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Wild Ideas: Black bear hibernation, part 2

By Pam Owen *Apr. 10, 2014*

Implications for human medicine and technologies advancing the research

Part 1 of this column is here.

With the help of advancing technology, researchers continue to dig deeper into how and why bears hibernate (see last week's column), and what they're finding could have implications for human medicine.

More than a decade ago, a team led by Mike Vaughan, who then directed Virginia Tech's Black Bear Research Center (BBRC), found that hibernating black bears did not lose bone mass, muscle mass or strength during hibernation.

Graduate student Bernardo Mesa, who is now continuing the research at BBRC under the direction of Virginia Tech associate professor Marcella Kelly, says it's "remarkable" that, after not using their muscles much in three months, bears "have the muscle tone and strength to just get up and run," while humans with just three weeks in bed will start to lose muscle mass and strength.

In a 2003 article in The Journal of Experimental Biology, Vaughan suggested what he and his team have found could have implications for humans with osteoporosis, those who sustain bone and muscle loss during long bed rest, or those in space. Mesa says he'd like to go deeper into Vaughan's findings to learn more about how bears conserve muscle and bone during hibernation, including the role of biological markers, such as hormones and proteins.

Mesa says he's also interested in using Vaughan's long-term data set to see whether climate change is affecting delayed egg implantation in black bears. To take the bear hibernation research to "a whole new level," he says, he's looking for partners from other disciplines — including veterinary medicine, human nutrition, biomechanical engineering, reproductive physiology and muscle metabolism.

Almost a decade after Vaughan's study, Øivind Tøien and his colleagues, who were doing research on captive black bears in Alaska, found that bears could decouple rates of metabolism and temperature. As the team wrote in the Feb. 18, 2011 issue of Science, their findings may help in better understanding comas in humans. In a press release, Brian Barnes, a partner in Tøien's study and director of the Institute of Arctic Biology at the University of Alaska, suggested several implications for human medicine from the bear-hibernation research:

See bears hibernating on YouTube

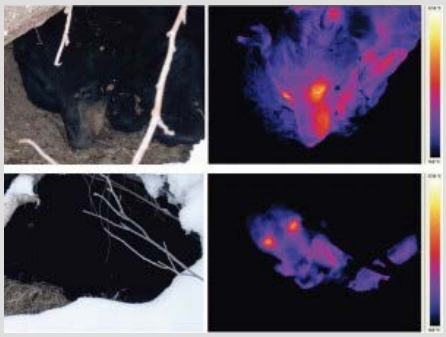
From filmmakers at BBC to researchers in Minnesota and Maine, schools doing education and corporations doing PR, videos on hibernating bears abound on YouTube.com. Among these is one of Moon, a black bear at the Black Bear Education Center in Wausau, Wis., preparing to make his den for the winter under a rock pile by pulling piles of leaves into it. The video ends with the bear yawning and howling, although it's not clear whether that's normal for him as he settles into hibernation or he's annoyed by having a light and camera within inches of his face. Either way, viewers get to see closeups of the snout and open mouth of a black bear. Another video shows Maine researchers tracking a collared sow and digging into her den to get data on her newborn cubs. Search on "black bear den hibernate" to see these and other videos.

"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."

Until recently, most bear-hibernation data — including blood chemistry, temperature and heart rate — was collected from domestically raised or captive bears, or from bears in the wild that were anesthetized, and gave only a snapshot of the bear at that time. However, new technology is enabling researchers to collect data over long periods and in real time without disturbing their subjects. Some of this technology came out of human medicine.

Medtronic Inc., based in Herndon, has developed a small, implantable heart monitor to collect data in human heart patients over time. Timothy Laske, a biomedical engineer at the company, along with some colleagues, implanted the monitors in 15 hibernating bears in Minnesota, seeking "to elucidate both the physical and environmental situations . . . and mechanisms . . . that motivate their physiological and behavioral changes," according to an article in BMC Physiology (August 2011). The researchers programmed the monitors and retrieved the data later using a portable programmer that sent and received signals through the skin of bears without disturbing them.

As Laske and his colleagues wrote, such monitors have become smaller, less invasive and more sophisticated, and the length of time they can collect data has increased to months. These advances enabled the researchers to collect data on annual variations in heart rate and activity for the first time in wild black bears.



PAUL IAIZZO AND TIM LASKE

Optical and infrared (IR) images of hibernating wild black bears are advancing understanding about the daily life of bears during hibernation. Above, IR images help to identify a black bear moving in a dark den. The images, taken upon researchers' arrival at two den sites in late December, clearly show that bears remain alert during the winter months. The bear's fur substantially reduces heat loss, with the maximum temperatures recorded from the eyes.

According to the researchers, the data told them a lot about the bears' ongoing physiology, including low heart and respiration rates during hibernation, dramatic respiratory sinus arrhythmias (the variations in heart rate that normally occur with animals at rest) in the fall and winter months, and elevated heart rates in summer and during interactions with hunters.

The data collected "has broad applications to wildlife management and physiological research, enabling the impact of environmental stressors from humans, changing seasons, climate change, social interactions and predation to be directly monitored over multiple years," the researchers concluded.

Small, high-resolution cameras are also helping researchers collect higher volumes of more detailed data on hibernating bears, and even watch them in their dens around the clock. From such monitoring, researchers now know that bears move "a little bit" while in their dens, Mesa reports, and one researcher even observed a sow with cubs urinating, undercutting the belief that bears never did this in their dens.

Lynn Rogers, the principal biologist for the Wildlife Research Institute in Ely, Minn. has been using wireless den cameras to study bears for years. When a sow Rogers was studying this way gave birth, he was able to watch remotely through a wireless 4G telephone network.

In a recent interview, Rogers explained that early researchers studying bears in the wild had to actually sit in dens, visiting often and sometimes drugging the bears so they would tolerate the intrusion. What they observed was mostly how the bears reacted to the researchers, and continued intrusions often led to bears' abandoning their dens.

Previous cameras had limited how Rogers and fellow researchers could observe bears in their dens, as observation could only be done near a power source. Now, with the combination of smart phones and solar power, Rogers says, "we can have a den cam anywhere" and share the live feed over the Internet.

Thermal-imaging cameras are also recording new dimensions in the physiology of hibernating bears, showing variation in temperature in different parts of a bear's body and at different levels of activity. In 2003, Rogers helped a BBC film crew collect thermal images by taking a thermal camera into the den of Dot, a three-year-old sow.

Once in the den, according to The North American Bear Center website, Rogers showed the camera to Dot, then "gently eased it underneath her, revealing cubs less than two weeks old." On its website, the BBC also has an infrared video, with sound, of a hibernating bear snoring away. Video from cameras tracking bear behavior outside and in dens, including live feeds via webcams, are available on several Internet sites, including NABC's and YouTube (see sidebar).

Along with the increased volume of high-resolution data technology is providing comes a greater challenge in connecting all the dots, Mesa says. The data are reshaping and redefining traditional concepts, such as hibernation, he says: "It's very easy for us to define nature and animals and processes in very straight lines, but they're not in straight lines."

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