

# Climate change will reshuffle marine ecosystems in unexpected ways, study finds

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Large predatory fish are expected to lag behind temperature shifts due to food-web dynamics. Credit: Gerald Schömb

Warming of the oceans due to climate change will mean fewer productive fish species to catch in the future, according to a new Rutgers

study that found as temperatures warm, predator-prey interactions will prevent species from keeping up with the conditions where they could thrive.

The new study, published in the journal *Proceedings of the Royal Society B*, presents a mixed picture of ocean health. Not only will large [species](#) and commercially important fisheries shift out of their historical ranges as climate warms, but they will likely not be as abundant even in their new geographic ranges. For instance, a cod fisherman in the Atlantic might still find fish 200 years from now but in significantly fewer numbers.

"What that suggests from a fisheries perspective is that while the species we fish today will be there tomorrow, they will not be there in the same abundance. In such a context, overfishing becomes easier because the population growth rates are low," said study coauthor Malin Pinsky, an associate professor in Rutgers' Department of Ecology, Evolution, and Natural Resources. "Warming coupled with food-web dynamics will be like putting marine biodiversity in a blender."

Previous studies of shifting habitat ranges focused on the direct impacts of climate change on [individual species](#). While these "one-at-a-time" species projections offer insights into the composition of ocean communities in a warming world, they have largely failed to consider how food-web interactions will affect the pace of change.

The new study looked at trophic interactions—the process of one species being nourished at the expense of another—and other food-web dynamics to determine how climate change affects species' ranges.

Using sophisticated computer models, the researchers determined that predator-prey interactions cause many species, especially [large predators](#), to shift their ranges more slowly than climate.

"The model suggests that over the next 200 years of warming, species are going to continually reshuffle and be in the process of shifting their ranges," said lead author E. W. Tekwa, a former Rutgers postdoc in ecology, evolution and natural resources now at the University of British Columbia. "Even after 200 years, marine species will still be lagging behind temperature shifts, and this is particularly true for those at the top of the food web."

As [climate](#) warms, millions of species are shifting poleward in a dramatic reorganization of life on earth. However, our understanding of these dynamics has largely ignored a key feature of life—animals and other organisms must eat. The researchers have filled this knowledge gap by examining how the basic need for nourishment affects species' movements.

The researchers developed a "spatially explicit food-web model" that included parameters such as metabolism, [body size](#) and optimal temperature ranges. By accounting for [climate change](#), their model revealed that dynamic trophic interactions hamper species' ability to react quickly to warming temperatures. They also found that larger-bodied top predators stay longer than smaller prey in historical habitats, in part because of the arrival of new food sources to their pre-warming ranges.

"These dynamics will not only be in one place but globally," Pinsky said. "That does not bode well for [marine life](#), and this is not an effect that has been widely recognized."

**More information:** Body-size and food-web interactions mediate species range shifts under warming, *Proceedings of the Royal Society B: Biological Sciences* (2022). [DOI: 10.1098/rspb.2021.2755](https://doi.org/10.1098/rspb.2021.2755).  
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