Unknowns of the permafrost microbiome

What part do pathogens play? What part will they play in the future?

Jessica Ernakovich and the International Permafrost Microbiome Network

University of New Hampshire

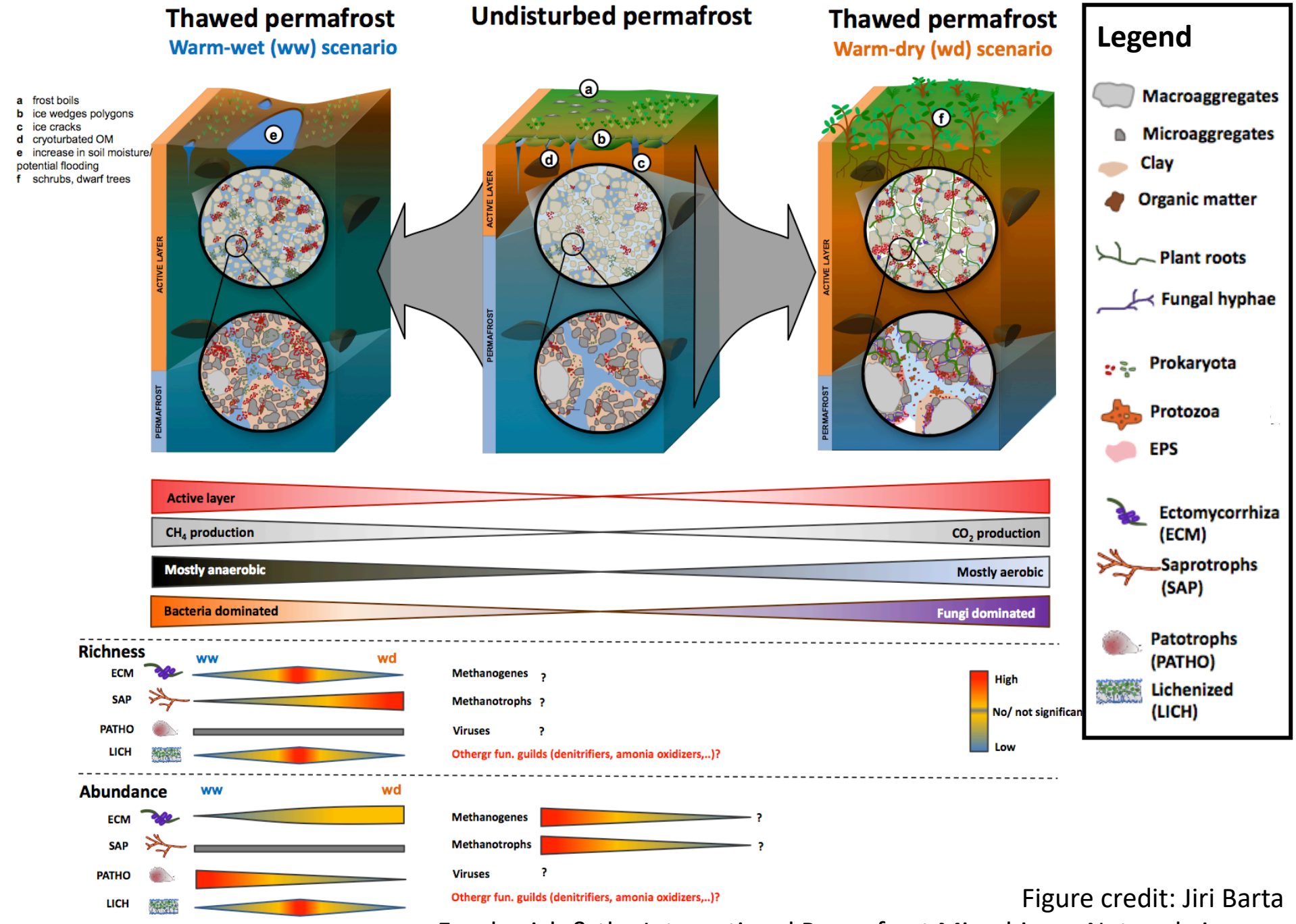


Figure credit: Jiri Barta

Ernakovich & the International Permafrost Microbiome Network, in prep

The permafrost microbiome: what do we know?

1. Active layer and permafrost communities are not the same

2. Diversity declines with depth (for bacteria and fungi; increases for archaea)

3. Microbes live in brine channels in frozen permafrost

4. Microbes selected for long-term survival in harsh conditions (Mackelprang et al., 2017; Bottos et al., 2018)

5. When permafrost thaws, community composition shifts
   - Can we predict how?

Ernakovich et al. 2017

The *thawed* permafrost microbiome: what *don't* we know?

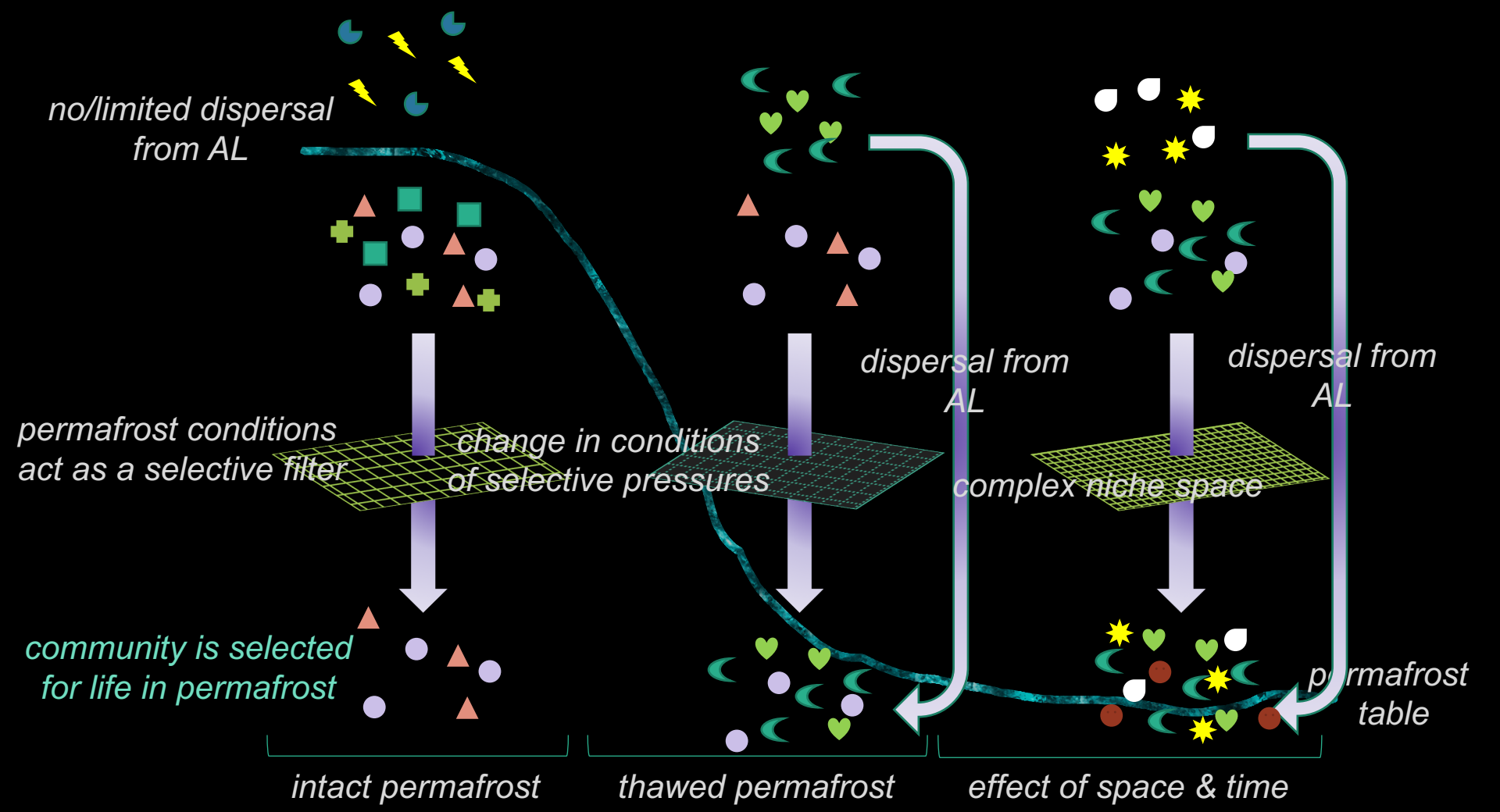
1. What proportion of the permafrost microbes survive the thaw? Is there a biological mechanism? Physical? Random?

2. Given that permafrost microbes are selected for survival, can they compete with newly dispersed active layer microbes?
   - New temperature x substrate x redox niches?

3. Do increasing biotic interactions affect community composition?

4. How do these play out over space and time?

Why does community assembly matter in thawed permafrost?



Adapted from Graham and Stegen, 2017

Using community theory to inform permafrost pathogen abundance

Assuming plant, animal, and human pathogens are in permafrost soil…

- Are pathogens in permafrost active or dormant?
  - This might tell us something about their ability to survive/thrive after permafrost thaw
- Will they be able to thrive and grow to required population size (to be effective pathogen)?
  - New temperature x moisture x substrate niches open
- Will pathogen populations be kept in check by effect of community?
- Or will low biomass & diversity of other community members immediately following allow them to get a foothold?
- Is pathogen dominance one of many alternate stable states?

International Permafrost Microbiome Network - Informing data gaps

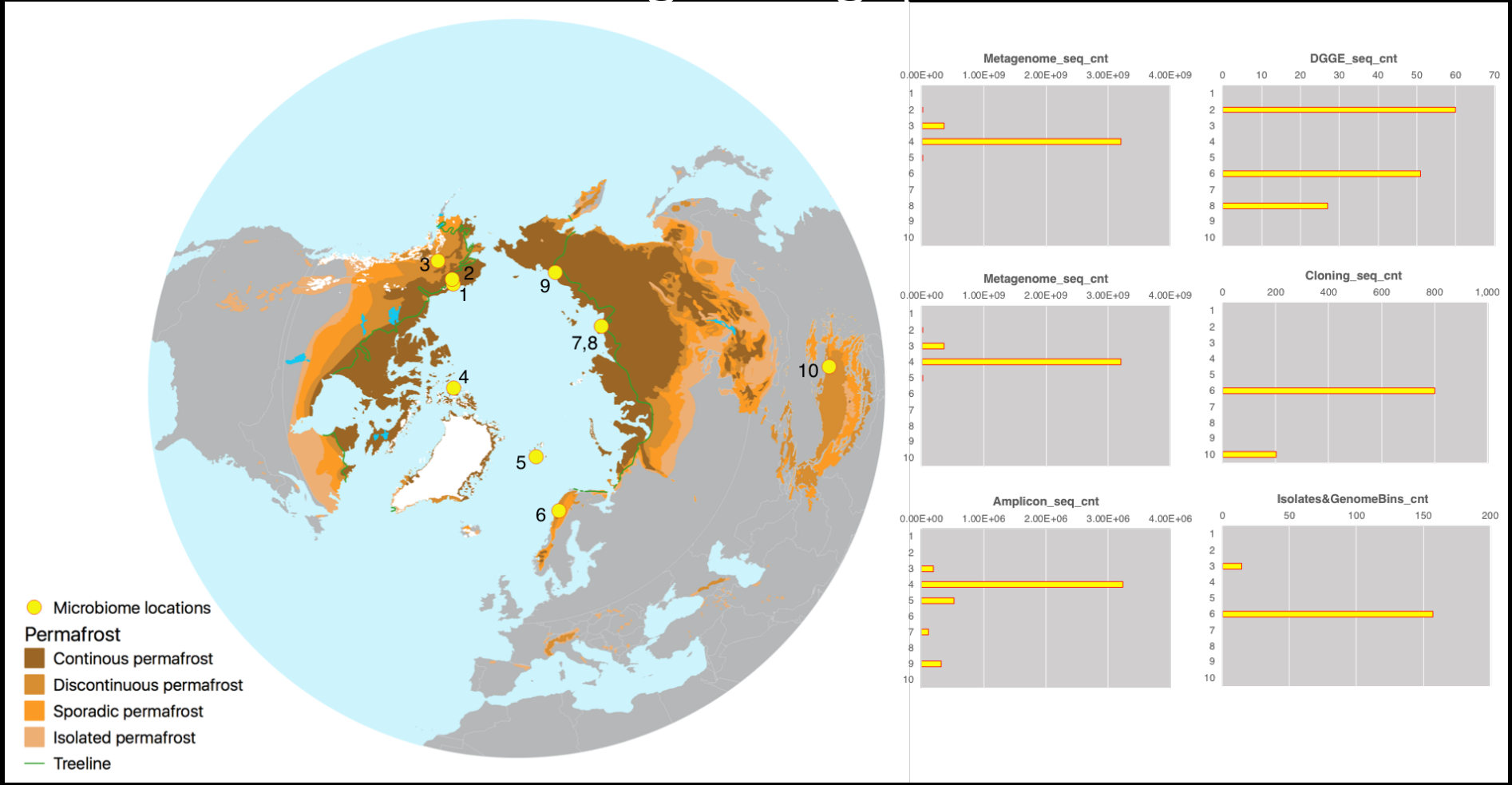


Figure credit: Maggie Lau
Ernakovich & International Permafrost Microbiome Network, in prep