How much does a tropical forest elevational gradient contribute to biodiversity? Insights from the ant communities of Mt. Wilhelm

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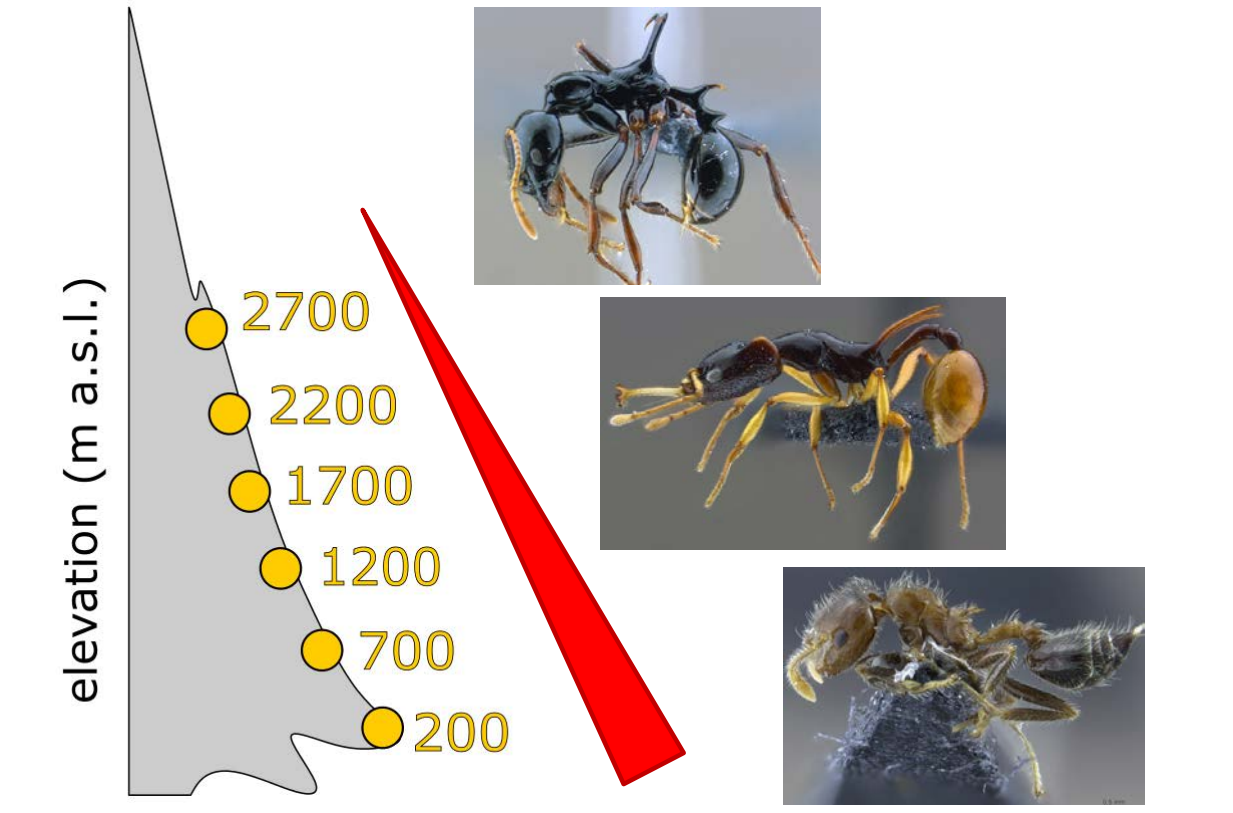

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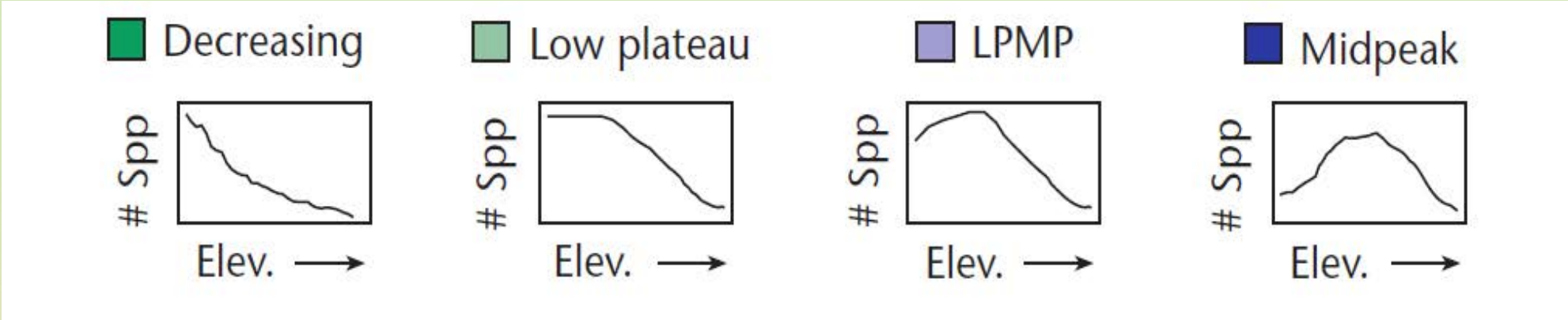
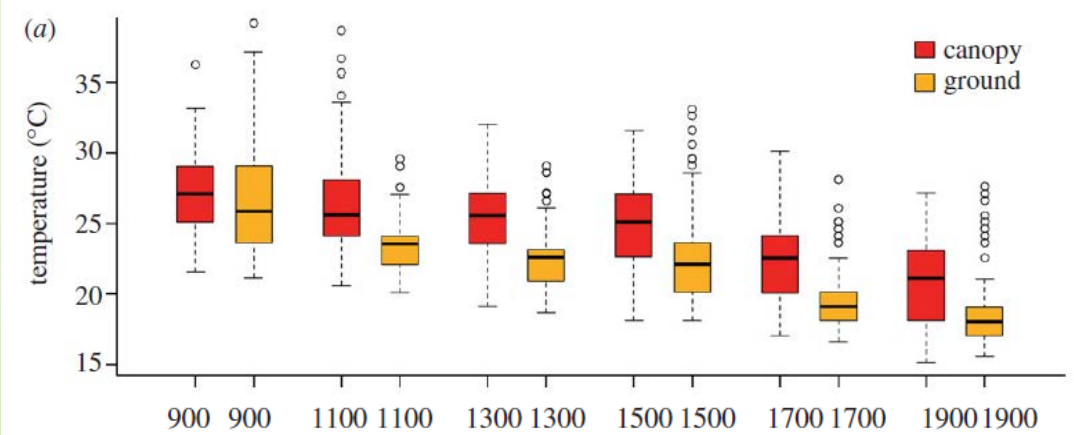
Changes of ants with elevation in the tropics

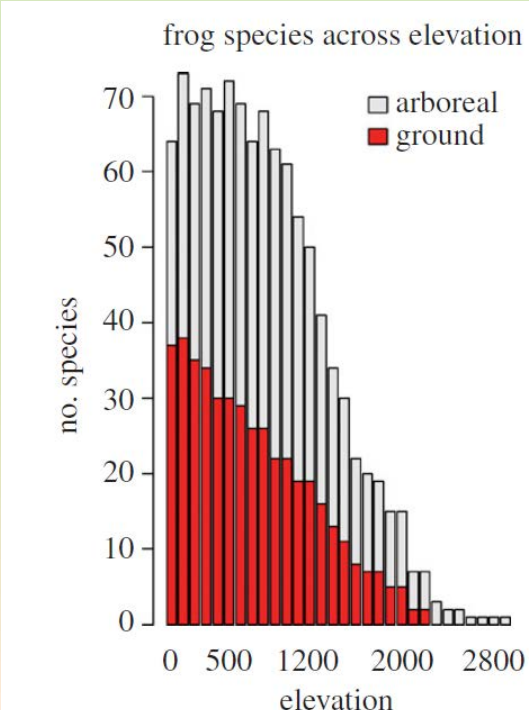
- **Ants** represent >20% of the arthropod biomass and play **a keystone role** in the rainforests
- as social insects are **sensitive to changes** of temperature (but wider range than e.g. termites)
- **Ants along mountain slopes** usually studied **on the ground level** only, and usually in not fully-forested habitats
- The communities living on **vegetation & trees** are understudied.



Various patterns observed (ants no exception)

Hunt JH 2003 Science

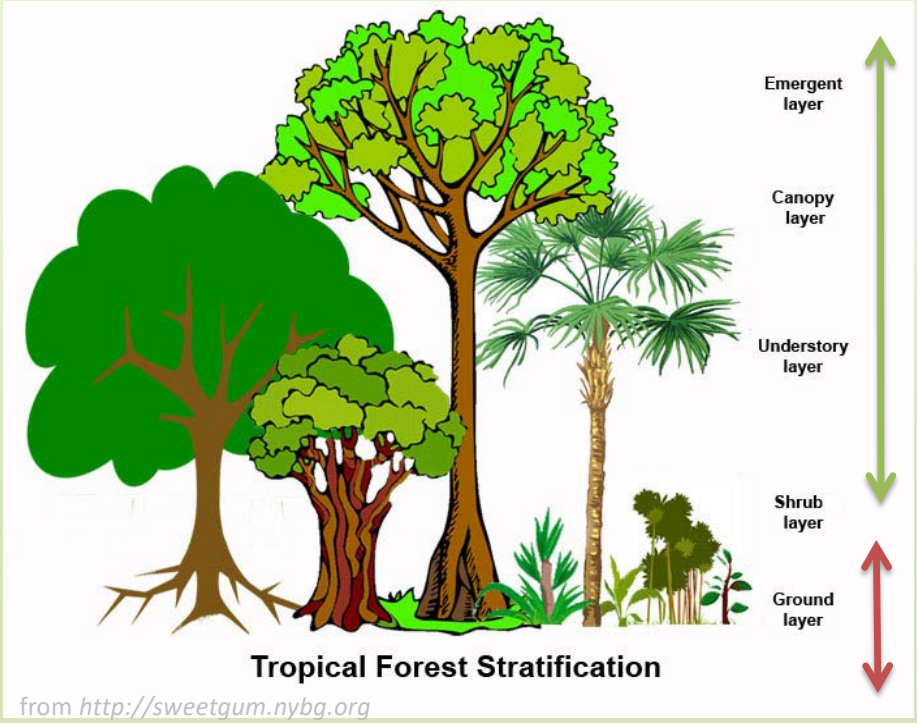




Arboreality hypothesis:

less steep decrease on vegetation with elevation as tree-dwelling species less limited by temperature

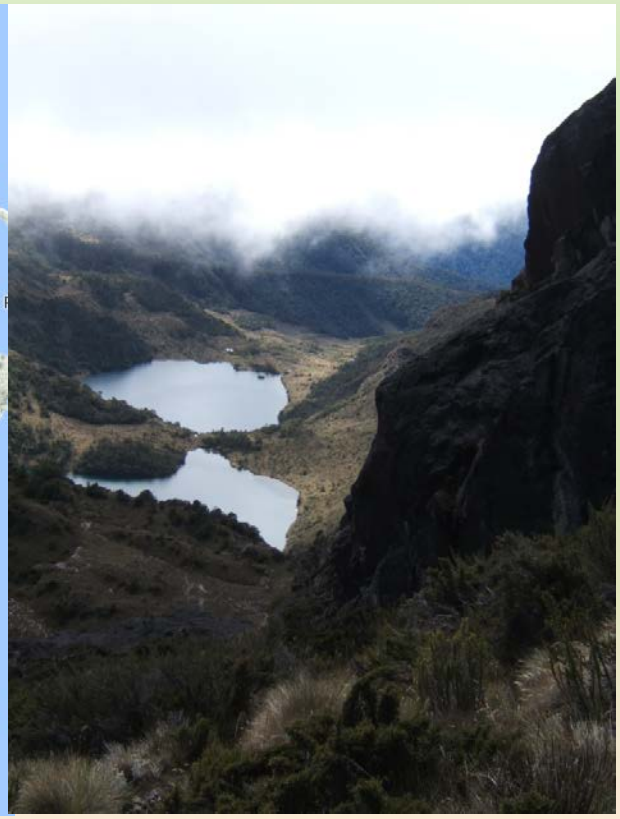
(Sheffers *et al.* 2013 *Proc. Royal Soc. B*)



from *http://sweetgum.nybg.org*

Complete altitudinal rainforest gradients

- **tropical mountain ranges:** a crucial role in the maintenance of global biodiversity
- not many natural systems available: the forests usually disturbed & modified by humans
- one of the few is **Mt. Wilhelm**, the highest peak of Papua New Guinea (4509 m)
- pristine forests from bottom up to 3700 m above sea level!

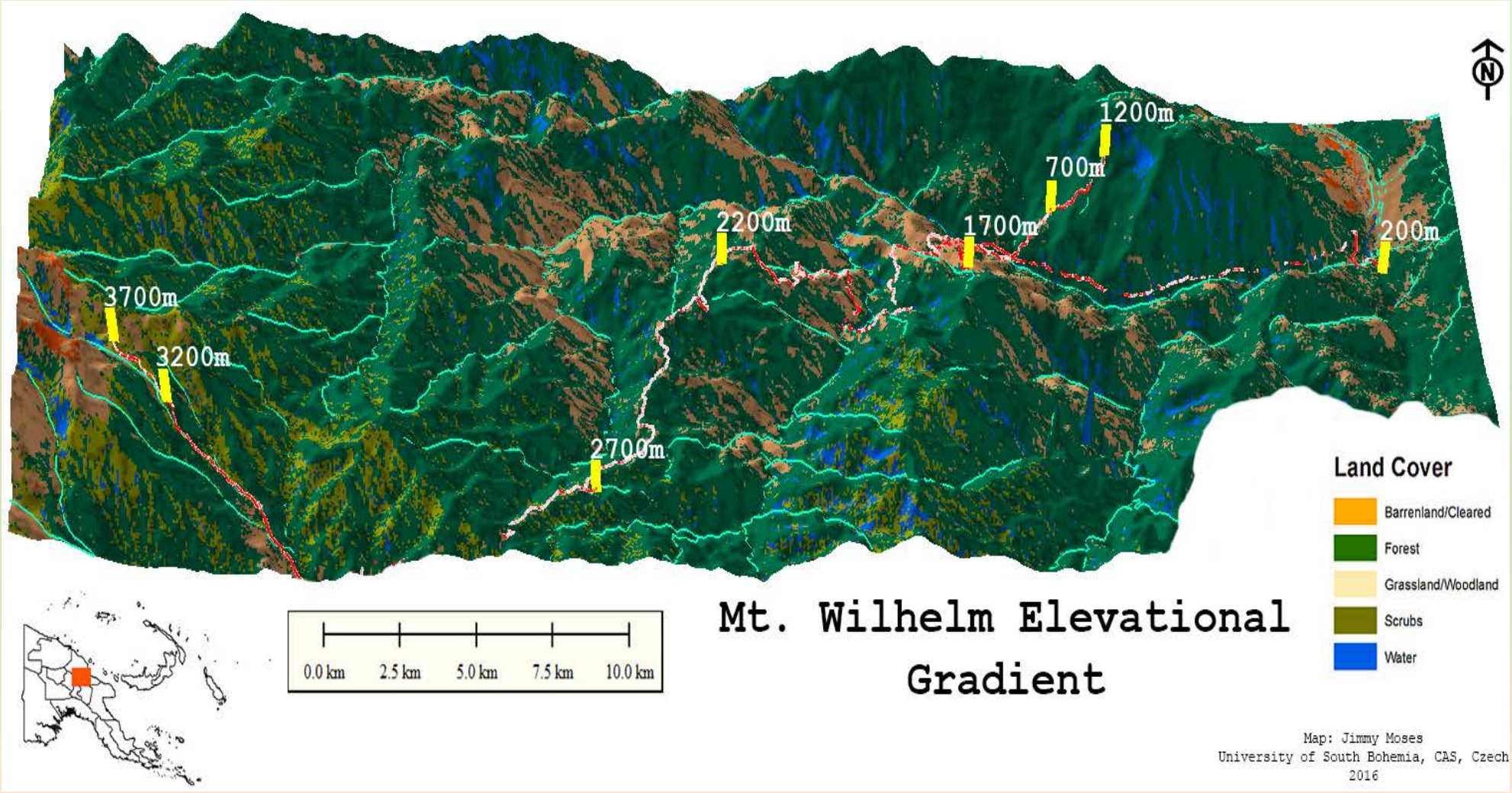


3700

200

Mt. Wilhelm natural rainforest gradient (200 m – 3700 m asl.)

8 studied main sites spaced by ~500 m elevational intervals



Sampling of ants from litter on the ground up to the canopies: equal effort per site

Ground stratum

4 complementary methods

pitfall traps (10 x per site)

hand-collecting (10 x per site)

bait removal (10 x per site)

feeding preference (60 tubes per site)

Vegetation

4 complementary methods

beating of vegetation (5 plots per site)

tuna-baits on trunks

(20 per site)

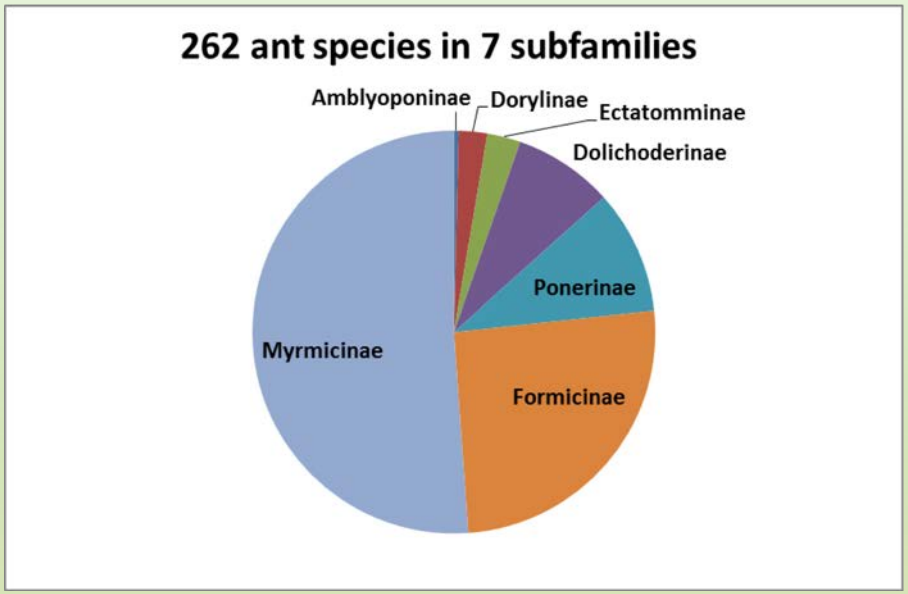
feeding preference (38 plants per site)

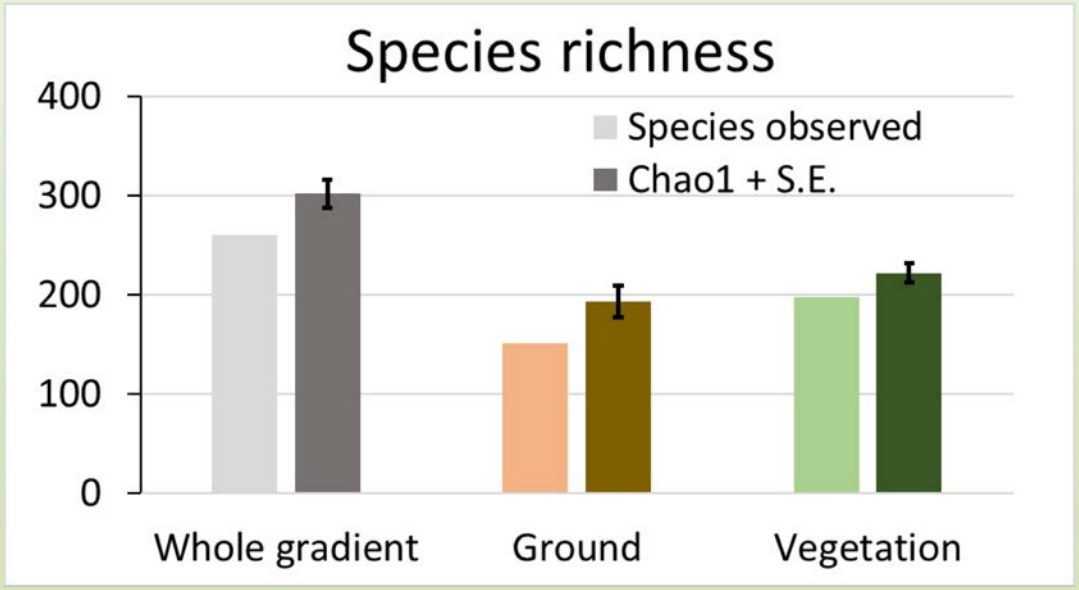
canopy (0.3 ha plot)

Questions:

- How many ant species live in the Mt. Wilhelm forests?
- How their diversity changes with elevation?
- Do sampling from the ground reflect the same pattern as sampling from the vegetation?
- How much does a tropical forest elevational gradient contribute to biodiversity?

Total ant species richness found at the Mt. Wilhelm:



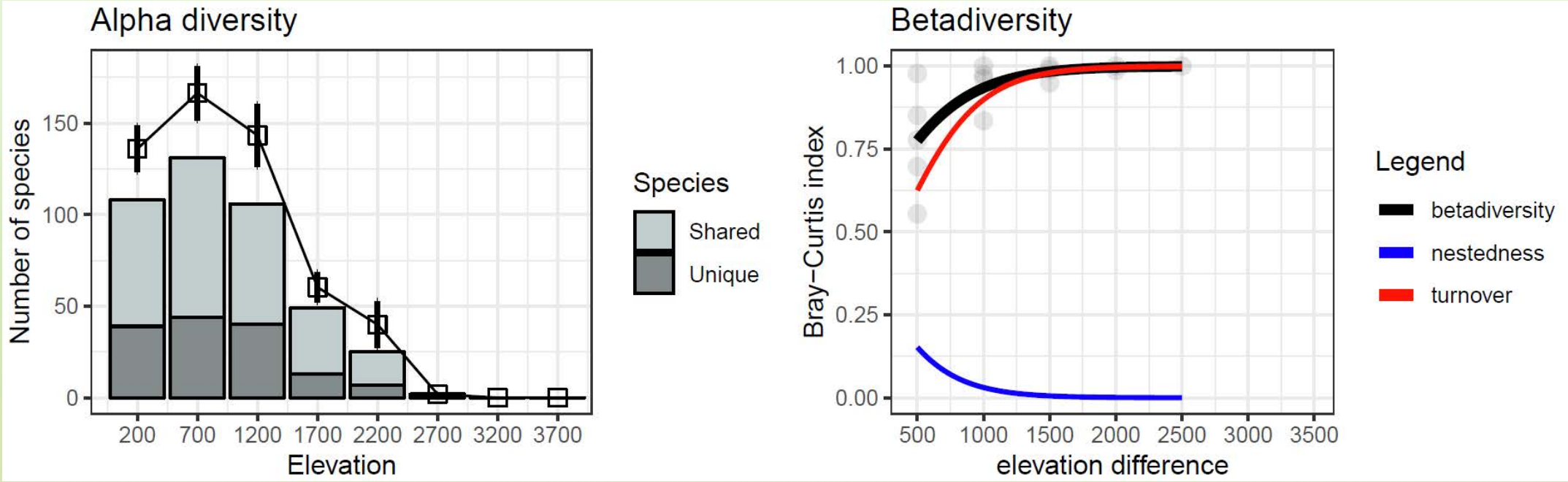


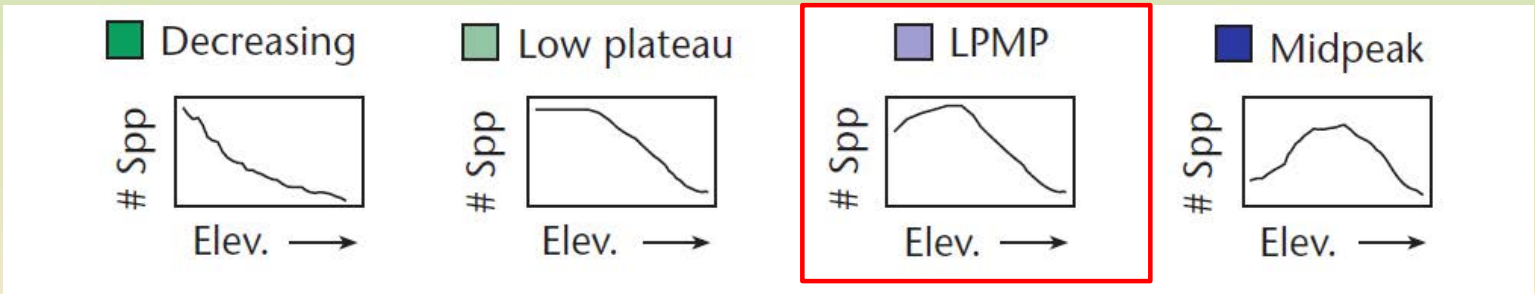
Camponotus wanangus
Klimes & McArthur

Echinopla undescr. sp. *nov.*

- Estimated over 300 ant species
- About half species probably not described

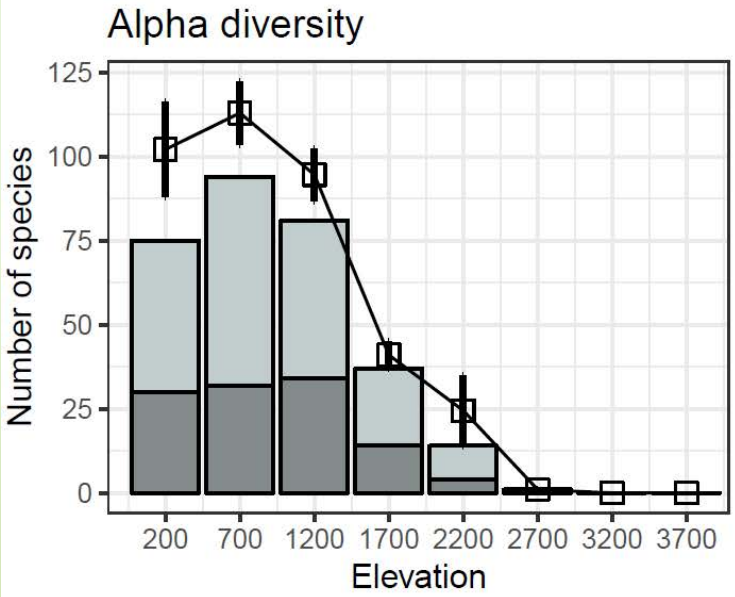
All ants: species alpha and beta diversity patterns

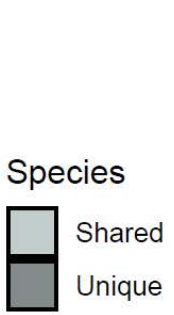


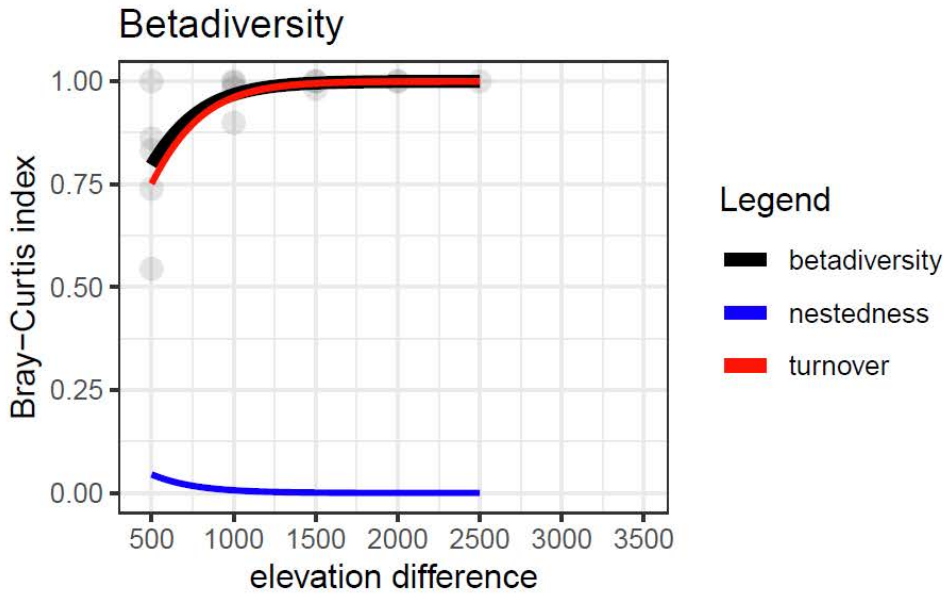


Low elevation plateau pattern with mid peak (LPMP) and about 1/3 of species is unique for each site

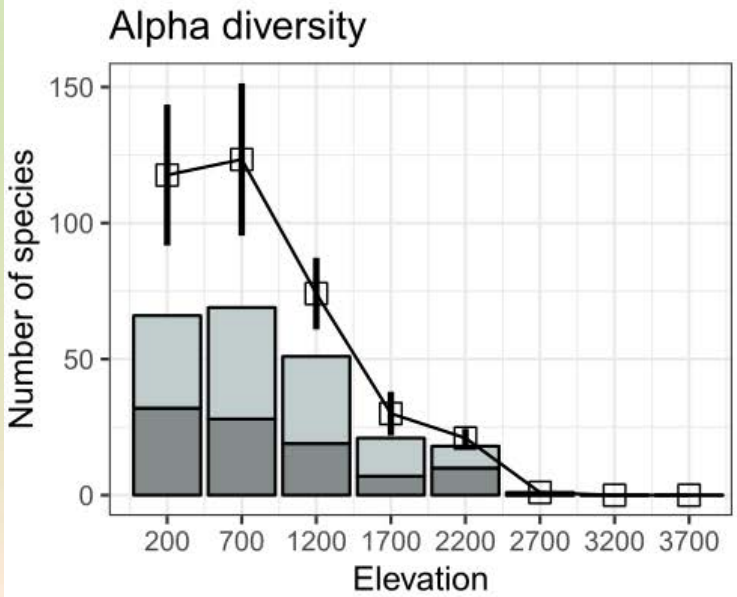
Vegetation

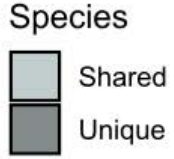


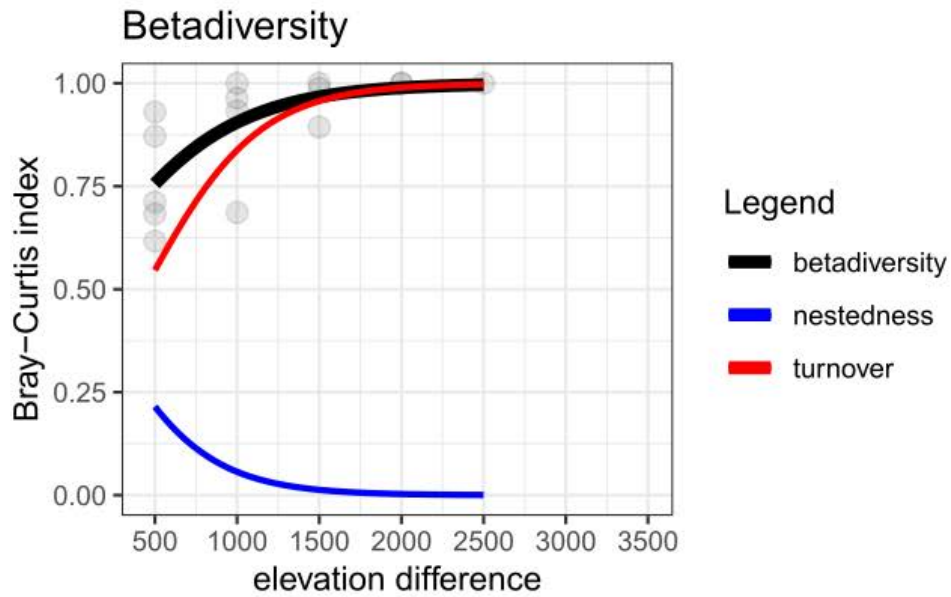




Ground

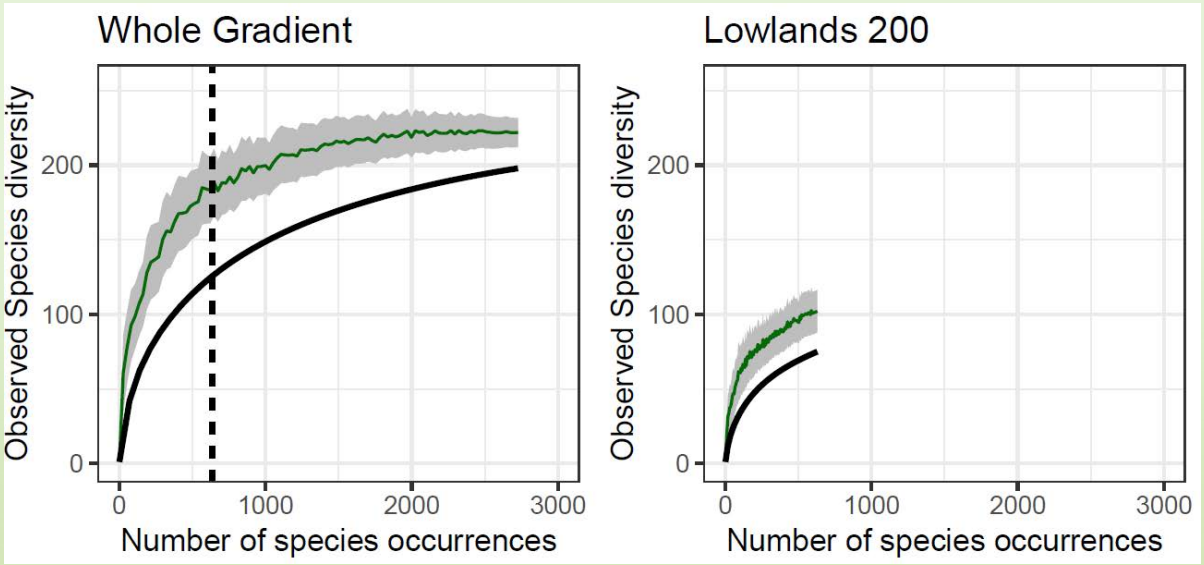


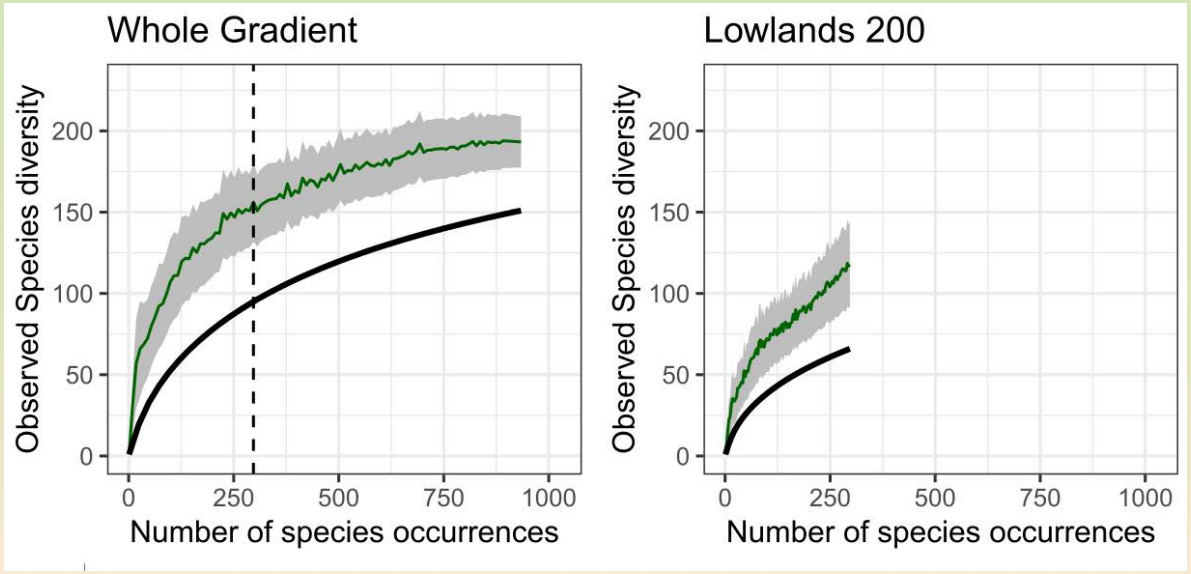




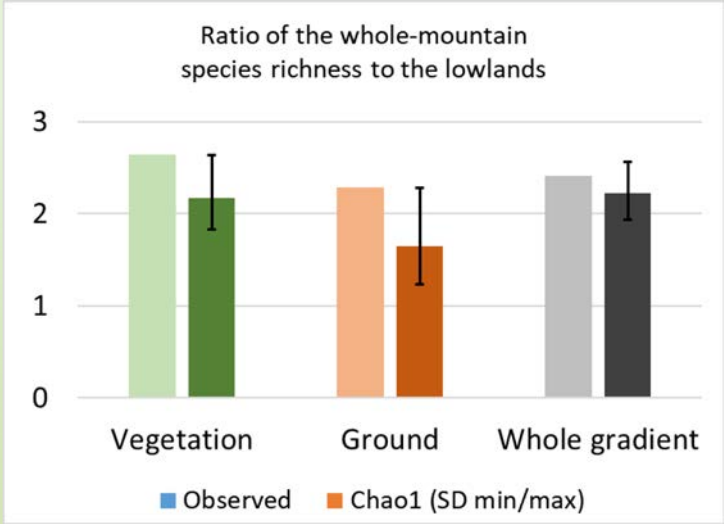
Vegetation

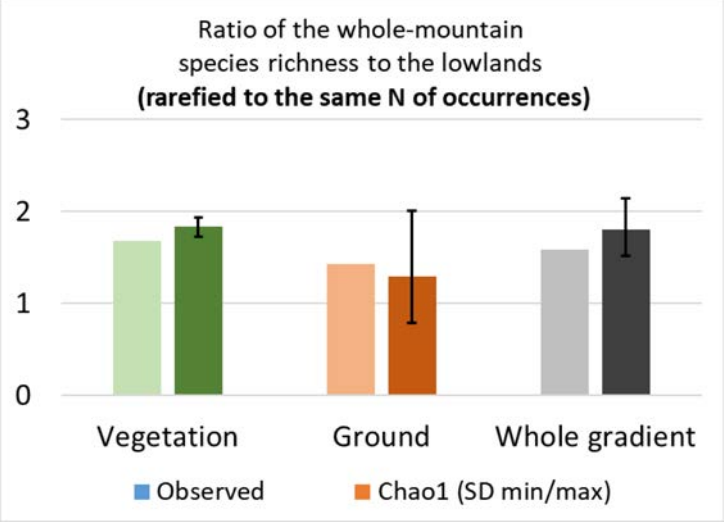
Ground





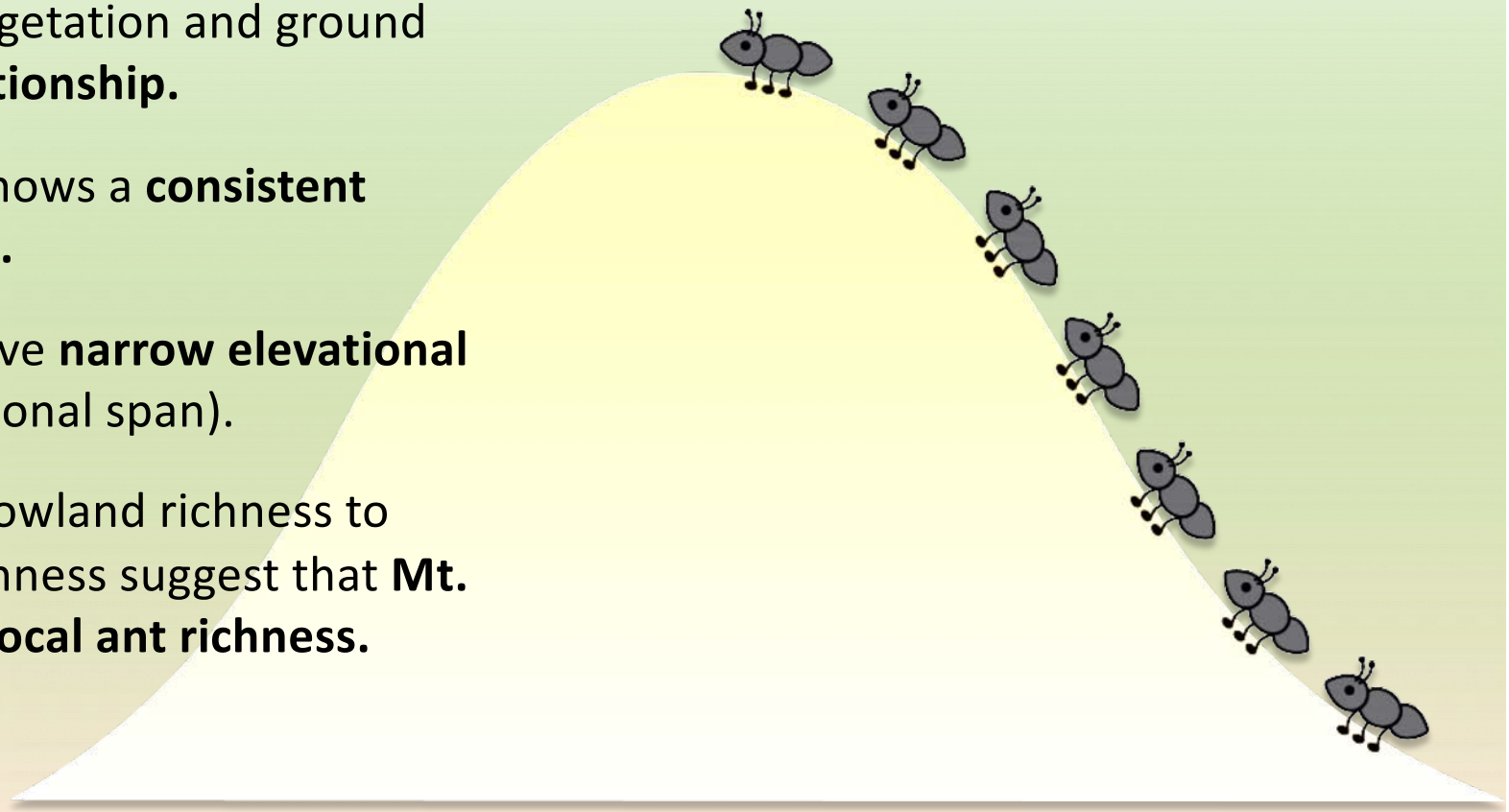
Mt. Wilhelm gradient doubles the local ant diversity:





Conclusions

- **Ant species diversity along a full rainforest elevational gradient** varies relatively consistently in both vegetation and ground strata, with **LPMP relationship.**
- Ant species diversity shows a **consistent mid-peak (~700 m asl).**
- Most of the species have **narrow elevational ranges** (~500 m elevational span).
- Rarefied ratios of the lowland richness to the whole gradient richness suggest that **Mt. Wilhelm doubles the local ant richness.**



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- all people who made possible to run ***Our Planet Reviewed Papua New Guinea expedition….***

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