

Rampant heatwaves threaten food security of entire planet, scientists warn

After hottest day ever, researchers say global heating may mean future of crop failures on land and ‘silent dying’ in the oceans

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- A stag takes a drink at Dülmen wildlife reserve in Münsterland, Germany, on a sweltering day this summer. Photograph: Imageplotter/Alamy

Successive heatwaves threaten nature’s ability to provide us with food, say researchers, as they warn of an “unseen, silent dying” in our oceans amid record temperatures scorching the Earth.

Heatwaves are ripping through Europe, the US and China, with **the global hottest day** ever recorded at the start of July, endangering human life as well as the land and sea it depends on.

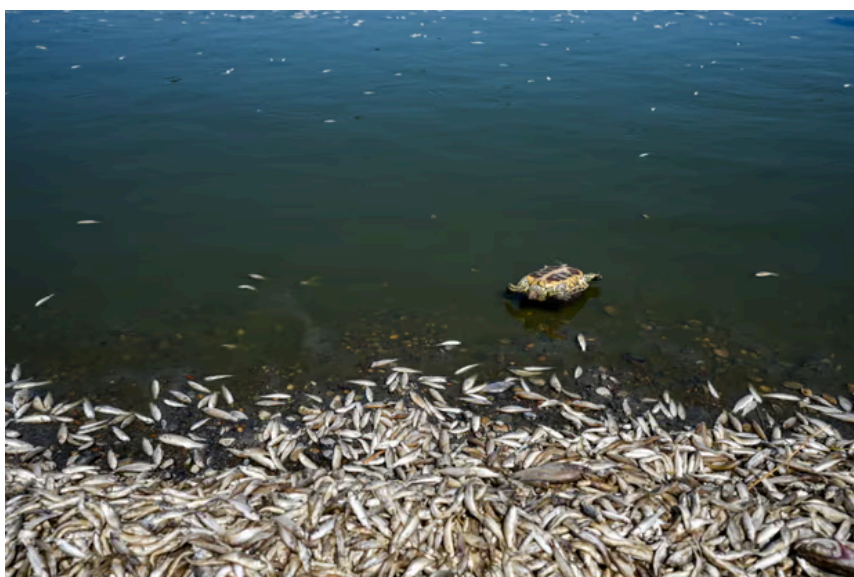
“Our food system is global,” said John Marsham, professor of atmospheric science at the University of Leeds. “There are growing risks of simultaneous major crop losses in different regions in the world, which will really affect food availability and prices. This is not what we’re seeing right now, but in the coming decades that’s one of the things I’m really scared of.

“As a human being, if you’re wealthy enough, you can get inside and put the air conditioning on. But natural ecosystems and farmed ecosystems can’t do that.”

The 2018 European heatwave led to **multiple crop failures** and loss of yield of up to 50% in central and northern Europe. In 2022, record temperatures in the UK killed **fruit and vegetables** on the vine.

Heatwaves are expected to become **12 times more frequent** by 2040 compared with pre-warming levels. Although one heatwave might not kill an ecosystem, longer and more frequent events will mean nature does not have time to recover.

Marsham said: “People are generally isolated from the effects of the weather on which we all depend. We go to shops to buy food – we don’t grow it ourselves. But if you talk to farmers anywhere in the world, they are extremely aware of what the weather is doing, and the impacts on their farming.



Thousands of dead fish float in the Amshar River in Iraq in July in a disaster thought to be linked to drought. Photograph: Asaad Niazi/AFP/Getty Images

The climate crisis doesn't just increase atmospheric heatwaves but oceanic ones too, harming coastal communities and threatening another key food source for humans. Heat stress causes dramatic die-offs, such as the 2021 "heat dome" along Canada's Pacific coast, which killed an estimated **1 billion marine animals**.

Daniela Schmidt, professor of earth sciences at the University of Bristol, said: "We often think about impacts on ecosystems on land because it's easy to see – the plants wilt and animals get too hot. But people generally don't think about marine heatwaves. That's what really worries me – that unseen, silent dying."

Some of the most vulnerable ecosystems are the ones used to having a stable temperature year-round, such as species in the tropical oceans. Warming of 2C is expected to essentially wipe out tropical corals reefs. They have the highest biodiversity of any ecosystem globally, and support more than **500 million people** worldwide, most of whom are in poor countries.

"I've got young kids," Marsham said. "Whenever you watch Finding Nemo or read a book about coral reefs, you can't help but feel that, on some level, you're selling them a lie. Unless we act fast, those systems are going to disappear. Some people might not care about coral reefs, but there's no part of the globe that is immune to the impacts of climate change."

Schmidt added: "Not everything has to have a financial value. You need plants for every breath you take. It's the oxygen you breathe – we tend to forget that."

Research is just starting to scratch the surface of understanding how **heat affects ecosystems**. Under a high-emissions scenario of 4.4C warming, 41% of land vertebrates will experience extreme thermal events by 2099, **according to research** published in Nature. Stresses induced by hot temperatures can cause numerous problems, affecting growth, fertility, immunity and changes in behaviour.

Species are **moving up mountains** and towards the poles to evade the heat. Ultimately, it is likely to drive more species towards extinction.

Nature can, however, play an important role in making extreme heat more bearable, say experts. Bodies of water such as ponds and fountains make landscapes more resilient in hot, dry summers, helping prevent wildfires and reducing the impacts of drought.



Pigeons cool down in the River Wharfe in North Yorkshire during the UK heatwave in June. Photograph: Rebecca Cole/Alamy

Dr Nicole Miranda, a senior researcher at the **Oxford Martin programme on the Future of Cooling**, said: “The presence of vegetation and water in our landscape can serve as ways to passively cool our surroundings. Trees and plants provide shading and also have the mechanism of evapotranspiration. Bodies of water, such as ponds and fountains, capture the heat around them by evaporating water.”

One example is the large-scale **green corridors** in Medellín, Colombia, which have reportedly cut urban heat by 2C.

Extreme heat could put 40% of land vertebrates in peril by end of century

This article is more than 6 months old

Study shows ‘disastrous consequences for wildlife’ if human-caused emissions push global temperatures up 4.4C

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- A female desert bighorn sheep in the Joshua Tree National Park, California. Such areas would be among the worse impacted if global emissions are not cut. Photograph: Michael S Nolan/Alamy

More than 40% of land vertebrates will be threatened by extreme heat by the end of the century under a high emissions scenario, with freak temperatures once regarded as rare likely to become the norm, new research warns.

Reptiles, birds, amphibians and mammals are being exposed to extreme heat events of increasing frequency, duration and intensity, as a result of human-driven global heating. This poses a substantial threat to the planet’s biodiversity, a new study warns.

Under a high emissions scenario of 4.4C warming, 41% of land vertebrates will experience extreme thermal events by 2099, **according to the paper**, published in Nature.

In worse affected regions, such as the Mojave desert in the US, Gran Chaco in South America, the Sahel and Sahara in Africa and parts of Iran and Afghanistan, 100% of species would be exposed to extreme heat. It is not possible to say if these areas would be uninhabitable, but it is likely that more species would become extinct.



A desert tortoise in the Mojave desert in California, US, an area that would be one of the worse hit by extreme heat. Photograph: Scott Trageser/Alamy

Researchers mapped the effects of extreme heat on more than 33,000 land vertebrates by looking at maximum temperature data between 1950 and 2099. They considered five predictions of global climatic models based on different levels of greenhouse gas emission, as well as the distribution of terrestrial vertebrates, to work out how exposed animal populations would be.

“A couple of studies have shown recent climate warming trends match the 4.4C scenario much better than the other scenarios,” said lead author Gopal Murali,

who was at Ben-Gurion University of Negev, Israel when he carried out the research. “We wanted to highlight the disastrous consequences for wildlife if we end up with a high, unmitigated emission scenario.”

Amphibians and reptiles were most affected, with 55% and 51% respectively likely to experience extreme heat events by the end of the century, compared with 26% of birds and 31% of mammals. Amphibians and reptiles are most vulnerable because they generally live within smaller temperature ranges.

Under 3.6C of warming, 29% of terrestrial vertebrates will experience extreme heat events, according to the report. This falls to 6% if warming is limited to 1.8C. “Deep greenhouse gas emissions cuts are urgently needed to limit species’ exposure to thermal extremes,” the researchers wrote.

Heat stress causes dramatic die-offs and can wipe out entire ecosystems, as happened in the 2021 heatwave along Canada’s Pacific coast, which experts estimate killed more than **one billion marine animals**. Murali said: “Heatwaves have become frequent. We see them every summer, with new records set all the time, and they have drastic impacts on wildlife. They can wipe out entire ecosystems overnight. But no large-scale studies have looked at how such extreme temperature events are going to affect biodiversity in the future.”



An Indian shepherd with dead sheep in a village in Gujarat, India, during an extreme heat event in June 2019. Photograph: Sam Panthaky/AFP/Getty Images

Extreme temperatures kill more than 5 million people a year globally, with heat-related deaths continuing to rise, **research shows**. “If we follow the current trends, the future is bleak,” said Uri Roll from Ben-Gurion University of the Negev.

While humans are able to shelter, and many can drink as much as they want and refrigerate their food, “this is obviously impossible for animals”, said Roll. “Ultimately, this will greatly affect many species – and this is just one facet of the many changes that are expected. We are not looking at changes of habitat or an increase in invasive species, or changes in rainfall [in the study]”

Prof Nathalie Pettorelli, an applied ecologist from the Zoological Society of London, who was not involved in the research, said the report provided “a good estimate” of the pressure that extreme heat may pose to land vertebrates by the end of the century, but added that it “fails to look at conservation status in relation to exposure. Taking this into account would help identify areas that are both likely to be hotspots for extreme heat events in the future and where things are already not looking good now, which would help prioritise action.”

Dr Ryan Long, associate professor of wildlife sciences at the University of Idaho, who was not involved in the research, said: “The authors make a compelling case that if current levels of emissions continue unchecked, a large percentage of the planet’s fauna will face unprecedented temperature extremes by the end of the century, especially in mid-latitude deserts, shrublands and grasslands.”