JUDY WANTULOK

Follow That Bear

How biologists track grizzlies, wolverines, and other elusive wildlife through the most remote reaches of Montana. By Becky Lomax

"It's a wonder we get any of these collars out," says Rick Mace as he describes the difficulty of capturing female grizzly bears and fitting them with collars containing GPS (Global Positioning System) transmitters. For the past three years, the Montana Fish, Wildlife & Parks bear biologist has been studying grizzly population trends in Montana's Northern Continental Divide Ecosystem (NCDE), which encompasses Glacier National Park and the Bob Marshall Wilderness south to the Blackfoot Valley. The study requires that Mace and his crew regularly trap bears, which have to be grizzlies, not black bears. The captured bears must also be female, not male. And each animal's neck must be large enough so the collar doesn't slip off. "Trapping the right bear is like trying to find a needle in a haystack," says Mace. Unfortunately, there is no other way to learn if NCDE grizzly numbers are rising, falling, or holding steady—vital information for determining the health of the grizzly population.

In 2004 bear specialists and biologists with FWP and other state and federal agencies, Indian tribes, and the University of Montana captured, tranquilized, and fitted GPS collars on 25 female grizzlies. Over the past three years the scientists have monitored the bears from aircraft to learn reproduction and survival rates. The results, based on a baseline population estimate, will help determine whether the NCDE grizzly population has recovered and should be moved toward federal threatened species delisting.

Key to this and dozens of other wildlife monitoring projects across Montana is the amazing technology of GPS. Originally invented for military purposes, a GPS unit can pinpoint the exact location of animals previously untrackable. The technology "has revolutionized our understanding of wildlife habitat and how animals use the landscape," says John Squires, a U.S. Forest Service (USFS) biologist tracking the movements of lynx in northwestern Montana.

They can run but not hide

Scientists use GPS to track everything from bears to burbots. Kim Keating of the U.S. Geological Service Northern Rocky Mountain Science Center in Bozeman has followed bighorn sheep in Glacier National Park and neighboring Waterton Lakes National Park in Alberta. He is learning how often the sheep visit mineral licks and cross the international boundary. Within both Glacier and Yellowstone national parks, biologists from the USFS Rocky Mountain Research Station in Missoula are using GPS to locate wolverine home ranges and learn how the animals use their habitat. In the Madison Valley, wildlife scientists from Montana State University and FWP are tracking GPS-collared elk to understand the ungulates' movements away from hunters and predators. The scientists are also following GPS signals sent from the collar of a single wolf to monitor the behavior of its pack. In addition, Montana-based scientists follow the movements of bison in Yellowstone National Park, waterfowl across North America, and fish in the Missouri, Blackfoot, Yellowstone, and Sun rivers.

Until recently, biologists relied on radio telemetry to track wildlife. The radio transmitter, attached to a collar, emits a signal frequency that a receiver picks up if the animal is within 1 mile. Like the child's game of Hot and Cold, the receiver beeps louder and more frequently the closer it gets to the transmitter. Biologists hold the receiver and

ROBERT J. WESELMANN

TIME FOR YOUR FITTING A biologist darts a fleeing wolf with a tranquilizer dart so it can be fitted with a GPS collar. One of the hardest parts of GPS monitoring is capturing the animal. In addition to tranquilizers, wildlife are captured by dropping nets from helicopters. Species that stay in wooded areas, such as bears and wolverines, are captured with snares or other live traps. Biologists take advantage of the opportunity to weigh and measure the sedated animals, as well as gather hair, blood, and saliva samples.

BRENT & DELLA LONNER

slowly rotate 360 degrees, listening to the beep frequency in order to get a fix on where the animal might be. These devices are still used, primarily because they are so inexpensive (roughly $300 each), but they require a great deal of walking and only work if the animal is nearby and in open terrain where trees and mountains don't block radio waves.

GPS works much better. Similar to the handheld models available in sporting goods stores, the GPS units used to monitor wildlife gather a location fix by trilateration, deriving coordinates from the intersection of any 4 of 27 satellites orbiting Earth. The GPS receiver determines where those four satellites are in space and how far away each one is from the receiver. The intersection of those distances pinpoints the exact location of the receiver, which is attached to a collar on the animal's neck.

Most of the weight on the collar is the battery, which regulates the life of the GPS. Every time the unit turns on, it eats up juice. Researchers in Glacier National Park last winter programmed the GPS units they put on trapped wolverines to take a reading every five minutes, which drained the batteries in just eight days. Some batteries last a year by gathering data less frequently. The Madison Valley wolf collar picks up data every three hours, while collars on Glacier National Park bighorns record locations in five-hour intervals. Madison Valley elk carry collars set to take readings every 30 minutes, and due to the animals' larger size, the GPS units can carry a large battery that lasts a year. Mace extends battery life by setting his GPS units to shut down from November through mid-April, when the grizzlies are hibernating. Squires conserves battery power by programming the units on lynx to turn on only in winter and summer, when he is most interested in gathering information.

Encased in a plastic shell and mounted on a collar, the GPS and battery hang on the animal's neck below the chin. To pick up information from satellites, a small flat antenna pack sits on top of the collar in direct line with the sky. Interference from heavy timber, cliffs, or even the animal's body when it sleeps prevents the GPS from consistently recording

---

Becky Lomax is a writer in Whitefish.

fixed locations. Due to the dense forest where the animals frequent, collars on the Glacier wolverines pick up the animals' locations only 50 percent of the time, compared to a 98 percent recording rate for elk in the open Madison Valley.

The GPS collar stores data until biologists collect the device and download the locations, called waypoints. Small locking devices programmed to unlock at a specific time release the collar from the animal's neck. Biologists then use radio telemetry receivers to find the GPS collar, which contains a radio transmitter, and retrieve the data. More expensive GPS receivers, like the $5,000 models Mace uses on grizzlies, relay the waypoints to satellites and then to ground stations. The biologist accesses the data by computer to track and map a bear's current whereabouts and route since the previous reading.

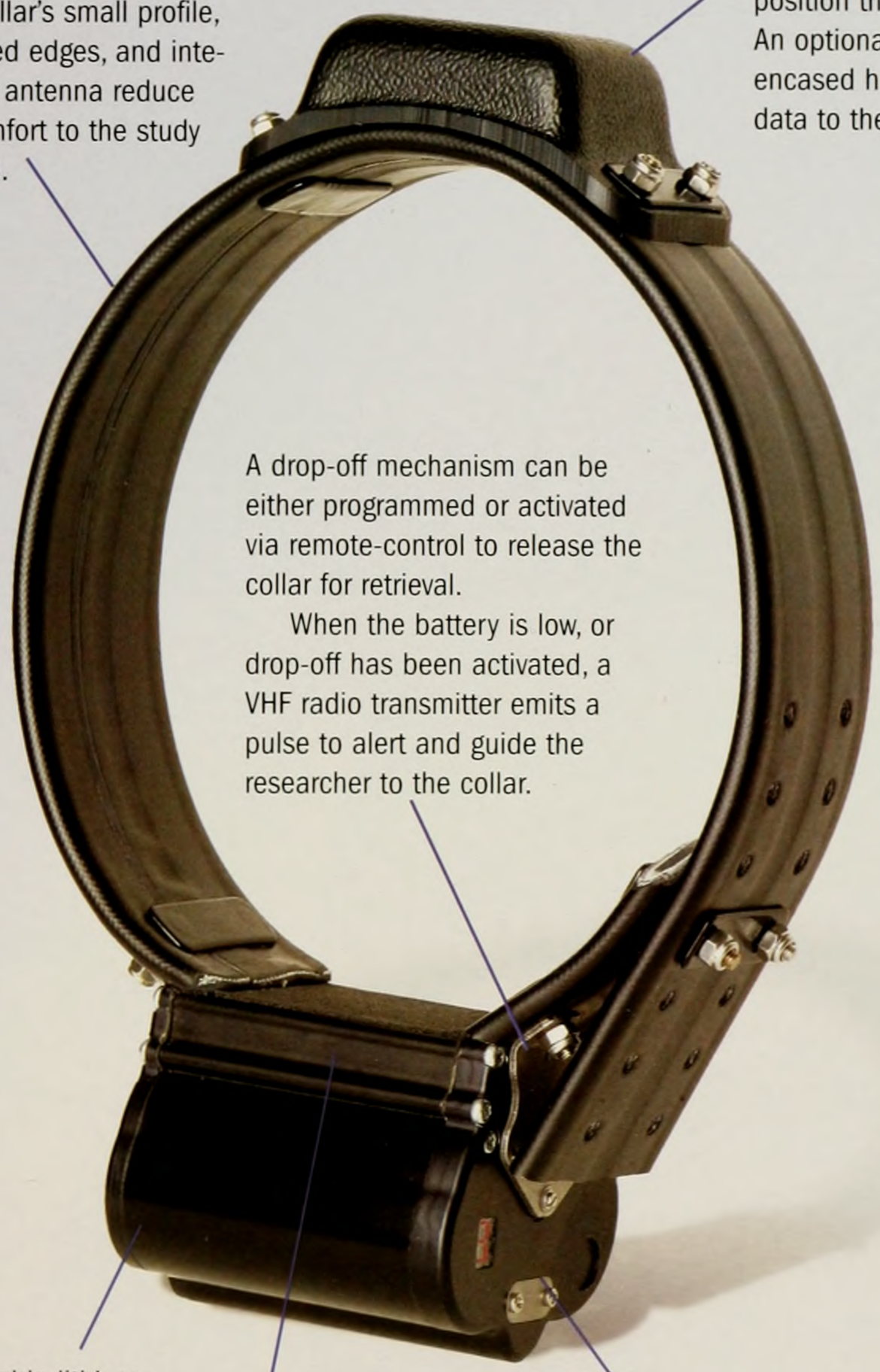
Getting a good fit

Biologists say trapping and collaring is one of the most difficult aspects of GPS tracking. No wild animal willingly submits to having someone cinch a plastic belt around its neck. Biologists use traps and then tranquilizers, or they drop nets on fleeing animals from helicopters, immobilizing the critters. Mace lures grizzlies into culvert traps or snares with deer road kill. While the bear is drugged, he fits a GPS collar snugly around its neck. As do researchers working on other species, he also takes advantage of the opportunity to gather hair, blood, and saliva samples, take measurements, and estimate age.

The collars must fit exactly. Too tight and the animal suffers; too loose and it will shed the hardware. Biologists help manufacturers devise collars that work for different species. Badgers, wolverines, and other mustelids, which have heads narrower than their necks, are especially difficult to fit. "One of the hardest parts about tracking wolverines is just getting the collars to stay on," says Rick Yates, lead field technician for the USFS studies. Mace's collars have to fit just right so the antenna stays on top. "You can't just slap any old collar on any bear," he says. The 25-inch collars are designed for female grizzlies at least three years old and 150 pounds or more. If a bear is too small, the antenna hangs askew and picks up fewer satellite connections.

Hi-Tech Wildlife Necklace

State-of-the-art GPS tracking collars provide wildlife researchers with accurate locations and other previously unobtainable information about study animals, even in remote locations. The collars, which can cost up to $5,000 each, make use of the same GPS technology found in units used by hunters, hikers, and drivers.



The collar's small profile, rounded edges, and integrated antenna reduce discomfort to the study animal.

The integrated GPS antenna keeps track of the animal's position through trilateration. An optional satellite antenna encased here can upload the data to the researcher.

A drop-off mechanism can be either programmed or activated via remote-control to release the collar for retrieval.

When the battery is low, or drop-off has been activated, a VHF radio transmitter emits a pulse to alert and guide the researcher to the collar.

A detachable lithium battery keeps the collar functional in temperatures as low as -30°F.

Sensors record temperature, activity, and mortality data. This information and position data are stored on an internal memory chip.

The data can be transmitted via radio frequency, text messaging (to a cell phone or e-mail message), or by satellite. Data can also be downloaded directly to a computer via a built-in USB port.

TELLUS GPS COLLAR PHOTO COURTESY OF TELEVILT

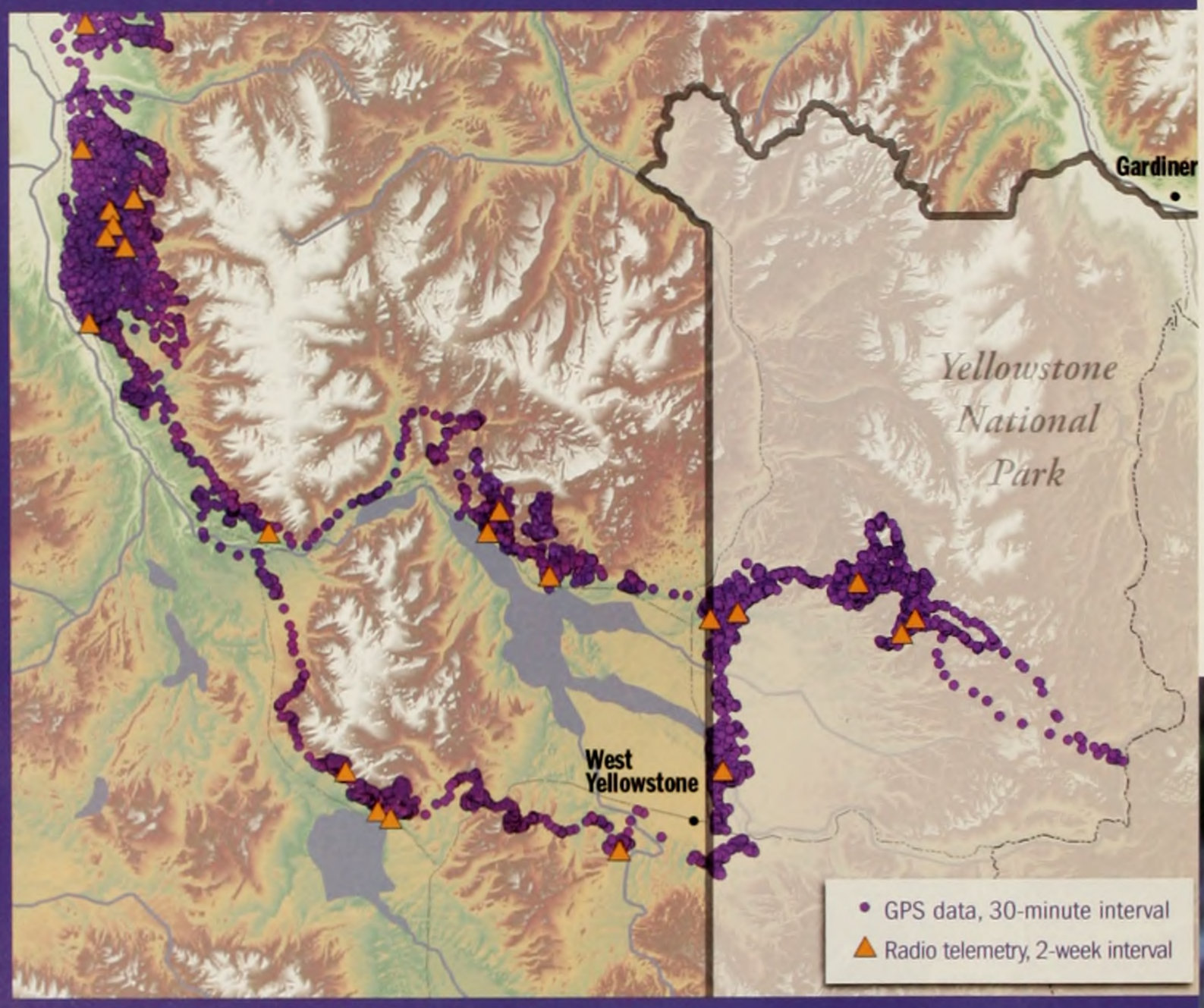
PJ DELHOMME / ROCKY MOUNTAIN ELK FOUNDATION

Animals can lose collars before the lock is supposed to detach. Grizzlies often try to wriggle free, and cubs sometimes chew them off their mother. Mace says he loses two or three per year. He can quickly tell when one has been dropped because the coordinates don't move. He then heads to the site and hones in on the collar using a handheld telemetry antenna that picks up the transmitter signals. One lost collar was detected almost immediately, near Glacier's Granite Park Chalet. The device was at the bottom of an old pit toilet where the bear had been poking its nose. Mace had it back in hand the next day, ready for another bear.

Where do they go?

Using GPS is the closest biologists can get to learning where an animal travels throughout a day, week, or year. After downloading waypoints from a retrieved collar, they enter the data into a computer software program that plots the animal's locations on a map. Each Madison Valley elk collar, for example, provided 16,000 locations over an 11-month period. Scientists see the rivers and mountain passes each animal crosses, which forest paths it takes, and where it spends summer and winter. The GPS data also shows when animals migrate, where they den or give birth, and where they feed. FWP and other agencies use the information to regulate both recreation and commercial uses to protect critical wildlife habitat. For example, if biologists see that a key deer wintering area is near a snowmobile trail, they may recommend rerouting the trail. Civil engineers use

Advantages of GPS tracking



MORE AND BETTER DATA For years, biologists relied on radio telemetry to track wildlife. The technology required getting to within 1 mile of the collared animal, either by hiking or using aircraft (top). By comparison, GPS tracking collars can be monitored from an office computer. The greatest value of GPS is the number of waypoints it records. The map above shows the difference between the few dozen waypoints logged by radio receivers on elk leaving Yellowstone National Park and the thousands of waypoints that GPS collars recorded.

ELK DATA FROM JAMIN GRIGGS AND DR. BOB GARROTT, MSU. MAP DATA GRAPHICS PROVIDED BY JULIE CUNNINGHAM AND KEN HAMLIN/MONTANA FWP.

GARY LEPPART

the data to protect wildlife migration corridors when routing roads and planning highway construction.

GPS units also reveal little-known behavior. Dr. Bob Garrott of Montana State University and FWP ungulate research scientist Ken Hamlin found that once elk leave the boundaries of Yellowstone National Park, they head to the safe confines of private land, which has less hunting pressure than national forests surrounding the park. Keating, the bighorn researcher in Glacier National Park, has confirmed that wild sheep shun dense woods. One bighorn, for example, followed an arduous mountain peak route rather than take a shortcut through heavy forest, where it would have been more vulnerable to mountain lions or other predators. Mace found that one grizzly did not emerge from hibernation until mid-May—two months after most bears wake up. And Squires confirmed the highly territorial nature of lynx. "They have inflexible boundary routes that are nearly set in stone," he says.

As GPS technology continues to improve and the hardware and batteries shrink, biologists soon will be able to track smaller animals. Some birds such as falcons and eagles have recently been outfitted with miniature backpacks carrying GPS transmitters. In fall 2006, Rob Domenech of Missoula's Raptor View Research Institute fit a GPS pack on an adult golden eagle to learn where it spent the winter.

GPS units and batteries are still too large and heavy to use for songbirds. But if the constant shrinking of personal computers is any indication, it won't be long before biologists will be able to track nearly any critter that flies, swims, runs, or crawls. That is, if they can figure out how to keep the darn collars from coming off.

For more information on Rick Mace's grizzly bear monitoring program, visit: http://fwp.mt.gov/wildthings/tande/monitoring.html. Additional information on bighorn sheep research in Glacier National Park is at http://www.nrmsc.usgs.gov/research/ungulate_research.htm. The study on wolf-elk interaction in the Greater Yellowstone Ecosystem is at http://www.homepage.montana.edu/~rgarrott/wolfungulate/project_description.htm.

BRUCE BECKER

WHERE TO NEXT? Tracking elusive species such as grizzlies has long been among the greatest challenges to wildlife researchers. GPS has been a godsend to wildlife science, and new technologies hold promise for even more accurate tracking.