

AI sorts public photos to show recovering pacific humpback whales hit climate ceiling

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Photographs of humpback whale tails, identified through artificial intelligence-based image recognition much like facial recognition, allow researchers to track individual whales across oceans, revealing population growth recovering from industrial whaling—and more recently, decline from a major marine heat wave. This whale is known as "Frosty" CRC-12492, named for the snowman-shaped barnacle scars on the tail. Credit: Ted Cheeseman.

Scientists have found that recovering humpback whales in the North Pacific are now responding to shifts in food availability affected by climate change. They drew the conclusion from thousands of whale photographs submitted over 20 years by researchers and the public.

The North Pacific humpback whale population had been recovering from [commercial whaling](#) over four decades when it abruptly declined during a massive marine heat wave that warmed the eastern Pacific Ocean, the scientists report in the journal [Royal Society Open Science](#). The population dropped by about 7,000 individuals from 2012 to 2021 as the marine heat wave called "The Blob" upset the marine ecosystem and reduced the whales' prey.

"We expected to see growth level off as the population recovered," said Ted Cheeseman, a doctoral student at Southern Cross University, Lismore, Australia, and lead author of the new research. The paper had 75 co-authors from NOAA Fisheries and Office of National Marine Sanctuaries, universities, and other organizations. "What we didn't anticipate was that [climate change](#) would lower the capacity of the ocean for humpbacks."

The paper's findings hinge on hundreds of thousands of photos of humpback and other whales submitted by researchers, whale watch crews, kayakers, and other members of the public. Photos were uploaded to [happywhale.com](#), a citizen science website Cheeseman co-founded and directs.

This ever-growing database uses artificial intelligence to match the individual shapes and patterns on the underside of humpback whale tails like facial recognition. It tracks the whales around the globe. As the photo treasure trove grows, Cheeseman and his colleagues are using it to track changes in whale populations.

"This is an ingenious way of leveraging the power of all those people out on the water seeing whales to create a comprehensive picture of the population," said Jay Barlow, a senior scientist retired from NOAA Fisheries' Southwest Fisheries Science Center and co-author of the new research. "We're getting cutting-edge science at very little cost that helps us understand the species and inform management."

"This information not only helps us understand the possible effects of climate change," said Ed Lyman, natural resource specialist for Hawaiian Islands Humpback Whale National Marine Sanctuary, "but also the effects from other risk factors, such as entanglement."

Photos cover the globe

About two-thirds of the photographs come from current and prior scientific collections and research efforts. That includes SPLASH, a multi-partner project of humpback whale populations from 2004 to 2006. The public contributes the rest of the photos from all corners of the world. "Some areas, if we didn't have the public's help, would be pretty sparse," Cheeseman said. "We would not have the same confidence in the results."

This is the first major research finding to come from the Happywhale photo database, which Cheeseman founded with Ken Southerland in 2015. Happywhale is now the largest photographic dataset assembled for any cetacean species. While artificial intelligence tools help scan and match the unique color patterns of whales across multiple photos, a scientist individually reviews and confirms every match.

The authors of the new research paper list the thousands of people who contributed humpback photos, taking up 14 single-spaced pages.

Whaling impacted population numbers

Commercial whaling may have reduced North Pacific humpback whale numbers to a few thousand before ending in the 1970s. The Marine Mammal Protection Act and Endangered Species Act prohibited hunting and harassment of whales in U.S. waters. Humpback whale numbers in the North Pacific Ocean climbed from about 16,875 in 2002 to a peak of 33,488 whales in 2012.

That likely reflected the recovery of the North Pacific humpback population, which approached the ocean's carrying capacity as they made full use of available food supplies. NOAA Fisheries recognized the improvements in a global status review of humpback whales. The review found that several humpback whale populations had recovered enough that they did not warrant protection under the Endangered Species Act.

Heat wave drives decline

Then, the picture changed.

Between 2012 and 2021, humpback numbers reversed course and fell by about 7,000, roughly 20%. This reflected declining food supplies as a massive marine heat wave enveloped much of the Pacific. The marine heat wave brought [sea surface temperatures](#) to record levels, disrupting the ocean ecosystem and shifting prey for many species. California sea lions also suffered; hundreds of starving sea lion pups stranded on Southern California beaches while their mothers swam farther and farther away to find food.

"The humpback whale population had recovered to a place that the ocean suddenly couldn't support," Cheeseman said. "About 7,000 whales died as that capacity declined."

Some studies suggest that marine heat waves may become more numerous and severe as climate change affects the world's oceans. "We weren't looking for climate change impacts when we started this, but it is something that we found," Cheeseman said.

Humpback whales wintering in waters off Hawai'i declined sharply, falling about 34% from their peak in 2013. On the other hand, the population of humpback whales that winter off Mexico hardly declined at all.

"Humpback whales in the North Pacific actually consist of several distinct population segments that breed and feed in different regions, and these populations have been affected differently by ocean changes," said Jeff Moore, a scientist at the Southwest Fisheries Science Center and one of the paper's co-authors. As photographs continue to arrive through happywhale.com, "We have the mechanism in place to track further changes in numbers," Cheeseman said.

Cheeseman doubts that climate change will threaten humpback whales with extinction the way that whaling did. Ship strikes and entanglement in fishing gear have also affected [humpback whales](#), he said, but not to the same degree as the climate-driven decline. He did note that as the impacts of whaling lessened, the new human impact of climate change began to influence the species instead. "We are at risk of less productive oceans because of climate change, and that is our doing as well," he said.

More information: Ted Cheeseman et al, Bellwethers of change: population modelling of North Pacific humpback whales from 2002 through 2021 reveals shift from recovery to climate response, *Royal Society Open Science* (2024). [DOI: 10.1098/rsos.231462](https://doi.org/10.1098/rsos.231462)

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