Effect of Stressors on Urbanized Corals

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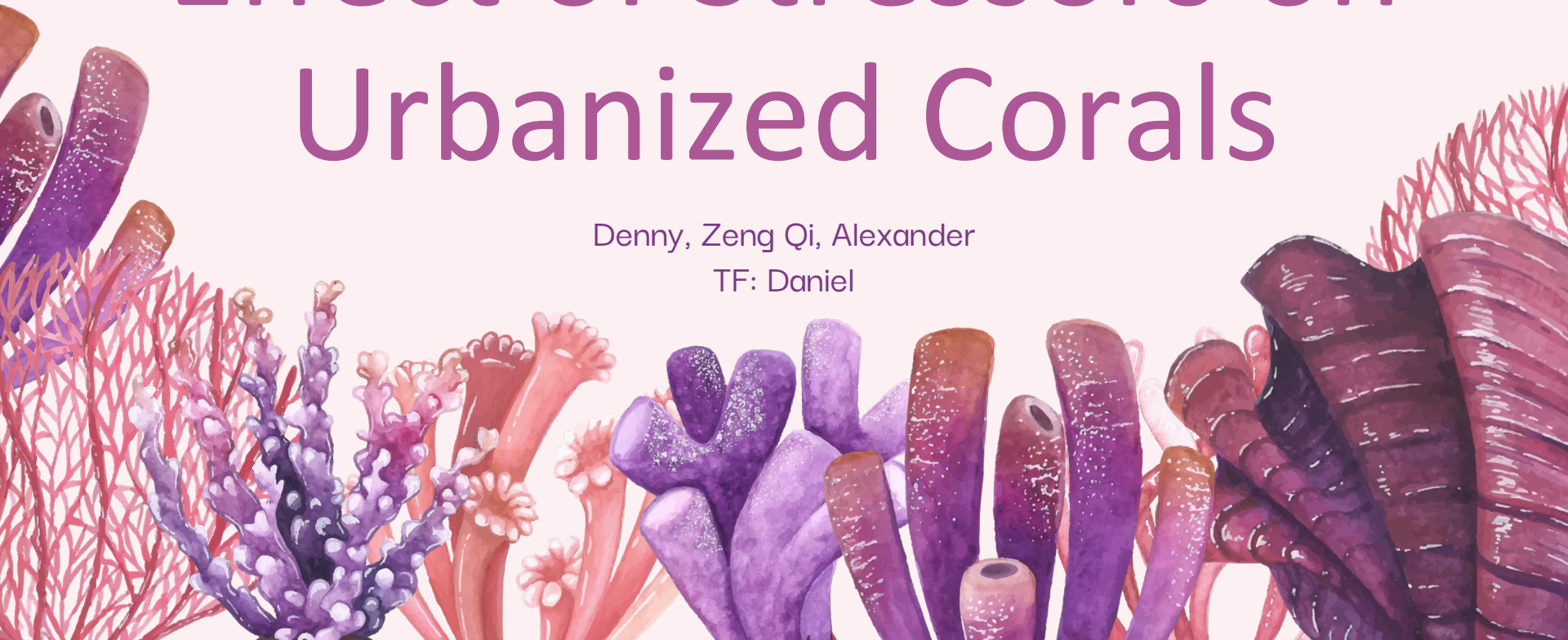
TF: Daniel



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Agenda

Background Introduction

Exploratory Data Analysis

Future Goals

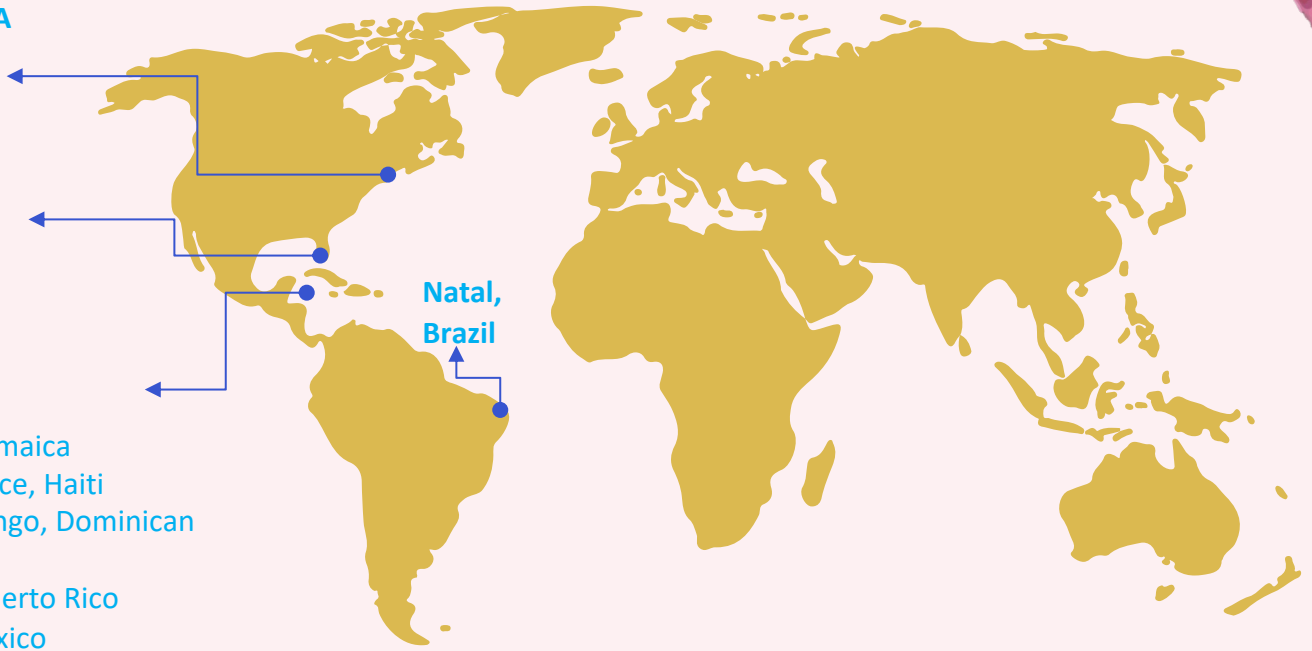
Caroline is a PhD candidate at Urban Program

- Urban Biogeoscience and Environmental Health
- A member of the Rotjan Marine Ecology Lab
- Investigating the physiological effects of urban pollutants on the temperate coral Astrangia poculata in Narragansett Bay, Rhode Island

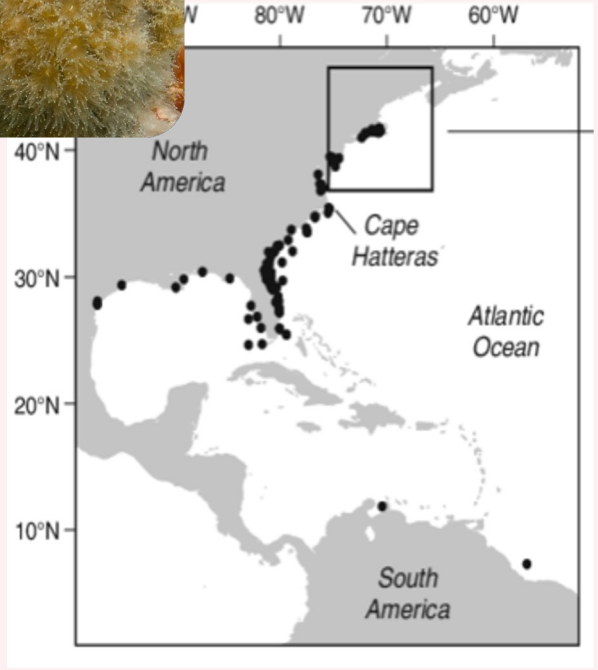
Astrangia poculata is the subject of our client's research

Corals lives in urban areasin

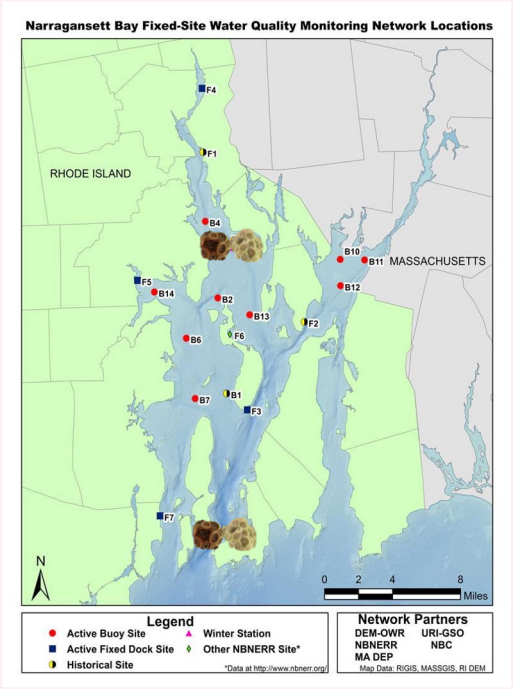
- **Northeastern USA**
  - NYC
  - Providence
  - New Bedford
- **Miami, Florida**
- **Caribbean**
  - Kingston, Jamaica
  - Port-au-Prince, Haiti
  - Santo Domingo, Dominican Republic
  - San Juan, Puerto Rico
  - Cancun, Mexico
  - Havana, Cuba
  - Barranquilla, Colombia
  - Cartagena, Colombia



Astrangia poculata is an urban coral



Narragansett Bay, RI



- Established history of nutrient and bacterial pollution
  - Balint et al. 2021, Tyrell et al. 1995
- Large population of *A. poculata*

Research Process

Sample acquisition

- Diving and coral collection
- Coral fragmentation & assigning

4mm

TREATMENTS

Ammonium NH4
Nitrate NO3

Concentrations
Extreme
High
Ambient
Zero

Symbiotic
Aposymbiotic

Combined in a single jar

22 °C Ambient

30 °C Elevated

Fed

Starved

Treatment summary:
2 N species x
4 N levels x
2 temperatures x
2 feeding regimes
= 32 treatment combinations

22 °C

NH4 / NO3
Extreme / high / low / ambient
Fed / Starved

30 °C

NH4 / NO3
Extreme / high / low / ambient
Fed / Starved

METHODS

Survival

Polyp Extension Score

Imaging & color analysis

Photosyntheic Efficiency (PAM)

Microplate respirometry + E. coli challenge

Metabolite profiling

Schedule

Day 1 Day 2 Day 3 Day 4 Day 5 Day 6 Day 7 Day 8 Day 9 Day 10 Day 11 Day 12

We eventually obtain **four** outcomes.

- PAM (numerical) → **Symbiont health**
- Respiration (numerical) → **O_2 consumption**
- RGB (numerical) → **Red value = Breaching**
- Behavior (Interger) → **1 ~ 5 score**

We broke down the `treat_ID_full` column into **five different treatment factors**.

A_0_20_F_A

Pollution Type
- **A**: Ammonium
- **N**: Nitrate

Dose Level

Dose Level	Nitrate	Ammonium
Control	0	0
Low	1.5	5
Medium	5	7.5
High	18	10

Temperature
- **20**: 20°C
- **30**: 30°C

Feed
- **F**: Fed
- **S**: Starved

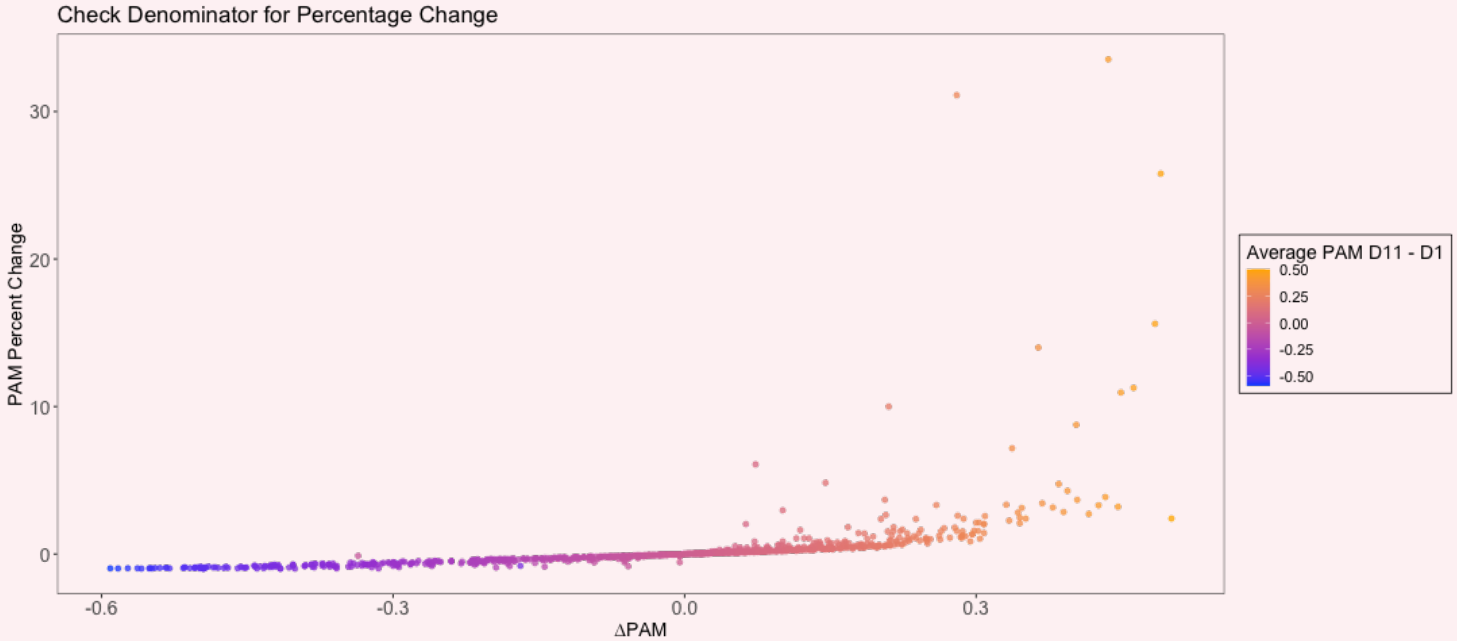
Symbiont
- **A**: Apo Symbiotic
- **S**: Symbiotic

And our first goal is the change in photosynthetic efficiency (PAM Δ%)

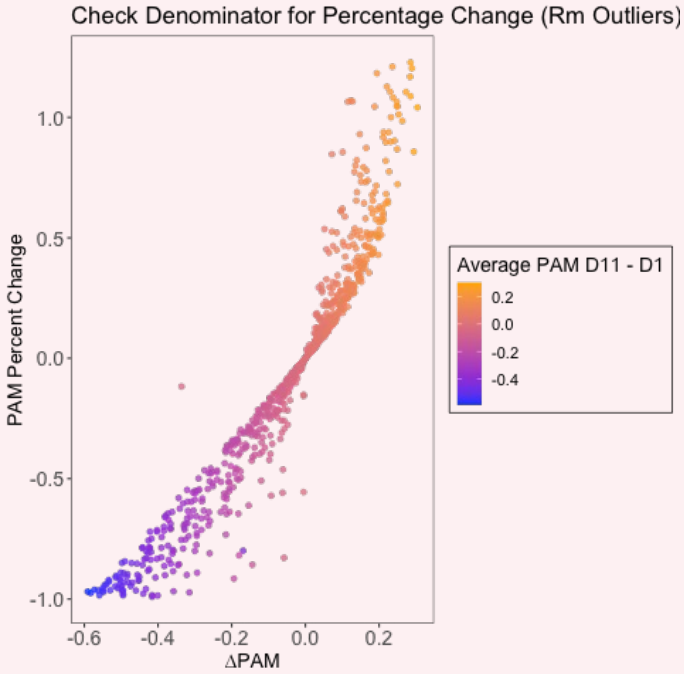
Pulse Amplitude Modulation (PAM) is a measurement of Photosynthesis.

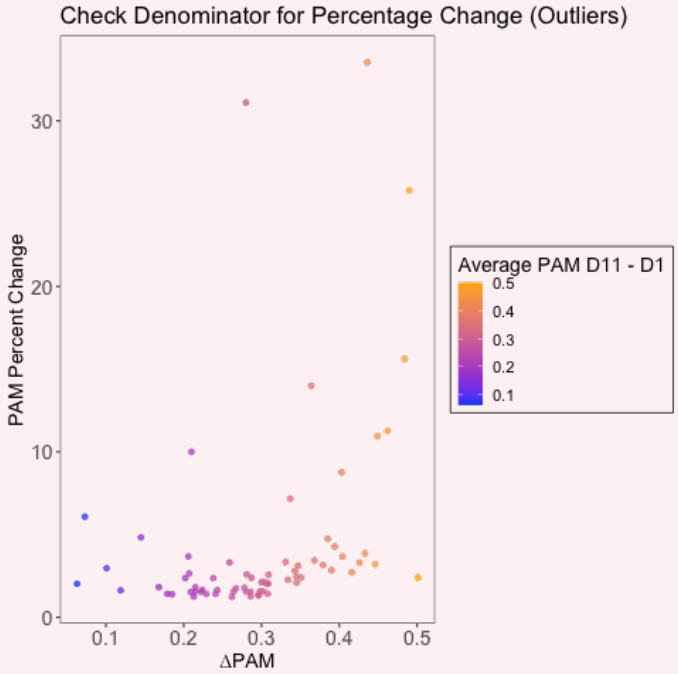
Pam_avg_day1	Average PAM on Day 1.
Pam_avg_day11	Average PAM on Day 11.
Pam_delta	Pam_avg_day11 – Pam_avg_day1
Pam_percent_change	Pam_delta / Pam_avg_day1
Pam_status	Pam_delta > 0 : increase -> better Pam_delta <= 0 : decrease -> worse

Since we are interested in **percentage change**, scale of the denominator matters.

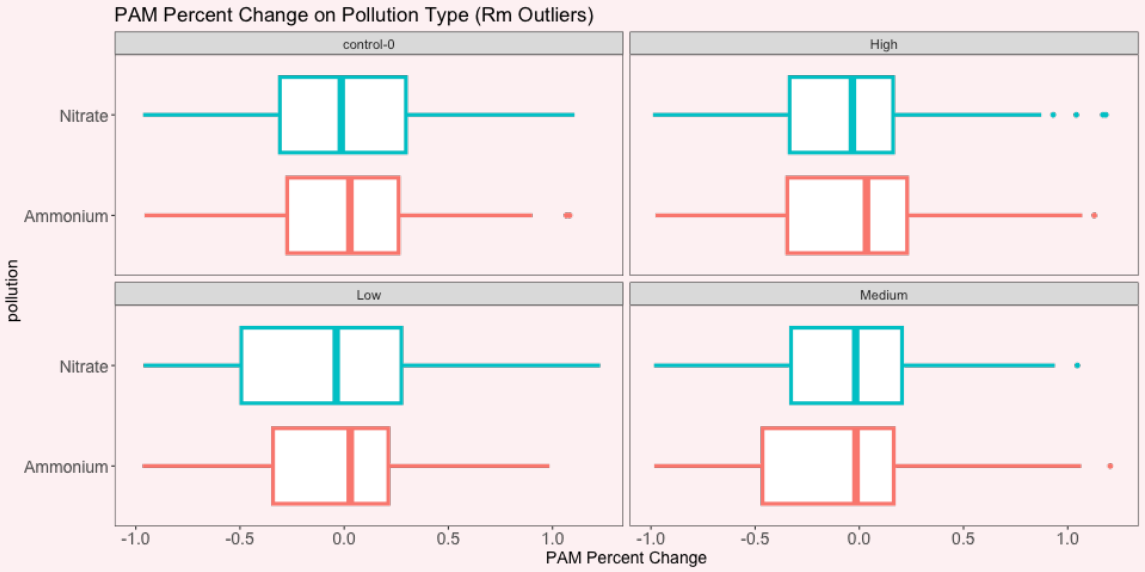


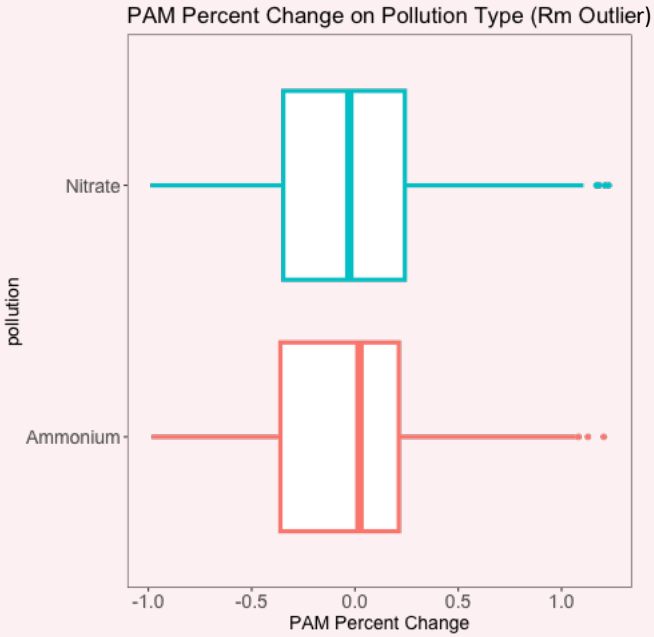
We boldly believe that **higher ΔPAM reflect a greater PAM percentage change.**



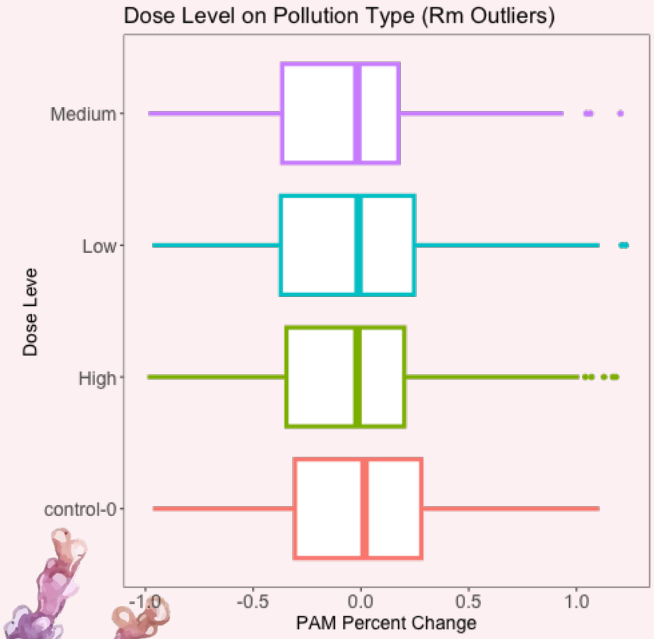


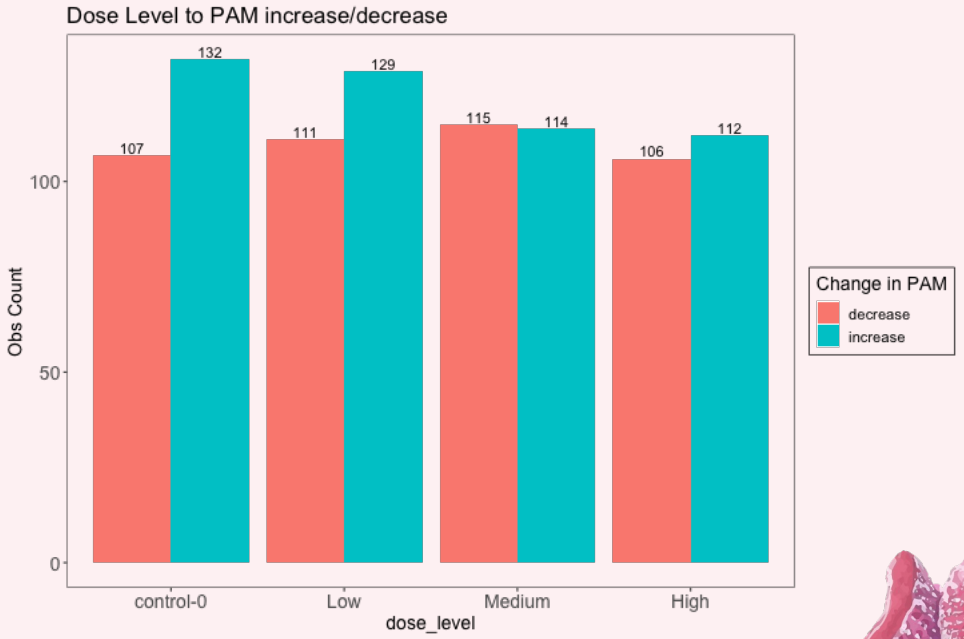
But The univariate analysis results **did not show significant differences** in the PAM change.



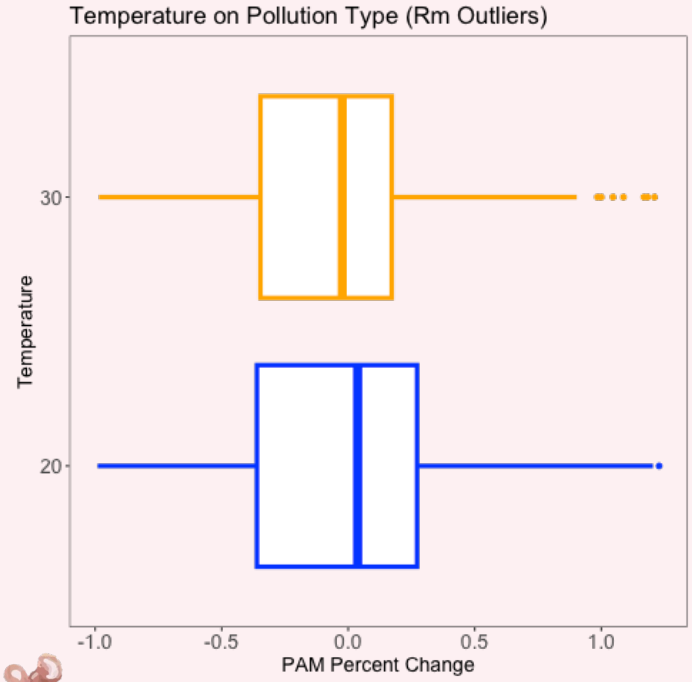


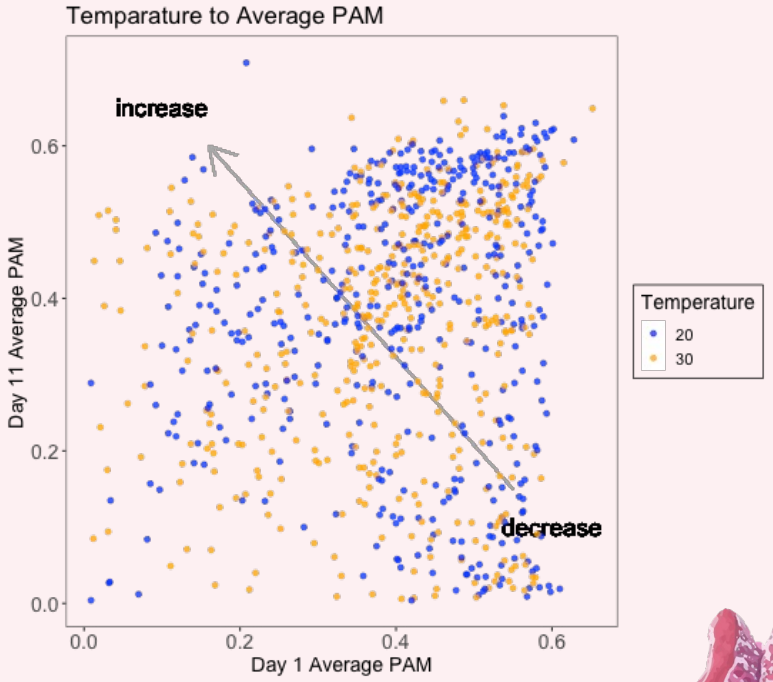
Looking solely at dose levels, there was **no decisive difference**.



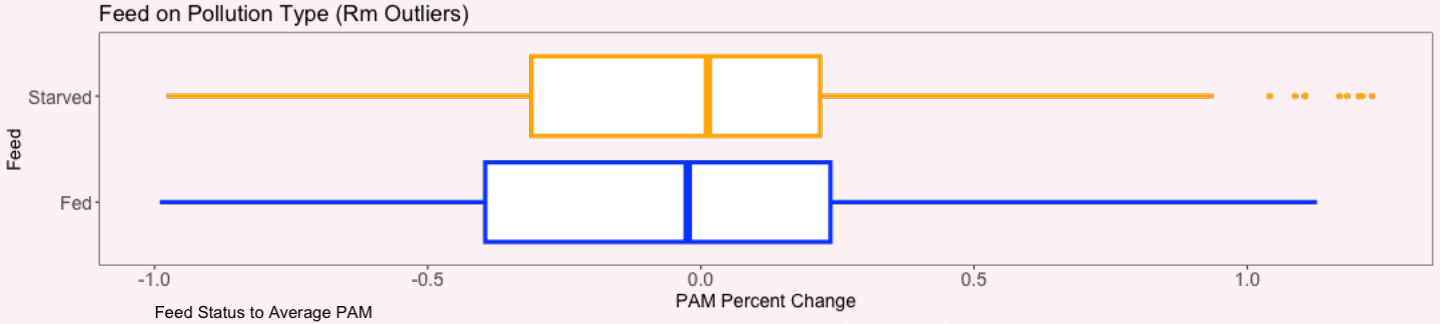


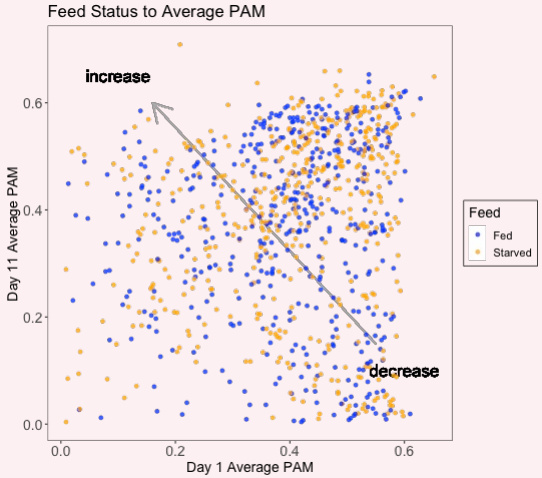
Neither the **temperature** factor.

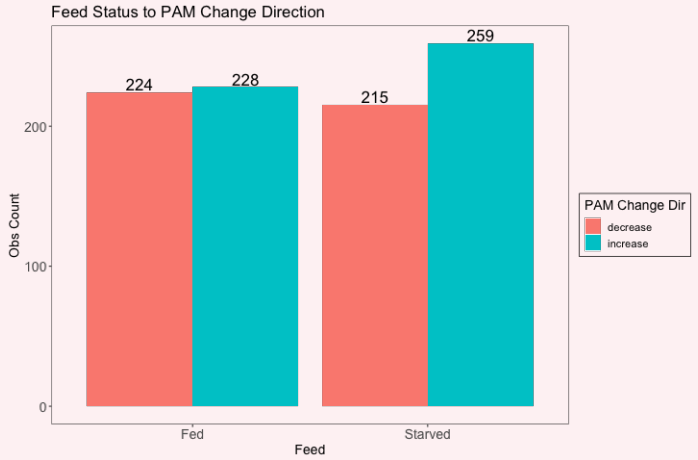




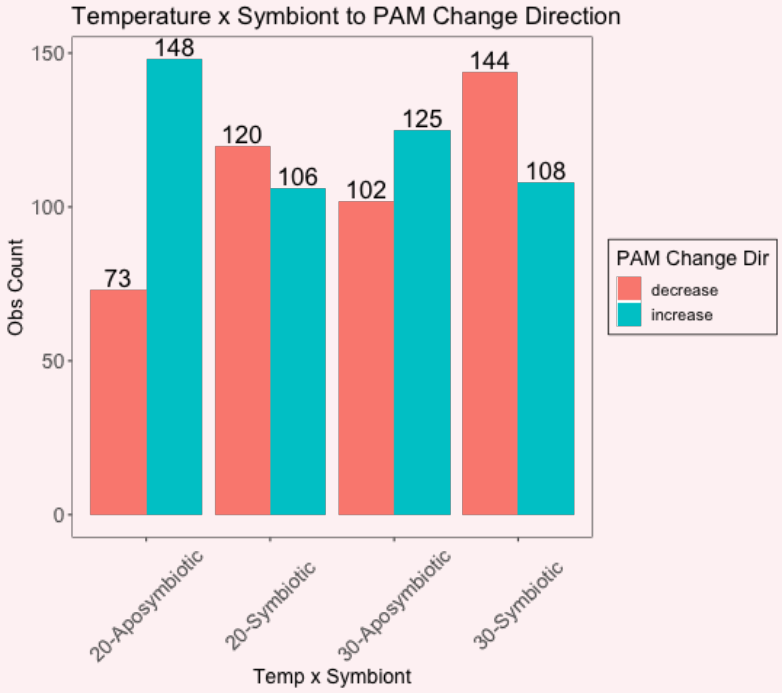
Also, there isn't an obvious difference on the **Feed** factor.

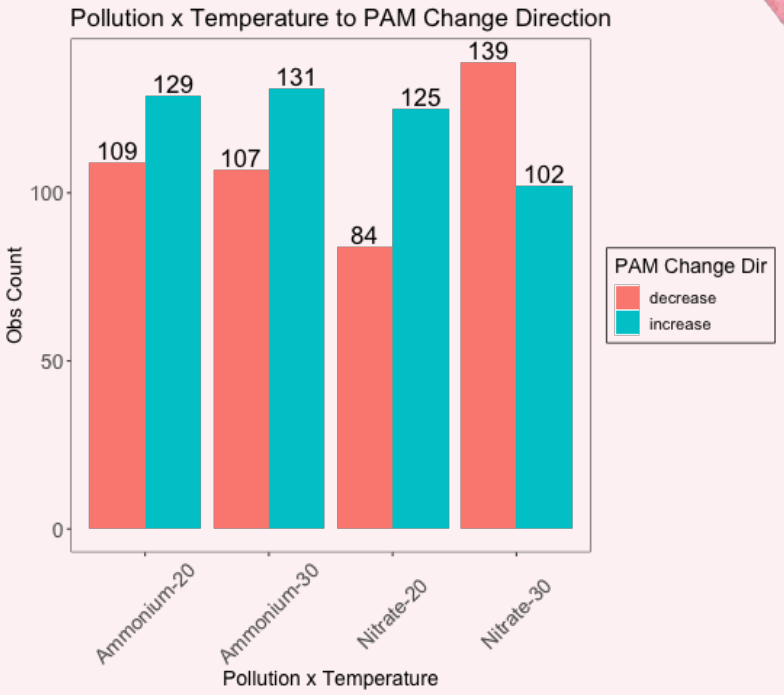




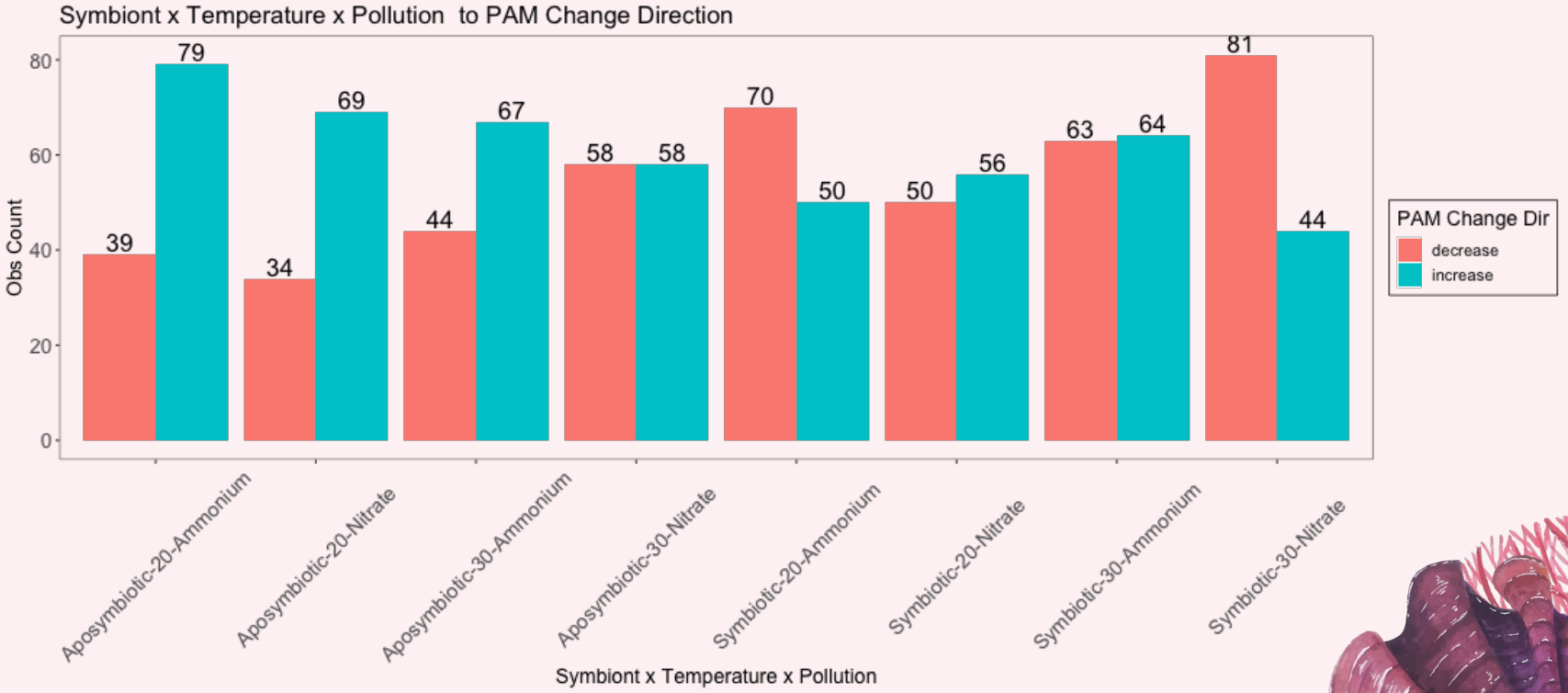


But things **go different** when we started looking at **factors combinations**.

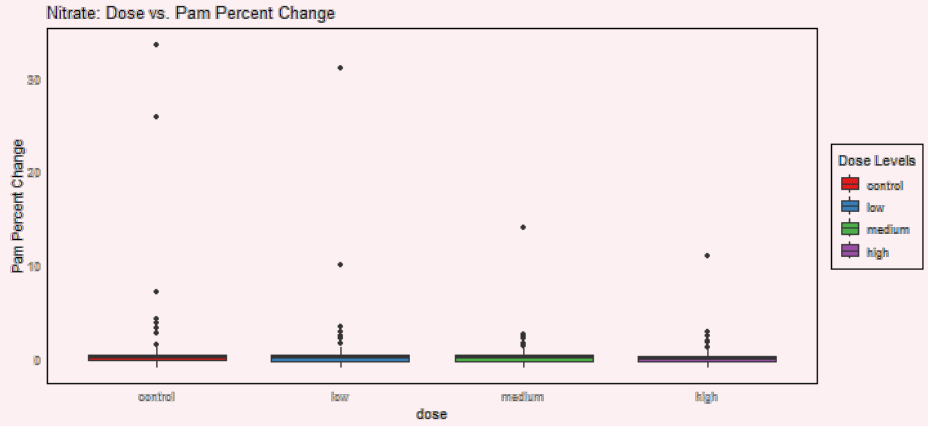


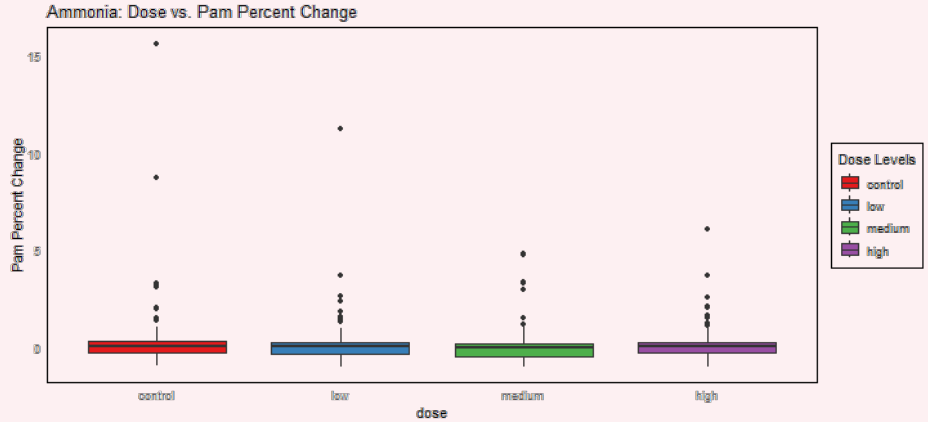


The PAM change direction **becomes more apparent** as the combination **gets more complicated**.



Dose = 0 is the control group.





Nitrate dataset

there is a significant variability at low and medium doses, while the variation at high doses is relatively small

Ammonia dataset

the highest variability is observed at medium doses.

The dose has interactive effects

pollution is Nitrate :

Feed x Dose:

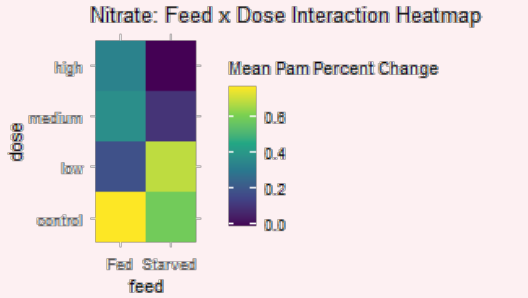
- In both Starved and Fed states, as the dose increases, pam_percent_change decreases.

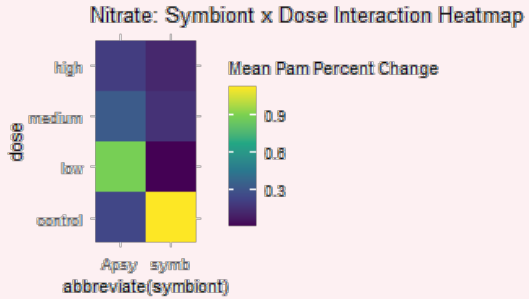
Symbiont x Dose:

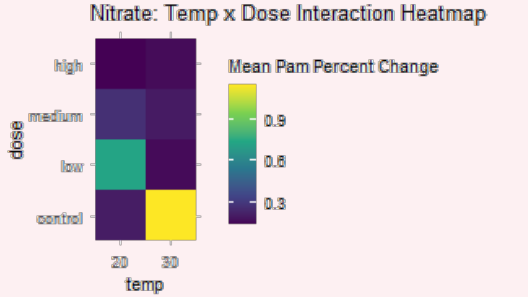
- With symbionts, pam_percent_change values are higher at low dose levels and decrease at other levels.
- Without symbionts, pam_percent_change values are lowest at the low dose level and increase at medium and high doses.

Temp x Dose:

- At 20°C, pam_percent_change values remain at lower levels.
- At 30°C, pam_percent_change decreases rapidly with increasing dose.







The dose has interactive effects

pollution is Ammonia :

Feed x Dose:

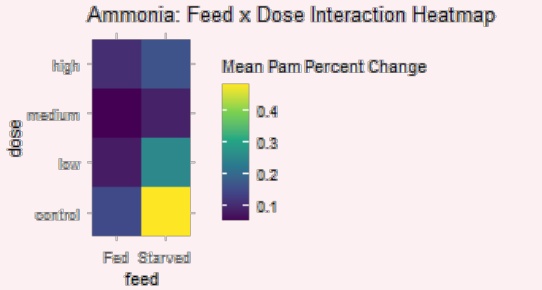
- In the fed state, pam_percent_change is lower.
- In the Starved state, as the dose increases, pam_percent_change decreases.

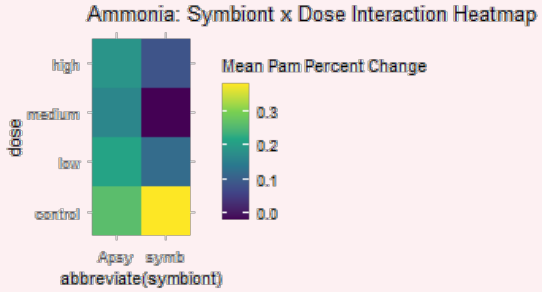
Symbiont x Dose:

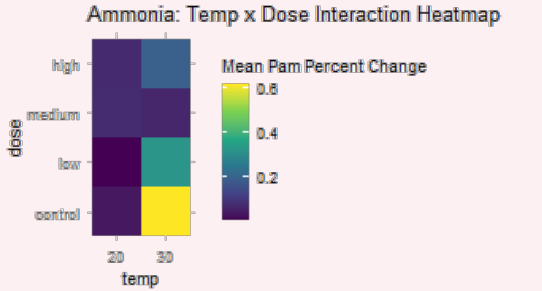
- Without symbionts, the pam_percent_change value at the control dose level is slightly higher.

Temp x Dose:

- At 20°C, pam_percent_change values remain at lower levels.
- At 30°C, pam_percent_change decreases rapidly with increasing dose, but it rebounds at the high dose level.







What will we do next?

1.

Explain how Bayesian regression works

2.

Explain what is a prior distribution and pick a suitable one if exists.

3.

Have at least one models to an outcome before January.

4.

Create a model for each outcomes (symbiont, respiration, RGB: red, Behavior)

Thanks

Do you have any questions?