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Hope for human hibernation heats up

By Alan Boyle

When bears hibernate, their body temperature drops. But a novel experiment conducted on Alaskan black bears in an artificial den, outfitted with high-tech sensors, indicates that the temperature doesn't drop as much as scientists thought it did. That finding is stirring up fresh questions about the phenomenon of hibernation, and it's also reawakening the sci-fi dream of putting humans into suspended animation for medical therapy or even space travel.

Oivind Toien / IAB / UAF

American black bears in Alaska were monitored while they hibernated in an artificial den, also known as a "hibernaculum."

The research on hibernating bears was published in this week's issue of the journal Science and discussed today at the American Association for the Advancement of Science's annual meeting in Washington.

"When black bears emerge from hibernation in spring, it has been shown that 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 time of immobility and disuse," said the study's senior author, Brian Barnes, who directs the Institute of Arctic Biology at the University of Alaska at Fairbanks.

"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," Barnes said in a news release.

Physicians already are using temperature cool-downs to reduce their patients' metabolic rate, and most researchers assumed that bears naturally operated under the same principle for their winter hibernation. Past studies with other species, such as ground squirrels, have shown that metabolic rates are typically reduced by 50 percent when body temperature drops 18 degrees Fahrenheit (10 degrees Celsius).

But when researchers conducted their experiment with five black bears who were captured in Alaska as nuisance animals, they were surprised by the results. The bears' temperatures fluctuated over the course of two- to seven-day cycles, between nearly the normal level (about 98.6 degrees F or 37 degrees C) and a minimum of 86 degrees F (30 degrees C). And yet their metabolism rate still fell to just 25 percent of the norm. The bears typically hibernated for five to seven months without eating, drinking, urinating or defecating, and roused themselves in the spring with no ill effects.

This kind of research is hard to do because bears are knocked out of their natural rhythm when they're in captivity. To get around that problem, the researchers behind the newly published study built structures out in the woods, away from human disturbances, that were designed to mimic a bear's den. These structures, also known as "hibernaculums," were outfitted with motion detectors, infrared cameras and other remote sensing devices. The bears were implanted with radio transmitters to feed back information about each animal's temperature, heart rate and muscle activity.

A hibernating bear is partially covered with straw in the "hibernaculum" set up for study.

"We measured the bears' metabolism by continuously measuring the oxygen and carbon dioxide concentrations of the air entering and leaving the den," the study's lead author, Oivind Toien of UA-Fairbanks, said in the news release. "The transmitters

inside each bear told us that the bear's body temperature was not stable, but varied over the winter in slow cycles each lasting several days."

"Such large, multi-day fluctuations in core body temperature are unlike those observed in any other mammal before. This detail was missed by past studies, and may have caused overestimation of metabolic rate because bears periodically shiver when they increase their body temperature," Toien said.

Scientists can't yet explain how bears do what they do, but the researchers suggested that some aspects of the mechanism could eventually be applied to humans. They noted that some form of hibernation has been found in nine orders of mammals (including a primate, the fat-tailed dwarf lemur of Madagascar), so some of the biochemical triggers may still exist in our own cellular machinery. "The trick would be to find drugs that would emulate those same changes in people," Barnes told reporters at today's AAAS briefing.

Toien said the hibernation trick would come in handy in outer space as well — and not just for long bouts of suspended animation, such as those depicted in "2001: A Space Odyssey" or the movie "Avatar." Toien noted that bone loss and muscle loss is a problem right now for long-term spacefliers on the International Space Station. New medications, sparked by future research into hibernation, could retard the bone-loss process in space and on Earth.

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

Stay tuned for more reports from the AAAS meeting in Washington. Join the Cosmic Log community by clicking the "like" button on our Facebook page or by following msnbc.com science editor Alan Boyle as b0yle on Twitter. To learn more about Alan Boyle's book on Pluto and the search for planets, check out the website for "The Case for Pluto."

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