

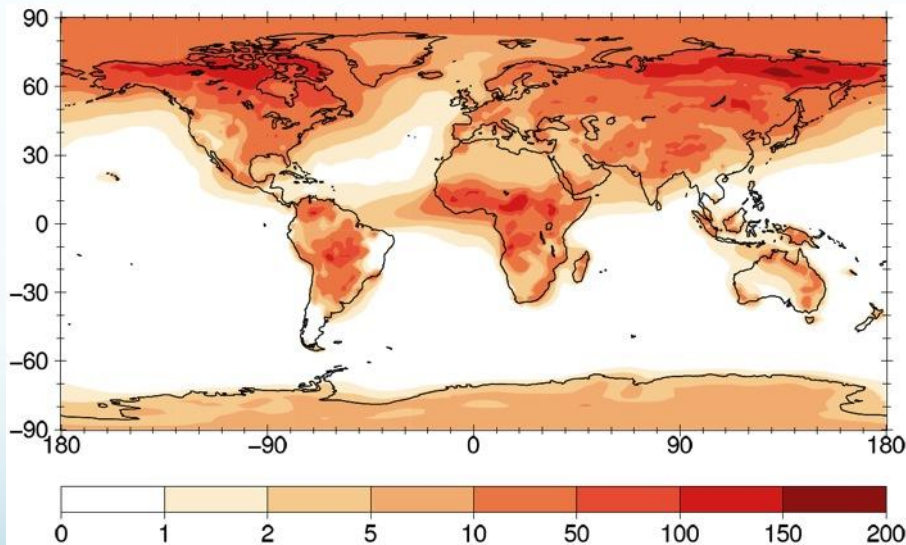
Airborne Microbes A-Team



PASI-PIRE 2011

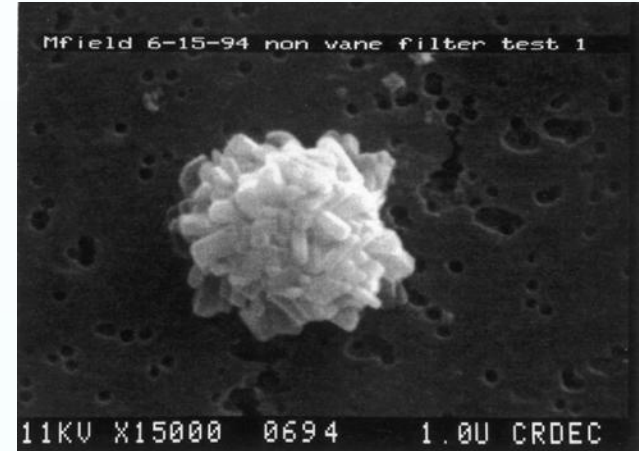
Microbes are ubiquitous in the atmosphere

- Lofted on small particles, bioaerosols



Burrows *et al.* 2009

Simulated concentrations of near-surface bacteria ($\times 10^3/\text{m}^3$)

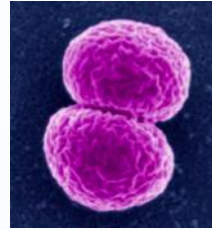


Lighthart 1997

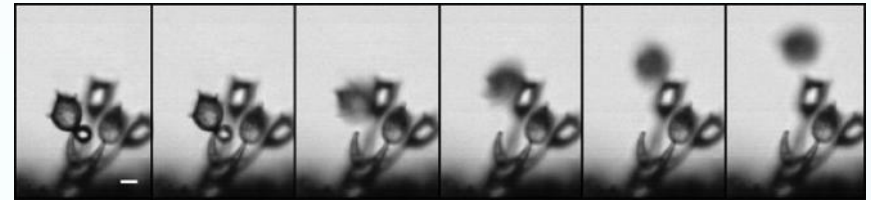
- $10^3 - 10^6$ microbial cells per m^3 air

Microbes in the atmosphere are important

- Human health and agriculture



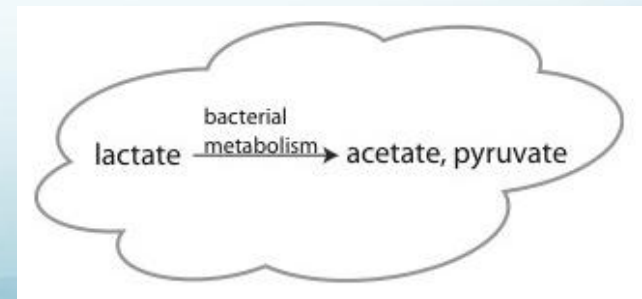
- Dispersal of terrestrial and aquatic organisms



- Meteorology?



- Atmospheric chemistry?



Specific questions

1. Total airborne microbial communities
 - Do airborne microbial communities in the forest canopy vary in space and time?
 - How similar are airborne and leaf-associated microbial communities?
2. Leaf-associated microbial communities
3. Active and culturable microbial communities
 - What is the active aerial microbe community comprised of (“species” richness)?
 - What are the temporal patterns of aerial microbial activity and do they differ in the understory and in the canopy?
 - Is there vertical structure to aerial microbe community composition?
 - How do temperature and relative humidity affect colony growth rates?
 - How does air turbulence influence microbe dispersal?

Methods

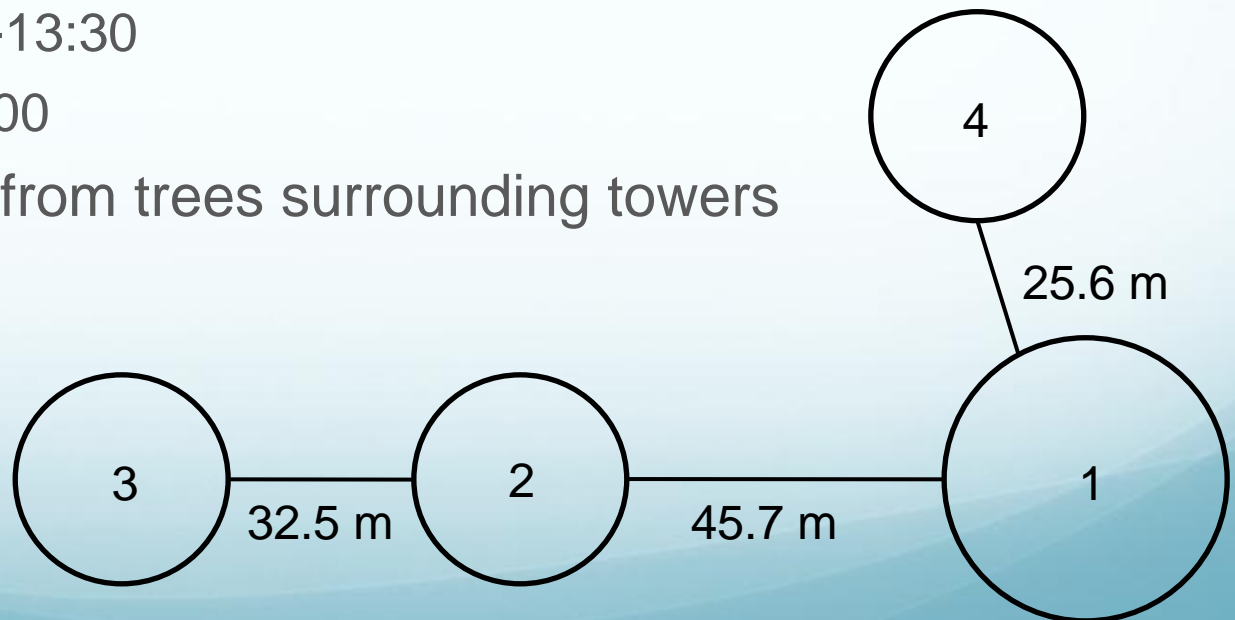
Total airborne communities



Methods

Total airborne communities

- Wayqecha sampling
 - 4 canopy towers
 - 3 times points per day over 4 days
 - AM – 6:00-8:00
 - Midday – 11:30-13:30
 - PM – 16:00-18:00
 - Sampled leaves from trees surrounding towers



Methods

Total airborne communities

- Tambopata sampling
 - 2 river sites
 - 2 forest sites
 - 2 time points per day over 3 days
 - Day (11:00-15:00)
 - Night (1:30-5:30)
 - Collected leaves from 5 plants surrounding samplers



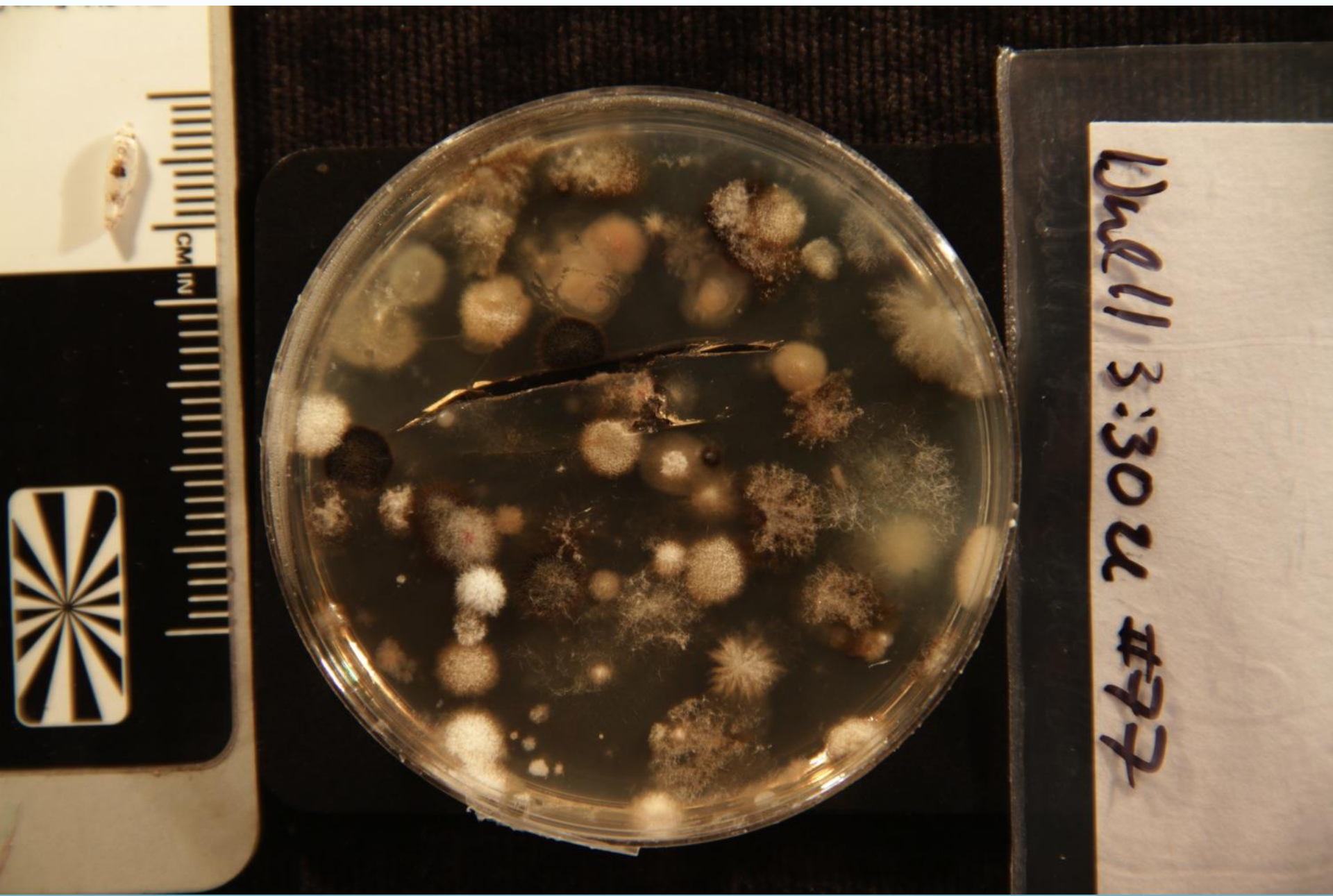
Methods

Active and culturable communities

- Similar exp. design as filters
- Malt extract growth media
 - promotes rapid growth
 - “non-selective”
- Sampling schemes:
 - pre-dawn, mid-day, dusk
 - ground, mid-canopy, canopy
- 30 min exposure
- Measure colony growth and morphology

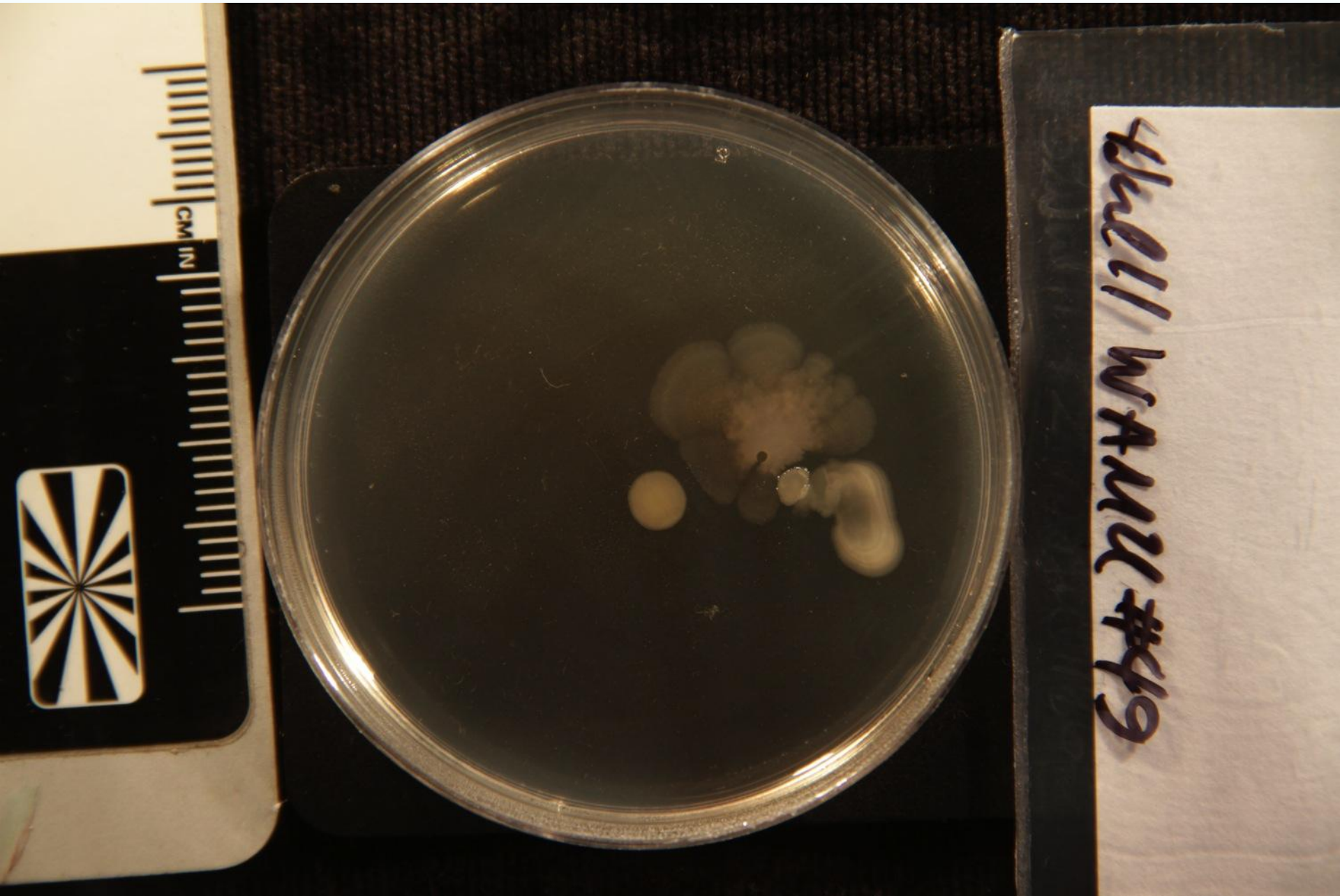


Some plates look like this



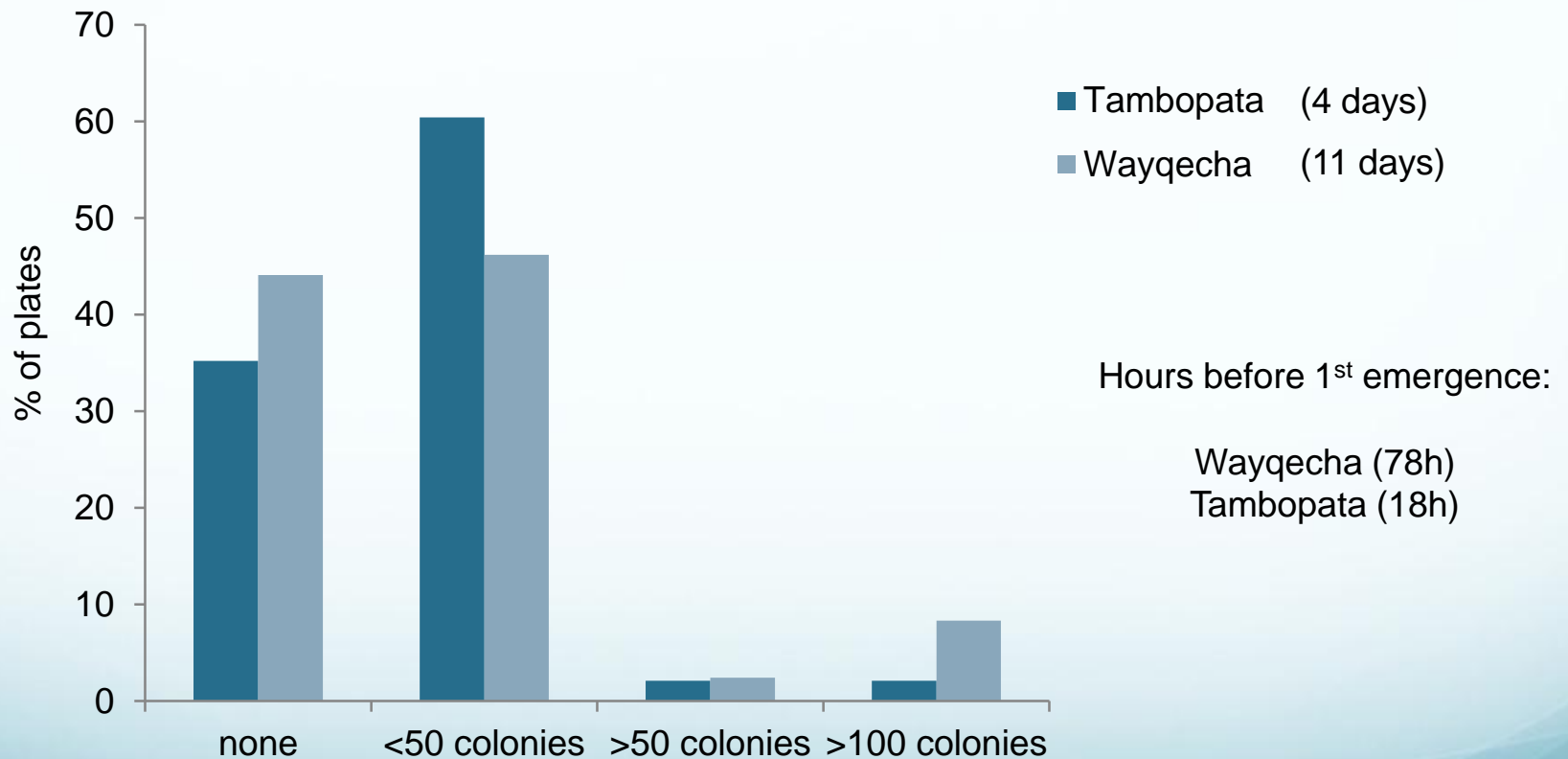
Dwell 3:30 & #77

Other plates look like this



Results

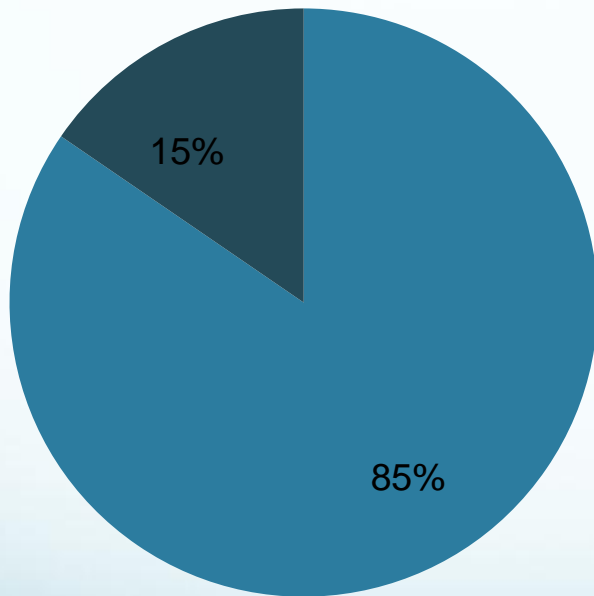
Colony emergence



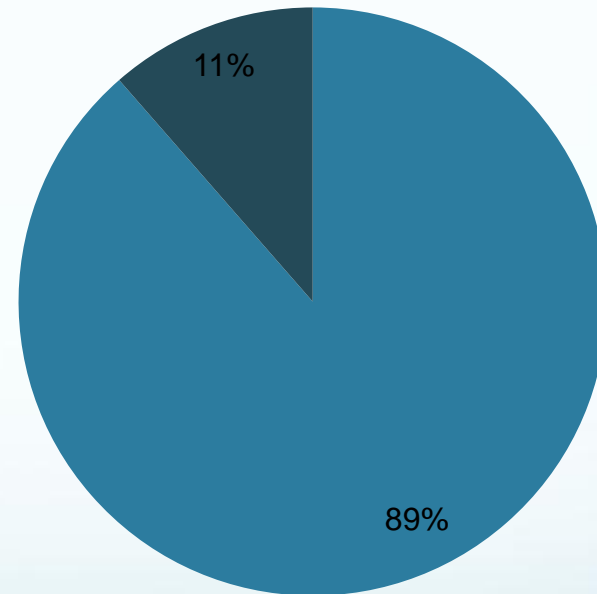
Results

similar bacteria & fungi relative abundance

Wayqecha



Tambopata



■ Bacteria
■ Fungi

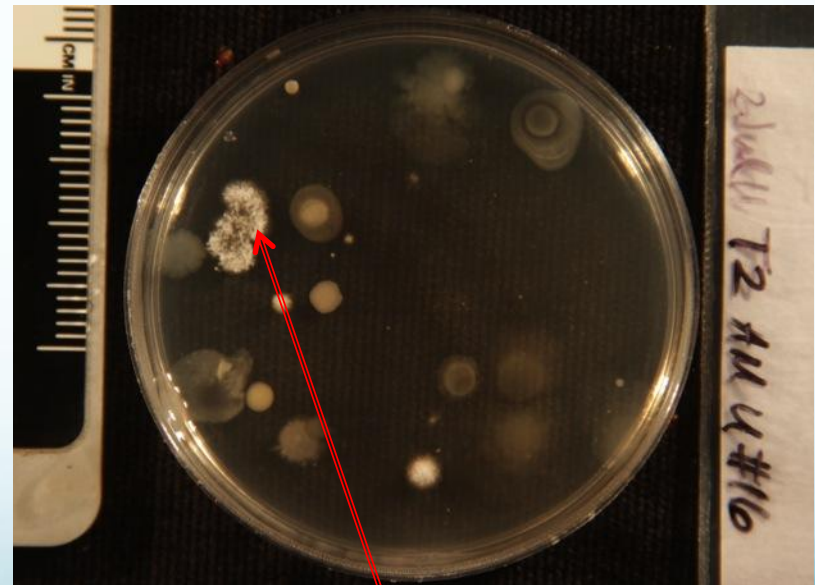
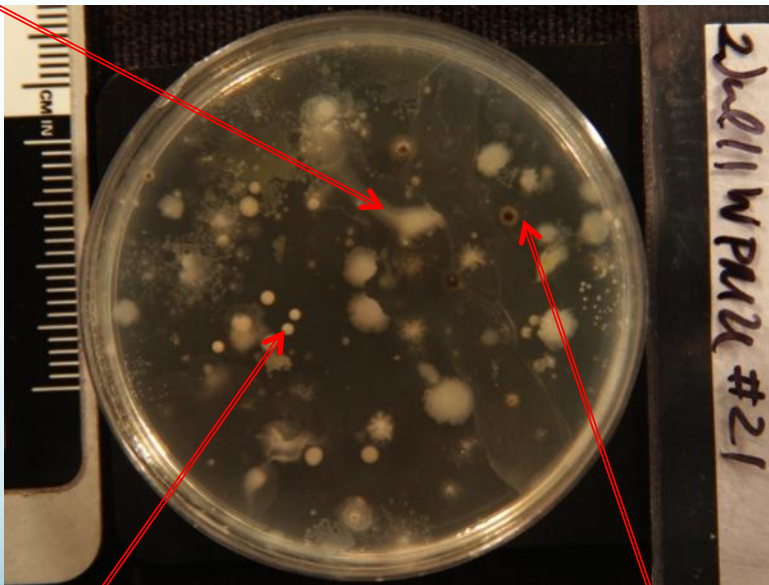
■ Bacteria
■ Fungi

Results

Colony type richness

- What is the active aerial microbe community comprised of (“species” richness) and is there an elevational gradient?

snot



small white

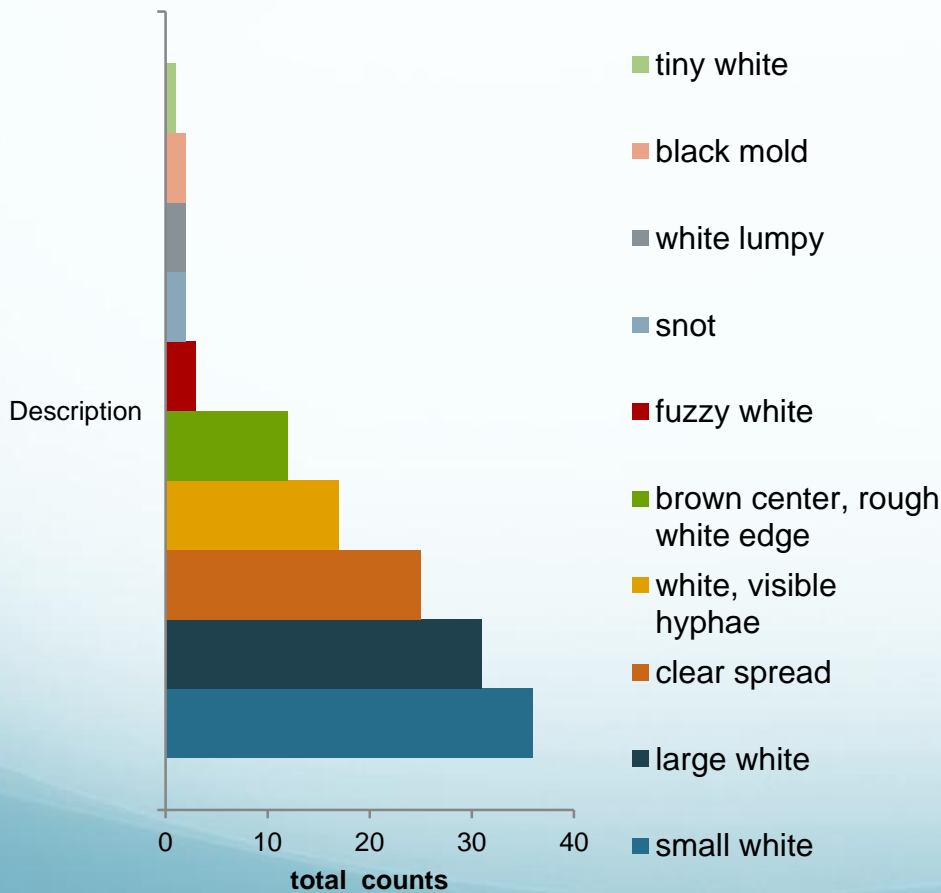
brown dot

white hyphae

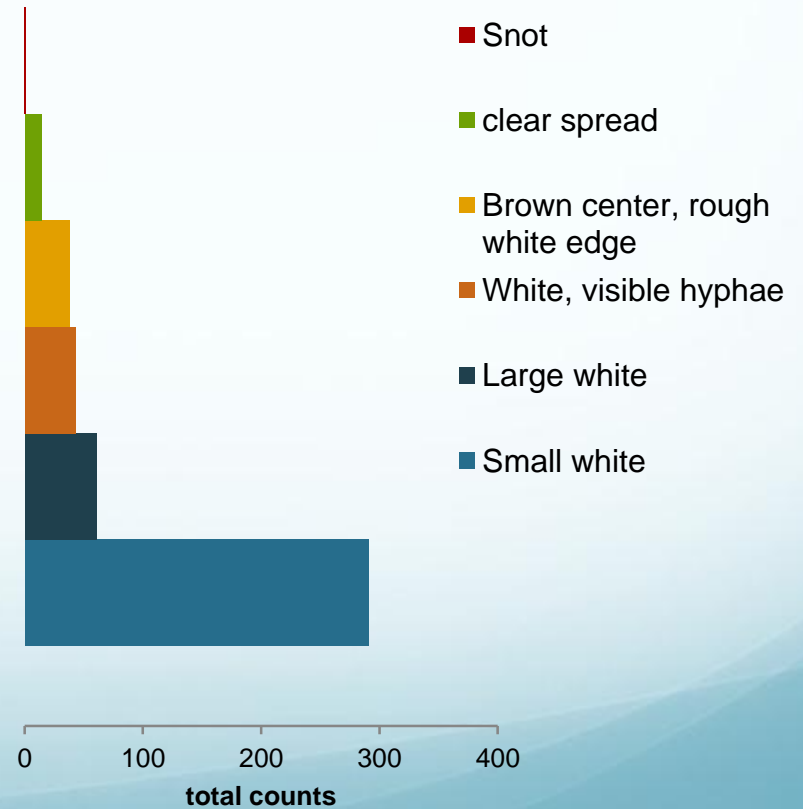
Results

Colony type richness

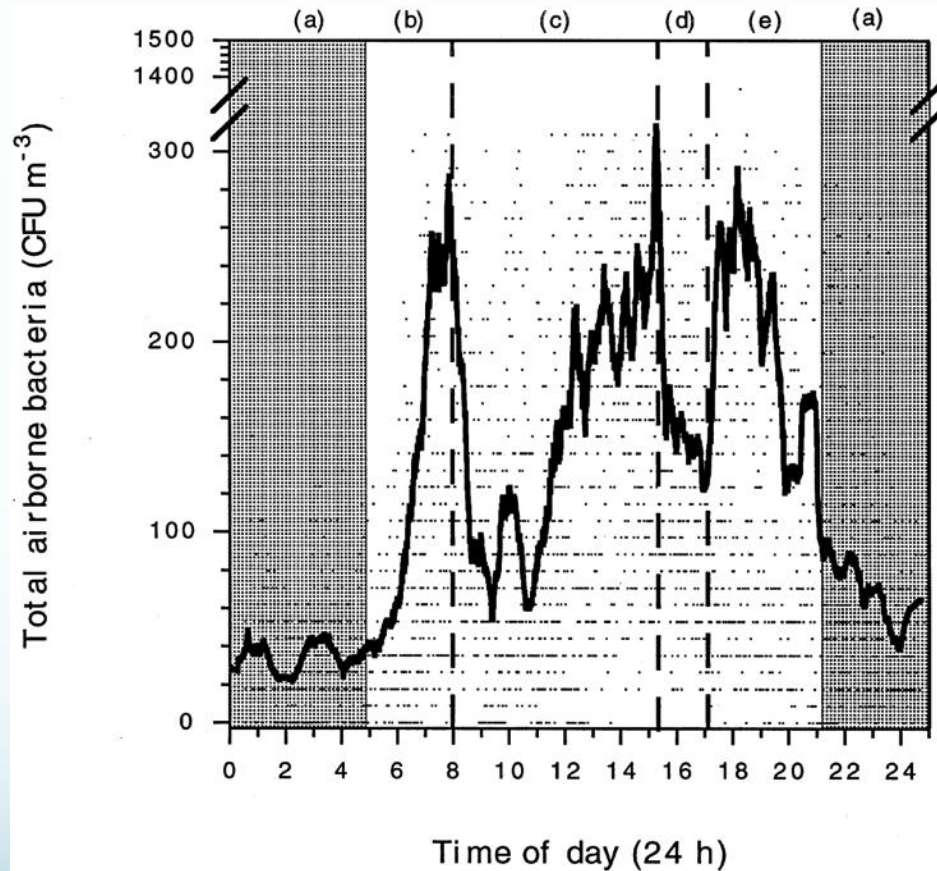
Wayqecha



Tambopata



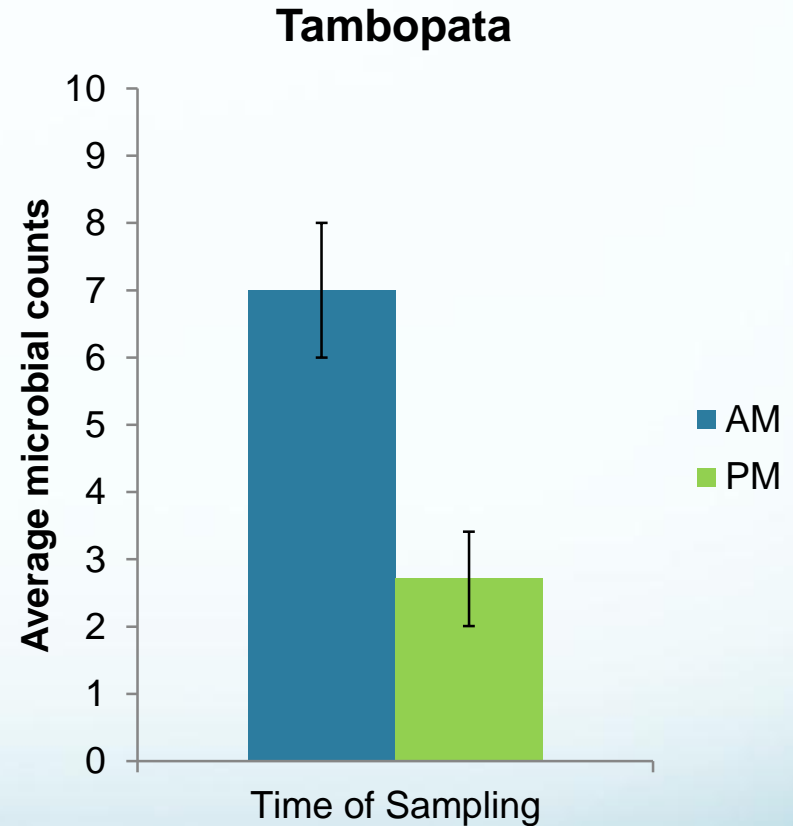
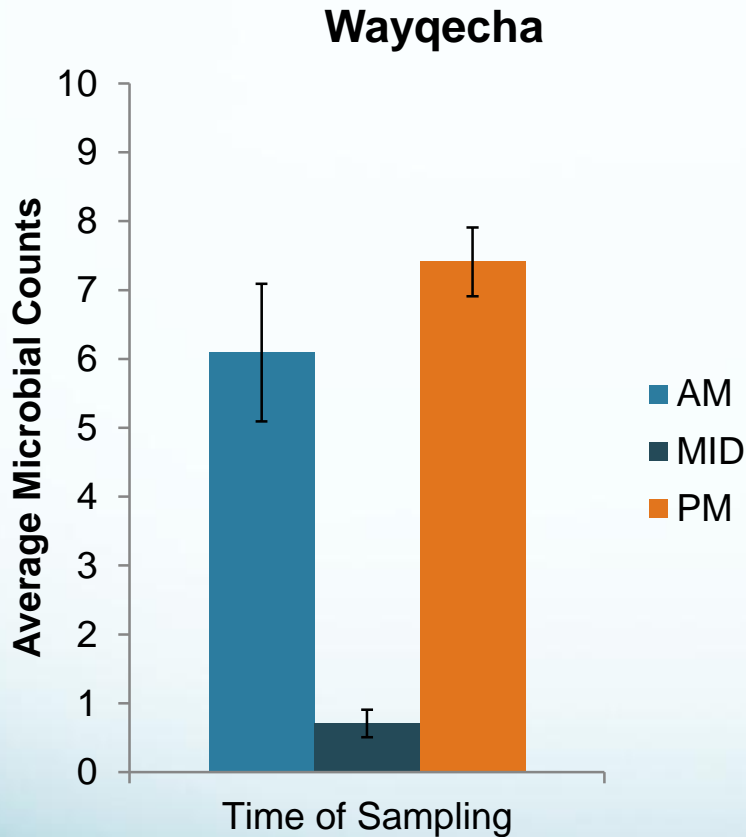
Temporal distribution of atmospheric bacteria



Lighthart/FEMS Microbial Ecology 23 (1997)

Results

Temporal patterns



- pre-dawn and dusk more similar than mid-day

- pre-dawn and dusk not similar

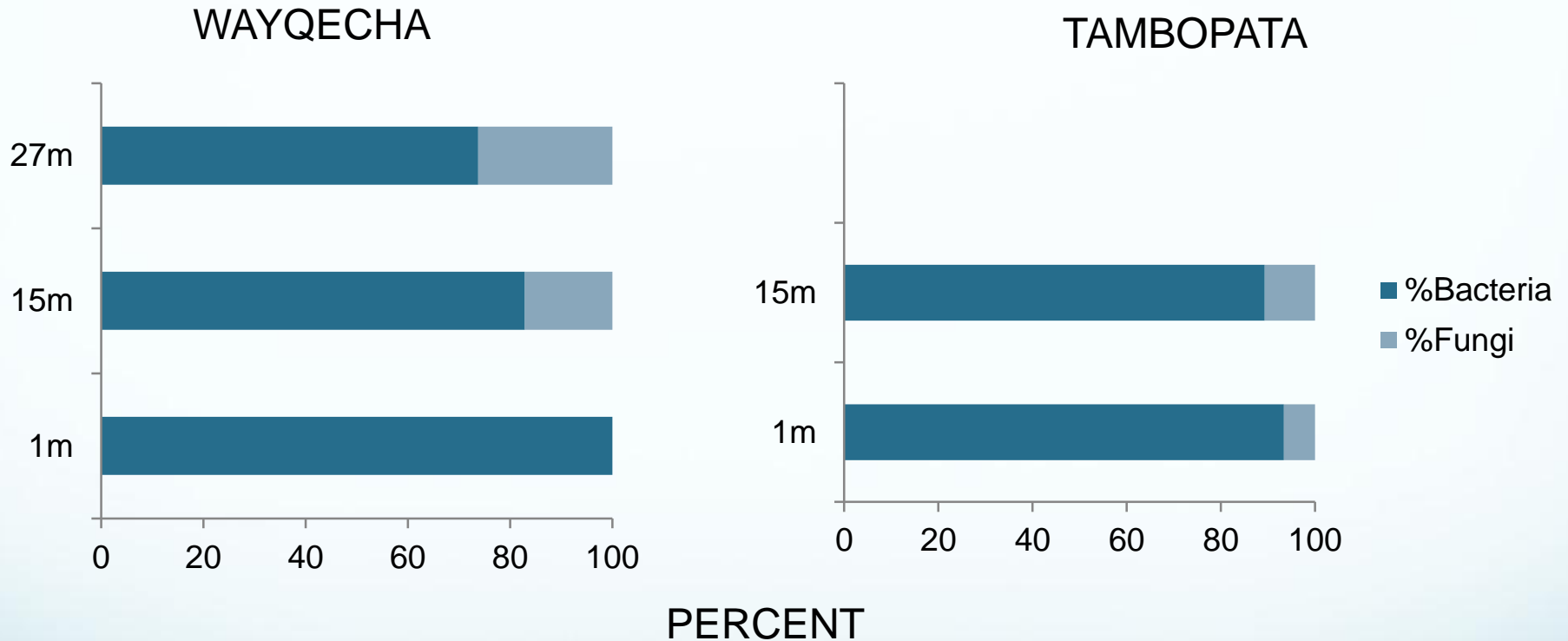
Differences:

- plant species richness & composition
- vertical structure
- temp & relative humidity
- Air turbulence?



Results

Vertical structure



- bacteria more abundant (faster growers)
- no fungi at ground layer (Wayqecha)

Results

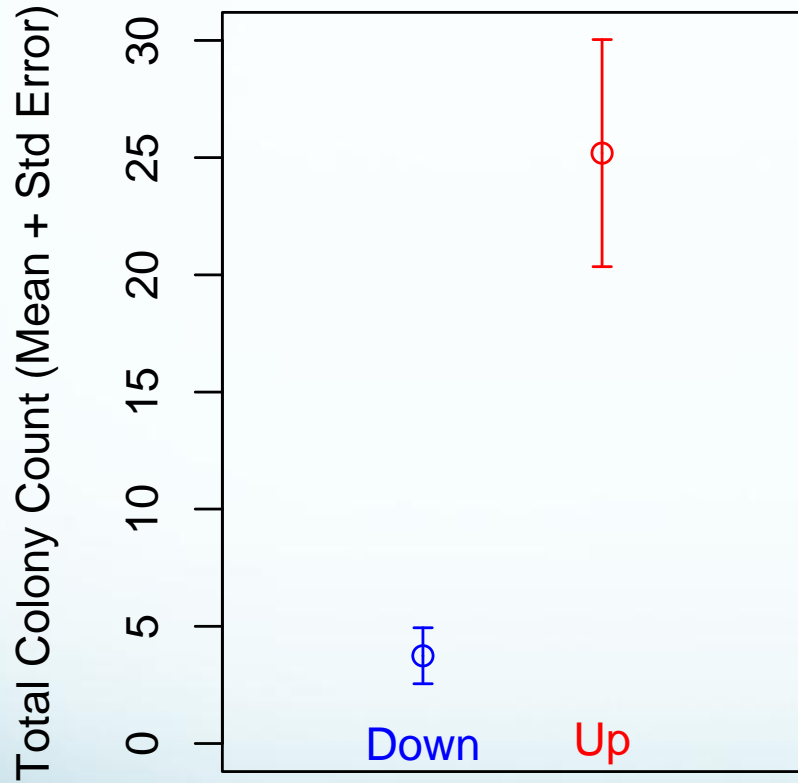
Dispersal patterns

- How does air turbulence influence microbe dispersal?

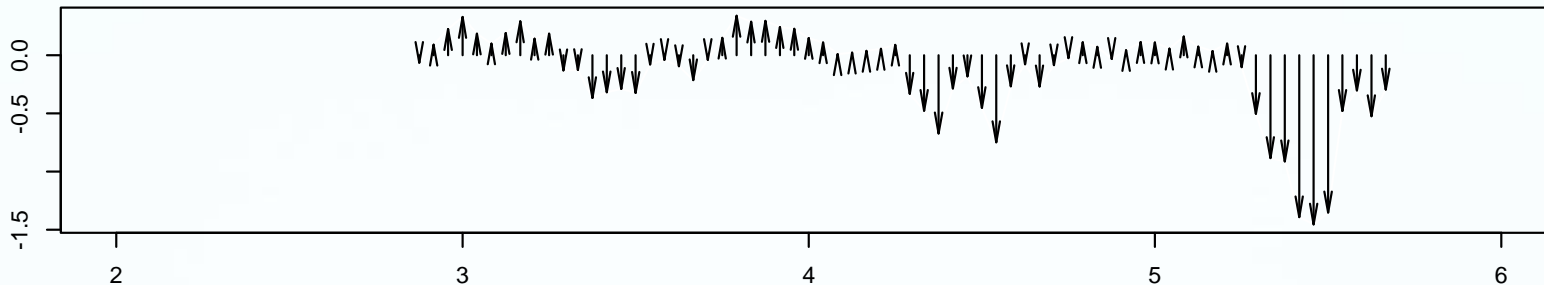


Results

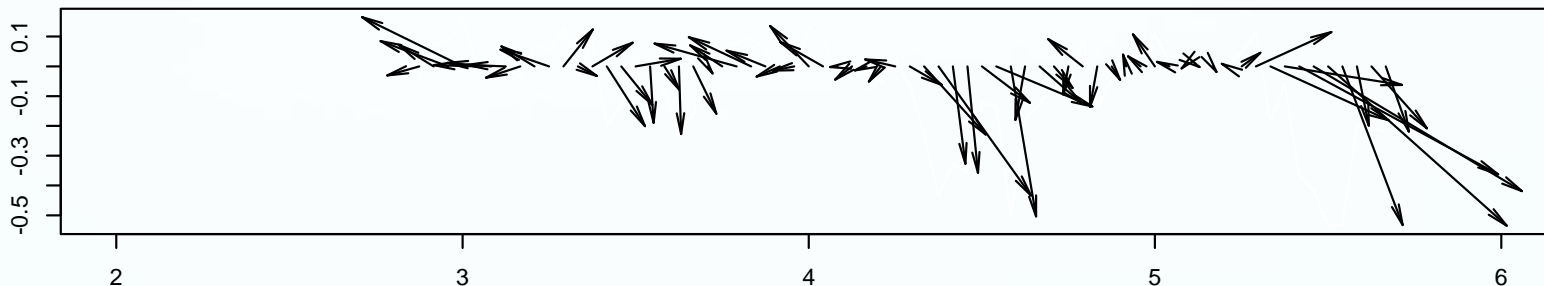
Dispersal patterns



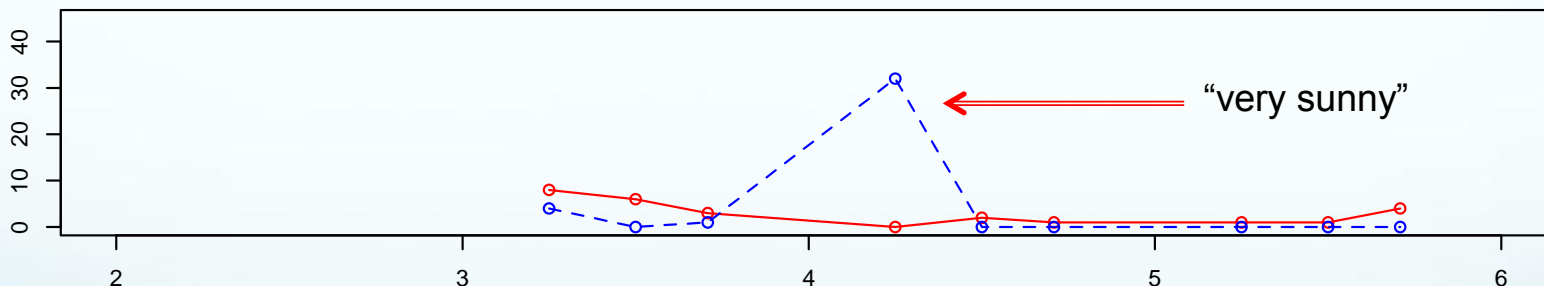
Vertical Wind Dimension (Uz_Avg)



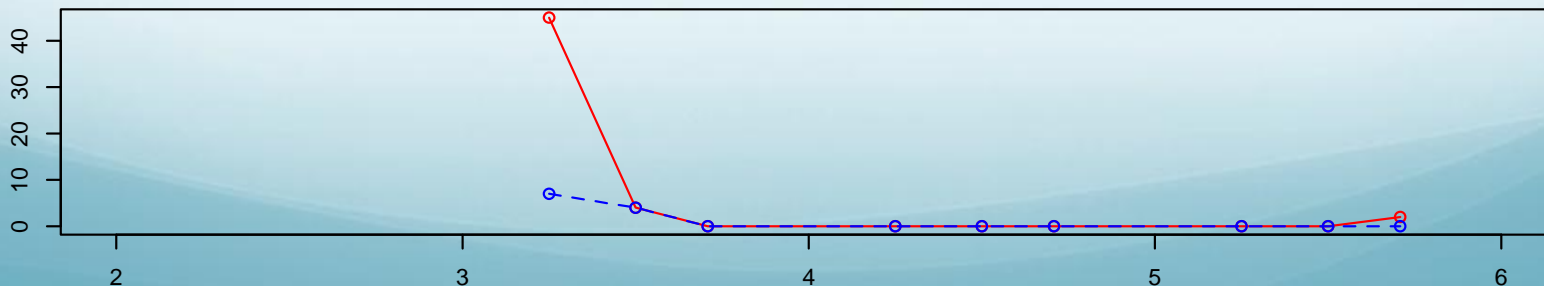
Horizontal Wind Dimension (Ux_Avg vs Uy_Avg)



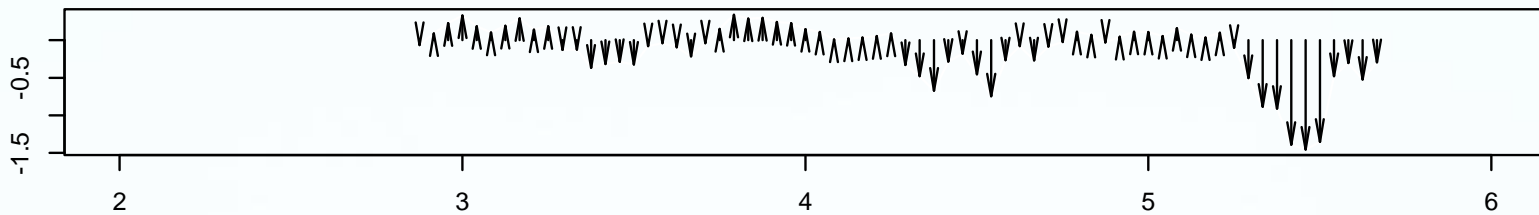
Cabin 2B (weather station)



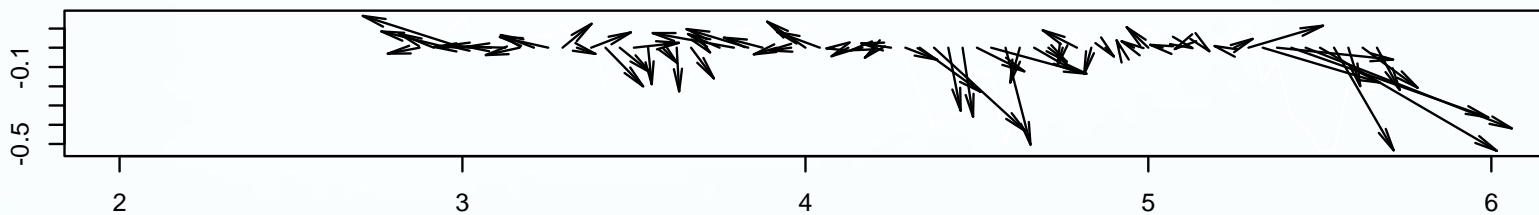
Forest near camp



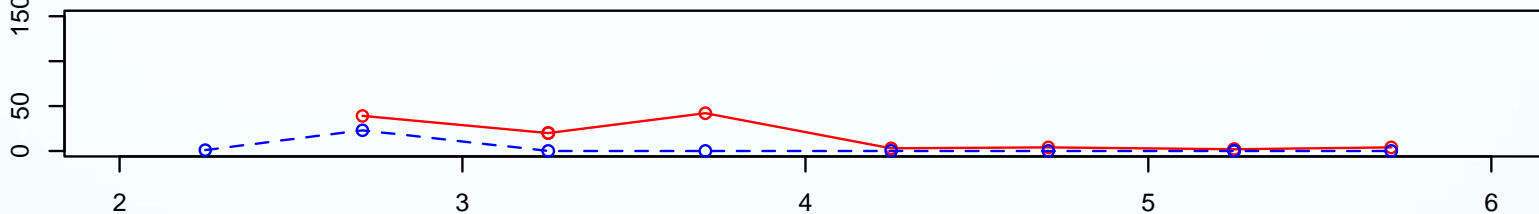
Vertical Wind Dimension (Uz_Avg)



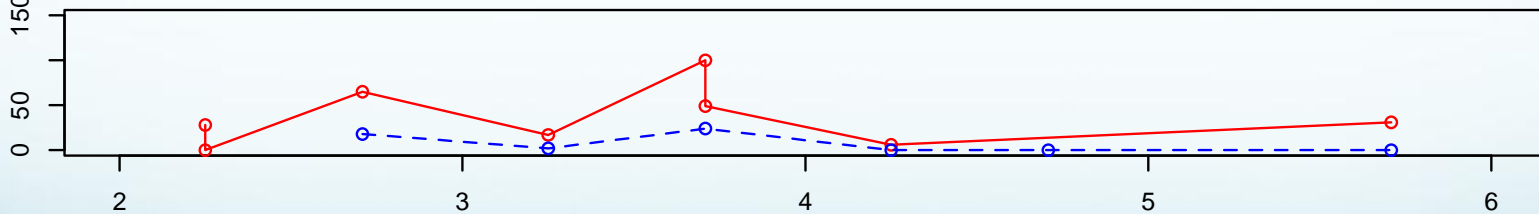
Horizontal Wind Dimension (Ux_Avg vs Uy_Avg)



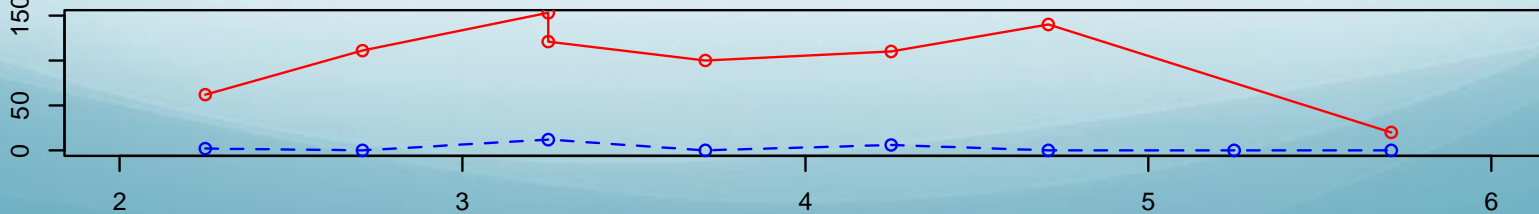
Canopy Tower



Canopy Walkway

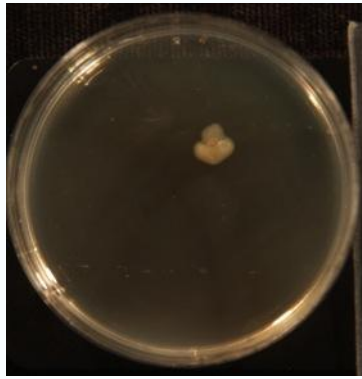
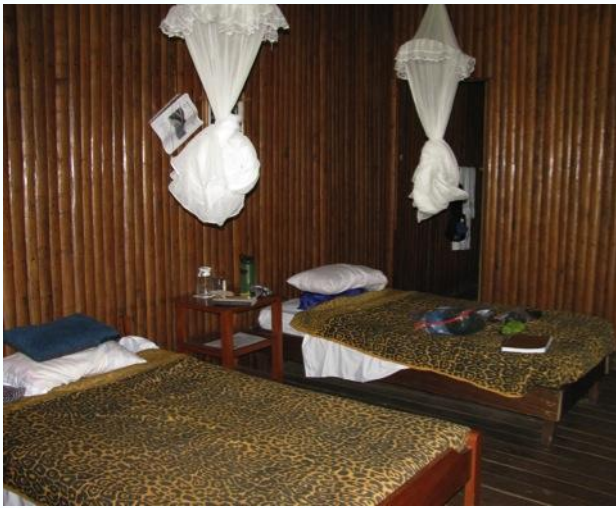


Canopy Litter

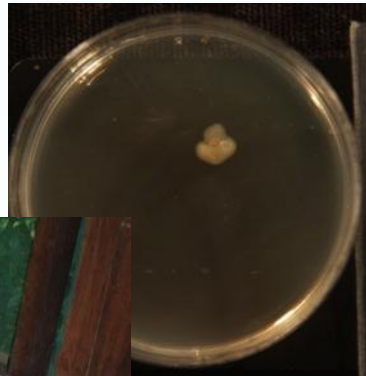


Summary

- Similar relative abundances of airborne bacteria and fungi in montane and lowland forests
- Higher temperature & relative humidity result in faster colony emergence, (but Wayqecha colonies are self limited in terms of growth?)
- Nocturnal/diurnal patterns different in Wayqecha and Tambopata
- No fungal cultures from understory in Wayqecha
- Things fall down



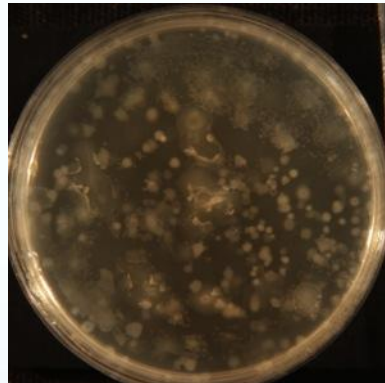
Girl's room



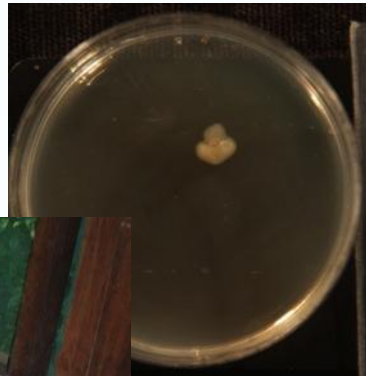
Girl's room



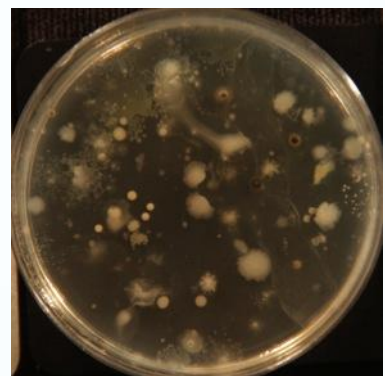
bathroom



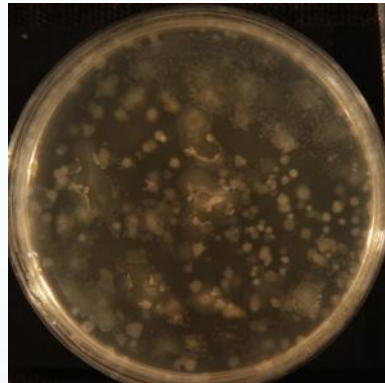
Boy's room



Girl's room



bathroom



Boy's room



Dan's socks

