

## Tracking the Great Outdoors

**From cacti to deer and tortoises, RFID is helping park and game managers monitor and protect precious natural resources.**

By John Edwards

Oct. 13, 2008—Sprawling across the scorching Sonoran Desert on the outskirts of Tucson, Ariz., [Saguaro National Park](#) is home to a forest of 1.6 million saguaros—giant cacti found nowhere else on Earth. The iconic plants, living symbols of the U.S. Southwest, are increasingly threatened by encroaching civilization, as well as a variety of natural diseases and predators. "You might think that something that can live to 150 years and stand over 25 feet tall wouldn't need much protection," says Chief Ranger Bob Love, "but you would be wrong."

Love is one of a growing number of nature and wildlife experts who are hoping that radio frequency identification technology can help them get the upper hand in a never-ending war against thieves, vandals and the forces of nature itself. While RFID isn't destined to replace other popular wireless tracking technologies, such as terrestrial radiolocation and GPS, the technology has unique attributes that make it an attractive tool for monitoring natural assets—both living and geologic—over extended periods of time at a relatively modest cost.



The cacti of Saguaro National Park are increasingly threatened by encroaching civilization.

Government agencies, conservation groups and other outdoors-focused organizations are discovering that RFID-based monitoring and tracking systems provide a great deal of versatility. Some RFID applications include the tagging and tracking of endangered species to determine how environmental changes are affecting their habitats. Other projects, such as the one at Saguaro National Park, are security projects designed to keep precious on-site assets safe. Still other outdoor projects aim to control and manage herds, or to answer questions about local geology.

"RFID can monitor a variety of activities and trends within an environment, as well as ensure that something doesn't suddenly appear in a place where it isn't supposed to be," says Chris Parkinson, president and CEO of [Integral RFID Services](#), a Richland, Wash.-based company that specializes in RFID wilderness applications. "The number of potential uses is quickly expanding, showing that RFID has a wide number of outdoors applications."

### **Prickly Project**

Love believes that RFID can help Saguaro National Park hold on to its namesake, and highly sought after, cactus. He's planning to inject tags into selected saguaros in an effort to reduce the number of stolen plants that end up decorating yards and business properties in growing desert cities, such as Phoenix and Las Vegas. "A single six-inch cutting can be worth up to \$25," Love says. "Larger specimens will sell for far more."

The park started thinking about using RFID as a security technology shortly after 17 saguaros were stolen in January 2007, the second such theft in recent years. Saguaros are attractive to thieves because of their high demand and extremely slow growth rate. It takes about 75 years for a saguaro to sprout its first branches, or "arms," and about a century to reach a height of 25 feet. "Since some people don't have the patience to wait for a saguaro to reach maturity, and aren't willing to purchase them through a legitimate commercial source, they think it's just easier to come here and take them," Love says.



In the Mojave Desert, desert tortoises are tagged in an effort to observe how changing habitats and human encroachment affect their behavior and reproduction rates.

Love says the park's project, which is set to get under way in early 2009, will be launched with a media campaign that alerts people to the fact that stolen cacti may be identified by rangers using both handheld and fixed readers. "We hope this knowledge alone will deter people from taking cactus," he says. "Still, if we saw a truckload of saguaro headed down the road, we could take a handheld reader and scan the load for tags."

Love says the system's overall cost is relatively modest. The PIT (passive integrated transponder) tags, supplied by [Biomark](#), a Boise, Idaho, company that primarily specializes in veterinary and livestock RFID solutions, cost about \$4.50 each. The handheld readers cost about \$600, while larger and more accurate fixed models are priced at about \$2,500. The park plans to buy one fixed reader for each of its districts—east and west—as well as several handheld units.

Other federal wildlife sites also have an interest RFID-based security. The [Lake Mead National Recreation Area](#) in Nevada was the first to use the technology to track cacti. The [U.S. Fish and Wildlife Service](#), meanwhile, places tags in antlers shed by elk near Jackson Hole, Wyo., where picking up antlers is illegal. "The technology is finding a variety of applications," Love says. "It's very promising."

### **Tortoise Tag**

Saguaros aren't the only desert inhabitants getting tagged. In the California and Nevada Mojave Desert, a project commissioned by the [U.S. Geological Survey](#) (USGS) involves tagging desert tortoises in an effort to observe how changing habitats, as well as human encroachment, are affecting the slow-moving reptiles' behavior and reproduction rates.

The Mojave's desert tortoises, which measure about nine to 15 inches long and can live up to 100 years, have reached "threatened" status in several areas, observes John Lund, a manager at [Bentonville International Group](#) (BIG), the company that's supplying the project's RFID technology. "Monitoring tortoise activities is vital to determining how they are coping with changes," he says.

The USGS has been tracking desert tortoises for several years, but antiquated RFID technology has hindered researchers' efforts to generate the detailed data they need



to get a complete view of the creatures' activities. BIG is providing the agency with BIGViz PAK, a system that features a mobile, "man-packable" RFID tracking and data collection unit and a tagging system designed specifically for wildlife tracking.

Lund notes that the system includes both passive and active RFID technologies. "For the active side of the solution, we are using RF Code tags and mobile readers," he explains. "For the passive side of the solution, we are using a variety of Gen 2 UHF tags along with an Alien reader and antenna."

According to Lund, BIG's system will help the USGS obtain data on a larger number of tortoises within a shorter period of time. "Their current system uses lower frequency transponders that operate on a single frequency," Lund says. "With the old system, each tagged tortoise has a unique frequency and the transceiver can only be set to one frequency at a time. Therefore, only one tortoise may be tracked at a time."

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BIG's technology addresses this limitation by placing all monitored tortoises on a pair of frequencies—433 MHz and 915 MHz—and enabling them to communicate via Unique Identification codes (UIDs). "Therefore, at any given point in the desert, the system can show any tortoise within range of the system," he says.

Lund describes the approach's potential benefits as immense. "Think of the size of a search area measuring five square miles," he says. "If you intend to locate 100 tagged tortoises, when you can only receive a signal from one tortoise at a time, how many man-hours would this require?" Lund says the project's goal is to reduce the number of man-hours required for large tracking projects by 70 percent to 80 percent compared with the current system. "That's an immense productivity improvement that's only achievable with state-of-the-art RFID technology," he says.

### Deer's Ears

Not all outdoors-oriented RFID projects are designed to preserve the natural status quo. Some initiatives, for instance, are aimed at ensuring that wildlife in artificially beneficial environments don't spiral out of control. Such is the case at the [Mianus River Gorge Preserve](#) in suburban Bedford, N.Y., where an exploding white-tailed deer population, which faces few natural predators, is endangering the local surroundings as well as their own welfare. "The deer's eating habits are changing the forest drastically, and not for the better," says Preserve Manager Mark Weckel.

In an effort to control their burgeoning deer population, preserve supervisors recently turned to archery, the community's only legal form of hunting, as a way to thin out the herd. Yet the jury is still out on whether bows and arrows, a generally inefficient hunting method, can make a significant dent in the local white-tailed population. Weckel and the preserve's directors are counting on RFID to provide the answer.

The study, which got under way in mid-2008, aims to determine whether the deer being killed (such as young females) are the ones most likely to contribute to rampant population growth, and if overall deer numbers are actually declining. "Since white-tailed deer have no natural markings, RFID is the best way to identify specific animals," Weckel states. Unlike other tracking approaches, ranging from paint marking to terrestrial radiolocation collars, RFID tags can't wear off or fall off.

To attach an ear tag, Weckel uses a dart gun to anesthetize the deer. "It takes time, but it's the safest method and ensures that the deer isn't hurt during tagging," he says. So far, he has tagged 19 deer with 433 MHz RF Code active tags; he hopes to tag an additional 10 to 15 during the next year. As the system amasses data, Weckel intends to track the deer's movements, study their social relationships and analyze survival rates to definitively understand whether the archery program is achieving its herd control goal. "It's an answer we need to know in order to protect the preserve as well as its deer population," he says. "RFID happens to be the best tool for the job."

It also happens to be the most cost-effective approach, notes Weckel. It costs less than \$100 to tag each deer, including the dart, tranquilizer and tag. "Compare that to GPS," he says. "Sure, it can provide you a wealth of data in real time, but at a collar cost of about \$5,000 to \$6,000 apiece—that's a bit outside my budget range."

## Natural Obstacles

Despite its operational and cost benefits, RFID can present some unique and unusual surprises when used in an uncontrolled outdoor environment. Tags can be torn off, crushed—even eaten and carried away (temporarily) in a predator's stomach. "One surprising roadblock we found was the interaction of the tortoise shell and the passive tags," BIG's Lund says. Project managers discovered that keratin, a tough, fibrous protein found in tortoise shells, can insulate some types of tags from RF signals. Fortunately, the problem wasn't insurmountable. "Although we're still testing this, we believe the use of six-inch wire tags will provide the near field range we desire," Lund notes.

Fortunately, surprises like tortoise shell shielding are rare. Most of the headaches associated with using RFID in the great outdoors tend to be mundane and preventable. In fact, nearly all hardware problems can be traced to the fact that most manufacturers design their systems for use in comparatively benign commercial environments, such as warehouses and on loading docks. But in the desert, where summer temperatures may soar as high as 120 degrees Fahrenheit (49 degrees Celsius), or in perennially damp environments such as wetlands and seaside locations, tags and readers can falter or fail due to extreme environmental conditions.

Getting RFID to work in the wilderness requires careful planning and a certain amount of "wiggle room" to account for tags that may eventually become either inoperable or simply lost in action. "Although there may be some similarities, tracking an animal in the wild isn't directly analogous to monitoring livestock inside a monitored corral," observes Integral RFID's Parkinson, whose company's systems are used to monitor everything from polar bears to beehives. He recommends that potential adopters pay close attention to manufacturers' spec sheets and be realistic about the environmental demands a proposed project will place on RFID hardware.

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Nonetheless, as more organizations begin using RFID in the great outdoors, environment-related headaches are gradually diminishing. "Manufacturers and solution providers are beginning to produce a greater number of rugged RFID devices specifically designed for use in natural environments," says Lund. "The situation is getting better all the time."

That's good news for Love, as he looks to keep his precious saguaros firmly rooted in his park's desert soil. "RFID technology is definitely ready for use in this environment," he says. "It's a fact we want would-be thieves to be aware of as well."



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