Symbiont Shuffling Hypothesis, and the correlation Between Environmental Factors and Associated with symbiont composition

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Symbiont Shuffling: Adaptive Bleaching Hypothesis

Buddemeier and Fautin suggests the Adaptive Bleaching Hypothesis, stating that corals holds the plasticity in adapting to thermally stress environment by shuffling their symbiotic algae from non heat tolerant algae clades to more heat tolerant algae clades, and hence gaining heat toleration under heat stress environments (Buddemeier & Fautin, 1993)

Even though a significant number of studies has been conducted on the Adaptive Bleaching Hypothesis, its controversies remain, with no studies confirming whether corals has gained thermal tolerance after the shuffling process, and the microbiological aspects of coral bleaching and shuffling remains inconclusive.

Evidence Supporting Symbiont Shuffling

Among evidence that supports the symbiont shuffling theory, there Is a general trend in both lab and field studies for the corals who are primarily clade C symbiodiniums to shift to clade D after exposure to heat stress conditions. Although there is variation on the extent to which the shuffling happened and whether the clade D symbiodiniums remained after the heat stress event, the most convincing evidence for Symbiont shuffling lies in the shifting from clade C symbiodiniums to Clade D symbiodiniums in both field and lab studies. (Fabricius et al., 2004; Kuguru et al., 2007;Cunning et al., 2018 Newkirk et al., 2020; Buerger et al., 2020).

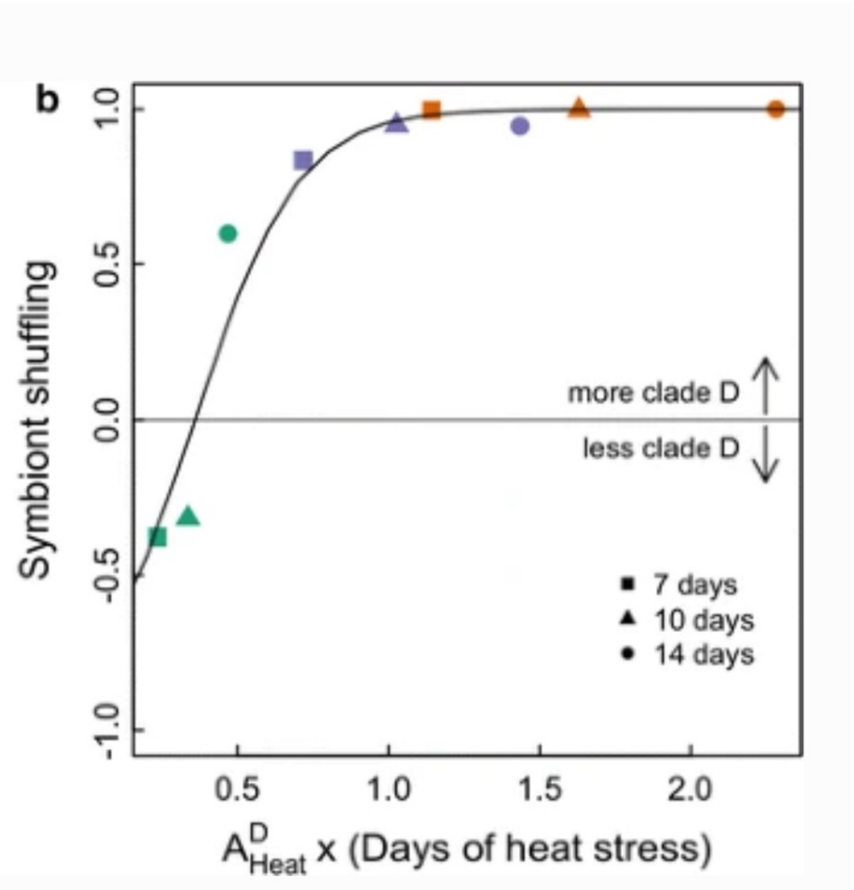


Figure 1, Cunning et al., 2018
This figure shows that the extent of shuffling from clade C symbiodiniums to clade D symbiodiniums is correlated with number of days of heat stress.

Evidence Against Symbiont Shuffling

In Jones et al's study in 2008 corals shifts back to clade D Symbiodinium after the recovery, and no evidence shows that after the coral has been more thermally tolerant after the recovery period and the drift back to the original composition of clade C Symbiodinium (Jones et al., 2008). In Cunning et al.'s study in 2014, it is stated that whether symbiont changes during and after stress depends on the severity and recovery environment of the coral holobiont, with no attempts of showing whether coral gained thermal tolerance after the shuffling of the symbionts takes place (Cunning et al., 2015)

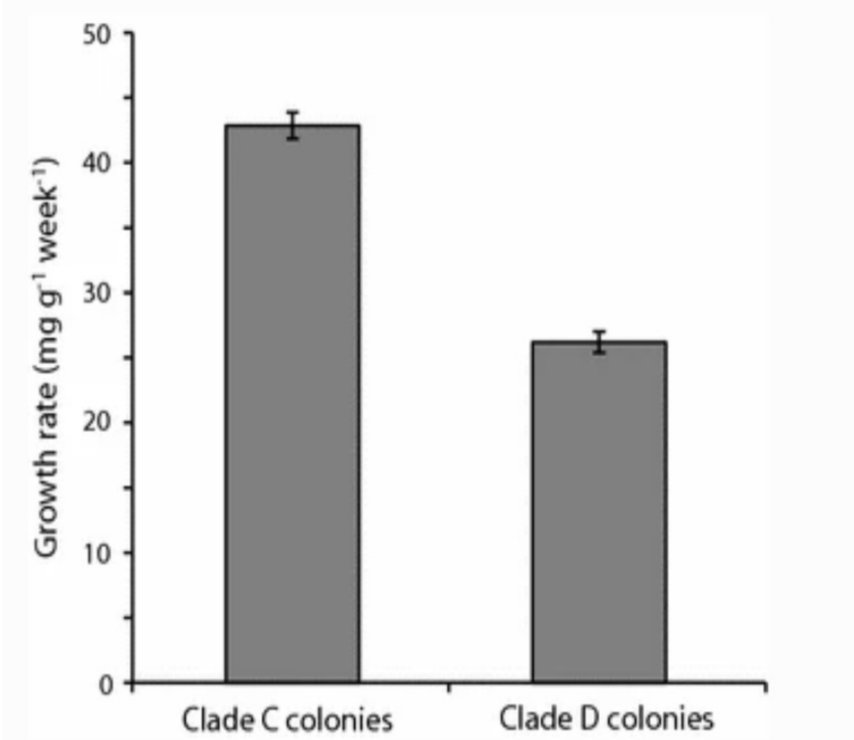
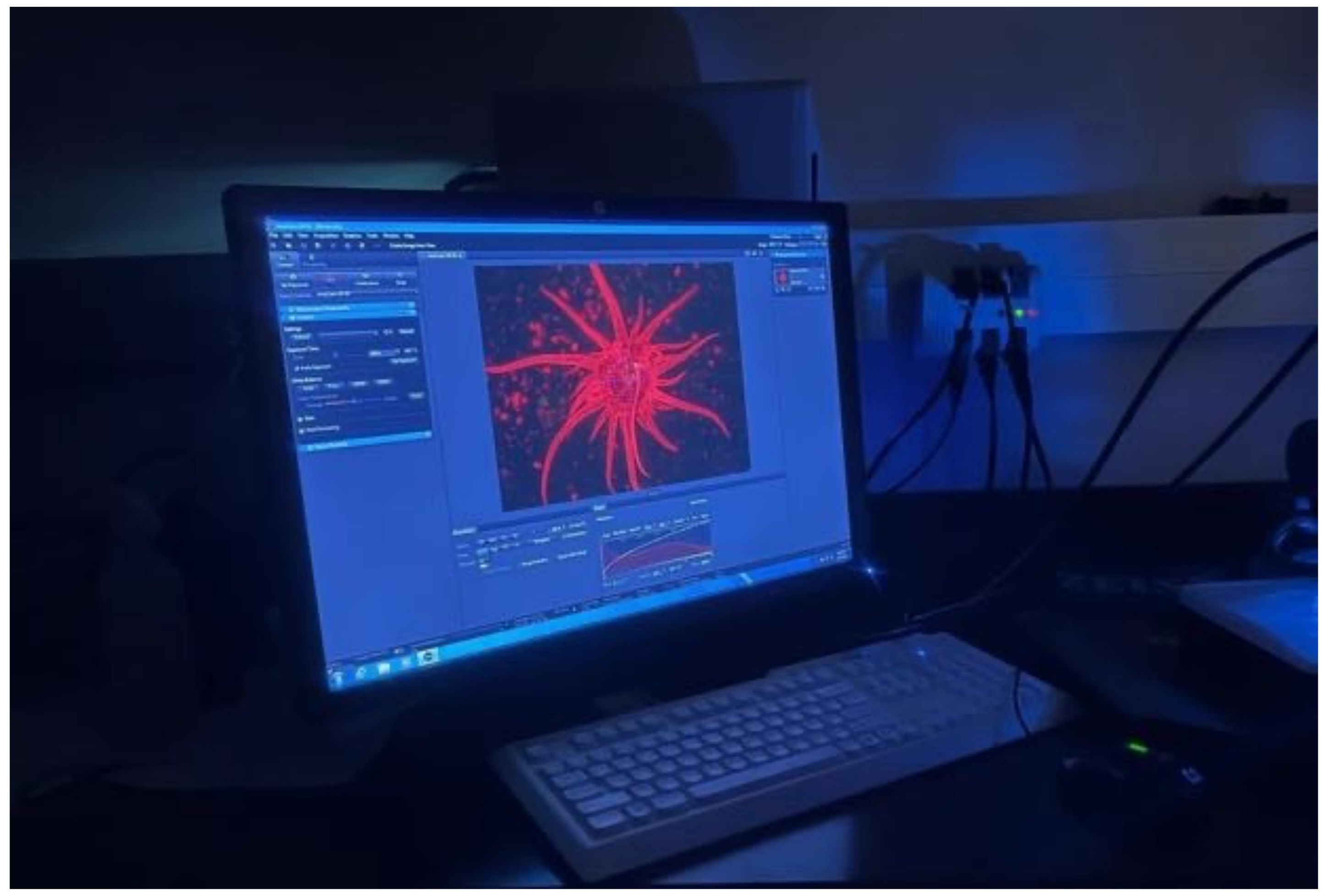


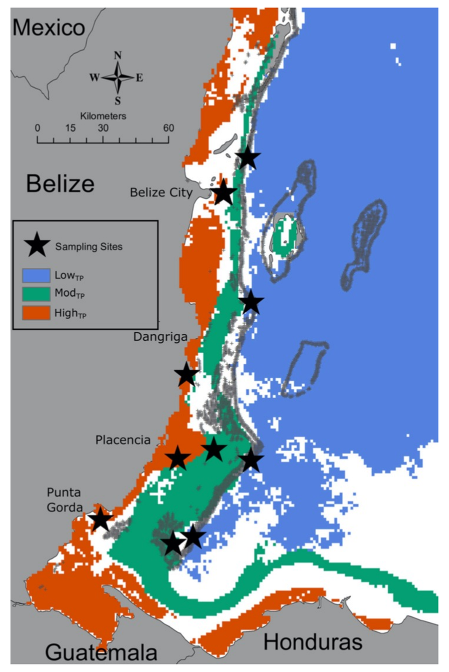
Figure 2, Cunning et al., 2016
Cunning et al. presented an explanation factor for the drifting from Clade C to Clade D, while drifting back to Clade D to Clade C symbiodiniums after the heat stress. Due to the fact that Clade D colonies has a disadvantage in growth, clade C is preferred, especially in the early recovering stages where growth is crucial to the coral holobiont.

Compiling Environmental Factors Associated With Symbiont Type Changes



S.p. Aiptasia and its symbionts

Hypothesis: Siderastrea siderea is associated with clade C symbiodiniums before bleaching events, and after bleaching events, they are associated with clade D symbiodiniums. It is also expected that other variables such as depth, temperature, near shore or not, and geographical locations.



Baumann et al., 2017
Map refrence for latitude and sampling sites

Steps to this Metanalysis

i. Collecting papers published in the last 20 years with data associated with symbiodinium community data on the coral siderastrea sidereal
ii. Clean and organize data into categories (e.g. field sites, different times of the year, geographical locations, sampling methods)
iii. Conduct Data Analysis such as ANOVA or model selection technique in R to explain the relationship within the data collected

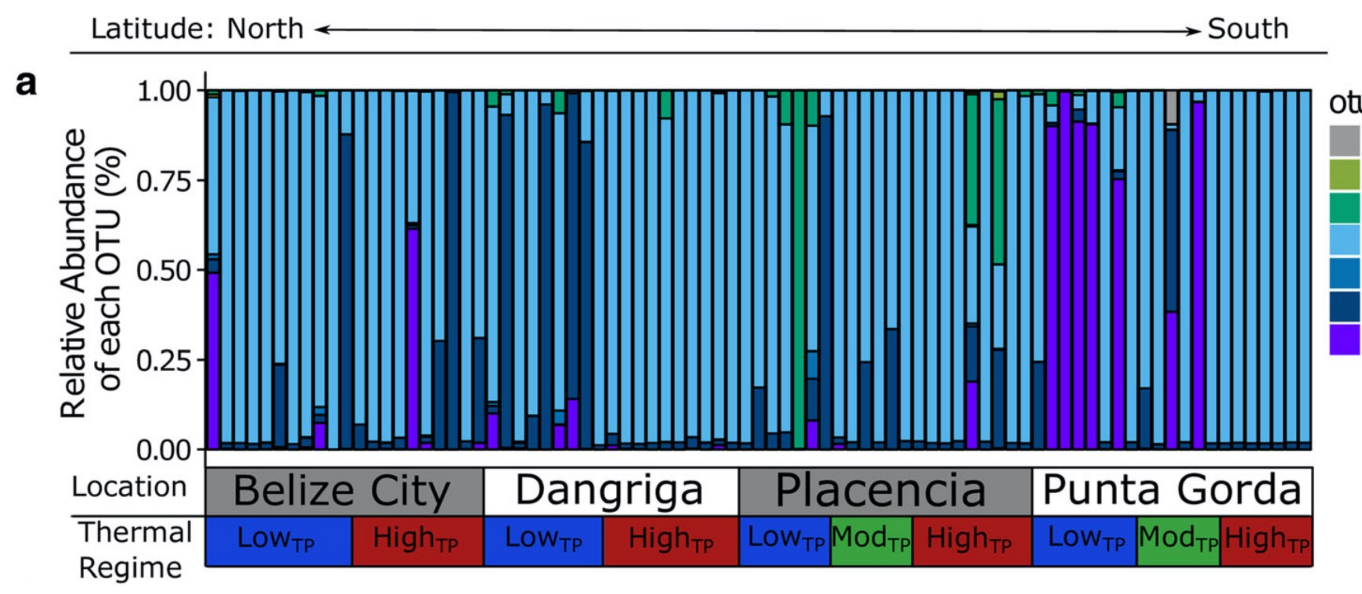


Figure 3, Baumann et al., 2017
This figure illustrate how latitude and temperature correlates with symbiodinium composition in Siderastrea siderea, where a low temperature correlates with south.

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