

The Ocean, Climate Change, and the Future



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The majority of Planet Earth is covered by oceans. Vast expanses of water that contain an ancient and delicately balanced ecosystem. Although rainforests are often described as the lungs of the planet, oceans absorb more carbon from our atmosphere, generate more oxygen, and provide a home to millions of marine animals, plants, and microscopic life. These systems, which are vital for the future of the planet, are incredibly sensitive and are under increasing threat from global temperature increases as part of the climate crisis.

Planet Earth is getting hotter every year due to the release of greenhouse gas emissions created by burning fossil fuels. Since the Industrial Revolution, carbon dioxide levels in our atmosphere have increased by over 50% to more than 410 parts per million. On average, the global temperature has risen by around 1.2 degrees.¹ This may seem like a small increase, but without the role played by the ocean in the global carbon cycle, the situation would be far more severe. The oceans have absorbed around a quarter of the carbon emissions, and 90% of the heat humans have released into the atmosphere since the 1970s through complex processes called the **biological and physical pump**. The **biological pump** moves carbon from the atmosphere to the deep ocean and sequesters it, using photosynthesis and the sinking of organic matter like phytoplankton. The **physical pump** moves carbon via ocean circulation and the absorption of CO₂ at the surface due to temperature and pressure differences. Colder water, which is better at absorbing gases, sinks to the bottom of the ocean, while warmer water

¹ Various Authors. "The Impacts of Ocean Acidification on Marine Ecosystems and Reliant Human Communities". *Annual Review of Environment and Resources* 17th October 2020.

expands and rises – these cycles enable heat and carbon dioxide to be absorbed at the surface and carried to the ocean floor, where it can be stored. The warming of the ocean at the surface (by around 1°C)² slows down these processes and makes them less productive, causing the ocean to be exponentially less productive as a **carbon sink** and accelerating global warming. Climate change harms the ocean, reducing its capacity to slow climate change; it's a self-reinforcing cycle and a slow-moving emergency with potentially devastating consequences for our planet.

The Amazon rainforest is often described as the lungs of Planet Earth, but in reality, the ocean is more deserving of this title. The fields and forests on the ocean floor absorb carbon and oxygenate the atmosphere using photosynthesis. Mangroves, zooplankton, seagrass meadows, and kelp forests protect coastal areas from erosion, generate half the world's oxygen, and provide nutrient-rich, diverse ecosystems that sustain marine life.³ We are more reliant on seaweed than we are on land systems; according to the Marine Conservation Society, “seagrass meadows alone absorb and store 35 times more CO₂ than rainforests,” producing “more oxygen than trees” and “storing an estimated 175 million tonnes of carbon each year.”⁴ These environments are under increasing threat as the climate warms. The Ocean turns carbon dioxide into carbonic acid, lowering the pH of the water and making it harder for kelp and other seaweeds to grow. Alongside human activities like overfishing and coastal development, these changes have led to a 61% erosion of kelp forests and a 19% decline in seagrass meadows, creating a knock-on effect for seal and turtle populations that rely on these ecosystems to survive.⁵

The warming of the ocean may have devastating consequences for humanity, too. The El Niño climate pattern, which brings warmer water to the Pacific and increases global temperatures, returned in 2023. As a result, warm, moist air above the water's surface acts as increased fuel for tropical cyclones. Huge storms are becoming more common and more destructive. 2023 was the hottest year ever recorded and saw an unprecedented frequency of wildfires, monsoons, droughts, and all other extreme weather events.⁶ Sea levels are rising as temperatures increase and the polar ice melts, causing the devastating flooding of coastal areas. Across Asia, in India, Pakistan, Libya, China, Bangladesh, Nepal, Thailand, and Vietnam, severe floods resulted in over 2,000 deaths over the course of the year.⁷ By 2050, hundreds of millions of people in these countries, some of the poorest nations in the world, will be displaced by flooding. The true

² Various Authors: “[Chapter 9: Ocean, Cryosphere and Sea Level Change Archived.](#)” *Annual Review of Environment and Resources*. 24th October 2024.

³ Ashworth, James. “[UK seaweeds face an uncertain future in a warming ocean](#)” *Natural History Museum*. 13th October 2023.

⁴ “How the Ocean and Climate Change are Linked” *Marine Conservation Society* <https://www.mcsuk.org/ocean-emergency/climate-change/how-the-ocean-and-climate-linked/>. Accessed 24th April 2025.

⁵ Various Authors. “[Impacts of Climate Change on Marine Foundation Species.](#)” *Annual Review of Marine Science* Vol. 16 January 2024.

⁶ Dunne, Daisy “[Major tropical cyclones have become '15% more likely' over past 40 years](#)”. *Carbon Brief*. May 18, 2020.

⁷ Tétrault-Farber, Gabrielle “[Asia is most climate disaster-impacted region, UN meteorological agency says.](#)” *Reuters*. 23rd April 2024.

effects of these changes to the ocean's delicate balance may not be seen in our lifetimes. The intricate web of global ocean currents can be altered by tiny variations in air temperature. These systems are infinitely complex and take thousands of years to move water across the globe. Scientists cannot be sure what effect their alteration may have on weather, climate, and global ice melt in the centuries to come.

As the ocean warms, it becomes deoxygenised and more prone to marine heatwaves. A heatwave occurs when an area is hotter than **90% of recorded temperatures** for that time of year over five consecutive days. This can have a devastating impact on marine life. During the heatwave that occurred close to Western Australia in January, 30,000 fish washed up dead along the Ningaloo coast.⁸ The water temperature was 1.6 degrees hotter than average, posing a significant risk to the Ningaloo coral reef and surrounding seagrass meadows. Heatwaves like this create habitat loss for grazers like endangered sea turtles and dugongs. 10% of the global dugong population depends on the seagrass meadows off Western Australia, and the habitat loss for these gentle mammals would be catastrophic for conservation efforts to protect them.⁹ The 31.6-degree shallow water, too hot for locals to swim in, and the miles of lifeless fish strewn across the shore provided stark evidence that our oceans are in serious distress. Reefs, which are formed by colonies of coral polyps held together by calcium carbonate,¹⁰ are one of the most important centres of biodiversity in the ocean, providing food, shelter, and breeding grounds to over 25% of marine species. The warmer, acidic ocean water is killing living coral reefs and bleaching them ghostly white. The damage is catastrophic and irreversible. Although coral bleaching has been a concern for scientists for decades now, the dramatic temperature increases in 2023 have caused an acceleration of this process. This “global bleaching event” has left up to 80% of the planet's reefs affected by bleaching in over 82 countries.¹¹ Ocean acidification is eroding the exoskeletons of shelled creatures like oysters, clams, crabs, sea snails, and cuttlefish, causing their populations to shrink and disrupting the food chain.

The biggest cause, and also consequence, of ocean warming is the melting of glaciers and polar ice. According to research from NASA, Antarctica is losing ice mass at an average rate of 136 billion tonnes per year, and Greenland is losing about 267 billion tonnes per year, adding to sea level rise.¹² Glaciers across Europe and Asia are also declining rapidly, having lost 39% of their ice as a result of climate change.¹³ Polar ice provides habitats and breeding grounds for penguins, polar bears, and seals; if the ocean continues warming at its current rate, then by the

⁸ Stock, Petra “Deaths of 30,000 fish off WA coast made more likely by climate change, research finds” *The Guardian* 4th February 2025.

⁹ “Understanding and Conserving Dugongs” *WA Parks Foundation* <https://www.ourwaparks.org.au/understanding-and-conserving-dugongs/>. Accessed 30th April 2025.

¹⁰ “How Reefs Are Made.” *Coral Reef Alliance*. <https://coral.org/en/coral-reefs-101/how-reefs-are-made/> Accessed 24 April 2025.

¹¹ Readfearn, Graham “More than 80% of the world's reefs hit by bleaching after the worst global event on record.” *The Guardian*. 23rd April 2025.

¹² “Ice Sheets” NASA <https://climate.nasa.gov/vital-signs/ice-sheets/?intent=121>. Accessed 24th April 2025.

¹³ Hutchins, Rob “Melting Glaciers Behind Nearly 2cm in Sea Level Rises” *Oceanographic* 20th feb 2025

end of this century, there will be no summertime sea ice and no habitat for marine mammals that rely on the ice to survive.¹⁴

While polar bears face extinction within our lifetimes, ocean ecosystem disruption is already triggering mass die-offs with immediate, severe impacts on global food chains. Seabirds, dolphins, whales and various fish species are already being impacted by a lack of prey and breeding grounds. In the Mediterranean Sea, increased temperatures and salinity are affecting the populations of small fish like sardines and anchovies, which are the main source of prey for the endangered common dolphin. Atlantic whale numbers are being affected as changes in ocean currents result in decreased plankton in their migration path. There have been mass die-offs of bottlenose dolphins and sea lions in the Pacific as a result of algal blooms, which produce a neurotoxin called domoic acid. When mammals eat shellfish that are contaminated by the poisonous algae, it can cause seizures, brain damage, and death. These blooms are becoming increasingly common as warmer water and chemical runoff from agriculture create the perfect conditions for algae to multiply.¹⁵

Food chains are essential for maintaining the ocean's balance between predators and prey. While poisonous plants multiply, the precious kelp forests along the Californian coast are declining, as marine heatwaves cause starfish to develop lesions and waste away. Stars are then unable to keep purple sea urchin populations under control, leaving them free to consume large swathes of the kelp forests that protect the coast from erosion and oxygenate the water.¹⁶ These small disruptions also impact global fisheries, and since hundreds of millions of people rely on commercial fishing for food, rising insecurity may increase dependence on animal farming and agriculture, which generate significantly more carbon emissions.

According to the Marine Conservation Society, if these heating trends continue:

"More than half of the world's marine species may be on the brink of extinction by 2100. Vital habitats such as kelp forests, seagrass beds, and oyster reefs will deteriorate further and could eventually die off, sponge beds and other coastal species won't be able to filter our seawater, removing pollutants, and a warming of 1.5°C threatens to destroy 70-90% of coral reefs."

Governments and international bodies must prioritise preventing this at all costs. The first and most important step is to reduce carbon emissions by ending the burning of oil and gas for electricity and regulating polluting industries to encourage sustainable practices. Every country must push to meet net-zero targets. The Paris Climate Accord established mitigation goals aimed at keeping the global average temperature rise below 2°C to avoid the irreversible consequences of ocean warming. We still have a small window in which it is possible to meet this target. Direct action can be taken to regenerate damaged areas of the ocean, for example,

¹⁴ ["Ice in the Arctic is melting even faster than scientists expected, study finds"](#). NPR. Accessed 24th April 2025.

¹⁵ Halpert, Madeline. ["Toxic algae kills hundreds of dolphins and sea lions on California coast"](#) BBC News. 21st June 2023.

¹⁶ Pinkerton, Byrd. ["At the edge of the ocean, a dazzling ecosystem is changing fast"](#) Vox. 22nd April 2025.

building artificial breeding grounds through coral restoration, replacing the reefs that have been bleached and lost. Rewilding and marine permaculture projects are already underway to help kelp and other seaweeds recover and regain their biodiversity. In Scotland, numerous projects of this kind hope to encourage populations of scallops and lobsters. There is also action underway to reintroduce European flat oysters to the waters around Scotland, which will stabilise the seabed and improve water quality.¹⁷ Chemical adjustments can be made to increase the alkalinity of the water, protecting coral and shelled creatures from bleaching. Iron fertiliser can be used to encourage the growth of plankton, which are crucial for the pump systems that absorb and sequester carbon in the ocean floor. International bodies must consider protecting the ocean with the same rigour that land areas are protected by law. Only 8% of the ocean is currently legally protected, and precious habitats on the ocean floor that we cannot afford to lose are vulnerable to destruction from marine trawling, oil drilling, and harmful tourism practices.¹⁸ International efforts, led by the UN to protect more of the ocean, are moving too slowly. Regulating bodies must listen to scientists and take steps immediately to keep our oceans safe and protect the delicate ecological balance that oxygenates Planet Earth and allows marine life to flourish.

¹⁷ “Restoration Forth” *WWF* <https://www.wwf.org.uk/what-we-do/projects/restoration-forth>. Accessed 2nd May 2025.

¹⁸ “Conserving Our Ocean” *The Nature Conservancy* <https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-land/land-and-water-stories/protecting-our-ocean/>. Accessed 24th April 2025.

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