

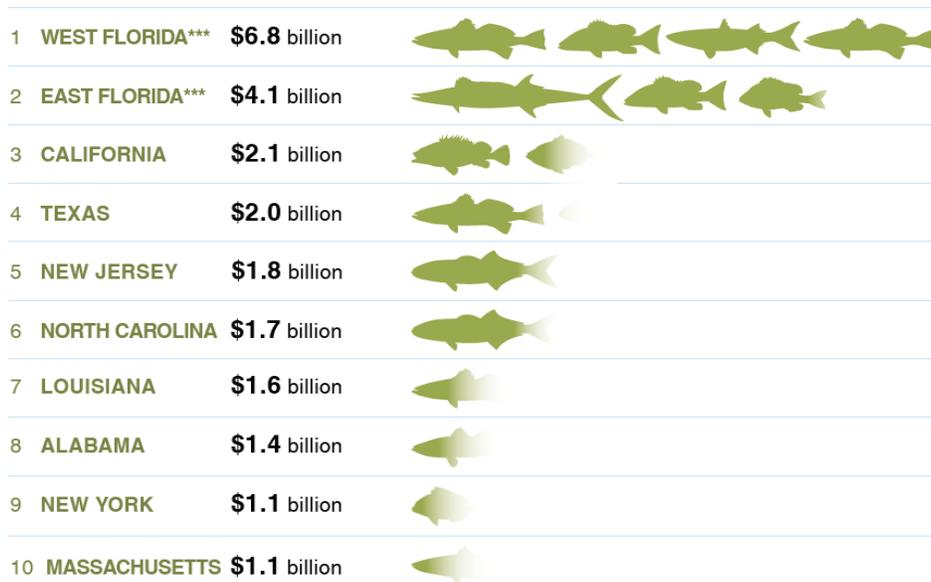
NC STATE ECONOMIST

New Study Explores Climate Change Impacts on North Carolina Coastal Angling

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Americans allocate a substantial portion of their time and household income to outdoor recreation. According to the Bureau of Labor Statistics, the average American spends 18 minutes a day engaged in exercise and outdoor recreation,¹ and according to the Bureau of Economic Analysis, 2.2 percent of U.S. gross domestic product (GDP) in 2017 was spent on the outdoor recreation economy, roughly double the percentage of GDP associated with agriculture nationwide.² Moreover, the outdoor recreation economy grew faster than the overall U.S. economy (3.9 to 2.4%) in 2017

Total Sales* Generated by U.S. Recreational Fishing Industries by State, 2016**



* Total sales — The combined value of sales by businesses within the state affected by recreational fisheries.
 ** Estimates for Atlantic and Gulf states rely upon the original MRIP estimates and not on the revised estimates released in 2018.
 *** Recreational impacts are collected separately for East and West Florida.

and, with rising living standards, should continue to climb in the coming decades. How climate change will impact outdoor recreation is an important question that remains poorly understood. In this Fall edition of the *NC State Economist*, I review key findings from recent research exploring how climate change will likely affect participation in an economically important type of outdoor recreation – shoreline recreational fishing along the coast. My main finding is that overall

participation in shoreline angling is predicted to decline by 1% under “best-case” climate change scenarios (i.e., those where aggressive mitigation efforts are adopted) and 15% under “business-as-usual” climate change scenarios (i.e. those where no new mitigation efforts are adopted). Such scenarios predict between a 3.8 and 8-degree Fahrenheit increase in global temperatures by the end

of the century. Also, anglers are likely to adapt by shifting the timing of their recreation from summer months to the shoulder and winter seasons and from day to night to avoid extreme temperatures.

Forecasting Economic Impact

Similar to the rest of the country, North Carolina’s outdoor recreation economy accounts for about 2.2 percent, or \$12 billion, of our state’s economy (2017 estimate). From the mountains to the sea, the Old North State offers a wide variety of nature-based experiences that attract recreators from around the world. Whether one prefers hiking a mountain trail, kayaking a scenic river, or surfing along the coast, North Carolina provides exceptional outdoor recreational opportunities. To be sure, the state’s mild climate plays an important role in these experiences. Climate change, however, represents a serious threat to the enjoyment we derive from outdoor recreation and, in turn, the viability of local businesses and communities.

Forecasting the likely impacts of climate change on outdoor recreation is difficult. Setting aside the challenges of forecasting how a complex and dynamic system like the global climate will respond to rising levels of greenhouse gases, a key question in predicting economic impact is how recreators will respond to higher temperatures. Former NC State University graduate student and current Oregon State University faculty member Steven Dundas³ and I

tackle this question in a recent publication in the *Journal of the Association of Environmental and Resource Economists*.⁴ Our analysis focuses on a particular type of outdoor recreation – shoreline recreational fishing – that is popular in our state. According to government statistics, North Carolina’s coast attracts 1.8 million fishermen annually, second only to Florida in terms of total angler participation. About half of these anglers reside outside North Carolina’s coastal counties, and thus are supporting local businesses – including hotels and restaurants – when they fish. The National Oceanic and Atmospheric Administration (NOAA) estimates that recreational fishing adds about \$1.7 billion in sales to local businesses and adds about \$1 billion to the state economy. This translates into 16,800 jobs in North Carolina.

For our study, Steve and I created one of the largest recreational fishing data sets ever assembled by combining administrative data from the NOAA’s Marine Recreational Information Program⁵ with

Total Jobs Supported by U.S. Recreational Fishing Industries by State, 2016*



* Estimates for Atlantic and Gulf states rely upon the original MRIP estimates and not on the revised estimates released in 2018.
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historical weather data from Oregon State's PRISM Climate Group. The data is rich in its temporal (2004 to 2009), seasonal (January to December) and spatial (Maine to Louisiana) coverage, and allows us to identify how fluctuations in weather influence shoreline angling participation. To isolate this relationship, we control for factors that also influence participation like the state of the economy and popular fish runs. Based on our empirical estimates, we then forecast how climate change will likely impact shoreline recreation participation for 132 different climate change forecasts generated by climate scientists from around the world.

Hotter Days and Angler Decisions

Interestingly, we find that extreme cold (i.e., maximum daily temperatures below 50 degrees Fahrenheit) and extreme heat (i.e., maximum daily temperatures above 95 degrees Fahrenheit) have significant negative impacts on recreational trips. This inverted-U shape relationship implies that another day with extreme heat will reduce the probability an angler takes a fishing trip by about 2%.

However, since climate change is likely to reduce the number of cold days and increase the number of hot days, the overall impact of climate change is ambiguous. In northern regions like New England, we predict that the net impact of climate change on recreation participation will be modestly positive as the number of cold days declines more so than the number of hot days increases. But in more southern climates like North Carolina, however, we predict the opposite – the net impact



of climate change on recreational angling is likely to be negative because the number of hot days will increase more so than the number of cold days will decrease. Overall, our results suggest that shoreline recreational fishing in North Carolina will decline by 1% under "best-case" and 15% under "business-as-usual" climate change scenarios. Hotter states like Florida and Louisiana are predicted to experience larger declines.

We also investigate how anglers might adapt to climate change in two key dimensions. First, we find evidence that more recreational fishing will occur during spring, fall and winter seasons relative to the summer months when temperatures will be at their hottest. For example, we predict a 47% decline in participation in July and August but a 25% increase in participation from November through April. Second, we find that anglers will likely shift the timing of their trips to early morning and night to avoid extreme afternoon heat. This suggests that, in the future, more shoreline recreation will occur on piers and in marinas where artificial lighting is present.

A Few Caveats

Overall, our results imply that climate change may generate significant negative consequences for shoreline recreational fishing in North Carolina. That said, there are a few important limitations with our research that readers should keep in mind when interpreting our findings. First, we do not incorporate changes in fish stocks and catch rates that might arise with climate change. The scientific understanding of how fish populations will be affected by climate change is in its infancy, although there is an emerging consensus that many fish species will migrate towards the North and South Poles as water temperatures rise. The impacts of climate change on popular North Carolina target species like red drum, bluefish and flounder are highly uncertain and will depend in part by how fishery councils respond to climate change with new management policies. Second, our baseline models primarily account for changes in temperature and do not account for other manifestations of climate change like hurricanes and other extreme weather events that may further disrupt shoreline angling. On top of all this, future modeling will likely need to control for short-term disruptions like the Coronavirus pandemic, which in 2020 has resulted in pier closures and other coastal access disruptions.

Finally, it is worth emphasizing that our research focuses on one type of outdoor recreation – shoreline recreational fishing. The generalizability of our findings to other forms of outdoor recreation popular in North Carolina (e.g., freshwater fishing, hiking, golfing, skiing) is unclear. With suitable data, however, the same methods we developed for our shoreline fishing analysis can be used to assess climate change’s impact on other types of recreation.



Endnotes

- 1 Bureau of Labor Statistics, American Time Use Survey, 2015 (<https://www.bls.gov/tus/charts/leisure.htm>).
- 2 Bureau of Economic Analysis, Outdoor Recreation Satellite Account, U.S. and Prototype for States, September 20, 2019. (<https://www.bea.gov/data/special-topics/outdoor-recreation>).
- 3 Assistant Professor, College of Agricultural Sciences, Oregon State University (<https://appliedecon.oregonstate.edu/users/steven- Dundas>).
- 4 Dundas, Steven J., von Haefen, Roger H., The Effects of Weather on Recreational Fishing Demand and Adaptation: Implications for a Changing Climate. *Journal of the Association of Environmental and Resource Economists*, Vol 7, No. 2 (March 2020).
- 5 <https://www.fisheries.noaa.gov/recreational-fishing-data/about-marine-recreational-information-program>.

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