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Hibernating bears studied in unprecedented detail

By Jason Palmer

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Infrared footage of a black bear snoring. Courtesy Oivind Toien / Institute of Arctic Biology / University of Alaska Fairbanks

Five bears have been the subject of the most detailed hibernation study ever undertaken in animals of their size.

Researchers reporting at the AAAS meeting in Washington say the bears' metabolism drops to just 25% of its normal level - much more than their drop in body temperature would suggest.

The bears remain in a state of reduced metabolism even weeks after awakening.

The research may in time inspire new techniques that could prove useful in emergency medicine.

Hibernation is widely held to be a means for animals to reduce their energy use during the coldest seasons.

The body temperatures of small mammals drop to near-freezing levels, with metabolism dropping in some cases to just 2% of normal rates.

But such small creatures also rise from their slumber briefly and repeatedly during the hibernation season, at a substantial energy cost.

Biologists have found that the reduction of temperature and metabolism in these creatures follows a neat relationship - metabolism dropping by half for each 10C drop in temperature.

As such, it was thought that the plunges in both are part of the same mechanism.

The body temperatures of bears and other large mammals, however, seemed not to drop so dramatically in previous studies.

So researchers from the University of Alaska Fairbanks and Stanford University rounded up a few American black bears - *Ursus americanus* - to investigate.

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As the researchers described to the American Association for the Advancement of Science meeting, the bears were initially captured as "nuisance animals" - coming a bit too close to residents of the US state of Alaska.

Researchers brought the bears to the Institute of Arctic Biology at the University of Alaska, Fairbanks, implanting radio transmitters that recorded the bears' temperature, muscle activity and pulse rate.

The researchers also set up "artificial dens" where the bears could begin their seasonal slumber under the watch of infrared cameras, oxygen and carbon dioxide detectors, and motion sensors.

Over the course of the winter, the curled-up bears were seen to rise on average once a day to groom and even re-arrange their straw bedding material - and were even caught snoring.

Their temperatures dropped to a low of about 30C, but their consumption of oxygen and production of carbon dioxide suggested their metabolism had dropped to just 25% of its normal rate.

However, the pattern of the bears' heartbeats held a surprise for the researchers.

"The bears typically during hibernation will take a deep breath and exhale and when they do, their heart stops and doesn't beat at all for 10, 15, 20 seconds," said Brian Barnes, the Institute of Arctic Biology researcher who led the study.

"They held their breath for about a minute, and it's only when they inhale again that their heart picks up," he told BBC News. "It's just this alternative way of being that's very spare, that we didn't know was possible, particularly in large animals."

As the bears' body temperature reached its lowest value, the bears would shiver, causing the temperature to rise almost to normal levels over the course of the cycles that lasted from two days to a week.

Another surprise was that even when the bears awakened and their body temperature rose to its normal level of about 38C, their metabolism remained low - nearly half the normal rate, for up to three weeks after finishing hibernation.

That the bears emerge in a fit state, with no loss of muscle and carrying on their routines even with lowered metabolism, suggests that they hold the secret to better medical care for humans, said Professor Barnes.

"If we could tell the mechanism by which they... do this decrease in metabolic demand, that would be very interesting; should you have a heart attack or stroke or be gravely injured, the ability of your heart to deliver oxygen to your brain is compromised," he explained.

"If we could do something to reduce your demand to be equivalent to supply - hibernating - it would put you in a protected state that would give us more time to get you to care. That's the most exciting potential application in my mind."



The bears occasionally rose to "fluff" their bedding material



Researchers in the "observation hut" caught the bears' every move and breath

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