WHAT CAN FOSSILS TELL US ABOUT THE EFFECT OF CLIMATE CHANGE ON CORAL REEFS?

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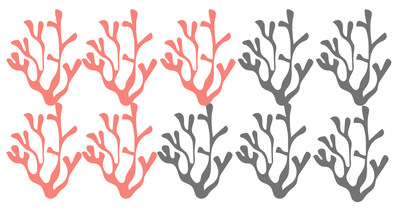
INTRODUCTION

Since 1950, it is estimated that the earth has lost over 50% of its coral reefs. These diverse ecosystems provide habitat and shelter for over 1 million species, protecting coastlines from storms and erosion and offering opportunities for tourism, employment, and the discovery of new medicines.

Over the next century, it is expected that global warming will rise by 2-4.8°C (O'Neill et al. 2017). This has the potential to be highly destructive to the biodiversity of millions of species, including coral reefs. Recent investigations into this estimate a further 40% of coral species could be lost in the next 30 years (Munday et al. 2008).



50%

An essential step towards conserving and protecting coral reefs is developing a better understanding of the potential consequences of human-induced climate change. One way to approach this is to model trends observed from the geological record, in which the Earth experienced a change in climate conditions similar to those we are seeing today. This will allow us to predict the probable effects of current and future climate change on coral reefs. This research analysed rates of speciation (evolution) in Scleractinia, a species of stony corals found across the globe.

In this investigation, a phylogenetic coral reef tree was analysed against atmospheric CO2, temperature, and sea level data to observe how coral reefs adjusted to changing conditions.

The results of this research will quantify how climate change will impact modern day coral diversity. This hypothesis reflects the outcomes of previous work for other marine species and aims to build upon the understanding of how changing climates affects coral reefs.

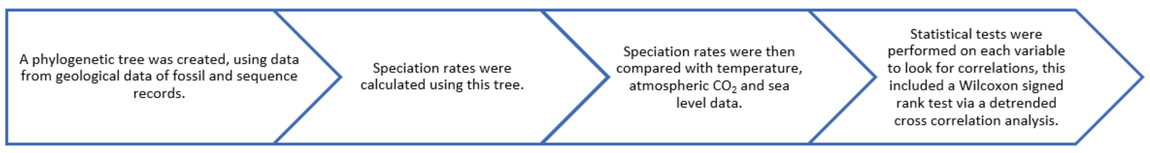
AIMS:

- To analyse prehistorical environmental data and test for correlations between speciation and environmental change.
- Use data to predict the effect of present day climate change on coral species.

HYPOTHESIS:

Coral reef diversity in the past was negatively impacted by climate conditions that are similar to those the earth is experiencing today.

METHOD



The methodology used R studio to undertake analysis of data (R Studio Team 2022)

WHAT THIS MEANS?

CONCLUSIONS

- Speciation was driven by cooler temperatures and lower atmospheric carbon dioxide concentrations.
- Further research into the impact of temperatures becoming similar to those estimated for future climate change would be necessary to draw reflections on the effect of present-day climate change on modern coral reefs.
- To further understand the effects of climate change on speciation of Scleractinia it would be necessary to investigate a wider range of environmental factors.
- Excluding the sea level results, the results of the analysis are in line with findings from relevant literature.
- However, despite the conclusions drawn, valid predictions about the future of extant Scleractinia cannot be concluded.

KEY INTERPRETATIONS

- Lack of correlations in sea level analysis could be due to large sample size, or the ability of Scleractinia to adapt to changing oceanic depths due to their morphology.
- Sea level increase could have been beneficial to Scleractinia as it counteracted rising temperatures (Hunt et al. 2020).
- Temperature increase decreased speciation due to coral bleaching.
- Carbon dioxide concentration increase decreased speciation due to ocean acidification also leading to coral bleaching.
- This data highlights the threat of climate change on coral reefs and the fundamental need for ocean management to prevent the approaching widespread loss of coral species.

RESULTS

Temperature

Hypothesis: Global temperature increase and speciation rates in Scleractinia will be significantly negatively correlated.

Findings: Significant negative correlation between temperature increase and speciation decrease found amongst Scleractinia. (Figure 1.0)

Atmospheric carbon dioxide

Hypothesis: Atmospheric CO2 and speciation rates in Scleractinia will be significantly negatively correlated.

Findings: A significant negative correlation between increases in atmospheric CO2 concentration and speciation rate decrease of Scleractinia was found in the phylogenetic tree (Figure 2.0)

Sea level

Hypothesis: Global temperature increase and speciation rates in Scleractinia will be significantly negatively correlated.

Findings: No correlation was found between sea level and speciation rates in Scleractinia (Figure 3.0)

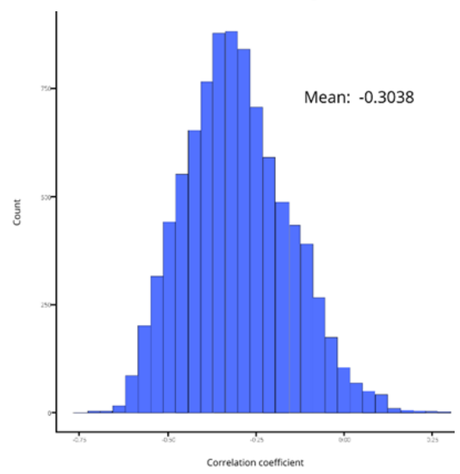


Figure 1.0: this histogram represents the results of correlational analysis showing a negative correlation between temperature and speciation

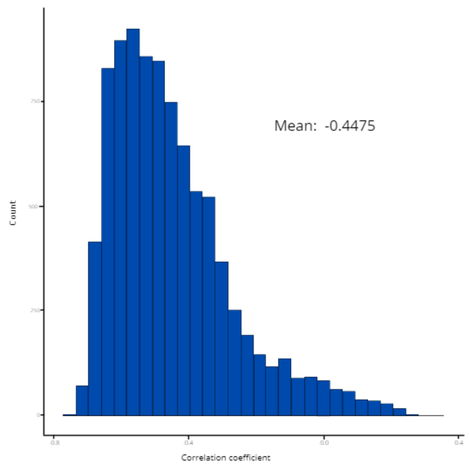


Figure 2.0: this histogram represents the results of correlational analysis showing a negative correlation between atmospheric carbon dioxide concentration and speciation

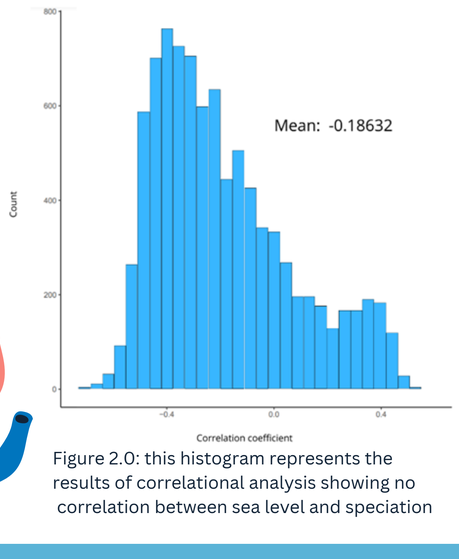


Figure 2.0: this histogram represents the results of correlational analysis showing no correlation between sea level and speciation

REFERENCES

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Information used to create this poster was extracted from an essay written by myself titled 'What can evolutionary modelling of coral reef diversity in the past tell us about how anthropogenic climate change will affect coral reef diversity today?' which is available on the Laidlaw Scholar Website

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