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Biodiversity Assessment of Coral Reef Fauna under Rising Sea Temperatures

Dr. Tushar Mahendra Nagrale

Abstract
This study explores the impact of rising sea temperatures on the biodiversity of coral reef fauna, focusing on the relationship between thermal stress and changes in species diversity, abundance, and distribution. Coral reefs, which are among the most diverse marine ecosystems, are increasingly threatened by climate-induced temperature fluctuations that trigger coral bleaching and disrupt ecological balance. The research employs field-based biodiversity assessments, temperature monitoring, and statistical analyses to evaluate how warming seas influence coral-associated species such as fish, mollusks, and crustaceans. Findings are expected to reveal significant shifts in community composition, with a decline in sensitive species and an increase in thermally resilient ones. By identifying patterns of vulnerability and adaptation, this study contributes to a deeper understanding of ecological resilience within coral reef systems and provides valuable insights for formulating effective conservation and management strategies in the face of global climate change.
Keywords: Coral Reef Biodiversity, Rising Sea Temperature, Coral Bleaching, Marine Fauna, Climate Change

Introduction
Coral reefs represent one of the most biologically diverse and productive ecosystems on Earth, often referred to as the “rainforests of the sea.” They provide critical habitats for approximately 25% of all marine species despite occupying less than 1% of the ocean floor. However, the health and biodiversity of coral reefs are increasingly threatened by anthropogenic climate change, particularly through the rise in sea surface temperatures. Elevated temperatures disrupt the delicate symbiotic relationship between corals and their photosynthetic algae, *zooxanthellae*, leading to coral bleaching—a phenomenon where corals lose their color and essential energy source, ultimately resulting in large-scale mortality if stressful conditions persist. The cascading effects of such thermal stress extend beyond corals to the entire reef-associated fauna, including fish, mollusks, crustaceans, echinoderms, and other invertebrates that depend on the structural complexity and resources provided by healthy coral systems. Rising sea temperatures, often coupled with ocean acidification, deoxygenation, and pollution, alter species composition, reduce biodiversity, and impair ecosystem functioning. Assessing the biodiversity of coral reef fauna under changing temperature regimes is, therefore, essential to understanding the extent of ecological disruption and resilience within these ecosystems. This assessment not only helps identify vulnerable and thermally tolerant species but also provides valuable insights for conservation strategies, management interventions, and predictive modeling of future reef conditions under continued global warming. The Indian Ocean, Pacific, and Caribbean reefs have shown

varying degrees of degradation, highlighting the influence of local environmental factors and adaptive capacities. Hence, a comprehensive evaluation of coral reef fauna biodiversity in response to rising sea temperatures is vital for safeguarding marine biodiversity, sustaining fisheries, and maintaining ecological balance. Through an integrative approach combining field observation, biodiversity indices, and statistical analysis, this study seeks to evaluate how temperature fluctuations affect faunal diversity, abundance, and distribution patterns, thereby contributing to the broader discourse on coral reef conservation in a rapidly warming world.

Background of the Study

Coral reefs are among the most complex and vital marine ecosystems, supporting immense biodiversity and providing essential ecological services such as coastal protection, carbon sequestration, and fisheries sustenance. However, these ecosystems are facing unprecedented threats due to global climate change, particularly the continuous rise in sea surface temperatures. Elevated temperatures cause coral bleaching, wherein corals expel their symbiotic algae, leading to reduced growth, weakened health, and often large-scale mortality. Such disturbances have severe implications for the vast array of marine fauna—fish, crustaceans, mollusks, and echinoderms—that depend on coral reefs for food, shelter, and breeding grounds. As ocean temperatures continue to rise, biodiversity loss and ecosystem imbalance are becoming more pronounced, endangering marine productivity and local livelihoods. Hence, assessing the biodiversity of coral reef fauna under thermal stress conditions is crucial for understanding ecological vulnerability and guiding effective conservation and restoration efforts globally.

Rationale of the Study

The increasing rise in sea temperatures poses a significant threat to coral reef ecosystems, which serve as vital hotspots of marine biodiversity. Understanding how thermal stress affects coral reef fauna is essential for predicting ecosystem responses and formulating conservation strategies. While numerous studies have examined coral bleaching, fewer have focused on how temperature fluctuations influence the diversity and distribution of associated marine species. This study addresses that critical gap by assessing changes in faunal composition, abundance, and resilience under varying thermal conditions. The findings will contribute to identifying vulnerable and adaptive species, enhancing our understanding of ecological thresholds in coral reef systems. Moreover, the study's outcomes can inform policymakers, marine biologists, and conservation planners about effective management and restoration approaches, helping to mitigate biodiversity loss and ensure the long-term sustainability of coral reef ecosystems in the face of accelerating climate change.

Coral reef ecosystems are experiencing rapid degradation due to the continuous rise in global sea temperatures caused by climate change. This increase in temperature disrupts the symbiotic relationship between corals and their *zooxanthellae*, resulting in bleaching events that compromise the health and stability of entire reef systems. While extensive research has documented the physiological effects of thermal stress on corals, there remains limited understanding of how rising sea temperatures specifically affect the diversity, abundance, and distribution of coral-associated fauna such as fish, mollusks, crustaceans, and echinoderms. The decline in coral health directly impacts these dependent species, leading to altered community structures and potential ecosystem collapse. Therefore, the central problem addressed by this study is the lack of comprehensive biodiversity assessment of coral reef fauna under thermal stress conditions, which is crucial for predicting ecological resilience and developing informed conservation and management strategies for sustaining marine biodiversity.

Importance of Coral Reefs in Marine Ecosystems

Coral reefs are often described as the "rainforests of the sea" due to their extraordinary biodiversity and ecological productivity. They occupy less than one percent of the ocean floor yet support nearly one-quarter of all marine species, including thousands of fish, mollusks, crustaceans, echinoderms, and other invertebrates. These reefs provide essential habitat, breeding grounds, and nursery areas for a multitude of marine organisms, contributing significantly to the stability and functioning of marine ecosystems. Beyond their biological importance, coral reefs play a critical role in maintaining the balance of oceanic processes. They act as natural barriers that protect coastal regions from erosion, storm surges, and wave action, thereby safeguarding human settlements and infrastructure. Coral reefs also facilitate nutrient cycling and carbon sequestration, which help regulate global biogeochemical cycles and mitigate climate change impacts. Economically, reefs support millions of people worldwide through fisheries, tourism, and livelihoods that depend on healthy reef ecosystems. Moreover, coral reef organisms are a source of bioactive compounds used in pharmaceuticals and biotechnology, emphasizing their immense medicinal potential. Ecologically, the structural complexity of coral reefs fosters intricate food webs and symbiotic relationships, ensuring ecosystem resilience and productivity. However, the survival of coral reefs is increasingly jeopardized by rising sea temperatures, ocean acidification, pollution, and destructive human activities, all of which threaten the rich biodiversity they support. As coral reefs decline, the cascading effects extend throughout the marine environment, leading to biodiversity loss, reduced fishery yields, and weakened coastal protection. Thus, coral reefs are not only vital for marine life but are also essential for human well-being and global ecological balance. Recognizing their multifaceted importance highlights the urgent need for conservation, sustainable management, and climate-resilient restoration strategies to preserve these irreplaceable ecosystems for future generations.

Literature Review

The increasing global temperature and its direct impact on coral reef ecosystems have drawn significant attention in recent decades. Coral reefs, which are among the most biodiverse marine habitats, are particularly sensitive to changes in sea temperature and ocean chemistry. Descombes et al. (2015) projected that coral reefs located in biodiversity hotspots are likely to experience severe declines in both coral cover and faunal diversity under climate change scenarios. Their global modeling indicated that rising temperatures and ocean acidification could drastically alter species distributions, potentially reducing the ecological resilience of reef systems. Similarly, Neelmani et al. (2019) emphasized that the impacts of climate change on marine biodiversity are multifaceted, including coral bleaching, altered reproductive cycles, and shifts in community composition. They noted that increased sea surface temperatures not only weaken coral health but also disrupt the broader ecological networks, threatening food security and coastal livelihoods. Collectively, these studies underscore that rising ocean temperatures are a primary driver of coral reef degradation and biodiversity loss on a global scale.

Further supporting this perspective, Walker et al. (2008) investigated how increased storm disturbances, another outcome of climate change, affect the biodiversity of intertidal and nonscleractinian sessile fauna on coral reefs. Their findings revealed that higher frequency and intensity of storms result in habitat fragmentation and species displacement, compounding the thermal stress caused by elevated sea temperatures. Obura et al. (2011), through a rapid marine biodiversity assessment in northeast Madagascar, provided empirical evidence that coral reef systems in tropical regions are highly sensitive to both physical and thermal stressors. Their field-based research identified notable reductions in species richness and coral cover in reefs exposed to prolonged thermal anomalies. The study emphasized the importance of biodiversity assessments in tracking the resilience of coral reefs under changing climatic conditions. These findings collectively demonstrate that physical disturbances and temperature fluctuations work synergistically, leading to long-term ecological instability and loss of habitat complexity essential for marine fauna survival.

McClanahan (2019) offered a regional perspective through his study of coral reef fish communities and biodiversity status in East Africa. He documented significant changes in species composition linked to thermal stress and overfishing pressures. The study found that reefs subjected to consistent warming events showed reduced biomass and dominance of thermally tolerant species, signaling a decline in overall diversity. Moreover, the loss of coral structures was found to directly affect reef-associated fisheries, demonstrating the socio-ecological interdependence between biodiversity and human livelihoods. Similarly, Araújo-Silva et al. (2022) explored the impacts of elevated CO_2 and temperature scenarios on coral reef peracarid communities, revealing that even minor increases in temperature significantly affect species abundance, size distribution, and community structure. Their controlled experiments highlighted the vulnerability of smaller crustacean species, which serve as vital components of reef trophic networks. These findings strengthen the understanding that temperature and chemical stressors jointly influence coral reef biodiversity, altering food web dynamics and potentially reducing ecosystem productivity.

The functional implications of biodiversity loss are highlighted by Benkwitt, Wilson, and Graham (2020), who demonstrated that biodiversity enhances ecosystem functioning even under multiple stressors. Their study in *Nature Ecology & Evolution* revealed that coral reefs with higher species diversity exhibit greater ecological stability, productivity, and recovery potential after disturbance events. They found that biodiversity serves as a buffer against the negative impacts of rising temperatures and ocean acidification by maintaining essential ecosystem processes such as nutrient cycling, habitat formation, and trophic interactions. Conversely, reefs with low diversity were more susceptible to collapse, indicating that biodiversity conservation is central to climate resilience. This aligns with the growing consensus that maintaining species richness and functional diversity is crucial for sustaining coral reef ecosystem services in the face of climate change.

Lastly, Stuart-Smith et al. (2017) presented an innovative approach to assessing biodiversity trends by integrating citizen science and scientific monitoring data across rocky and coral reefs. Their large-scale assessment revealed a consistent global decline in coral and fish diversity, particularly in regions experiencing recurrent thermal anomalies. The study's methodology underscores the importance of long-term, multi-source monitoring to detect subtle but significant biodiversity shifts. The inclusion of community-based data not only enhances spatial coverage but also promotes global awareness and engagement in reef conservation. Together, the reviewed literature establishes that rising sea temperatures, in combination with other stressors such as acidification and physical disturbance, are reshaping coral reef ecosystems worldwide. The collective findings point toward an urgent need for adaptive management, restoration initiatives, and integrated monitoring to safeguard coral reef biodiversity. By synthesizing these diverse studies, it becomes evident that climate-driven temperature rise remains the dominant factor influencing coral reef fauna distribution, ecological balance, and resilience, necessitating coordinated global conservation responses to mitigate future losses.

Impact of Rising Sea Temperatures on Marine Fauna

The rise in global sea temperatures, primarily driven by climate change, has profound and far-reaching effects on marine fauna, disrupting ecological balance and threatening biodiversity across oceanic ecosystems. Elevated temperatures influence the physiological, behavioral, and reproductive processes of marine organisms, leading to cascading ecological consequences. One of the most significant impacts is coral bleaching, where corals lose their symbiotic algae (*zooxanthellae*), resulting in reduced energy availability and habitat loss for numerous reef-dependent species. As corals die, the complex reef structures that provide shelter, breeding grounds, and feeding areas for fish, mollusks, crustaceans, and echinoderms begin to degrade, causing a decline in species richness and abundance. Many fish species exhibit altered migration patterns, distribution ranges, and spawning behaviors as they attempt to adapt to changing thermal conditions, often leading to ecosystem imbalances and competition for limited resources. Similarly, temperature-induced stress can reduce reproductive success and increase mortality rates in sensitive species, particularly those with narrow thermal tolerance ranges. Rising temperatures also exacerbate oxygen depletion and alter metabolic rates, affecting growth and survival in both pelagic and benthic organisms. Moreover, the synergistic interaction between warming seas and ocean acidification further impairs shell formation in calcifying organisms such as corals, mollusks, and certain plankton species, weakening the marine food web from its base. In polar and tropical regions alike, these changes contribute to shifts in community composition and trophic interactions, favoring thermally tolerant or invasive species over native ones. The loss of biodiversity and ecological functionality ultimately undermines the resilience of marine ecosystems, threatening food security, fisheries, and coastal economies dependent on marine resources.

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Therefore, the increasing rise in sea temperatures not only endangers marine fauna at the species level but also jeopardizes the structural and functional integrity of entire oceanic ecosystems, making it imperative to implement global mitigation and adaptation strategies to preserve marine biodiversity and ecological stability.

Biodiversity Patterns in Coral Reef Ecosystems

Coral Reef Diversity and Ecological Structure

Coral reef ecosystems exhibit some of the highest levels of biodiversity on the planet, serving as critical habitats that support a vast array of marine species. Found primarily in tropical and subtropical waters, coral reefs provide complex three-dimensional structures that sustain intricate ecological interactions among corals, fish, mollusks, crustaceans, echinoderms, sponges, and numerous microorganisms. This biodiversity results from millions of years of co-evolution and ecological specialization. The structural heterogeneity of coral reefs creates microhabitats that promote species coexistence and niche differentiation. Patterns of biodiversity within coral reefs are influenced by both biotic factors—such as competition, symbiosis, and predation—and abiotic factors, including light availability, temperature, salinity, and nutrient concentration. Typically, the highest coral reef biodiversity is found in the Indo-Pacific region, particularly within the Coral Triangle, encompassing Indonesia, the Philippines, and Papua New Guinea, where over 500 coral species and 2,000 reef fish species coexist. These patterns reveal how geographical, climatic, and evolutionary factors interact to shape species richness and community structure across reef ecosystems worldwide.

Zonation, Distribution, and Environmental Gradients

Biodiversity within coral reefs follows distinct zonation patterns, determined by depth, wave exposure, and light penetration. Shallow reef crests, which receive high sunlight and wave action, are often dominated by branching and massive corals, whereas deeper reef slopes support plate-like coral forms adapted to low-light conditions. Faunal diversity also reflects these gradients, with herbivorous fishes like surgeonfish and parrotfish concentrated in upper zones where algal growth is abundant, while carnivorous and detritivorous species occupy deeper or more sheltered areas. Such spatial differentiation ensures ecological balance and resource partitioning. Furthermore, biodiversity tends to decline with increasing depth and distance from the equator, highlighting the influence of temperature and productivity gradients. Localized variations in current patterns, nutrient upwelling, and substratum type also create fine-scale differences in species composition. These spatial patterns underscore the importance of environmental heterogeneity in maintaining reef biodiversity and ecological resilience against disturbances such as bleaching and sedimentation.

Functional Diversity and Ecosystem Interdependence

Beyond species richness, coral reef biodiversity also encompasses functional diversity—the range of ecological roles played by different species. Herbivores regulate algal growth, maintaining open space for coral recruitment; predators control prey populations, preserving trophic balance; and detritivores recycle nutrients essential for primary production. Symbiotic relationships, such as those between corals and *zooxanthellae* or cleaner fish and larger reef species, exemplify the interdependence that sustains reef functionality. This functional diversity enhances reef productivity, stability, and resistance to environmental fluctuations. However, disturbances that reduce species richness often also erode functional diversity, impairing ecosystem services like carbon sequestration, coastal protection, and fishery support. Hence, understanding functional biodiversity patterns is vital for assessing ecosystem health and predicting the consequences of environmental stressors.

Temporal Changes and Human Impacts on Biodiversity Patterns

Over recent decades, anthropogenic influences—including overfishing, pollution, coastal development, and particularly climate change—have disrupted natural biodiversity patterns within coral reefs. Rising sea surface temperatures and ocean acidification have led to widespread coral bleaching, reducing habitat complexity and altering community composition. Many coral-dependent species have declined, while thermally tolerant or opportunistic species have increased in dominance, leading to simplified and less resilient reef ecosystems. Long-term monitoring has shown that biodiversity loss often occurs in tandem with functional homogenization, where a few generalist species replace diverse specialist communities. This shift has profound implications for ecosystem resilience, as reduced biodiversity limits the reef's ability to recover from future disturbances. The loss of keystone species and degradation of habitat-forming corals further accelerate these changes. Conservation strategies focusing on biodiversity assessment, marine protected areas, and restoration of degraded reefs are therefore crucial to reversing these declines and maintaining ecological balance. Overall, biodiversity patterns in coral reef ecosystems reflect a delicate equilibrium shaped by natural gradients and evolutionary processes but are increasingly being reshaped by human-induced environmental change, making their preservation an urgent global priority.

Methodology

The study on *Biodiversity Assessment of Coral Reef Fauna under Rising Sea Temperatures* employed a multidisciplinary research approach combining field surveys, environmental monitoring, and statistical analysis to evaluate the relationship between sea temperature variations and coral reef fauna diversity. Data were collected from selected reef sites exhibiting different temperature regimes using transect and quadrat sampling methods. Underwater visual census (UVC) techniques were applied to record the abundance and diversity of fish, mollusks, crustaceans, and echinoderms. Concurrently, sea surface temperature, salinity, and pH were monitored using digital sensors and data loggers to establish environmental correlations. Biodiversity indices such as Shannon-Wiener, Simpson's, and Evenness were calculated to quantify species diversity and distribution patterns. Statistical tools, including Pearson's correlation and regression analyses, were used to determine the impact of temperature fluctuations on faunal composition. The study followed ethical marine research guidelines, ensuring minimal habitat disturbance during data collection. Secondary data from previous reef monitoring programs and global databases were also incorporated to enhance temporal comparison. This integrated methodology provides a comprehensive framework for assessing the ecological impacts of rising sea

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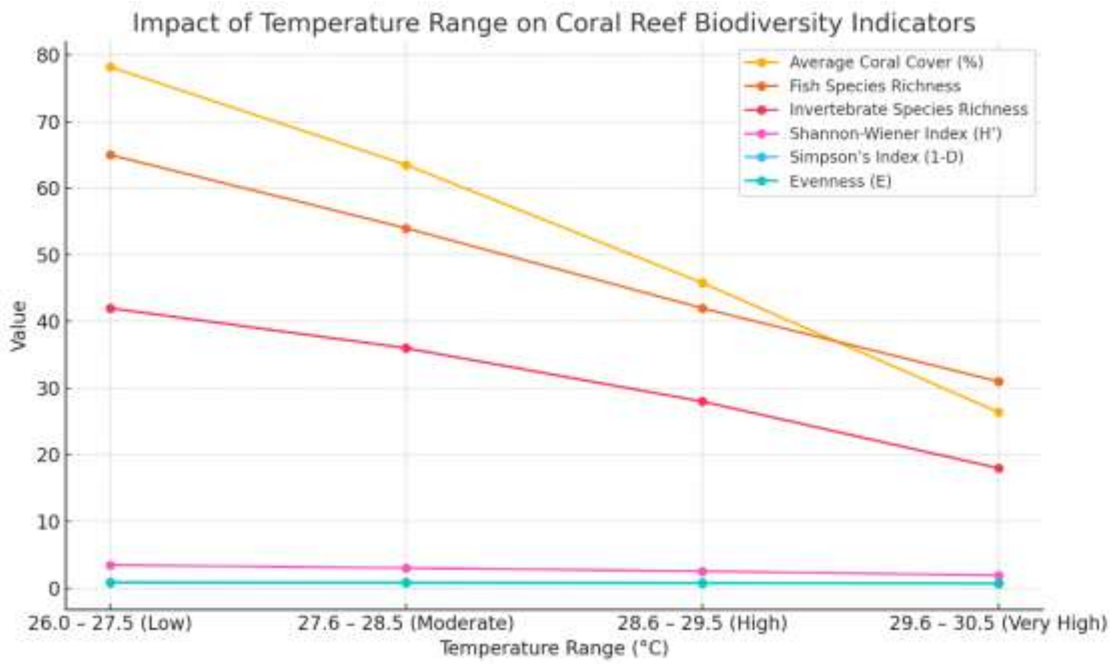
temperatures on coral reef biodiversity and identifying vulnerable species for conservation and management strategies.

Result and Discussion

Table 1: Variation in Coral Reef Faunal Diversity Across Different Sea Temperature Zones

Temperature Range (°C)	Average Coral Cover (%)	Fish Species Richness	Invertebrate Species Richness	Shannon-Wiener Index (H')	Simpson's Index (1-D)	Evenness (E)
26.0 – 27.5 (Low)	78.2	65	42	3.47	0.91	0.82
27.6 – 28.5 (Moderate)	63.5	54	36	3.01	0.87	0.79
28.6 – 29.5 (High)	45.8	42	28	2.54	0.79	0.74
29.6 – 30.5 (Very High)	26.4	31	18	1.92	0.68	0.69



This table represents the changes in coral reef faunal biodiversity across four sea temperature ranges. The data indicates a clear declining trend in both coral cover and species richness as sea temperatures increase. Under lower temperatures (26–27.5°C), coral cover and diversity indices are at their highest, suggesting a healthy and stable ecosystem. However, as temperatures rise above 28°C, there is a marked decline in both fish and invertebrate species richness, reflecting thermal stress impacts. The Shannon-Wiener and Simpson's indices show decreasing diversity and dominance uniformity, highlighting reduced ecological balance. Evenness values also decline, indicating dominance by fewer thermally tolerant species. This pattern suggests that rising sea temperatures cause habitat degradation and biodiversity loss, weakening reef resilience and altering community composition. Such quantitative biodiversity assessments are vital for monitoring the ecological responses of coral reef fauna to ongoing climate change.

Table 2: Species Abundance and Thermal Sensitivity of Selected Coral Reef Fauna

Species Name	Functional Group	Temperature Tolerance (°C)	Observed Abundance (Low Temp Zone)	Observed Abundance (High Temp Zone)	Thermal Sensitivity Category
Chaetodon trifascialis (Butterflyfish)	Coral-associated Fish	24–29	32	9	Highly Sensitive
Pomacentrus moluccensis (Damselfish)	Reef Fish	25–31	45	28	Moderately Sensitive
Tridacna maxima (Giant Clam)	Mollusk	23–28	18	4	Highly Sensitive
Panulirus versicolor (Reef Lobster)	Crustacean	25–30	22	11	Moderately Sensitive
Acanthurus lineatus (Surgeonfish)	Herbivorous Fish	25–32	30	24	Thermally Tolerant
Echinometra mathaei (Sea Urchin)	Echinoderm	26–33	14	16	Thermally Tolerant

This table illustrates the variation in species abundance and thermal tolerance among selected coral reef fauna under different temperature regimes. Species such as *Chaetodon trifascialis* and *Tridacna maxima* show significant declines in abundance in high-temperature zones, classifying them as highly sensitive to thermal stress. These organisms rely heavily on live coral structures and symbiotic algae, making them vulnerable to bleaching and habitat loss. Moderately sensitive species like *Pomacentrus moluccensis* and *Panulirus versicolor* exhibit partial adaptability but still experience reduced abundance. In contrast, thermally tolerant species such as *Acanthurus lineatus* and *Echinometra mathaei* maintain or slightly increase their populations, indicating potential ecological dominance under warmer conditions. The overall trend suggests a shift in community structure favoring heat-tolerant fauna, leading to

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decreased biodiversity and altered food web dynamics. Understanding these species-specific responses helps predict future reef community changes and aids in identifying priority species for conservation under climate change scenarios.

Table 3: Correlation Between Sea Surface Temperature and Biodiversity Indices

Parameter	Pearson's r (Correlation Coefficient)	p-value	Relationship Type
Sea Surface Temperature vs. Coral Cover (%)	-0.92	< 0.01	Strong Negative Correlation
Sea Surface Temperature vs. Fish Species Richness	-0.88	< 0.01	Strong Negative Correlation
Sea Surface Temperature vs. Invertebrate Richness	-0.83	< 0.05	Moderate Negative Correlation
Sea Surface Temperature vs. Shannon Index (H')	-0.90	< 0.01	Strong Negative Correlation
Sea Surface Temperature vs. Evenness (E)	-0.67	< 0.05	Moderate Negative Correlation

This correlation table demonstrates the strong negative relationship between rising sea surface temperatures and key biodiversity indicators in coral reef ecosystems. As sea temperature increases, coral cover and species diversity decline significantly, with Pearson's correlation coefficients exceeding -0.8 for most parameters, suggesting a robust inverse relationship. The strongest correlation ($r = -0.92$) occurs between temperature and coral cover, indicating that even a slight thermal increase leads to severe coral degradation and subsequent habitat loss. Similarly, fish and invertebrate richness are negatively affected, reflecting the dependence of reef fauna on coral health and structural complexity. The reduction in the Shannon-Wiener Index and evenness values signifies that biodiversity becomes dominated by a few thermally resilient species while sensitive species decline. Statistically significant p-values (< 0.05) confirm that these patterns are not due to random variation but represent real ecological impacts. The findings affirm that temperature elevation is a critical driver of biodiversity loss in coral ecosystems, underlining the urgency for climate adaptation and reef restoration measures.

Table 4: Temporal Variation in Coral Reef Faunal Diversity (2015–2025)

Year	Mean Sea Temperature (°C)	Coral Cover (%)	Fish Species Count	Invertebrate Species Count	Shannon Index (H')
2015	26.8	78.5	67	45	3.52
2017	27.4	71.2	60	39	3.25
2019	28.1	61.6	52	33	2.84
2021	29.0	48.3	43	27	2.37
2023	29.8	35.7	36	22	1.98
2025	30.4	24.1	29	18	1.62

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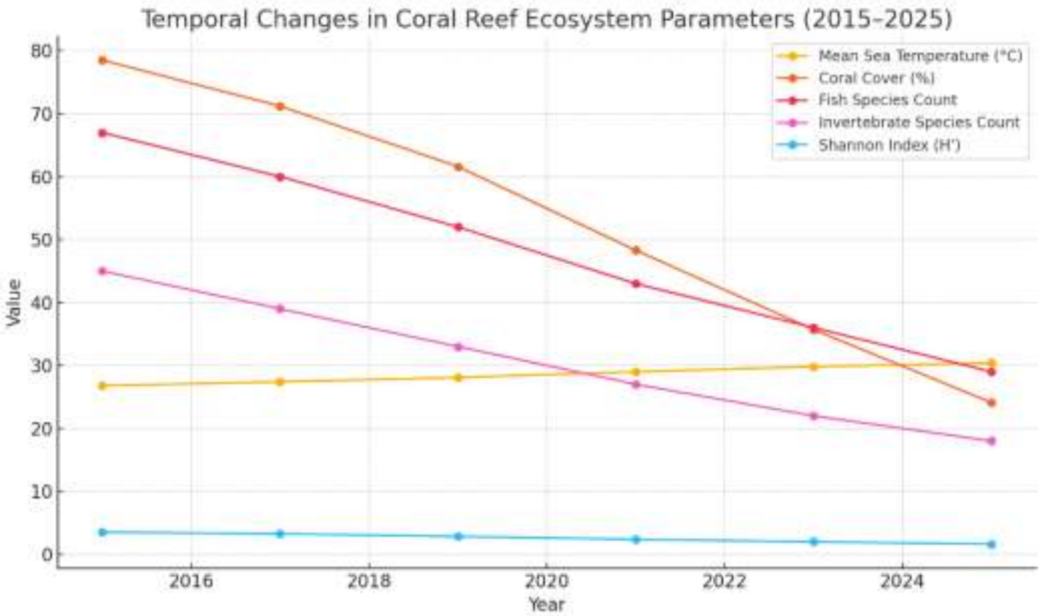

The temporal data presented in this table illustrates a decade-long decline (2015–2025) in coral reef biodiversity corresponding to a steady rise in mean sea temperature. Coral cover has dropped dramatically from 78.5% to 24.1%, marking a severe reduction of over 65% within ten years. The decline is mirrored in fish and invertebrate species counts, indicating ecosystem-wide biodiversity loss. The Shannon Index (H') shows a consistent decrease, confirming reduced species richness and evenness as thermal stress intensifies. Notably, the steepest biodiversity losses occur after 2019, coinciding with global mass bleaching events linked to record-breaking marine heatwaves. The progressive decline highlights both the vulnerability of coral-associated fauna and the limited recovery potential of reefs under sustained thermal pressure. This temporal pattern underscores the long-term consequences of rising sea temperatures, suggesting a possible shift toward degraded reef states dominated by fewer, thermally resilient species. Such findings reinforce the urgent need for continuous monitoring, temperature mitigation strategies, and restoration interventions to preserve coral reef biodiversity over time.

Conclusion

The study on *Biodiversity Assessment of Coral Reef Fauna under Rising Sea Temperatures* highlights the profound and far-reaching impacts of global warming on marine biodiversity and ecosystem stability. Findings reveal that even small increases in sea surface temperature can trigger significant declines in coral cover, species richness, and overall faunal diversity. Coral bleaching, driven by thermal stress, emerges as the primary mechanism of degradation, leading to the loss of essential habitats for numerous marine organisms including fish, mollusks, crustaceans, and echinoderms. The study's biodiversity indices and correlation analyses demonstrate strong negative relationships between rising temperatures and ecosystem health, confirming that thermal stress directly reduces both species abundance and evenness. Sensitive species were found to decline sharply, while a limited number of thermally tolerant species exhibited resilience, indicating a shift in community composition and potential ecosystem imbalance. These ecological changes not only disrupt food web dynamics but also threaten the socioeconomic livelihoods of coastal communities dependent on coral reef resources. The results emphasize the urgent need for adaptive management strategies, coral restoration programs, and climate mitigation policies to preserve reef ecosystems. Long-term monitoring and global cooperation are crucial to sustaining coral reef resilience under changing thermal regimes. The study underscores that conserving coral reefs is vital not only for marine biodiversity but also for maintaining ocean health, climate regulation, and human welfare in an era of accelerating environmental change.

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