

MARINE HEAT WAVES - ENVIRONMENT

NEWS: *In January 2025, marine heatwaves (MHWs) in Western Australia led to the death of over 30,000 fish.*

WHAT'S IN THE NEWS?

1. Extremely High Ocean Temperatures:

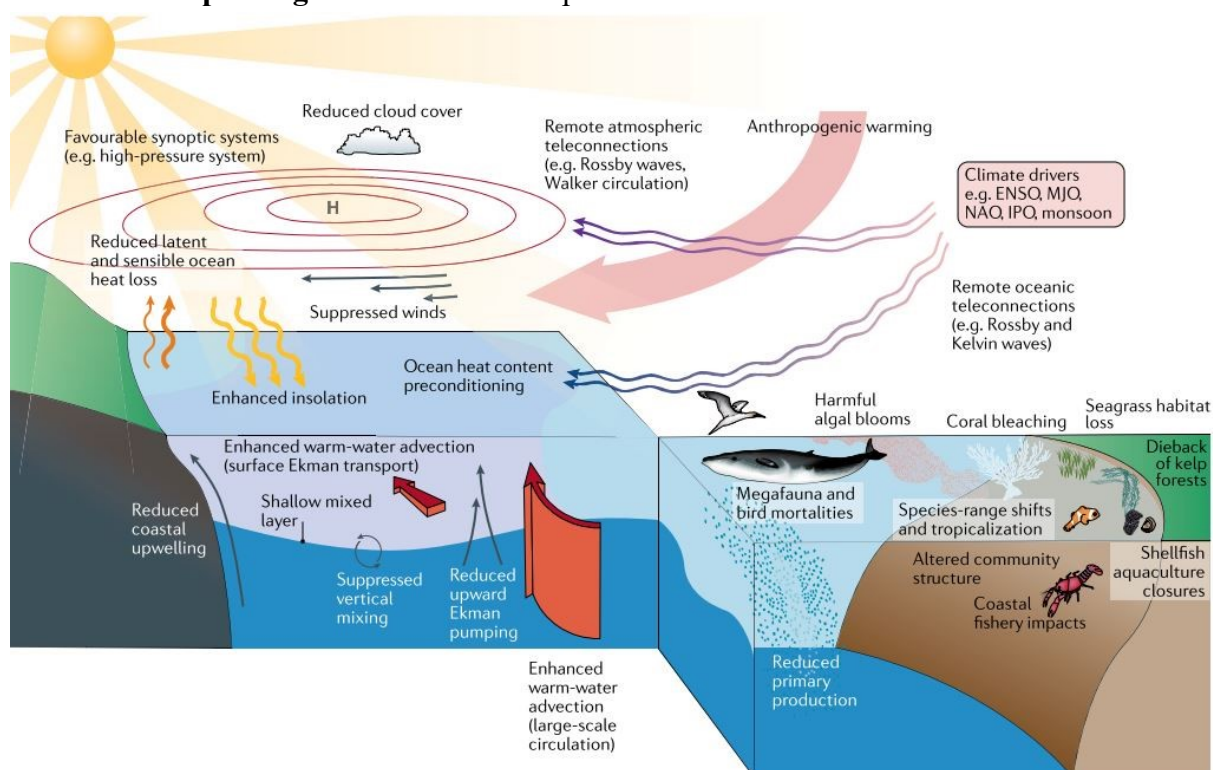
- Marine Heatwaves (MHWs) are periods of **abnormally high ocean temperatures** that exceed the typical seasonal range.
- These temperature spikes can significantly alter marine ecosystems and disrupt climate patterns.

2. Temperature Threshold and Duration:

- An event is classified as an MHW when **sea surface temperatures (SSTs) rise by 3-4°C above the average for at least five consecutive days**.
- While some MHWs last only a few weeks, others can persist for several months or even **multiple years**.

3. Role of Climate Change in MHWs:

- Climate change is the **primary driver** of increasing MHWs, as **over 90% of the excess heat** trapped by greenhouse gases is absorbed by the ocean.
- Rising global temperatures have led to **more frequent, intense, and prolonged** MHWs over the past few decades.



Global Presence of Marine Heatwaves

1. Widespread Occurrence Across Oceans:

- Marine Heatwaves have been observed in various oceanic regions, including:

- **North Pacific Ocean**
- **North Atlantic Ocean**
- **Mediterranean Sea**
- **Caribbean Sea**
- **Parts of the Indian Ocean**

2. **Impact on Global Weather Patterns:**

- MHWs can intensify extreme weather events such as **tropical storms, hurricanes, and cyclones.**
- They also **disrupt the global water cycle**, leading to increased occurrences of **floods, droughts, and wildfires.**

Recent Trends in the Indian Ocean

1. **Rising Frequency in the Indian Ocean:**

- In the past, MHWs were considered **rare events** in the **tropical Indian Ocean.**
- However, in recent decades, they have become an **annual phenomenon** due to sustained ocean warming.

2. **Increased Occurrence in the Western Indian Ocean and Bay of Bengal:**

- Between **1982 and 2018**, the frequency of MHWs in the:
 - **Western Indian Ocean** rose to **1.5 events per decade.**
 - **Bay of Bengal** recorded **0.5 events per decade.**
- This trend suggests that **MHWs are becoming more intense and widespread**, affecting climate systems across South Asia.

Impacts of Marine Heatwaves

1. **Influence on Monsoon Patterns**

- **MHWs in the western Indian Ocean and Bay of Bengal significantly impact the South Asian monsoon system.**
- **Altered atmospheric circulation due to heatwaves** has led to:
 - **Reduced rainfall in central India**, causing dry spells and droughts.
 - **Increased rainfall in southern India**, leading to extreme precipitation events and flooding.

How does the Bay of Bengal Impact Monsoon?

- **Moisture Source:**
 - The warm and humid air mass over the Bay of Bengal provides the **necessary moisture** that is carried by the monsoon winds towards the Indian subcontinent.
- **Heat Exchange:**
 - The Bay of Bengal has warm sea surface temperatures, especially in its northern part. During the monsoon season, the landmass of the Indian subcontinent gets heated up, **creating a low-pressure area.** The warm air

rises, and cooler air from the Bay of Bengal rushes in to replace it, **causing a pressure gradient**. This pressure gradient helps draw in **moisture-laden winds from the Bay of Bengal**, contributing to the monsoon rainfall.

- **U-Turn of Monsoon Currents:**

- The monsoon winds **blowing from the southwest over the Arabian Sea** cross over into the Bay of Bengal. When they reach the Bay of Bengal, they make a U-turn and start moving towards the northeast, eventually bringing rainfall to different parts of India.
- The warm temperatures in the Bay of Bengal facilitate this **U-turn and the transport of moisture to the Indian subcontinent**.

- **Low-Level Jet Stream:**

- The Bay of Bengal also influences the formation and intensity of the low-level jet stream, known as the **Somali Jet**.
- This jet stream plays a crucial role in the transport of moisture from the equatorial Indian Ocean to the Indian subcontinent.
- The warm sea surface temperatures in the Bay of Bengal contribute to the **strengthening of this low-level jet, enhancing the moisture supply during** the monsoon season.

2. Socio-Economic Disruptions

- MHWs **negatively affect the livelihoods** of coastal communities, particularly those dependent on:
 - **Aquaculture and fisheries**, as warming waters alter fish migration patterns and disrupt breeding cycles.
 - **Tourism**, especially in destinations reliant on marine biodiversity and coral reefs.
- Specific marine species suffer **declines in productivity**, including:
 - **Lobsters, snow crabs, and scallops**, which are commercially important seafood species.
 - The collapse of these fisheries **threatens food security and local economies**.

3. Biodiversity Loss and Ecosystem Destruction

- **Mass Mortality of Marine Species:**
 - MHWs cause widespread **death of marine organisms**, forcing many species to **relocate or change their natural behavior**.
- **Impact on Coral Reefs and Kelp Forests:**
 - Coral reefs are **highly sensitive** to prolonged heat stress, leading to **coral bleaching**.
 - Coral bleaching weakens reproductive ability and increases coral **susceptibility to diseases**.
 - Kelp forests, another vital marine habitat, experience **die-offs**, leading to habitat loss for many marine organisms.
- **Compounding Threats:**

- The damage from MHWs is **worsened by other environmental threats like ocean acidification, overfishing, and coastal pollution.**

How does Marine Heatwave Impact Rainfall in Northwest India?

- The marine heatwave in the Bay of Bengal **increased sea surface temperatures, causing higher evaporation rates** and a greater moisture supply in the atmosphere. This surplus of moisture contributed to above-average rainfall in northwest India.
- The marine heatwave likely **influenced the formation and behavior of depressions** in the Bay of Bengal, which may have contributed to an **increase in the frequency and intensity of depressions**, particularly on faster timescales (3-10 days).
 - Depressions, which are low-pressure systems, play a significant role in the monsoon and rainfall patterns.
- The marine heatwave, along with changing timescales of depressions, **affected the path and trajectory of these weather systems**. Depressions tended to move more towards northwest India rather than **north-central India, causing a higher concentration of rainfall in the northwest region**, leading to **above-average rainfall** in that area.

Strategies to Combat Marine Heatwaves

- 1. Reducing Ocean Warming Through Climate Action**
 - Countries must **reduce fossil fuel emissions to slow ocean temperature rise**, aligning with the targets of the **Paris Agreement**.
 - A transition towards **renewable energy and sustainable industrial practices** is essential in mitigating further damage.
- 2. Investing in Nature-Based Solutions (NbS)**
 - Governments and environmental organizations should:
 - **Restore marine ecosystems** like mangroves, seagrass beds, and coral reefs to enhance natural resilience against MHWs.
 - Follow guidelines from the **IUCN Global Standard for Nature-based Solutions** to implement effective conservation strategies.
- 3. Enhancing Scientific Research and Monitoring**
 - It is crucial to **expand research capacity** to:
 - Improve real-time **monitoring and prediction** of MHWs.
 - Analyze **long-term ecological impacts** on marine biodiversity.
 - International cooperation should be strengthened through **global research networks** like the **Marine Heatwave International Group**.

Way Forward

- 1. Implementing Protective Marine Policies**
 - Governments must establish **marine protected areas (MPAs)** to safeguard vulnerable species and habitats from MHW-related destruction.

- Policies should **regulate human activities** like deep-sea fishing, coastal development, and tourism to minimize further environmental damage.
2. **Strengthening Fisheries Management**
 - Enforcing **strict fishing regulations** and **catch limits** can help sustain marine populations affected by MHWs.
 - Sustainable fisheries management will reduce **economic losses for coastal communities**.
 3. **Raising Awareness Among Stakeholders**
 - Policymakers, environmental groups, and the private sector must be **actively engaged** in climate adaptation measures.
 - Educating **fishermen, tourism operators, and local communities** about the risks and mitigation strategies can improve resilience against MHWs.

Conclusion

- **Marine Heatwaves (MHWs) are a growing global concern**, with devastating effects on **ocean ecosystems, climate stability, and economic activities**.
- **The Indian Ocean is experiencing a significant rise in MHWs**, impacting **monsoons, fisheries, and coastal livelihoods**.
- **Urgent climate action and targeted conservation strategies** are required to mitigate the effects of MHWs and protect marine biodiversity.
- **Collaboration between governments, scientists, and industries** is key to ensuring the long-term sustainability of marine ecosystems.

Source: <https://indianexpress.com/article/explained/explained-climate/climate-crisis-marine-heatwaves-9821129/>