

ARE MANGROVE RANGE LIMITS CONSTRAINED BY PHYSIOLOGICAL TOLERANCES? *AN EXPERIMENTAL APPROACH.*

John Parker // SERCecology.com

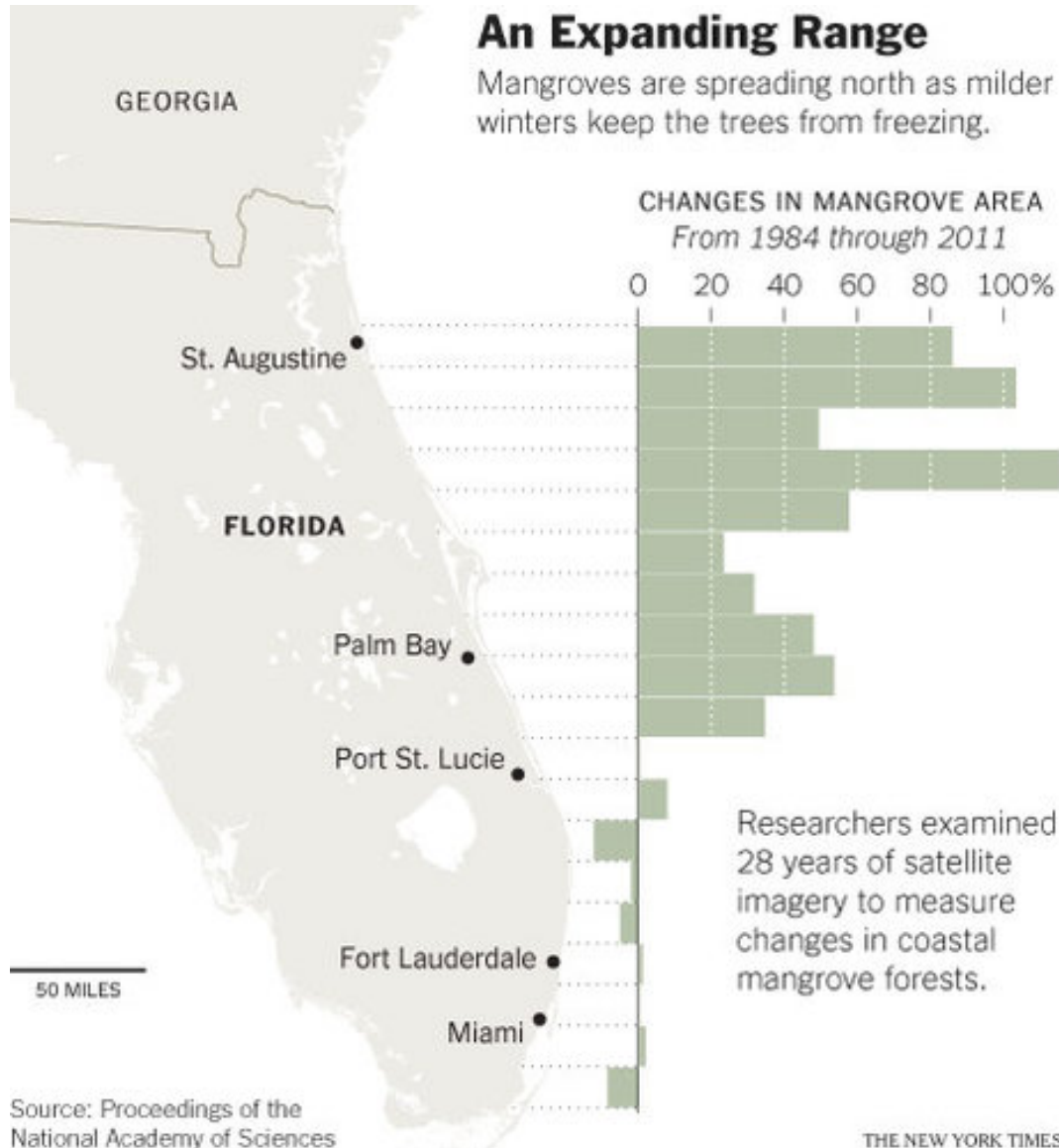


Smithsonian Environmental
Research Center



Mangrove area expanded within the ecotone, 1984-2011

Cavanaugh et al. 2014 *PNAS*

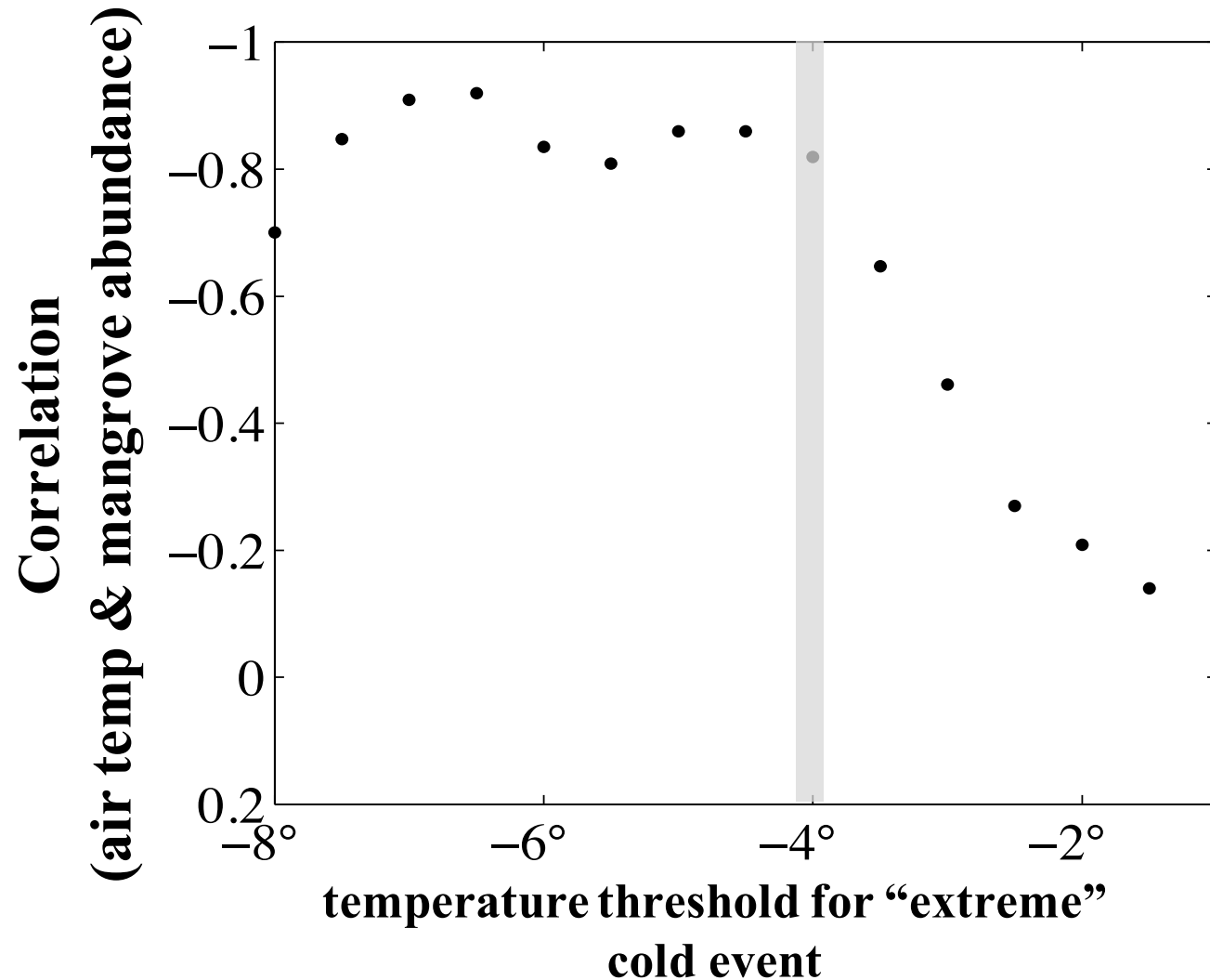


THE NEW YORK TIMES



Temperature threshold

$\leq -4^{\circ}\text{C}$ in winter = reduced mangrove cover in summer

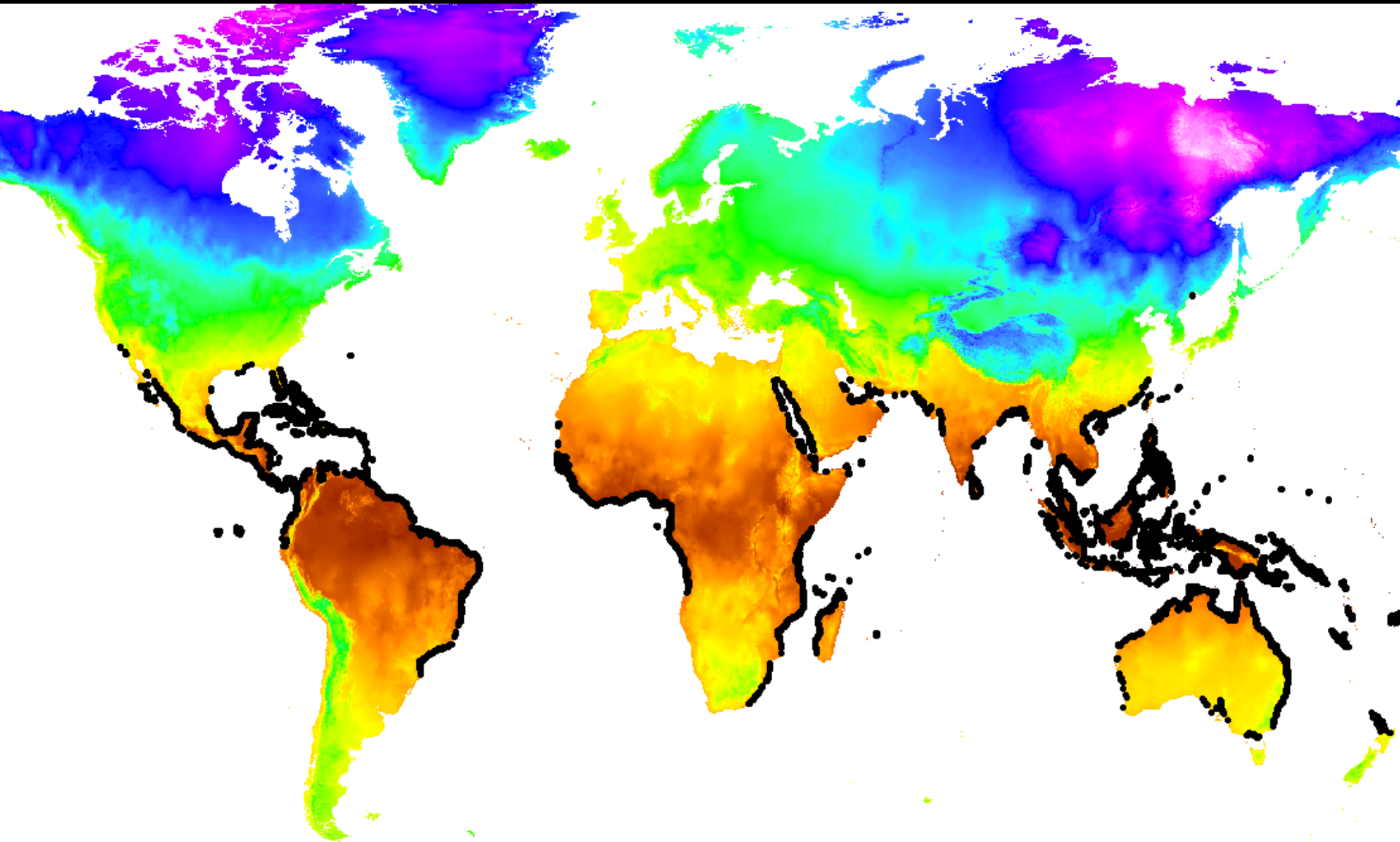


DO RANGE LIMITS = PHYSIOLOGICAL LIMITS?

- 1. Cold Air?**
- 2. Cold Water?**
- 3. Aridity*Cold Air/Water?**



RANGE-LIMITS ~ COLD AIR?

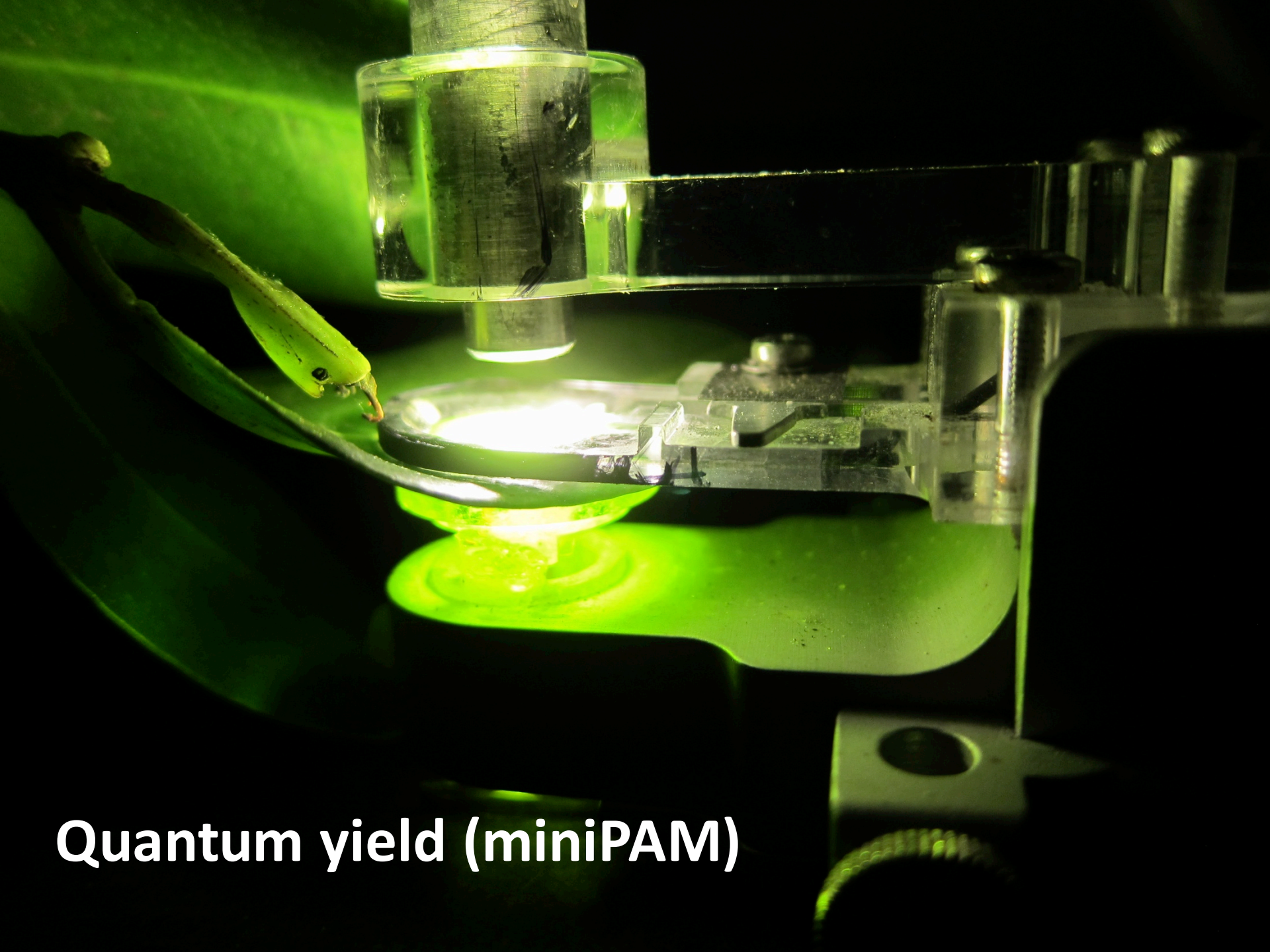


**Air Temp: mean winter
minimum (BIOCLIM)**

Simulated 'freeze' events

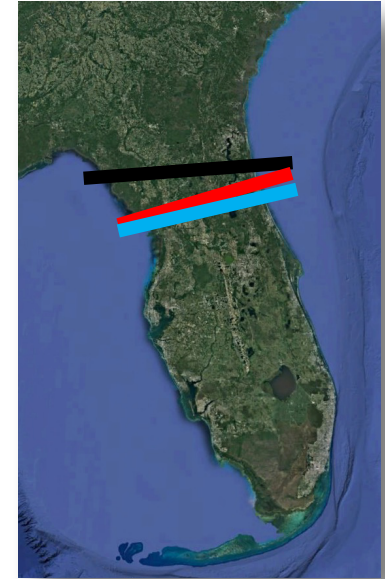
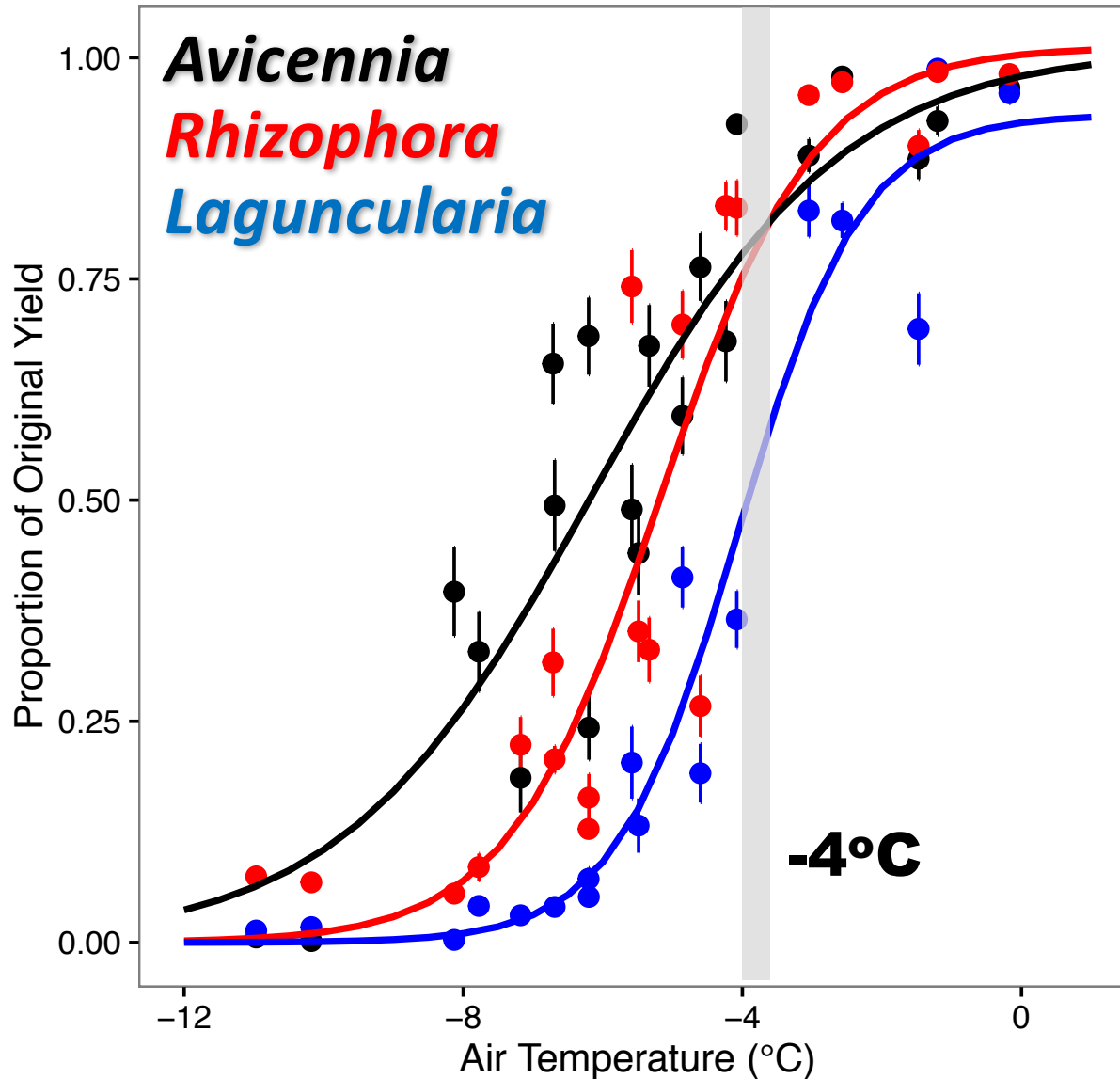
-11°C, -10, -8, -6, -4 -2, 0



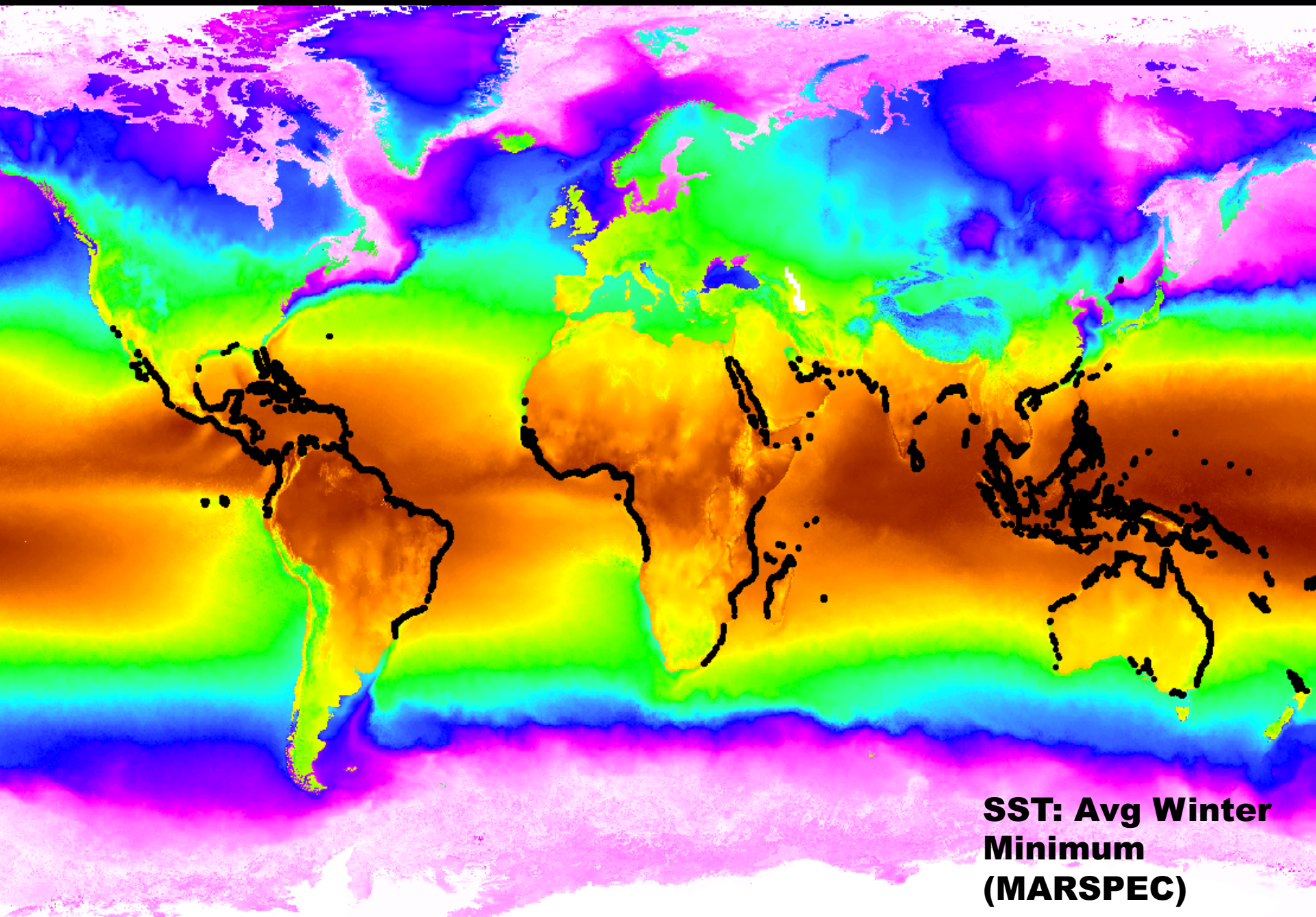


Quantum yield (miniPAM)

SPECIES-SPECIFIC RESISTANCE TO FREEZING AIR = RANGE-LIMITS

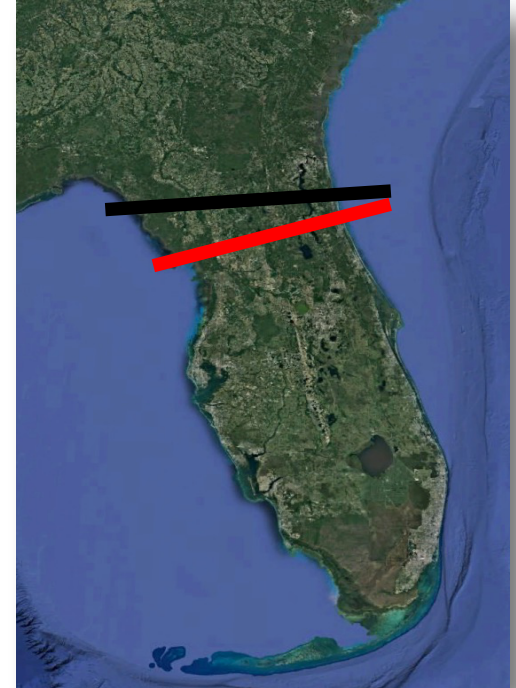
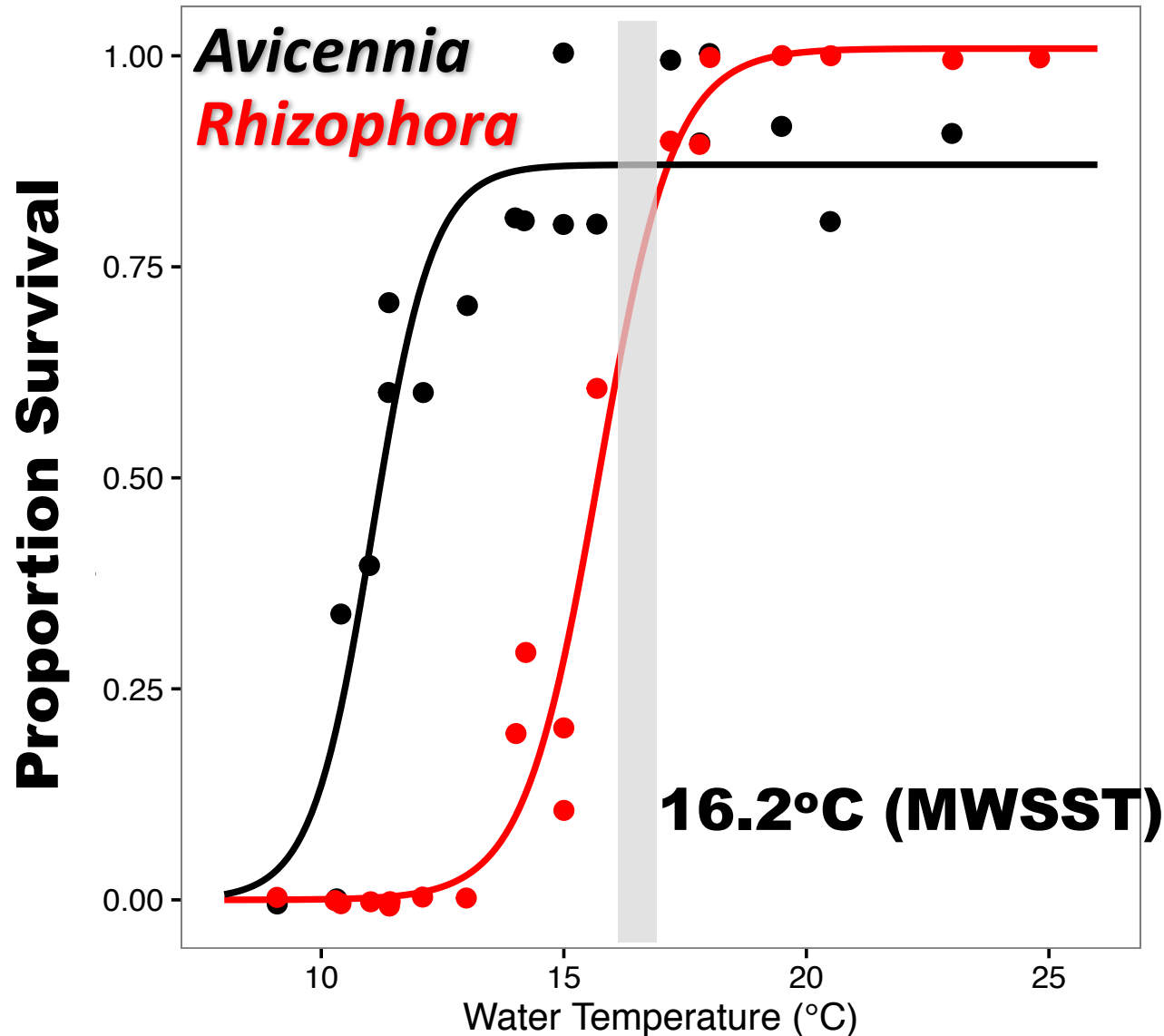


RANGE-LIMITS ~ COLD WATER?

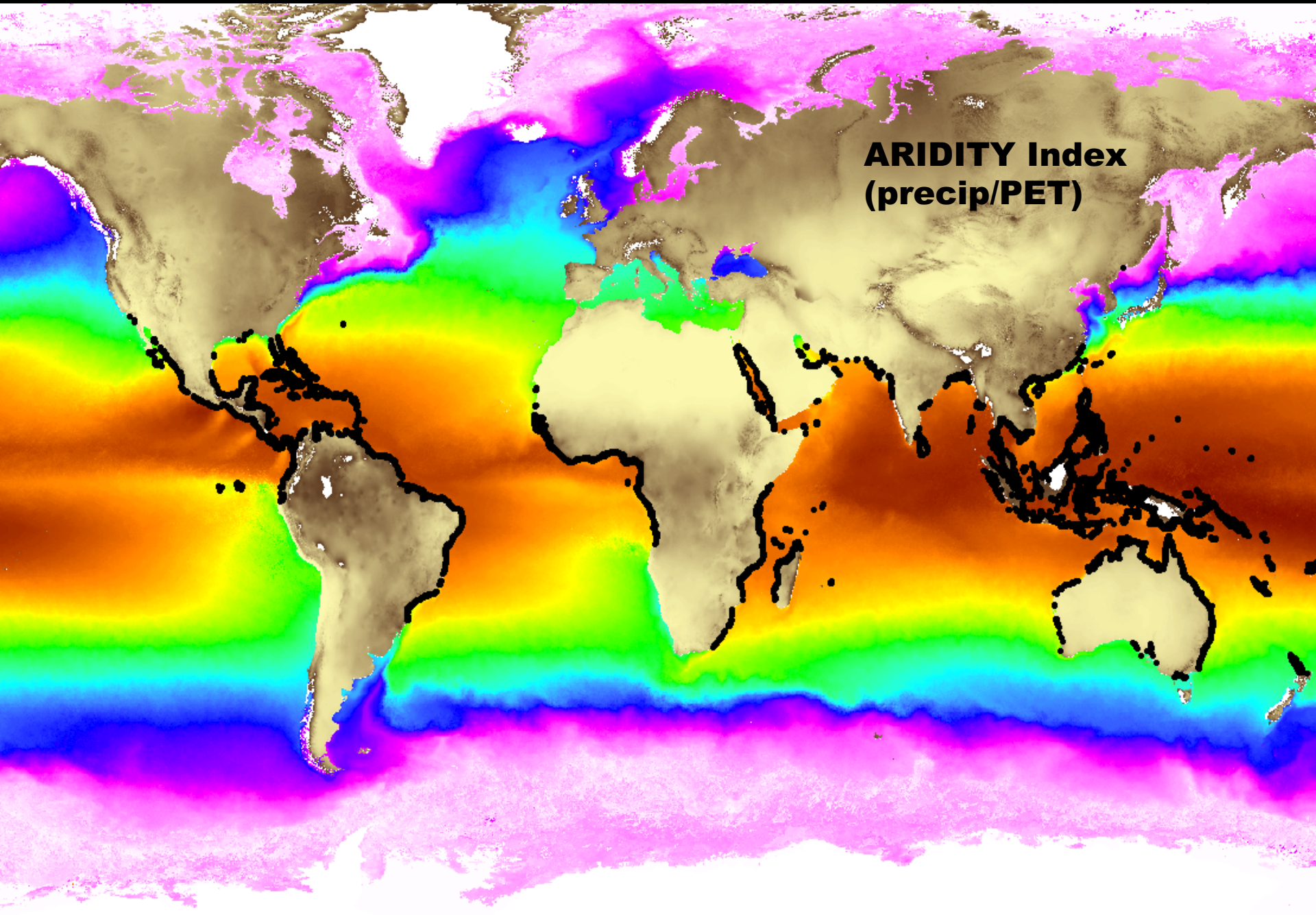


**SST: Avg Winter
Minimum
(MARSPEC)**

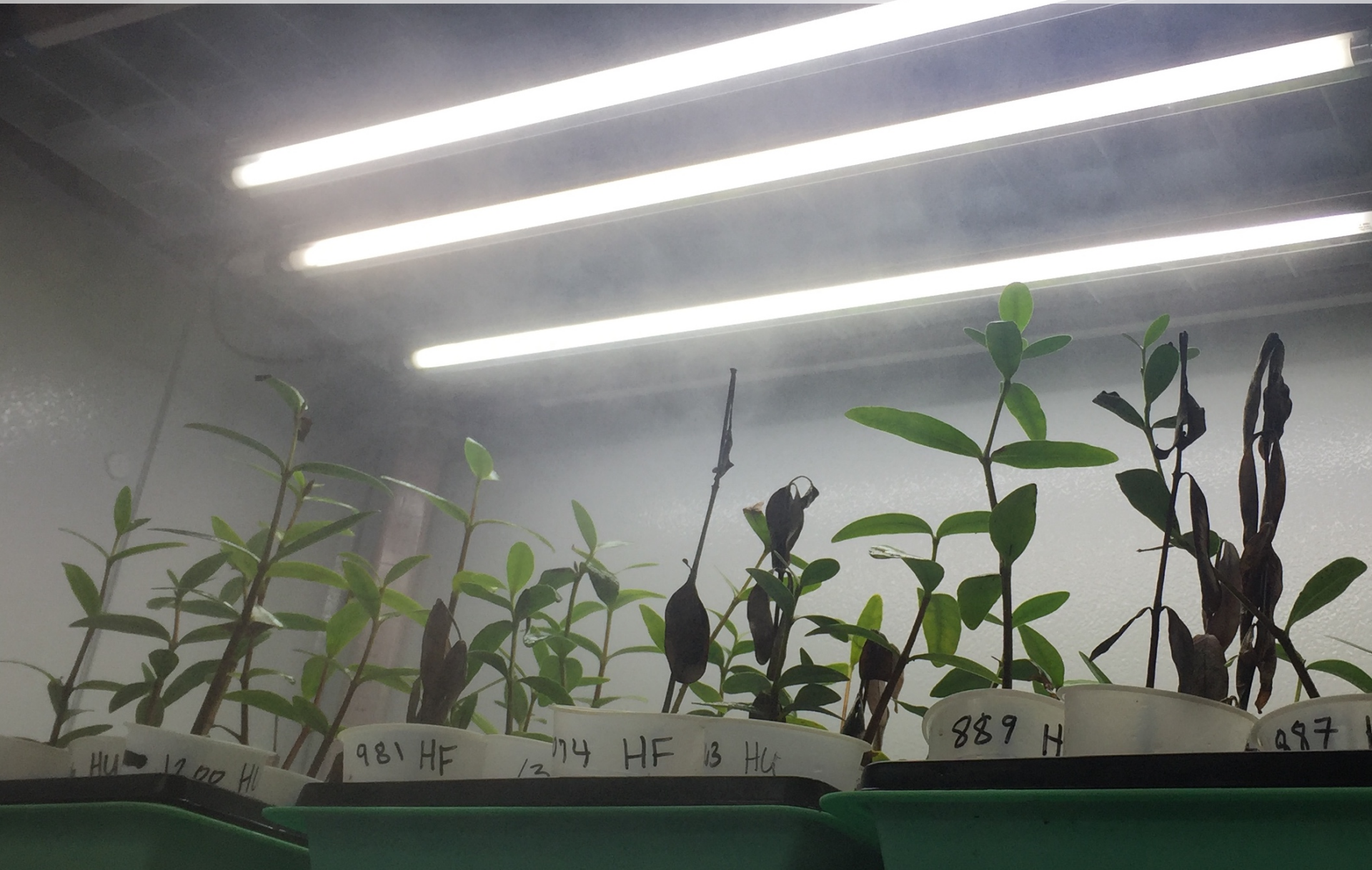
SPECIES-SPECIFIC RESISTANCE TO FREEZING WATER = RANGE-LIMITS



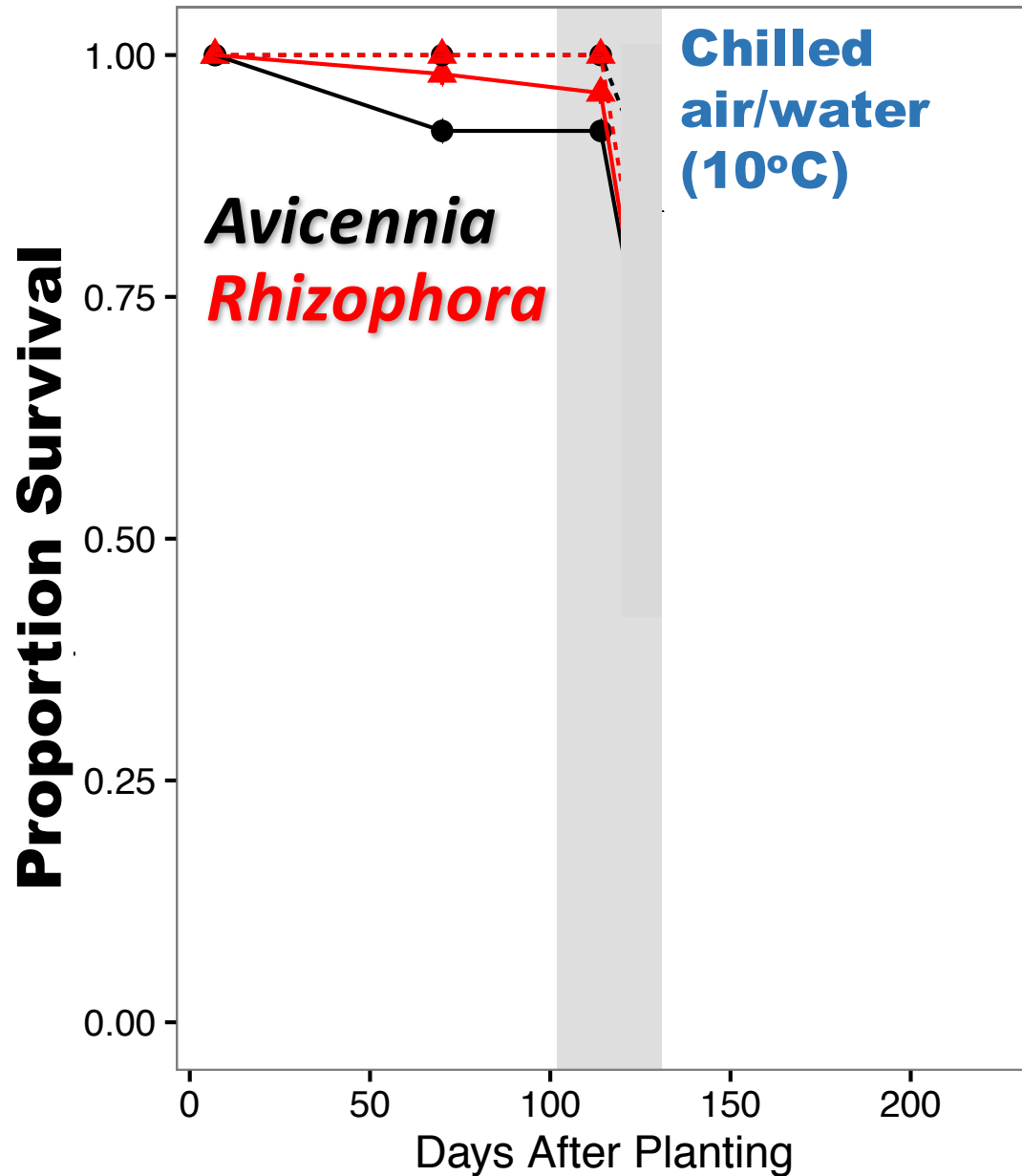
RANGE-LIMITS ~ ARIDITY?



GROWTH-CHAMBER EXPERIMENTS: HUMIDITY*CHILLING



Survival ~ Humidity*Chilling*Species

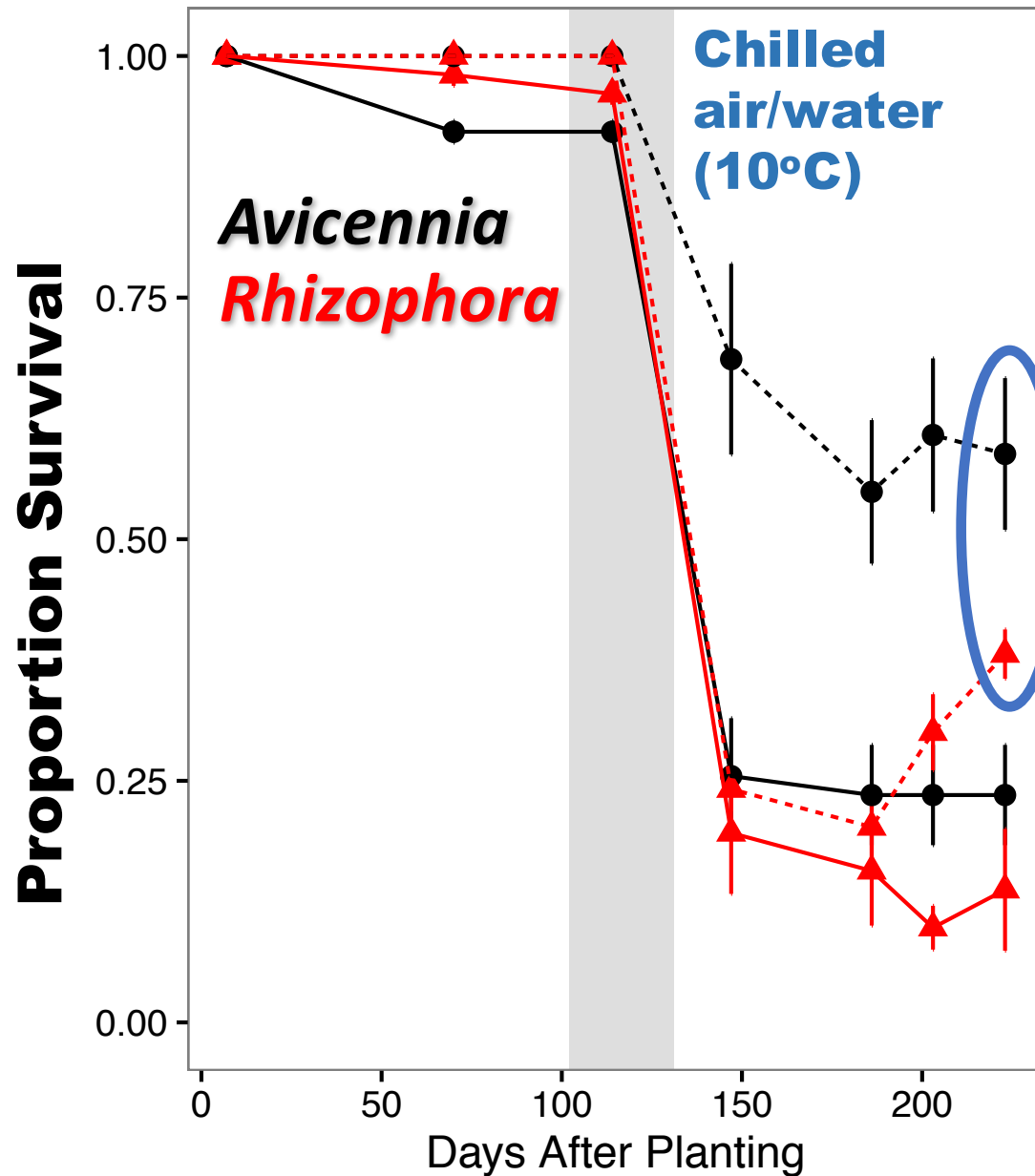


40%
RH



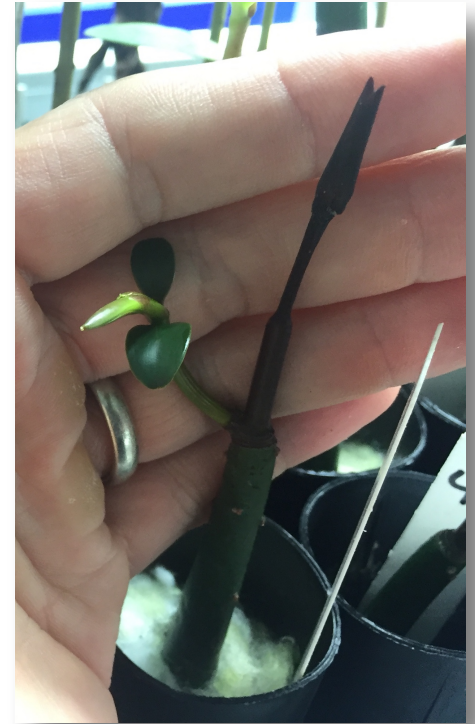
90%
RH

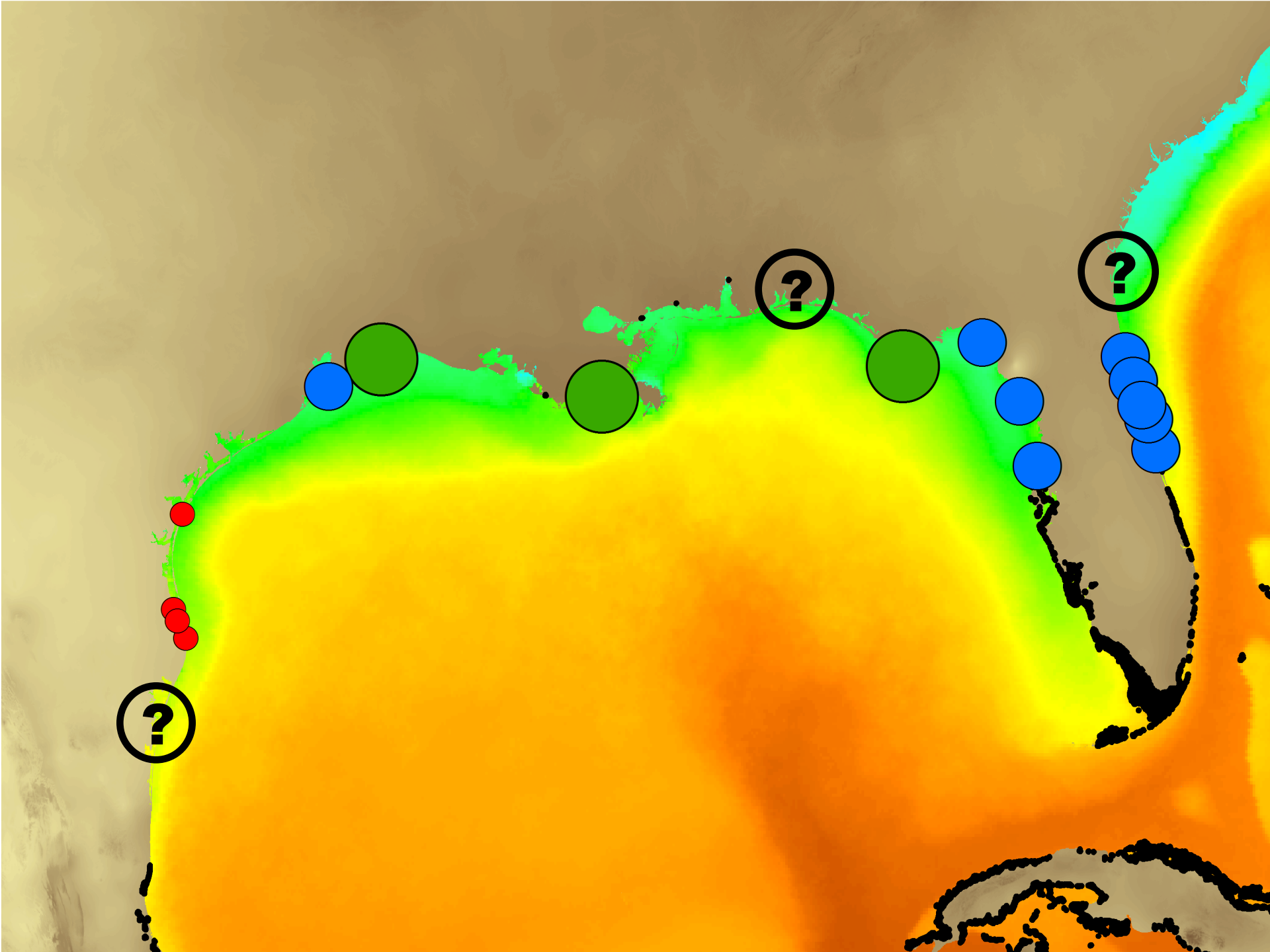
Survival ~ Humidity*Chilling*Species



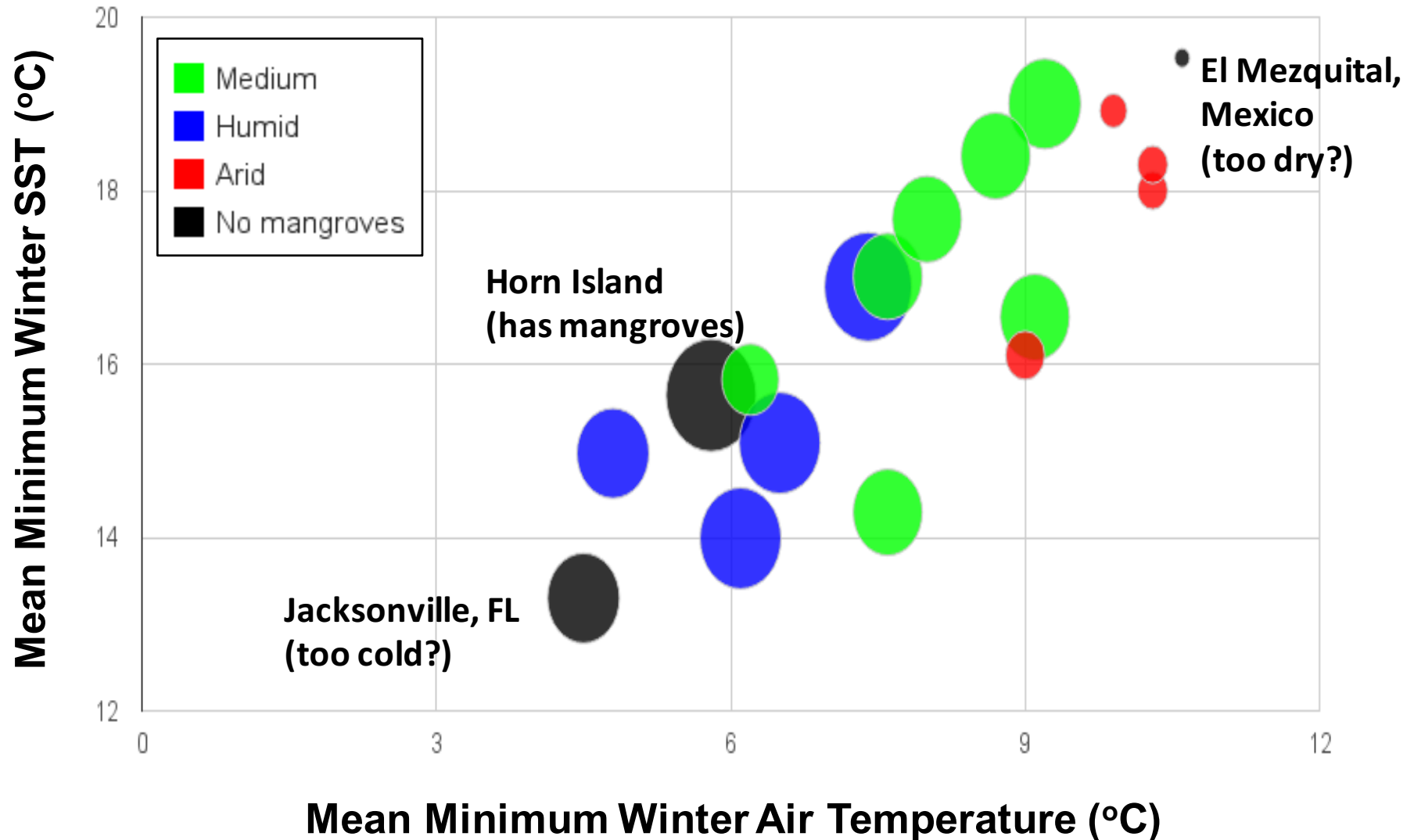
**90%
RH**

**40%
RH**





RANGE LIMITS ~ COLD AIR * COLD WATER * ARIDITY



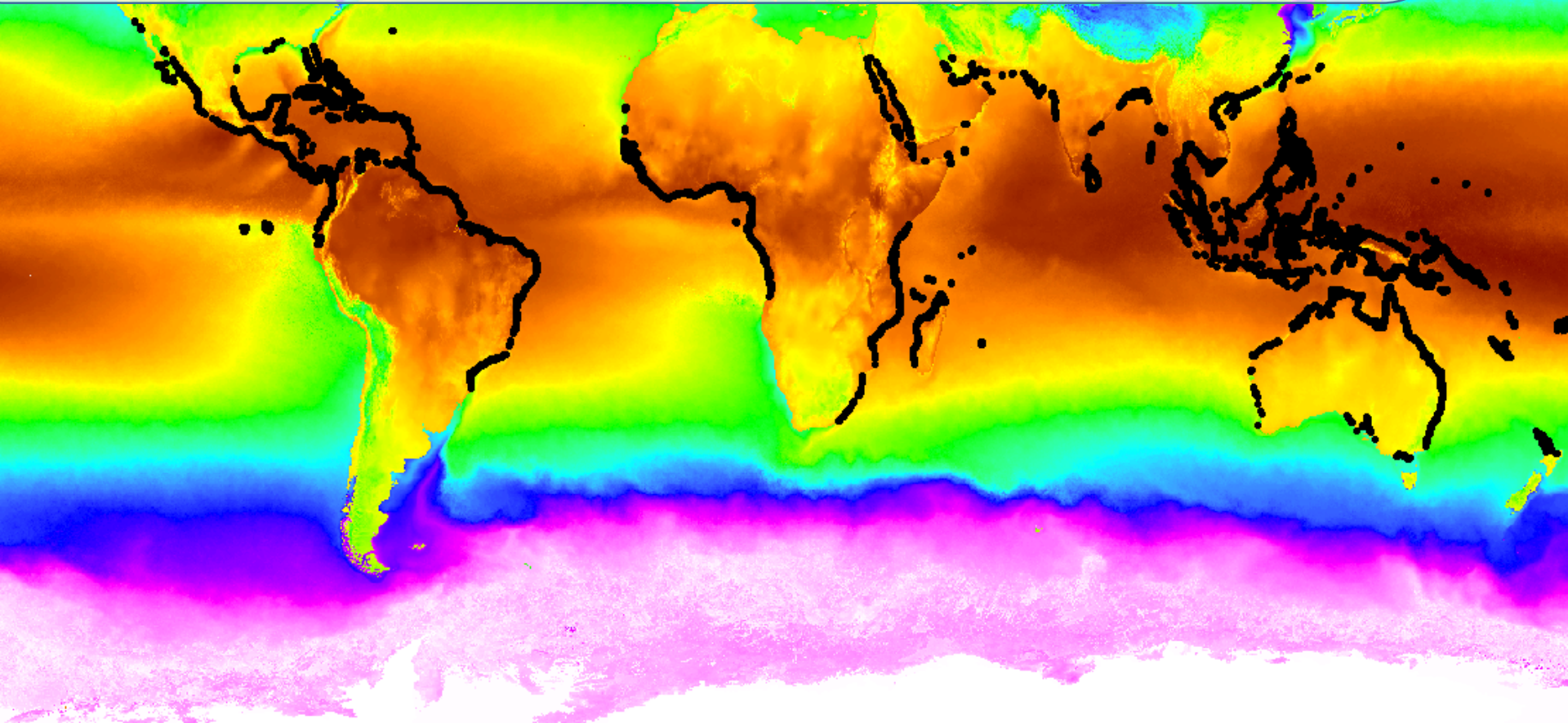
DO RANGE LIMITS = PHYSIOLOGICAL LIMITS?

1. Cold Air*Cold Water*Aridity

2. BETTER ENVIRONMENTAL DATA

3. BETTER RANGE MAPS (SPECIES!)

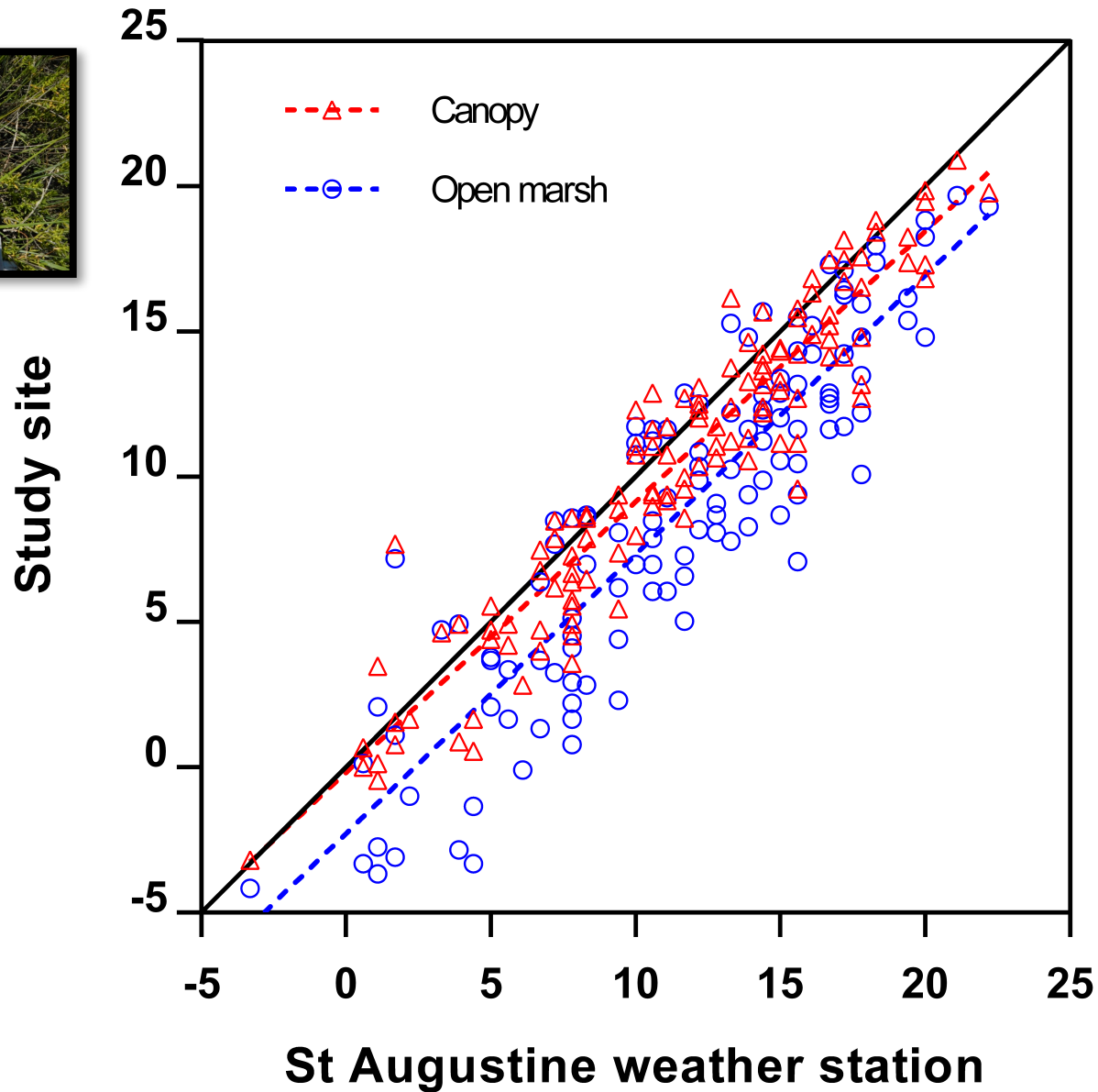
4. MORE FACTORIAL EXPERIMENTS



HOW GOOD ARE OUR ENVIRONMENTAL DATA?



Field site *COLDER* than nearby station



GROWTH-CHAMBER EXPERIMENTS:

HUMIDITY* SALINITY

**40%
RH**



60ppt

35ppt

15ppt

**90%
RH**

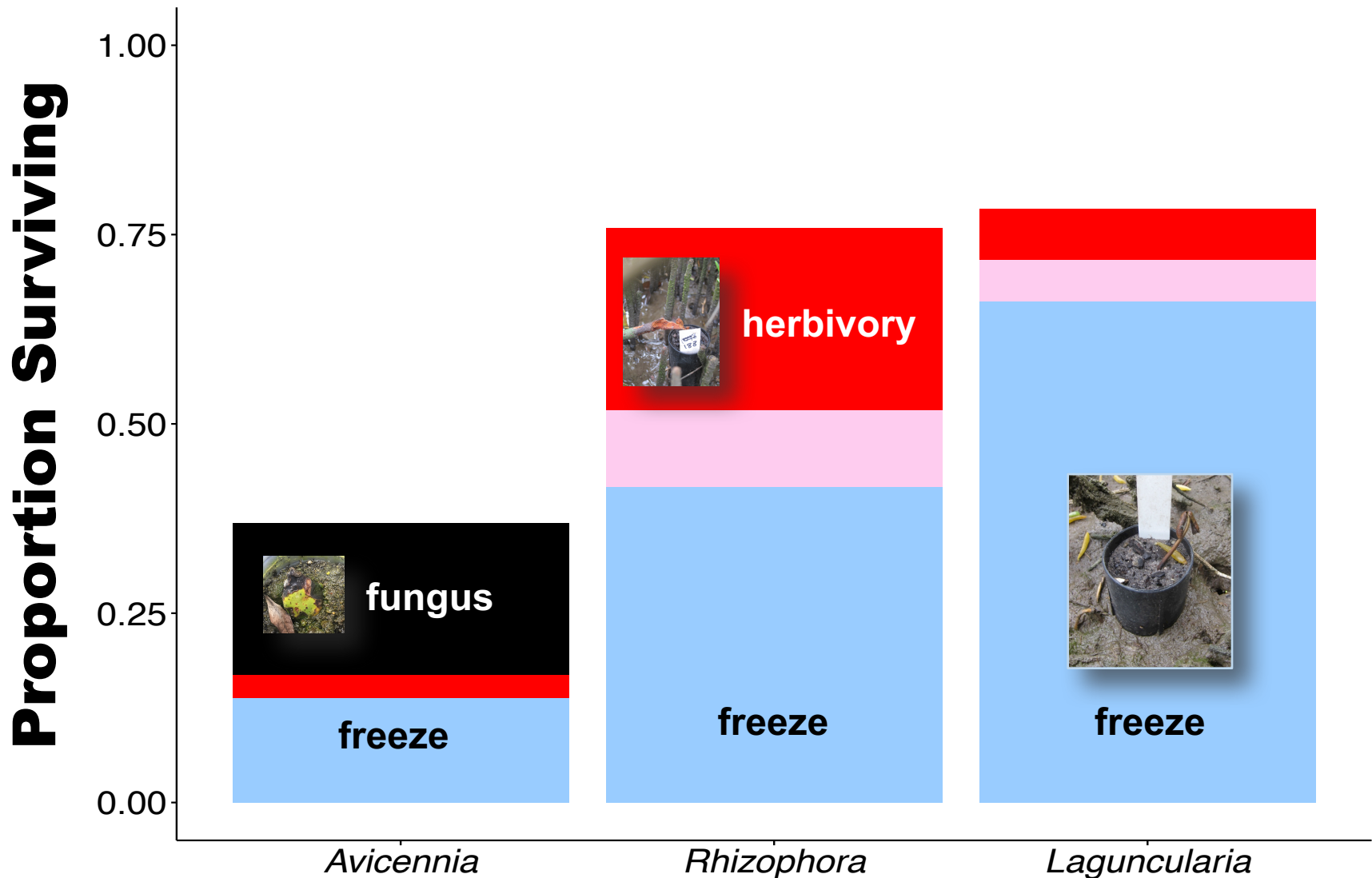


IS SURVIVAL LIMITED BY FREEZING IN THE FIELD?

TRANSPLANT EXPERIMENTS AT RANGE EDGE



SOURCES OF MORTALITY... FUNGUS, CRABS, & FREEZING





1990s: very few mangroves



2000s: MANGROVES!!!





CONTROL

FROZEN

