

Tracking effects of changing precipitation regimes on biocrust microbial communities

Mary Lilibeth Sanchez and Ferran Garcia-Pichel

Center for Fundamental and Applied Microbiomics, Arizona State University, Tempe AZ

Research Question

How will biological soil crusts (BSC) microbial communities change in response to alterations in precipitation regimes due to climate change? Can finding the molecular mechanisms behind these responses help us predict these impacts?

Hypothesis

We predict that **1)** BSC microbial community members display a diverse range of physiological responses to precipitation regimes **2)** the reason behind these preferences can be explained by management of storage reserves that power them through growth and dormancy transitions.

Background

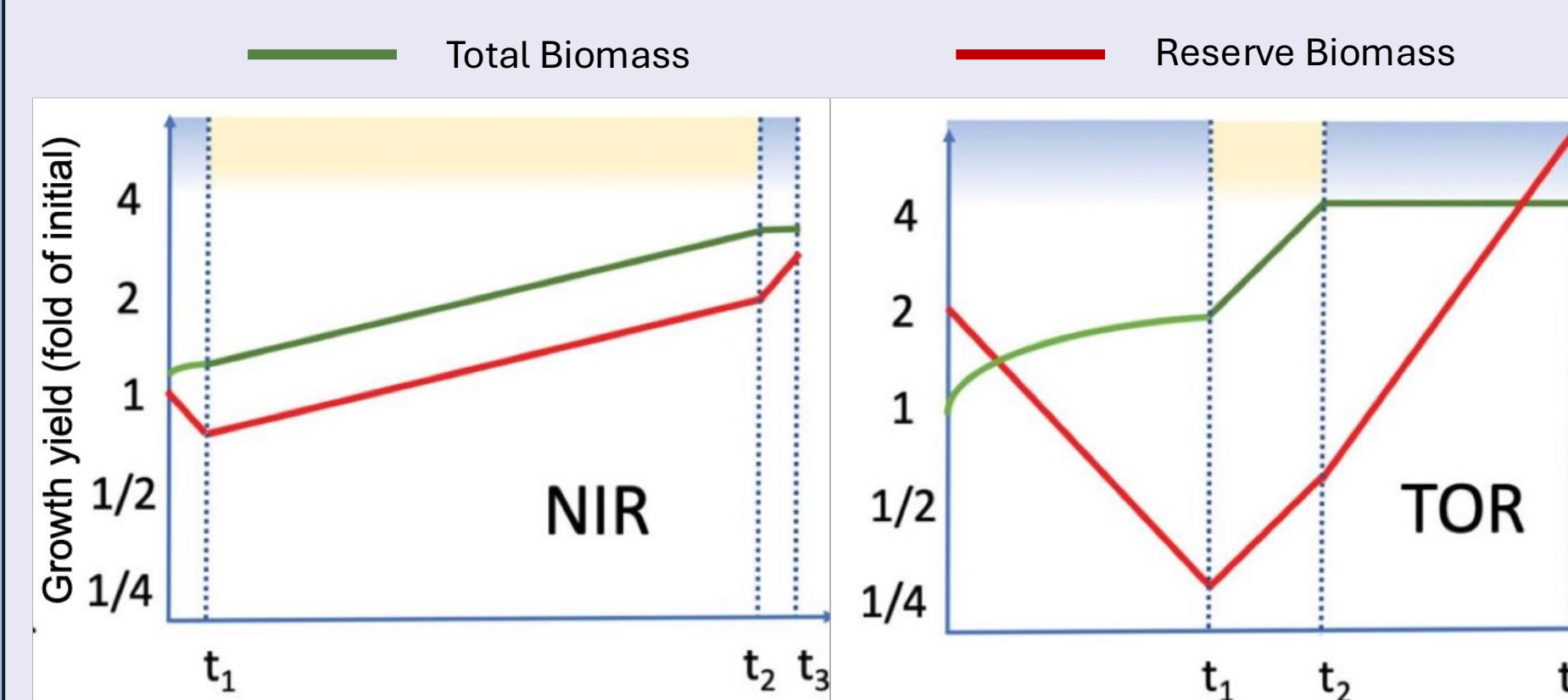


Fig 2. Visual representation of proposed differences in NIR and TOR reserve strategy over a hypothetical duration of time. Yellow shading represents period of activity in between dormancy (Garcia-Pichel and Sala, 2023)

Changes in BSC communities due to altered precipitation regimes have been observed, with some performing better under short hydration pulses (classified as Nimble Responders or NIRs) and others under long ones (Torpids Responders or TORs).

Theory suggests this can be explained by their management strategy of storage reserves that power them through growth and dormancy transitions.

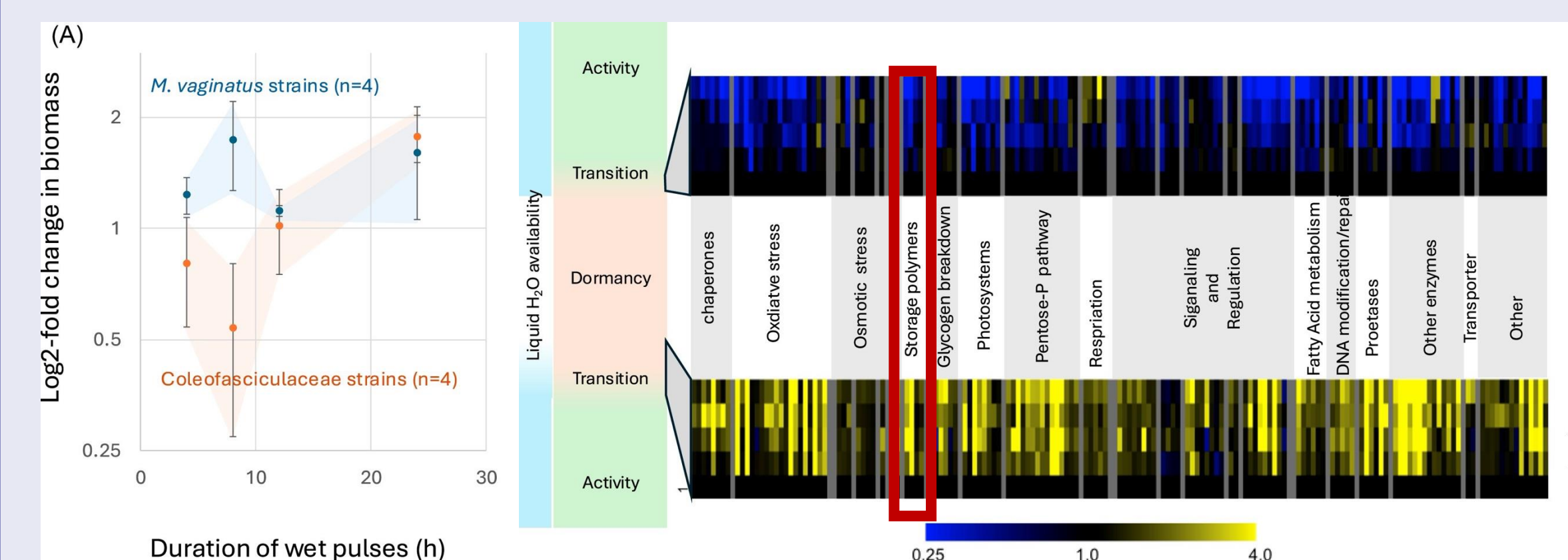


Fig 2. a) Average responses in growth yield as a function of hydration durations in BSC cyanobacteria (Fernandes and Garcia-Pichel, unpublished). **b)** Gene upregulation associated with transitions into desiccation-driven quiescence, and their downregulation upon resuscitation in *M. vaginatus* (Rajeev et al., 2013) (Garcia-Pichel, 2026).

Part 1: Pulse response in isolation

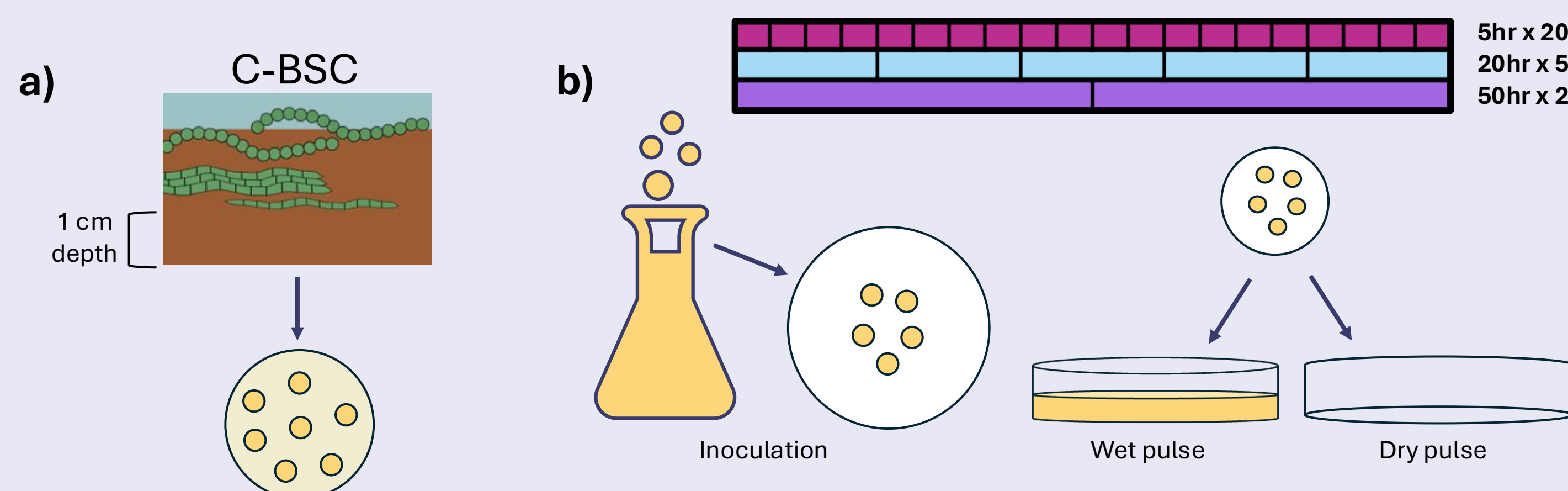


Fig 3. a) Undercrust C-BSC microbes were isolated from soil sampled from the Jornada Experimental Range. **b)** Pure cultures of isolates were inoculated onto polycarbonate filter membranes to test effects of pulse duration and frequency on biomass growth.

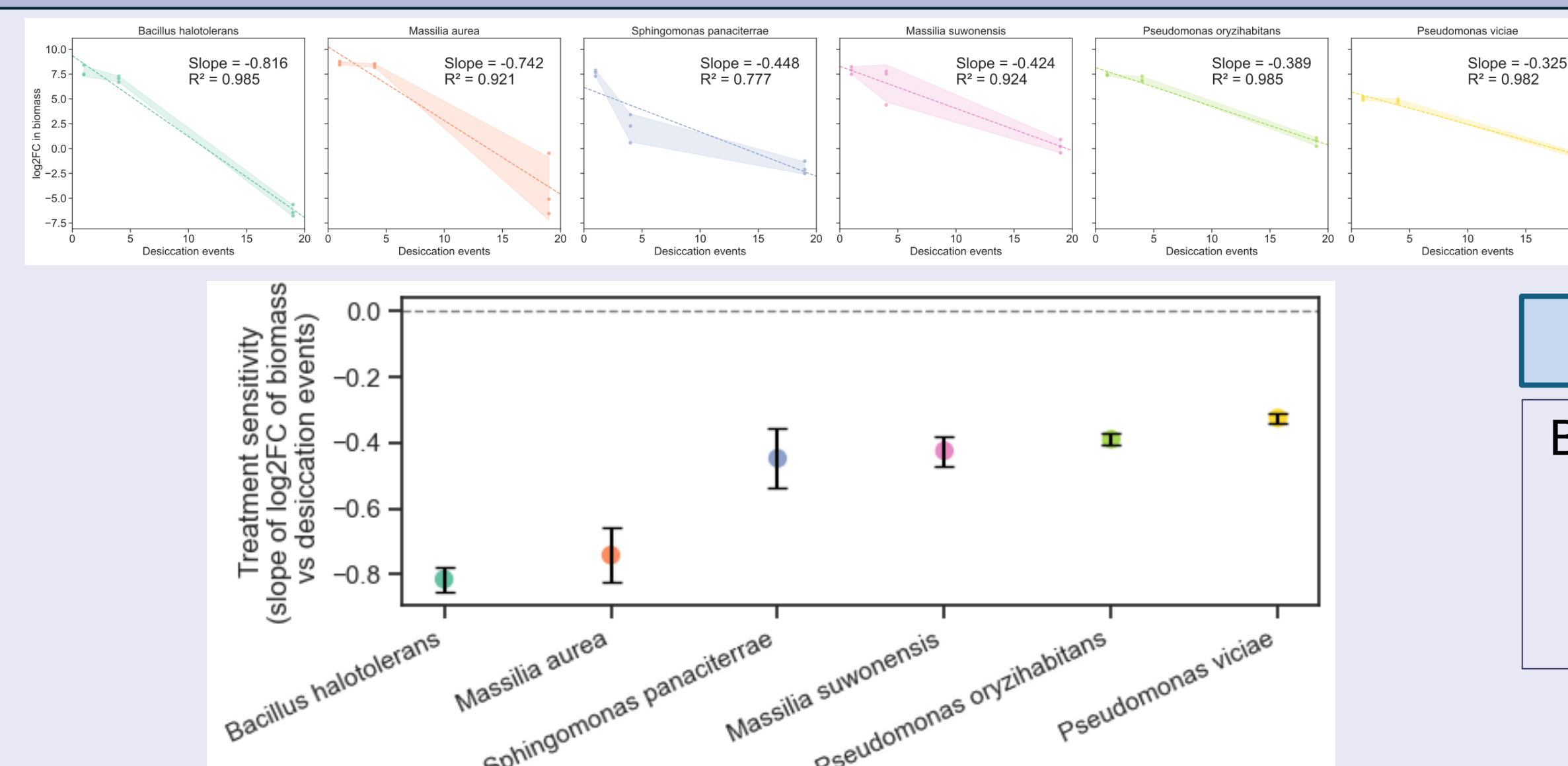


Fig 4. Sensitivity of BSC microbes in response to decreasing pulse durations and increasing events **a)** Average responses in growth yield as a function of hydration duration **b)** each slope depicted in a) was plotted to compare overall sensitivity

Conclusion

BSC microbes displayed a range of physiological responses to decreased pulse duration and increased pulse frequency.

Acknowledgements and References

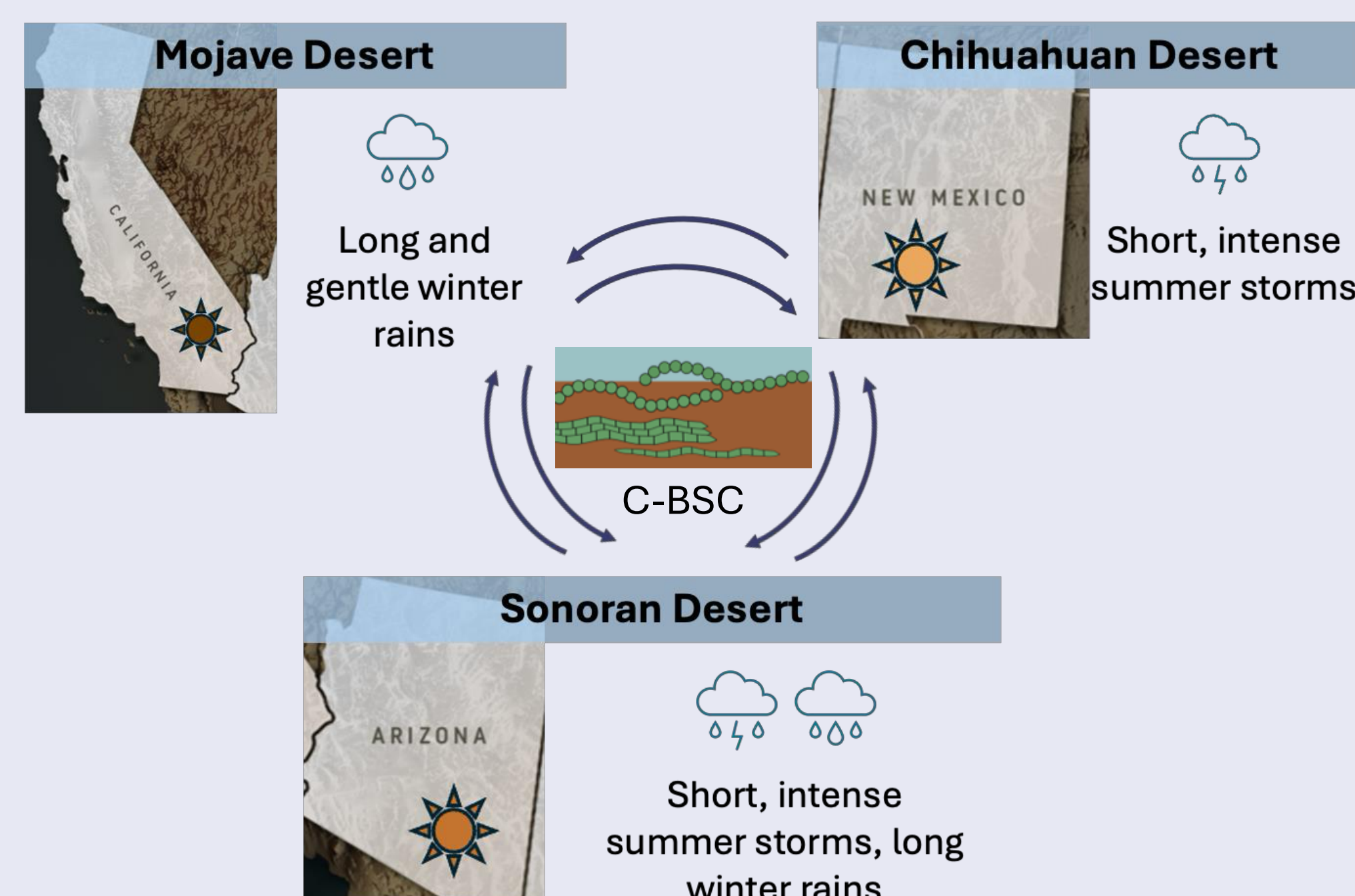
This research is supported by NSF LTER grant GR47822. Thank you to the Garcia-Pichel lab for their help establishing field sites and to collaborators at the Santa Rita Experimental Range, Jornada Basin Experimental Range, and Sweeney Granite Mountain Desert Center for hosting the field sites and their ongoing support. Thank you to my cat, Doja Perera-Sanchez for the moral support and aiding with data visualization.



Scan here for references

Part 2: Pulse responses across drylands

Fig 5. Schematic of reciprocal transplant field experiment



C-BSCs were reciprocally transplanted at three deserts with varying precipitation regimes to observe impacts of regime change in real-time



Fig 6. Sonoran desert BSC transplant site at the Santa Rita Experimental Range, AZ featuring **a)** transplanted Chihuahuan BSC, n=6 **b)** Transplanted Mojave BSC, n=6 and **c)** Sonoran BSC control, n=5.

Future Experiments

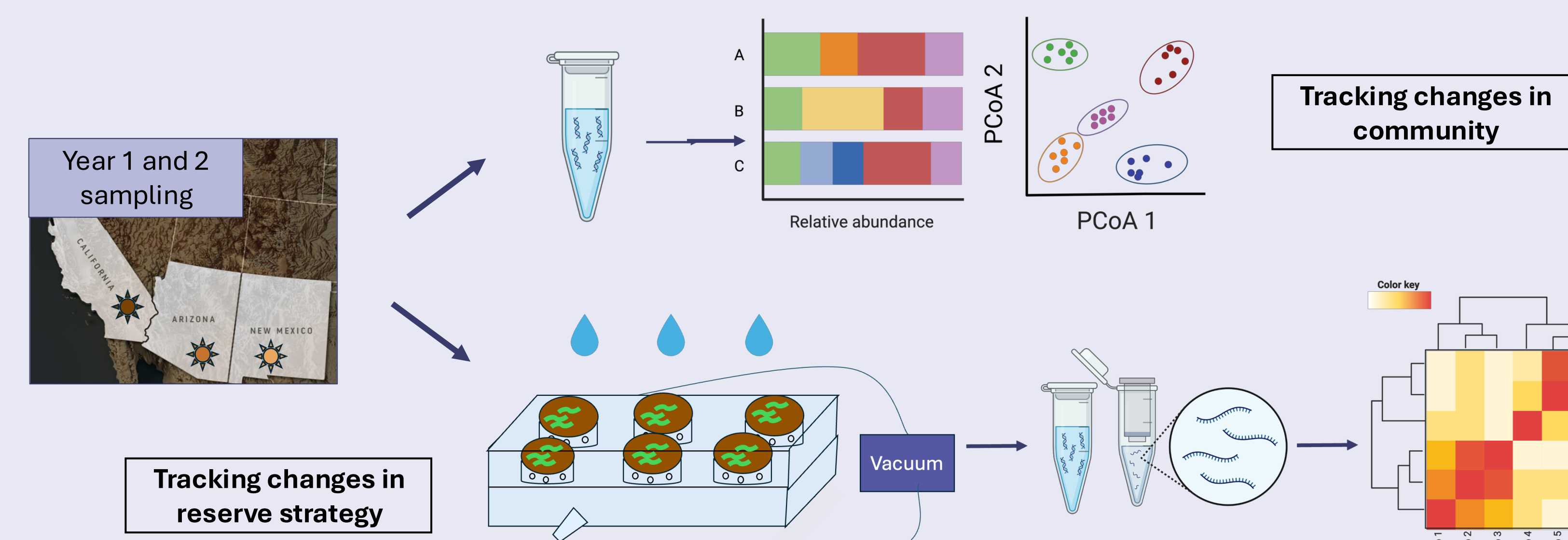


Fig 7. Transplant sites will be sampled over two years to **a)** track changes in community composition and **b)** reserve polymer gene expression during controlled wetting and drying pulses