

Marine Heat Waves: A Growing Threat to Ocean Ecosystems and Fisheries

Aitwar Vaijnath*, Usharani A., Chamundeshwari B., Madhavi K., Neha P. and Prasanna Laxmi U.

College of Fisheries, Narsapuram, West Godavari (Andhra Pradesh)- 534 275

*Corresponding author mail: vaijuaitwar99@gmail.com

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Introduction

Marine heat waves (MHWs), which are extended episodes of abnormally warm ocean temperatures, have emerged as one of the most serious impacts of global climate change, drastically affecting marine ecosystems and the fisheries that rely on them. MHWs were once thought to be rare phenomena, but they are now occurring with greater frequency, duration, and severity over the world's seas, thanks to growing greenhouse gas emissions and altered ocean circulation patterns. These heat extremes cause a cascade of impacts, ranging from extensive coral bleaching and kelp forest mortality to shifts in species distributions, disrupted food webs, and decreased biodiversity. The effects on fisheries are also serious, jeopardizing millions of people's livelihoods by triggering unexpected collapses in fish supplies, interrupting migration pathways, and reducing the productivity of critical fishing grounds. As these events become more frequent, recognizing and reducing the hazard of marine heat waves is crucial to protecting ocean health and global food security.

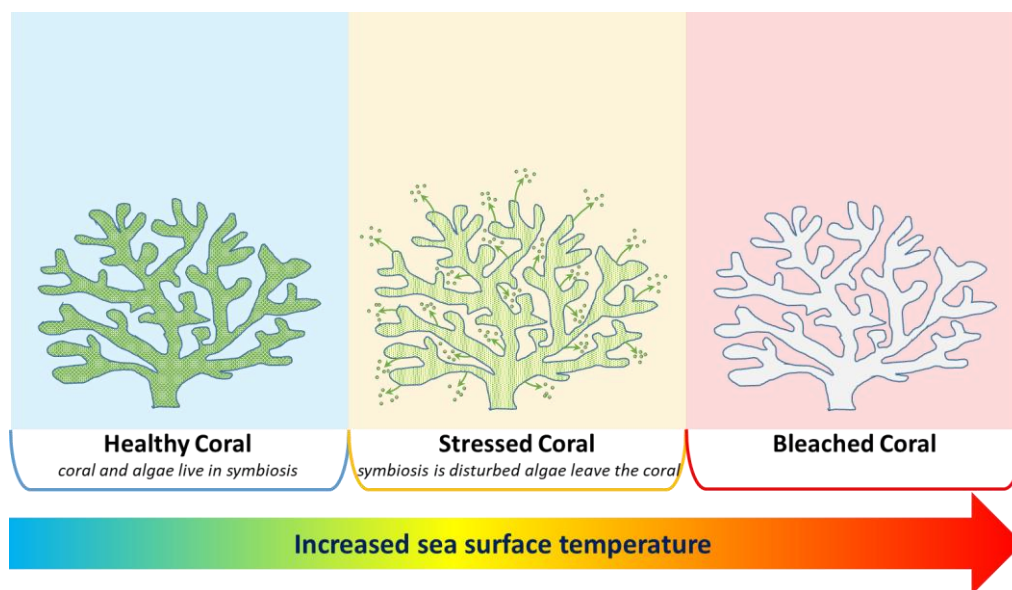
What Exactly Is a Marine Heat Wave?

A marine heat wave is characterized by a period of at least five consecutive days during which sea surface temperatures exceed the 90th percentile of historical averages for a given location and season. These episodes can span hundreds or thousands of kilometers and last for weeks, months, or even years. Scientists define them as moderate, strong, severe, or extreme, depending on how far temperatures differ from the average.

While natural variability such as high-pressure systems or variations in ocean currents can cause them, climate change, fueled by greenhouse gas emissions, makes them hotter, longer, and more common. The global yearly number of MHW days has increased by around 54% over the last century, with the majority of the most extreme instances happening since 2010 (Oliver et al., 2018).

Iconic Examples: "The Blob" and Beyond

One of the most well-known was "The Blob," a gigantic MHW in the northeast Pacific from 2013 to 2016. It lasted from Alaska to Baja California, with temperatures up to 7°F (4°C) above normal. It disturbed the food web, causing massive seabird die-offs and shifting species distributions. More recently, MHWs in 2023-2024 set new global records (Huang et al., 2025). Nearly 10% of the ocean reached record high temperatures, and summers saw nearly 3.5 times as many MHW days as prior records. Events hit regions from the North Atlantic to Australia, contributing to the fourth global bleached coral disaster.



Marine heatwave intensification threatens coral reef health | EUMETSAT - User Portal

Devastating Impacts on Ecosystems

MHWs hit marine life hard, often from the bottom up:

- Coral bleaching and mortality:** Heat stress causes corals to expel their symbiotic algae, leaving them bleached and famished. Repeated incidents on the Great Barrier Reef (2016, 2017, 2020, 2022, 2024, 2025) have caused extensive bleaching, with some colonies losing over 50% of their population due to heat and malnutrition. Between 2023 and 2025, around 84% of coral reefs worldwide underwent bleaching stress.
- Food web disruption:** Warmer waters diminish phytoplankton and change zooplankton, starving larger populations. In the Northern California Current, MHWs preferred gelatinous pyrosomes and Pacific jack mackerel while reducing energy flow to salmon and other



predators. Biomass decreases are accelerating, favouring smaller, faster-growing species over large predators such as tuna and salmon.

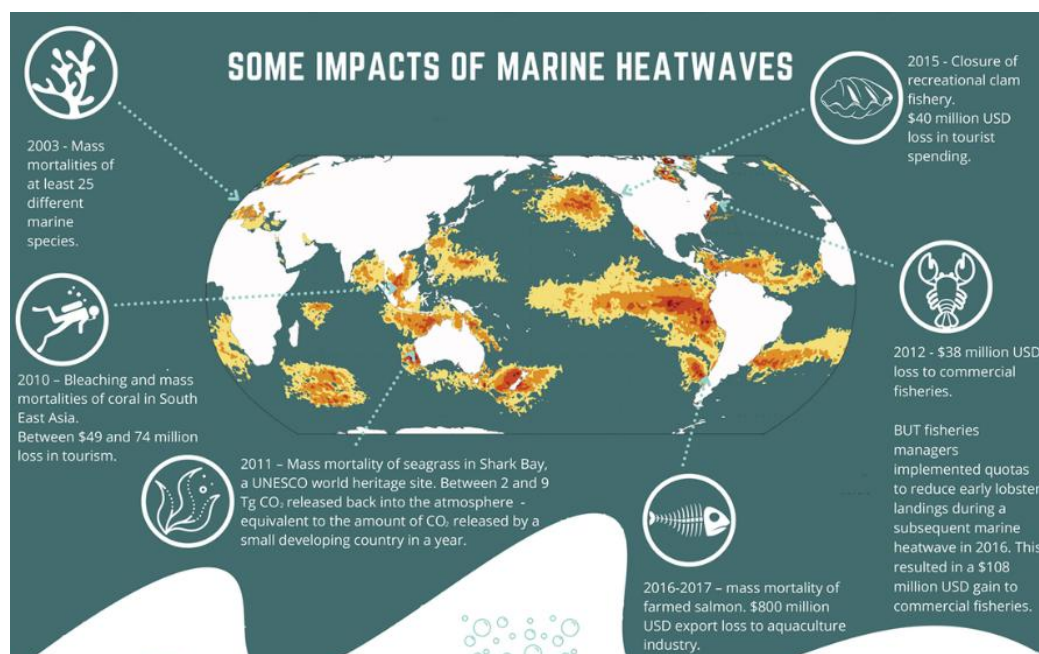
- **Mass mortalities and shifts:** Seagrass meadows deteriorate, resulting in the mortality of fish and invertebrates, while species relocate towards polar regions or deeper aquatic environments. Clownfish have even been recorded shrinking under heat stress. Harmful algal blooms, often toxic, grow increasingly common, shutting down fisheries and injuring marine creatures.

Tropical systems, home to highly productive fisheries, face the most pronounced long-term biomass losses.

Hammering fisheries and coastal economies

Fisheries suffer direct hits through:

- Declines in key stocks (e.g., Pacific cod dropped sharply in the Gulf of Alaska; Chinook salmon harvests fell dramatically in California).
- Species shifts across borders, complicating management (e.g., tuna moving into U.S. waters).
- Closures and lost revenue: Events have caused hundreds of millions to billions in losses globally, from crab fisheries poisoned by domoic acid to salmon aquaculture collapses (Smith et al., 2021).



Indirect costs include tourism losses from dead reefs and higher insurance or adaptation expenses. Some "winners" emerge temporarily (e.g., certain squid or mackerel), but overall, the instability threatens food security for coastal communities.

The future outlook and what can be done

Without sharp emissions cuts, MHWs will become the new normal, with profound consequences for biodiversity and the "blue economy." Oceans are already at record heat content, and events like El Niño can amplify them.

Hopeful steps include:

- **Climate-ready fisheries management:** Dynamic quotas, habitat protection, and monitoring that accounts for rapid shifts.
- **Reducing local stressors:** Improving water quality and protecting refugia (like upwelling zones that provide cooler water).
- **Global action:** Rapid decarbonization to limit warming, plus international cooperation on transboundary stocks.

Marine heat waves are a strong warning of our changing oceans. They threaten not just colourful reefs and numerous fish but the livelihoods, coastal protection, and carbon storage that healthy waters supply. Protecting them requires urgent worldwide effort-before the heat becomes unbearable.

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