

Warming Oceans Are Reshaping Fisheries

Scientists detect global shift in species

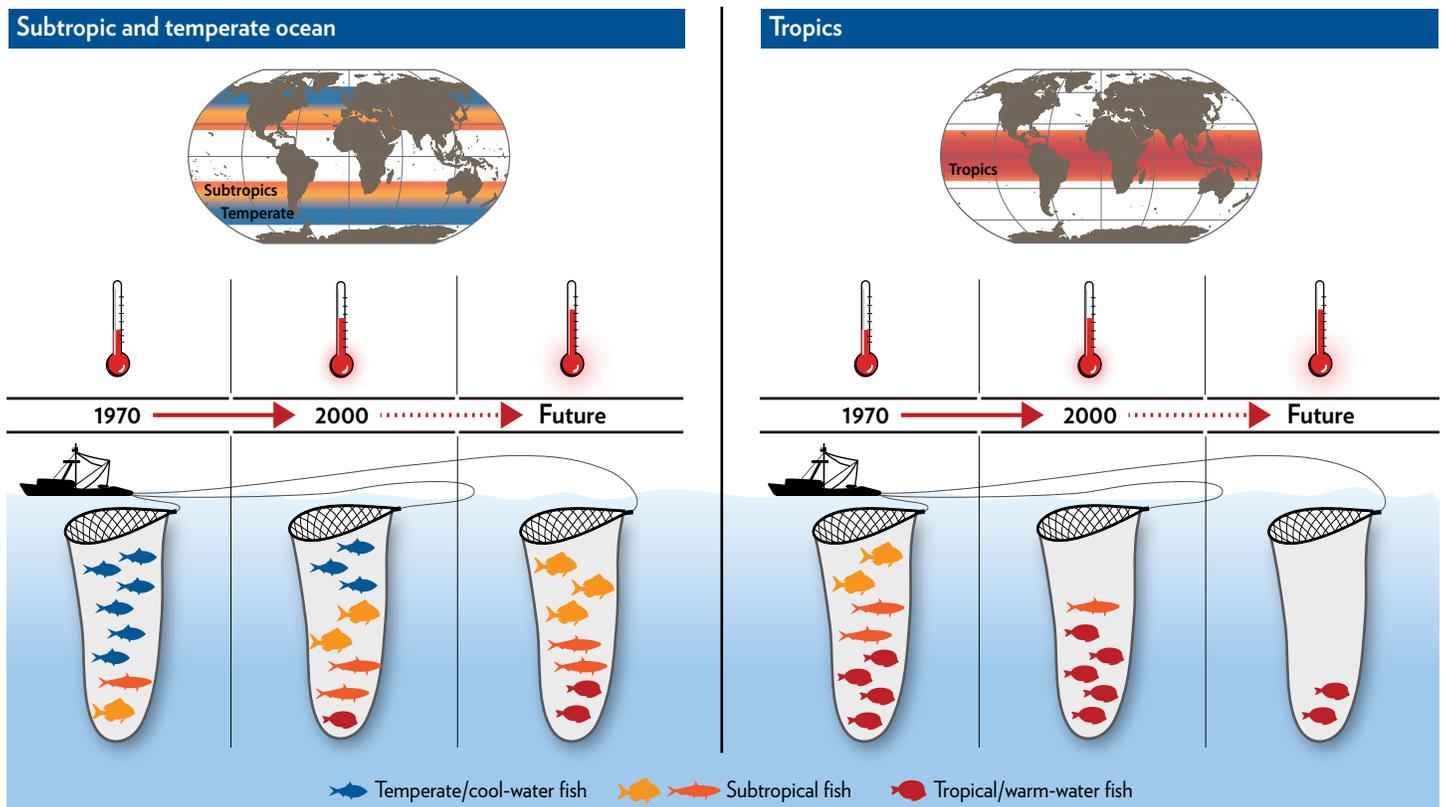
For the first time, scientists have shown that ocean warming has had a global impact on the mix of species caught by fishermen. Previous studies indicated that some species are shifting location in response to temperature increases, with fish gradually moving away from the equator into cooler waters. However, research published in May 2013 in *Nature* shows that species from warmer

waters have also been replacing those traditionally caught in many fisheries worldwide at least since 1970.

Study Methods

Dr. William Cheung of the University of British Columbia and his co-authors used the temperature preferences of fish caught around the world to determine the relationship between fisheries catch and ocean warming.

They first assembled data on the distribution of 990 marine fish and invertebrates. They assigned each species a temperature preference based on the average sea surface temperature in areas where that species was predicted to have occurred between 1970 and 2000. Next, to measure changes in the composition of marine fisheries, the researchers compiled data on the tonnage of each species caught in the 52 marine



Species from warmer waters are replacing those that are traditionally caught in fisheries worldwide.

Previous studies show that the ranges of individual fisheries are shifting in response to ocean warming (e.g., Cheung *et al.* 2012, Pinsky & Fogarty 2012, McCay *et al.* 2011). For example, red mullet, a warm-water species, is replacing Atlantic cod, a commercially valuable fish in the cold waters of Great Britain. And off the East Coast of the United States, Atlantic surfclams have declined in the warmer shallow and southern parts of the fishery's range off of Delaware, Maryland, and Virginia but have remained intact in the northern and deeper areas off of New England. This shift caused fishing boats to move and a Virginia-based processing plant to close. The study by Cheung *et al.* (2013), summarized here, shows that such changes in distribution have been occurring globally for several decades.

This graphic presents concepts from Cheung *et al.* (2013). The thermometers are representative of trends in ocean temperature over time and the fish are representative of trends in catch composition over time. They do not represent specific values. Please consult the results section of Cheung *et al.* (2013) for exact data points. Graphic by The Pew Charitable Trusts' ocean science division.



A fisherman in Malaysia. Tropical nations like Malaysia could experience a large reduction in fisheries catch as a result of ocean warming and fisheries shifting. Photo credit: Jamie Oliver

ecosystems that account for most of the world's fisheries. Then, for each ecosystem and each year from 1970 to 2006, they calculated the average temperature preference of the species, weighted by the amount caught. Finally, the researchers determined the connection between ocean warming and changes in fisheries catch by using a statistical model that separates out other factors, such as fishing effort and oceanographic variability.

Results

The authors found that, except in the tropics, catch composition in most ecosystems slowly changed to include more warm-water species and fewer cool-water species. In the tropics, the catch followed a similar pattern from 1970 to 1980 and then stabilized, likely because there are no species with high enough temperature preferences to replace those that declined. Statistical models showed that the increase in warm-water species was

significantly related to increasing ocean temperatures.

Implications

Earlier research led by Dr. Cheung predicted continuing changes in fish distribution and catch as oceans warm (Cheung *et al.* 2010). These shifts could have several negative effects. These may be felt most in the tropics, where water temperatures could exceed the preferences of many tropical species, resulting in a large reduction in catch. Additional impacts could include loss of traditional fisheries, decreases in profits and jobs, conflicts over new fisheries that emerge because of distribution shifts, and food security concerns, particularly in developing countries.

References

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Study Citation

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