

Major Climate Report Warns of Severe Damage to the World's Oceans

Climate change is severely straining the world's oceans, creating profound risks for coastal cities and food supplies, a U.N. report finds

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The warming world is disrupting aquatic life and ocean patterns, with dire global consequences. Photo: Scott McIntyre for The New York Times

By *Brad Plumer*

WASHINGTON — Climate change is heating the oceans and altering their chemistry so dramatically that it is threatening seafood supplies, fueling cyclones and floods and posing profound risks to the hundreds of millions of people living along the coasts, according to a sweeping United Nations report issued Wednesday.

The report concludes that the world's oceans and ice sheets are under such severe stress that the fallout could prove difficult for humans to contain without steep reductions in greenhouse gas emissions. Fish populations are already declining in many regions as warming waters throw marine ecosystems into disarray, according to the report by the Intergovernmental Panel on Climate Change, a group of scientists convened by the United Nations to guide world leaders in policymaking.

“The oceans are sending us so many warning signals that we need to get emissions under control,” said Hans-Otto Pörtner, a marine biologist at the Alfred Wegener Institute in Germany and a lead author of the report. “Ecosystems are changing, food webs are changing, fish stocks are changing, and this turmoil is affecting humans.”

Hotter ocean temperatures, combined with rising sea levels, further imperil coastal regions, the report says, worsening a phenomenon that is already contributing to [storms like Hurricane Harvey, which devastated Houston two years ago](#).

For decades, the oceans have served as a crucial buffer against global warming, soaking up roughly a quarter of the carbon dioxide that humans emit from power plants, factories and cars, and absorbing more than 90 percent of the excess heat trapped on Earth by carbon dioxide and other greenhouse gases. Without that protection, the land would be heating much more rapidly.

But the oceans themselves are becoming hotter, more acidic and less oxygen-rich as a result, according to the report. If humans keep pumping greenhouse gases into the atmosphere at an increasing rate, marine ecosystems already facing threats from [seaborne plastic waste](#), unsustainable fishing practices and other man-made stresses will be further strained.

“We are an ocean world, run and regulated by a single ocean, and we are pushing that life support system to its very limits through heating, deoxygenation and acidification,” said Dan Laffoley of the [International Union for Conservation of Nature](#), a leading environmental group that tracks the status of plant and animal species, in response to the report.

The report, which was written by more than 100 international experts and is based on more than 7,000 studies, represents the most extensive look to date at the effects of climate change on oceans, ice sheets, mountain snowpack and permafrost.



Fishing in the Gulf of Guinea near Ghana. Rising temperatures are causing a drop in the amount of fish that humans can sustainably catch. Photo: Natalija Gormalova/AFP/Getty Images

Changes deep in the ocean or high in the mountains are not always as noticeable as some of the other hallmarks of global warming, such as heat waves on land, or wildfires and droughts. But the report makes clear that what happens in these remote regions will have ripple effects across the globe.

For instance, as ice sheets in Greenland and Antarctica melt and push up ocean levels, the report said, extreme flooding that was once historically rare could start occurring once a year or more, on average, in many coastal regions this century. How quickly this happens depends largely on the ability of humanity to reduce emissions of greenhouse gases that are heating the planet.

Around the world, glaciers in the mountains are receding quickly, [affecting the availability of water](#) for millions of people who depend on meltwater downstream to supply drinking water, irrigate agricultural land and produce electricity through dams and hydropower.

But some of the report’s starkest warnings concern the ocean, where major shifts are already underway.

The frequency of [marine heat waves](#) — which can kill fish, seabirds, coral reefs and seagrasses — has doubled since the 1980s. Many fish populations are migrating far from their usual locations to find cooler waters, and local fishing industries are often struggling to keep up. Floating sea ice in the Arctic Ocean is declining at rates that are “likely

unprecedented for at least 1,000 years,” the report said.

The report notes that some pathogens are proliferating in warmer waters, including [vibrio](#), a bacteria that can infect oysters and other shellfish, and that already sickens some 80,000 Americans who eat raw or undercooked seafood each year. “That’s a good example of how changes in the ocean can affect even people who live far from the coasts,” said Sherilee Harper, a public health expert at the University of Alberta and an author on the report.

The report warns that more dramatic changes could be in store. If fossil-fuel emissions continue to rise rapidly, for instance, the maximum amount of fish in the ocean that can be sustainably caught could decrease by as much as a quarter by century’s end. That would have sweeping implications for global food security: Fish and seafood provide about [17 percent of the world’s animal protein](#), and millions of people worldwide depend on fishing economies for their livelihoods.

And heat waves in the ocean are expected to become 20 to 50 times more frequent this century, depending on how much greenhouse-gas emissions increase. Vibrant underwater ecosystems such as coral reefs, kelp forests and seagrass meadows are all expected to suffer serious damage if global temperatures rise even modestly above today’s levels.

The potential for these heat waves to wreak havoc in coastal communities is already becoming noticeable in areas like the North Pacific Ocean, where what became known as [a “blob” of unusually hot water](#) in 2013 and 2014, partly fueled by global warming, killed thousands of seabirds and helped spawn toxic algae blooms that forced fisheries to close down from California to British Columbia.

Last year, officials in the Gulf of Alaska had to [reduce permitted cod catches by 80 percent](#) to allow stocks to rebuild in the wake of the heat wave, roiling the local fishing industry.

“When that happens, it’s like a punch in the gut,” said Brett Veerhusen, 33, a fisheries consultant and commercial fisherman based in Seattle and Homer, Alaska. “And it’s not just fishermen who are affected, it’s an entire supply chain, from processing plants to shipping to grocery stores and restaurants.”



Lobster larvae being studied in Maine, where scientists hope to understand what the larvae eat and if it affects where they migrate to avoid warming waters. Photo: Joe Raedle/Getty Images



A receding glacier in the Kenai Mountains near Primrose, Alaska. Photo: Joe Raedle/Getty Images

Changes in the ocean also threaten to disrupt the complex and often delicate ecosystems that underpin marine environments. The report notes that the upper layers of the open ocean have lost between 0.5 percent and 3.3 percent of their oxygen since 1970 as temperatures have risen. And, as the ocean absorbs more carbon dioxide, it is becoming more acidic, which could make it harder for corals, oysters, mussels and other organisms to build their hard shells.

Acidification and declining oxygen levels are already affecting the California Current, a nutrient-rich pattern of water currents in the Pacific Ocean that supports one of the world’s most lucrative fisheries, the report notes. While scientists are still trying to understand the full effects of these changes, one risk



is that shifts in the food chain could cause fish to migrate away.

“If the fish leave, that affects the small fishing fleets we have up and down the California coast,” said Gretchen Hofmann, a professor of marine biology at the University of California, Santa Barbara who was not involved in the report. “So there’s the risk of real economic and social problems.”

While the report recommends that nations sharply reduce greenhouse gas emissions to lessen the severity of most of these threats, it also points out that countries will need to adapt to many changes that have now become unavoidable.

Even if, for instance, nations rapidly phase out their greenhouse gas emissions in the decades ahead and limit global warming to well below an increase of 2 degrees Celsius from preindustrial levels — a goal enshrined in the Paris Agreement, a pact among nations to fight warming — the world’s oceans and frozen landscapes would still look very different by the end of the century than they do today. Warm-water coral reefs would still suffer mass die-offs. Global sea levels could still rise another 1 to 2 feet this century as ice sheets and glaciers melted. Fish populations would still migrate, creating winners and

losers among fishing nations and potentially leading to increased conflicts, the report noted.

To cope with these problems, coastal cities will need to build costly sea walls and many people will likely need to move away from low-lying areas, the report said. Fishery managers will need to crack down on unsustainable fishing practices to prevent seafood stocks from collapsing. Nations could also expand protected areas of the ocean to help marine ecosystems stay resilient against shifting conditions.

But the report also makes clear that if greenhouse gas emissions keep rising, many of these adaptation measures could lose their effectiveness. In the report’s worst-case emissions scenario, where greenhouse gases continue piling up unchecked in the atmosphere throughout the century, sea levels could keep rising at a relentless pace for hundreds of years, potentially by 17 feet or more by 2300, the report said.

“Our fate is probably somewhere in between” the best- and worst-case emissions scenarios laid out in the report, said Michael Oppenheimer, a climate scientist at Princeton University and a lead author of the report’s chapter on sea levels. “But if you think about the possibility of indefinite or even accelerating sea level rise for centuries to come, that bodes very poorly for coastal civilization.”

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