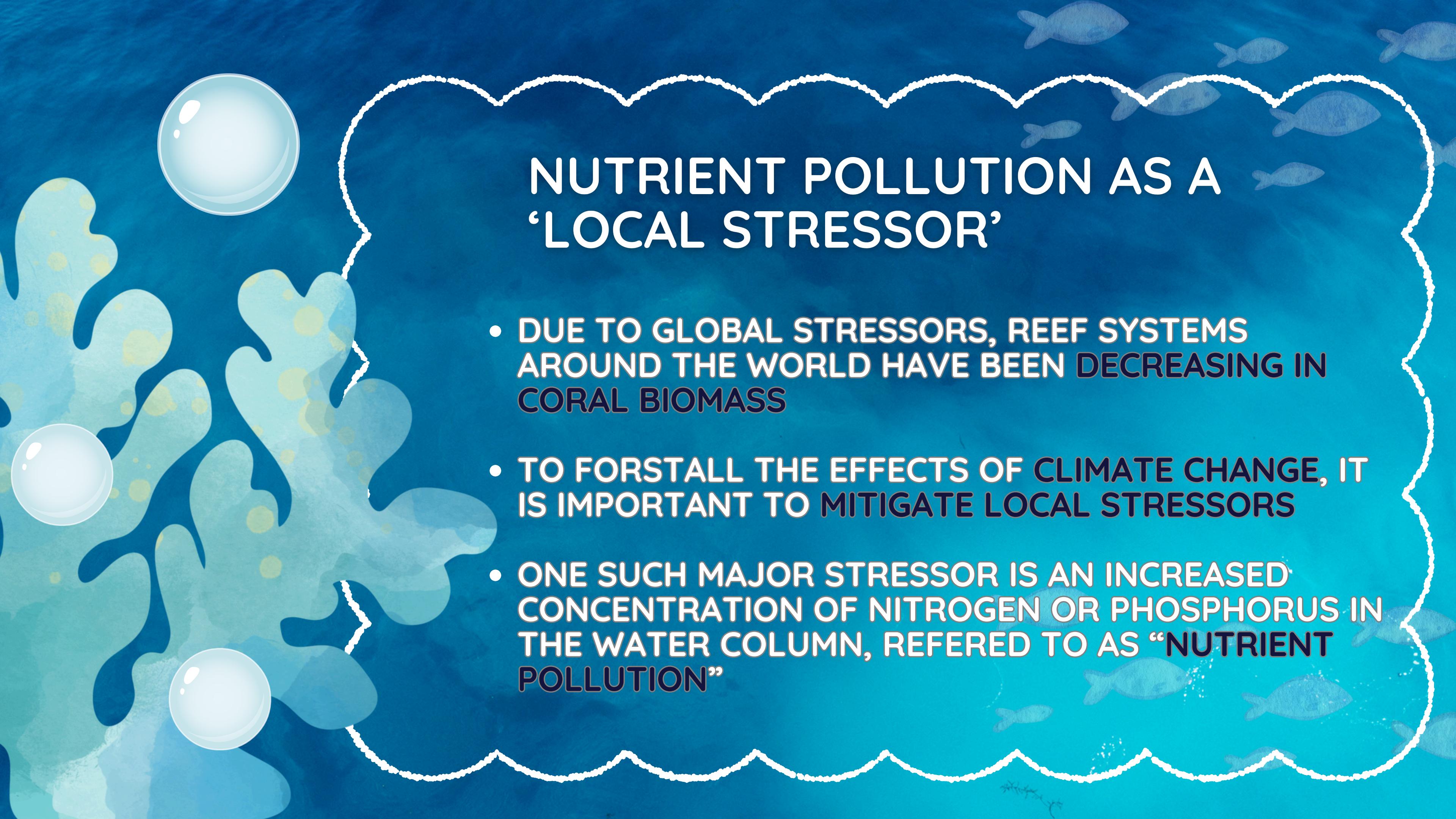


# NUTRIENT POLLUTION AND CORAL REEFS: ARE LARVAL POPULATIONS AT RISK?

MADISON ENDA  
EDS 222: STATISTICS FOR EDS  
12/09/2024

The background of the slide features a stylized underwater environment. On the left, there's a large, textured blue shape resembling a coral reef or kelp forest. Several white bubbles of varying sizes are scattered throughout the scene, some rising from the bottom and others floating in the middle ground. In the top right corner, a school of small, greyish-blue fish is swimming in a circular pattern. The overall color palette is shades of blue and teal.

## NUTRIENT POLLUTION AS A 'LOCAL STRESSOR'

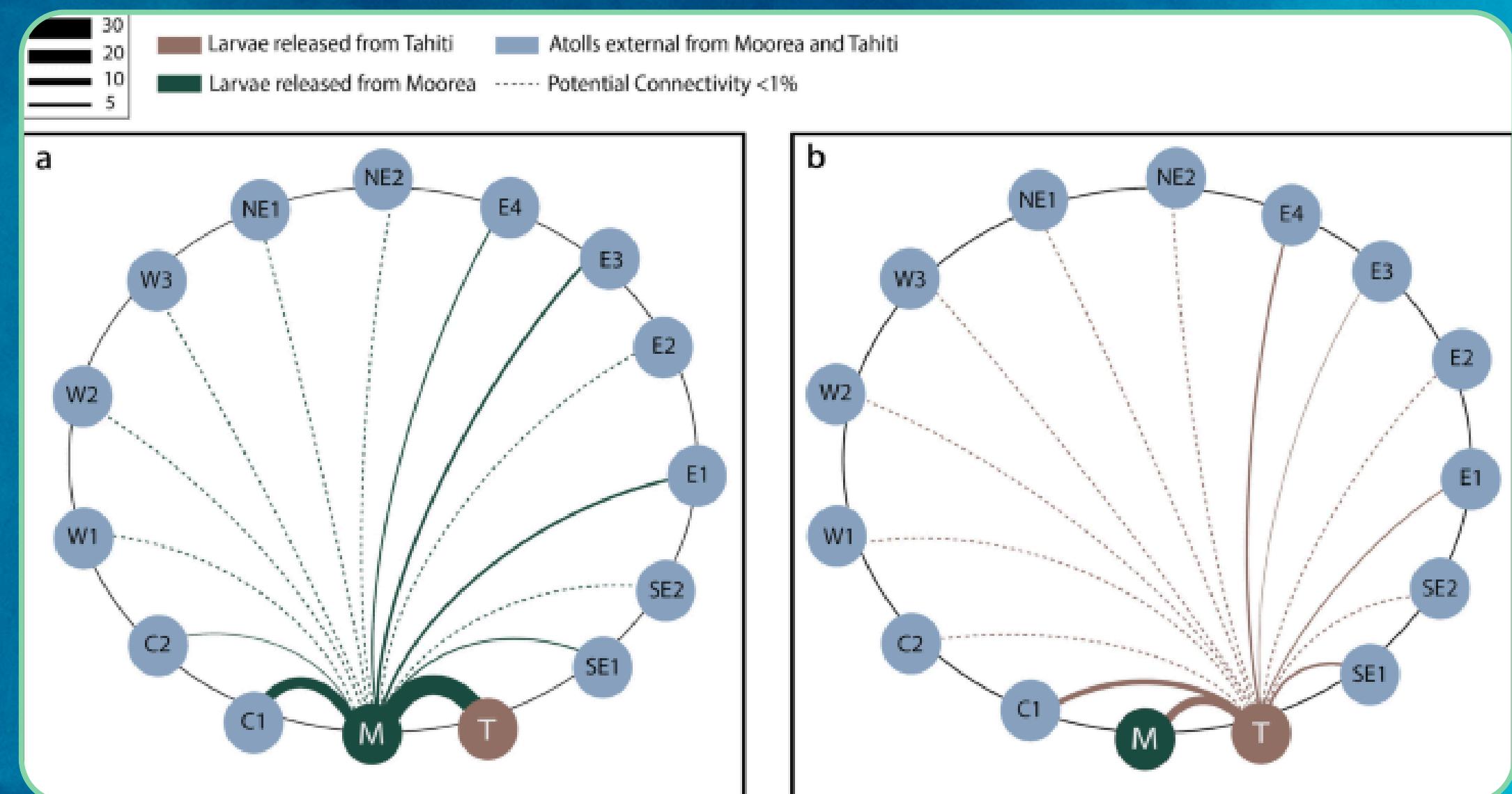
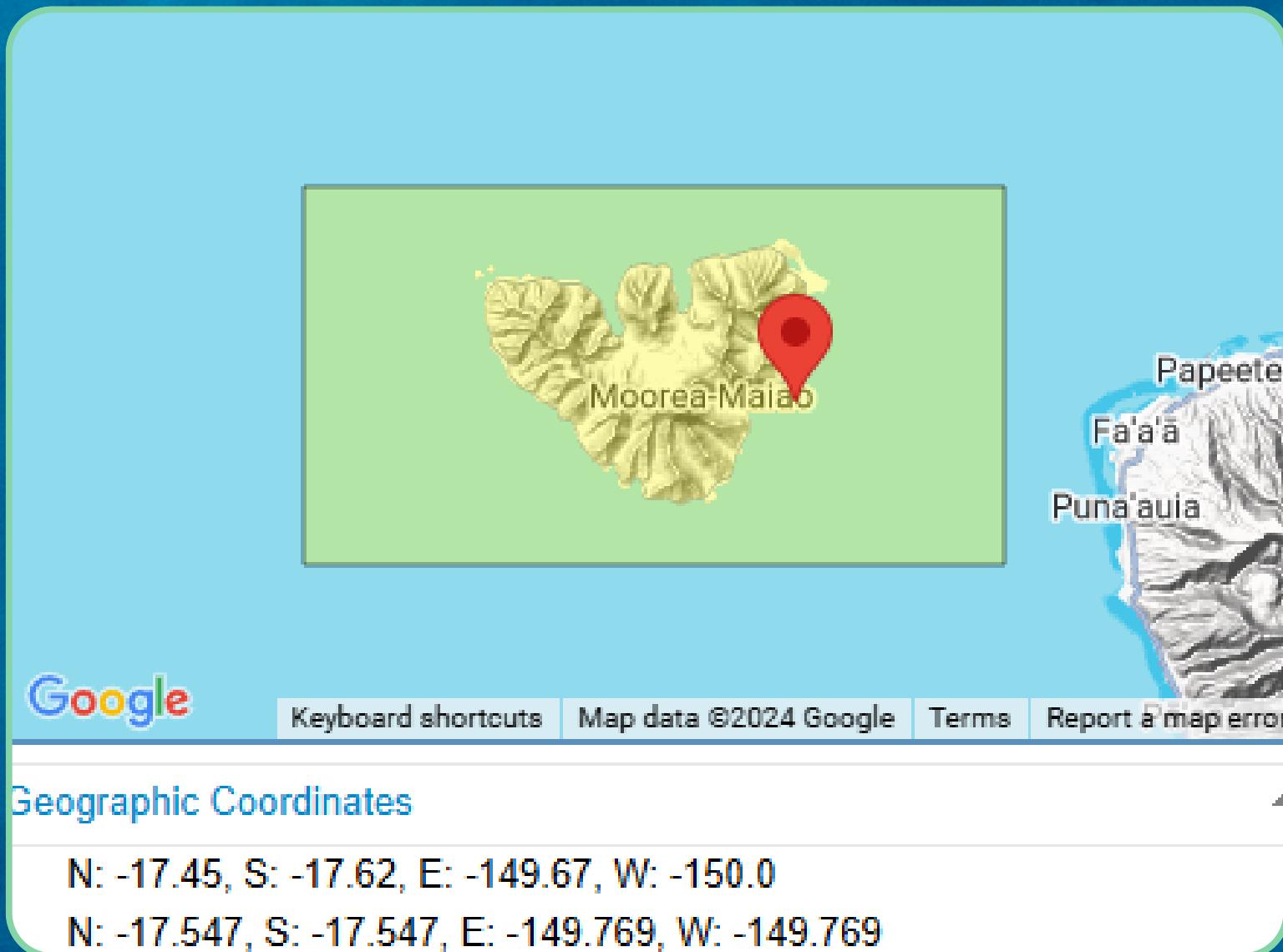
- DUE TO GLOBAL STRESSORS, REEF SYSTEMS AROUND THE WORLD HAVE BEEN DECREASING IN CORAL BIOMASS
- TO FORSTALL THE EFFECTS OF CLIMATE CHANGE, IT IS IMPORTANT TO MITIGATE LOCAL STRESSORS
- ONE SUCH MAJOR STRESSOR IS AN INCREASED CONCENTRATION OF NITROGEN OR PHOSPHORUS IN THE WATER COLUMN, REFERED TO AS "**NUTRIENT POLLUTION**"

# WHAT ARE WE LOOKING FOR?

- ADULT CORALS CAN DEAL WITH DISSOLVED INORGANIC NITROGEN (DIN) AND NITROGEN (N) IN THE WATER COLUMN
- THEIR Symbionts CAN MAKE USE OF IT TO PRODUCE SUGARS, ATP, AND OXYGEN FOR THE CORAL TO USE
- HOWEVER, CORAL LARVAE WOULD LIKELY NOT BE ABLE TO COPE WITH THE NEGATIVE EFFECTS OF PURE NITROGEN AS WELL WITH THEIR LOW SYMBIONT LOADS
- I WAS INTERESTED IN SEEING IF THERE WAS ANY CORRELATION BETWEEN NITROGEN CONTENT AND THE LARVAL POPULATION, AND IF THAT IN TURN AFFECTS THE ADULT DISTRIBUTION

# SITE OF INTEREST: MOOREA, TAHITI LTER SITE 4

FIGURE 1.) SHOWS THE LOCATION WHERE THE DATA WAS COLLECTED (MCR LTER WEBSITE, 2024)



# MODEL 1: NO INTERACTIONS

Year	Algae	Nitrogen	Temp	Adult_Pop	Larval_Recruits
2013	2481.093	0.8627778	27.89	9	38
2014	2122.400	0.7026667	27.14	33	31
2015	2193.600	0.5860000	27.80	39	51
2016	1953.800	0.8646667	27.97	38	27

TABLE 1.) MEAN DATA GROUPED BY YEAR FOR THE ADULT CORAL COUNTS MODEL. THE UNIT FOR ALGAE DRY WEIGHT ( G), NITROGEN CONCENTRATION IS IN WEIGHT PERCENT OF ALGAE, TEMPERATURE IS IN DEGREES CELSIUS, AND BOTH ADULT POPULATION AND LARVAL RECRUITS ARE IN COUNTS

```
Call:  
lm(formula = Adult_Pop ~ Larval_Recruits + Algae, data = acro_data)  
  
Residuals:  
    1      2      3      4  
-0.78304  2.54078 -0.06457 -1.69317  
  
Coefficients:  
            Estimate Std. Error t value Pr(>|t|)  
(Intercept) 159.916650 18.280657  8.748  0.0725 .  
Larval_Recruits  0.682923  0.193226  3.534  0.1755  
Algae        -0.070971  0.009254 -7.670  0.0825 .  
---  
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1  
  
Residual standard error: 3.153 on 1 degrees of freedom  
Multiple R-squared:  0.9833,   Adjusted R-squared:  0.9499  
F-statistic: 29.42 on 2 and 1 DF,  p-value: 0.1293
```

FIGURE 3.) THE LINEAR REGRESSION MODEL FOR THE NON-INTERACTION CORAL COUNTS DATA

- DUE TO LACK OF ALIGNMENT BETWEEN THE DATA SETS, THE MODEL COULD NOT UTILIZE INTERACTIONS
- OVERALL, THERE IS LITTLE CONTRIBUTION FROM EITHER OF THE COEFFICIENTS TO THE MODEL
- WITH OUR P-VALUE, WE CANNOT CLAIM THAT THESE VARIABLES ARE HIGHLY CORRELATED (EFFECTS COULD BE CHANCE)



# MODEL 2: LARVAL:NITROGEN INTERACTION

FIGURE 4.) THE LINEAR REGRESSION MODEL FOR THE INTERACTION REGRESSION ON CORAL BIOMASS

```
Call:
lm(formula = coral_cover ~ Larval_Recruits + Algae + Nitrogen +
    Temp + Larval_Recruits:Nitrogen, data = acro_data_7)

Residuals:
   1      2      3      4      5      6      7      8 
0.187111 -0.134637 -0.141670  0.104926  0.009547 -0.056687  0.045147 -0.013736 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) -6.3589782  7.0191251 -0.906   0.4606    
Larval_Recruits 0.1090842  0.0313785  3.476   0.0737 .  
Algae        -0.0007993  0.0005309 -1.506   0.2711    
Nitrogen       1.3028797  1.9745061  0.660   0.5772    
Temp          0.2448541  0.2573716  0.951   0.4418    
Larval_Recruits:Nitrogen -0.1105027  0.0351219 -3.146   0.0879 .  
---
Signif. codes:  0 '****' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2118 on 2 degrees of freedom
Multiple R-squared:  0.9619,    Adjusted R-squared:  0.8667 
F-statistic: 10.11 on 5 and 2 DF,  p-value: 0.09248
```

- OUT OF ALL THE INTERACTIONS, THE LARVAL RECRUITS:NITROGEN INTERACTION HAD THE LOWEST P-VALUE, INCREASED R-SQUARED THE MOST, AND DECREASED THE RESIDUALS THE MOST.
- THERE IS STILL LITTLE CONTRIBUTION FROM THE COEFFICIENTS TO THE MODEL
- WITH OUR P-VALUE, IT IS STILL LIKELY THESE RESULTS ARE DUE TO CHANCE

Year	Algae	Nitrogen	Temp	Coral_Cover	Larval_Recruits
2009	2311.575	0.7454500	27.21	0.2285714	23
2010	2270.207	0.6881724	27.77	0.0488372	20
2011	2552.082	0.9279592	27.14	0.0138889	107
2012	2469.520	0.9688000	27.58	0.0390244	124
2013	2481.093	0.8627778	27.89	0.1428571	38
2014	2122.400	0.7026667	27.14	0.4233333	31
2015	2193.600	0.5860000	27.80	1.7641026	51
2016	1953.800	0.8646667	27.97	0.4062500	27

TABLE 2.) MEANS OF THE CORAL COVER MODEL DATA, WITH INCREASED TIMESCALE. UNITS FOR ALGAE ARE IN DRY WEIGHT (G), NITROGEN IS IN WEIGHT PERCENT OF ALGAE, TEMPERATURE IS IN DEGREES CELSIUS; CORAL COVER IS IN PERCENT COVER OF A 0.25 SQUARE METER TRANSECTS, AND LARVAL RECRUITS IS IN COUNTS.

# PLOS BIOLOGY

OPEN ACCESS

PRIMER

## Youthful insight: Nitrogen sequestration in larvae provides clues to coral bleaching

Christian R. Voolstra 

Published: November 13, 2024 • <https://doi.org/10.1371/journal.pbio.3002890>

Article	Authors	Metrics	Comments	Media Coverage
				

### Abstract

References

Reader Comments

Impaired nutrient cycling under thermal stress foregoes coral bleaching, the loss of symbiotic algae. A new study in *PLOS Biology* sheds light on how coral larvae avoid bleaching through nitrogen sequestration to uphold glucose translocation from their algal symbionts.

Citation: Voolstra CR (2024) Youthful insight: Nitrogen sequestration in larvae provides clues to coral bleaching. PLoS Biol 22(11): e3002890.  
<https://doi.org/10.1371/journal.pbio.3002890>

Published: November 13, 2024

# CONCLUSIONS

CORAL LARVAE MAY HAVE INCREDIBLE  
REGULATORY PROCESSES THAT INCREASE  
THEIR THERMAL TOLERANCE OVER THEIR  
ADULT COUNTERPARTS!

EPHEMERAL CHANGES ARE KEY COMPONENTS  
IN UNDERSTANDING NUTRIENT POLLUTION

# REFERENCES:

## DATA:

CURRENT PATTERNS AND BIOCHEMISTRY AT MOORING SITE FOR04 [USED FOR LARVAL DISPERSION AND RESIDENCY TIME IN THE WATER COLUMN]:  
[HTTPS://PORTAL.EDIREPOSITORY.ORG/NIS/MAPBROWSE?PACKAGEID=KNB-LTER-MCR.31.43](https://portal.edirepository.org/nis/mapbrowse?packageid=KNB-LTER-MCR.31.43)

CORAL RECRUITMENT DATA (ISLAND WIDE) [USED FOR LARVAL DENSITY]: [HTTPS://PORTAL.EDIREPOSITORY.ORG/NIS/MAPBROWSE?PACKAGEID=KNB-LTER-MCR.4001.13](https://portal.edirepository.org/nis/mapbrowse?packageid=KNB-LTER-MCR.4001.13)

MACROALGAE AND NUTRIENT POLLUTION (ISLAND WIDE) [USED FOR AVERAGE NUTRIENT POLLUTION CONCENTRATION AND PREDICTED INCREASES]:  
[HTTPS://PORTAL.EDIREPOSITORY.ORG/NIS/MAPBROWSE?PACKAGEID=KNB-LTER-MCR.20.21](https://portal.edirepository.org/nis/mapbrowse?packageid=KNB-LTER-MCR.20.21)

ALgal BIOMASS IN COMPARISON TO CORALS (ISLAND WIDE) [USED TO COMPILE AVERAGE PERCENTAGES OF ALGAE IN POPULATION]:  
[HTTPS://PORTAL.EDIREPOSITORY.ORG/NIS/MAPBROWSE?PACKAGEID=KNB-LTER-MCR.8.36](https://portal.edirepository.org/nis/mapbrowse?packageid=KNB-LTER-MCR.8.36)

DEMOGRAPHY INFORMATION FOR THREE KEY CORAL SPECIES (ISLAND WIDE) [USED FOR MORTALITY RATES, RECRUITMENT PERCENTAGE, AND IDENTIFYING WHICH SPECIES TO USE IN MODELS]: [HTTPS://PORTAL.EDIREPOSITORY.ORG/NIS/MAPBROWSE?PACKAGEID=KNB-LTER-MCR.4009.5](https://portal.edirepository.org/nis/mapbrowse?packageid=KNB-LTER-MCR.4009.5)

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THANK YOU :)