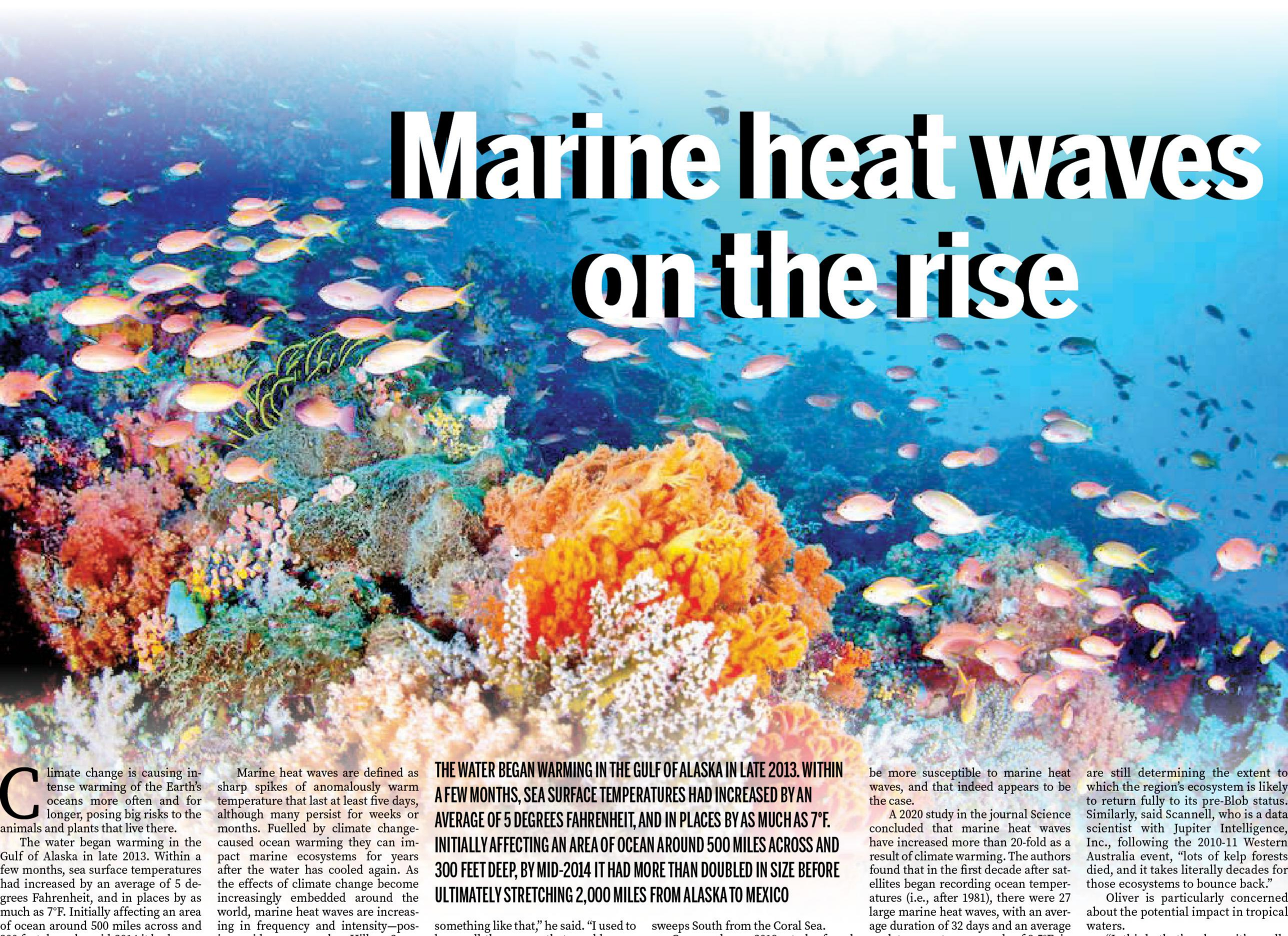
Daily News epaper

Marine heat waves on the rise



THE WATER BEGAN WARMING IN THE GULF OF ALASKA IN LATE 2013. WITHIN A FEW MONTHS, SEA SURFACE TEMPERATURES HAD INCREASED BY AN AVERAGE OF 5 DEGREES FAHRENHEIT, AND IN PLACES BY AS MUCH AS 7°F. INITIALLY AFFECTING AN AREA OF OCEAN AROUND 500 MILES ACROSS AND 300 FEET DEEP, BY MID-2014 IT HAD MORE THAN DOUBLED IN SIZE BEFORE ULTIMATELY STRETCHING 2,000 MILES FROM ALASKA TO MEXICO

Climate change is causing intense warming of the Earth's oceans more often and for longer, posing big risks to the animals and plants that live there.

The water began warming in the Gulf of Alaska in late 2013. Within a few months, sea surface temperatures had increased by an average of 5 degrees Fahrenheit, and in places by as much as 7°F. Initially affecting an area of ocean around 500 miles across and 300 feet deep, by mid-2014 it had more than doubled in size before ultimately stretching 2,000 miles from Alaska to Mexico. Scientists called it the blob, an example of a phenomenon known as marine heat waves, and over the course of three years it turned the North Pacific ecosystem inside out and upside down.

Plankton and krill numbers crashed. Numbers of Pacific cod off Alaska diminished, before ultimately the population collapsed. Starving sea lions washed ashore in their thousands, and massive numbers of seabirds died. Without krill to eat, humpback whales turned to anchovy, in search of which they swam closer to shore and became entangled in fishing gear.

Humpback whale births also fell 75 percent in the subsequent six years. Toxic algal blooms shuttered crab fisheries. The food web shifted from one supported by tiny crustaceans to one dominated by nutritionally-poor gelatinous organisms called pyrosomes that had never been recorded so far north.

Marine heat waves are defined as sharp spikes of anomalously warm temperature that last at least five days, although many persist for weeks or months. Fuelled by climate change-caused ocean warming they can impact marine ecosystems for years after the water has cooled again. As the effects of climate change become increasingly embedded around the world, marine heat waves are increasing in frequency and intensity—posing, said oceanographer Hillary Scannell, "a very big concern" for ocean environments.

Warming event

Just as scientists were coming to grips with the unfolding events in the Northeastern Pacific, a group of 15 ocean experts gathered in Perth, Western Australia, to pull together the emerging science on marine heat waves. Their meeting was prompted not by the blob, the full nature of which was only just emerging, but a warming event during the summer of 2010-11 in which the waters off Western Australia heated up an astonishing 11°F, killing huge swathes of kelp forest and large numbers of animals, from abalone and scallops to penguins.

At that time, said Eric Oliver, now of Dalhousie University in Nova Scotia, Canada, who was at the meeting, the science was in its relative infancy; since then, however, interest in the subject has exploded.

"I think the first use of the term marine heat wave was in 2010, 2011, something like that," he said. "I used to know all the papers that would come out. Now, I can't keep track of them."

That increase in scientific study reflects a growth in reports of marine heat wave events. In 2016, a marine heat wave off Chile triggered algal blooms that devastated fish farms. From 2015 to 2019, a series of heat waves in the Mediterranean Sea led to multiple mass mortalities of seagrass and coral, heralding what has been called a new normal in the region. In 2021 and 2022, New Zealand experienced its highest ocean temperatures on record, resulting in the bleaching of "millions" of sponges, according to reports.

The precise causes of these heat waves vary, though a warming climate is making them more frequent. The Western Australia event was prompted by a strengthening of the Southward-flowing Leeuwen Current, which brought increased amounts of warm water from the Indian Ocean. Similarly, a 2015-16 heat wave in the Tasman Sea between Australia and New Zealand was kicked off by a strengthening of the East Australian Current, which sweeps South from the Coral Sea.

Conversely, a 2019 study found that 60 percent of marine heat waves in the Southwestern Atlantic, including one off Brazil in 2013-14, originated in high-pressure systems over the Indian Ocean. The blob was precipitated by what has been called a "ridiculously persistent ridge" of high pressure parked over the North Pacific, preventing cooler air from generating storms that might churn up the water. Consequently, the water stratified and an anomalously warm layer settled on the surface.

Climate change

But there is an underlying element making such heat waves more frequent and more intense: climate change. The ocean has absorbed 90 percent of the extra heat added to the atmosphere by burning fossil fuels, and as a result, the top 2,300 feet of the world's oceans—where most of that absorbed heat is concentrated—has warmed by about 1.5°F on average since 1901.

An ocean that is already warmer could reasonably be expected to be more susceptible to marine heat waves, and that indeed appears to be the case.

A 2020 study in the journal Science concluded that marine heat waves have increased more than 20-fold as a result of climate warming. The authors found that in the first decade after satellites began recording ocean temperatures (i.e., after 1981), there were 27 large marine heat waves, with an average duration of 32 days and an average peak temperature anomaly of 8.5°F; in the 2010s, there were 172, which lasted 48 days on average with an average peak temperature almost 10°F above normal.

Much remains unclear about marine heat waves. For example, said Nicholas Bond, research scientist at the University of Washington and Washington's state climatologist, there is the question of why so many persist for weeks or months. "There must be something else that's going on that helps maintain them," he said. He added that one explanation is that as the ocean surface warms, it radiates heat into the atmosphere that prevents cloud cover from forming, exposing the seawater to increased sunlight and further warming.

However, enough is known about marine heat waves for scientists to be gravely concerned about their potential impacts. Of special note is the fact that those impacts can last long after the heat waves have disappeared. After three years of the blob, the waters of the Northeastern Pacific began to cool in 2016; but years later, scientists are still determining the extent to which the region's ecosystem is likely to return fully to its pre-Blob status. Similarly, said Scannell, who is a data scientist with Jupiter Intelligence, Inc., following the 2010-11 Western Australia event, "lots of kelp forests died, and it takes literally decades for those ecosystems to bounce back."

Oliver is particularly concerned about the potential impact in tropical waters.

"I think that's where it's really worrying," he said. Life in the tropics, he added, is adapted to "quite a narrow range of temperatures. So that's where things can get really messy. We can have complete shifts in tropical systems. That's why people are so concerned about coral reefs."

As disruptive to marine ecosystems as marine heat waves can be in isolation, Bond said that they are multiplying and intensifying at the same time as the ocean is facing a raft of other pressures, making heat waves' potential impacts all the more severe.

"In many parts of the global ocean, fishing is probably at unsustainable levels," he said. "There's just incredible pressure there on those ecosystems. And when you add to that the changes that are occurring due to events such as marine heat waves, changes that will reduce the productivity of these systems, it's very distressing. It's something we had better recognise before we see collapses that would have tremendous impacts. *-National Geographic*