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GROWTH RATE OF FIVE BRANCHING CORALS AT MADRE REEF IN TABO-O, JIMÉNEZ, MISAMIS OCCIDENTAL

Charlemagne P. Recente, Maiko A. Dalagan, Van Rey Axton F. Carpo, Antonette L. Patac

Marine Biology Department, University of Science and Technology of Southern Philippines, Panaon Campus, Misamis Occidental, Philippines

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ABSTRACT

This observational study determined the growth rates of five branching coral species (Stylophora pistillata, Pocillopora damicornis, Seriatopora caliendrum, Acropora cervicornis, and Palaustrea ramosa) to assess the impact of environmental variations at Madre Reef in Tabo-o Jimenez, Misamis Occidental, from November 2023 to March 2024. Using a longitudinal, field-based design, the researchers conducted direct in situ measurements and observations to monitor coral development. The collected data were subjected to statistical analysis to identify significant differences in growth among the species and to test correlations between growth rates and environmental parameters, specifically dissolved oxygen and light penetration. Results revealed diverse growth patterns: S. caliendrum exhibited the highest average growth (28.6%), while P. damicornis recorded the lowest (11.5%). S. pistillata (19.6%), P. ramosa (18.8%), and A. cervicornis (17.8%) showed intermediate averages with notable seasonal fluctuations. Statistical analyses confirmed that seasonal environmental shifts significantly impacted growth; the Southwest monsoon increased turbidity, while the Northeast monsoon provided optimal conditions. These results emphasize a strong correlation between water quality metrics and coral development, underscoring the need for continuous monitoring to support regional reef conservation efforts.

Keywords: *Branching corals, Growth rates, Seasonal changes, Madre Reef, Coral health, Monsoon, Turbidity, Light availability, Dissolved oxygen*

INTRODUCTION

Coral reefs, constructed by scleractinian corals (Phylum Cnidaria, Class Anthozoa), are among the most biodiverse ecosystems on the planet (Baird et al., 2013; Hoegh-Guldberg et al., 2017). Often referred to as the 'rainforests of the sea,' these formations serve as vital breeding grounds, nurseries, and safe havens for various marine life (Moberg & Folke, 1999). Beyond their ecological significance, coral reefs play essential roles in providing coastal protection, supporting fisheries, and generating tourism opportunities. The foundational growth of these reefs relies on a mutualistic symbiosis with photosynthetic algae called zooxanthellae, which live within coral tissues and provide essential nutrients in nutrient-poor tropical waters (Baker et al., 2018; Muscatine & Porter, 1977). Specifically, the growth of branching corals plays a pivotal role in shaping these unique habitats and maintaining the overall health and structural complexity of the reef (Anderson et al., 2017).

Despite their ecological and economic importance, coral reefs face unprecedented and timely challenges driven by global climate change. Rising sea temperatures, ocean acidification, and the increasing frequency of extreme weather events pose severe threats to coral health and resilience (Hughes et al., 2018). Prolonged ocean warming, even in subtropical regions, has been shown to severely stunt coral growth and survival (Anderson et al., 2014). Understanding the biology, ecology, and corals' responses to these mounting environmental stressors is crucial for global conservation efforts (Grottoli et al., 2018).

While existing literature extensively documents the broad, global impacts of climate change on coral reef ecosystems, a significant research gap remains in understanding the localized, species-specific responses of corals to regional environmental variations. Global studies often lack the high-resolution, localized data necessary to understand how specific reef systems are changing (van Oppen et al., 2017; Bourne et al., 2016). Continuous, long-term monitoring and standardized, localized data collection are vital for accurately tracking environmental impacts on coral reef ecosystems and developing targeted management plans (Bruno et al., 2019; Gleason et al., 2019).

To address this gap and the observed increase in environmental stress on local reefs, this research monitors the growth rates of five specific branching coral species, *Stylophora pistillata, Pocillopora damicornis, Seriatopora caliendrum, Acropora cervicornis,* and *Pocillopora ramose*, at Madre Reef in Tabo-o, Jimenez, Misamis Occidental. By documenting these growth rates and correlating them with local environmental variations, this study provides essential, timely baseline data. This localized knowledge is a crucial step toward developing effective conservation strategies, implementing regional management measures, and safeguarding the resilience of the Madre Reef ecosystem for future generations.

Research Questions

1. What are the length and width growth rates of *S. pistillata*, *P. damicornis*, *S. caliendrum*, *A. cervicornis*, and *P. ramosa*?
2. What are the physicochemical parameters (temperature, light intensity, dissolved oxygen, turbidity, pH, and salinity) at Madre Reef in Tabo-o, Jimenez, Misamis Occidental?
3. Is there a significant difference in the growth rates among the branching corals, and do they significantly correlate with the physicochemical parameters?

METHODOLOGY

The study was conducted at Madre Reef in Tabo-o, Jimenez, Misamis Occidental (8.3309° N, 123.8567° E). A comparative-descriptive research approach was utilized, employing the manta tow method for systematic sampling to determine the taxonomic composition of branching coral species in the area. Five branches per colony were carefully selected and individually tagged with small plastic cable ties to ensure traceability and measure the linear extension of the coral branches.

Over a six-month monitoring period (September 2023 to March 2024), coral growth rates in both length and width were documented at bi-monthly intervals using a Vernier caliper. Simultaneously, specific data-gathering procedures for physicochemical parameters were conducted in situ to capture environmental conditions. The instruments used included a multimeter for dissolved oxygen and pH, a thermometer for temperature, a refractometer for salinity, a Lux meter for light penetration, and a turbidity meter.

The scope of this study was limited to monitoring the physical growth of these five specific branching corals and the designated physicochemical parameters during the study timeframe. For data analysis, statistical methods, including the nonparametric Mann-Whitney U test, were used to identify differences in growth rates among coral species. Additionally, correlation analysis utilizing the de Vaus 2002 correlation coefficient was applied to determine relationships between coral growth and water parameters.

RESULTS

Table 1. Percent growth rates of five branching corals in terms of length from September to March at Madre Reef in Tabo-o, Jimenez, Misamis Occidental.

	Growth Rates (%) in Length			
Coral species	**November**	**January**	**March**	**Average**
Stylophora pistillata	28.1	18.8	11.9	19.6
Pocillopora damicornis	17.9	6.0	10.4	11.5
Seriatopora caliendrum	39.5	19.6	26.6	28.6
Acropora cervicornis	17.7	21.6	14.0	17.8
Paluastrea ramosa	16.9	15.5	24.1	18.8

Table 2. Percent growth rates of five branching corals in terms of width from September to March at Madre Reef in Tabo-o, Jimenez, Misamis Occidental.

Growth Rate (%) in width				
Coral species	**November**	**January**	**March**	**Average**
Stylophora pistillata	15.0	22.4	18.7	18.7
Pocillopora damicornis	11.5	11.2	11.8	11.5
Seriatopora caliendrum	35.0	40.7	34.2	36.7
Acropora cervicornis	58.0	15.6	15.2	29.6
Paluastrea ramosa	30.0	30.8	24.7	28.5

Table 3. Physicochemical Parameters from the 1st sampling to the last sampling at Madre Reef in Tabo-o, Jimenez, Misamis Occidental.

	D.O (ppm)	**Salinity (ppt)**	**Temperature (°C)**	**pH**	**Turbidity (NTU)**	**Light pen. (LUX)**
Sept	4.57	40	32	8.359	0	140
Nov	7.64	38	27	9.57	50	120
Jan	8.73	37	30	9.74	0	161.5
Mar	9.37	40	38	8.178	4	171.4

Table 4. Statistical computation of the significant difference between and among the five species of branching corals.

Factor	**p-value**	**alpha**	**Decision**
S.pistillata* VS. *P.damicornis	0.01	0.05	Reject Ho.
S.pistillata* VS. *S.caliendrum	0.04	0.05	Reject Ho.
S.pistillata* VS. *A.cervicornis	0.00	0.05	Reject Ho.
S.pistillata* VS. *P.ramosa	0.27	0.05	Fail to Reject Ho.
P.damicornis* VS. *S.caliendrum	0.00	0.05	Reject Ho.
P.damicornis* VS. *A.cervicornis	0.02	0.05	Reject Ho.
P.damicornis* VS. *P.ramosa	0.00	0.05	Reject Ho.
S.caliendrum* VS. *A.cervicornis	0.00	0.05	Reject Ho.
S.caliendum* VS. *P.ramosa	0.52	0.05	Fail to Reject Ho.
A.cervicornis* VS. *P.ramosa	0.00	0.05	Reject Ho.
Among species	0.00	0.05	Reject Ho.

Table 5. Statistical computation of the significant relationship between the species of branching corals and the water parameters.

Factor	r- value	p-value	Correlation Strength
***S. pistillata* VS. Salinity**	0.16	0.83	Weak
***S. pistillata* VS. Temperature**	0.54	0.46	Strong
***S. pistillata* VS. Turbidity**	-0.24	0.75	Weak
***S. pistillata* VS. Dissolved Oxygen**	0.94	0.05	Almost perfect
***S. pistillata* VS. Light Penetration**	0.78	0.21	Very Strong
***S. pistillata* VS. PH Level**	0.01	0.99	Non-significant
***P. damicornis* VS. Salinity**	-0.20	0.80	Weak
***P. damicornis* VS. Temperature**	0.50	0.53	Moderate
***P. damicornis* VS. Turbidity**	-0.10	0.90	Weak
***P. damicornis* VS. Dissolved Oxygen**	0.98	0.02	Almost perfect
***P. damicornis* VS. Light Penetration**	0.70	0.31	Very strong
***P. damicornis* VS. PH Level**	0.07	0.93	Non-significant
***S. caliendrum* VS. Salinity**	-0.10	0.90	Weak
***S. caliendrum* VS. Temperature**	0.56	0.43	Strong
***S. caliendrum* VS. Turbidity**	-0.16	0.84	Weak
***S. caliendrum* VS. Dissolved Oxygen**	0.95	0.05	Almost perfect
***S. caliendrum* VS. Light Penetration**	0.74	0.26	Very strong
***S. caliendrum* VS. PH Level**	-0.04	0.96	Weak
***A. cervicornis* VS. Salinity**	-0.08	0.92	Weak
***A. cervicornis* VS. Temperature**	0.60	0.40	Strong
***A.cervicornis* VS. Turbidity**	-0.24	0.76	Weak
***A. cervicornis* VS. Dissolved Oxygen**	0.93	0.07	Almost perfect
***A. cervicornis* VS. Light Penetration**	0.79	0.21	Very strong
***A. cervicornis* VS. PH Level**	-0.07	0.93	Weak
***P. ramosa* VS. Salinity**	0.02	0.98	Non-significant
***P. ramosa* VS. Temperature**	0.66	0.34	Strong correlation
***P. ramosa* VS. Turbidity**	-0.24	0.76	Weak
***P. ramosa* VS. Dissolved Oxygen**	0.90	0.10	Almost perfect
***P. ramosa* VS. Light Penetration**	0.79	0.21	Very strong
***P. ramosa* VS. PH Level**	-0.17	0.83	Weak

DISCUSSION

The tabular data reveal diverse growth patterns among the observed species. As seen in Table 1, *S. pistillata* showed a decline in length growth from November to March (averaging 19.6%), suggesting environmental conditions may have worsened over time. *P. damicornis* exhibited the lowest overall growth rates, dropping significantly in January, which indicates a high sensitivity to environmental changes. Conversely, *S. caliendrum* displayed the highest average growth rate (28.6%), demonstrating resilience and adaptability to varying conditions.

These growth fluctuations corresponded closely with shifts in physicochemical parameters (Table 3). The decline in growth from November to January aligns with the Southwest monsoon, which is characterized by increased turbidity (50 NTU in November) and reduced light penetration, thereby negatively impacting coral growth. Conversely, the January to March period aligns with the Northeast monsoon, bringing clearer waters and better conditions for growth.

Statistical analysis using the Mann-Whitney U-test (Table 4) confirmed significant differences in growth between most species pairings, leading to the rejection of the null hypothesis for pairings such as *S. pistillata* and *P. damicornis*. However, species such as S. caliendrum and P. ramosa failed to reject the null hypothesis, suggesting they may occupy similar ecological niches or exhibit similar biological resilience.

Correlation analysis (Table 5) highlighted that dissolved oxygen and light penetration have an almost perfect to very strong correlation with coral growth across all species. This aligns with established literature emphasizing that optimal light levels are crucial for photosynthesis, which drives coral calcification and overall development.

Conclusions

The study confirms that the growth of the five branching corals at Madre Reef is significantly influenced by seasonal environmental changes. The study successfully measured the specific growth rates of length and width for the target species, noting that *S. caliendrum* demonstrated the most resilient growth, while *P. damicornis* was the most sensitive. The results confirm significant variations in growth rates among coral species, reflecting distinct adaptive capacities. Furthermore, the study emphasizes a strong statistical relationship between coral growth and specific physicochemical parameters: optimal light conditions and reduced turbidity during the Northeast monsoon favor coral development, whereas increased turbidity during the Southwest monsoon hinders it.

Recommendations

Based on the results, it is recommended to conduct future studies within Marine Protected Areas (MPAs) to mitigate damage from local anthropogenic activities. To enhance data reliability, future research should deploy surface buoys, increase the replication of coral branches to a minimum of 10 per species, and implement higher-frequency (monthly or daily) monitoring of physicochemical parameters to better capture environmental fluctuations and mitigate potential stressors.

Compliance with Ethical Standards

This study involved observational, in-situ measurements of marine coral species. All procedures were conducted with strict adherence to environmental protection, ensuring no destructive sampling occurred and the well-being of the marine ecosystem was maintained. No conflict of interest exists in the conduct of this study. Plagiarism was strictly avoided, and there was no bias in interpreting the results. The results were used purely for research purposes. The researchers declare that AI was used strictly for formatting and structuring the manuscript for publication

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Corresponding author: *charlemagne.recente@ustp.edu.ph*