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Permafrost

Beavers are changing the face of the Arctic

The large rodents are penetrating deeper and deeper into the Alaskan tundra - with far-reaching consequences for local ecosystems

[16. July 2018] **Beavers are highly effective ecosystem engineers: if a given landscape isn't quite to their liking, they simply rearrange the terrain. And that's what they've been doing for millennia in the temperate latitudes. But now they're expanding their territory, and can increasingly be found in the North American Arctic. A German-American research team recently investigated the ramifications of this development. According to their findings, the animals could change entire ecosystems and contribute to the thawing of permafrost soils, as they report in the journal *Global Change Biology*.**



For the past several decades, the North American beaver has enjoyed an extremely successful comeback. After nearly becoming extinct due to overhunting in the 19th and early 20th centuries, in many parts of the planet its numbers are now on the rise. And this resurgence seldom goes unnoticed, since the rodent, which can grow to 32 kilogrammes, is capable of transforming entire landscapes. It can fell trees and build dams, flood meadows and create entire lakes - activities that often produce favourable living conditions for many other species.

That being said, it is no longer limiting itself to those regions it has traditionally called home. For a few years now, the beaver can even be found in the treeless tundra of West and Northwest Alaska, as well as Northwest Canada. Biologists are still speculating as to the reasons for this change. It's possible that the beaver populations are only now recovering from the effects of excessive hunting in past centuries, and are accordingly expanding with a vengeance. "However, climate change is likely part of the cause," says Ingmar Nitze from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI).

After all, the beaver has traditionally had every reason to avoid the Arctic tundra. For one thing, it lacked the wood it needed for food, and for material to use in dams and lodges; for another, the waters of the tundra often froze too deep, so that there wasn't enough water below for the large rodents to swim and manoeuvre. As a result of climate change, however, the Arctic has warmed by 1.8 degrees since the end of the 19th century. It's become greener, more and taller trees grow on the banks of its rivers and lakes, and there is less ice on the water - all of which is good news from a beaver's standpoint.




Will the restless landscape architects now spread to the Arctic in droves? And if they do, what will it mean for local ecosystems? These are the key questions that Ken Tape, Benjamin Jones and Christopher Arp from the University of Alaska in Fairbanks are currently exploring together with Ingmar Nitze and Guido Grosse from the AWI. To do so, they're relying on a bit of help from




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above. "Beaver activities can be clearly recognised in satellite images," explains Ingmar Nitze. For the well-trained eye, a given body of water's form belies whether it was created by one of the four-legged architects: beaver ponds are typically found in small valleys, are between 100 and 200 metres long, and tend to be long and narrow. If all of these criteria match, the researchers then examine a higher-resolution image of the region in question. If they find dams or lodges, they can be certain: it's the handiwork of beavers.

In a part of Northwest Alaska that, with an area of 18,000 square kilometres, is nearly as large as the German state of Saxony, the team used this approach to find the rodents' trail. Their findings indicate that, between 1999 and 2014, the animals created a total of 56 new ponds in the region. The distribution of the ponds also allowed the researchers to estimate how quickly and along which routes these landscapers are conquering the Arctic. They surmise that the animals will above all spread along the region's coasts and larger rivers, advancing by roughly eight kilometres per year. According to Ingmar Nitze, "In 20 to 40 years, they may well have settled along suitable bodies of water throughout the Arctic regions of Alaska."

If that comes to pass, it could have a number of consequences. First of all, the rodents could transform the steadily flowing waters of the Arctic into a varied and dynamic mosaic of ponds, stretches of flowing river, and wetlands. Just as elsewhere on our planet, many other animals and plants could profit from these changes - not to mention the fact that beaver ponds and the stretches of river downstream from them are warmer than other waters, which translates into more favourable living conditions for many species. For example, salmon can be found in Arctic rivers from time to time, but the water and sediment are too cold for them to spawn. The researchers consider it quite possible that this could change in the future, thanks to beaver activities.

But there's one major snag to this development; the warmer waters also affect the surrounding soils, which, except for the top few centimetres, normally remain frozen to a depth of several hundred metres. Researchers are observing with consternation how this permafrost is increasingly thawing in the wake of climate change. When this happens, the soils can become unstable and release greenhouse gases. And apparently, beavers' actions can also spark these effects. "The permafrost below and surrounding their ponds is increasingly degraded," says Ingmar Nitze, who is quick to add that there's no need to combat the rodents' expansion. "The main problem for the Arctic and its soils is climate change, not the beaver."

The Alfred Wegener Institute pursues research in the polar regions and the oceans of mid and high latitudes. As one of the 19 centres of the Helmholtz Association it coordinates polar research in Germany and provides ships like the research icebreaker Polarstern and stations for the international scientific community.

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