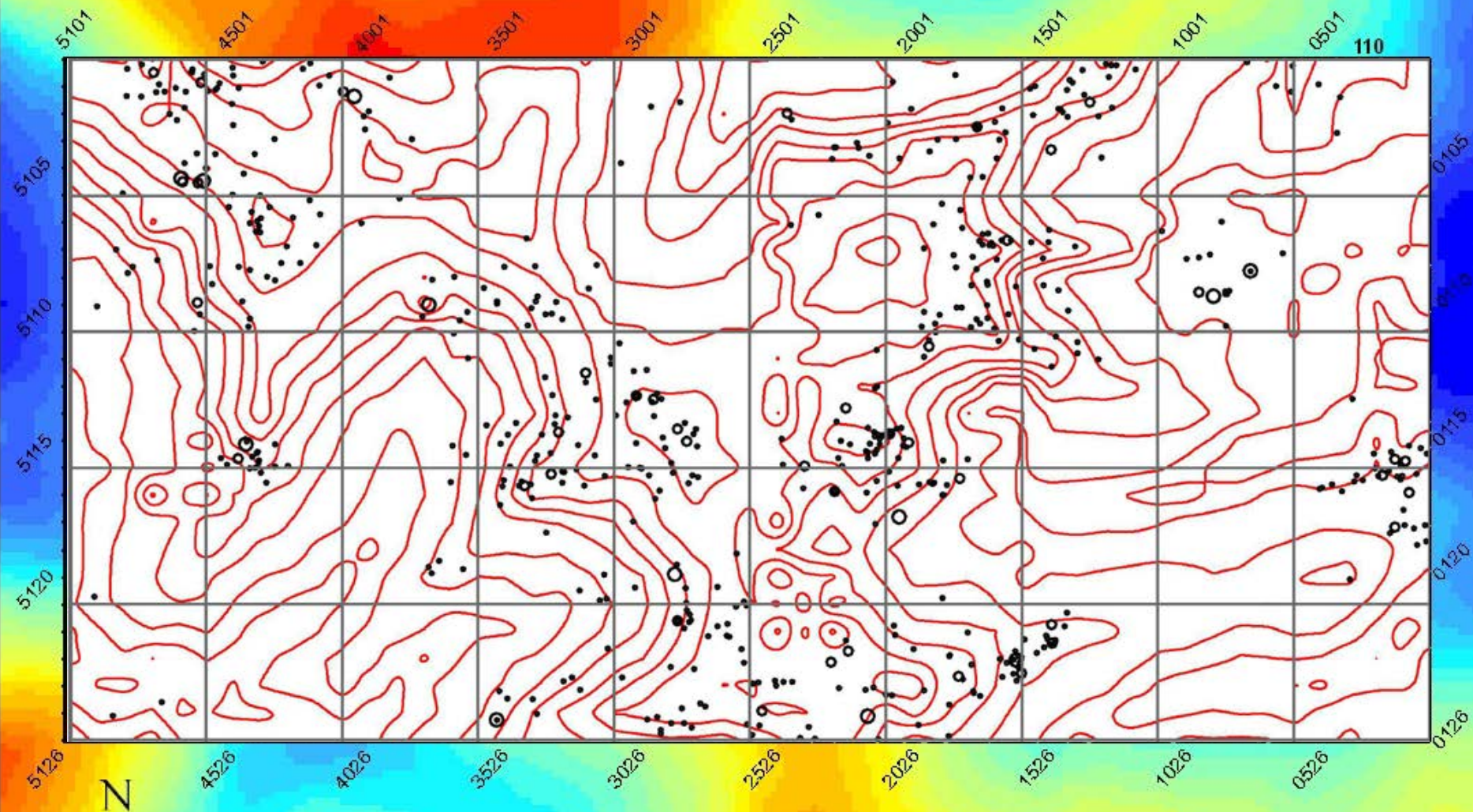


Wanang 50ha Plot

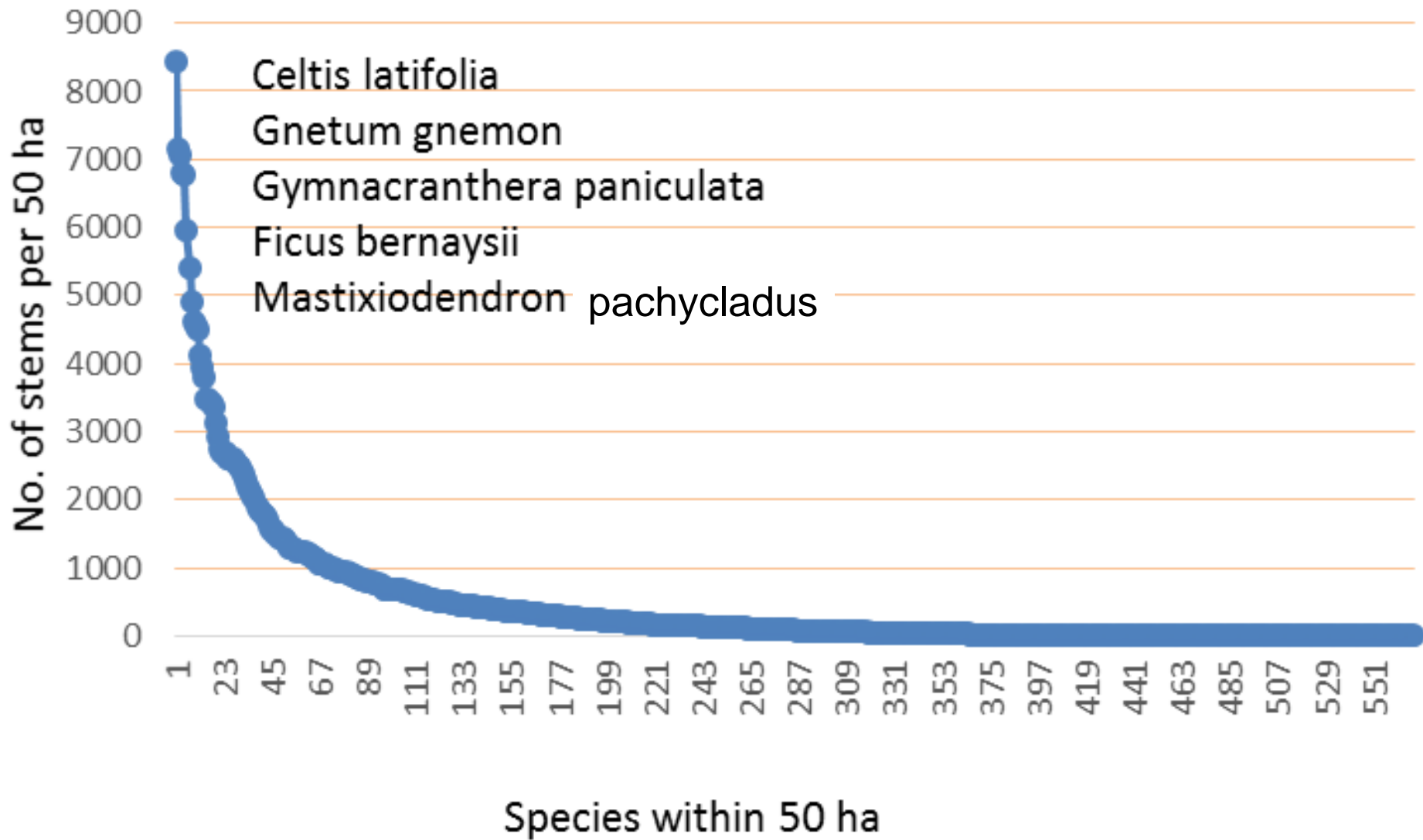


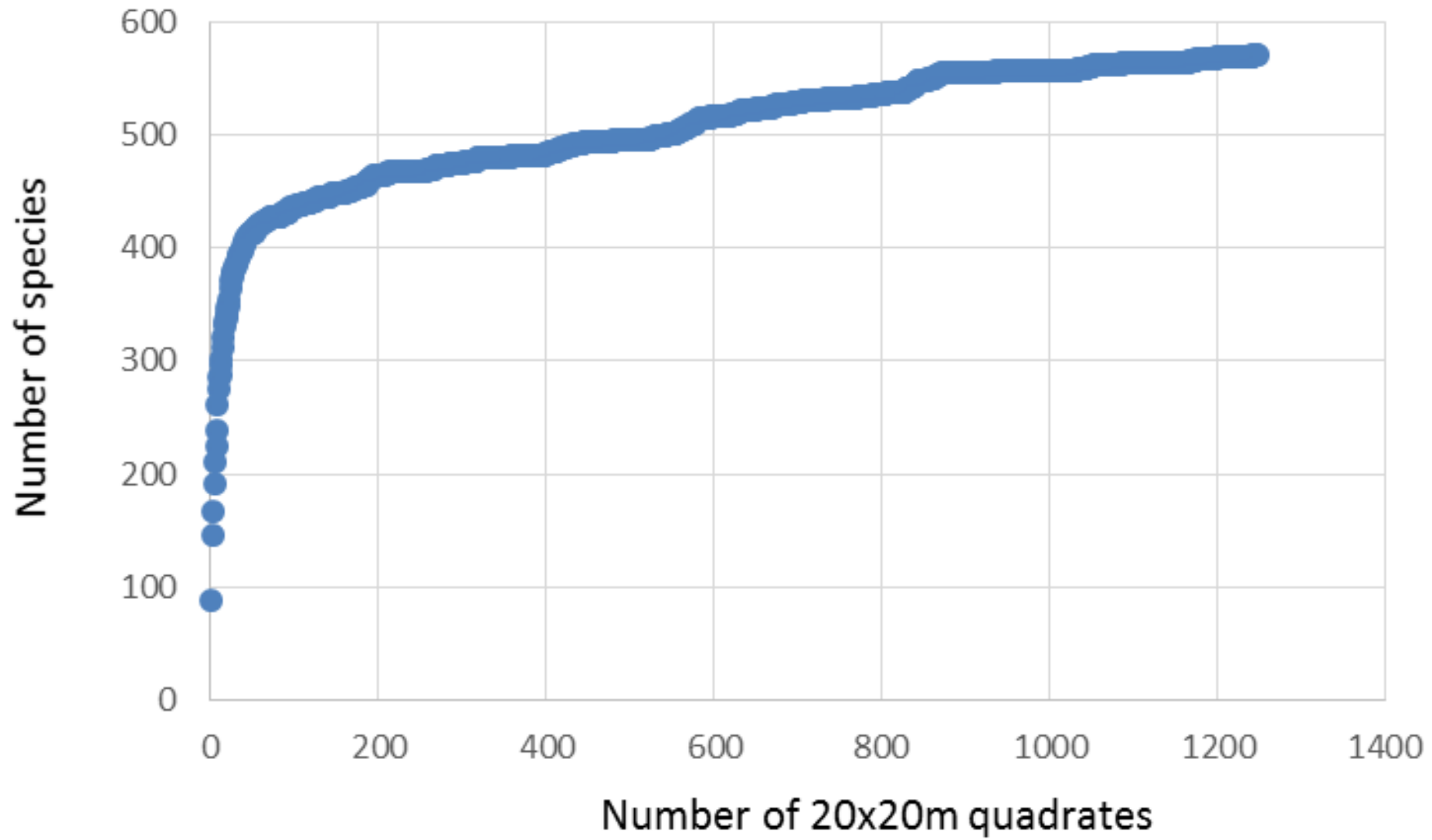
Pometia pinata

Wanang 50ha Plot

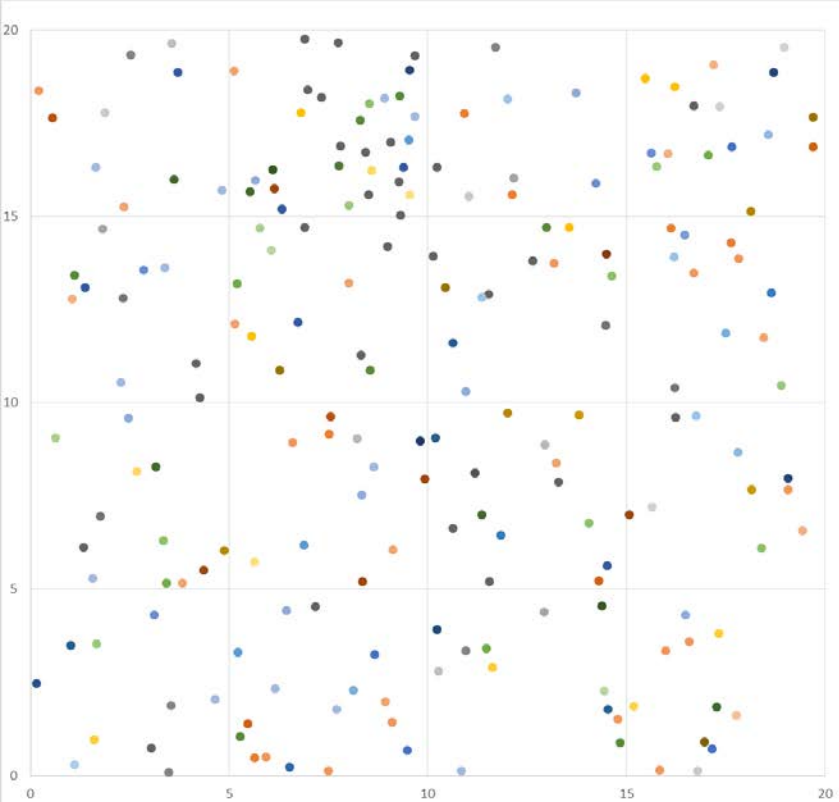


Intsia bijuga





Experiments with food webs studying interactions between plants, insect herbivores, fungal pathogens and vertebrate predators



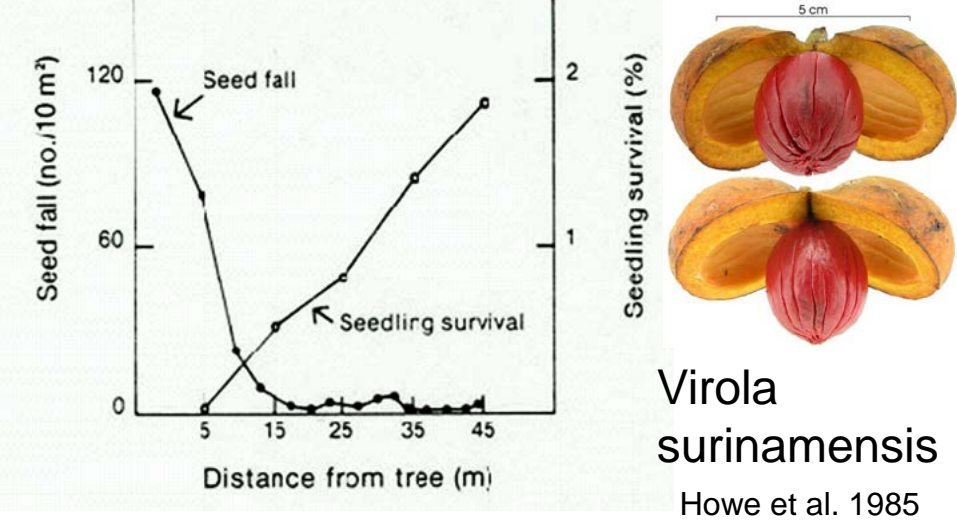
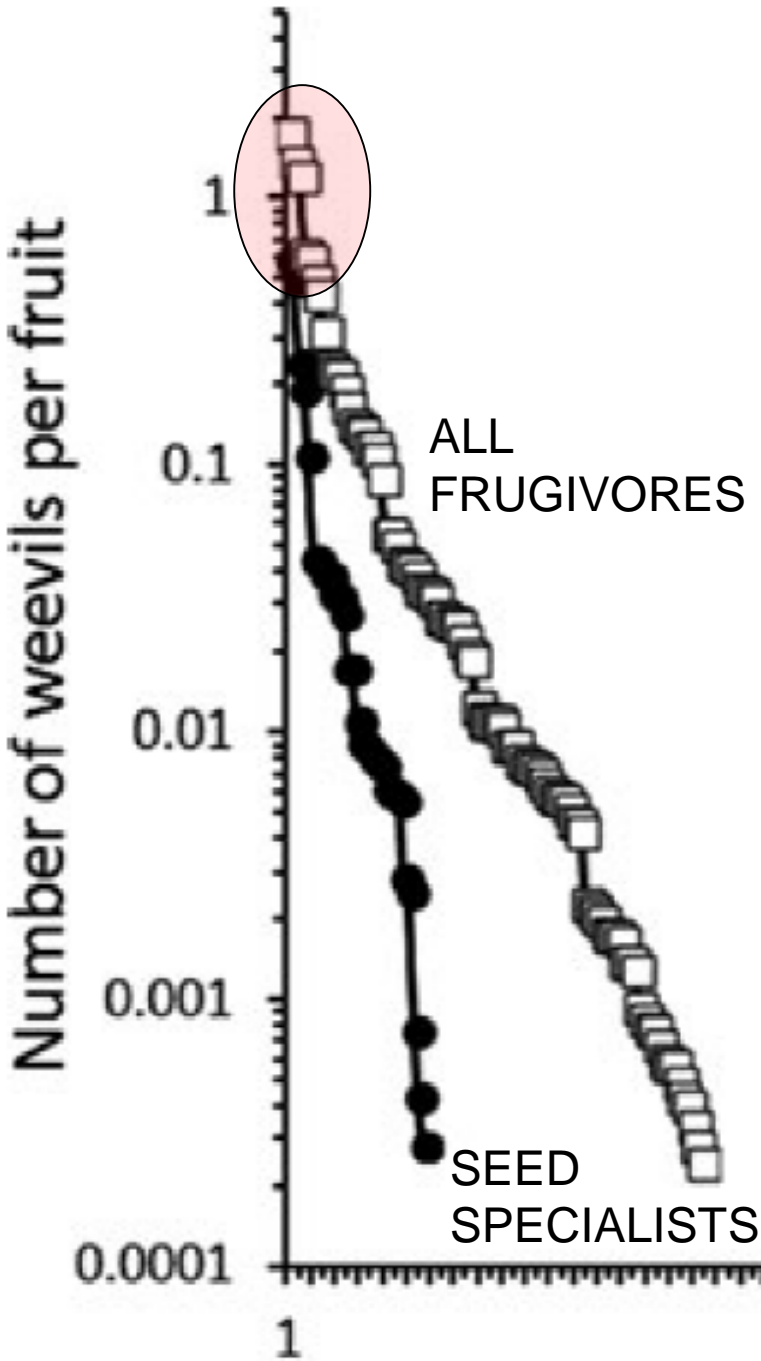
- *Actinodaphne nitida*
- *Aglaiia agglomerata*
- *Aphanamixis polystachya*
- *Canarium asperum*
- *Chionanthus ramiflora*
- *Chisocheton weinlandii*
- *Dysoxylum papuanum*
- *Erythrospermum candidum*
- *Garcinia dulcis*
- *Graptophyllum pictum*
- *Haplostichanthus longirostris*
- *Licuala beccariana*
- *Mallotus sp.*
- *Mastixiodendron pachyclados*
- *Myristica hollrungii*
- *Pimelodendron amboinicum*
- *Planchonella xylocarpa*
- *Prunus gazelle-penisulae*
- *Ryparosa calotricha*
- *Syzygium hylophilum*
- *Uvaria lutescens*
- *Aglaiia sp.*
- *Aglaiia lepiorrhachis*
- *Artocarpus sepicanus*
- *Celtis latifolia*
- *Chisocheton formicarum*
- *Cryptocarya medicinalis*
- *Dysoxylum macrostachyum*
- *Ficus badiopurpurea*
- *Garcinia hunsteinii*
- *Gymnacranthera paniculata*
- *Harpullia longipetala*
- *Litsea timoriana*
- *Mallotus oblongifolius*
- *Medusanthera laxiflora*
- *Neuburgia corynocarpa*
- *Pisonia longirostris*
- *Podocarpus nerifolius*
- *Pterocymbium beccarii*
- *Steganthera hirsuta*
- *Syzygium longipes*
- *Versteegia cauliflora*
- *Aglaiia argentea*
- *Aglaiia rimosa*
- *Bridelia macrocarpa*
- *Celtis philippensis*
- *Chisocheton pachyrhachis*
- *Cryptocarya multipaniculata*
- *Elaeocarpus amplifolius*
- *Ficus gul*
- *Gardenia hansemannii*
- *Haplolobus floribundus*
- *Horsfieldia basifissa*
- *Macaranga fallacina*
- *Mallotus peltatus*
- *Microcos sp.*
- *Palaquium warburgianum*
- *Pittosporum sp.*
- *Polyalthia oblongifolia*
- *Randia dryadum*
- *Sterculia sp.*
- *Tabernaemontana orientalis*
- *Xanthophyllum papuanum*
- *Aglaiia brownii*
- *Aglaiia tomentosa*
- *Calophyllum soulatrii*
- *Chionanthus brassii*
- *Chisocheton trichodadus*
- *Dysoxylum arnoldianum*
- *Endocomia macrocoma*
- *Ficus mollior*
- *Gnetum gnemon*
- *Haplolobus lanceolatus*
- *Kingiodendron novoguineense*
- *Macaranga punctata*
- *Maniltoa megalcephala*
- *Microcos grandiflora*
- *Picrasma javanica*
- *Pittosporum sinuatum*
- *Pometia pinnata*
- *Rhyticaryum sp.*
- *Syzygium gonatanthum*
- *Ternstroemia cherryi*



... but it is inexplicably diverse

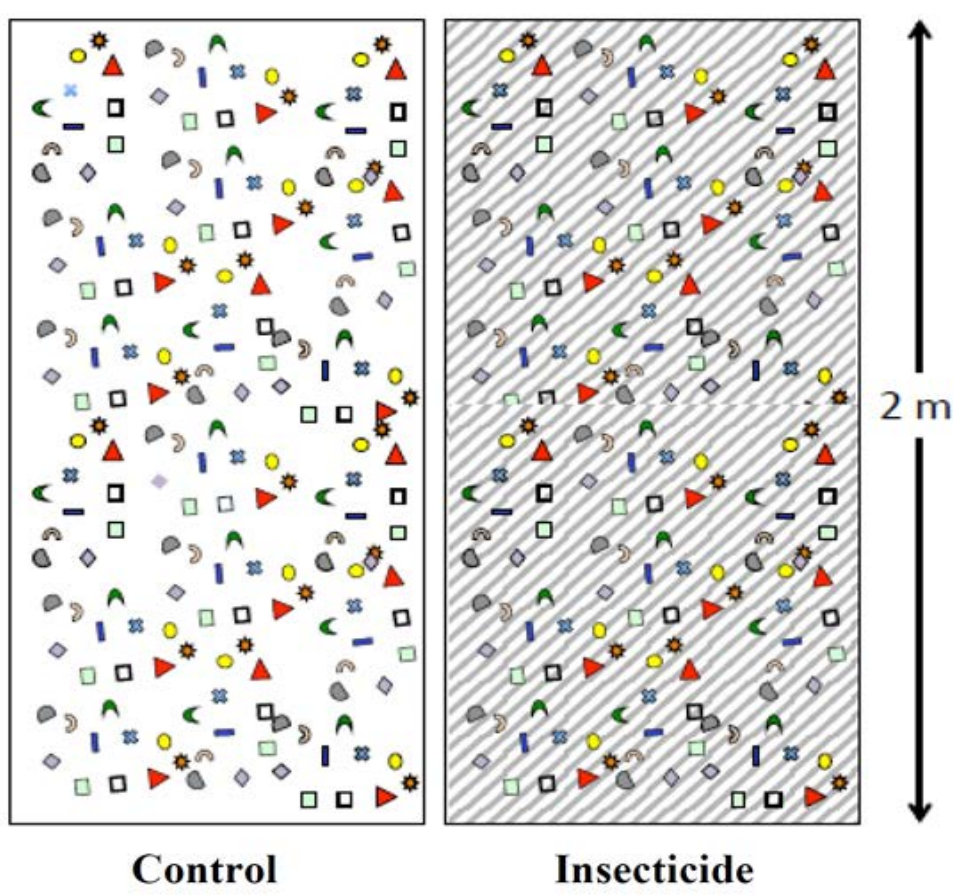






More on Janzen-Connell: assembling artificial seed communities with/without insect herbivore pressure

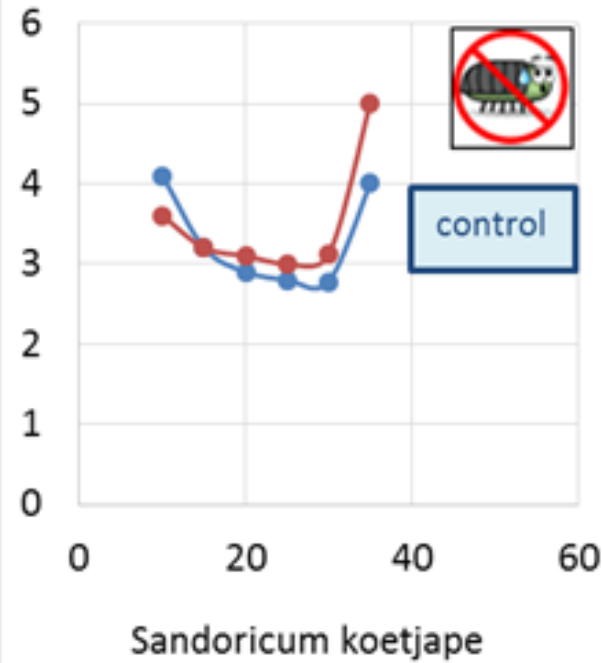
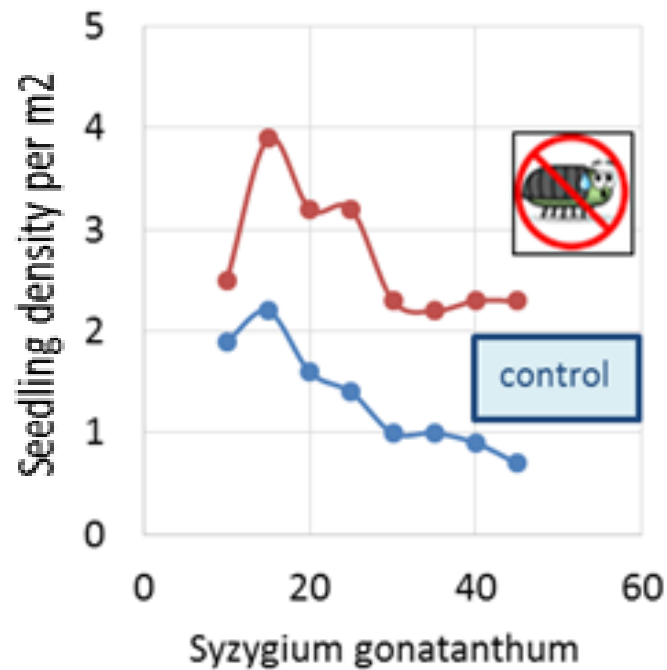
mixed seed communities from 20 tree spp.
with insects without insects



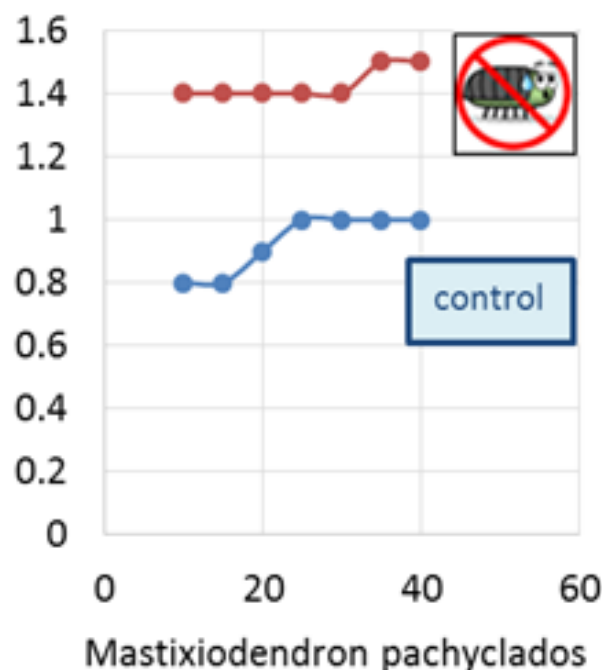
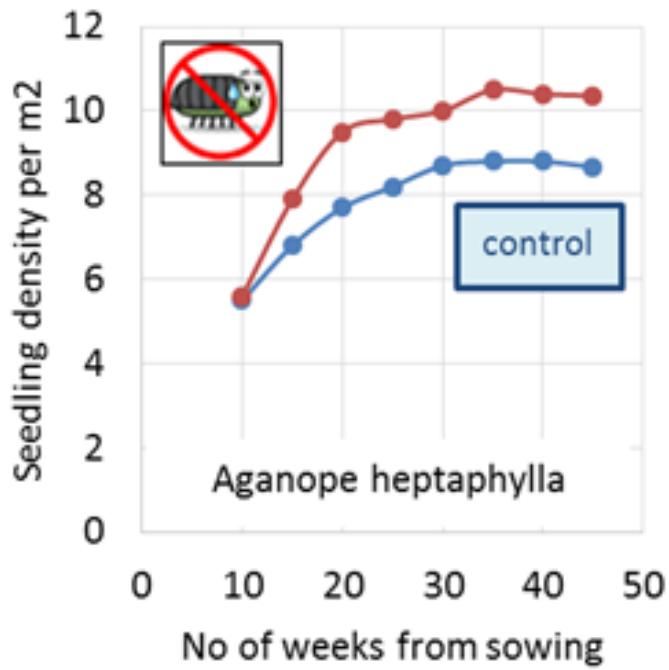
Y. Basset et al.







“Some” insects cause seedling mortality



CONTROL

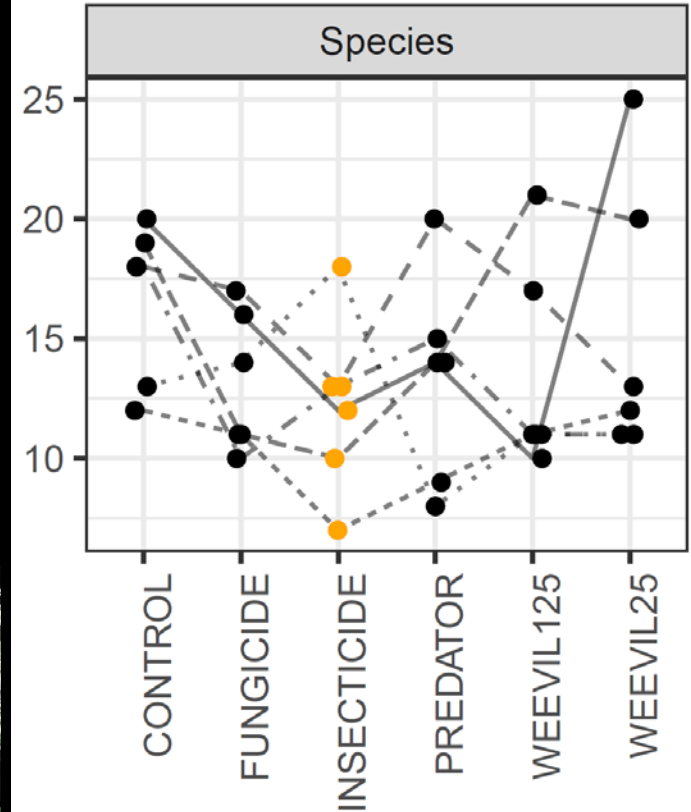
FUNGICIDE

INSECTICIDE

NO
PREDATORS

ADDED
HERBIVORES
LOW

ADDED
HERBIVORES
HIGH



Piotr Szefer, Legi Sam et al.





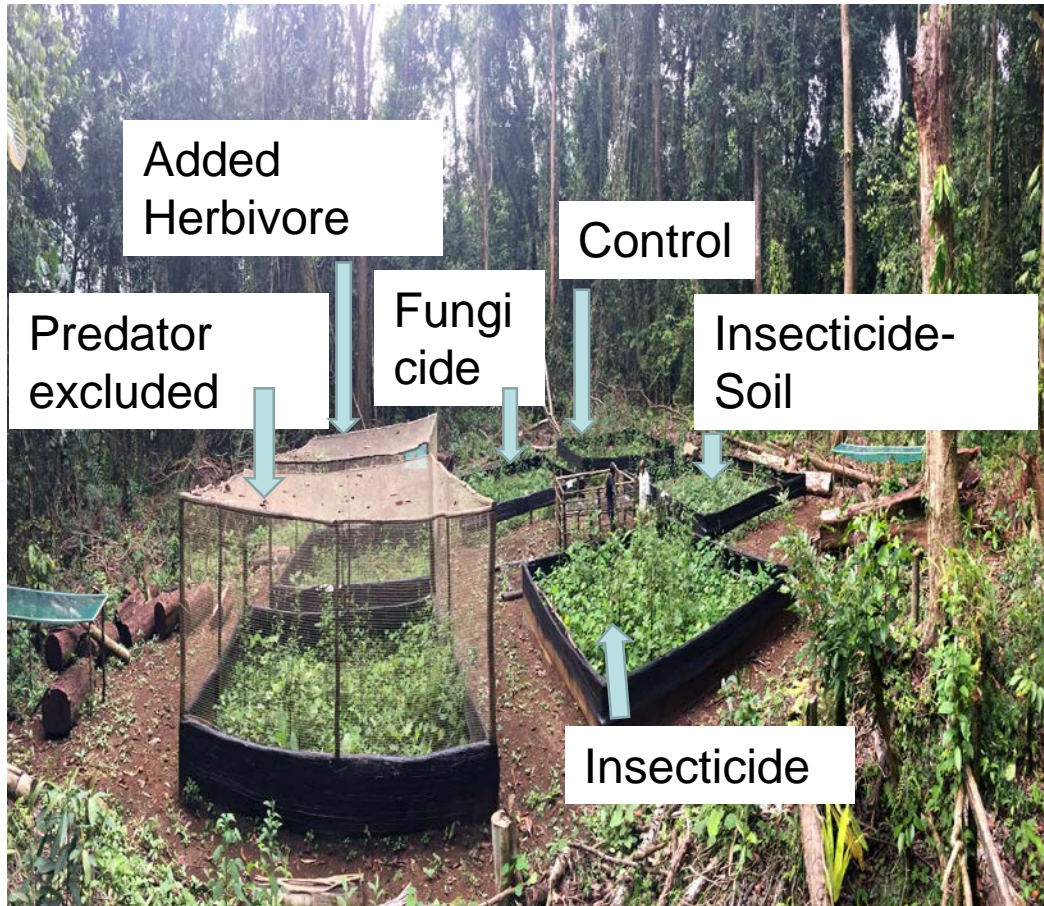
Sampling design: How plots are designed



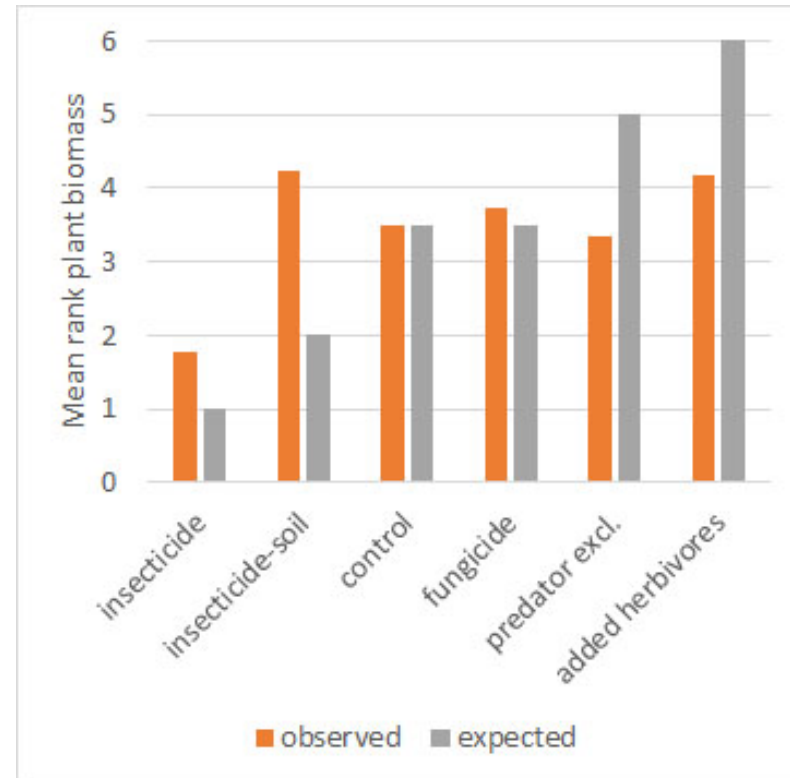
1. Clearing of 400m sq. of plot
2. Removing all aboveground vegetation without tillage
3. 5 x 5m plots design according to the type of experiment
4. 12 months Undisturbed growth for sampling



Preliminary results



Rank of Plant Biomass in each experimental plot



Removal of predators in rainforest: effect on herbivore abundance declines with elevation

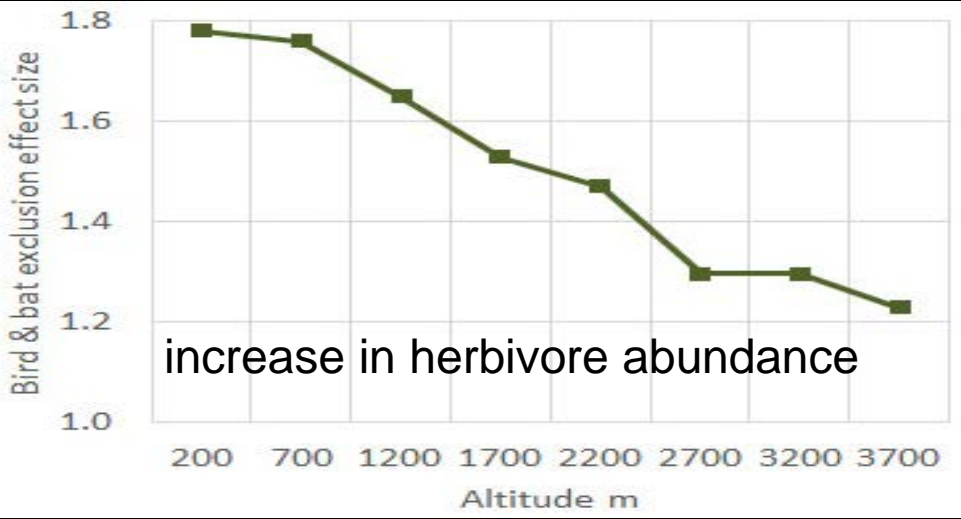
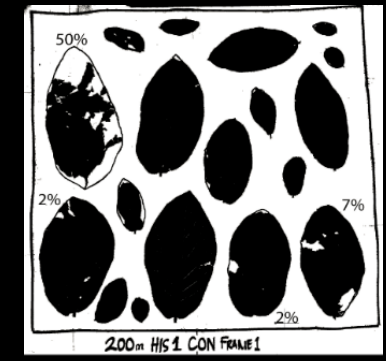
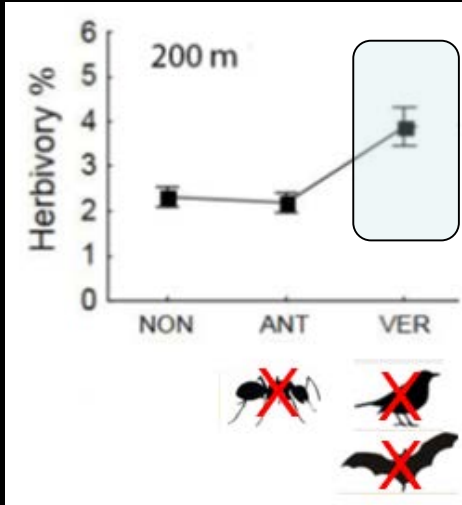
Removal of: Ants - Birds - Bats



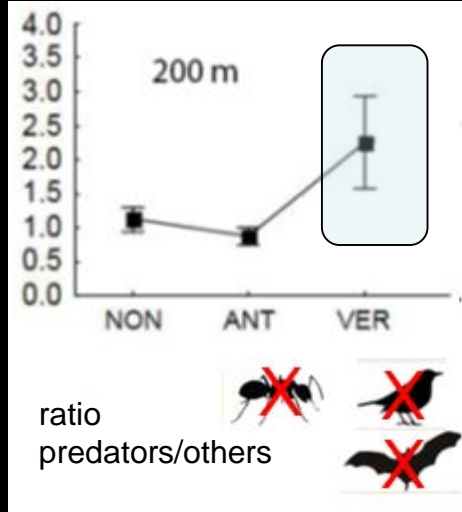
Katerina Sam

Bonny Koane

Removal of predators in rainforest:
insect herbivores increase
1.8x in lowlands, 1.2x at high elevation

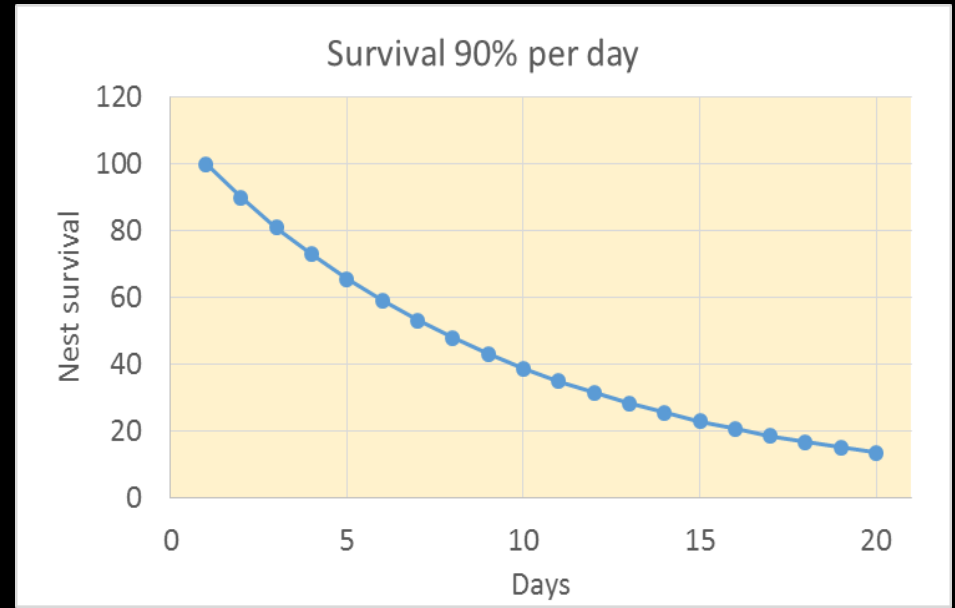


Exclusion of predators → increased herbivory in a trophic cascade



Exclusion of predators → invertebrate predators compensate

Predation of predators in tropical forests



Krystof Chmel
Luda Paul
Mark Mulau



Wanang Conservation
and
Baitabag Canopy Crane



HAUS SAIENS



Wanang community: Equator Prize for innovative conservation





