

F R I N G E B E N E F I T S

TOROWEAP IS ONE OF THE MOST ISOLATED OUTPOSTS IN THE NATIONAL PARK SERVICE. IT'S OFF THE GRID, LITERALLY, AND THE NEAREST GROCERY STORE IS A FOUR-HOUR ROUND-TRIP AWAY. YET, FOR THE RANGERS WHO LIVE AND WORK THERE, THE DISTANT WONDERLAND ON THE NORTH RIM OF THE GRAND CANYON IS A HOME FROM WHICH THEY NEVER WANT TO LEAVE. AND SOME DON'T.

**BY MATT JAFFE
PHOTOGRAPHS BY JOHN BURCHAM**

Toroweap Ranger Station, located near the Grand Canyon's Toroweap Overlook on the North Rim, is one of the most remote postings in the National Park Service. The station's buildings were built of local stone in 1935.

**GREEN AFTER RECENT MONSOON RAINS,
TOROWEAP VALLEY SPREADS WEST,
TOWARD THE UINKARET MOUNTAINS.
RABBITBRUSH AND SUNFLOWERS
SPLASH THE REMOTE EXPANSE, MORE**

than 50 miles from the nearest pavement, with yellows and golds. In the distance, beneath a promontory of the Toroweap Cliffs, Toroweap Ranger Station's metal roof flares with the reflection of the midday September sun.

During previous drives to camp at Grand Canyon National Park's Toroweap Overlook, where the rim plunges 3,000 feet straight down to the Colorado River, I'd never seen the valley so green or appreciated its desolate beauty. Then again, I'd never walked this road before.

A couple of miles back, I left my buddy Tom Gamache cursing as he unloaded his prized 1972 Chevy Blazer, now balanced precariously on its driver's side. To recap: We came over a blind rise and into a sloping "S" curve, the rough dirt road's counterpart to one of the Colorado River's rapids. Take a bad line or enter a rapid at the wrong speed, and you'll flip. The same is true at this spot on the 65-mile route to the rim.

Cresting the hill, I knew we were in trouble. The Blazer caught sand along the right and overturned onto the passenger side, then bounced or rolled before landing hard on Tom's door and sliding to a halt. The dislodged windshield lay shattered in a single piece nearby. We walked straight out through its frame.

Tom has a couple of cuts, and my arm is swelling, but we're in better shape than the truck after the most turbulent 100 feet of its nearly 1.6 million-mile run. The last thing I heard as I set out for the ranger station was Tom: "There are just days in your life. That's the end of the Blazer."

I step over cattle guards and try to gauge whether the desert light is making the ranger station, among the most remote postings in the National Park Service, appear closer than it actually is. After 3 or 4 miles (it's hard to say), a motorcyclist comes up behind me,

then goes ahead to alert the ranger.

In a few minutes, someone on a mountain bike approaches from the station. He's coming fast — not coasting on the downhill, but with legs pumping hard and in perfect cadence. Soon, I'm describing the accident to Todd Seliga, Toroweap's ranger, before he pedals back, grabs his truck and drives to the Blazer.

According to the Tao of Tom, "you don't want to meet anybody on the road." That's his way of saying something has probably gone wrong if you unexpectedly find yourself talking to a stranger by the side of the road.

Maybe so. But I sure am happy to meet Todd Seliga.

"So, whaddaya know about Riffey?" This journey began a few years ago, in my mother's Tucson apartment, when UCLA professor emeritus of biology Henry "Harry" Thompson asked me about legendary Toroweap ranger John H. Riffey.

Now 95, Harry was my mother's constant, loving companion in her final years, during what came to be her "second spring." In the 1970s, Harry



LEFT: Tom Gamache's 1972 Chevy Blazer lies on its driver's side after a mishap on the way to Toroweap.

ABOVE: Park Service ranger Todd Seliga has patrolled half a million acres of the Toroweap area on mountain bike, raft and foot for eight years.



traveled to Toroweap ("Not an easy place to get to — you don't go through there on the way to somewhere else") to search for a new species of encelia, a desert shrub.

I told Harry that I knew only slightly more about Riffey than I did about encelia. But if ever a man and a place were inseparable, that was Riffey and Toroweap, where he served from 1942 to 1980.

When Harry met Riffey, the ranger's spirit immediately impressed him. "He was just a charmer, smiling all the way," Harry explained. "Get lost? Forget your lunch? Riffey would take care of you. He thought everyone had a right to go out there and experience the area where he was the expert. So often, you have a guy who wants to shut a place down — he treats it like his private possession. But Riffey was not a grumpy guy at all. He welcomed everyone into his house, then got to know and

remember them."

Harry spent time with Riffey and his wife, Meribeth, an ornithologist. They shared fresh-baked cookies and brewed a pot of coffee as Harry described his fieldwork. Harry so liked Riffey that he decided to name the new plant species after the ranger. But the directions Harry carried from previous researchers sent him to the wrong spot by the rim. Harry never did find any specimens of what would have been *Encelia riffeyi*.

wanted to explore Riffey's world and talk with Seliga about his experiences at Toroweap (the Park Service calls it Tuweep, but the two terms are used more or less interchangeably). Rangers have worked there since the 1930s — when this area on the Arizona Strip was administered

separately from the park, as Grand Canyon National Monument. For eight years, Seliga has covered a vast country: 500,000 acres, including a 140-mile stretch of the Colorado River.

Seliga is a throwback to the classic age of rangers. Visitor contact (and emergencies like ours), range management, monitoring archaeological sites ... they're all part of the job. Seliga acts as a naturalist, and the pistol holstered on his hip is a reminder that he's sometimes the law, too.

"I've always been self-motivated and independent. I'm perfectly happy by myself, but I also love my time with people," the Boston-area native says. "And I like serving and making a difference."

Seliga is 38 and looks younger. He's tanned and impeccably fit, with tightly braided muscles in arms and legs sculpted from rugged backcountry patrols on foot, mountain bike and river raft. His handsome face frequently brightens into a sweet, easy smile. He's cute as nails.

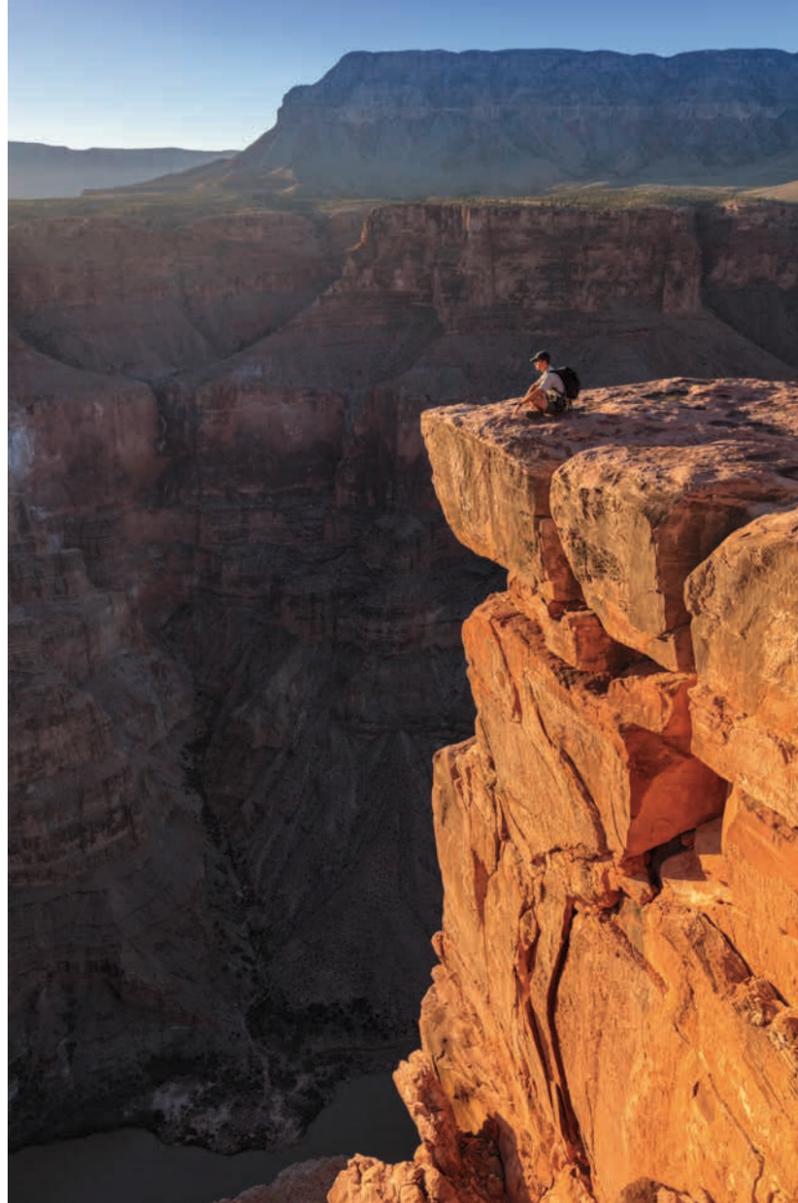
Seliga interned and worked at Jewel Cave National Monument in South Dakota. He quickly fell in love with the work, then did stints at Yellowstone, Yosemite and Saguaro national parks, among others. He never wanted a job at the Grand Canyon, ironically, because he didn't think it offered many trails or much hiking.

While he sometimes surveys his turf from Park Service aircraft, Seliga mostly goes out on his own, self-powered. He'll hike 20 miles down a side canyon to reach the Colorado, then set out by river for another 20 miles, in a pack raft that compresses to the size of a water bottle, before trekking back to the rim and repeating the process. Seliga competed nationally as a mountain biker and can cover 100 miles in a day. But the Grand Canyon's topographical complexity means his patrols are never the same. "When I'm on foot, some days I might cover 30 miles," he says. "On others, it might take me all day to go 1 mile."

Today, there will be no exploring, just trips to shuttle our gear and long waits by the Blazer — first for the Mohave County sheriff, then for a wrecker out of Fredonia. I cool off inside Toroweap's barn with a crescent of sweet watermelon that Seliga has offered (he's just restocked on food after going into town) and talk with Miki Magyar, a volunteer from Boulder, Colorado.

She and her husband, John, first met Seliga out in the backcountry and are spending a month at Toroweap. Through the barn's big doors, Miki and I look across the valley. Whenever anyone approaches the station on the way to the rim, Miki greets them and provides information.

I wander around Toroweap, which has undergone numerous improvements during Seliga's time. Built of local stone in 1935, both the barn and the



ranger cabin have new roofs that volunteers and Park Service workers installed. Generators, first diesel and then propane, once powered the station, but now an eight-panel solar array provides the necessary juice.

Climbing toward a saddle above the cabin, I check out the nearly 10,000-gallon rainwater catchment system, which volunteers updated in 2014 after hauling 10,000 pounds of half-inch corrugated steel sheets up the slope. I continue to a higher point, then look back to see two plumes of dust, one moving toward Fredonia and the other approaching the station, as Tom and Seliga return just before night falls on Toroweap Valley.

Though *Encelia riffeyi* wasn't meant to be, Riffey nevertheless achieved a measure of immortality through the loving, often laughing memories of those who knew him. I found the biography *John H. Riffey: The Last Old-Time*



ABOVE, LEFT: Todd Seliga enjoys a view of the Grand Canyon at Toroweap Overlook.

ABOVE: John H. Riffey, who served as Toroweap's ranger from 1942 until his death in 1980, takes in a similar view at the overlook in the 1950s. *Courtesy of Grand Canyon National Park Museum Collection*

Ranger, by Jean Luttrell, and also sent a copy to Harry. Later, I tracked down transcripts from the John Riffey Memorial Tall Tale Rendezvous, a 2001 event organized at Toroweap by Liz and Clair Roberts, the station's rangers until 2002.

A native of Mancos, Colorado, Riffey earned a master's degree in forestry and range management, then worked for the U.S. Forest Service before arriving in Toroweap Valley at 31 years old. He was no company man: I've never seen a picture of Riffey in uniform. If you'd come upon him, typically in a plaid or checked shirt and wearing his white straw cowboy hat, you'd have assumed he was a local rancher. Riffey remained more committed to Toroweap and its people — the ranchers whose families had lived here for generations, along with first-time visitors — than to any bureaucracy. He resisted all efforts to transfer him, and eventually, the Park Service gave up trying.

"In many ways he was like a shepherd," wrote friend Gene Wendt in a tribute from the Rendez-

vous. "A stern guardian on one hand, and gentle, kind-hearted caretaker on the other."

Riffey learned to fly, then searched for wildfires, poachers and wayward cattle in "Pogo," a single-engine Piper Super Cub perpetually plagued by nesting mice and named for the many short hops the ranger flew over his domain. Pogo and Riffey managed to avoid any serious mishaps while taking off and landing from what he dubbed an "international airport" — the dirt airstrip a short distance from the station. Riffey put up signs designating gates 1 and 2, as well as the north and south concourses, of what was just a wooden shed he built to protect Pogo.

Riffey could certainly riff. The Rendezvous transcripts offer a long glossary of his terms and sayings. When visitors asked for plant identifications, Riffey called flowers close to the road "nearodas," while those in the distance were "farrodas."

"Rancid Roy" was a skunk who lived by the ranger station. And in 1976, when visitor Jim Stiles mentioned that he knew Edward Abbey, the author of *The Monkey Wrench Gang*, Riffey said that he might even try some monkey wrenching himself if it meant keeping the Toroweap road free of asphalt. "And if that doesn't work," he added, "they'll have to pave the road over my dead body."

Riffey never wanted to leave, and according to Luttrell, Meribeth purchased land in the valley for a cabin where the couple could live after he retired. Riffey also said that if he ever fell ill, no one was to call a helicopter until they were 100 percent sure he was dead.

In July 1980, Riffey's heart gave out. He died before reaching pavement.

If Riffey left this world somewhere on the road between Toroweap Valley and civilization, Kaelin Zielinski nearly entered it here. For almost nine years, starting in 1988, her late father, Ed Cummins, served as ranger at Toroweap along with her mother, Cathy Alger — who still works for the Park Service, at Pipe Spring National Monument near Fredonia.

In June 1989, Alger went into labor out at Toroweap. The couple loaded son Eli, still under 3, and their dogs, Zack and Bear, into the car for an anxious, bumpy two-hour drive out through Colorado City to reach a St. George, Utah, hospital.

"We were known as the feral children of the Park Service," says Zielinski, who lived at Toroweap until she was nearly 8. She and Eli led an idyllic existence connected to their natural surroundings. Often barefoot, they played cowboys and Indians, and built a fort among the rocks. They grew up aware, not fearful, of the rattlesnakes, tarantulas and scorpions common at Toroweap. Zielinski



IF THE OVERLOOK AND ITS FAMOUS VIEW BELONG TO THE WORLD, THE STATION BELONGS TO THE REMARKABLE GROUP OF PEOPLE — FROM RIFFEY TO SELIGA — WHO HAVE CALLED IT HOME.

remembers “talking” to coyotes by standing on the picnic table and howling into the valley’s emptiness.

Their parents trusted her and Eli, and placed few limits on what the children could do. “It was cool because there were no boundaries,” Zielinski says. “Their attitude was: ‘Come back home. Don’t die.’”

Even with the nearest groceries a four-hour round-trip away, and even though she had to clean diapers in an old-fashioned wringer washer, Alger says Toroweap was “just a delight.” With a steady stream of rim-bound visitors from all over the world, the station hardly felt isolated, and the couple used Toroweap as a classroom as they home-schooled their children.

Curiosity and exploring became a way of life. From a young age, Eli rode with local ranchers on roundups and now works as a packer at Yellowstone, while Zielinski has a job with the Wildland

Trekking Co., a Flagstaff outfitter.

Eventually, the family, concerned that the children needed more chances to socialize, finally moved. Ed took a job at Lees Ferry. “There was drama and trauma and tears, but it really was time,” Alger says.

“I was leaving the only home I had ever known,” Zielinski says. “I have a very specific image of turning around in the back seat and watching the cabin disappear in the distance. I cried my heart out.”

Riffey would have understood.

With the battered Blazer in Fredonia, Tom and I aren’t leaving Toroweap tonight. We won’t make it to the rim, and I’m disappointed to be so close, yet still miss one of my favorite places.

But if the overlook and its famous view belong to the world, the station belongs to the remarkable group of people — from Riffey to Seliga — who have called it home. “I used to be drawn to the big, dramatic Canyon views,” Seliga says. “After being here for so long, it’s the valley that means the most to me.”

I unroll my pad below the cabin and orient it for

Like Riffey, Seliga has found his place in the Arizona Strip community. He has family ties here: One of his maternal great-great-grandfathers was Mormon pioneer Jacob Hamblin, and another operated the sawmill on Mount Trumbull. He’ll stop to talk to ranchers moving their cattle from pasture to pasture, and he attends big events

such as the Bundy family’s recent 1,500-person reunion. “Kindness was Riffey’s religion,” Seliga says. “Because of his generosity, people wouldn’t do things that were offensive or destructive to the park. They wouldn’t want to disrespect Riffey.”

Seliga understands he works in a region that’s far from fed-friendly. I mention that we saw big shotgun blasts in the sign for Grand Canyon-Parashant National Monument. He’s had his moments, including a life-threatening encounter, and has tried to build a rapport with those in the area. “You only worry about the people who don’t know you — who see you as a uniform, not as an actual person,” he says.

While Tom organizes his gear for the trip to St. George, Seliga and I walk past the 1921 road grader that Riffey nicknamed “Big Scratchy” on the way to his and Meribeth’s gravesite. Riffey said he wanted to be stuffed and put in a rocking chair on the cabin’s porch, then given a push every now and again. But I’m guessing he’s pretty happy at this spot overlooking the valley.

I unlatch an ammo box that protects a tribute book placed here in 2000 by Clair Roberts and flip it open to a page that reads, “Thanks John for the homemade cookies back in 1967.” Then I write a note to Riffey and mention that Harry sends his regards.

Riffey’s gravestone is engraved with an image of Pogo soaring along the Canyon rim. The inscription reads, “A man who could spend a lifetime on the rim and not waste a minute.” Words to live by, especially when everything can change in an instant. **OH**

the best view of the sky over Toroweap Valley. Then I can’t sleep. When I shut my eyes, the accident repeats like a GIF in my head. And I can’t resist checking the sky. The night is without clouds, the stars brilliant, and I wait for total darkness to come once the quarter-moon sets.

Doze. Wake up. Repeat. Finally, I open my eyes to the Milky Way smeared across the moonless sky. Shooting stars break the stillness, and twinkling red-eyes out of Las Vegas move like spacecraft across the universe, silent, until sound catches up to light.

Around dawn, we gather at a table by the antique drill press that Riffey installed in the barn. Seliga offers clusters of wild grapes dropped off by locals before we walk around the property.

Riffey is inescapable. There’s his hand-painted sign for Grand Canyon National Monument and a caricature in the cabin of Pogo and Riffey with his fist raised; the caption reads, “Doggone tenderfoot tourists!” Seliga points out the porch Riffey added onto the cabin and a stone root cellar he built behind it.

ABOVE, CLOCKWISE FROM FAR LEFT: Rangers posted at Toroweap often find it difficult to say goodbye to the secluded ranger station.

A nearly 10,000-gallon rainwater catchment system provides water for the station’s cabin and barn.

From Toroweap Overlook, the Grand Canyon’s North Rim plunges more than half a mile to the Colorado River.

Longtime Toroweap ranger John H. Riffey nicknamed this 1921 road grader “Big Scratchy.”

To learn more about the Toroweap (or Tuweep) area of Grand Canyon National Park, visit www.nps.gov/grca/planyourvisit/tuweep.htm.

IDENTIFYING FLYING OBJECTS

The facility is modest — a small control room in the upper elevations of the Santa Catalina Mountains — but the research being done by the Catalina Sky Survey is out of this world. Literally. Its mission is to discover asteroids and comets that pass within 30 million miles of Earth's orbit. And since its start nearly 20 years ago, the NASA-funded lab has identified almost half of the 15,000 known near-Earth objects. \// **BY MATT JAFFE**

The University of Arizona's facility on Mount Lemmon includes telescopes operated by the Catalina Sky Survey, which has been scanning the night skies for near-Earth objects since 1998.
Sean Parker

IT CAME FROM OUTER SPACE. A LONG TIME AGO. Bright gold and shedding glowing debris, a small asteroid surged across the violet afternoon sky. I was hiking near Northern New Mexico's Brazos Cliffs, and I remember the tail as a mix of pink and green light in those long seconds that it etched a nearly horizontal streak above the granite ridge. Then, nothing. Gone.

This was a time before smartphone cameras. There were no dashcams to record the moment in living color, no social media to tweet my wonder in 140 characters or fewer. Hiking alone, I didn't even bother with a "Did you see that?" after witnessing the daylight fireball.

I'm in the Santa Catalina Mountains, describing this moment to Eric Christensen, director of the University of Arizona's Catalina Sky Survey (CSS), one of a handful of NASA-funded programs with the mission of discovering asteroids and comets that pass within 30 million miles of Earth's orbit.

We're in the chilly control room for the survey's Schmidt telescope, up an icy forest road off the Catalina Highway, at 8,200 feet, on Mount Bigelow. Senior research specialist Gregory Leonard sits at a bank of monitors where, just the night before, he found 10 new near-Earth objects (NEOs). Since its start nearly 20 years ago, the survey has identified 45 percent of the 15,000 known NEOs, including a record 930 in 2016.

The CSS is part of the university's esteemed Lunar and Planetary Laboratory (LPL), founded in 1960 by Gerard P. Kuiper — for whom the Kuiper Belt, the vast area of frozen objects and rocks on the edge of the solar system, is named. The LPL is also leading the OSIRIS-REx project, which in September 2016, at Florida's Cape Canaveral Air Force Station, launched a satellite that in 2020 will intercept and later gather rock from the asteroid Bennu.

Christensen grew up in Boise, Idaho, and came to the university as a fine arts major specializing in ceramics. Growing up, he also had a deep interest in astronomy, and after first working on infrastructure and telescope maintenance on Mount Lemmon, Christensen began observing for the survey in 2003. That May, he made his first discovery: a comet that now bears his name. Since then, he's found 23 more.

Christensen tells me he's never seen a daylight fireball, then puts my sighting into perspective. Asteroids like the one I observed, probably the size of a baseball or basketball, are nothing unusual. Ten-foot asteroids strike Earth monthly. Nor was Chicken Little just crying wolf: According to NASA, 100 tons of space material reaches Earth every day. The sky really is falling.

But this chunk of rock was big enough and bright enough to be visible during daylight. And Christensen says it briefly connected me, over an almost unfathomable chasm of time and events, to the very origins of the solar system.

"Your history and its history converged," he says. "You were born when and where you were born, then led a life that brought you to that place at that specific time. Meanwhile, on the other side, back at the beginning of the solar system, this object was created or came off another object in a collision. Its orbit evolved over time, or changed; then, it maybe suffered more collisions.

"We think of the solar system as infinite. But any given rock, any given asteroid, often has an end state. On that day, at that moment, you were able to witness the end of this particular asteroid. After maybe four and a half billion years."



INDEED, THEY'RE OUT THERE: comets and asteroids. Some are tiny, while others are large enough that in the unlikely scenario of striking Earth, they could trigger extinction-level events, such as 65 million years ago, when a roughly 6-mile-wide asteroid gouged the 110-mile-wide Chicxulub Crater along Mexico's Yucatán Peninsula.

A fireball spread out hundreds of miles, as did a towering tsunami. A massive earthquake rocked the planet. Ash and debris from the impact, roughly equal to 100 million megatons of TNT, eventually obstructed sunlight and led to a global winter that killed off the dinosaurs, as well as most life on Earth. Talk about your terrible, horrible, no good, very bad days.

Nor do asteroids have to be nearly that big to leave their mark. Just detour off Interstate 40 west of Winslow, to Meteor Crater. The object that created that 1-mile-diameter, 550-foot-deep impact crater was only about 130 feet wide. Then again, it weighed 300,000 tons and slammed into the ground at 26,000 mph.

So the prospect of a collision with an asteroid or comet stirs a certain morbid fascination — if not apocalypse now, then apocalypse maybe, someday. Hollywood, for one, loves a good end-of-the-world scenario, and in 1998, two hit movies — *Deep Impact* (the better of the two) and *Armageddon* (the more profitable) — explored the idea of an NEO clobbering us.

That was also the year that the Catalina Sky Survey began operations. Four years earlier, the world watched with a measure of planetary schadenfreude as Comet Shoemaker-Levy 9 smashed into Jupiter. Inspired by that event and hoping to identify threats to Earth, the LPL's Steven Larson wrote a proposal to launch the survey, then received NASA funding. The CSS joined Spacewatch, the LPL's existing NEO project; it observes from Kitt Peak National Observatory, which is located southwest of Tucson.

Although the CSS expanded from its modest beginnings and now operates three telescopes on Mount Lemmon, the Mount Bigelow control room feels a bit like a basement where my geeky buddies and I played Risk in junior high, albeit with a bank of powerful computers humming in the background. Posted on the cheap wall paneling, there's a *National Geographic* Milky Way map and a photo of Comet Skunk, the survey's mascot. According to the caption, this Western spotted skunk earned the name for his comet-like traits: fuzzy white tail, occasional outgassing and tendency to stir panic during close encounters. Larson arrives in the control room and further explains that Comet Skunk, forever seeking warmth, had an uncanny ability to find ways into the observatory before settling contentedly on the control-room couch. Yet no outgassing incidents occurred prior to Comet Skunk's successful relocation to nearby Bear Canyon.

If the control room looks like a clubhouse, then the domed

Star trails form over a creek in the Santa Catalina Mountains' Sabino Canyon in a long-exposure photograph. Jeff Maltzman



telescope room currently resembles a do-it-yourselfer's garage. Maxwell House coffee cans, filled with washers, screws and bolts, are lined up on a table. Across the room, a red Sears Craftsman workbench stashes drill bits, sandpaper, wire and socket wrenches.

As part of ongoing improvements designed to allow observers to both cast a wider galactic net and observe the sky in greater detail, the survey is upgrading the Schmidt telescope's camera and optics. While a crew from the university performs more complicated work, survey astronomers handle much of the upgrade, as well as ongoing maintenance.

"If it's out of alignment, you get to align it," Christensen says. "The telescope needs grease? Then you grease it. We're all involved at more than one level, with observing, writing software and adjusting the optics. We wear different hats on different nights."

Observers typically drive up the mountain for three-night shifts. After choosing a section of the sky, telescopes make pictures of that area every five to 10 minutes. Typically, 200 different fields are photographed, generating as many as 1,000 images some nights.

Computers conduct an initial screening to identify potential NEOs, which range from 1 yard to more than 2 miles across.

Christensen says even though the computers rapidly process massive amounts of data, astronomers still must filter out false detections — sometimes hundreds of them. Then, Christensen and Leonard show me an actual NEO discovered the previous night. Seen in a sequence of photos, the object's trajectory is unmistakable as it races against a fixed backdrop of stars.

This is astronomy for the rest of us. Deep-space astronomy observes an incomprehensibly distant past, the light from events that took place billions of years ago. The collected data might not be analyzed for months, or even years. But the survey's work is near Earth and virtually in real time. "We're often analyzing within five minutes of the last image being taken," says Christensen. "It's an unusual way to run a telescope."

One morning in October 2008, survey observer Richard Kowalski identified a small NEO, maybe 10 feet in diameter, and reported it to the Minor Planet Center in Cambridge, Massachusetts. Researchers calculated that the object would enter the Earth's atmosphere above northern Sudan the next day.

Less than 21 hours after the discovery, the asteroid exploded about 25 miles above the Earth as it traveled nearly 8 miles per second. The incident marked the first time the location and time of a potential NEO impact were accurately predicted.

"So we're one up on the dinosaurs," Larson says.

"What we do is like Coast Guard work," Leonard adds. "There's stuff literally falling down on us all the time. Rocks from space. In this job, it's as if we get to touch space."



IF THE SKY SURVEY is our first line of defense against potential space invaders, then the OSIRIS-REx mission is a discovery expedition, the 21st century counterpart to the trailblazing explorations of Lewis and Clark.

It's an audacious effort that will span seven years as the satellite first travels to and then explores the asteroid Bennu, which orbits the sun at 63,000 miles per hour. Nor is Bennu just some random asteroid. Out of 500,000 contenders, only five satisfied the mission's criteria, which included size, distance from Earth and composition. With a diameter of a third of a mile, a thick middle and the stout build of an NFL nose tackle, Bennu consists of carbon-rich material that scientists anticipate is rich in organic compounds present in the solar system 4.5 billion years ago, when Earth was forming. Those compounds could help explain how early life on Earth developed.

After spending two years mapping Bennu's surface and examining its composition, in July 2020, the satellite will

deploy an 11-foot robotic arm, known as TAGSAM (Touch-and-Go Sample Acquisition Mechanism), near the asteroid's surface. A five-second blast of nitrogen gas will then dislodge material for collection. If it all works, in 2023, a capsule will deliver to Earth between 2 ounces and 4.5 pounds of dust and gravel — the most material returned from space since the Apollo lunar missions more than 50 years earlier.

So, with only enough nitrogen for three attempts, this seven-year mission, first conceptualized in 2004, comes down to just 15 critical seconds.

For OSIRIS-REx principal investigator Dante Lauretta, the close encounter with Bennu — which he calls "the moment of truth, the moment of terror" — is a culmination not only of the mission, but of a boyhood dream. Growing up in New River north of Phoenix, Lauretta aspired to be an explorer — hardly a promising career path in the waning decades of the 20th century.

Undaunted, Lauretta still hoped to boldly go where no man had gone before. He backpacked in the desert for days, certain he could reach a pristine place, only to notice a beer can on the ground nearby. So Lauretta concluded he would have to explore the solar system instead.

Referring to the fragments of asteroids and other space objects that survive entry into Earth's atmosphere, Lauretta says: "Meteorites were a way for me to be an explorer. Because that's where the true firsts are still available to us. You can have the experience — when you're holding an ancient fossil that's billions of years old and then cut it open — that you're going to see something that nobody has ever seen before. A great scientific discovery."

The operations center for OSIRIS-REx is not on campus, but in a low-slung contemporary building west of the university, surrounded by streets of older houses with low stone walls and prickly pear thickets in their yards. The building is named for Michael J. Drake, the late planetary scientist and LPL director who championed OSIRIS-REx and worked on the project until his final days.

Drake was Lauretta's mentor and inspiration. "He was a very big thinker. He asked the big questions, and he went after them," Lauretta says. "He wasn't intimidated. He always said to me, 'If you're going to make an impact in science, you have to ask the right questions. That's where it all starts.'"

Lauretta says asteroids just may offer the big answers to those big questions: Why is the Earth unique? Why is this a habitable planet? How did life begin?

"They tell the story of how our solar system came to be," he says. "I was just fascinated by that whole idea that you could hold a rock in your hand that's older than the Earth itself, that represents the dawn of our solar system. With the organic molecules that may be our ultimate ancestors."

I'll admit to a measure of envy as I listen to Lauretta describe what it might be like to truly touch both space and time. As I think back to the daylight fireball, I'm intrigued by the convergence of the spiritual and the scientific that it and other asteroids represent, as well as their inherent contradictions. They are the deliverers of life and potentially the destroyers of worlds, both solid and ephemeral — objects that have endured forever, only to arrive on Earth and sometimes disappear in a flash. 



Comet Lovejoy, which lit up the night sky in late 2014 and early 2015, makes an appearance near the Pleiades, or Seven Sisters, star cluster. Sean Parker

A LITTLE CAT GOES A LONG WAY



Although they weigh less than a well-fed house cat, jaguarundis have the second-greatest north-to-south distribution of any wild cat in the Americas, ranging from Argentina to Arizona. Sort of. Chiricahua National Monument lists them as “documented historically” in the mountain range, and there have been other sightings in the state, but, to date, no one has ever photographed a wild jaguarundi in Arizona.

BY MATT JAFFE

THERE ARE ALL SORTS OF CATS in Arizona — from coddled condo kitties and feral Tucson toms to bobcats and cougars, the big cats of the Santa Catalina Mountains. The ringtail, sometimes called a ring-tailed cat, is actually not a cat, but jaguars and ocelots, baroquely patterned migrants from the south, wander up from Mexico into the mountain ranges of the Arizona borderlands.

Another neotropical cat ranges from Mexico to South America. It also sometimes ventures into Arizona. Which is to say, rarely. Or, possibly, never.

This would be the jaguarundi.

Like most residents of the U.S., I’ve never seen a jaguarundi in the wild. I hadn’t even heard of jaguarundis until sometime in the 1990s, when I noticed them listed on a directory of animals at the Arizona-Sonora Desert Museum. Based on the name, I anticipated seeing a smaller jaguar-like animal — powerfully built, with a richly spotted yellow coat. But there it was, in the enclosure: a rather odd, slinky creature, its fur a solid color, with none of the jaguar’s telltale rosettes. This animal didn’t look at all like a jaguar, and among the roughly three dozen different species of felines, the jaguarundi is truly a different breed of cat.

Conservation biologist Anthony Giordano, founder and executive director of the Society for the Preservation of Endangered Carnivores and their International Ecological Study (SPECIES), has observed jaguarundis while working in South America’s Gran Chaco region. He’s also analyzed data from visitor observations of jaguarundis at Big Bend National Park in Texas and prepared a peer-reviewed paper synthesizing existing knowledge of the animal’s ecology.

“The jaguarundi, for me, represents a big mystery,” says Giordano. “In the Western Hemisphere, it’s one of the cats we know the least about and one of the cats where there are the most misconceptions. In some areas, they’re more like ghosts.”

Giordano says few scientists have focused on jaguarundis. Basic information, such as where jaguarundis live, is incomplete. There was a tendency, he says, to assume that the animals were common and widespread in certain areas but

For decades, jaguarundis have been rumored to venture into Arizona, but so far, no one has been confirmed to have seen a wild jaguarundi in the state.

BLICKWINKEL/ALAMY STOCK PHOTO

didn't occur elsewhere. That reinforced self-fulfilling prophecies about the jaguarundi's range — a bad starting point for accurately determining the distribution of such a sketchily researched animal.

"It's actually a cat that is supposedly seen, or observed, or reported in many places where they shouldn't be," Giordano says.

That includes Arizona. Jaguarundis are frequently identified as ranging into the state, and Chiricahua National Monument lists these cats as "documented historically" in the mountain range. But no one has ever photographed a jaguarundi in the wild in Arizona. Nor have carcasses or other physical evidence been found. A native of Brooklyn, New York, Giordano lived in Tucson for three and a half years and conducted fieldwork in Arizona's "sky island" mountain ranges. During that time, he never saw any jaguarundis.

Still, he's reluctant to totally discount the possibility that jaguarundis make their way into the state.

"If someone asked me whether jaguarundis occur in Arizona now, or have occurred there naturally in the recent past, based on the data that I've really tried to dig into, I would say ... no," Giordano declares, after a long pause. "But if someone said tomorrow that they caught a jaguarundi in the sky islands, I would be like, 'Yeah, that's about right.'" He laughs, and then adds, "Like I said, they're kind of a mystery."



THE JAGUARUNDI IS CERTAINLY a curious cat. Considerably smaller than jaguars, jaguarundis top out at around 20 pounds, though many weigh even less than a well-fed house cat. Except while briefly speckled as kittens, their fur ranges from gray to reddish-brown. The head is oblong, with small, round ears set far back and a long crown that tapers straight to a barely-there snout on a flat face with no brow.

Seen in profile, the head appears streamlined, like an old Pontiac hood ornament. It's undersized for the jaguarundi's body, where already lithe contours are exaggerated by comparatively stubby legs and a skinny tail that's nearly as long as the rest of the animal. These odd proportions, combined with a sinuous movement while walking, have earned the jaguarundi the nicknames "otter cat" and "weasel cat," labels any self-respecting felid would disdain.

Puma yagouaroundi, the cat's scientific designation, contains a couple of hints about the jaguarundi's biology. *Puma* refers to the fact that the jaguarundi is actually classified as part of the same genus as mountain lions, not jaguars. And the Latin root *und* roughly translates as "wave," an allusion to the jaguarundi's distinctive body type and way of walking.

The jaguarundi's odd proportions may be related to its preferred thorn-scrub habitat, a transition zone of brushy and spiny plants between the desert and tropical forests. In this densely packed tangle of vegetation — where the jaguarundi feeds on an assortment of rodents, small reptiles and birds —

a low profile is certainly an advantage for moving freely and avoiding detection by predators.

Giordano says jaguarundis have one of the most diverse vocal repertoires of any feline their size, likely an adaptation to facilitate communication while concealed in the scrub. And they also have the second-greatest north-to-south distribution of any wild cat in the Americas, behind only mountain lions — which, in turn, happen to have the biggest range of any mammal in the Western Hemisphere, other than humans.

Arizona pushes the very northern limits of the jaguarundi's range, theoretically taking them from Patagonia, Argentina, to Patagonia, Arizona. That prospect is not as far-fetched as it might seem when you consider the jaguarundi's adaptability and the state's geography.

The Chiricahuas, along with other sky island ranges in Arizona, New Mexico and northwestern Mexico, comprise the Madrean Archipelago, part of a corridor that helps link the tropics to the Rockies. These ranges are "a world biodiversity

Seen in profile, the head appears streamlined, like an old Pontiac hood ornament. It's undersized for the jaguarundi's body, where already lithe contours are exaggerated by comparatively stubby legs and a skinny tail that's nearly as long as the rest of the animal.

hot spot," according to the Sky Island Alliance, an environmental organization dedicated to preserving this complex of uplands, deserts and grasslands where "jaguar and black bear meet, where bromeliads grow in the arms of maple trees, and spicy chiltepin pepper and sweet Arizona canyon grape grow side by side."

Within the sky islands, there are 600 species of bees and nearly 500 vertebrate species, including, according to many sources, the jaguarundi.

But in an email correspondence, Lisa Haynes, coordinator of the University of Arizona's Wild Cat Research and Conservation Center, echoes Giordano's skepticism about jaguarundis in the state. "There have been hundreds, if not thousands of unverified sightings ... but not one verified documentation," she says. "With all the trapping that has been done over decades, and now with the ubiquity of trail cameras in the landscape, it's highly unlikely that they are here with no evidence."

The record of unconfirmed jaguarundi sightings in Arizona

dates to 1938, when one of the animals was allegedly spotted in the Canelo Hills, an area between the Huachuca Mountains and the town of Patagonia. A 2009 study on neotropical cats in the U.S.-Mexico border region identified 51 sightings of jaguarundis in Arizona, including 26 Class 2 (considered credible, though unconfirmed) observations. That's actually more than three times the number of ocelot sightings in the state — although, unlike jaguarundis, three of the ocelot sightings were officially corroborated.

If, as it appears, jaguarundis don't range into Arizona, the question becomes: Why not? They're resilient creatures and not especially timid, ranging from the thorn-scrub habitat into forests and agricultural areas. They sometimes get into trouble with farmers for preying on chickens, but unlike ocelots and jaguars, jaguarundis aren't poached for their pelts.

To avoid predation and competition from their fellow cats, jaguarundis are active during the day — another reason that if they were present in Arizona, some sightings should have been verified. But even the closest documented observation of a jaguarundi was hundreds of miles south of the Arizona-Sonora border.

Dr. Howard Quigley, jaguar program executive director and puma program director for Panthera, the global wild cat conservation organization, says that when he inquired with colleagues in Mexico about the northernmost occurrence of jaguarundis in Sonora, they told him there were no recent records.

"It really surprised me," Quigley says. "That's the kind of landscape I would expect to see them in and that they would be adapted to. I spoke with a guy with the Northern Jaguar Project, where they do camera trapping all the time. But they haven't had any jaguarundis."

Quigley says that while the proposed border wall risks fragmenting the landscape for wildlife, jaguarundis are small enough that they could work their way through gaps, at least in some sections of the existing barrier. "We aren't out there all the time," he says. "They could slip across the border and be living in Arizona for a decade, and we wouldn't necessarily know it. On the other hand, I would think they would show up sooner or later. But everyone loves the romantic notion that there may be this mysterious animal out there. Whether it's a sasquatch or a jaguarundi."



MY OWN SEARCH FOR THE JAGUARUNDI, more virtual than real, eventually leads to the unlikely convergence of sasquatches and jaguarundis. Online, I find a grainy 2013 video shot by four surveillance cameras operated by the late Mitchell Waite, a researcher seeking to capture footage of Arizona's own Bigfoot — the legendary Mogollon Monster. Instead, one night Waite recorded what he concluded was a jaguarundi.

While speaking by phone with Giordano, I send him the



A jaguarundi perches on a tree trunk. Despite their name, jaguarundis are in the same genus as mountain lions, not jaguars.

ISTOCK

link and ask whether the animal in the Mogollon Rim video might, in fact, be a jaguarundi.

He turns off Waite's narration and asks me not to say anything so he can concentrate on the images. Giordano is mostly silent through the two-and-a-half-minute video: "Here we go. ... Huh. ... Hmm." He stays quiet through the rest of the footage before declaring, "The resolution is horrible, of course. But you look at the body, you look at the size, you look at the build. And the fact that it's at night is a trigger that this is unlikely to be a jaguarundi. My idea on what the animal could be is that it looks like ... a ringtail."

Jaguarundi or no jaguarundi, the video's comments section is revealing. A number of posters have never heard of jaguarundis, while for others, the notion of these cats in Arizona is no surprise at all. Someone says they spotted a jaguarundi near their cabin at the base of the Mogollon Rim, while another writes, "I don't know why you call them rare; they can be seen up north in Arizona. I'm 46 years old, and I've seen them all my life when I'm hunting [and] watch them in the daylight, families of them all around Northern Arizona."

Giordano says such reactions are just part of the mystery of jaguarundis. While he was at Texas Tech University, Giordano says, graduate students would come to him with what seemed to be credible observations of jaguarundis in very unlikely places. Jaguarundi sightings are "a thing," he says, with elements of Bigfoot. But, of course, these cats are real.

"I'm constantly wanting to be in their heads. Trying to figure out what they're doing," he says. "There's something definitely strange about them. You're looking at a jaguarundi and can't help but think, *Yeah, it's a cat, and very cat-like. But ... other. Something else.*" 

HE KNOWS WHAT HE'S TALKING ABOUT

At the age of 13, Adam Teller became the youngest guide at Canyon de Chelly. He likes to tell stories, but it's not all talk. His family has lived in the canyon for at least 200 years, and his great-great-great-grandfather Barboncito, a legendary chief and spiritual leader, created some of the pictographs on the walls at Running Antelope House. Mr. Teller has learned a lot through oral tradition, but he has a modern education, too: He studied cultural anthropology at the University of Arizona.

BY MATT JAFFE

PHOTOGRAPHS BY JOHN BURCHAM





Adam Teller makes his way back from a trip to Mummy Cave Ruins at Canyon de Chelly National Monument. Teller's family still has property in Canyon del Muerto, which branches off Canyon de Chelly.

ADAM TELLER EASES HIS JEEP WRANGLER INTO THE FLOW OF THE CREEK AT THE bottom of Canyon de Chelly. Swollen by rains, the creek is running high, and soon we're plunging axle-deep through the red, muddy water as Teller turns upcanyon. The Jeep creates a wake, and I roll up my window a bit to keep dry. The engine's muffled hum plays off the splashing of the water as we cross and recross the creek. Neither of us says much at first, which is pretty much what I had expected. I met Teller a few years ago, after hiring him for a tour into Canyon de Chelly. An entrepreneur, Navajo historian and storyteller, he wasn't one for false intimacies or forced levity. Today is no different. Before heading into the canyon, Teller had greeted me with a quick smile and handshake, but little in the way of ceremony. He's a pretty serious dude. The 53-year-old Teller doesn't reveal much at first, other than that he clearly roots for the

Arizona Cardinals. A pair of wraparound Cardinals shades conceals his eyes, and his long hair is gathered into a loose ponytail that cascades out from beneath a black cap emblazoned with the team logo. Teller wears the hat pulled down low along his brow.

We catch up a bit, and Teller updates me on the latest Navajo tribal news, always a subject that inspires strong opinions from him. But the conversation doesn't settle into an easy rhythm until he points out a spot where another guide's Chevy Suburban got sucked down into the creek's quicksand — all the way to the hood — before locals helped winch it out.

"So, how do you keep a vehicle running in these conditions?" I ask.

"Magically," Teller laughs. "Brake pads don't last longer than four months. Some things, you can't keep an eye on, like starters and batteries. They go out unexpectedly, and occasionally you do get stranded. When that happens, I just tell people it's all part of the tour."

We almost didn't venture into the canyon because of the high water. A day earlier, after driving through a near-blizzard for the last 60 miles before Chinle, I had arrived to find snow along the mesas of Canyon de Chelly's south rim. Ephemeral waterfalls wisped down the cliff faces as lingering storm clouds cloaked Carson Mesa to the northwest in a black shroud of mist.

But today dawned clear and warm. Inside the canyon, many of the cottonwoods are already fully leafed out. The new greens play off the sandstone walls, their reds deepened by the moisture from the storm. Three wild horses walk along the banks of the creek, and sheep graze on fresh grasses. Orchards of peaches and apricots, descended from trees that Teller says were brought up from Mexico hundreds of years ago, are close to flowering.

Although we're only a few miles past the hardscrabble streets of Chinle, there's an Eden-like aspect to Canyon de Chelly. It is astoundingly beautiful, serene and seemingly pristine. But Teller reveals the canyon as far more than a latter-day paradise cut off from the outside world.

In 1864, it was here, in this sacred place, that a group of Navajos retreated to the top of Fortress Rock and held out against U.S. troops, led by Kit Carson, to avoid being killed or forcibly relocated from their homeland during the infamous Long Walk.

Canyon de Chelly is still a stronghold, a haven for old ways now vulnerable to the modern influences that threaten to undermine the traditional Navajo way of life.

"You want to live in the traditional world, but at times you have to live a contemporary life as well," Teller says. "There's a balance you need to know how to deal with. Just like being happy and being angry. You have to balance those two things out. To give your life a sense of duty, a sense of priority."

Teller's family has lived here for at least 200 years and still has property set back in Canyon del Muerto, which branches off Canyon de Chelly. Teller's relationship to these canyons proves the oft-quoted William Faulkner adage: "The past isn't dead. It's not even past." The lives of the people who dwelt here centuries earlier and Teller's ancestors' stories are inseparable from his own life.



In addition to his work as a guide, Adam Teller appears in schools and at storytelling festivals to help bring Navajo history and culture to life.

farther from tribal land than Gallup, New Mexico. He needed time to adjust, but the experience at the university awakened him to different ways of seeing the world.

“Growing up in a place like Chinle or the canyon here, you appreciate the quietness,” Teller says. “You hear the trees. You hear the water. You hear the birds, and you’re just in tune with nature. When you go to a city like Tucson, it’s like a disturbance to your balance, to your way of life. I needed some time to adjust to that before I could even get a good night’s sleep.

“Everything was exciting and new. For me, it was a new world, a beginning. Everything was challenging. New foods to explore. New places to go. New friends to meet. Each day, there was something else I could look forward to and learn about.”

Teller also began to find his voice. Sometimes, archaeology professors asked him for a Navajo perspective on what was discussed in class. “I learned how to tell a good story in the Navajo way, to entertain people,” he says. “And some of the students came up to me and said that my stories were more important to hear than the theories. Which made me feel good — that the other kids felt I told important aspects of the history that were not covered in the books.”

Some of that history is recorded on the canyon stone. We arrive at Running Antelope House, his family’s property, and Teller points to a series of pictographs on the walls. Barboncito drew a circle with a cross inside to symbolize a peace treaty, and there’s also a rainbow higher on the cliff face. But most striking are the four pronghorns that give this spot its name. The animals were painted in 1867 by one of Teller’s ancestors, Chief Who Wore Lamb Skins on His Hat, to symbolize his hope for the eventual safe return of the four Navajo clans to their homeland after the Long Walk.

In addition to his guiding services, Teller appears in schools, and occasionally at storytelling festivals, to bring age-old Navajo legends and history to life. “They’ve been told for hundreds of years, and I want to get these stories out for the rest of the world to understand,” he says. “I have to learn every aspect and every detail, but my most important job is to translate from Navajo to English. The language is very complicated — so complicated that you can change the meaning if something isn’t put in exactly the right context.

“Sometimes I have to improvise a little bit as well. But basically, the story is there. All you have to do is put it in your heart, learn it by heart and understand that people have been telling these same stories for centuries.”

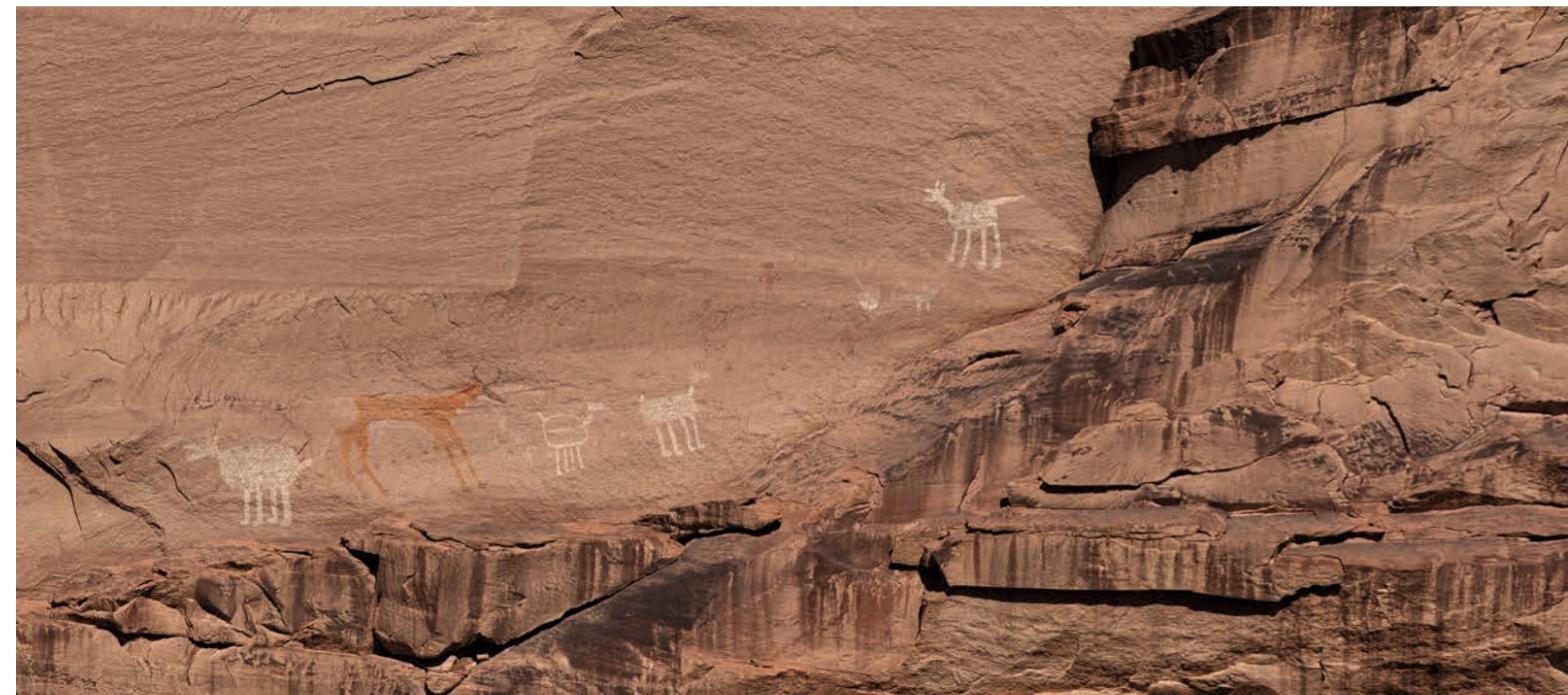
After saying goodbye to his relatives at Running Antelope House, Teller works the Jeep back down Canyon del Muerto,

easing past a fresh rockfall. Once we’re in Canyon de Chelly, he again finesses the creek, attacking the crossings to maintain the Jeep’s momentum and avoid any hesitations that might result in water getting sucked into the engine.

As we drive, Teller opens up and talks about many things: drug problems on tribal land, the lack of economic opportunities, changes to families. Grandparents, who once were central to teaching Navajo ways and lived with their grandchildren in multigenerational homes, no longer play as central a role. Teller worries about the possible loss of Navajo culture and language.

“Once your identity goes, your land goes. Your history goes,” he says. “So it’s very important, even if just a few people keep the culture alive for future generations, to at least give them a chance to pick it up again someday.”

Not long before we emerge from the canyon, I ask Teller about his plans for the evening, one of those small-talk questions that typically elicit equally empty answers. But not from



At Running Antelope House, Teller’s family’s property in Canyon del Muerto, his ancestors added pictographs to this sandstone wall.

Teller. He’s going over to a neighbor’s property for a traditional cleansing and healing ceremony. A family will march an effigy depicting evil to a medicine man, who will attempt to heal a patient by using a sand painting that serves as a kind of X-ray or diagram of the victim’s body. According to tradition, by casting the evil or source of pain out of the sand painting, it will also be cast from the patient.

“All of these songs are sung to invoke the holy ones to come and help with the healing that’s taking place,” Teller says. “All of the people are praying at that time, too. It’s the power of the people, not just the medicine man. The power of the people comes through the power of the god.”

I’m a little embarrassed when he asks me what I’ll be doing: “Watching basketball, I guess.”

Spring, winter, spring and winter again: March can’t make up its mind this year, and as I drive out along the north rim of Canyon de Chelly the morning after seeing Teller, temperatures have yet to creep out of the 30s. The clouds are building again, and another storm seems imminent as the road climbs toward the nearly 7,000-foot Mummy Cave Overlook and, beyond it, the town of Tsaile.

Teller had told me that he has a few places on the north rim where he likes to escape — “places to sit and think and get away from the world for a few minutes or a few hours. At some point, you have to cut off the technology, to be with yourself. It refreshes you.”

Only one car is in the parking lot when I pull up, then heed Teller’s advice and walk out to a quiet spot along the rim. When you’re on the floor of the canyon, there’s an intimacy, a feeling of being cradled by the earth. From here, the scale of the landscape becomes more apparent. Tucked into alcoves a few hundred feet above the ground, the cliff dwellings

at Mummy Cave, some three stories tall, are reduced to insignificance. A stand of mature cottonwoods, still bare in early spring, traces a gray, serpentine course along the creek and across the canyon floor.

When I return to the parking lot, someone inside the other car beckons me over. He has a door open and is in the back seat, staying out of the cold while working on acrylics of local rock art that he paints on sections of pine. He’s selling the paintings, including one depicting a herd of pronghorns. “They’re from the cliffs above Antelope House,” he says.

“Yeah, I was there yesterday,” I say. “With Adam Teller.” “Oh, that’s good. Adam. He knows a lot.” 