Warming waters caused rapid—and opposite—shifts in connected marine communities

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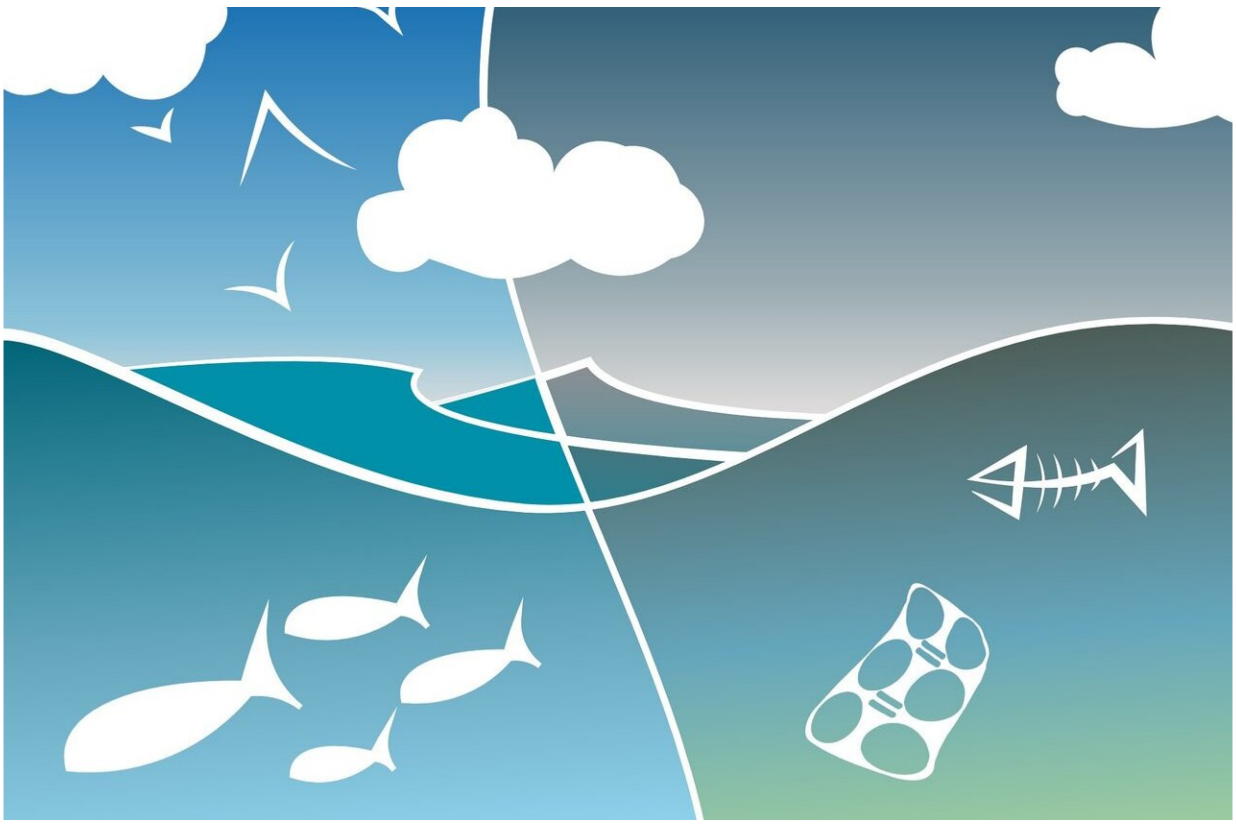

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Two connected marine ecosystems—the Eastern English Channel and Southern North Sea—experienced big and opposite changes in their fish communities over a 30-year period, according to researchers who report their findings in *Current Biology* on November 8. Rapid warming drove smaller ocean fishes to shift abruptly northward from one ecosystem to the other.

This inversion in the structure of the two ecosystems also caused a big switch in the way those connected ecosystems functioned. Ecosystem function refers to the way an assemblage of species together with inorganic materials operate as a larger whole to influence biological, geochemical, and physical processes. Changes in the structure and function of an ecosystem can, for example, alter the rate of carbon uptake from the atmosphere or the rate at which organic materials are broken down.

The findings suggest that the expected increase in the frequency and severity of climate oscillations and extreme warming events could trigger shifts in the distribution and abundance of species with profound consequences for the way ecosystems around the world function, the researchers say.

"This warming caused an abrupt change in fish communities as small, rapidly maturing fishes, particularly pelagic fishes, simultaneously decreased in the English Channel and increased in the North Sea," says Matthew McLean of IFREMER, Boulogne-sur-Mer, France. "This suggests both that fishes shifted northward between the ecosystems and that the English Channel became an unfavorable environment for certain fishes while the North Sea became a more favorable environment."

In the mid-1990s, a natural climate oscillation called the "Atlantic Multidecadal Oscillation" switched from a cool to a warm phase, producing warmer sea surfaces throughout the Atlantic Ocean. McLean and colleagues realized that the majority of studies examining the impacts of such warming on fishes have focused on changes in particular species, often focusing on commercial fishery species.

In the new study, the researchers took a newer approach to factor in the characteristics of particular species that explain how they respond to changes in the environment and what roles they play in the ecosystem. "Surprisingly few studies have used this approach to understand how rapid warming can affect marine ecosystems and how shifts in fish abundances and distributions can impact ecosystem functioning," McLean says.

The researchers used over 30 years of fish monitoring data and an extensive compilation of ecological traits to examine the dynamics of fish functional structure in the Eastern English Channel and Southern North Sea. They characterized functional structure using ten traits related to life history, habitat use, and feeding ecology for 73 fish species in the English Channel and 110 in the North Sea.

While the researchers weren't surprised to find changes in species' abundances and distributions in response to human impacts and warming, they were surprised to find an inverse shift in entire fish communities within connected ecosystems. They were also surprised by the exceptional speed of those changes, as the "functional inversion" occurred only one or two years after a major temperature rise. Their data also suggest that the influence of fishing was minor in comparison to the effects of warming.

The findings suggest that warming events in the future could have major and long-lasting impacts on marine ecosystems and fisheries. The researchers say that the results of the new study could be used to anticipate how other marine ecosystems may change under future warming.

"We must plan for rapid changes in fish communities between ecosystems, particularly as species shift poleward," McLean says.

More information: *Current Biology*, McLean et al.: "A Climate-Driven Functional Inversion of Connected Marine Ecosystems" www.cell.com/current-biology/f … 0960-9822(18)31275-2 , DOI: 10.1016/j.cub.2018.09.050

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