Microclimate Matters:
Airborne Fungal Spores in a Coastal Forest and Grassland

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INTRODUCTION

Fungi colonize plant shoots from the air, infect roots to form mycorrhizal networks in the soil, and germinate in leaf litter to facilitate decomposition of organic matter. In some cases, airborne fungi can cause disease in plants, animals, and trigger allergies and respiratory illness in humans.

Investigating microclimate and airborne spore concentrations over time allows us to determine when and under what meteorological conditions we can expect to find peak spore counts. Numerous studies track the seasonal trends of fungal reproduction and the impact of weather events like rainstorms, highlighting the importance of larger meteorological factors in fungal dispersal. In addition, there is some evidence that day-night changes in temperature and relative humidity can create predictable diel patterns when spores are released and disperse. For instance, peak spore counts occur at night in tropical forests, when there is higher ambient relative humidity compared to the day. We compare the diel phenology of airborne spores in a temperate coastal forest and grassland in California.

QUESTIONS

1) Can temperature and relative humidity predict airborne spore density?

2) Do diel (daily) spore counts occur in the morning and evening when there is large shift in microclimate conditions?

3) Are there differences in total airborne spore concentration between a forest and grassland?

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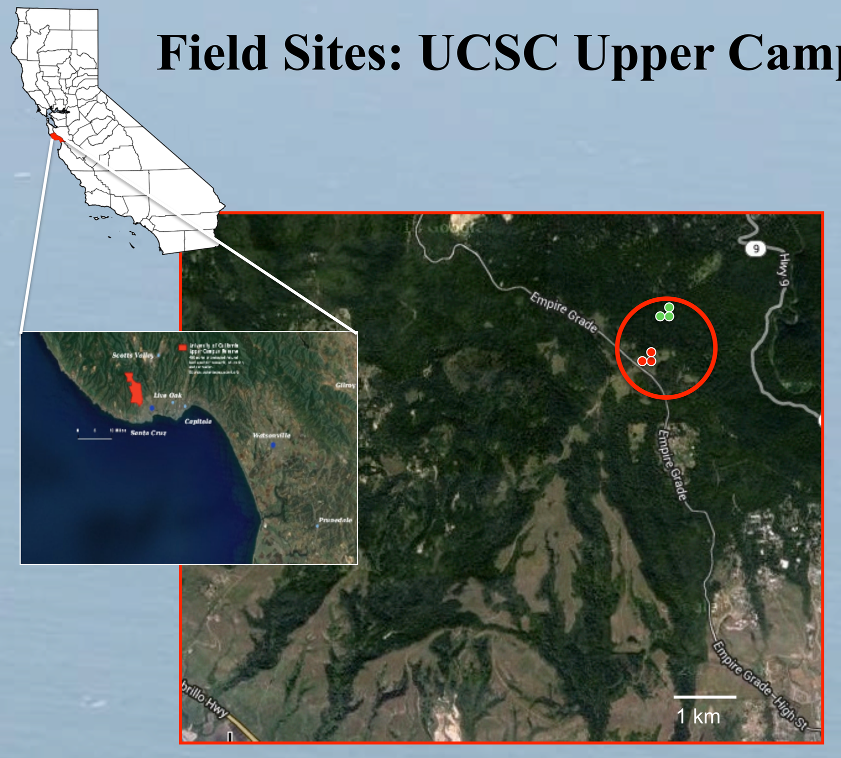
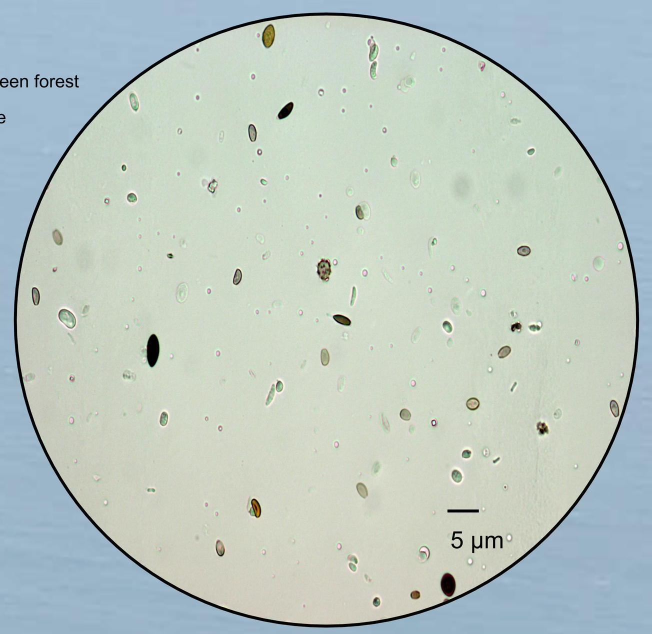
METHODS

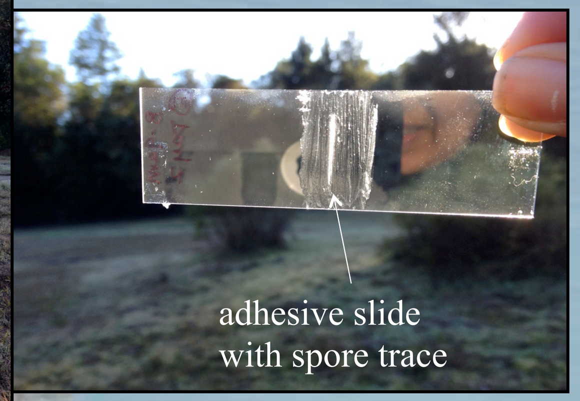
Field Sites: UCSC Upper Campus Natural Reserve



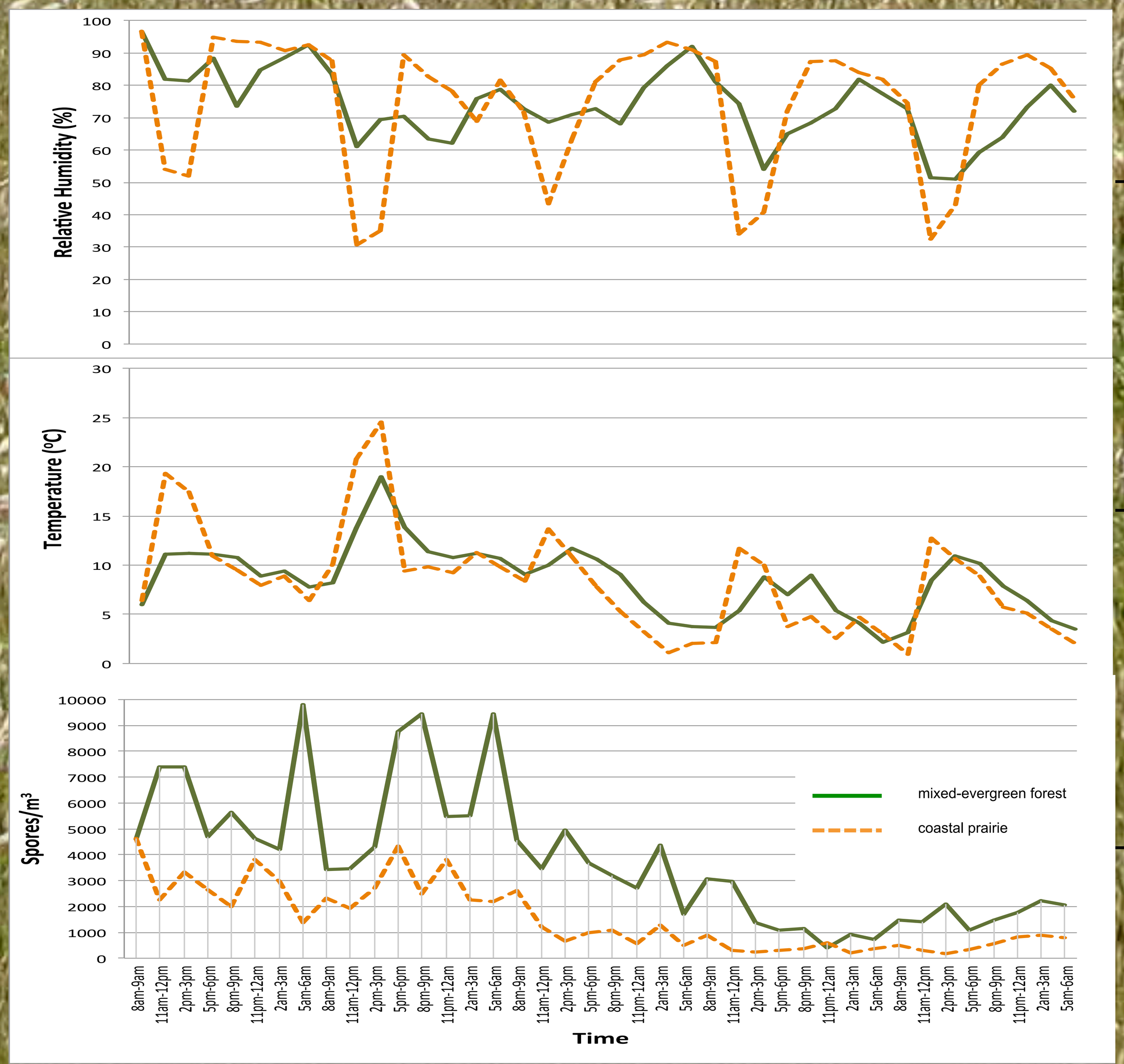


Spore Trapping & Lab Analysis

- 3 replicate field sites per habitat type: forest and grassland
- Air Vacuum spore trap 15L air/min 1 m from the ground
- Sampled at each site for 10 minutes every 3 hours for 5 days and 5 nights in January 2013
- Samples collected on an adhesive microscope slide inside spore trap
- Spore density counted under a light microscope at 200x
- Total of 2400 digital photos taken and analyzed



RESULTS

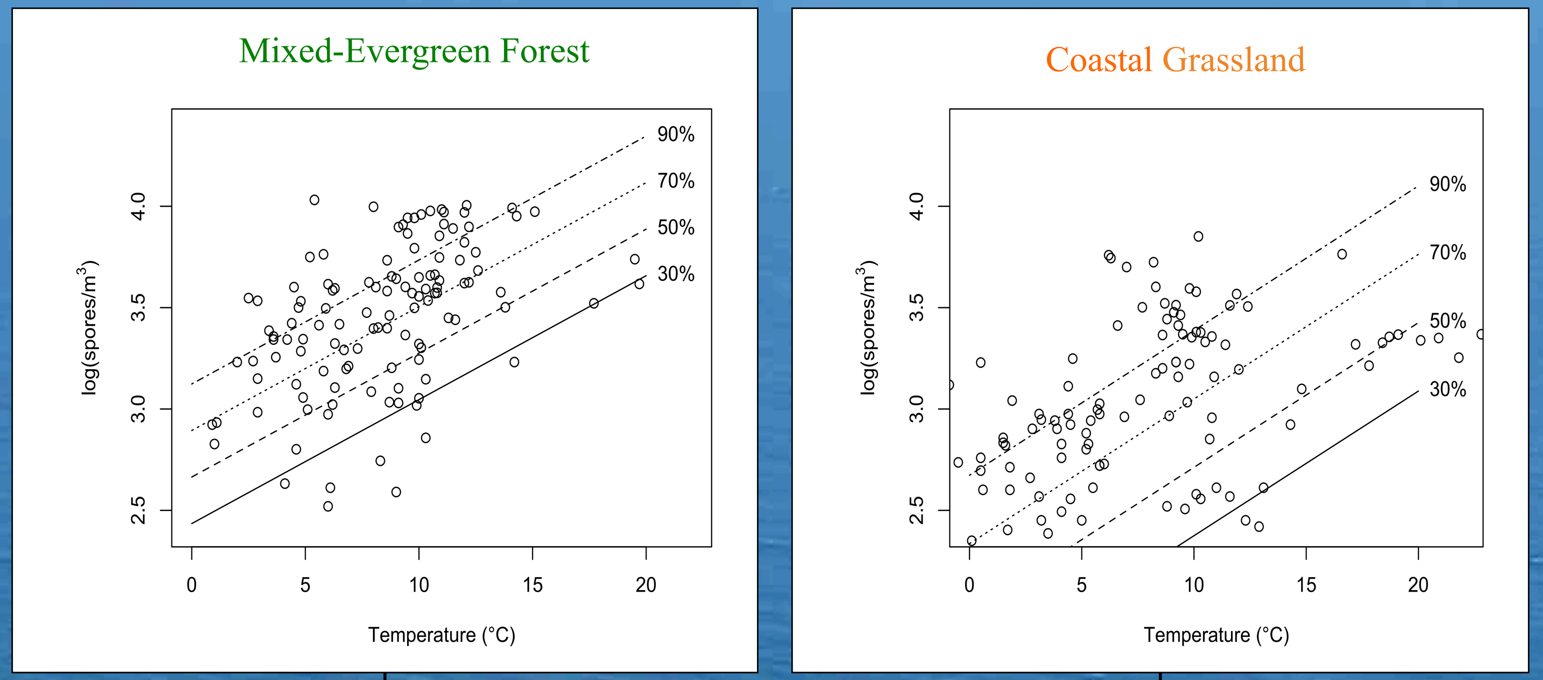


Relative humidity increased at night in both habitats; it was drier in the grassland during the day compared to the forest.

The largest shift in temperature occurred in the mornings (warmed up) and evenings (cooled down).

Spore densities tracked daily fluctuations in microclimate in both habitat types.

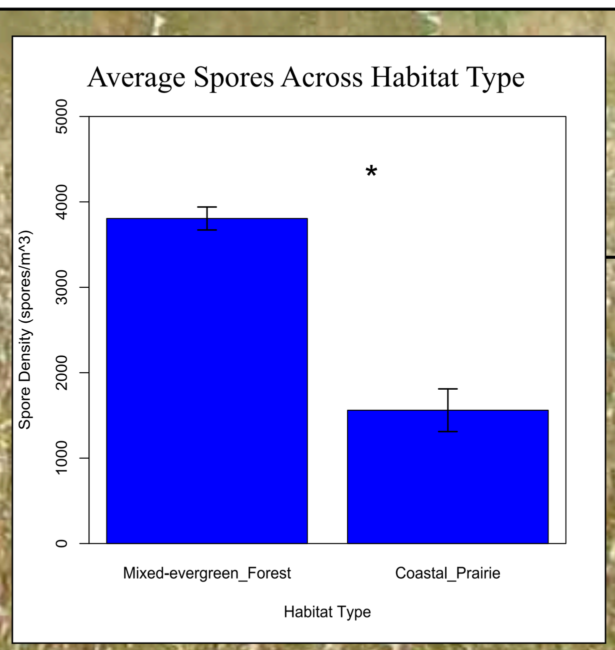
RESULTS



In the forest, there was a strong effect of temperature ($p < 0.001$, $R^2 = 0.2$) compared to relative humidity ($p = 0.005$, $R^2 = 0.1$). Both microclimate factors significantly predict airborne spore density in the forest, although their interaction does not seem important. See AIC Model test table below.

In the coastal prairie, there was a stronger positive relationship between temperature and spore densities ($p < 0.001$, $R^2 = 0.1$) compared to relative humidity ($p = 0.001$, $R^2 = 0.1$). Both temperature and relative humidity were important predictors for airborne spore concentration. See AIC Model test table below.

Model	AIC	
	Mixed-evergreen Forest	Coastal Prairie
Spore density ~ Temperature + Relative Humidity + (Temperature * Relative Humidity)	33.53	50.17
Spore density ~ Temperature + Relative Humidity	33.26 *	49.39 *
Spore density ~ Temperature	64.17	117.4
Spore density ~ Relative Humidity	87.43	125.33



More than twice as many fungal spores were found in the coastal forest (n =119) versus the grassland (n = 113) (p = 0.001).

DISCUSSION

- Air temperature and to a lesser degree relative humidity, both predict airborne spore abundance in a forest and grassland.
- Microclimate was more important than time of day for predicting airborne spores.
- Spore density in a mixed-evergreen forest was twice that in the coastal prairie.
- These data support other studies that show:
  1) airborne fungal spores are strongly influenced by temperature & moisture.
  2) strong spatial structuring of fungal communities over short distances.
- This research is useful for understanding when and where there may be fungal pathogens found in the air that could infect plants, animals, and trigger respiratory illness in humans.