**Polar Bear Evolution Was Fast and Fatty**

GREENLANDIC POLAR BEAR / RUNE DIETZ, AARHUS UNIVERSITY

**By Janet Fang**

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Polar bears are a much younger species than we thought. A comprehensive genome comparison reveals how polar bears diverged from brown bears less than half a million years ago, rapidly evolving a metabolism that lets them live off a blubber-rich diet -- extremely useful for high Arctic living.

“For polar bears, profound obesity is a benign state,” [UC Berkeley’s Eline Lorenzen](http://cteg.berkeley.edu/members/lorenzen.html) says in a [news release](http://newscenter.berkeley.edu/2014/05/08/polar-bear-genome-gives-new-insight-into-adaptations-to-high-fat-diet/). Fat makes up half their body weight, and they consume a high-fat diet while avoiding fatty plaques in their arteries and cardiovascular diseases (unlike us). “We wanted to understand how they are able to cope with that,” [she adds](http://newscenter.berkeley.edu/2014/05/08/polar-bear-genome-gives-new-insight-into-adaptations-to-high-fat-diet/).

As the northern latitudes warm up, brown or grizzly bears (*Ursus arctos*) are expanding their range northward, creating hybrid babies with polar bears (*Ursus maritimus*) called pizzlies. Being able to interbreed means their relationship must be close, though previous estimates put their divergence anywhere between [600,000](http://www.sciencemag.org/content/336/6079/344) to [5 million years ago](http://www.pnas.org/content/early/2012/07/20/1210506109).

A large international collaboration between [Danish](http://snm.ku.dk/english/), [Chinese](http://www.genomics.org.cn/), and American researchers collected blood and tissue samples from 79 Greenlandic polar bears and 10 brown bears from Sweden, Finland, Glacier National Park in Alaska, and three islands off Alaska called Admiralty, Baranof, and Chichagof. They sequenced the genomes and analyzed them using the “[identity by state (IBS) tract” method](http://en.wikipedia.org/wiki/Identity_by_descent), which has been used to estimate divergence and interbreeding among ancient human populations. The method looks at the length of DNA segments shared by the two bears; since sequences break up and shorten as species evolve, longer segments indicate a more recent divergence.

They discovered that the split from brown bears was surprisingly recent: [between 343,000 and 479,000 years ago](http://www.cell.com/cell/abstract/S0092-8674%2814%2900488-7). The team also uncovered several genes that were involved in polar bears’ extreme adaptations to life on sea ice. In particular, genes related to fat transport, fatty acid metabolism, and cardiovascular function -- all of which helps them subsist on a diet of mostly tubby marine mammals like ringed and bearded seals. "Usually, the genes that evolve most radically in species are immune and defense genes," [UC Berkeley’s Rasmus Nielsen](http://cteg.berkeley.edu/~nielsen/) [tells New Scientist](http://www.newscientist.com/article/dn25535-zoologger-polar-bears-evolved-to-eat-junk-food.html#.U3MOGa209OB). "What's surprising was the focus on cardiovascular function." Polar bears adjusted to this ultra-high-fat diet in less than 20,500 generations.

Of the 16 most distinctive genes, nine of them are associated with heart disease in humans. One of the most strongly selected genes is APOB, which encodes the main protein in low-density lipoprotein (or LDL, [the “bad” cholesterol](http://healthyeating.sfgate.com/meaning-high-ldl-cholesterol-calc-3470.html) that clogs arteries). Changes in this gene reflect the importance of fat in their diet and their need to cope with high blood levels of glucose and triglycerides. The sequence of this gene varies from one brown bear to another, but all polar bears have an identical version -- suggesting that it must be very beneficial, though researchers don’t know exactly what this particular variant does for polar bears just yet.

Here’s a family on sea ice near Kap Tobin, Scoresby Sound, in Central East Greenland.

“The life of a polar bear revolves around fat,” Lorenzen [says](http://newscenter.berkeley.edu/2014/05/08/polar-bear-genome-gives-new-insight-into-adaptations-to-high-fat-diet/). “Nursing cubs rely on milk that can be up to 30 percent fat and adults eat primarily blubber of marine mammal prey. Polar bears have large fat deposits under their skin and, because they essentially live in a polar desert and don’t have access to fresh water for most of the year, rely on metabolic water, which is a byproduct of the breakdown of fat.” That means they get water by burning fat.

In addition to all these physiological and metabolic changes, there were also transformations in fur color (brown to white, stark) and the development of a sleeker body. All of these unique adaptations to the arctic evolved in a surprisingly short amount of time. Why?

The split from brown bears coincides with a particularly warm interglacial period called [Marine Isotope Stage 11](http://www.nature.com/nature/journal/v436/n7047/abs/436039b.html). Ancestral brown bears may have been encouraged move farther north. When the warm interlude ended and a glacial cold period set in, a pocket of brown bears may have become isolated and forced to adapt rapidly to new conditions. The physiological changes had to be quick if they were to subsist on a diet considered dangerously unhealthy for other mammals. “It’s a schoolbook example of evolution,” [University of Copenhagen’s Eske Willerslev](http://geogenetics.ku.dk/staff/beskrivelse/?id=26558) [tells Science](http://news.sciencemag.org/biology/2014/05/polar-bear-evolution-was-fast-and-furious). Analysis of a [120,000-year-old polar bear jawbone fossil](http://news.sciencemag.org/paleontology/2010/03/early-polar-bear-discovered-arctic-tundra) shows how they were already dependent on a marine diet by then.

"Their ancestors will have eaten healthy food like tubers and berries, and all of a sudden there they were eating almost exclusively fat and blubber from seals," Nielsen [tells New Scientist](http://www.newscientist.com/article/dn25535-zoologger-polar-bears-evolved-to-eat-junk-food.html#.U3MOGa209OB). "So the fast-food experiment [Super Size Me] has already been done by nature."

The [work](http://www.cell.com/cell/abstract/S0092-8674%2814%2900488-7) was published in *Cell* last week.

[[UC Berkeley](http://newscenter.berkeley.edu/2014/05/08/polar-bear-genome-gives-new-insight-into-adaptations-to-high-fat-diet/), [BGI Shenzhen](http://www.eurekalert.org/pub_releases/2014-05/bs-pgs050814.php) via [Science](http://news.sciencemag.org/biology/2014/05/polar-bear-evolution-was-fast-and-furious), [New Scientist](http://www.newscientist.com/article/dn25535-zoologger-polar-bears-evolved-to-eat-junk-food.html#.U3MOGa209OB), [Nature](http://www.nature.com/news/genome-reveals-polar-bear-s-youth-1.15188)]

<https://www.iflscience.com/plants-and-animals/polar-bear-evolution-was-fast-and-fatty/>