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## The Big Melt

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*Brave New Arctic: The Untold Story of the Melting North*

by Mark C. Serreze

Princeton University Press, 255 pp., \$24.95

*Extreme Conservation: Life at the Edges of the World*

by Joel Berger

University of Chicago Press, 376 pp., \$30.00



*Austin Post/National Snow and Ice Data Center, University of Colorado, Boulder*  
*The McCall Glacier in the Brooks Range of Alaska, photographed in 1958*

Joel Berger's extraordinary new book *Extreme Conservation* reveals just how hard-won knowledge about various Arctic species is. His abiding interest is snow oxen, a diverse group of herbivores adapted to life in the most hostile regions of Earth. One of them, the musk ox, is Berger's most long-standing subject of study. A relative of sheep and goats, it was once widespread across the Arctic. But the last European musk ox died around nine thousand years ago and the last Asian ones around two thousand years ago, leaving the sole survivors in Alaska, western Canada, and Greenland. The Alaskan population was wiped out when native people obtained guns from European traders, but was reintroduced from Greenland in 1935.

Berger's research has taken him to two of Earth's three poles: the Arctic and the "third pole," the Tibetan plateau. He has had to work in all-but-impossible situations—for example, in restricted military areas where he was opposed by bureaucrats, and in the most remote parts of Mongolia and Bhutan, where cultural differences can make research very difficult. In the US, he succeeded in securing pronghorn migration routes, convincing ranchers and oilmen of the necessity of setting aside land for conservation.

Berger has a record of achieving great things in the toughest places on earth. Yet he is not always welcome. In remote Inuit villages, for example, he's perceived as a symbol of distant and threatening America, which in the eyes of the locals has already done enormous damage to native cultures.

He is also interested in a creature that the local Inuit have little sympathy for. As they see it, musk oxen were introduced by Americans without any local consultation, and they are thought to compete for food with the caribou upon which the villagers depend.

One of the most dangerous climatic trends for musk oxen, Berger explains, is ever-warmer winters, which can induce rain-on-snow events. He has had his own experiences with them: "Winter jackets that were dry in the cold became waterlogged in rain. In wetness and grueling wind, we grew hypothermic. Snow machines overheated. Thick sheens of river ice lost outer coats." For herbivores the impact is even more catastrophic, because the rain freezes to a hard layer of ice, making it impossible for them to reach their food. After one rain-on-snow event on Banks Island, Canada, 20,000 musk oxen, out of a population of 70,000, perished. And the effects can be felt for years, as calves born underweight struggle to survive.



Matt Nolan/National Snow and Ice Data Center, University of Colorado, Boulder

*The McCall Glacier, photographed in 2000*

But why should we care about the fate of the musk oxen? Apart from the fact that they are one of the toughest and most magnificent herbivores, they and other snow oxen may well be canaries in the Arctic coal mine. Because of their unique ecology, they are among the first to be affected by climate change, but it won't be long before the changes affecting them begin to affect other species, including ourselves. Scientists fear that, as the Arctic loses its biodiversity, the ecology of our living world will begin to unravel.

In March 2011 Berger found evidence of yet another climate-related threat to the musk ox. While flying near Cape Espenberg, Alaska, he discovered a group of fifty-two dead musk oxen, including a male who had been frozen while standing in the ice. The group had been killed by an *ivu*—a storm-driven surge of freezing seawater and ice that can travel hundreds of yards inland and push up waves of ice as high as twenty feet. As the sea ice, which absorbs wave energy, retreats, *ivus* and coastal erosion are increasing, with tragic effects on both musk oxen and Inuit villages, which are being relocated from the coast.

Stabilizing the Arctic's climate, if it can be done at all, is the task of decades or centuries. It will require a swift cessation in the use of fossil fuels and the development of methods and technologies that will draw CO<sub>2</sub> out of the atmosphere. But other threats to Arctic wildlife can be dealt with more swiftly. One such threat is hunting. Hunters tend to target male musk oxen, which are twice as large as females and have magnificent hooked horns. But in groups of musk oxen that lack males, infant mortality is high.

This appears to be because musk oxen have an unusual defense mechanism. If threatened by bears or wolves, they form a circle, within which they protect their young. The males, which can be very aggressive, suddenly lunge out of the circle and try to hook the predator with their horns. As the Arctic warms, grizzly bears are pushing further north, and researchers hypothesize that grizzlies and other predators are killing enough young musk oxen in herds lacking protective males to cause the population to decline.

Such scientific hypotheses are interesting, though of little use unless they can be tested. But testing hypotheses about musk ox predation is extraordinarily arduous. Predation events are rare, and a researcher would never gather enough data just by tailing a herd of musk oxen in the hopes of witnessing one. Instead, to test the idea Berger decided to try to determine whether musk oxen fear bears, reasoning that if they did, then bears must be significant predators. So he dressed in a bear costume and approached herds of musk oxen, recording their response. Just to be sure that it was the bear costume they were responding to, he also approached the same herds dressed in a caribou outfit.

Berger discovered that the approach must be made from at least a mile away and, like that of a bear bent on attack, it must not be direct. With a wind-chill factor of  $-15^{\circ}\text{C}$  and a skin of ice over the snow, on his first attempt Berger took an hour and a half to get within forty-five

yards of the herd. Then a bull charged—from twenty-five yards away. Instinct kicked in, and he tossed the head of his bear costume skyward, causing the confused bull to halt. Berger then struggled through the deep snow toward his colleagues, who were approaching on their snowmobiles.

The astonishing thing is that Berger did not give up but repeated the exercise again, and again and again, over deep snow, sharp rocks, and permafrost, enduring hours of agonizing cold. At most, he got to record two encounters per day, but often only one. Over the years, he built a data set of more than one hundred encounters and got charged “seriously” by bulls four times. Always, in the back of his mind, a question lurks: What if, while dressed in his costume, he meets a real bear?

Some of Berger’s interactions with musk oxen are deeply disturbing, and it’s greatly to his credit that he admits to the failures as well as the triumphs of his work. As part of his research, he darted female musk oxen with a sedative and placed radio tracking devices on them. In all, he darted 215 musk oxen, 90 percent of which returned to their herds. But some became isolated, initiating what Berger accurately describes as a “tragedy.” As he tracked the isolated individuals, a sad picture emerged. Without herd protection in a harsh land, they became distressed and sought safety in holes in the snow, where they led a lonely and fearful existence.

Investigating musk oxen killed by predators can be even more traumatic. One of the animals Berger collared was attacked by wolves. The radio collar pinged in a way that signified that the animal wearing it was dead. Unable to investigate right away, Berger arrived on the scene two days later and was astonished to find another carcass, beside which the rest of the herd waited “patiently, now for a full three days, as if somehow their presence will usher their two dead companions back to life.”

Berger leaned down to remove the collar: “A chunk of leg is gone. A hole punctures her abdomen. Part of the rump is eaten.... The cow lies in the snow, edges melted away by the warmth of her decaying body. I push down on her throat. Her eyes open.” Horrified, Berger realized that the mutilated creature was still alive—indeed it had been eaten alive for days. She tried to get to her feet. It took three shots to put her out of her misery.

Such nightmarish moments can give researchers a form of PTSD. While studying saiga antelopes in Mongolia, Berger worried about trying to capture and collar the high-strung creatures, upon whom the procedure had never previously been tried. At night he was haunted by a repeating dream “involving talons—vise grips tearing into my shoulder, blood exploding—the eagle’s victory dance.”

The bleak nature of Berger’s work comes through strongly in a letter he wrote to his wife while he was researching musk oxen in the “postapocalyptic” world of Wrangel Island, in

Russia. The island, in the Arctic Sea, is famous as the last redoubt of the woolly mammoth, which survived there until the Pharaonic era. Today it forms part of a military zone, and upon entering it Berger was arrested, then released to live among the rotting buildings of an old gulag. His letter reads, in part:

Three days, almost 100 miles of riding [on a snowmobile] from 5 above to 20 below, just to get a single data point. One! Just crazy? And, by the time I submit our work for publication—well, who knows, some reviewer will probably say, “sample size is too small.”

Berger is a committed conservationist whose work has increased the chance that musk oxen, saiga antelopes, takin, and pronghorns will survive. But is such altruism sufficient to induce someone to live a life of freezing discomfort, trauma, frequent failure, and social alienation? As a biologist who undertook twenty-six expeditions to remote parts of Melanesia, I have some insights into the life Berger has chosen. Yes, the idea that you might be helping species survive is a powerful incentive. But another reason that near-death experiences don't put you off is incurable curiosity: you just have to know what's over that next mountain, or what that next observation will bring.

But the boiling frog syndrome also plays a part. After spending months raising the money, recruiting the staff, and acquiring the equipment needed for a project, you've invested a lot in the journey. By the time you reach your first serious hurdle in the field, to quote Macbeth, you are “in blood stepped in so far that, should I wade no more, returning were as tedious as go o'er.” By the time you face that arrow pointed at your chest or that charging musk ox, it's simply too late to turn back. Such fieldwork is mostly for the young. I gave up in my forties, when those mountains just seemed to be getting steeper and more exhausting to climb, and I began to believe that I might actually die in the field. But Berger continues, his hair graying and his body crying out for rest. He is a hero of biology who deserves the highest honors that science can bestow.