Taylor is headed toward the research site she and her advisor, Arizona State University professor and veterinarian Dale DeNardo, have staked on acreage adjacent to the Tortolita Mountains. Earlier in the week at their ASU laboratory, the two scientists had anesthetized the snakes and inserted a transmitter under each animal’s ribs. Each broadcasts a beeping signal at its own unique frequency. Using a receiver, Taylor and DeNardo can locate the snakes in the field by following the signals.

Radio telemetry—which emerged in general use in biology in the 1960s and reptile research in the 1980s—has caused seismic changes in reptile studies. Just imagine trying to find the same snake twice.

In the past, researchers marked rattlesnakes by painting (or injecting, as Taylor and DeNardo were the first to do) their rattles with acrylic paint in coded patterns. That helped them to recognize a snake if and when they were lucky enough to find it again.

To reveal patterns in animal behavior with any reliability, studies must gather data over time from individual animals in their natural environments, away from the laboratory conditions that can cause uncharacteristic behavior. Radio telemetry allows scientists to find an animal even when it moves to a new location.

Other new tools include the global positioning system (GPS) and passive integrated transponder (PIT) tags—.injected microchips that give each animal a scannable bar code like cereal boxes in the supermarket. Conceivably, scientists could use radio telemetry to observe an individual rattler from the time it was big enough to accommodate a lipstick-sized radio transmitter until it died.

A well-graded road into the research site soon yields to a heaving trail. Geared into four-wheel drive, Taylor’s truck bucks its way to a wide space in the track. She parks beneath heavy... is just before dusk, the moment when shadows define the contours of desert rock that appear two-dimensional in midday sun.

Early morning and dusk are prime tracking times for diamondbacks and Gila monsters, a side interest for DeNardo and Taylor. May to September are the busiest months for desert creatures. ... through gravel to search for some of the more than 20 diamondbacks and Gila she and her advisor are following.

Taylor’s field is behavioral neuroendocrinology. She studies how hormones trigger an animal’s brain to command specific actions, such as breeding. “The field is so young,” says Taylor, “that in 10 years we’ll laugh at what we think we know today.”
Scientists and DeNardo are investigating snake biology on several levels. First, they want simply to document the basic ecology and habits of the rattlesnake. Scientists still have fundamental questions to answer about the rattlesnake. Virtually nothing, for example, is known about its denning behavior. Why do animals that hunt and sleep alone aggregate in dens when hibernating? Why do researchers find mainly large, mature males in those dens? Why do young and small males seem not to be included?

Second, the ASU scientists want to compare individual diamondbacks within a geographic population. As other researchers compare individuals of other rattlesnake species, generalizations will emerge, eventually allowing scientists to compare the various species from an evolutionary perspective.

Third, once they fully explain the basic reproductive biology of the diamondback, they want to pinpoint how snakes allocate energy to reproduction. And finally, while it is not an immediate goal, Taylor and DeNardo do keep a research eye open for evidence of how snakes’ allocation of energy in reproduction differs from what mammals do.

“The interesting thing about the mammal-reptile comparison,” says Taylor, “is that most research in behavioral neuroendocrinology is on mammals—mostly lab mice and rats. Studying reptiles opens the door for a perspective on the evolutionary transition from reptile to mammals.”

The focus of Taylor’s doctoral research lies in the third area: how hormones in the female diamondback trigger breeding and the energy expenditure that fuels it. The key is fat.

“In any female animal, fat is crucial to reproduction,” Taylor says. “If an animal is undernourished due to drought or other stressors, she won’t attempt to breed that season. Because breeding would divert fat from supporting her life systems to manufacturing yolk for her eggs.”

An extraordinarily lean female—including highly conditioned female athletes with minute quantities of body fat—may not even enter puberty. But what precisely happens in a female’s brain that tells her she has fat enough to breed and can welcome a male’s courtship?

Taylor and DeNardo suspect that a hormone called leptin is involved. Scientists know that leptin in mammals helps to regulate eating and reproductive events. And while they know that reptiles produce leptin, exactly what function the hormone plays in the reptile body is unclear.

However, in mammals, the fatter the animal the more leptin is found in the bloodstream. In fact, leptin issues from fat cells. The hormone is tightly involved in many physiological functions. It “informs” the brain of the body’s condition—that is, how much fat it has stored.

When it detects high quantities of leptin, the hypothalamus area of the brain signals the body to decrease feeding and increase thermogenesis (the production of heat, which uses energy). When leptin is low, the hypothalamus directs the body to increase feeding and decrease thermogenesis (thus conserving energy).

Researchers have demonstrated that leptin allows female mammals to menstruate and ovulate, and that it seems to trigger different effects in males and females. Does it also signal a female mammal to breed? And does this happen in rattlesnakes as well as gray wolves and human beings?

To answer these questions, Taylor and DeNardo spend four to five days per week at the field research site, tracking their tagged reptiles. Fieldwork in the Sonoran Desert requires the biological equivalent of “when in Rome...” The researchers surrender to the rhythms of the desert and live like lizards: stalking prey in the cool morning and evenings, sneezing and swimming at a nearby RV park in the midday heat.

Typically, either Taylor or DeNardo arrives at the site in late afternoon, tracks the animals until about 5:30 p.m., sleeps under the stars, and rises to track again with the sunrise. The goal is to follow the animals through a season’s hibernation, which occur in August. By November, the rattlesnakes will retreat to dens for the winter. Each time they recapture an animal, the researchers weigh it. By comparing a female’s pre- and post-birth weights, they begin a complicated process that calculates how much fat and protein snakes invest in their offspring. Taylor spent much of 1999 refining this calculation, and says it looks promising.

Two knots start the research question. Considered alone, a female’s gain or loss of weight does not demonstrate how much energy she has invested in reproduction. Exercise or diet rather than pregnancy might have created the weight change. Moreover, the researchers need to know how much of the weight change is protein versus fat.

To find out, Taylor and DeNardo are using on snakes a technique often used to measure body fat on humans. Called bioelectrical impedance, the method relies on sending an electrical signal through the body. The signal travels at different speeds through fat and lean body mass (protein). After some number crunching, this information allows researchers to approximate the animal’s lean body mass.

By subtracting lean mass from total weight, they find the animal’s fat percentage. After factoring in information on the animal’s movements (her exercise quotient) and the habitat’s food supply (her diet), Taylor and DeNardo will be able to estimate how much body fat energy the female has funneled into procreating.

Every three to four weeks, the researchers draw blood from the reptiles. After spinning the blood in a centrifuge to separate red cells from plasma, Taylor and DeNardo return the plasma to their lab, where they freeze it. During the winter Taylor tests the samples to fix hormone levels.

Taylor’s highest priority on this field visit is a female diamondback that she has been trying to catch above ground and bleed for three weeks. With reptiles, the question is always, is the animal up? Or down in a burrow?

Sophisticated radio equipment may pinpoint an animal’s location, but nature’s whims prevail: if a rattler or Gila monster is cut out in a burrow, Taylor cannot just ring the bell and ask to borrow a cup of sugar.

Holding her radio receiver aloft, Taylor strikes out from her truck toward the base of a butte where Gila monster number 5 has been holed up in a wood rat’s nest. Wood rats are important food sources for diamondbacks, and one of the rattlesnakes’ common hunting strategies is to ambush the rats when they emerge from their burrows. Having consumed the occupants of a wood rat burrow, the reptiles also establish squatter’s rights in the cool tunnels, hiding in them during the heat of the day.
long. “Oh look at you, bad boy,” says Taylor, “you are a beautiful boy.” She rushes toward the snake, which tries to escape into the brush.

But rattlesnakes are slow. They can crawl at no more than three miles an hour. Taylor swiftly clamps her tongs around the snake’s body, holding it at full arm’s length. The animal goes vent to the defensive displays that are its natural arsenal against predators: the muscled cylinder of its body thrashes, the hollow segments of keratin that compose its rattles clash furiously against one another; it gapes its pink cave of a mouth and hisses, foul-smelling emissions seep from its cloaca.

With her right hand controlling the tonged snake, Taylor uses her left to bring the tube toward the viper’s head. Again and again the snake strikes the plastic with sharp snaps, making onlookers grateful that it is not Taylor’s shin being struck.

She is trying to lure the diamondback into the tube, and finally, in it goes, shooting about half the length of its body into the plastic pipe. Now Taylor grips in one hand the tube and the tail end of the snake. The tail hangs free, while the menacing head is encased by the wedging of the rattlesnake’s body into the tube. “The snake could turn around in the tube, shoot back out and get your hand,” Taylor explains. “Never take your eyes off a tubed snake.”

Scientists speculate about why snakes will enter the tube. “It may remind them of heading into a burrow to escape a predator,” says Taylor, “so maybe it’s an instinctive defensive move. They’ll fight going in, but sooner or later they all do.” Besides, she says, “They’re not super bright. The tube is in the forward direction, and eventually they just go forward.”

With her free hand Taylor pulls a syringe from her pack and bites the cap off the needle. The intern takes the tube, and Taylor works the needle into the snake’s smooth posterior skin, seeking...
“Rattles are not to be trusted,” wrote Laurence M. Klauber, author of the 1,500-page standard text on rattlesnakes, “for some violate all rules.”

A rule breaker indeed is Lucifer the Jumping Snake, who got his name when he licked Emily Taylor in her laboratory at ASU. That’s the thing about interacting with the animals, sometimes, they get bitten. One of Taylor’s standing jokes is to fold down her middle fingers to demonstrate the herpetologist’s two-digits-lacking handshake.

The accident with Lucifer happened when the snake behaved uncharacteristically as Taylor was coaxing him into a tube.

“He jerked his head out,” Taylor says, “and sprang up to bite my hand. Usually the snake won’t behave this way. He’ll strike the tube, because it’s the closest thing to his face, or sit in defensive posture. But the term ‘usually’ should never be applied to venomous reptiles.”

Nature is never entirely predictable; forgetting that in Lucifer’s case, says Taylor, was her mistake.

Worldwide, several hundred thousand people per year receive venomous snake bites, and of those, some 20,000 die, according to Harry W. Greene, author of Snakes: The Evolution of Mystery in Nature and Taylor’s undergraduate advisor at the University of California, Berkeley.

Most deaths occur in Third World countries with poor access to medical treatment; properly treated, snakebites in developed countries cause death in less than 1 percent of victims, says Greene.

In the United States, most bites occur when untrained young men sacrifice sense to testosterone and handle snakes in the wild. Some victims die simply because they refuse medical care. Of nine fatalities in Arizona in recent years, three befell victims who refused treatment.

Almost all the old folk remedies for snakebite are useless or dangerous, according to toxicologists. Laymen on the scene should not cut into a bite wound to suck out venom, nor apply a tourniquet unless a physician says to.

Toxicologists universally agree that the best first aid for snakebite is to keep the victim calm and warm to prevent shock, and to seek medical help immediately. In Taylor’s case, she received standard antivenin treatment.

“At first I thought it was a dry bite,” she said of Lucifer’s strikes, meaning that the snake injected no venom, which is the case in up to 25 percent of bites. “But the swelling began after about five minutes and I knew I had been envenomated.”

Although many victims report feeling a swift surge of pain as soon as venom enters the bloodstream, Taylor’s arm did not hurt until about four hours after the bite, when the arm swelled “like the Michelin man.”

She feared an even more than snake venom, because it derives from horse serum that causes an allergic reaction in 98 percent of patients. Symptoms can include rashes, fever, and joint stiffness. Doctors treat the reaction with steroids and antihistamines.

Taylor did suffer the reactive symptoms but responded quickly to treatment and was handling snakes again within a week.

“Among scientists,” she says, “physiologists are how people; ecologists are what people; and evolutionary biologists are when and why people. Dale and I are definitely how people, but we also like to think of ourselves as all of the above.”

But the general public can be the who cares people, “especially when it comes to rattlesnakes.” So, why care?

Taylor points out that, for human beings, all biology is ultimately self-understanding. “Studying reptiles gives you a great evolutionary perspective,” she says, “because reptiles gave rise to mammals.” Besides, “some of the biggest discoveries in science occur during basic research, kind of by accident.”

She admits, “I’m not saying that I expect to find the cure for AIDS by studying snake hormones.” But she does expect to add facts to science’s understanding of snake biology, physiology in general, and the evolution of vertebrates—“we happy creatures blessed with backbones.”

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