Environment

What climate change looks like in Alaska now

Author: **Yereth Rosen** Updated: September 28, 2016 Published August 29, 2015

Long before the terms "global warming" and "climate change" became part of the national dialogue, Alaska's indigenous people noticed that things were going askew in the natural world.

"Ice cellars were sweating because we were losing the permafrost," said Patricia Cochran, an Inupiaq from Nome who is the executive director of the Alaska Native Science Commission. Berries were ripening two to three weeks earlier than normal, and beavers, once unknown in the treeless tundra regions, began showing up in rivers and streams as woody plants sprouted farther north, she said.

Elders in North Slope whaling communities also called attention to strange things happening at sea, said Edward Itta, a Barrow whaling captain and former mayor of the North Slope Borough.

"They had noticed 30, 35 years ago that the multiyear ice was getting different, and they didn't see the huge *ivus* anymore," said Itta, using the Inupiaq term for jumbled ice piles pushed to shore by currents or winds. "Sure enough, here I am, 35 years later, seeing now that these guys were way ahead of us. They knew things were changing, which is not surprising because they were masters of observation."

Winter 6.3 degrees warmer

The mainstream scientific community that once relegated such traditional knowledge to anecdotal footnotes now has data confirming the indigenous reports.

Since the mid-20th century, Alaska and the Arctic have been warming about twice as fast as the global rate.

Over the past five decades, average Alaska temperatures have increased by 3.4 degrees Fahrenheit, with the increases most pronounced in winter at 6.3 degrees.

That warming can have drastic consequences here: open water rather than solid ice at sea or on rivers traditionally used for travel, or soft and collapsing soil instead of hard-frozen ground, or rain instead of snow.

It also means that warming creates more warming and explains the phenomenon known as "Arctic Amplification" — the self-reinforcing process that warms the Arctic and subarctic far faster than the rest of the world.

"As ice melts, you have less white ice to reflect heat and more dark ground to absorb heat, and that makes ice melt faster," said Nancy Fresco, a research professor at the University of Alaska Fairbanks' International Arctic Research Center. Quicker melt of sea ice, land ice and snow cover lead to yet more melt. Heat-stoked, lightning-sparked wildfires char the ground and also can feed into the cycle. Clouds created from water vapor released from seas no longer covered by ice help trap atmospheric warmth. Permafrost thaw releases carbon, some of it thousands of years old, that also feeds the warming cycle.

With the Arctic crucial to the Earth's climate and much of its wildlife, and with new evidence coming in that links the rapid Arctic warming to extreme weather events in highly populated latitudes far south, the rest of the world should pay attention to the changes first noticed by Alaska's indigenous residents, scientists say.

"The Arctic is not like Vegas. What happens in the Arctic doesn't stay in the Arctic," Howard Epstein, an environmental scientist at the University of Virginia, said when the National Oceanic and Atmospheric Administration released a 2013 Arctic Report Card showing profound changes.

Weather changes, weather extremes

Alaska in the past few years has been posting some of its warmest temperatures on record, with new marks in various places for all-time highs, daily highs, high daily lows and lack of snow.

That is part of a global pattern. The world's 10 hottest years on record have occurred since 1998, and last year was the hottest ever measured. July was the hottest month on record and 2015 — with the help of the brewing El Nino system in the Pacific — is poised to break the annual record.

It can be difficult to parse out the differences between the chaos of daily weather from medium-term cycles from long-term climate change, experts say.

"Weather is what clothing you put on in the morning, and climate is what clothing you have in your closet," Fresco said. "Weather is still a day-to-day thing that can vary enormously."

Beyond the day-to-day and year-to-year fluctuations, some long-term trends have emerged.

The Arctic as a whole has gotten warmer and wetter since the start of the 21st century, a change attributed to sea-ice reduction. Other forces like reduced snow cover — which this year hit a near-record June low in the Northern Hemisphere — and cloud formation amplify the warming. Records show that Alaska's North Slope has warmed dramatically, most so in autumn, the time of minimal ice when more summer heat absorbed by the ocean is emitted into the atmosphere, thanks to ever-bigger areas of open water in that season.

Lack of sea ice means fall storms are more destructive. On the Bering Sea coast, storms are sending seawater far inland, as much as 20 miles in southwestern Alaska's Yukon-Kuskokwim region, the U.S. Geological Survey reports.

For Alaska, history is being used to make predictions about what appears to be a vastly different future. UAF's Scenarios Network for Alaska and Arctic Planning, led by Fresco, gives community-by-community predictions for higher temperatures and shifts to rain rather than snow.

Melt and thaw — glaciers and permafrost

Alaska's glaciers pale in comparison to the Greenland ice sheet and Antarctica, but they have become major contributors to sea level rise, scientists say.

Mountain glaciers hold only 1 percent of the world's glacial ice, but they are contributing 30 percent of the water that is increasing sea levels, said Shad O'Neel of the USGS. Alaska holds 11 percent of the world's mountain glaciers but contributes about a quarter of the world's mountain glacier meltwater, O'Neel said. "We're the most disproportionate region," he said.

In all, Alaska's glaciers are losing 75 billion tons of ice a year, and almost all of that comes from the glaciers on land rather than those spilling into tidewater. The alpine glaciers in western Alaska's Ahklun Mountains, already shrunken, are expected to disappear entirely by the end of the century.

Glacial melt affects more than sea levels. The increasing amount of fresh water pouring off them changes marine salinity and currents and, ultimately, circulation in the Arctic Ocean, O'Neel said.

Permafrost is dwindling in its southern range in Alaska and Canada and warming even in its northern range, where the frozen layer is thickest. At Prudhoe Bay, temperatures last year edged to just a few degrees below thaw, compared to a temperature of 17.6 degrees Fahrenheit in the 1980s, according to UAF's Vladimir Romanovsky, one of the world's top permafrost experts.

Forests, fires and plants

Wildfires are a natural part of the forest ecosystem, but the increased frequency of large fires and expanded duration of the Alaska fire season is not. There were twice as many large Alaska wildfires in the 2000s as in the 1950s and 1960s, and the state is winding up what has turned out to be the second-biggest fire season on record, with nearly 5.2 million acres burned. Coupled with vast and fierce wildfires in neighboring parts of Canada, this year's fires are part of a broad upheaval of the northern boreal forest.

In the short term, that means property damage costs and health and safety hazards from smoke. In the long term, it means a transformation of what has been a spruce-dominated forest into something else.

It is not yet clear what that future landscape will be, said Epstein, who researches northern forests and tundra vegetation. As spruce trees wither and burn, deciduous birch, aspsen and willows seem to be taking

their place, he said. Grasslands are another future possibility.

Farther north, tall, woody shrubs are expanding northward into the tundra, and vegetation that already existed there is growing more vigorously, Epstein said.

Could that new plant life become a carbon sink offsetting atmospheric emissions? No, Epstein says. The carbon dioxide consumption is "really minor" compared to other effects, such as darkening of the land surface.

"I don't think that anybody believes that increased vegetation in the Arctic is going to be a savior in terms of carbon dioxide uptake," he said.

Wildlife on thin ice

The ice-dwelling polar bear, the first animal granted Endangered Species Act protections because of climate change, has been the icon of global warming. But it is not the only animal species that faces an uncertain future as the summer and fall sea ice disappears, federal biologists say.

Bearded and ringed seals, also dependent on the diminishing summer and fall sea ice and the snow atop it, are listed as threatened. Pacific walruses, which have in recent years crowded the Chukchi Sea shoreline because they can't find floating sea ice in late summer and fall, are also candidates for Endangered Species Act protections.

Land animals have their own problems with the ecosystem changes.

The northward expansion of shrubs is bad for caribou, musk oxen and other animals that depend on tundra habitat, Epstein said. Caribou herds across North America have declined, and some biologists point to winter rain events that coat forage food with hard ice as a persistent problem. Earlier springs are causing timing problems for some migrating birds. If they arrive in Alaska too late, they will miss the most nutritious vegetation growth.

But not all animals are losing out. There are some climate change winners, like North Slope black brant, geese that are thriving as they feed on salt-tolerant plants growing in the place of upland vegetation that dies as permafrost sags, shorelines erode and saltwater seeps in.

Erosion, villages and culture

Much of the world has seen photographs of homes slumping into the sea in the Inupiat village of Shishmaref in Northwest Alaska. But Shishmaref is just one of several Alaska villages struggling as thawing permafrost and stronger waves eat away at its coasts.

Two others — Newtok and Kivalina — are working on relocations, with the move already started in the former. In all, 26 communities have erosion problems that are bad enough to warrant major and immediate response, ranging from aggressive shore bolstering projects to total relocation, according to a 2009 report by the U.S. Army Corps of Engineers.

Some of the fastest erosion is on Alaska's North Slope, where an average 4.6 feet has been lost each year since the mid-20th century, according to a U.S. Geological Survey report. That puts oil field infrastructure at risk, along with the villages.

Even past generations are affected. In Barrow, archaeologists excavated ancient and eroding gravesites, transferring bodies to the more modern local cemetery. In the Yukon-Kuskokwim region, archaeologists have embarked on an ambitious project to save relics from an eroding settlement site that dates back to the 1300s. Erosion is threatening important sites in Northwest Alaska, where the Bering Land Bridge once connected Asia to North America and was a pathway for human migration.

Food security, health and safety

Years ago, said Aleut leader Larry Merculieff, elders pointed to lesions appearing on salmon skins and predicted hard times ahead for the fish that is a staple of traditional diets and rural household incomes.

It turns out that there is a climate explanation, Merculieff said. Faster and earlier snowmelt has changed hydrology patterns, flushing rivers and streams early but leaving water levels lower than they would be if snowmelt were gradual, he said. Low water means salmon have little space to swim, and the lesions came from "salmon going against rock and not water," he said.

Warmer conditions, changing weather patterns and extreme weather events have myriad effects on Alaskans who depend on wild foods for their nutrition and income.

Rivers that were once dependably frozen for winter travel are treacherous when ice is thin. Lack of snow strands rural travelers.

Warmer waters also mean a northward movement of disease-carrying pathogens.

A stomach-turning ailment that struck tourists who ate Prince William Sound oysters in 2004 turned out to be the northernmost documented case of *Vibrio parahaemolyticus*-caused illness among humans. Algal blooms proliferate in warm conditions, and it is suspected that 30 dead whales found this summer in the western Gulf of Alaska succumbed to toxins produced by such a bloom. Ripple effects of paralytic shellfish poisoning appear to be spreading through the marine food web, new research shows.

Warming also allows contaminants to be released into the food system. Thawing permafrost and eroding soils free sequestered elemental mercury that adds to pollution carried in the atmosphere and oceans from faraway industrial and coal burning operations. Persistent organic pollutants like pesticides and PCBs that were once trapped in sea ice are being released into the water column as the ice thaws.

Ocean acidification pronounced in Alaska waters

Nearly a third of the carbon released into the atmosphere winds up absorbed by the oceans, according to NOAA. That process slows the greenhouse effect and the resulting climate warming, but it comes at a cost — changes to the oceans' chemistry makes their waters more acidic. More acidic waters degrade the calcium that is needed by a variety of shell-building organisms — from tiny pteropods that form much of the base of the ocean food web to big king crabs that fetch premium prices in seafood markets.

Globally, the oceans have become 30 percent more acidic since the start of the Industrial Age, according to NOAA. For Alaska, the characteristics that make the marine waters rich with fish and wildlife — and a major global seafood harvesting center — put it at enhanced risk for acidification.

Cold waters that benefit salmon and other fish hold more carbon dioxide. Alaska's marine waters, underlain by a broad continental shelf, are relatively shallow, allowing absorbed carbon to concentrate in the water column. The rich supply of sea life emits yet more carbon through processes of decay. And ocean currents carry carbon from around the world to waters off Alaska

Come winter, the Bering Strait holds the world's most acidic ocean waters, partly because of natural characteristics and partly because of ongoing changes. Changes have been particularly rapid in the Beaufort Sea, where waters have already become so altered that they hold, on average through the year, too little calcium to support shell-building organisms. Waters in the Chukchi and Bering seas, for now buffered a bit by plentiful carbon-consuming phytoplankton blooms, are expected to reach similar milestones in the future.

Accelerated glacier melt contributes to the changes. The outpouring of freshwater into the ocean dilutes natural calcium, and the glacial melt carries carbon that contributes to the load in the water.

'Cold Rush'

When Swedish scientist Svante Arrhenius theorized more than a century ago that carbon emissions from fossil-fuel burning would warm the Earth significantly, he believed that would be a good thing. The "hothouse effect," he hypothesized, would stimulate plant growth and usher in a global agricultural boom.

Some Alaskans are also embracing what they see as the upside of northern climate warming.

They look forward to the thousands of jobs and billions of barrels of new oil that might be produced if Royal Dutch Shell, drilling this summer in the Chukchi Sea, is successful in its Arctic offshore exploration program. They hope that Northwest Alaska, and possibly the hub city of Nome, could emerge as a thriving port, providing much-needed maritime assistance while generating jobs and income in a region that has struggled with poverty. Members of the Alaska Legislature are touting sea ice melt as an opportunity to open up more northern mines, including those extracting coal, considered the most polluting of fossil fuels.

But new economic development carries its own complications. Increased ship traffic and oil drilling means increased likelihood of spills in a remote region where emergency response is difficult and where the U.S. Coast Guard takes extraordinary measures to maintain a seasonal presence. It means:

• Air pollution and industrial noise that can harm sea life;

• Expected Arctic shipping routes that overlap precisely with the well-used seabird migratory routes there;

• The specter of black carbon from ship exhaust darkening melting sea ice, though that issue was not addressed in the International Maritime Organization's new Polar Code for shippers;

• The United States and four other Arctic nations are trying to persuade the rest of the world to refrain from commercial fishing in the yet-unexploited and little-understood international waters of the Arctic Ocean.

Development "has its blessings and its curses, that's for sure," said Merculieff, who served as a state commerce commissioner, among other positions in government and in Native organizations. He sees in the new commercial "Cold Rush" echoes of the past, when armies of commercial whalers and fur traders converged on Alaska to exploit its resources for riches. The industrial-scale hunts of centuries past triggered a cascade of ill effects, some of which linger today, Merculieff said.

"They didn't have a clue as to what they were doing," he said.

Could history repeat itself? He worries that too much development too fast will alter the future of an already-stressed region. "Things have changed so quickly, we can't grasp what is happening now," he said. "To plan these types of activities when we don't know what effects there are going to be and when we don't know what effects the current activities have, it's not good."

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About this Author

Yereth Rosen

Yereth Rosen has been a journalist in Alaska since 1987. For most of that time, she was the sole Alaska-based reporter for Reuters. She has been reporting on energy issues, the environment, politics and all things Alaska – from oil spills to sled-dog races. She enjoys running, skiing and other outdoors pursuits. She lives in Anchorage with her family.

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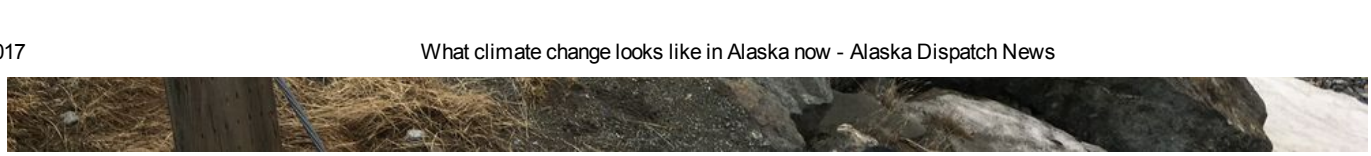

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