

OPINION

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Climate change has big implications for Yellowstone region

By **ANDREW HANSEN**

Guest columnist

Is the climate changing in the Yellowstone region and what might this mean for fish, wildlife, and people? Colleagues and I examined this question extensively in a new book. Our conclusion: The ecosystem is undergoing long-term warming and this has big implications for all of us.

When towns like Bozeman were founded in the 1860s, the Yellowstone region was in the height of the Little Ice Age. Long, cold winters led to a snowpack about 10 percent above the long-term historic average. Since then, average annual temperature has warmed by more than 2 degrees Fahrenheit and current snowpack is about 20 percent below that long-term average.

Climate scientists project that average temperatures in the year 2100 will be between 6 and 11 degrees warmer than they are now, depending on greenhouse gas emissions. This would give us temperatures at the end of the century that are similar to the southwestern U.S. today.

How has the 2-degree warming since 1900 influenced the Yellowstone region? The decline in snowpack has reduced river flows by about 25 percent in the Yellowstone River since the 1950s. Because of the current low flows and warmer water temperatures, summer fishing restrictions are now the norm in rivers across the region. The Yellowstone River has become suit-

able for some warm-water fish species as indicated by eastern smallmouth bass being caught near Livingston. Native trout and grayling are increasingly challenged by warmer temperatures and non-native fish species that thrive in warmer waters.

Looking upslope to the forests, the gray pallor of dead trees is evident. Warmer winter temperatures have favored eruptions of bark beetles. These insect outbreaks have killed the majority of larger whitebark pine trees across the region in the past decade. Loss of these trees likely leads to earlier spring snowmelt, reduced summer runoff, and fewer of the calorie-laden pine seeds eaten by grizzly bears and other wildlife. Rates of fire in the lower elevation forests have increased dramatically since the year 2000 and increasingly threaten rural homes that surround the public lands of Yellowstone.

Some wildlife species appear to be coping well with climate changes. Grizzly bears use a wide range of foods and habitats and may be eating more berries and other foods to replace whitebark pine seeds. Elk and deer are able to shift range to find suitable forage and habitat. Wolverine, in contrast, are dependent on snow for denning, and alpine habitat for them has likely declined. Pika, the cute small mammal that lives in high mountain talus slopes, cannot tolerate warm summer temperatures and their populations have dropped across the Rockies.

For people, the warming has had mixed effects.

Extreme winter cold is becoming increasingly rare. The number of days below zero in Bozeman averaged 20 during the 1950s yet 14 in the past decade. This winter warming likely makes living much easier in higher elevation places like Bozeman Pass. The summer frost-free period has increased by 24 days since the 1950s, allowing gardeners to now harvest ripe red tomatoes at the end of the summer. Where irrigated water is available, crop production has also likely increased with the summer warming. Dryland farming, in contrast, is increasingly challenged by summer drought. Water for irrigation, domestic use, and to support recreational fishing is in short supply in many years. Risk of fire and exposure to smoke are increasing. And ski areas at lower elevations have more low-snow, low-skier revenue years.

If these changes in river flows, fish, wildlife, and human activity have resulted from a warming of 2 degrees over the last 116 years, imagine what would result from a warming in the next 80 years of 6 to 11 degrees.

Engineering solutions are being used to mitigate some of the adverse changes. Rocky Mountain National Park is redesigning its road culvert system to cope with the increased landslides that have come with more severe fires. Federal forest managers are planting whitebark pine seedlings genetically selected to survive under increasing forest pests. Improvements in crop breeding and irrigation efficiency

are improving crop yields under the warming climate.

The tough questions about coping with climate change remain unanswered, however. What will be the social and economic costs of adapting to future dramatic warming? Will climate change exceed thresholds whereby Greater Yellowstone shifts to a desert shrub ecosystem and people are required to make fundamental changes in agriculture, development patterns, employment, and lifestyle?

In answering these questions, we should factor in the constraints imposed by our rapidly growing population. Nearly 4,000 homes are added to the 20 counties of Greater Yellowstone each year and natural habitats have been lost to development at a rate of about 60,000 acres (2.2 percent) per year since 1970. Thus demand for land and resources are increasing while that the habitats that allow fish and wildlife to cope with climate change are decreasing.

Now that we know climate is changing, citizens, elected officials, and business leaders need to be increasingly discussing how to reduce and/or cope with climate change and the social, economic, and ecological consequences of those changes.

Andrew Hansen is a professor in the Ecology Department at Montana State University. He is lead editor on, "Climate Change in Wildlands: Pioneering Approaches to Science and Management," published this month by Island Press.