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A Climate ‘Wake-up Call’

If we proactively implement effective fisheries management and limit global temperature rise, the world’s oceans still have the potential to be significantly more plentiful in the future than today, despite climate change. This finding is among several that appear in a first-of-its kind study, “Improved fisheries management could offset many negative effects of climate change,” that appears today in the American Association for the Advancement of Sciences’ journal Science Advances.

“The expected global effects of climate change on our oceans are broadly negative,” said Steve Gaines, the study’s lead author and dean of UC Santa Barbara’s Bren School of Environmental Science & Management, “but we still have the fortunate opportunity to turn the tide and create a more bountiful future.”

The study finds that with concerted and adaptive responses to climate change, the world’s oceans could actually create more abundant fish populations, more food for human consumption and more profit for fishermen despite the negative impacts of climate change. Conversely, the study cautions, inaction on fisheries management and climate change will mean even more dramatic losses of fish and the benefits they provide to people.

A dozen leading scientists from institutions including UCSB’s National Center for Ecological Analysis and Synthesis, Hokkaido University and Environmental Defense Fund (EDF) conducted the research. It is the first study to examine future fishery outcomes under both climate change projections and alternative human responses. It demonstrates that our oceans can be highly productive for decades to come if

action is taken now to put effective and forward-looking management practices in place.

“The results from this study are surprisingly positive — if we can adopt sustainable fishing policies and keep global warming at no more than 2 degrees Celsius, we can still realize significant benefits to fisheries across the globe,” said Merrick Burden, senior economist with the EDF Oceans program and an author of the paper. “But these benefits require action and this study serves as a wake-up call to governments that they must change the way that fishing takes place or risk losing a crucial opportunity to secure our food supply for generations to come.”

This study examines potential future outcomes for 915 fish stocks across the world under alternative management and climate scenarios. The authors modeled the impact of climate change on fishery productivity and geographical range distribution, which affects how many fish are available and where they can be caught, under four climate projections. These range from a global temperature increase of 1 degree Celsius (strong climate mitigation) to an increase of 4 degrees Celsius (business-as-usual) by 2100. For each of these climate scenarios, the authors examined future biomass, harvest and profit under alternative management approaches using bioeconomic modeling.

The new research shows that roughly 50 percent of species examined will shift across national boundaries and nearly all species are expected to experience changes in productivity in response to rising ocean temperatures. These changes will present new challenges for fishing nations. The study found that the implementation of management practices that account for changes in productivity and geographic range distribution can lead to global gains in profits, harvest and biomass compared to today. These practices range from flexible management strategies, including responsible harvest policies that account for changing stock productivity, to the creation and improvement of existing governance institutions to deal with shifting stocks, such as multilateral fishery agreements.

“Cooperation among nations will be increasingly important for ensuring future fisheries benefits as stocks shift across management boundaries,” said Tracey Mangin, an author of the paper and researcher at UCSB’s Sustainable Fisheries Group, explaining that rising ocean temperatures can send fish stocks beyond their traditional geographical ranges as they track their preferred thermal habitats. “These shifts can undermine previously effective and well-designed management

approaches, as they can incentivize overfishing and change which nations have access to the fish stocks, which can weaken existing fishing agreements."

While improved management may lead to improved global outcomes, those outcomes will vary regionally. The results indicate that future fishery profits are expected to decline in tropical latitudes even with management that fully adapts to climate challenges. This means that equatorial nations, many of which have developing economies and are highly dependent on seafood as a source of food and income, will be hardest hit. And how much planetary warming occurs will make a significant difference on the abundance, harvest and profit from fisheries.

"Even with the right management changes, there will be winners and losers, and we have to tackle this head-on," Gaines said. "Success will require not only emissions reductions but also multilateral cooperation and real changes in fisheries management. With our growing global population and the increasing needs for healthy sources of protein, these changes will be critical for meeting United Nations Sustainable Development Goals."

The impacts of inaction are also clear. Billions of people rely on fish as their primary source of protein. Most fishing nations are not responding fast enough to create change, and successful transboundary management programs are relatively rare. But action doesn't take long to have an impact on some species. Studies have demonstrated that many fisheries can bounce back from overfishing in as little as 10 years' time under the right policies.

"Climate change is expected to hit hardest in many of the places where fisheries are already poorly managed — things are likely to get a lot worse if we don't act," said Christopher Costello, an author of the paper and a professor of environmental and resource economics at UCSB. "We can expect inaction to bring increased conflict as fish move into new waters, along with threats to food security in some of the world's most vulnerable places."

"Fishermen will be among the most affected by climate change, and this research confirms what they are already seeing on the water," said Katie McGinty, senior vice president of EDF Oceans. "The window is narrow, but we have the tools and a clear roadmap to build a future with more fish, more food and more prosperity — if we act now."

The study did not examine other potential threats from climate change such as ocean acidification, or new ways that species might interact. These threats require further study beyond the scope of this paper.

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