Hibernation mystery

In winter, bears slow their metabolic rates far more than their body temperatures would predict

By Susan Milius
Web edition : 2:14 pm

Text Size

View the video

Don't judge a bear by its temperature, or so suggests first-of-its-kind data on hibernation physiology.

There's something as-yet-unknown going on with black bear hibernation that slows metabolic rates more than lower body temperatures alone can explain, reports ecological physiologist Øivind Tøien of the University of Alaska Fairbanks.

In the depths of Alaskan winters, closely monitored black bears dropped their temperatures only a modest 5.5 degrees Celsius on average, Tøien and his colleagues report in the Feb. 18 *Science*. A standard physiologist's calculation predicts that such a chill would slow metabolism to 65 percent of nonhibernating resting rates. But the bears' metabolisms plunged down to even more energy-saving zones, averaging only 25 percent of the basic summer rate.

This sustained, big disconnect hasn't shown up so far in research on any other hibernating mammal, says study coauthor Brian M. Barnes, also of UA Fairbanks.

Mammal hibernation matters to human medical research, says physiological ecologist Hank Harlow of the University of Wyoming in Laramie. Relying on mechanisms that scientists would love to understand, black bears spend five to seven months without eating, drinking or taking a single bathroom break. But unlike bedridden or spacefaring people, the hibernators don't lose their muscle strength or bone mass. "Bears are just remarkable," Harlow says.

ENLARGE

SLOW WINTER
The most detailed monitoring yet of black bears in Alaska revealed that their modest drops in body temperature during hibernation belie a much deeper drop in metabolic rate, thanks to physiology yet to be explained.
Øivind Tøien/Institute of Arctic Biology/Univ. of Alaska Fairbanks

This Alaska study is the first to manage continuous monitoring of metabolic rate and body temperature throughout bear hibernation in low-disturbance conditions, Tøien says. Other studies based on intermittent sampling with older instruments, indirect evidence or studying bears with lots of people nearby have left the matter "uncertain," as he puts it.

He and his colleagues get such abundant data by volunteering to take in black bears that have developed a taste for foraging close to people and are about to be killed as menaces. "We read about them in the *Anchorage Daily News* before we get them," Tøien says.

For their hibernation studies, the researchers monitored five bears, setting the animals up in wooden den boxes in an enclosure deep in the woods. The boxes were rigged to allow a bear

SUGGESTED READING :

- N. D. Barrows, O. L. Nelson, C. T. Robbins, B. C. Rourke. Increased Cardiac Alpha-Myosin Heavy Chain in Left Atria and Decreased Myocardial Insulin-Like Growth Factor (IGF-I) Expression Accompany Low Heart Rate in Hibernating Grizzly Bears. Physiological and Biochemical Zoology, 2011; 84 (1): 1 DOI: 10.1086/657589
- B. Harder. Hibernation concentrates chemicals. Science News. Vol. 171, March 17, 2007, p. 173. [Go to]
- B. Harder. Perchance to Hibernate. Science News. Vol, 171, January 27, 2007, p. 56. [Go to]
- Hershey JD, Robbins CT, Nelson OL, Lin DC. Minimal seasonal alterations in the skeletal muscle of captive brown bears. Physiol Biochem Zool. 2008 March/April;81(2):138-147.

CITATIONS & REFERENCES :

- Ø. Tøien et al. Hibernation in black bears: independence of metabolic suppression from body temperature. Science, Vol. 331, February 18, 2011, p. 906. doi: 10.1126/science.1199435

READER FAVORITES:

'Atomtronics' may be the new 'electronics'
Black holes take light for a spin
'Magnetricity' behaves like electricity
How cuts can spur tumor growth
Milky Way munched on galactic snack

to break out anytime it wanted. But while bears were inside, researchers checked the oxygen concentration to track metabolic rate. Instruments also measured muscle movements and heart function.

One bear's temperature did not drop much during early hibernation — until she gave birth to a cub. The cub did not survive, and the female's temperature afterward behaved more like that of the other bears.

Reports of respectable drops in bear metabolic rates during hibernation cheer Eric Hellgren of Southern Illinois University Carbondale, who admits to "a biased viewpoint as a bear biologist." He says the Alaska study may lay to rest some of the long-running discussions from physiologists who treat bear hibernation as "a different and 'lesser' form" compared with the big metabolic shifts seen in small animals such as ground squirrels.

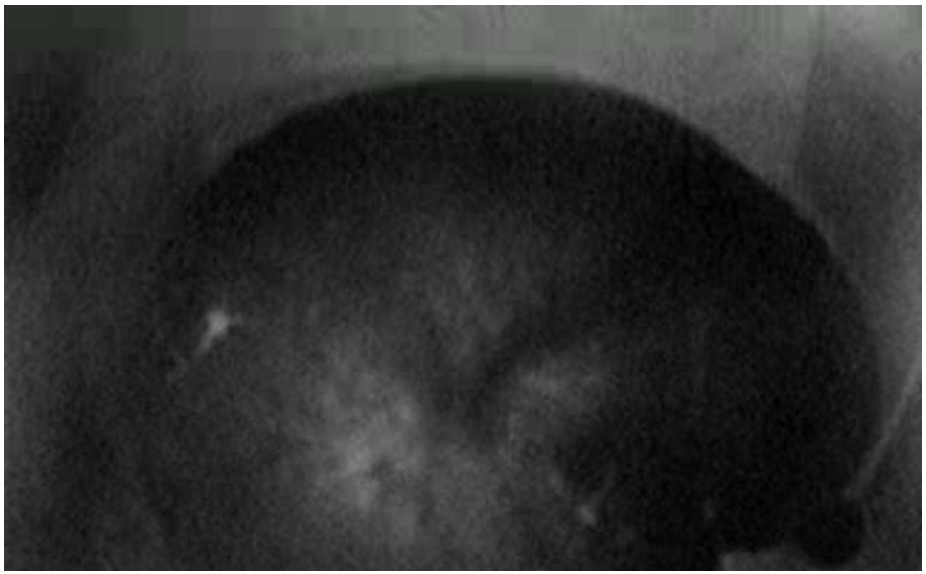
The detailed monitoring also revealed other bear quirks, such as the cycles of a few days or a week during midhibernation when bears temporarily shiver themselves up several degrees in body temperature. Tøien doesn't rank these upticks as equivalent to the periodic, full warm-ups typical of almost all small hibernators, who spike their body temperatures into the normal range every few weeks, urinate and then subside back into cold, extreme torpor. Whatever the bears' cycles mean to the animals, researchers who inadvertently tried to measure metabolism during a shivering bout would have gotten inflated numbers for baseline hibernation he notes.

Heart rate tracking for three of the Alaska bears showed a drop from 55 beats per minute on average before hibernation to 14 erratic ones per minute in winter. Harlow says that he too has listened to hibernating bear hearts going still for a stretch and then kerthumping arrhythmically. Maybe it saves energy, he speculates.

The Alaska team also found that when bears got moving again in spring, their metabolisms took several weeks to creep back to normal. Monitoring data showed that bears with half-speed metabolic rates still displayed normal bearish behavior.

That observation fits with studies on grizzlies, which spend the first few weeks after hibernating with heart rates at half the summer speed, says Lynne Nelson of Washington State University in Pullman. "It never ceases to amaze me just how adaptable the physiologic systems of these bears can be."

BIG SNORE



SN ON THE WEB:

Find us on Facebook
Twitter Updates

A video from the monitoring cameras inside a hibernation-research bear den shows practically no motion, but listen for the few, widely spaced snores the bear takes fewer breaths and has fewer heart beats per minute than in the summer.

Credit: Øivind Tøien/Institute of Arctic Biology/Univ. of Alaska Fairbanks

Email | Print | Comment | Tweet | Like

Found in: Biomedicine and Life

SHARE & SAVE

slashdot digg facebook yahoo
del.icio.us reddit google technorati

COMMENTS 1

A likely explanation is that oxygen consumption goes way down because the brain uses more oxygen at rest than any other organ. Arrhythmic heart rates and brainwaves have been shown to be commonality in people with reduced stress, heart attacks and strokes. The reason is that a regular strong pulse sets up a harmonic entrainment that keeps cells operating at maximum capacity. Researchers at NASA should experiment with harmonically interfering body rhythms.

Santa Fe Feb. 17, 2011 at 2:51pm

Please login or register to participate.

post a comment (please note: all links will be removed from comments.)