

Arctic Marine Heatwaves: An Intensifying Threat to a Fragile Ecosystem

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“After a solemn prayer, Shaman Bird opened his eyes and said:

“These are vengeful spirits... The white skeleton ghost is Coral Ghost, and the small ones are Algae Ghosts. Coral and Algae used to coexist happily before suffering tragic deaths due to the burning of the ocean caused by greenhouse gases. Bleached by climate change-induced heat.””

In “Ghosts”; *Wild Wise Weird* [1]



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As the Arctic warms faster than any other region on Earth, a new threat is emerging from the thinning ice: marine heatwaves (MHWs). These extreme ocean temperature events—previously rare in the ice-covered Arctic—are projected to intensify dramatically throughout the 21st century, bringing with them potentially devastating consequences for marine ecosystems [2-4].

Using a high-resolution climate model, researchers show that MHWs in the Arctic will increase in both magnitude and variability as sea ice continues to retreat. Initially, the intensification of these heatwaves closely tracks the loss of sea ice. However, once the Arctic becomes largely ice-free in summer, MHWs will be driven more by erratic air-sea interactions, leading to unpredictable spikes in ocean temperature [5].

What makes these future heatwaves particularly alarming is not just their intensity but their abruptness. Temperature anomalies in some regions are expected to jump by over 3°C within just over two weeks—a tenfold increase in warming rate compared to historical conditions. Such sudden shifts may exceed the physiological thresholds of many Arctic species, especially cold-adapted zooplankton like *Calanus glacialis*, whose upper thermal tolerance is around 6°C [6,7].

Beyond direct thermal stress, MHWs also indirectly reshape ecosystems by enhancing ocean stratification—layering that limits nutrient mixing from deeper waters. This reduces food availability for phytoplankton, the base of the marine food web, and may prompt a shift toward smaller, less nutritious species. These changes ripple upward through the food chain, increasing the risk of mass die-offs among fish, seabirds, and marine mammals already adapted to nutrient-poor environments [5].

Importantly, this study highlights a double-edged transformation: the Arctic is not only warming—it is becoming more ecologically unstable. While the sea ice once shielded the Arctic Ocean from heatwaves, its disappearance exposes ecosystems to extreme and unpredictable stressors.

The Arctic's unfolding transformation under climate change is a stark reminder of the interconnectedness between natural systems and human futures [8,9]. As the ocean loses its icy armor, the resilience of marine life—built over millennia—faces an unprecedented test. Understanding and anticipating these changes is crucial, not only for Arctic species but for the global climate system they influence.

References

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