What we didn't know about hibernating black bears

American black bear from the Kenai Peninsula, Alaska. Credit:

For the first time, Alaskan black bears were monitored continuously through their long winter hibernation. Scientists monitoring them were surprised by the changes they saw in the bears' body functions.

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A new study that continuously monitored black bears during their long winter rest has changed our understanding of their hibernation. Scientists discovered that even though the bears' body temperature did not drop significantly, they functioned at only 25 per cent of their active metabolic rate. The bears' body temperature fluctuated between 30 and 36 degrees Celsius (86 and 97 degrees Fahrenheit) over cycles that ranged from two to seven days. After their long slumber, the bears took two to three weeks to return to an active metabolic state, even though their body temperature had climbed back to normal soon after they awakened from hibernation.

These hibernation characteristics have never been observed in other hibernating animals, where body metabolism typically falls by 50 per cent for every 10 degree Celsius (18 degrees Fahrenheit) drop in body temperature.

The results of this unprecedented study were published in the February 18th issue of *Science*. In a press release issued by the American Association for the Advancement of Science, lead researcher Dr. Øivind Tøien remarked,

> *A very important clue to understand what is going on with the bear's metabolism is their body temperatures. We knew that bears decreased their body temperatures to some degree during hibernation, but in Alaska we found that these black bears regulate their core temperature in variable cycles over a period of many days, which is not seen in smaller hibernators and which we are not aware has been seen in mammals at all before.*

Shireen Gonzaga

Shireen Gonzaga - Shireen Gonzaga is a freelance writer who enjoys writing about natural history. She is also a research and instrument analyst at the Space Telescope Science Institute, where she works on image calibration and analysis of Hubble data. Shireen has way too many interests and hobbies, and frequently gets quite exhausted from it. She lives in Baltimore, Maryland, with over 60 fish, more than 100 houseplants, and a few hundred red wigglers.

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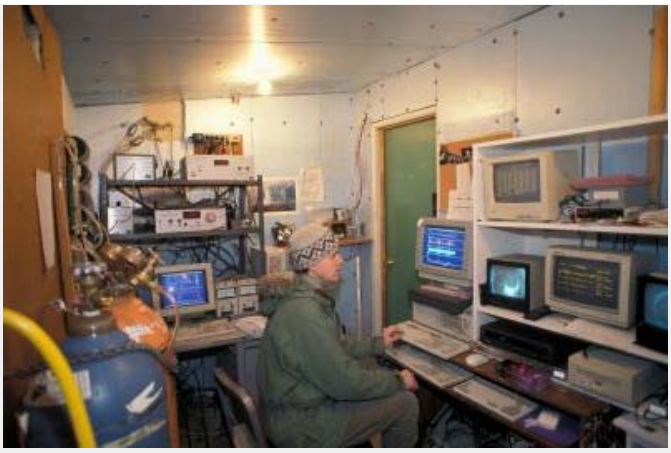

Øivind Tøien, research scientist with the Institute of Arctic Biology at the University of Alaska Fairbanks, checks on the hibernating bears using computer monitors connected to video and physiological recording equipment. Image Credit: Øivind Tøien, Institute of Arctic Biology, University of Alaska Fairbanks

These tests were carried out on bears that had wandered too close to where people lived. They were caught by the Alaska Department of Fish and Game, and transported to a study area set up by the Institute of Arctic Biology, which is tucked away in a wooded location away from any human disturbances. Sensors attached to radio transmitters that recorded body temperature, heart rate, and muscle activity were implanted in the bears before they were placed in winter lodgings that resembled a den. There, the bears' every movement would be monitored with infrared cameras.

There's a video clip of a slumbering bear, taken by Dr. Tøien, posted at the PBS News Hour You-Tube channel.

Bears in a state of hibernation during winter do not eat, drink, urinate, or defecate. Yet they emerge each spring in physical condition very similar to their condition before they went into hibernation. What goes on during that time of deep slumber?

A young male American black bear, captured in south-central Alaska as a nuisance animal, is shown having been just placed in an artificial den. Image Credit: Øivind Tøien, Institute of Arctic Biology, University of Alaska Fairbanks

The scientists observed that during hibernation, as the bears' body temperature fell to about 30 degrees Celsius (86 degrees Fahrenheit), the bears would shiver until their temperature

climbed back up to about 36 degrees Celsius (97 degrees Fahrenheit). Then, the shivering would slow down until the bears' body temperature fell back to 30 C (86 F). This temperature/shivering cycle would last several days.

Meanwhile, implanted sensors also measured the amount of oxygen taken in by the bears. This revealed a 75 percent drop from their active summer metabolic rate. The bears' heart rate was around 14 beats per minute, compared to 55 during their active state. Furthermore, Dr. Tøien noted that the bears' hearts do not beat at a constant rate during hibernation.

> *Sinus arrhythmia is a variation in heartbeat frequency relative to breathing, and the bears show an extreme form of this. They have an almost-normal heartbeat when they take a breath. But, between breaths, the bears' hearts beat very slowly. Sometimes, there is as much as 20 seconds between beats. Each time the bear takes a breath, its heart accelerates for a short time to almost that of a resting bear in summer. When the bear breathes out, the heart slows down again.*

One of the bears in the study was a pregnant female. During hibernation, her body temperature remained at the same level as her active state, around 37 degrees Celsius (98.6 degrees Fahrenheit). But after her cub was born, her body temperature trended to the same cycling pattern seen in the other bears. (Unfortunately, the cub died of a birth defect in its diaphragm.)

When spring arrived and the bears left their dens, the scientists had expected to see the bears' metabolism quickly revert to normal active levels. But even though the bears resumed an active body temperature of 37 degrees Celsius (98.6 degrees Fahrenheit) soon after waking up from hibernation, the scientists were surprised to find that it took the bears about two to three weeks to transition back to an active metabolism.

The black bears also did not suffer from muscle and bone mass loss during their hibernation. Said Dr. Tøien,

> *If we could discover the genetic and molecular basis for this protection, and for the mechanisms that underlie the reduction in metabolic demand, there is the possibility that we could derive new therapies and medicines to use on humans to prevent osteoporosis, disuse atrophy of muscle, or even to place injured people in a type of suspended or reduced animation until they can be delivered to advanced medical care – extending the golden hour to a golden day or a golden week.*

A young male American black bear after emergence from hibernation. The bear was part of the hibernation research conducted by Øivind Tøien, research scientist with the Institute of Arctic Biology at the University of Alaska Fairbanks. Image Credit: Øivind Tøien

In a first-of-its-kind study, Alaskan black bears were constantly monitored during their winter hibernation. And it was hardly boring for the scientists who watched them sleep. Even though the bears' body temperature dropped by just a few degrees, they functioned at only 25 percent of their active metabolic rate. When they left the den in spring, the bears' body temperature returned to its normal level but their metabolic rate took two to three weeks to catch up to its normal active rate.

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3 Responses to *What we didn't know about hibernating black bears*

Joe *says:*

February 22, 2011 at 10:14 am

This is amazing. The abilities of bears to hibernate for such long periods is unparalleled by almost any other creature. I love biology.