Scientists dig into Alaska tundra's effect on warming
In Alaska, they seek bushes, fish and answers
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McClatchy Newspapers
(08/10/08 00:04:45)

TOOLIK LAKE -- Ground here that for tens of thousands of years was frozen solid is terra firma no more.

Across the tundra and coast of the Arctic Ocean, land is caving in. Soils loosed by freshly thawed earth set off a new era of rot, and of bloom -- dumping a bonanza of nutrients into this top-of-the-world environment.

Will nature channel the nourishment of this soil into a great flowering of plant life that soaks up greenhouse gas and tamps down the causes of climate change? Or will a microbial awakening of decomposition simply belch out more planet-heating carbon dioxide?

Scientists flock here, to the northern foothills of the Brooks Range, to find out and to guess at the planet's future. They sample water from streams and ponds, tag fish and mark their growth, count creepy crawlies squirming in clumps of moss, watch the grass and bushes grow.

"I'm really glad it's getting warm and not cold. An ice age would be really bad," said Chris Luecke, a fish biologist from Utah State University who first traveled to the Arctic as a University of Kansas graduate student in the 1970s.

"But the rate of change is alarming," he said. "Species can't adapt or keep up in an evolutionary sense because everything is happening so fast."

It's futile to engage polar researchers like him on whether the planet is warming naturally or if mankind is to blame. You might as well challenge these biologists on evolution.

They see the numbers that show temperatures rising more dramatically than ever before. Temperature changes have been most pronounced near the poles -- double the global average. They see charts correlating precisely the steep rise in greenhouse gases to the industrial revolution, and they move on.
Scientists dig into Alaska tundra's effect on warming

Investigations here focus on what happens to the natural world when it's thrown off course by the massing clouds of greenhouse gases.

The analyses are still taking shape, and they don't yet clearly reveal whether a warming tundra mellows out climate fluctuations or revs them up.

NO INTERFERENCE

Researchers come to the Toolik Field Station because it offers a rare laboratory with virtually no interference from civilization. Ecosystems studies began here more than 30 years ago -- on land that only became practically accessible on the highway used to build the Alaska pipeline -- so scientists can compare results against decades of research.

The site, which sits about 150 miles north of the Arctic Circle, lies over a vast permafrost area and gives a sort of hothouse look at ecological change.

"The changes are all happening faster than the models had predicted," said Syndonia Bret-Harte of the Institute of Arctic Biology, an overseer of work at the tents and trailers that make up the Toolik outpost.

The spring day on which the last snow leaves Barrow to the northwest has crept from mid-June in the 1970s to early May. Ice cover in the Arctic Sea has dwindled more than 7 percent per decade since the late 1970s. And because ice reflects the sun and dark ocean water absorbs its light, less ice now speeds the warming process.

Several models suggest there will be no summer ice in the Arctic Ocean in 60 years. Or maybe sooner.

On land, even the temperature of still-frozen ground is climbing. At about 7 feet below the surface, temperatures have risen about 5.5 degrees in the last 20 years.

The emphasis at Toolik is on whether nature adds to or subtracts from global warming once it starts to heat.

It's especially critical here because one-third of the world's soil carbon is stored on the one-sixth of the planet's land in the Arctic's tundra and forests. It's an amount equal to two-thirds of the carbon blowing around the planet's atmosphere. So the loss of carbon from the soil could mean an even greater rise in the carbon dioxide buildup blamed for climate change.

Gaius Shaver, an ecosystems scientist from the Marine Biological Laboratory, has been studying the Arctic tundra for more than 30 years -- especially whether higher temperatures are making it a bushier, less mossy place. He's not sure yet.
Willows and other woody, bushy plants now have a longer growing season. It's unclear what taller, more robust bushes might mean for the ecosystem.

Beneath that tundra sits, for the most part, frozen mud. Think of giant, frozen, underground mud pies. Then think of them melting. Scientists call that thermokarst.

As those mud pies thaw, the ground above caves in. Often the dirt crumbles into the shore of a nearby stream or lake. Tons of soil that had been frozen into a state of suspended animation are suddenly brought to life. The microbes that had been trapped in the frozen dirt come to life, burping carbon dioxide into the atmosphere as the rot of decomposition kicks in.

Likewise, the earth's nutrients get called up for active duty, perhaps stimulating grasses or bushes, or maybe fortifying moss in streambeds that expands habitat for invertebrates that end up feeding more salmon-like grayling fish.

Breck Bowden, a University of Vermont watershed scientist, concluded in a recent paper that the melted and collapsed earth that makes up thermokarst could have a widespread impact on Arctic streams that is "currently poorly understood."

Temperatures are changing most in northernmost Alaska near the coast of the Arctic Ocean. Scientists say it would take dramatically lower air temperatures to reverse the ground-warming trend.

To predict how the planet will respond to the changes, scientists try to mimic the future. They sprinkle fertilizer on plots of tundra or water bodies to imitate the nutrients freed from previously locked-tight permafrost. Or they warm the ground with small greenhouses and test how plants respond to varying levels of rainfall and thaw.

Meanwhile, Vladimir Romanovsky drills his holes to see what's going on below. The geophysicist from the University of Alaska Fairbanks finds less of the ground frozen. And what's frozen isn't as cold as it was.

And he sees what scientists call a "positive feedback" -- meaning changes become exaggerated over time like a rock picking up speed as it rolls down a mountainside -- where warmer ground temperatures only beget even warmer ground.

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**Monday:** Last fall, Barrow residents awoke to find 400 German tourists waling around town. How did they get there? The opening of the Northwest Passage allowed them to arrive by sea.