26. Polar bears

The polar bear is found in the Arctic Circle and adjacent land masses as far south as Newfoundland. They have a very specific diet based on the blubber of seals they eat. As a result of such a diet fat can make up to 50% of their body weight. Now, a new extensive comparison of the genomes of polar bears and their closest relatives, the brown bear, has revealed how polar bears survive such unhealthy diets.

It is known that polar bears evolved from brown bears, but until now, it wasn't clear when this happened. A jawbone, which was between 110,000 and 130,000 years old, provided the key to the polar bears' past because it offered a sample of genetic material. Scientists sequenced this DNA and compared it with the DNA of modern polar bears and modern brown bears. DNA from a polar bear jawbone revealed the Arctic species first originated about 150,000 years ago. Polar bears are an extremely specialized species. Whereas brown bears are more generalized and can survive in a variety of habitats, polar bears evolved to take advantage of a very specific ecological niche.

This research also suggests that the bears evolved these changes relatively quickly because they had to adapt to extreme conditions that forced them to switch to a diet that would be toxic to other mammals. “It’s a schoolbook example of evolution,” says Eske Willerslev, an evolutionary geneticist at the University of Copenhagen who helped lead the research.

In the latest sequencing effort researchers from Denmark, China, and the United States analyzed the genomes of 80 polar bears from Greenland and 10 brown bears from North America and Europe. It was the most comprehensive bear genomic study to date.

The most distinctive polar bear genes include many related to fat processing and to the development of the heart and circulatory system. Nine of the 16 most distinctive genes are ones that in humans are associated with heart disease. One of the most important is a gene called *APOB*, which is involved in fat metabolism of mammals including humans. It helps transfer fat from blood into cells. This gene when mutated leads to high cholesterol levels in humans.

In brown bears, the sequence of this gene varies from one bear to another, but all the polar bears surveyed had an identical version, with the exact same genetic code at nine variable spots in the gene, about half of which should change the function of the *APOB* protein.

The scientists who studied the polar bear’s genome detected multiple mutations in APOB. They determined that the mutations were very likely to be damaging — that is, likely to degrade or destroy the function of the protein that the gene codes for.

The polar bear adjusted to its environment by degrading genes rather than evolving new

genes. In fact, about half of the mutations in the 17 most highly selected polar bear genes were damaging. About 67 - 80 percent of selected genes had suffered at least one damaging mutation.

What do we learn from this story? The fast adjustment of polar bears to a new environment was the result of damaging mutations, not constructive mutations. The damaged genes could not produce the correct proteins, but the damaged proteins resulted in changing the polar bear’s bodies in such a way that they were adjusted to new conditions. This supports our observations that mutations are mainly damaging and are not able to generate new complex functions or organs.