

# SO THAT'S WHERE THEY GO

New **Motus technology** helps biologists learn where birds, small mammals, and even butterflies travel throughout the year.

By Sneed B. Collard III

of ever finding an inexpensive way to track the life cycle of birds and learn crucial information about their biology, habitats, and conservation needs.

Then came Motus.

#### SMALL ENOUGH FOR A BEE

Motus relies on two components: tiny radio tags affixed to birds, mammals, and other animals, and receiving stations that pick up signals from the tags as the animals move past. Biologist William Blake, formerly of the MPG Ranch in Montana's Bitterroot Valley, is now the American Bird Conservancy's Pacific Northwest Motus coordinator. "The way Motus works is there's an embedded signature in each tag very similar to a Morse code that tells you exactly which bird you're listening to," Blake explains. "That way, you can tag thousands of birds in one area and Motus can pick them all up at the same time."



**PING, PING, PING** Key to the Motus Wildlife Tracking System are a series of stations fitted with antennae that pick up the unique signal of each tagged bird that flies past.

first spot it from half a mile away—what looks like the TV antenna that jutted up from our family's roof when I was a kid. But as Montana Fish, Wildlife & Parks Motus technician John Kuntz pulls up to the structure in his pickup, I see a glinting, 30-foot-tall steel pole supporting three long aerials. This modest metal structure, it turns out, is key to one of the most important wildlife research and conservation breakthroughs in decades—a technology called the Motus Wildlife Tracking System.

Motus (Latin for "movement") was developed by the conservation organization Birds Canada in collaboration with dozens of international scientific research partners. Launched in 2013, the system allows scientists to gather critical but previously unobtainable information on the movements of birds and other wildlife species.

Traditionally, tracking animals has been time-intensive, expensive, or both. For decades, scientists have attached VHF transmitters to animals and then, using hand-held receivers that beep when the subject is nearby, spend days, weeks, or months following them on foot or in vehicles trying to learn where they go. During

the past two decades, scientists have outfitted animals with expensive transmitters that communicate via GPS satellites and allow them to follow wildlife movements with far more precision.

Unfortunately, both methods require large, bulky transmitters—like those on elk neck collars—that are too heavy for smaller animals, including most birds. Besides their high cost, some satellite tags also require researchers to recover the devices to retrieve the data. Tracking efforts often fail when an animal dies or its tracking unit is damaged or lost. This has forced biologists wanting to gather bird movement information to capture birds and fit them with multi-colored leg or neck bands unique to each individual. They release each banded bird hoping that someone will later spot and report it and its location.

That doesn't happen too often. Most of the reported birds are those that return to the original banding locations year after year, something that doesn't provide information on where they've been in the meantime. Only occasionally do scientists get lucky enough for a banded bird to be sighted or recaptured elsewhere.

For decades, wildlife biologists despaired

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PHOTOS: SWITSONMAN'S NATIONAL ZOO & CONSERVATION BIOLOGY INSTITUTE



#### MIGRATION TRACKER

A Sprague's pipit outfitted with a Motus tag is ready for release.

Equally revolutionary is the tiny size of Motus tags, says Dr. Andy Boyce, a research ecologist with Smithsonian's National Zoo and Conservation Biology Institute. He explains that a transmitting device placed on a bird can't weigh more than three percent of the bird's total weight. "That creates a major problem for the vast majority of passerines [songbirds and other perching birds] that weigh under 100 grams, because satellite tags are too big and heavy."

Motus tags, though, can be light enough to attach to any songbird—as well as to bats and even dragonflies, butterflies, and bees.

Of course, without a way to detect them, the tags are pointless. That's where the receiving stations come in.

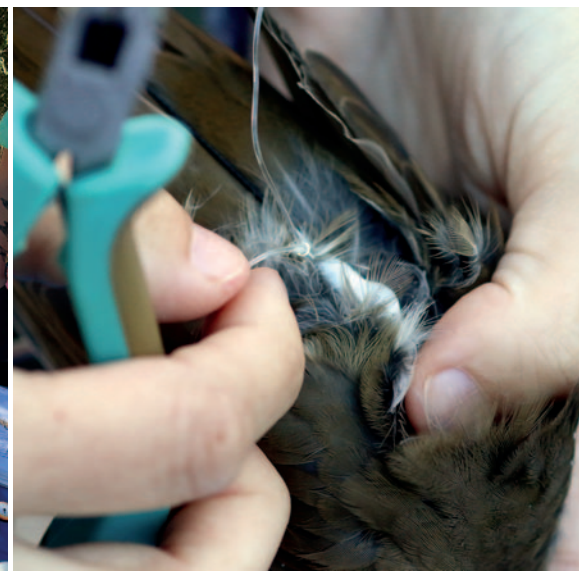
#### DETECTION STATIONS

I follow Kuntz up a steep hill for a closer look at one of FWP's first receiving stations—one of two the agency erected to monitor experimental sharp-tailed grouse populations in parts of western Montana. Kuntz explains that each of the three aerials on this station, located between Drummond and Helmville, points in a specific direction and can detect a sharptail's Motus tag signals as far as 12 miles away.

Received signals pass from the antenna down through cables into a waterproof box that houses a computer circuit board—what Kuntz calls the brains of the system. From there, data are stored and periodically transmitted via cellphone networks to the Motus center of operations in Canada. In remote locations such as where we are standing, solar panels power the entire setup. But Motus stations can also be installed on buildings, telephone poles, and other locations



**TAG TEAM** From left to right: A crew including Megan Fylling, research director at the University of Montana Bird Ecology Lab, fits a Motus tag harness to a Wilson's warbler and a Swainson's thrush.



#### Attaching the tag

A Motus tag consists of a transmitter and an antenna. To equip a songbird, scientists create a kind of "saddle," attaching the tag to two soft, thin plastic loops cinched around the bases of the bird's legs, with the tag sitting on its back. Batteries in bird tags can last a year or longer. Solar-powered Motus batteries extend the life of the tags even more. If a tagged bird lives long enough, the plastic loops eventually decay and the tag falls off after a year or so. Tags for bats and insects are much smaller, and are attached to the animals using glue or thread. These tags have smaller batteries that operate for only a few days or weeks. They fall off as the glue decays, or in the case of bats, when the animal's hair grows out or is replaced. ■

that have easy plug-in power options.

The Motus tracking system doesn't work well without a lot of receiving stations. The technology was first used on a wide scale in the eastern United States, where today there are hundreds of stations. The West, meanwhile, has been working to catch up. The privately owned MPG Ranch set up more than 30 stations in and around the Bitterroot Valley. Recently, FWP has committed to building 50 stations using state marijuana tax revenue, part of which is earmarked for nongame wildlife conservation.

FWP hired Kuntz, whose background with bats, birds, and other wildlife, plus skills with construction and technology, made him ideal for the job. Kuntz built the agency's first Motus radio receiver, the one he and I are visiting, and has been watching to see whether the technology can monitor the

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sharp-tailed grouse recently reintroduced in western Montana (see “West Side Story,” March-April 2022 *Montana Outdoors*).

An even bigger priority is to create a series of Motus stations across eastern Montana. That would help fill in the vast empty regions without any Motus coverage in much of the Intermountain West. Though Idaho, Utah, and Colorado have some stations, a bird can easily follow the Central Flyway from northern Canada to Mexico without setting off a single ping in the current network.

According to Allison Begley, FWP avian conservation biologist, the department in 2024 will begin building a series of Motus stations from Butte to the North Dakota border along the Interstate 90 corridor, much of which follows the Yellowstone River. What's being called the “Yellowstone fence” of stations will detect any bird with a Motus tag moving north or south through Montana's eastern half and support several wildlife studies, including

one of Montana's top conservation priorities: grassland birds.

#### PRAIRIE EPICENTER

The 2022 State of the Birds report released by the U.S. North American Bird Conservation Initiative revealed that almost every group of North American birds has suffered steep declines in the past 50 years. The hardest hit have been grassland birds, whose populations have declined by one-third (34 percent) over the past 50 years. Montana is vitally important for many of these species, including the Sprague's pipit, chestnut-collared longspur, and Baird's sparrow.

Boyce, the Smithsonian ecologist, studies grassland bird breeding and survival in northeastern Montana. “This is the epicenter of grassland bird diversity in the United States,” he says. “The intact prairie and grasslands that we are fortunate to still have here are the stronghold for the most imperiled grassland birds in North America.”

Key to protecting these species is understanding their movements during migration and when they arrive on their Montana breeding grounds. Blake, with the American Bird Conservancy, says that federal, state, and private conservation programs protect many of those critical spring and summer habitats. “But understanding how individual birds migrate and behave outside their breeding grounds shows us other critical threats and conservation needs,” he explains. “You

can't adequately manage healthy populations if you don't understand where individuals go for half or three-quarters of the year.”

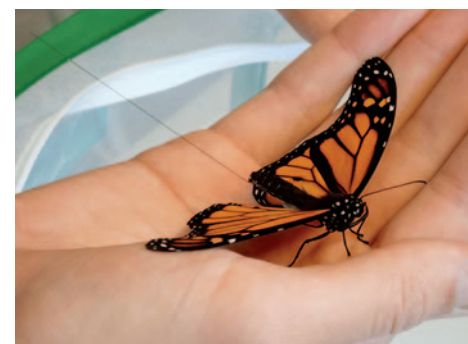
Until recently, grassland birds have been difficult to track. They move around a lot, even during breeding season, and they hunker down out of sight in tall grass. It doesn't help that they are the color of that grass.

“They also don't return to the same place each year,” Boyce says. Historically, prime breeding habitat locations changed from year to year due to prairie fires, bison move-

ment, or drought that altered vegetation height and composition. “Because ideal habitat for, say, a Baird's sparrow, is shifting constantly, these birds evolved to go where the good habitat is every year.”

Motus helps track even these constantly relocating birds. Boyce and doctoral student Nancy Raginski have tagged more than 200 Sprague's pipits and other grassland birds since 2021. In northeastern Montana, they have set up a dozen Motus stations to track the regional movements of

Motus tracked a Baird's sparrow from its release site in southwestern Saskatchewan on June 16, 2022, through Montana to a station at Fort Collins, Colorado, on August 11, 2022.



**TINY TRACKERS** Minuscule Motus tags are attached with glue to butterflies and bumblebees. Previously, scientists could only guess at where these and other insects flew during migration.

CLOCKWISE FROM TOP LEFT: SNEED COLLARD; SNEED COLLARD; MOTUS; DR. ANDY BOYCE; WIKIPEDIA; DAVID LAMON/MAINE AUDUBON



## Situating the stations

A lot of work goes into installing a single Motus station, much less the more than four dozen that FWP is planning to install along the I-90 corridor from Butte to Glendive. To work correctly, each station requires line-of-sight “viewsheds” where mountains or other objects won’t interfere with signals transmitted by birds. Remote sites need enough sun exposure to power solar panels even in winter. They also need enough cellphone coverage so that data can be transmitted from the station.



This station, which FWP Motus technician John Kuntz built himself, was a challenge to situate. “There’s no cell service in this valley below us,” he says, “so I had to consider the viewshed, the cell coverage, and whether or not I could even reach it by road during various times of the year.”

After testing dozens of locations, Kuntz finally found a sliver of cell reception at the site, north of Drummond. “Thank goodness for this place, because I think that rock,” he says, pointing to a spot 10 yards below us, “is where the cell coverage drops.”

Fortunately, finding sites in eastern Montana has proved much easier. In fact, Kuntz spent most of 2023 locating dozens of potentially functional Motus sites for the Yellowstone fence and other station locations. This will greatly speed the process of installing stations in 2024. ■

these birds. FWP’s planned Motus station infrastructure will vastly boost their research results and scope.

While the current stations in northeastern Montana can tell Boyce and other researchers what birds are doing during breeding season, once the birds leave they may not get detected again. The FWP Yellowstone stations, scheduled for completion in 2024, should help close that information gap. “Getting that data from the FWP stations during migration is especially important for our ability to estimate survival probability, because that’s when most birds are killed by predators, collisions with power lines, and starvation or exhaustion,” Blake says.

### BRANCHING OUT

FWP biologists are now setting their sights on other species in other areas. “The next place we’re considering is the Rocky Mountain Front, to learn where aerial insectivores like swallows and nighthawks—which we don’t know much about—are moving as they travel north and south,” says Begley. Montana’s new Motus network will also be used to support research on bats, butter-

flies, and small mammals too tiny to track with traditional means.

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That expansion will benefit not only FWP scientists but also those throughout the Western Hemisphere—all of them trying to figure out what routes migrating wildlife follow and which habitats are most critical and need protection. The more stations that are added to the Motus network, the greater the benefit to the entire scientific community—and to the animals themselves.

One of the technology’s best features is

that the information it captures is available to anyone. As I was winding down my visit with Kuntz, he turned on his laptop to see if any new “hits” had been detected by a new FWP Motus station in Miles City. Kuntz told me the station had previously detected one Baird’s sparrow and one chestnut-collared longspur as the birds were beginning their migration south. “Let’s see if it has picked up anything else,” he said, logging onto the Motus website run by Birds Canada, then to the Miles City station, where he clicked on a table of detections.

“A Sprague’s pipit!” he said. “That’s one of Andy Boyce’s birds!”

Nothing could have better affirmed both the utility of Montana’s new Motus network and the wisdom of investing in it. Boyce had tagged the bird on June 7, 2023, near Zortman, and now, 107 days later, Motus indicates it’s winging its way south past Miles City. To top it off: Kuntz learned all this from a windy hilltop more than 400 miles away. 🐦

*See how Motus works by visiting [motus.org](https://motus.org). Zoom in on the map and click on the station of interest to see which birds and other wildlife it has detected and when.*

## Following bird #37809’s journey across the Great Plains

To appreciate the power of Motus, all you have to do is look at the journeys of birds that have been tagged. Take #37809, a Sprague’s pipit equipped with a Motus tag on its breeding grounds at the American Prairie Reserve. The Smithsonian team tagged the bird on July 14, 2022, and through October 8, the pipit was detected dozens of times by the Motus stations in northeastern Montana. After October 8, #37809’s transmitter fell silent—only to show up a week later near the Kirwin National Wildlife Refuge in northern Kansas.

After that, the bird disappeared. It could have reached its wintering grounds in Mexico or the southwestern United States, beyond the reach of any other Motus stations. Or its tag could have failed. Or the bird could have been killed by a predator or exhaustion.

Six months later, however, on April 14, 2023, stations in central Kansas picked up the pipit again. Only 11 days—and 800 miles—later, it was back on its breeding grounds in northeastern Montana. All told, Motus stations detected the bird more than 140 times while its tag remained active, providing remarkable details of one Sprague’s pipit’s movements and life cycle.

As Montana’s Yellowstone Motus “fence” takes shape, and as other stations go online across the continent, scientists will get the most complete pictures yet of some of our most fascinating and imperiled bird species.

Check out #37809’s amazing journey by visiting <https://motus.org/data/track?tagDeploymentId=37809>. ■

