

Impact of Climate Change on Marine Species Diversity: A Focus on Marine Fishes and Mammals

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ABSTRACT

The impact of climate change on marine ecosystems is undeniable globally. Understanding how these changes affect marine biodiversity is crucial to protecting and conserving it in the future. During the last few decades, Climate change has caused a wide array of changes in marine ecosystems due to its pronounced impacts, such as acidification, deoxygenation, warming.

Introduction

Climate change is affecting the marine ecosystem in a wide range of varied and significant ways. These factors adversely affect their capability to adapt, function, and provide vital ecological services [1]. According to the IPCC's 2019 Reports, the marine environment is affected by climate change in many ways. Heat, acidification of oceans, sea level rise, and storm intensity are some of these influences. Such alterations affect marine life diversity and the ecosystems that support it in different areas and over varying times [2]. Scientists have observed that marine organisms undergo adaptations due to climate change. These adaptations include changes in growth patterns and phenology [3, 4], migration patterns [5], and the risk of extinction [6]. It has been found that these adaptations have several effects on aquatic environments as well. A comprehensive global investigation reveals that marine species exhibit conflicting patterns. Still, the equatorward boundaries encounter difficulties in adjusting and experiencing a decline. Future warming will significantly impact marine species' abundance [7].

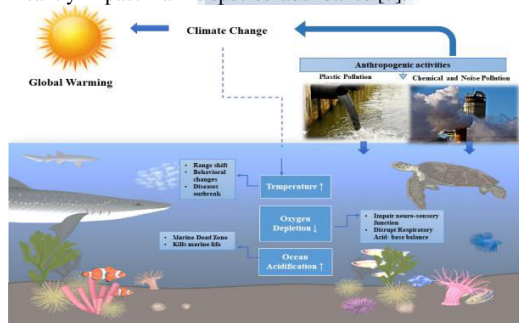


Figure 1: Overview of adverse effects of anthropogenic activities and climate change on marine life and ecosystem [8].

Impact on Marine fishes

According to Comte and Olden [9], climate change poses serious threats to biodiversity, especially for freshwater and marine fish species. Fish commonly exhibit changes in growth as a key and widely reported response to climate change [10]. Scientists have demonstrated that temperature variations affect the rate at which fish grow, particularly water and air temperature alterations due to climate change [11, 12]. A research study has found that extreme temperature events significantly negatively impact fish. These occurrences can potentially impair fish growth, reproduction, and metabolism [13].

Impact on Marine Mammals

A systematic review found that almost all marine mammal species are threatened by various factors, including incidental catch, pollution, direct harvesting, and traffic impacts. Risk maps showed that more than half of marine mammal core habitats and coastal waters are high-risk areas, particularly in temperate and polar regions [14]. There has been an increase in the frequency of infectious disease outbreaks, resulting in mass mortality events in marine mammals. Viral infections cause these epidemics and are also affected by seasonal fluctuations and the warming of the sea surface [15]. Marine mammals worldwide are greatly affected by climate change. Various changes occur due to the melting of ice cover, including shifts in geographic distribution and loss of habitat. The food chain is also impacted, resulting in modifications. There's also a greater sensitivity to disease and a heightened exposure to algae poisons. The effects of climate change on marine mammals, particularly in polar spots, are readily apparent due to the depletion of sea ice habitats. Some species that have been greatly affected include the bearded seal, ringed seal, polar bear, walrus, and narwhal [16]. Marine conservation

programs must incorporate improved models, data collection, and interdisciplinary collaboration to protect marine mammals and adapt to climate change efficiently.

Conclusion and Recommendations

Fish diversity is at greater risk due to the profound effects of climate change. In the future, extensive research is needed to evaluate how fish respond to different species and environments in climate change scenarios. Therefore, upcoming research must focus on investigating the harmful impacts of climate change on various species of fish, including the deep sea (mesopelagic and abyssal), coral reef, demersal, nutritional strategies, and stress tolerance variants to mitigate the stress of high temperatures. Also, little research has been conducted on marine mammals, including deep-diving cetaceans (sperm whales, beaked whales), Antarctic seals, monk seals, and coastal dolphins, which require further research. For fish and mammals, further research is required in geographical areas, such as the Indo-Pacific region, tropical and sub-tropical regions, Arctic Ocean, Polar regions, and coastal and estuarine areas. Conclusively, protecting and conserving marine species diversity is crucial for the resilience and stability of the ecosystem and human benefits.

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