



Ocean Acidification: Impacts on Marine Ecosystems and Global Climate

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Abstract

Ocean acidification refers to the ongoing decrease in ocean pH caused by the absorption of anthropogenic carbon dioxide (CO₂) from the atmosphere. This process alters carbonate chemistry, threatening calcifying organisms, disrupting food webs, and affecting ecosystem services. Ocean acidification poses significant risks to fisheries, coral reefs, and global climate regulation. This article reviews the causes, biological impacts, and ecological implications of ocean acidification, emphasizing the urgency of mitigation and adaptation strategies to preserve marine ecosystems and associated human livelihoods.

Keywords: Ocean Acidification, Carbon Dioxide, Marine Ecosystems, Calcifying Organisms, Coral Reefs, Climate Change, Ecosystem Services

Introduction

The oceans act as a major carbon sink, absorbing nearly one-third of anthropogenic CO₂ emissions. While this moderates atmospheric CO₂ levels, it leads to ocean acidification—a process in which CO₂ reacts with seawater to form carbonic acid, lowering pH and reducing carbonate ion availability. Since the Industrial Revolution, ocean surface pH has decreased by approximately 0.1 units, with projections indicating a further decline of 0.3–0.4 units by 2100 under high-emission scenarios (IPCC, 2021).

Ocean acidification affects a wide range of marine organisms, particularly those that rely on calcium carbonate for shell and skeleton formation, including corals, mollusks, and some plankton species. Changes in species physiology and behavior can cascade through food webs, impacting fisheries, tourism, and ecosystem resilience. Understanding the mechanisms and consequences of ocean acidification is critical for developing effective mitigation and adaptation strategies to protect marine biodiversity and human livelihoods [1].

Biological and Ecological Impacts of Ocean Acidification

Calcifying organisms, such as corals, oysters, and coccolithophores, rely on carbonate ions to build shells and skeletons. Reduced carbonate availability under acidified conditions impairs calcification, growth, and structural integrity. Coral reefs, which provide habitat for 25% of marine species, are particularly vulnerable, resulting in biodiversity loss and diminished reef-based fisheries.

Ocean acidification can alter the abundance, distribution, and nutritional quality of primary producers and planktonic organisms. Disruptions at the base of the food web propagate to higher trophic levels, affecting fish populations, marine mammals, and seabirds [2]. Changes in prey availability and physiological stress may reduce reproductive success and survival rates across multiple species. Acidified conditions can impair sensory systems, behavior, and metabolic processes in fish and invertebrates. For example, studies show that some fish species exhibit altered predator avoidance, navigation, and feeding behaviors under low pH, potentially increasing mortality rates and reducing population resilience [3]

Ocean acidification threatens ecosystem services, including fisheries, carbon sequestration, and coastal protection. Declining coral reef health reduces biodiversity, fishery yields, and tourism revenue. Acidification also interacts with other stressors such as warming, hypoxia, and pollution, compounding ecosystem vulnerability [4]. Mitigation strategies include reducing CO₂ emissions globally and enhancing marine carbon sequestration. Local adaptation measures involve protecting and restoring habitats, such as seagrass beds and mangroves, which can buffer pH changes and improve ecosystem resilience. Continued monitoring and research are essential to understand species-specific responses and inform conservation and policy decisions [5].

Conclusion

Ocean acidification is a pressing threat to marine ecosystems, driven primarily by anthropogenic CO₂ emissions. It affects calcifying organisms, disrupts food webs, and undermines ecosystem services critical to human well-being. Addressing this challenge requires a combination of global emission reductions, ecosystem-based management, and habitat restoration. By integrating scientific research with policy and community engagement, we can mitigate the impacts of ocean acidification, safeguard marine biodiversity, and maintain the essential services oceans provide to society.

References

1. Doney C, Fabry J, Feely A. 2009. Ocean acidification: the other CO₂ problem. 1:169–192.
2. Kroeker J, Kordas L, Crim N. 2013. Meta-analysis reveals negative yet variable effects of ocean acidification on marine organisms. 13:1419–1434
3. Munday L, Dixon L, Donelson M. 2009. Ocean acidification impairs olfactory discrimination and homing ability of a marine fish. 106:1848–1852.
4. Gattuso P, Hansson L. 2011. Ocean Acidification.
5. IPCC. 2021. Climate Change 2021: The Physical Science Basis.