This fact sheet reviews the state of scientific knowledge regarding how climate change can impact inland recreational fishing. Climate change impacts inland recreational fishers in three dominant ways: 1) by affecting fish abundance and diversity; 2) by altering environmental conditions at inland recreational fishing sites; and 3) through indirect management actions and policies put in place to mitigate the undesirable impacts of climate change on fish species and inland recreational fishing settings.

Inland recreational fishing results in billions of dollars spent in local economies and millions of dollars generated for state agencies through license sales. Insights about fishers using inland (i.e., freshwater) locations are rare however, with research on marine fisheries being more common. This factsheet summarizes a recent article (Hunt et al., 2016) examining existing research to better understand the potential for climate-change impacts on inland recreational fishing in North America.

Existing literature suggests climate change influences inland recreational fishers in a variety of ways including impacts to fish populations, the functioning of natural environments, resource management frameworks, policy, and broader economic conditions (as shown in Figure 1). In order to manage the impacts of climate change on fishing, it is necessary to understand how these factors interact. The authors suggest this can happen through three major pathways:

1. Climate-altered environmental conditions that affect fish and fishers
2. Climate-altered environmental conditions that directly affect fishers
3. Policy and management decisions mitigating climate change that directly and indirectly change fishers’ decisions and opportunities

**FISHERS AND FISH**

Although seemingly straightforward, knowing how the abundance and variety of fish affects fishers’ attitudes and actions is not clear. Assuming there is a strong relationship between the quantity of fish available at a site and fisher well-being would
be easy, but there is not much evidence for this. In fact, research has shown that catch rates decline much more slowly than fish stocks. This is because fishers with different skill levels mobilize their efforts differently. Skilled fishers stick to sites with fewer fish for reasons not related to fish abundance. But, whether the catch matters to the fisher or not, it is clear that climate change will substantially alter fish abundance and variety within inland waters in the U.S.

Some authors estimate that climate change could negatively impact the economic value of recreational fishing by between $101 million and $7.1 billion by the year 2100. This negative impact may occur in several ways. For instance, it could occur through reduced distribution and numbers of coldwater fish species. In the early 1990s, fishers in western, mountainous, and northeastern states mostly targeted coldwater fish. Since that time, the focus has changed overwhelmingly to warmwater species, as shown in Figure 2. It is not clear that climate change was a direct cause of this phenomenon. Other factors, such as management decisions and overexploitation, could also have had an influence on fish communities.

Climate change also has the potential for positive impacts on fishing in some regions. One study, for instance, looked at the effects of a doubling of greenhouse gas emissions on Rainbow Trout, other trout, and panfish in the northeastern U.S. The authors estimated the potential changes in catch rates with climate change and economic models. Within the region, Maine and New Hampshire were predicted to benefit from climate change, though the outcomes for New York and Vermont were less certain.

FISHERS AND THE ENVIRONMENT
Changes in air temperature, precipitation, wind, and other weather events can alter fishers' behavior. High temperatures and low water events can prompt the closure of a popular fishing destinations in the summer. Unseasonably warm weather can also make early spring and late fall fishing trips more comfortable, and an unseasonably warm winter can create unsafe ice conditions.

Fishers from northern latitudes appear to respond positively to warmer conditions because open water fishing is favored over ice fishing. However, climate change is expected to reduce participation in ice fishing because a warmer climate will result in less ice. Changing climatic conditions have already led to the cancellation of an ice fishing championship in Ontario. By 2100, changing climatic conditions are projected to reduce the ice fishing season in northeastern Ontario by 6 to 15 percent. Even if fishers concentrate their ice-

Fig. 2  Many states, mostly in the northeast, have seen a switching in the thermal guild of their most targeted fish species. (Dark blue, light blue, and pink refer to cold (10-18 degree Celsius), cool (19-25 degree Celsius), and warm (greater than 26 degree Celsius) water species guilds.)
fishing trips into the smaller season, congestion at the sites may negatively impact the recreational experience.

Some scientists have predicted positive impacts on recreational fishing (including inland and marine) as temperatures increase. Higher temperatures would result in longer open water fishing seasons and more comfortable temperatures for outdoor activities. However, it is important to consider how these warmer temperatures will affect the availability of fish and fishing regulations.

Climate change is also expected to increase extreme weather events. Weather and wind damage to boats represented the third most common claim to insurance companies among members of the Boat Owners Association of the United States between 2008 and 2012, up from fifth just a few years before. Such damage will increase the cost of equipment, maintenance, and insurance.

Increased climate variability can also impact fishers through drought. Fishing was down, for example, at Lake Mead after the closure of several boat launches and marinas during low water levels due to drought. In another example, over a quarter of marina operators on the Canadian side of the Great Lakes have had to close slips and conduct dredging activities to combat low water levels.

**ECONOMICS, POLICY, AND FISHING**

National and local policies aimed at reducing the impacts of climate change can also affect fishing. Efforts to reduce greenhouse gas emissions are already underway in many places around the world. These efforts make energy more expensive by increasing fuel prices. Higher fuel prices will likely reduce fishing in remote locations, while places nearer to cities will see increased use. Fuel costs will also affect how people use their boats, concentrating use nearer to boat launches and perhaps increasing the use of non-motorized watercraft. Higher costs, fishery closures, and changes in species and habitat will likely change fishers’ choices in destinations and the number of fishing trips they take.

Although climate models predict more punctuated precipitation across most of North America, the change will likely not be an overall benefit to fishing. Demand for water will likely increase because of population growth, reduced snowmelt runoff, and food production. In many parts of the U.S., maintaining water flow to protect fisheries will be competing with residential, commercial, and agricultural demands. As water temperature, quality, and levels are negatively affected, so too is fishing.

**CONCLUSION**

Climate change will continue to impact inland recreational fishers and fish. Part of the challenge scientists and managers now face is trying to understand how people and systems will respond so they can do their best to protect fish populations and fishing opportunities.

To date, research into the effects of climate change on fishing has been conducted at a coarse scale, making specific impacts of climate change on the well-being of inland recreational fishers uncertain. Climate change and the societal response to its impacts will create new challenges for research attempting to better understand the complex interactions between climate change, altered biophysical conditions, and fishing behaviors.

**REFERENCE**