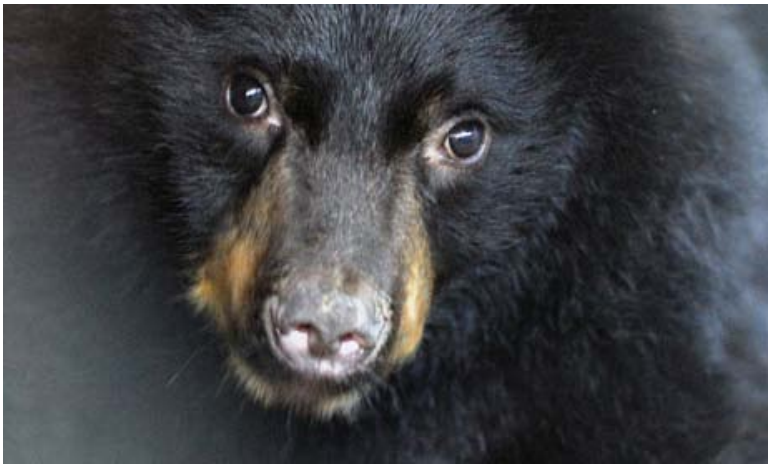
Hibernating bears teach scientists tricks for human hibernation

A study of hibernating black bears paves the way for using hibernation-like states in humans for treating the critically ill and helping astronauts survive journeys through deep space

Alok Jha, science correspondent
guardian.co.uk, Thursday 17 February 2011 19.00 GMT
Article history



Black bears have a remarkable ability to reduce their metabolic rate during hibernation. Photograph: Oivind Toien/Arctic Biology/Univ/PA

The black bears of Alaska spend up to seven months in hibernation every year, without eating, drinking, urinating or defecating, and when they emerge from their slumber, it is as if nothing had happened. They are in practically the same physiological condition as when they entered hibernation.

Researchers studying this remarkable feat have found that the bears are able to drop their heart rate to just 14 beats per minute and reduce their metabolism by three quarters. Their findings could lead to the development of techniques for inducing hibernation-like states in humans, paving the way for improved treatment of the critically ill and helping astronauts survive long missions in deep space.

The hibernation of smaller animals such as mice and hedgehogs is well undersood, but larger, human-sized animals that hibernate have never been studied before.

Øivind Tøien and colleagues from the Institute of Arctic Biology at the

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University of Alaska, Fairbanks, placed captured bears in wooden huts designed to look like dens. The huts were fitted with infrared cameras and the researchers implanted radio transmitters into the animals to monitor their body temperature, heart rate and muscle activity. The results were published on Thursday in Science and were presented at the annual meeting of the American Association for the Advancement of Science.

"We wanted to follow metabolism to see whether or not the animals were regulating body temperature. We wanted to study EEG in order to reveal their sleep states and circadian rhythms," said Craig Heller of Stanford University in Washington DC, who took part in the study.

The scientists monitored the bears during five months of hibernation and watched as their body temperatures fluctuated between 30C and 36C in cycles lasting two to seven days. These fluctuations have never been seen before in hibernating animals.

"A very important clue to understand what is going on with the bears' metabolism is their body temperatures," said Tøien. "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."

When a typical animal hibernates, its metabolism slows down by about half for every 10C drop in body temperature. The bears' metabolism dropped to a quarter of normal, but their body temperature only fell by 5-6C. Their heart rates also slowed from around 55 beats per minute to about 14 beats per minute.

At the end of the hibernation season, it took the bears a while to get back to normality – their metabolism remained suppressed for up to three weeks after they emerged from sleep. "That indicates there's some biochemical mechanism that suppresses metabolism and that could be a very interesting discovery," said Heller.

The findings suggest how hibernation could be induced in people. "If our research could help by showing how to reduce metabolic rates and oxygen demands in human tissues, one could possibly save people," said Tøien. "We simply need to learn how to turn things on and off to induce states that take advantage of the different levels of hibernation."

Brian Barnes, also of the University of Alaska and another author of the study, noted that when black bears emerge from hibernation in spring, they have not suffered the losses in muscle and bone mass and function that would be expected to occur in humans over such a long period of immobility and disuse.

"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, and disuse atrophy of muscle," he said, "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 [when medical intervention is most effective] to a golden day or a golden week."

Heller also pointed to lessons that the hibernation study could have for deep-space exploration. "There has always been a thought that, if there is ever long-distance space travel, it would be good to be able to put people into a state of lower metabolism or suspended animation – that's almost science fiction but you can see the rationale."

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