

In an attempt to adapt, some breeding pairs have relocated hundreds of kilometres north since the 1970s.

"The penguins are trying to move," Boersma said. "But they can't move as fast as climate change is occurring, nor can they possibly adapt to what's happening in the world."

Adding to their woes, Boersma said, Magellanic penguins have started laying eggs an average of three days later every decade since she started her research. Delayed laying gives penguins less time to fatten up their offspring and increases the chances that chicks will face food shortages.

Together, the data suggest that conservation practices need to focus on what's happening with a specific species rather than banning activities in a general area — especially when the species in question moves or commutes outside the area of protection.

"We need to go to version 2.0," said Emily Pidgeon, who leads the marine climate change program at Conservation International in Arlington, Va. "Things are going to have to change."

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Climate change will force fish species towards poles

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The world's fish stocks will soon suffer major upheaval due to climate change, scientists have warned. Changing ocean temperatures and currents will force thousands of species to migrate polewards, including cod, herring, plaice and prawns. By 2050, US fishermen may see a 50% reduction in Atlantic cod populations.

Zoom

The predictions of "huge changes", published in the journal *Fish and Fisheries*, were presented at the AAAS annual meeting in Chicago.

Marine biologists used computer models to forecast the future of 1,066 commercially important species from across the globe.

"The impact of climate change on marine biodiversity and fisheries is going to be huge," said lead author Dr William Cheung, of the University of East Anglia in the UK.

"We must act now to adapt our fisheries management and conservation policies to minimise harm to marine life and to our society.

"We can use our knowledge to improve the design of marine protected areas which are adaptable to changes in distribution of the species," he told the conference.

The world's oceans are already experiencing changes in temperature and current patterns are changing due to climate change.

To quantify the likely impact on sea life, Dr Cheung and his team developed a new computer model that predicts what might happen under different climate scenarios.

While scientists have made projections of climate change impact on land species, this is the most comprehensive study on marine species ever published.

"We found that on average, the animals may shift their distribution towards the poles by 40km per decade," said Dr Cheung.

"Atlantic cod on the east coast of the US may see a 50% reduction in some populations by 2050."

The invasion of new species into unfamiliar environments could seriously disrupt ecosystems, the researchers warn.

Some species will face a high risk of extinction, including Striped Rock Cod in the Antarctic and St Paul Rock Lobster in the Southern Ocean.

But of course, as fish migrate polewards, fishermen in some areas will see their stocks increase.

The model predicts an increased catch in the North Sea - benefiting fishermen from Nordic countries.

But fishermen in tropical developing countries will suffer major losses in catch.

The socio-economic impact could be devastating, according to another study published recently in the same journal.

Thirty-three nations in Africa, Asia and South America are highly vulnerable to the impact of climate change in fisheries, according to scientists from the World Fish Centre.

Of these, 19 were already classified by the United Nations as "least developed" because of their particularly poor socio-economic conditions.

"Economically, people in the tropics and subtropics likely will suffer most, because fish are so important in their diets and because they have limited capacity to develop other sources of income and food," said Edward Allison, director of policy, economics and social science at WorldFish.

"We believe it is urgent to start identifying these vulnerable countries, because the damage will be greatly compounded unless national governments and international institutions like the World Bank act now to include the fish sector in plans for helping the poor cope with climate change.

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