



WHY WARMER OCEANS ARE A PROBLEM FOR HUMPBACK WHALES

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Humpback whales are marine mammals that swim long distances between cold and warm waters every year to feed and have babies (calves), but rising ocean temperatures could make their breeding and calving grounds too warm. This article explains how we studied these changes by creating detailed maps predicting ocean temperatures in the future. We discovered that many humpback whale breeding areas could become too hot by the year 2100 if we do not make changes now. Whales are important for the health of our planet because they recycle nutrients and store carbon in the ocean. By switching to clean energy and taking care of the environment, we can protect

humpback whales and their ocean home. This is a call to action for kids, parents, and teachers to learn about climate change and how to make a difference.

BREEDING GROUNDS

Geographic areas where humpback whales give birth and raise their calves. Also called calving grounds.

PREDATORS

Animals that hunt other animals for food, like killer whales.

Figure 1

A humpback whale mother and calf on the breeding grounds of Maui, Hawai'i (Photograph collected under NMFS/MMPA research permit #21476).

BLUBBER

A thick layer of fat under the skin of all marine mammals, which helps them stay warm in cold water and can be used for energy when food is scarce.

WHAT ARE HUMPBACK WHALES?

Humpback whales are large mammals that live in the ocean. They like to spend their summers eating food in cold waters and then travel to warm tropical areas in the winter to have their babies (Figure 1). These warm areas, called **breeding grounds**, need to be just the right temperature for the whales and their calves. The warm waters of the breeding grounds are mostly free of **predators**, like killer whales, and are more comfortable for the baby whales that do not have much **blubber** yet.



WHY ARE HUMPBACK WHALES IN TROUBLE?

The Earth is getting warmer because of things people do, like driving gasoline-powered cars, cutting down trees, running factories, and using lots of coal, oil, and gas. This warming makes the ocean hotter, too. Whales like to give birth in water that is between 21 °C and 28 °C (like a nice warm bath), which helps their calves to grow and gain weight rapidly [1]. But if the ocean gets hotter than this, the whales might have to move to new breeding and calving grounds to feel comfortable. Moving is not easy for humpback whales because they have certain favorite spots where they like to return every year [2].

MODELS

Computer tools used to predict certain scenarios, such as how the climate might change in the future.

RENEWABLE ENERGY

Energy from natural sources that can be replenished, like water, wind, and solar power.

HOW DO SCIENTISTS STUDY THIS PROBLEM?

To figure out what might happen to humpback whales in the future, scientists use computers to create informed predictions based on past trends, which are called **models**. For this project, we created detailed maps of the ocean that show how warm or cool different areas will be as the Earth gets hotter [3]. The process consisted of three basic steps.

Looking at the Past and Present

First, other scientists collected information about how warm the ocean is right now and how these temperatures have changed in the recent past in whale breeding areas. They published their work and made this information available to us online.

Making Predictions for the Future

Next, we used computers to make predictions of how ocean surface temperatures might change by the year 2100. We explored two different scenarios:

- What if people do not change much and keep using lots of coal, gas, and oil?
- What if people start using **renewable energy** sources, such as solar and wind, and try to stop the planet from warming up so much?

Focusing on Whale Homes

Based on these two scenarios, we explored the predicted future ocean temperatures in the specific breeding areas used by humpback whales. This helped us to see exactly which places might become too warm for the whales in the future.

WHAT DID WE FIND OUT?

After this experiment, we discovered something worrying: If people keep using lots of coal, oil, and gas, about 67% of whale breeding areas could get too warm by the year 2100 ([Video 1](#)). That would impact more than half the world's populations of humpback whales! Even if people use cleaner energy and take better care of the planet, about 35% of breeding areas might still get too warm, but many places would stay comfortable for the whales ([Video 2](#)). This means that most of the present-day breeding areas will become too warm for the whales if we do not act right away [3].

Video 1

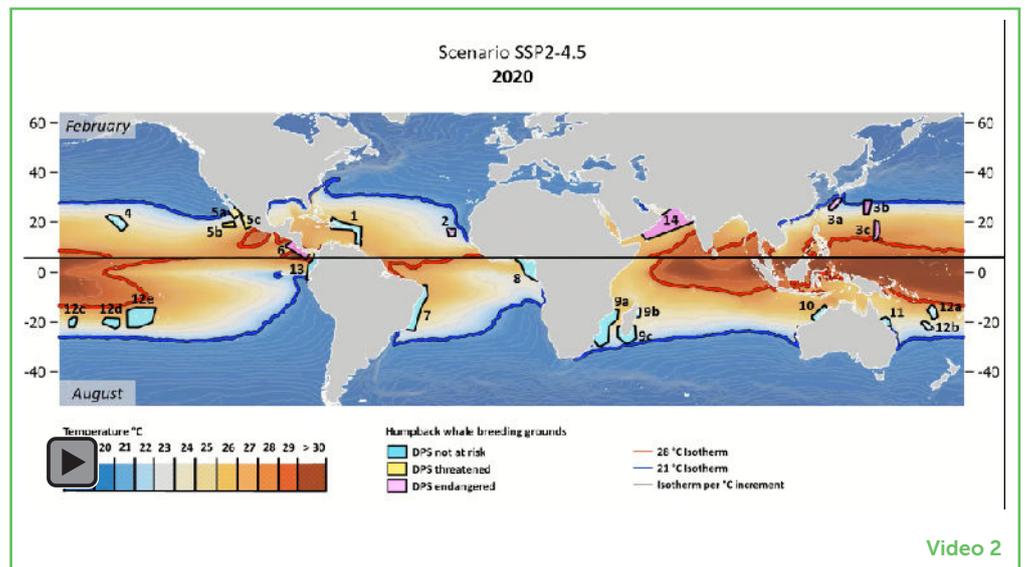
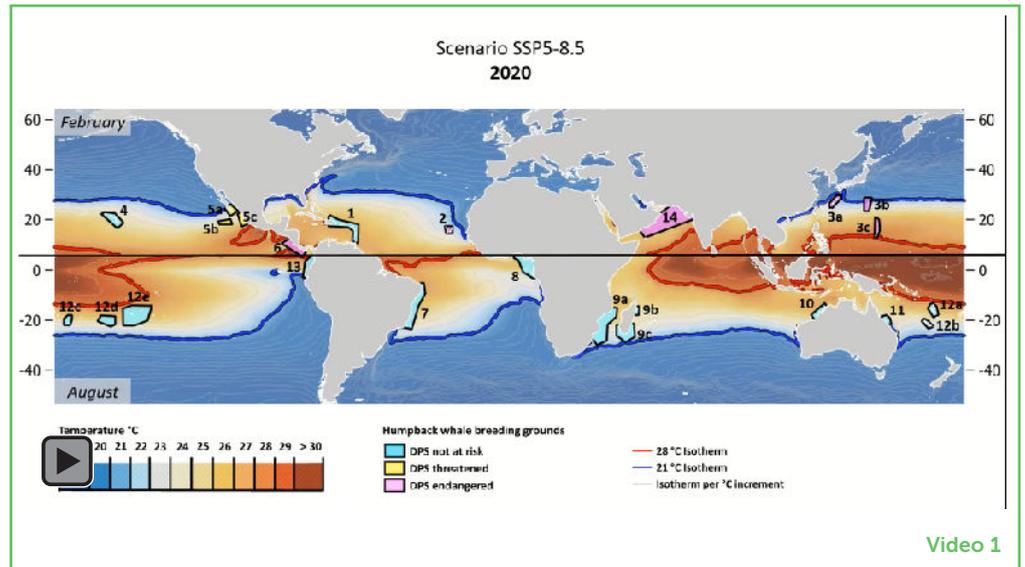
Animation showing the potential warming of ocean temperatures from the year 2020 to 2100 in the areas where humpback whales go to breed and have babies if we keep burning a lot of fossil fuels. The red line shows where ocean temperatures reach 28 °C, and the blue line shows where they reach 21 °C. Humpback whales prefer warm water (21 °C–28 °C) for breeding and calving. If water gets too warm, whales might have to move, or they could have trouble finding suitable homes.

Video 2

Animation showing the potential warming of ocean temperatures from the year 2020 to 2100 in the areas where humpback whales go to breed and have babies if we use more clean energy sources. The red line shows where ocean temperatures reach 28 °C, and the blue line shows where they reach 21 °C. Humpback whales prefer warm water (21 °C–28 °C) for breeding and calving. If water gets too warm, whales might have to move, or they could have trouble finding suitable homes.

PLANKTON

Tiny plants and animals in the ocean that are a key part of the food chain and help produce oxygen.



WHY ARE WHALES IMPORTANT?

Whales are incredibly important for the health of the ocean. When whales dive and swim, they mix up the water, which helps cycle nutrients in the ocean [4]. Whales are like gardeners; they poop in the ocean, which acts as fertilizer causing tiny plants called **plankton** to grow. These plants make some of the oxygen we breathe and feed lots of other ocean animals.

Also, when whales die and sink to the bottom, they help trap carbon, collected throughout their lifetime, at the bottom of the ocean floor [4]. This is called **carbon sequestration**, and it keeps the planet cooler. If the ocean becomes too warm, it will change how marine life can survive and find food, which could hurt the entire **ecosystem**.

CARBON SEQUESTRATION

The process of capturing and storing carbon dioxide, which helps slow global warming.

ECOSYSTEM

A community of living things, like animals and plants, and their environment, working together.

Whale watching also provides jobs for boat operators, tour guides, and even scientists who help educate the public. This industry supports businesses, such as restaurants, hotels, and souvenir shops, in many coastal towns. For example, in places like Hawai'i, whale watching is a major tourist attraction that helps communities thrive.

WHAT CAN WHALES DO IF THE OCEAN WARMS TOO MUCH?

If the ocean gets too warm, whales might have to move to new places. Moving can be hard for whales, because they might not find enough food in new areas. Moving to new places could also make it harder for groups of whales to find each other and stay together, and babies could be in danger if they are born in places with more predators or where there are too many boats. Moving also drains whales' energy. After moving, they may not have enough energy left to hunt for food or take care of their babies. Some whales might stay in their old homes even if it is too warm, but this could stress them out and make it harder for them to have healthy babies.

HOW CAN WE HELP?

The best way to help humpback whales is to slow down how quickly the Earth is heating up. We can do this by choosing clean energy sources like water, wind, and solar instead of coal, oil, and gas. It also helps to take good care of the ocean by keeping it clean and safe for marine life. People can ask leaders to make decisions that protect nature, and they can teach friends and family about how a warming ocean affects whales.

By working together, we can help whales keep their favorite homes and make sure they are around for a long time. It is up to us all to protect these gentle giants and their ocean home!

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REFERENCES

1. Rasmussen, K., Palacios, D. M., Calambokidis, J., Saborío, M. T., Dalla Rosa, L., Secchi, E. R., et al. 2007. Southern Hemisphere humpback whales wintering off Central America: insights from water temperature into the longest mammalian migration. *Biol. Lett.* 3:302–5. doi: 10.1098/rsbl.2007.0067
2. Cheeseman, T., Barlow, J., Acebes, J. M., Audley, K., Bejder, L., Birdsall, C., et al. 2024. Bellwethers of change: population modelling of North Pacific humpback whales from 2002 through 2021 reveals shift from recovery to climate response. *R. Soc. Open Sci.* 11:231462. doi: 10.1098/rsos.231462
3. von Hammerstein, H., Setter, R. O., van Aswegen, M., Currie, J. J., and Stack, S. H. 2022. High-resolution projections of global sea surface temperatures reveal critical warming in humpback whale breeding grounds. *Front. Mar. Sci.* 9:837772. doi: 10.3389/fmars.2022.837772
4. Roman, J., Estes, J. A., Morissette, L., Smith, C., Costa, D., McCarthy, J., et al. 2014. Whales as marine ecosystem engineers. *Front. Ecol. Environ.* 12:377–85. doi: 10.1890/130220

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YOUNG REVIEWERS



SANTIAGO, AGE: 9

Hello, I am Santiago, and I am 9th years old. I like to build 3d puzzles, play video games, and play at the park with other kids. I love reading adventure books and drawing.

AUTHORS



STEPHANIE H. STACK

I am a scientist who studies humpback whales to learn how they live, migrate, and take care of their babies. I work with other scientists and with governments around the world to help create respectful whale-watching practices that protect whales and keep people safe too. *stephanie.stack@gmail.com



HANNAH VON HAMMERSTEIN

I am a scientist studying how climate change affects ocean animals. I work in special aquarium labs around the world where I study how fish do in warmer and more acidic water, just like what the oceans might be like in the future. My research has taken me from Germany to Fiji, Hawai'i, Costa Rica, and Colombia. I also work on a computer to use the data I collect to understand how climate change might affect sea animals, ocean habitats, and the people who depend on the ocean for food and jobs.



RENEE O. SETTER

I am a scientist studying how climate change will affect the ocean. I focus on coral reefs and how warming and acidifying seawater might change them in the future. I use computer models and lots of data to figure out what conditions coral reefs may face as the climate changes. I have also studied how climate change affects many other things, including diseases, rainbows, whales, bogs, and the ways communities can protect their coastlines.



MARTIN VAN ASWEGEN

I am a scientist who studies humpback whales in Hawai'i and Alaska. Since 2018, I have used drones to take pictures and videos of whales so I can learn how big they are and how healthy their bodies look. I also study how whales use their energy, how their bodies work, and how human activities can affect them. I use what I learn to help people make smart choices that protect whales and keep the ocean healthy.



JENS J. CURRIE

I am a scientist who studies whales and dolphins to keep them safe. I look at if populations are healthy and what problems they face. I use tools like drones and special suction-cup tags to learn about their bodies and how much energy they need to survive. I work with other scientists, government leaders, and local communities to make sure our research helps protect whales and dolphins.